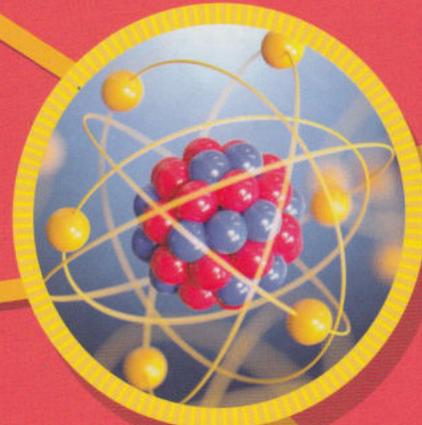
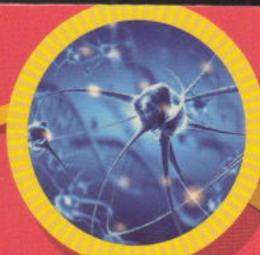


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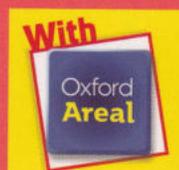
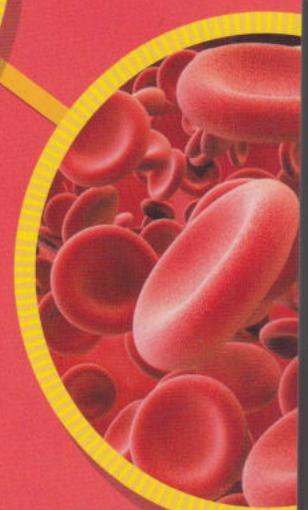
NEW SCIENCE

IN

EVERYDAY LIFE

7

VAISHALI GUPTA | SHALINI BAJAJ | SUPRIYA D SESHADRI





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Unit 1: Food

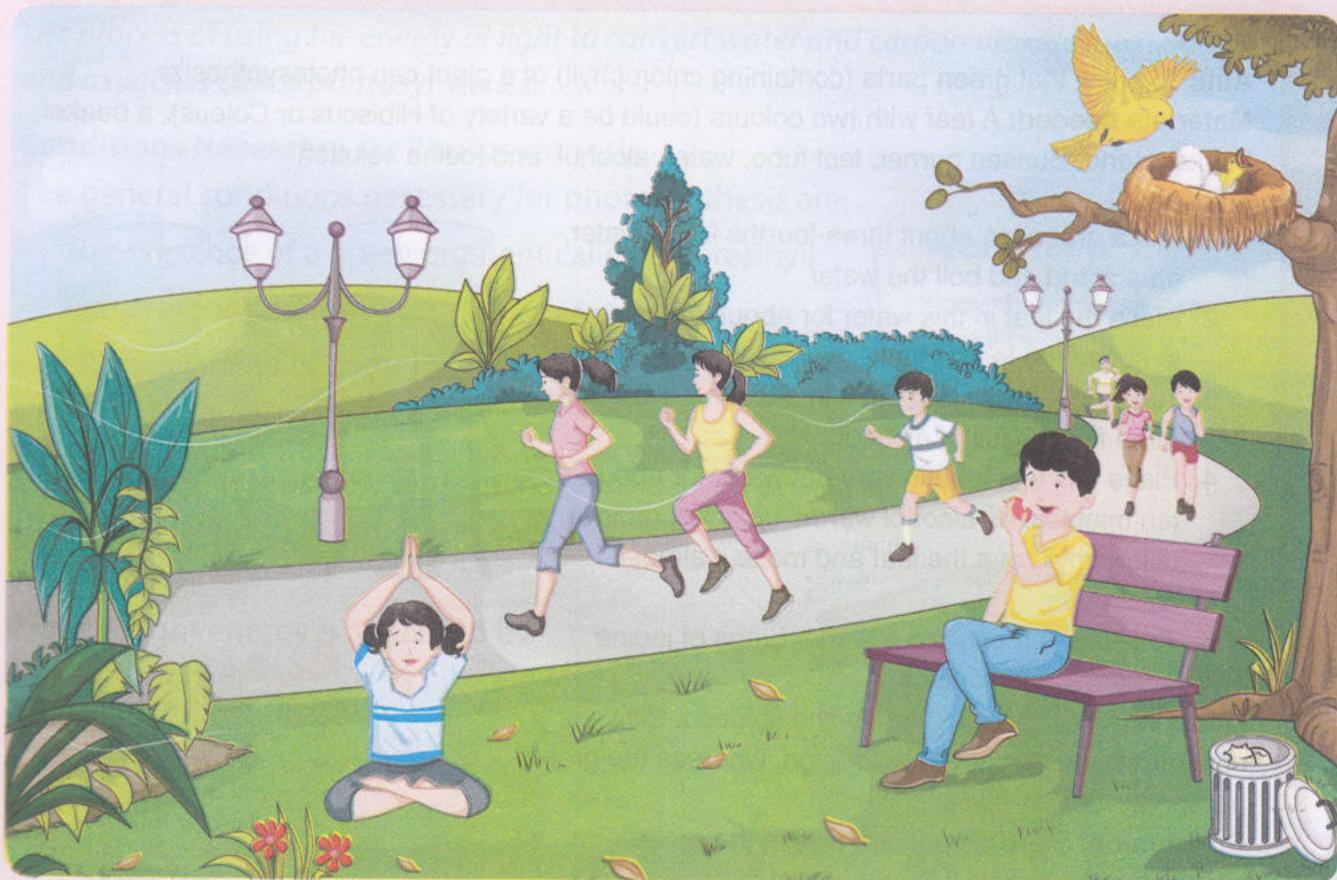
Nutrition in Plants

Living things or organisms have some basic characteristics that differentiate them from the non-living things. These characteristics are called *life characteristics*. Some of the life characteristics are nutrition, respiration, growth, response to stimuli, etc.

You will learn about

- Nutrition
- Autotrophic nutrition
- Heterotrophic nutrition
- Replenishment of nutrients in the soil

Circle any five life characteristics displayed by living things in the picture below. Name them.



In this chapter, we will learn about *nutrition* in plants. But, what does the term nutrition mean? Let us find out.

Answers: The hatching egg: reproduction; the boy eating a fruit: nutrition; the girl doing pranayam: breathing and respiration; people jogging: locomotion; and green plants: growth (respiration & nutrition)

NUTRITION

Organisms need energy to live and grow. This energy is obtained from food. *The substance broken down by chemical processes in the body of an organism to give energy is called food.*

The process by which food is taken in by an organism and used by its body is called nutrition.

There are two main modes of nutrition: *autotrophic* and *heterotrophic*.

Autotrophic Nutrition

Green plants make their own food through a process called *photosynthesis* (*photo*: light; *synthesis*: to put together).

The mode of nutrition in which an organism makes its own food is called autotrophic nutrition. Organisms that follow the autotrophic mode of nutrition are called *autotrophs* (*auto*: self; *trophe*: nutrition).

Activity

Aim: To show that green parts (containing chlorophyll) of a plant can photosynthesize

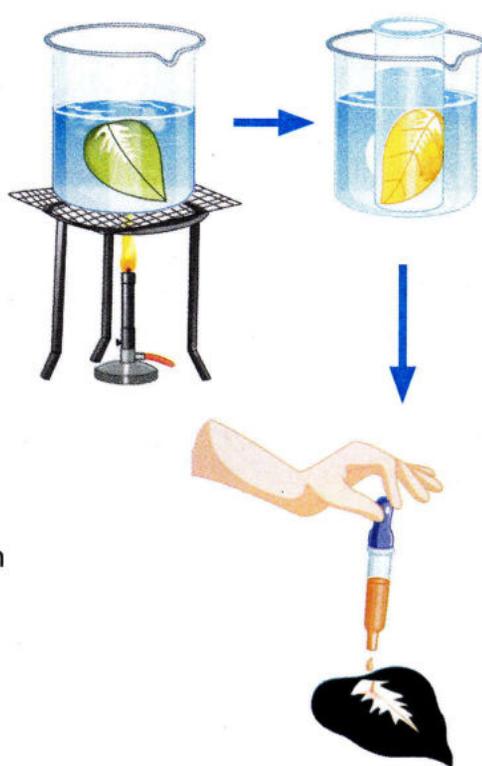
Materials needed: A leaf with two colours (could be a variety of Hibiscus or Coleus), a beaker, beaker stand, Bunsen burner, test tube, water, alcohol, and iodine solution

Method:

1. Place a beaker, about three-fourths full of water, on a stand and boil the water.
2. Place the leaf in this water for about two minutes to soften the leaf.
3. Take the leaf out and put it in a test tube about three fourths full of alcohol.
4. Place this test tube in very hot water for about ten minutes. As alcohol warms up, it will remove chlorophyll from the leaf and make it almost colourless.
5. Take the leaf out and add four drops of iodine solution on its surface.

Observation: On adding the iodine solution, the colourless portion shows no change, whereas the green portion turns blue-black.

Conclusion: Starch is present only in the green area (where chlorophyll is present) of the leaf. Thus, green parts of the leaves containing chlorophyll can photosynthesize and make food.



Photosynthesis

AN

The term photosynthesis was coined by Charles Reid Barnes in 1893. Plants take in carbon dioxide from the atmosphere and water from the soil. Water reacts with carbon dioxide in the presence of light (e.g., sunlight) and *chlorophyll* to produce sugar and oxygen (Fig. 1.1). The sugar so produced is stored in the form of starch in various parts of the plant and oxygen is released.

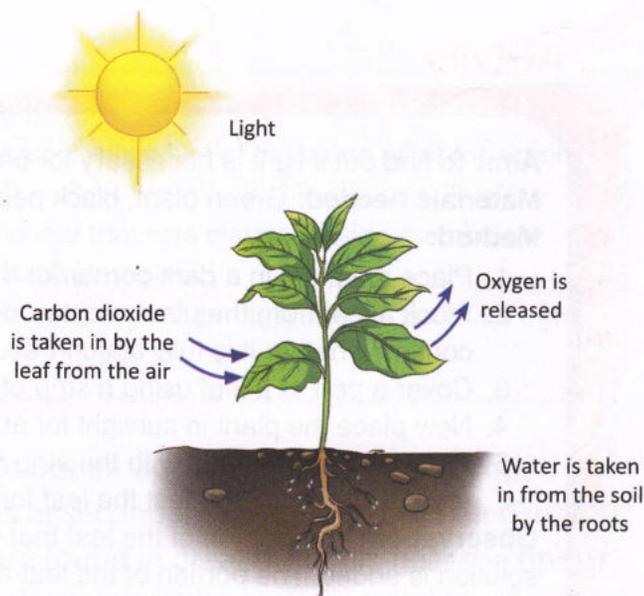
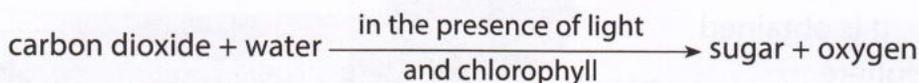


Fig. 1.1 Photosynthesis

The reaction that takes place during photosynthesis can be written as:



The process of using the energy of light to convert water and carbon dioxide into sugar and oxygen is called **photosynthesis**.

Conditions Necessary for Photosynthesis

The general conditions necessary for photosynthesis are:

- The presence of a green pigment called chlorophyll
- The presence of light
- The availability of carbon dioxide
- The availability of water

Word help

Pigment A naturally occurring substance that gives a particular colour to a plant or an animal part

Chlorophyll It is usually present in the leaves (Fig. 1.2) in structures called *chloroplasts*.

Light Light energy is absorbed by the chlorophyll.

Fact File

On an average, there are about 500,000 chloroplasts per square millimetre of a leaf.

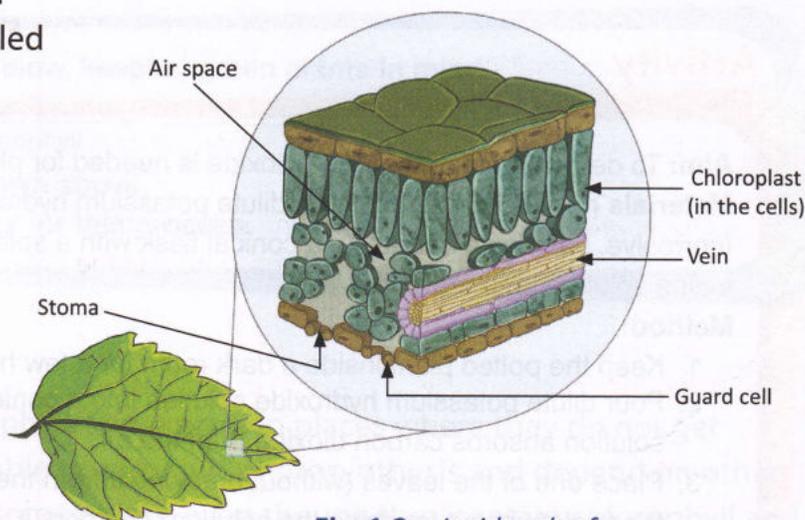


Fig. 1.2 Inside a leaf

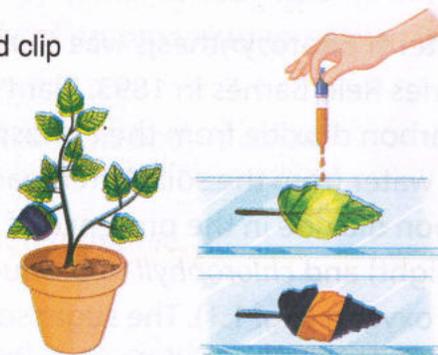
Activity

Aim: To find out if light is necessary for photosynthesis

Materials needed: Green plant, black paper, scissors, and clip

Method:

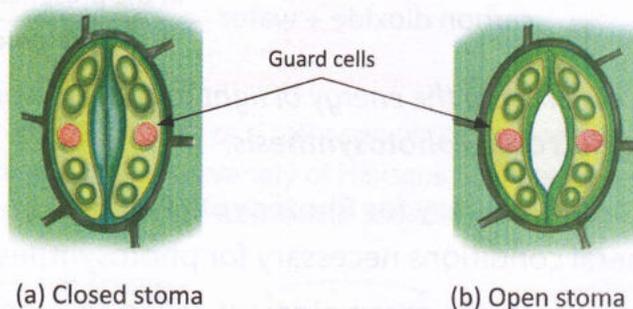
1. Place the plant in a dark corner for three days.
2. Pluck a leaf from the plant and test it for starch to confirm whether it is fully starch-free.
3. Cover a part of a leaf using a strip of black paper.
4. Now place the plant in sunlight for at least six hours.
5. Pluck the leaf covered with the strip of black paper, remove the strip, and test the leaf for starch.



Observation: The portion of the leaf that was covered shows no change when iodine solution is added. The portion of the leaf that was uncovered turns blue-black.

Conclusion: As there was no starch formation in the covered part, it did not turn blue-black. This shows that light is necessary for photosynthesis.

Carbon dioxide It is obtained from the atmosphere through small openings called *stomata* (singular: *stoma*) mostly present on the underside of the leaves (Fig. 1.3).



Let's Discuss

What would happen if the leaves of a mango plant are coated with oil?

Each stoma is bounded by two half-moon-shaped guard cells. The guard cells regulate the opening and closing of the stoma.

When there is enough light and water, the guard cells swell up and curve away from each other, thus opening the stoma. This allows carbon dioxide to enter the cells of the leaf.

Fig. 1.3 Stomata

Activity

Aim: To demonstrate that carbon dioxide is needed for photosynthesis

Materials needed: A potted plant, dilute potassium hydroxide solution (corrosive, so handle carefully), a conical flask with a split cork, iodine solution, and a dropper

Method:

1. Keep the potted plant inside a dark room for a few hours. Water it
2. Pour dilute potassium hydroxide solution into a conical flask. The solution absorbs carbon dioxide from the air.
3. Place one of the leaves (without breaking it from the plant) inside the flask (without touching the solution) and cork it.



- Now, keep the entire arrangement in sunlight.
- After a few hours, test the leaf in the flask and another leaf of the same plant for starch, using iodine solution.

Observation: When iodine solution is added, the leaf that was clasped inside the conical flask shows no change, whereas the other leaf turns blue-black.

Conclusion: The leaf inside the conical flask did not carry out photosynthesis because there was no carbon dioxide available to it.

Water The root system of plants enables them to obtain water from the soil. The root system consists of a main or primary root, rootlets or secondary roots, and root hair (Fig. 1.4). Root hair increase the surface area of roots, and are found in great numbers near the tips of roots. Water and soluble nutrients travel through the root system and reach the leaves.

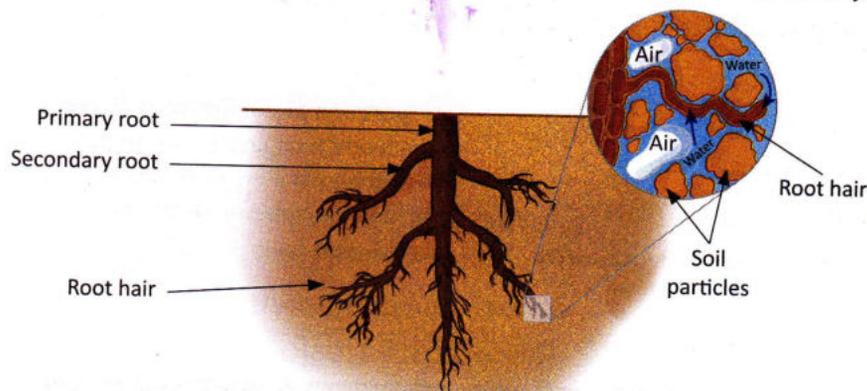


Fig. 1.4 Root system

Let's Discuss

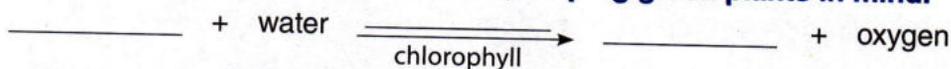
Xylem and phloem help to transport substances within a plant body. How?

Water and soluble nutrients are transported from roots to other parts of the plant through structures called *xylem*. The sugar formed as a result of photosynthesis is transported to the various parts of the plant by structures called *phloem*.

Let's Remember



- A.** Complete the equation given below, keeping green plants in mind.



- B.** Name the reaction process shown above.
C. Name the four things necessary for this process.

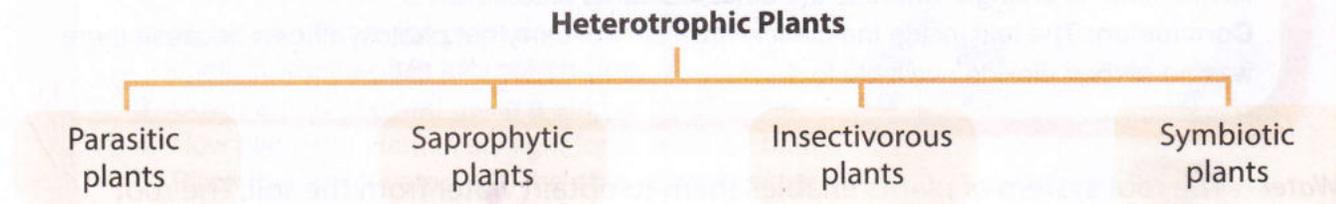
Heterotrophic Nutrition

LL

Some plants do not contain chlorophyll; some grow in places where they do not get enough light. Such plants are not able to carry out photosynthesis and depend on other organisms for nutrition. However, some plants, even though they contain chlorophyll and carry out photosynthesis, depend on other organisms for certain nutrients.

The mode of nutrition in which an organism depends on other organisms for food is called **heterotrophic nutrition**. Organisms that follow heterotrophic mode of nutrition are called **heterotrophs** [*heteron*: (an)other; *trophe*: nutrition].

Heterotrophic plants are of the following types.



Let us learn more about them.

Parasitic Plants

A **parasitic plant** is one that partially or completely depends on another plant (called **host**) for nutrition.

Usually, parasitic plants develop special roots, which penetrate into the tissues of the host plant. The prepared food is generally absorbed from the root or the stem of the host plant. Some examples are *Cuscuta* (dodder) and mistletoe.

Fact File

A parasitic plant, *Rafflesia*, bears the world's largest flower. The flowers have five petals and may have a diameter of up to 106 cm, and weigh up to 10 kg!



Cuscuta (Dodder) has a short root and a long, thread-like stem. It twines around the host stem and sends branches around neighbouring stems.



Mistletoe has leathery, green leaves, and it can make its own food. However, the plant still depends on the host for minerals and water.

In a parasitic relationship, only the parasitic plant benefits. The parasitic plant harms the host plant to some extent by slowing down its growth and sometimes causing heavy damage.

However, a parasitic plant rarely kills the host plant.

Saprophytic Plants

A **saprophytic plant** is one that obtains its nutrients from dead and decaying plant and animal matter (*sapros*: rotting; *phyton*: plant). It is usually whitish, but some plants can have brightly coloured flowers. These plants often have no leaves at all. They often grow in deep shade in tropical forests. Examples are the Indian Pipe and coral root.



The Indian Pipe is found commonly in Asia and North America.



The Coral root is found in forests around the world.

The roots of saprophytic plants contain organisms called *fungi*. The fungi convert the dead and decaying matter into nutrients that can then be used as food (like sugar) by these plants. Fungi are also called *saprotrophs*.

Get it Right

Fungi were earlier considered to be saprophytic plants. However, they are no longer classified as plants. They belong to an entirely different category of organisms classified under the Kingdom 'Fungi'. Mushrooms and toadstools are common examples of fungi.

Activity

Aim: To grow fungi

Materials required: A piece of bread, water, and a box

Method:

Moisten the bread with water and keep it outside, in the closed box for a few days.

Observation: You will see some grey patches on the bread.

Conclusion: The patches are due to the growth of fungi.

Insectivorous Plants

Insectivorous plants are the ones that derive some or most of their nutrients by trapping and consuming animals, mainly insects. These plants mostly grow in places where the soil is deficient in certain nutrients (e.g., nitrogen).

Hence, these plants need to obtain the required nutrients from other sources. Examples are the Venus flytrap, pitcher plant, *Drosera* (sundew), and bladderwort.



The Venus flytrap has leaves modified to trap insects. The inner surface of the leaves have short, stiff hair. When an insect touches the hair, the leaves snap shut in less than a second. The insect is then trapped and digested.



The leaf of the pitcher plant is modified to form a tubular pitcher-like structure. The inside of the pitcher is lined with downward pointing hair that do not allow any trapped insect to climb up and escape. The fluid at the bottom of the pitcher contains digestive juices that digest the trapped insect.



The leaves of the *sundew* plant have long, thin structures called tentacles, which have drops of a sticky substance, called *mucilage*, at their ends. Once an insect touches the tentacles, it gets stuck in the mucilage and is unable to escape. It is then digested.



The slender leaves of *bladderworts* bear a large number of very small, pear-shaped bladder structures, which act like trapdoors and suck in small insects in less than a second.

Symbiotic Plants

Certain plants live in association with other organisms, share food and other resources. Both the types mutually gain from each other. Such plants are called *symbiotic plants* and the relationship is called *symbiosis*.

Lichens are symbiotic association between a *fungus* and microscopic chlorophyll-containing organisms—*green algae* (singular: *alga*). The algae provide nutrients to the fungus, and the fungus helps the algae to grow in harsh conditions and places where they would otherwise not survive.



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REPLENISHMENT OF NUTRIENTS IN THE SOIL

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Plants use the mineral nutrients, especially nitrogen, present in the soil for their growth. As a result, there is a **depletion** of nitrogen in the soil over a period of time. Manures and fertilizers are used to **replenish** the nutrients in the soil. Besides nitrogen, they also contain potassium and phosphorus needed by plants for healthy growth.

Word help

Depletion Reduction
Replenish To fill up again

The symbiotic association of *Rhizobium* and

leguminous plants, such as the pea plant, is a natural way of replenishing the soil with nitrogen. So, sometimes farmers grow leguminous plants alternately with other crops to restore the nitrogen content of the soil.

Roots of plants such as pea contain bacteria called *Rhizobium*. *Rhizobium* converts atmospheric nitrogen into usable forms, e.g., ammonia. The plant in turn provides nutrients for the bacteria's growth.



Let's Remember



Identify the mode of nutrition in each of the following plants.

Insectivorous plant Parasitic Saprophytic Symbiotic



Key Words

Food

Any substance that can be broken down by chemical processes in the body of an organism to give energy is called food.

Nutrition

The process by which food is taken in by an organism and used by its body is called nutrition.

Autotrophic nutrition

The mode of nutrition in which an organism makes its own food is called autotrophic nutrition.

Photosynthesis

The process of using light to convert water and carbon dioxide into sugar and oxygen is called photosynthesis.

Heterotrophic nutrition

The mode of nutrition in which an organism depends on other living organisms for nutrition is called heterotrophic nutrition.

Parasitic plants

A parasitic plant is one that partially or completely depends on another plant (called host) for nutrition.

Saprophytic plants

A saprophytic plant is one that obtains its nutrients from dead and decaying plant and animal matter.

Insectivorous plants

Plants that derive some or most of their nutrients by trapping and consuming animals, mainly insects, are called insectivorous plants.

Symbiotic plants

Plants that live in association with other organisms, share food and other resources are called symbiotic plants.

Summary

- Organisms need energy for growth and maintenance. This energy is derived from food.
- Green plants are autotrophs as they prepare their own food through the process of photosynthesis.
- Photosynthesis involves the use of the energy in light to convert water and carbon dioxide into sugar and oxygen.
- Carbon dioxide is obtained through stomata present mostly on the underside of leaves, and water is obtained from the soil through the roots of the plant.
- Plants that do not contain chlorophyll are heterotrophic because they are unable to carry out photosynthesis.
- Some green plants also follow the heterotrophic mode of nutrition due to lack of nutrients.
- Heterotrophic plants are of four main types: parasitic, saprophytic, insectivorous, and symbiotic.
- Parasitic plants absorb food from another growing green plant through special roots.
- In a parasitic relationship, only the parasitic plant benefits.
- Saprophytic plants have no green leaves, and often, no leaves at all.
- The roots of saprophytic plants contain microbes called fungi.
- Insectivorous plants are usually green but mostly grow in places where soil is deficient in certain nutrients (e.g., nitrogen). Hence, these plants need to obtain the required nutrients from other sources.
- In a symbiotic relationship, both the organisms mutually gain from each other.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

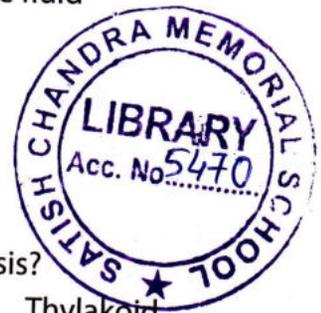
1. The mode of nutrition in which an organism makes its own food is called _____ (autotrophic/heterotrophic) nutrition.
2. The green pigment found in leaves is present in structures called _____ (chloroplasts/chlorophyll).
3. Water and other nutrients absorbed by the roots are transported from the roots to other parts of the plant through structures called the _____ (xylem/phloem).
4. The roots of saprophytic plants contain _____ (fungi/bacteria) that convert dead and decaying matter into _____ (nutrients/oxygen).
5. The _____ (symbiotic/parasitic) association between *Rhizobium* and leguminous plants replenishes the soil with _____ (oxygen/nitrogen).

B. Write T for the True and F for the False statements. Correct the false statements.

1. All plants are autotrophic in nature.
2. Plants make food in the form of starch as a result of photosynthesis.
3. The leaf of the pitcher plant is modified into a tubular pitcher to trap insects.
4. Lichens are a parasitic relationship between a fungus and a bacteria.
5. Farmers grow leguminous plants alternately with other crops to restore potassium and phosphorus content of the soil.

C. Choose the correct option.

1. Which of these absorbs light energy?
a. Chlorophyll b. Stomata c. Guard cells d. Veins
2. Which of these increases the surface area to absorb water and minerals through the roots?
a. Rootlets b. Secondary roots c. Root hair d. Primary root
3. Which of these is the reason for heterotrophic nutrition in certain plants?
a. They do not contain chlorophyll.
b. They grow in places where there isn't enough light.
c. They depend on other organisms for certain specific nutrients.
d. All of these
4. Which of these plants live in association with other organisms in such a way that both gain from each other?
a. Insectivorous plants b. Saprophytic plants
c. Symbiotic plants d. Parasitic plants
5. Which of these does a sundew plant have for trapping and digesting insects?
a. Tentacles and mucilage b. Pitcher and digestive fluid
c. Short, stiff hair and leaves that snap shut
d. Bladder structures that snap shut
6. Which of these is needed for photosynthesis?
a. Chlorophyll b. Sunlight and water
c. Carbon dioxide d. All of these
7. Which of these helps leaves to get carbon dioxide for photosynthesis?
a. Xylem b. Phloem c. Stomata d. Thylakoid
8. Which of these tissues help in conducting prepared food from leaves to the roots?
a. Xylem b. Phloem c. Guard cells d. Both a and b
9. Which of these plants live off dead and rotting material?
a. Parasitic b. Saprophytic c. Insectivorous d. Symbiotic
10. Which of the following do pea plants get into a symbiotic relationship with?
a. Fungus b. Algae c. Bacteria d. Virus



II. Very short answer type questions

Give two examples for the following.

1. Plants that have autotrophic mode of nutrition _____

2. Plants that have heterotrophic mode of nutrition _____
3. Plants that grow in nitrogen-deficient soil _____
4. Plants that harm their host plant _____
5. Symbiotic plants _____

III. Short answer type questions

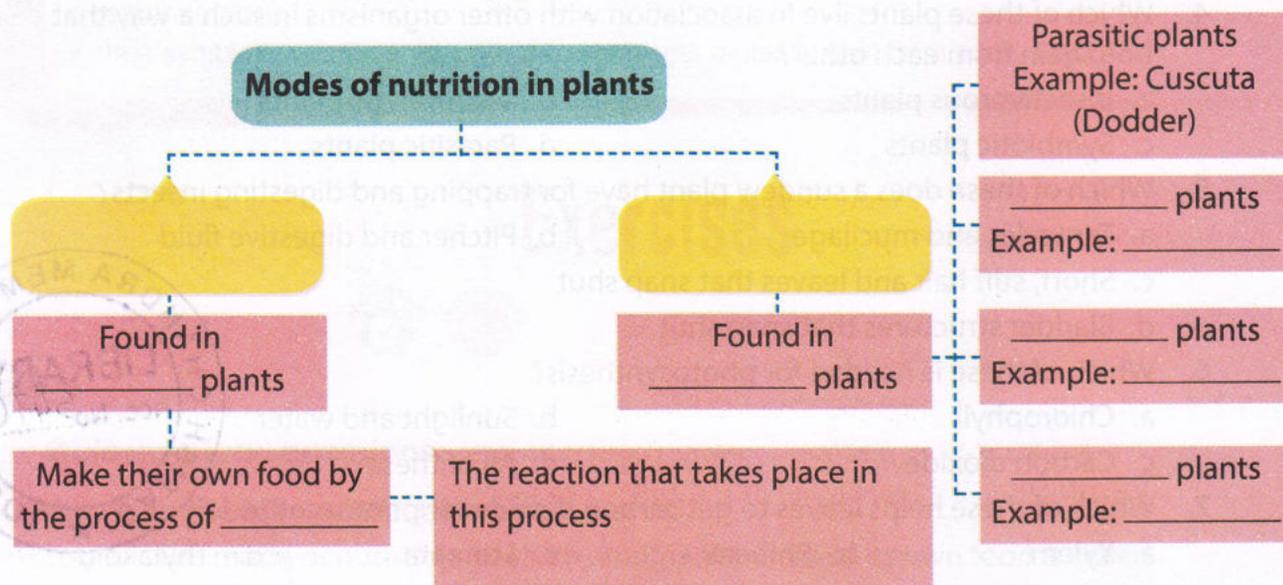
1. Define heterotrophic mode of nutrition. Name the four types of heterotrophic nutrition in plants.
2. How do parasitic plants benefit from their host plants?
3. What is the symbiotic association in lichens?

IV. Long answer type questions

1. With the help of a labelled diagram, describe the process of photosynthesis in autotrophs.
2. Describe how insectivorous plants trap and digest insects for nutrition. Support your answer with examples.
3. Discuss the different ways in which nutrients are replenished into the soil.

LET'S RECALL

Recall and complete the concept map given below.

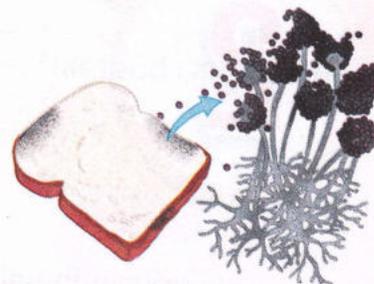


LET'S OBSERVE

1. Draw labelled diagrams of a closed and an open stoma.



2. a. What mode of nutrition is shown in this picture—autotrophic or heterotrophic?
- b. What is the type of nutrition displayed?
 - i. Parasitic
 - ii. Saprophytic
 - iii. Symbiotic



LO 2

LET'S CONNECT ENGLISH

Imagine yourself to be an insectivorous plant. Give yourself a 'plant name'. Write why and how you catch insects for nutrition.



LET'S APPLY

Anita put a few drops of iodine on the leaf given alongside (after it was de-starched and made colourless).

- Which part of the leaf will turn the iodine bluish-black and why?
- a. The entire leaf
 - b. The part of the leaf that is green
 - c. The part of the leaf that is white

LET'S ANALYSE AND EVALUATE

1. Analyse how bean plants help the soil.
2. Evaluate and justify whether it is a good idea to grow bean plants along with wheat plants.



LO 5

LET'S CREATE

1. Make a chart showing different types of heterotrophic nutrition in plants. Collect pictures of different heterotrophic plants and paste them under respective heads on the chart. Write their names in English as well as in your mother tongue.
2. Make a clay model of a door hinge to show how leaves of a Venus flytrap are modified to trap insects. Then, use it as a prop to explain the process.

LO 2

LO 11

LO 15

Web Research

- Browse the Internet and find out how plants can survive in artificial light, and how chloroplasts can trap light energy from any source, not necessarily sunlight. Some suggested websites are:
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3949401/> (accessed and checked on 03/09/19)
<https://photosynthesiseducation.com/artificial-photosynthesis/> (accessed and checked on 03/09/19)
<https://plantcaretoday.com/growing-plants-indoors-artificial-light.html#understanding-light-and-plant-needs> (accessed and checked on 28/08/19)
- Find out and make a list of some more plants other than the ones in the book, that exhibit heterotrophic mode of nutrition. Also, find out the kind of nutrition in each. Some suggested websites are:
<http://www.biologydiscussion.com/plants/heterotrophic-plants/list-of-9-heterotrophic-plants-botany/48977> (accessed and checked on 28/08/19)
<https://courses.lumenlearning.com/wm-biology2/chapter/heterotrophic-plants/> (accessed and checked on 28/08/19)

2

Nutrition in Animals

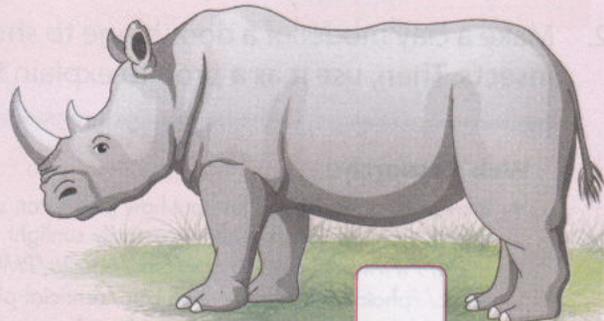
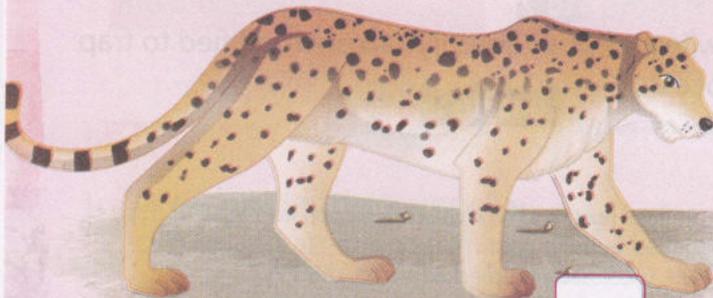
In Chapter 1, you learnt how plants obtain nutrition. How are animals different from plants in the way they obtain nutrition?

Animals, including humans, depend on plants or plant-eating animals for their food.

You will learn about

- Nutrition in animals
- Nutrition in *Amoeba*
- Nutrition in humans
- Types of teeth
- Nutrition in ruminants

Look at the animals below and write H for Herbivore, C for Carnivore and O for Omnivore, depending on the kind of food each of them eats.



Do you know what happens to the food after it is eaten? Let us learn about it.

Answers: Bear-O; Deer-H; Leopard-C; Rhinoceros-H

NUTRITION IN ANIMALS

LL

Food is broken down in an animal's body into simpler substances. This food can then be used by the body to obtain energy.

The process of nutrition in animals involves five stages:

Ingestion The intake of food into body is called ingestion.

Digestion The breakdown of food into simpler substances is called digestion.

Absorption The uptake of the soluble substances produced during digestion by the tissues in the body is called absorption.

Assimilation The use of simple substances to build complex substances required by the body is called assimilation.

Egestion Elimination of undigested food from the body is called egestion.

Different organisms have different ways of ingesting food. In some organisms, food is ingested with the help of outgrowths on their bodies, e.g., *tentacles* in *Hydra* and *cilia* in *Paramecium*.

Small animals such as insects and worms have special mouth parts for ingesting food. The mouth of a bird is modified into a beak, which helps it to catch food and tear or crack it. Birds have different kinds of beaks depending on the kind of food they eat. Snakes swallow their food whole.

Let us first learn about nutrition in one of the simplest living organisms — *Amoeba*.

NUTRITION IN *Amoeba*

AN

Amoeba is an organism made up of a single cell. It is usually found in ponds and ditches. Its food consists of the microscopic organisms found in these water bodies. It does not have a very structured body.

When *Amoeba* senses food, it forms finger-like projections called *pseudopodia* (*pseudo*, false; *podium*, foot), which completely enclose the food, resulting in the formation of a space or cavity called a *food vacuole* (Fig. 2.1). Some digestive juices are **secreted** in the food vacuole and the food is digested there. It is then absorbed and assimilated, and the undigested part is thrown out.

Word help

Secrete To produce and release a substance

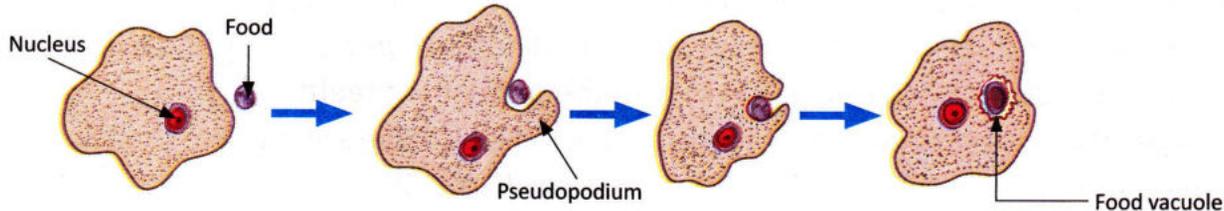


Fig. 2.1 An Amoeba feeding

NUTRITION IN HUMANS

AN

As compared to an *Amoeba*, the whole process of nutrition in humans is a complex one. The food passes through a number of organs in the body that together form the digestive system. The digestive system consists of the alimentary canal or the digestive tract and other organs such as the gall bladder, pancreas, and liver. The digestive tract is a long tube starting from the mouth to the anus. Food is digested with the help of digestive juices secreted by various glands of the digestive system, e.g., salivary glands, liver, and pancreas.

Ingestion

Food is taken into the body through the *mouth*, and is chewed. We have different types of teeth, which help us in breaking down food into smaller pieces.

Types of Teeth

LL

There are four different types of teeth: incisors, canines, premolars, and molars.

Incisors They are also called *biting teeth*. They are flat, blade-like teeth. The incisors are the front teeth and are so-called because they help to incise (cut) food [Fig. 2.2 (a)].

Canines They are also called the *tearing teeth*. They have very sharp edges and help to tear the food [Fig. 2.2 (b)].

Premolars They have broader surfaces and, therefore, help to chew and grind the food [Fig. 2.2 (c)].

Molars These are large back teeth. They have a wide grinding surface and are used primarily to chew food [Fig. 2.2 (d)].

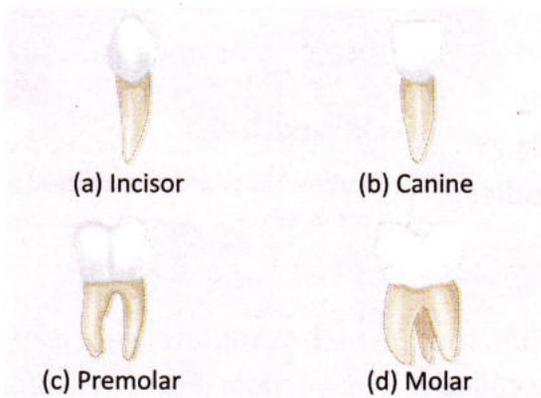


Fig. 2.2 Types of teeth

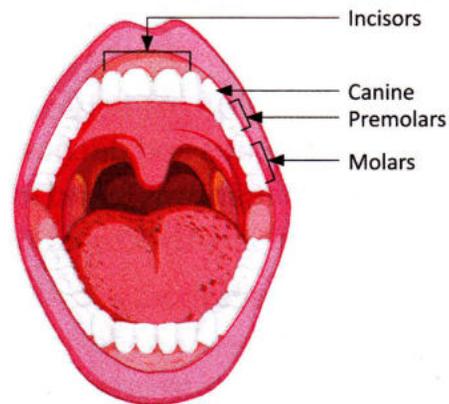


Fig. 2.3 Permanent set of teeth

Humans develop two sets of teeth in their lifetime: *the temporary set* and *the permanent set*. The temporary set has 20 teeth, which are also called the *milk teeth*. Around the age of six, the milk teeth start falling out, giving way to the permanent teeth.

In the permanent set, there are 32 teeth, 16 in each jaw. There are four incisors, two canines, four premolars, and six molars in each jaw (Fig. 2.3).

Taking care of our teeth

Bacteria are present all around us, even in our mouths. But all bacteria are not harmful to us. However, when we do not clean our teeth properly, some harmful bacteria start growing in the mouth. These bacteria, together with the food particles and the saliva, form a thin sticky layer, called plaque, on the surface of the teeth. Plaque that is not removed by brushing, produces acid. The acid dissolves the hard tooth enamel. Tiny holes appear on the surface of the enamel, which slowly get bigger until one large hole appears. This is called a cavity.

Tongue

The tongue is a fleshy muscular organ present in the mouth. It helps to mix saliva with the food while chewing and also helps in swallowing. The tongue is also a very important sense organ and has taste buds, which help to sense four different tastes: sweet, salty, bitter, and sour.

Digestion

The process of digestion starts in the mouth itself where the food is mixed with *saliva*. Saliva, secreted by the *salivary glands*, contains digestive juices that help in the breakdown of starch into sugar. Saliva also makes the food slimy so that it can be easily swallowed. Once swallowed, the food passes from the mouth into a long tube called the *oesophagus* (also called *food pipe*). The walls of the oesophagus contract and relax to produce wave-like movements (called *peristaltic* movements). These movements help to move the food down into a large sac-like muscular organ called the *stomach*.

Further digestion of food takes place in the stomach. The inner wall of the stomach secretes digestive juices, hydrochloric acid, and mucus. The digestive juices help in the breakdown of proteins into simpler forms. The hydrochloric acid kills microorganisms and provides an acidic medium for effective digestion.

From the stomach, the semi-digested food called the *chyme* passes into the *small intestine*. Further digestion of food takes place in the small intestine where the secretions of the liver and pancreas are released.

The liver secretes *bile*, which plays an important role in the digestion of fats. Bile is stored in an organ, called *gall bladder*, before being released in the small intestine. The secretions of the pancreas, called *pancreatic juice*, help in the breakdown of carbohydrates into sugars, proteins into amino acids, and fats into fatty acids and glycerol. Thus, the digestion of various components of food is completed in the small intestine.

Know your Scientist

Charaka was a famous physician of ancient India, who in his famous work 'Charaka Samhita' presented the concept of digestion and immunity. He mentioned that our body contains three main principles called *doshas*: *vata* (wind), *pitta* (bile), and *kapha* (phlegm), which get produced when we eat food. He believed that any imbalance in these three *doshas* causes disease.

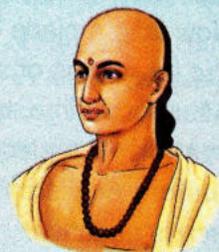


Figure 2.4 shows the human digestive system diagrammatically.

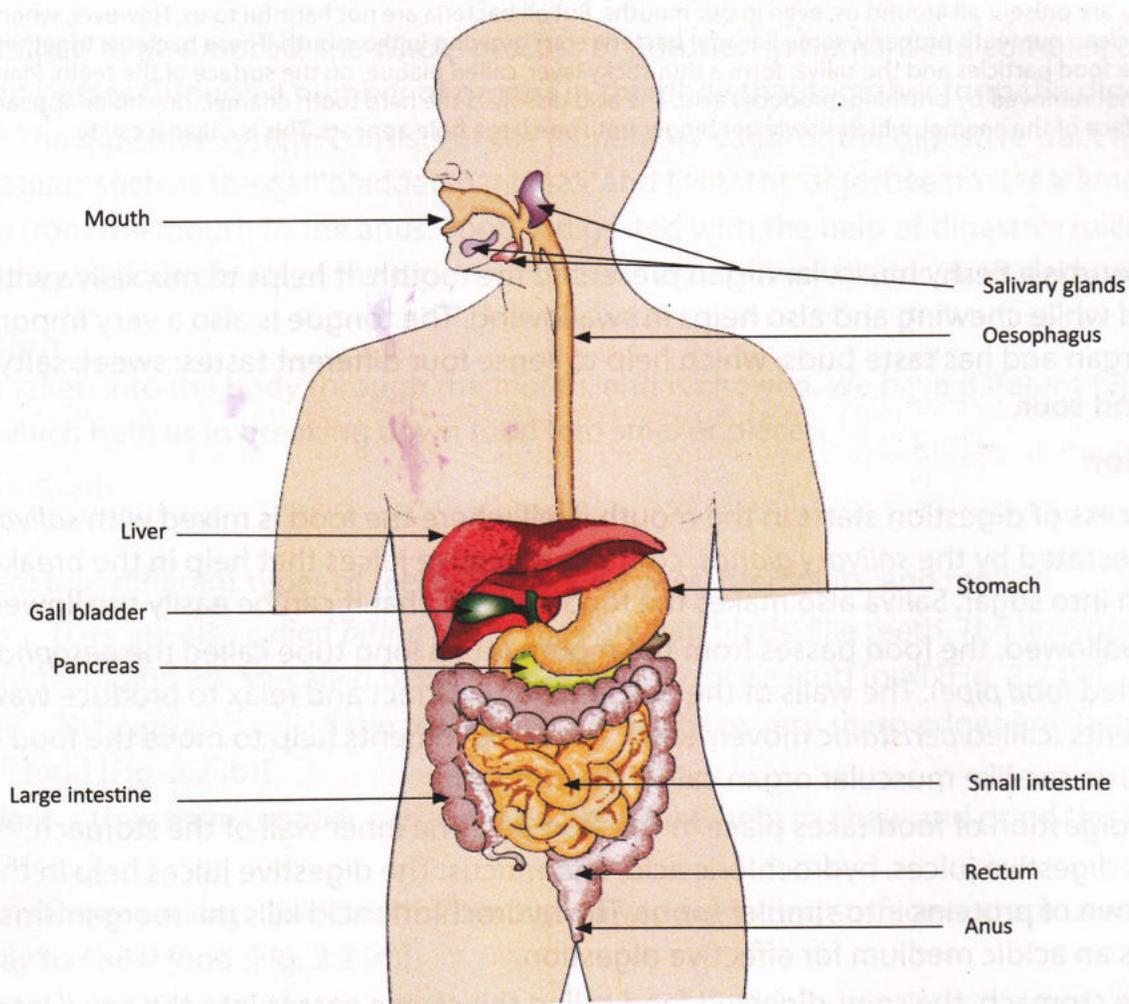


Fig. 2.4 Diagrammatic representation of the digestive system in humans

Activity

Aim: To study the effect of saliva on food

Materials needed: Bread, watch glass, petridish, iodine solution, and saliva from your mouth

Method:

1. Break off a small piece of bread and test it for starch using iodine solution. If it turns blue-black, starch is present.
2. Now take a piece of bread in the petridish.
3. Put four drops of saliva on the bread and leave it for some time.
4. After some time, test for starch again on the portion where saliva was added.

Observation: The piece on which saliva was put shows no change in colour.

Conclusion: As starch has been converted to sugar by the digestive juices in saliva, the test for starch is negative.

How do you get hiccups?

You can blame your diaphragm, an arched muscle below the lungs, for hiccups. Normally when you inhale, the diaphragm contracts (goes down) to help fill air into the lungs. When you exhale, the diaphragm expands (rises up) to help push air out of the lungs. But sometimes, say when you eat too quickly, the diaphragm goes down with a jerk, which causes air to enter very fast. The air rushing in causes the flap at the top of our windpipe to snap shut briefly producing the typical 'hic' sound of a hiccup. This may happen a number of times. Most hiccups last only a few minutes. The common remedy is drinking a glass of cold water.

Absorption

Even though digestion continues in the small intestine, the main job of the small intestine is to absorb the nutrients obtained as a result of digestion. The lining of the small intestine has finger-like projections called *villi* (singular: villus) that increase the surface area of the lining. This makes absorption more efficient. Each villus has a network of fine blood vessels. Nutrients are absorbed into the blood present in these fine blood vessels.

The chyme now passes into the large intestine, where water and minerals are absorbed.

Assimilation

The nutrients that are absorbed in the blood are transported to the rest of the body. The final product of carbohydrate digestion, i.e., glucose, is broken down into carbon dioxide and water in the cells with the help of oxygen, to release energy. Amino acids are used for repairing worn out cells and tissues. Fatty acids and glycerol act as energy reserves and are stored for further use.

Egestion

TD

After absorption of water and minerals in the large intestine, the undigested food becomes semi-solid. It is then stored in the *rectum* until it is removed through the *anus*.

Diarrhoea

Sometimes, consumption of dirty food or unclean water can result in a condition called diarrhoea. It is an infection of the intestine and involves passage of watery stools very frequently. This leads to the loss of useful salts from the body and can cause dehydration. Dehydration is a condition caused by the loss of water from the body and can be serious. It can be avoided by giving Oral Rehydration Solution (ORS) to the patient suffering from diarrhoea. The World Health Organization (WHO) has recommended a simple ORS remedy that can be made at home by adding salt and sugar to water. ORS sachets are also easily available in all chemist stores.

Case Study: How did we come to know so much about digestion?

There is an amazing story behind it. In 1822, a 19-yr-old man named Alexis St. Martin was accidentally hit at close range by a shotgun. Dr William Beaumont, who treated him, was very surprised when St. Martin survived. All his wounds healed except for one hole that did not

heal for years. The inside of the stomach could be seen through this hole. Dr Beaumont studied this case and discovered many facts about the process of digestion. He also observed that sad mood has a negative effect on digestion.

Let's Remember



A. Write T for the True and F for the False statements. Correct the false statements.

1. Digestion involves the intake of food into the body.
2. When an amoeba senses its food, it forms a food vacuole.
3. Incisors have very sharp edges and help to tear the food.
4. The liver secretes bile which is stored in a small bag-like organ called the gall bladder.
5. The nutrients absorbed in the blood are transported to the rest of the body by egestion.

B. Match the following.

Column A

1. Ingestion
2. Digestion
3. Liver
4. Pancreas
5. Egestion

Column B

- a. Carbohydrates, proteins and fats
- b. Anus
- c. Fats
- d. Mouth
- e. Stomach, liver and small intestine

NUTRITION IN RUMINANTS

AN

Have you seen a cow chew continuously or ever wondered why it does so?

Actually, cows and some other plant-eating animals like goat, deer, etc. swallow their food after chewing once. Later, they bring back the swallowed food into the mouth and chew it again. *A plant-eating animal that brings back swallowed food into the mouth to chew it again is called a ruminant and the process is called rumination.*

This habit of ruminants makes their digestive system different from ours and, thus, the need to study them separately.

Ingestion

The food is ingested with the help of the tongue and chewed. Ruminants have sharp incisors and large molars to bite and chew grass. They also have powerful jaw muscles.

Digestion

After being chewed once, the food passes down the 2 to 3 feet long oesophagus. The oesophagus leads into the stomach. The stomach of a ruminant has four chambers: *rumen*, *reticulum*, *omasum*, and *abomasum* (Fig. 2.5).

Fact File

A cow makes 40,000 to 60,000 jaw movements per day. The process of digestion in a cow takes 70–100 hours, as compared to 2–24 hours in humans. This, however, permits them to obtain as much nutrition as possible from the plant materials.

Let's Discuss

Ruminants do not have canines as sharp as carnivores. Why?

Rumen The rumen helps in storing the large quantity of food that has been quickly consumed. The food is partially digested here and is now called the *cud*. The cud is then brought back to the mouth, re-chewed, and re-swallowed in a process called cud-chewing. The rumen has billions of bacteria and protozoa, which break down the carbohydrate called *cellulose* found in hay and grass.

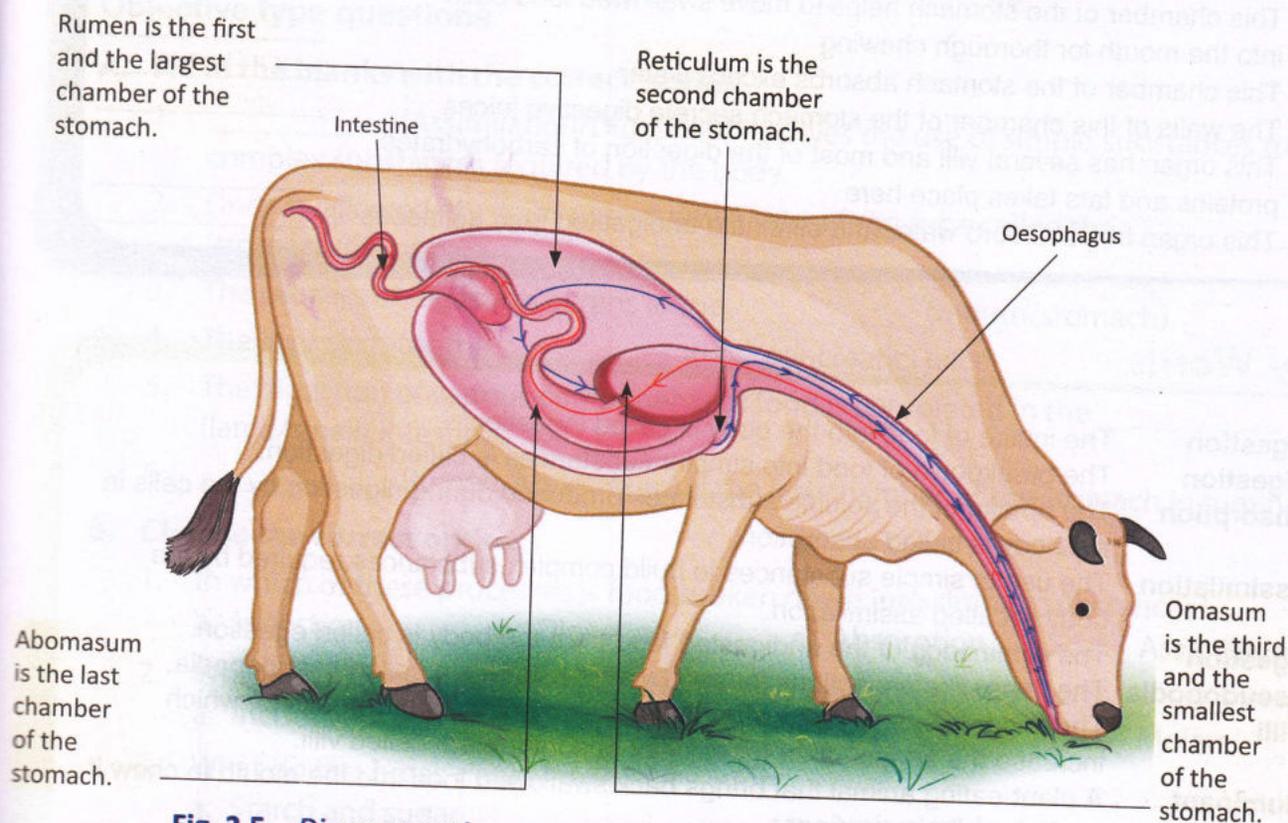


Fig. 2.5 Diagrammatic representation of the digestive system of a ruminant

Reticulum The reticulum helps in moving the swallowed food back into the mouth for thorough chewing. The reticulum opens into the omasum.

Omasum The omasum absorbs excess water.

Abomasum The walls of the abomasum secrete digestive juices.

Absorption

Absorption begins in the four-chambered stomach, but the main absorptive organs are the intestines.

The food from the abomasum passes into the *small intestine*, where it mixes with secretions from the pancreas and liver. Most of the digestion of carbohydrates, proteins, and fats takes place here. Several villi are present here, which help in increasing the surface area for absorption.

The small intestine leads into the *large intestine*. The main function of the large intestine is to absorb water and eliminate the undigested food as faeces.

Let's Remember



Identify the following parts of a cow's digestive system.

1. This muscular part of the mouth helps in ingesting food _____
2. This is the largest chamber of the stomach where cud is formed . _____
3. This chamber of the stomach helps to move swallowed food back into the mouth for thorough chewing _____
4. This chamber of the stomach absorbs excess water _____
5. The walls of this chamber of the stomach secrete digestive juices _____
6. This organ has several villi and most of the digestion of carbohydrates, proteins and fats takes place here _____
7. This organ helps absorb water and eliminate undigested food as faeces _____

Key Words

Ingestion	The intake of food into the body is called ingestion.
Digestion	The breakdown of food into simpler substances is called digestion.
Absorption	The uptake of the soluble substances produced during digestion by the cells in the body is called absorption.
Assimilation	The use of simple substances to build complex substances required by the body is called assimilation.
Egestion	The elimination of the undigested food from the body is called egestion.
Pseudopodia	The finger-like projections formed by an Amoeba are called pseudopodia.
Villi	The finger-like projections found on the lining of the small intestine, which increase the surface area for efficient absorption are called villi.
Ruminant	A plant-eating animal that brings back swallowed food into the mouth to chew it again is called a ruminant.
Rumen	The first and the largest part of the ruminant's stomach is called the rumen.

Summary

- The process of nutrition involves the following five stages: ingestion, digestion, absorption, assimilation, and egestion.
- The four different types of teeth in humans are incisors, canines, premolars, and molars.
- In humans, two sets of teeth arise in their lifetime: the milk teeth and the permanent teeth.
- The process of digestion begins in the mouth where the food is mixed with saliva.
- The major part of the digestive process takes place in the stomach and the small intestine.
- The main job of the small intestine is to absorb nutrients.
- Solid waste is stored in the rectum and eliminated through the anus.
- Ruminants have a four-chambered stomach consisting of the rumen, reticulum, omasum, and abomasum.
- Absorption begins in the rumen and the omasum but the majority of the nutrients are absorbed in the small and the large intestines.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

- _____ (Assimilation/Digestion) involves the use of simple substances to build complex substances required by the body.
- Once swallowed, the food passes down into a long tube called the _____ (stomach/oesophagus).
- The process of digestion begins in the _____ (mouth/stomach).
- The liver secretes the _____ (bile/pancreatic) juice.
- The digestion of various components of food is completed in the _____ (large/small) intestine.
- _____ (Rumen/Abomasum) is the last chamber of the stomach in ruminants.

B. Choose the correct option.

- In which of these processes is food broken down into simpler substances?
a. Ingestion b. Digestion c. Absorption d. Assimilation
- Which of these are flat blade-like teeth used for cutting food?
a. Incisors b. Canines c. Premolars d. Molars
- What do fats break down into?
a. Starch and sugar b. Amino acids
c. Fatty acids and glycerol d. Fatty acids and amino acids
- In which of these chambers of ruminants does the food get partially digested and stored as the cud?
a. Rumen b. Omasum c. Abomasum d. Reticulum
- Which of these nutrients gets mostly digested in the small intestines?
a. Carbohydrates b. Proteins c. Fats d. All of these
- With the help of which of the following does a hydra catch its food?
a. Tentacles b. Cilia c. Beak d. Pseudopodia
- Which of these help to digest food in an amoeba?
a. Outgrowths called pseudopodia b. Digestive juices in the liver
c. Digestive juices in the food vacuole d. Digestive juices in the stomach
- Which of these primarily helps in the digestion of fats in human beings?
a. Pancreatic juice b. Saliva c. Bile d. Villi
- Which of these act as energy reserves and are stored for later use?
a. Amino acids b. Glycerol c. Fatty acids d. Both b and c

10. Which of these is not a chamber of the stomach of ruminants?

- a. Abomasum and Omasum
- b. Rumen and reticulum
- c. Liver and pancreas
- d. None of these

II. Very short answer type questions

Give two examples for the following.

- 1. Organisms made of a single cell _____
- 2. Outgrowths that help unicellular animals to catch food _____
- 3. Digestive juices that aid in digestion _____
- 4. Glands of the digestive system _____

III. Short answer type questions

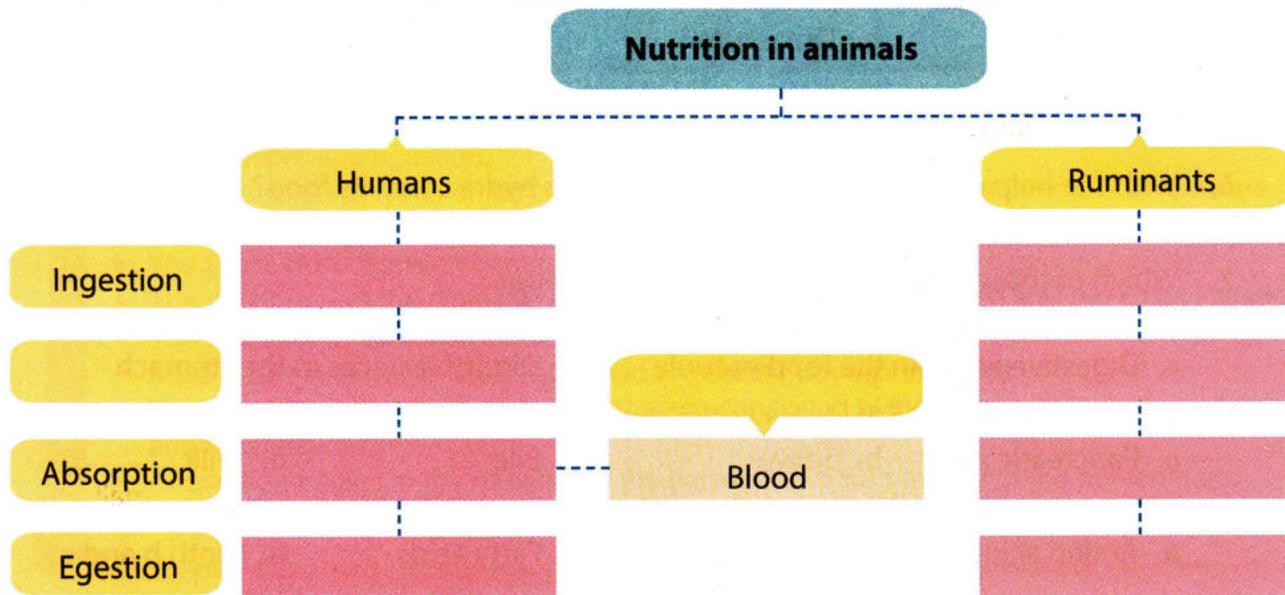
- 1. How is ingestion different from egestion?
- 2. Name the four types of teeth and their main functions in the human jaw.
- 3. How do villi help in small intestines of human beings?
- 4. What is rumination?

IV. Long answer type questions

- 1. With the help of a well-labelled diagram, describe how an amoeba catches and digests its food.
- 2. Explain the process of digestion in human beings.
- 3. How do nutrients get assimilated after digestion in the human body?
- 4. Describe in brief the process of digestion in ruminants.

LET'S RECALL 

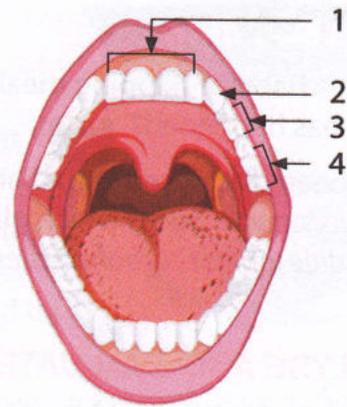
Recall and complete the concept map given below.



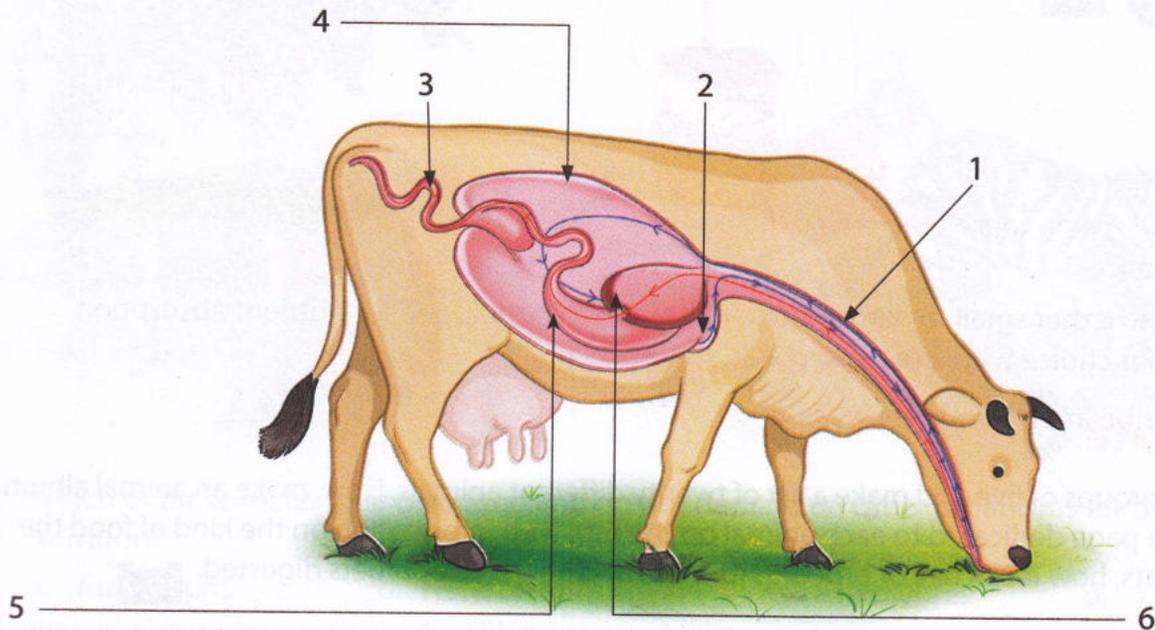
LET'S OBSERVE



1. Look at the picture and write the correct numbers. Also label the teeth in the picture. **LO 1**

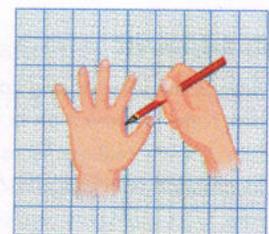
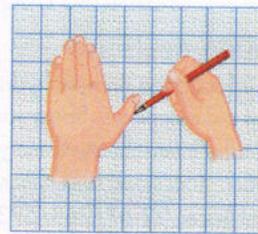


- a. There are _____ teeth in all, in an adult jaw.
- b. An adult has:
- _____ incisors
 - _____ canines
 - _____ premolars
 - _____ molars
2. Label the parts of a cow's digestive system in the diagram given below.



LET'S CONNECT MATHS

Discuss the surface areas of various objects in the classroom environment to help children clearly learn the distinction between perimeter, area, and surface area. Trace your hand on a graph sheet—first with the fingers together and then spread out. Discuss the area, surface area, and perimeter. See how the surface area



gets increased when the fingers are spread out. Villi are finger-like projections in the small intestine that help to increase the surface area in a similar manner.

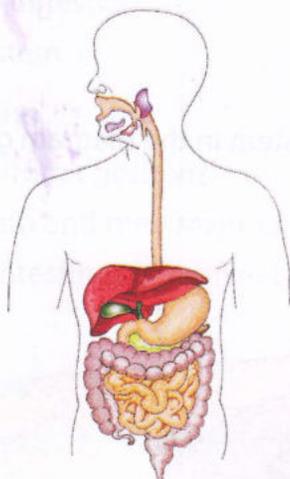
LET'S APPLY



1. Shriya has a habit of skipping meals. Her doctor says she has developed acidity. Why do you think this has happened? **LO 5**
2. Vijay has been diagnosed with diabetes because one of his glands is not functioning efficiently. Can you guess which gland we are talking about? (*Hint: Diabetes is caused due to improper digestion of carbohydrates.*) **LO 13**

LET'S ANALYSE AND EVALUATE

1. Analyse which part of the grass-eating animals is drastically different from a human digestive system. Why? **ANALYSING** **LO 5**



2. Estimate whether small (or large) intestines are better equipped for nutrient absorption. Justify your choice with a reason. **ANALYSING** **EVALUATING**

LET'S CREATE



1. Get into groups of five and make a list of twenty different animals. Now, make an animal album (with one page dedicated to each animal on the list), with information on the kind of food the animal eats, how it catches or procures its food, and how the food gets digested. **LO 2**
2. Make a model of the human digestive system, by reusing things easily available at home like beads, cotton wool, thread, thread wool, cardboard, etc. In groups of five, plan and design how you would use the resources. **LO 11** **LO 15**

Web Research

- Browse the Internet and collect information on how hydra makes outgrowths to derive its nutrition. Draw diagrams to show it on backs of old calendars. Some suggested websites are:
<http://www.biologydiscussion.com/invertebrate-zoology/phylum-coelenterata/hydra-history-habitat-and-locomotion-with-diagram/28686> (accessed and checked on 28/08/19)
<http://jcs.biologists.org/content/joces/s2-67/268/593.full.pdf> (accessed and checked on 28/08/19)
- Browse the Internet and make a list of any five diseases that affect the digestive tract, their symptoms and prevention. A suggested website is:
<https://www.everydayhealth.com/digestive-health/common-digestive-conditions-from-top-bottom/> (accessed and checked on 28/08/19)

Worksheet 1

Skills assessed:

Problem solving, and qualitative analysis

Read the passage given below and answer the questions that follow.

Food for life

The food we eat contains the nutrients needed by our body to grow, to get energy for work and play, to replace worn out tissues, as well as to stay healthy and strong. Similarly, food is needed by all living organisms to carry out their life processes.

Since the living organisms eat a variety of foods, there are many different ways by which they get it. Some animals eat only plants and plant-based foods, while some are flesh eating, or both. Plants on the other hand are mostly autotrophs and very seldom heterotrophs.



1. Which of these make their own food and do not depend on other organisms for their nutrition?
 - a. Autotrophs
 - b. Heterotrophs
 - c. Herbivores
 - d. Carnivores
2. Which of these plants cannot make their own food?
 - a. Neem and peepal
 - b. Cotton plant and hibiscus
 - c. Grapevine and peas
 - d. Dodder and Indian coral
3. Which of these animals will have specially developed canines?
 - a. Plant-eating animals
 - b. Flesh-eating animals
 - c. Autotrophs
 - d. All heterotrophs
4. Which of these is not true about autotrophs?
 - a. They trap insects for meeting their nutrition requirements.
 - b. They contain chloroplasts.
 - c. They manufacture their own food using air, water and light.
 - d. None of these



Activity

Skills learnt:

Collaborating, communicating, critical thinking, and creating

Aim: To design a simple system for the stem of a plant that would help to catch insects

- Discuss in your group how the system would work and make the design here.

A yellow pencil icon is positioned at the top left corner of the design area.

- Make a list of different things that you would use to make the system.

- After making the system, discuss whether it worked well or not.
- What changes could be made to make it work better? Discuss.

*For the Teacher: Please refer to the teacher's manual for more details

3

Unit 2: Materials

Fibre to Fabric

What is the first thing that comes to your mind when you think of clothes? Some may say fashion, some colours, some would say designers, some tailors. Those who say fibres are not wrong either. Fibres are, after all, the basic materials that are used to make clothes. Some fibres are obtained from plants and animals; some are made by humans.

Write P for Plant, A for Animal and M for Man-made (or Synthetic) fibres that would be most suited to make the following.

You will learn about

- Wool
- Wool production
- Health hazards in the wool industry
- Silk
- Sericulture
- Health hazards in sericulture



1.



2.



3.



4.

Clothing material or fabric is woven from yarns and yarns are spun from fibres. Different types of fabrics are used for making dresses, curtains, sofa covers, carpets, etc. In this chapter, we will learn about some animal fibres, their sources, and how they are used to make fabrics.

Answers: 1. A; 2. M; 3. P; 4. A

WOOL

Wool is an animal fibre. It is present as a thick coat of hair on the body of certain animals to keep them warm. Air gets trapped in the spaces between the hair and does not allow the body heat to escape (you will learn more about this in later chapters). That is why we wear woollens in winter.

Wool from Sheep

A sheep's hairy coat has two types of fibres: *the coarse beard hair* and *the soft under-hair*, found close to the skin. It is the soft under-hair that is used to make wool. Scientists have developed certain breeds of sheep that only have the soft under-hair.

The wool from different varieties of sheep differs in fineness, shine, length, and strength. The finest wool is obtained from the Merino, a breed of sheep originally from Spain (Fig. 3.1). Their wool is very soft and light, and is therefore, used in making the finest woollen clothes.



Fig. 3.1 Merino sheep

Rearing of Sheep

Sheep are herbivores and eat mainly grass and leaves. They are sometimes also fed a mixture of pulses, corn, jowar, etc.

In India, sheep are reared in the hilly regions of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Arunachal Pradesh, Sikkim, Punjab, Haryana, Rajasthan, and Gujarat.

Table 3.1 gives a list of some Indian breeds of sheep and examples of products made from the wool obtained from these sheep.

Around the world, sheep are reared in countries ranging from the hot desert regions of Australia, Asia, and the Middle East to the cold regions of Northern Europe, Russia, Iceland, and southern South America.

Table 3.1 Some Indian breeds of sheep

Name of the breed	Products made from the wool
Lohi	Carpets (good quality wool)
Nali	Carpets (good quality wool)
Bakharwal	Woollen shawls
Marwari	Carpets (coarse quality wool)
Patanwadi	Hosiery such as socks and stockings

Word help

Breed A particular type of animal developed for certain desirable characteristics

Rearing Keeping animals and caring for them to obtain useful products

Wool from Other Animals

Although the main source of wool is sheep, wool is also obtained from animals of the camel family, goat, and even rabbits.

Camel hair is obtained from the very soft and fine fur of the **undercoat** of the camel. The Bactrian camels (two-humped camels found in Siberia, Mongolia, and China) (Fig 3.2) give the best quality camel wool. The alpaca

and llama (Figs. 3.3 and 3.4) also belong to the camel family. They are found in South America. Their undercoat hair is very soft and **lustrous**, and the fibres are light-weight.

Word help

Undercoat A covering of short hair found below the longer outer hair on an animal's body
Lustrous Shiny

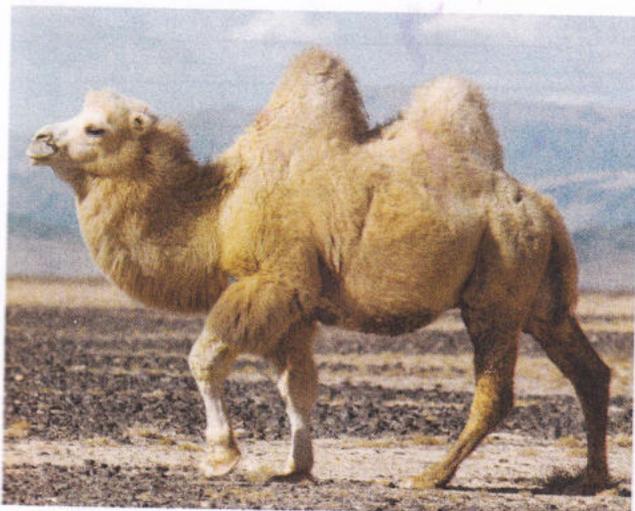


Fig. 3.2 Bactrian camel

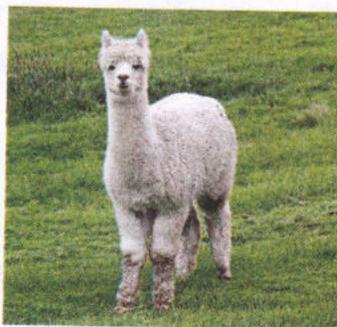


Fig. 3.3 Alpaca (belongs to the camel family)



Fig. 3.4 Llama (belongs to the camel family)

The Cashmere goat (Fig. 3.5) is found in the high plateaus of Asia. The Cashmere fibre, very soft and warm, is obtained from this goat.

The Angora goat (Fig. 3.6) originally belongs to the Angora (former name of Ankara, the present day capital of Turkey) region in Turkey. The fur of Angora goat provides a type of fibre called *mohair*. Mohair is very similar to wool in chemical

composition but has a much smoother surface. It is durable, light, and warm, and is especially preferred for making soft sweaters and soft coverings for furniture.

The Angora rabbit (Fig. 3.7) is originally from the Angora (Ankara) region of Turkey. The wool obtained from the Angora rabbit is known as Angora wool.



Fig. 3.5 Cashmere goat



Fig. 3.6 Angora goat



Fig. 3.7 Angora rabbit



Let's Remember



A. Match the following.

- | Column A | Column B |
|--------------|---------------------|
| 1. Merino | a. Angora goat |
| 2. Mohair | b. Woollen shawls |
| 3. Alpaca | c. Asian goat |
| 4. Cashmere | d. Camel family |
| 5. Bakharwal | f. Sheep from Spain |

B. Give two examples for the following.

- | | | |
|--|-------|-------|
| 1. Products made from wool | _____ | _____ |
| 2. Places in India where sheep are reared | _____ | _____ |
| 3. Countries where sheep are reared | _____ | _____ |
| 4. Breeds of the camel family that provide us wool | _____ | _____ |
| 5. Places where Bactrian camels are found | _____ | _____ |

WOOL PRODUCTION



The different processes involved in wool production are shearing, scouring, grading or sorting, dyeing, drying, and the making of yarn.

Shearing

The process of removal of the **fleece** from an animal is called **shearing**.

Sheep are usually shorn annually in the spring/summer months. Shearing is done with a manual razor and blade, or with special clippers. Just as a haircut does not hurt us, shearing does not hurt the sheep—it actually helps them by removing the heavy woollen coat that they do not require in summer.

Word help

Fleece Woollen coat of an animal

Scouring

The sheared hair is washed properly to remove dirt, dust, and grease. *The process of removing dirt, dust, and grease from the sheared hair is called scouring.* It is done with the help of machines.

Grading or Sorting

In this process, the wool is sorted on the basis of length, colour, texture, and the ease with which it can be dyed (coloured).

Dyeing

As the natural colour of fleece is white, brown, or black, the sheared wool is dyed in different colours.

Fact File



Vicuna, an endangered species, is a member of the Llama family and gives us material for the softest coat in the world.



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Silk is

Drying

In this process, containers of wool are put through rollers to squeeze out as much water as possible. Then the wool is weighed and packed into bales. The bales are transported to the mills where they are processed further.

Making of Yarn

Figure 3.8 explains how the fleece is woven into yarn.

Tech Specs

In 1994, Australian scientists invented a way of removing wool from sheep without shearing. They inject the sheep with a special hormone, then wrap them in tight hairnets. Three weeks later, the fleece can be peeled off. This technology is called Bioclip.

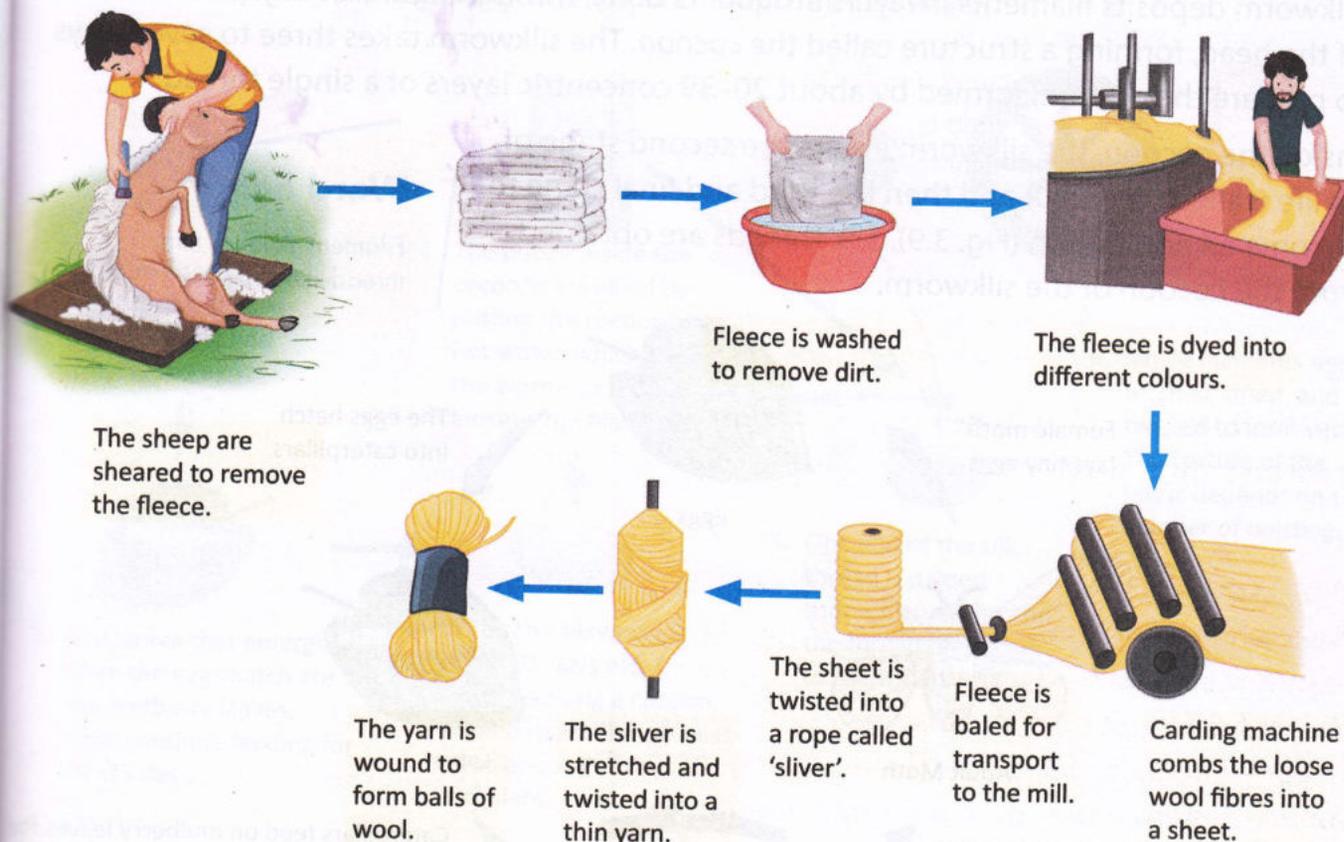


Fig. 3.8 Fleece to yarn

HEALTH HAZARDS IN THE WOOL INDUSTRY

In earlier days, the workers who sorted wool were often infected by bacteria that cause a fatal disease called *anthrax*, also known as *sorter's disease*. The bacteria are found in the wool of contaminated sheep and can enter the human body through inhaled air. Nowadays, this disease occurs rarely because of the use of vaccines for prevention.

SILK

AN

Silk is an animal fibre produced by the silkworm. Silk fibres are soft and lustrous.

Life Cycle of a Silk Moth

The female silk moth lays about 300 to 400 eggs at a time. The eggs hatch and the caterpillars, or silkworms, emerge. This is called the *larval* stage. The silkworm feeds on mulberry leaves.

The silkworm secretes fine **filaments** from two glands on its head. The filaments are made of a protein that hardens to form silk fibres when exposed to air. The silkworm deposits filaments in layers around its body, through figure-of-eight movements of the head, forming a structure called the *cocoon*. The silkworm takes three to seven days to prepare the cocoon, formed by about 20–39 concentric layers of a single thread.

Inside the cocoon, the silkworm enters the second stage of its life (called the *pupa*) and then the third and final stage to become an adult moth (Fig. 3.9). Silk threads are obtained from the cocoon of the silkworm.

Fact File

It takes about 110 silkworm cocoons to make one good silk tie. The length of thread making the cocoon may range between 600 m and 1500 m.

Word help

Filament A long, thin, thread-like structure

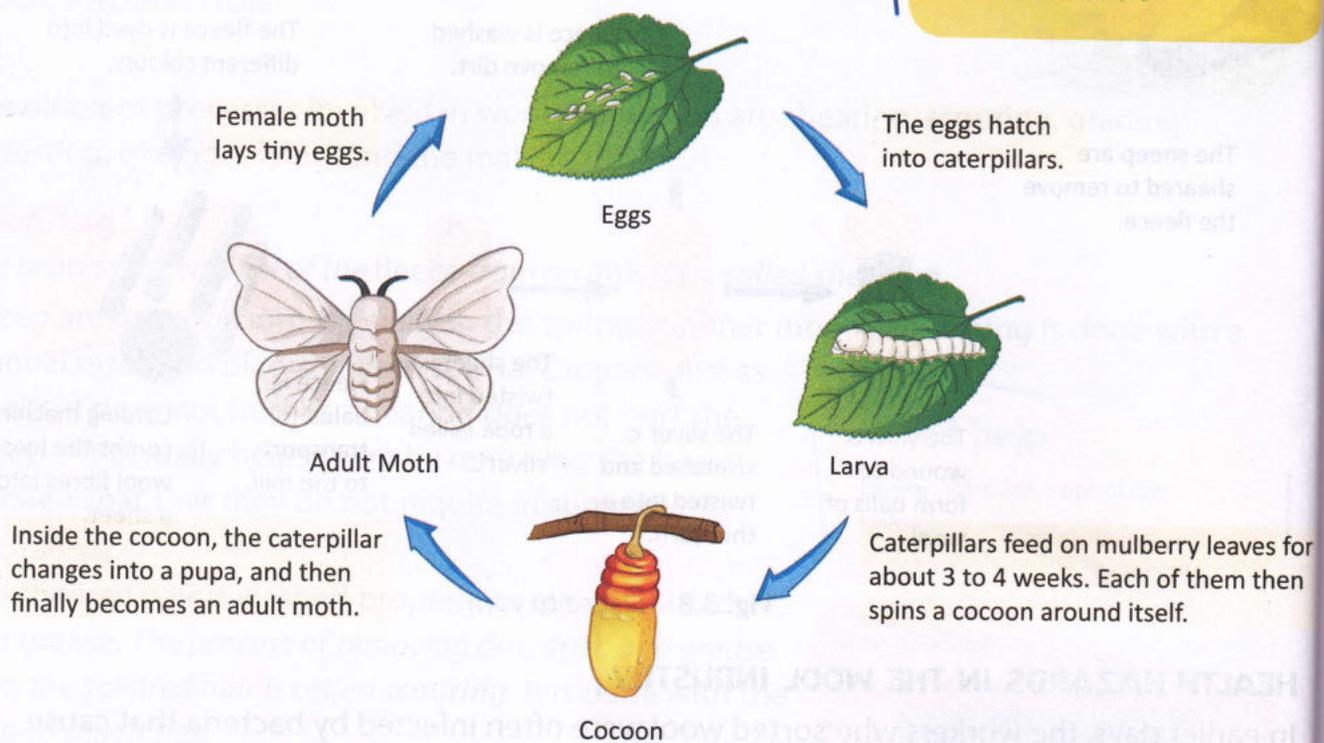


Fig. 3.9 Life cycle of the silk moth

SERICULTURE

AN

Rearing of silkworms for silk production is called **sericulture** (Fig. 3.10).

The healthiest moths are chosen for breeding and laying eggs. The first step involves washing the silkworm eggs that had been stored; the eggs hatch only once a year in spring.

After the eggs hatch, the larvae are spread out on trays to grow. They are usually fed chopped mulberry leaves for 20–35 days. Racks or twigs are placed on the trays where the worms spin the cocoons. Spinning may take about 3–7 days, after which the cocoons are put in hot water; this kills the worms and loosens the filaments. The filaments are taken out from the cocoons by a process called *reeling* or *filature*. Filaments from several cocoons are twisted together to make a strong thread, which is wound on a reel. The threads are then dyed and woven into silk fabric.

There are different varieties of silk moth, which feed on different plants. They produce silk of different quality and texture, e.g., *tassar*, *mooga*, and *kosa* silk.

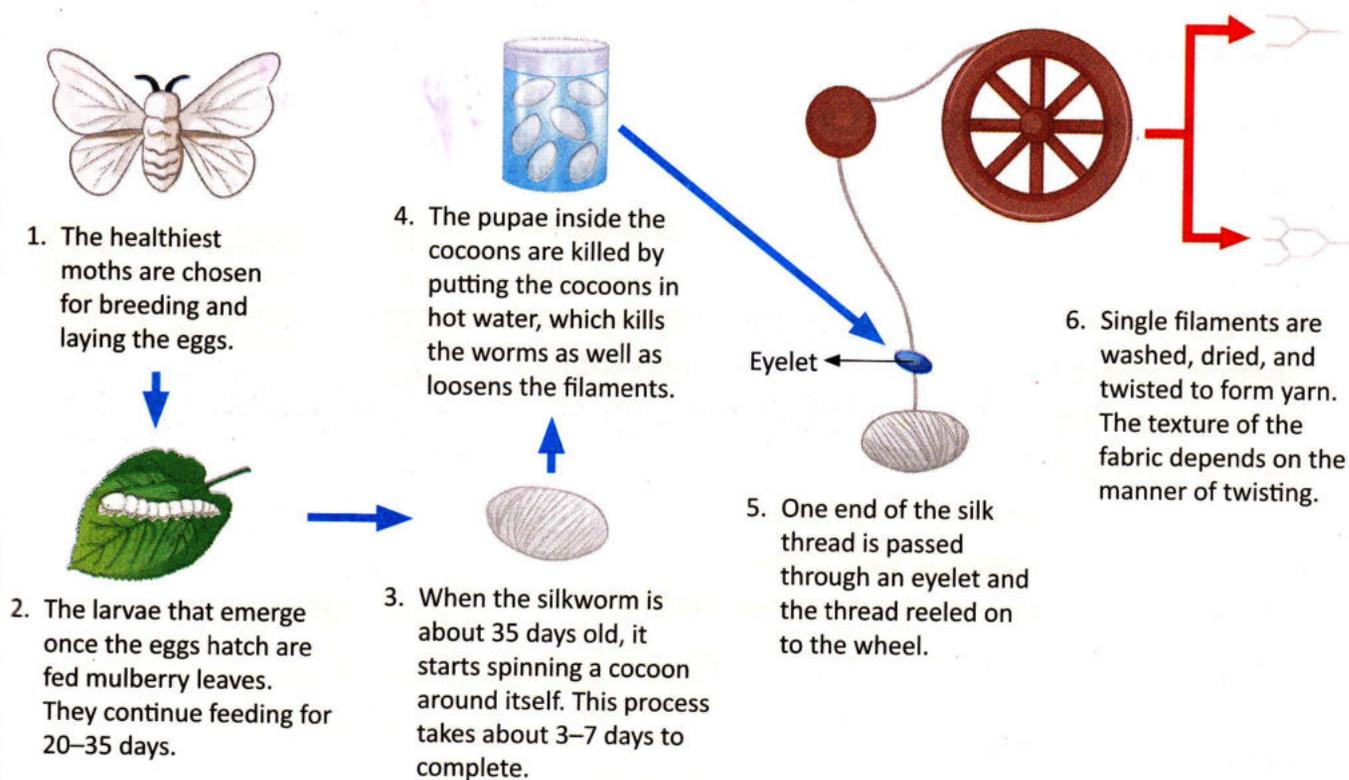


Fig. 3.10 Summary of the process of sericulture

Sometimes, artificial silk is sold as natural silk. The difference between the two can be found out by burning a small piece of the fabric. Artificial silk when burnt either smells like a burning paper (if it is made using a plant fibre) or melts and forms a bead (if it has synthetic fibre in it). Natural silk when burnt, smells like burning hair.

Fact File

India is the world's second largest producer of silk following China.

Activity

Aim: To observe the difference between animal fibre and man-made fibre (when brought near a flame)

Materials needed: A candle, a matchbox, a pair of forceps, and swatches of silk, woollen and nylon fabrics

Method:

1. Light the candle.
2. Cut a small piece of silk fabric. Hold it with the help of forceps and bring it near the flame of the candle.
3. Notice how it burns. Blow off the fire and smell the smoke of the fabric.
4. Repeat the above steps with woollen and nylon fabrics.

Observation: Silk and wool burn with the smell of burning hair, while nylon melts and forms a bead.

Conclusion: Animal fibres burn with the smell of burning hair, and man-made fibres melt and form beads on burning when brought near a flame.

HEALTH HAZARDS IN SERICULTURE

Some of the health hazards associated with sericulture are:

- Handling of dead worms with bare hands contributes to infection and illness. Workers generally need to dip their bare hands into the hot water, and judge by touch whether the fine threads of silk have loosened enough to be wound. This causes blisters and open wounds/injuries, leading to infection.
- Standing almost continuously for about 12–16 hours a day, reeling the fine silk threads, may lead to health disorders like backaches, spine and vision-related problems.
- Vapours from boiling cocoons and diesel fumes from machines may lead to respiratory diseases such as asthma and bronchitis.
- Continuous exposure to the noise made by spinning and winding machines and looms, where the fabric is woven, may result in hearing disorders.

Discovery of silk

Silk production began in China almost 6,000 years ago. Legend dates this back to 2640 BCE, to Empress Xi Ling-Chi, who discovered that a certain caterpillar's cocoon was created from a single strand of shiny thread. She encouraged sericulture and soon developed the process of reeling thread from the cocoon. This was a closely guarded secret for many years.

Let's Discuss

Sericulture is not considered an eco-friendly activity. Why?

Let's Remember



Answer the following questions orally. Give one reason for the following.

1. Sheep are shorn in spring/summer months.
2. Workers who sort wool often suffer from anthrax.
3. Cocoons of silkworm are put in hot water.
4. Handling of dead worms with bare hands causes infections and illnesses.
5. People involved in sericulture are at a risk of developing asthma and bronchitis.

Key Words

- Shearing** The process of removal of the fleece from an animal is called shearing.
- Scouring** The process of removing dirt, dust, and grease from the sheared hair is called scouring.
- Sericulture** Rearing of silkworms for silk production is called sericulture.
- Filature** The process of taking out filaments from the cocoons is called reeling or filature.

Summary

- Clothing material or fabrics are woven from fibres.
- Wool is obtained from sheep, camel, llama, alpaca, goat, and even rabbits.
- Shearing, scouring, grading (or sorting), dyeing, drying, and making of yarn are the different stages involved in wool production.
- Silk is obtained from the cocoons of the silkworm.
- The silkworm takes 3–7 days to make the cocoon, formed by 20–39 concentric layers of a single thread.
- There are several health hazards associated with sericulture, respiratory problems and skin infections being the major ones.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

1. A fabric is woven using _____ (yarns/fibres).
2. During _____ (scouring/grading), wool is sorted on the basis of different parameters.
3. The silkworm eggs hatch only once a year in _____ (winter/spring).
4. The filaments secreted by silkworm are made of a _____ (vitamin/protein) that hardens to form silk.
5. _____ (Filaments/Fibres) from many cocoons are twisted together to make a strong thread which is wound on a reel.

B. Write T for the True and F for the False statements. Correct the false statements.

1. All varieties of sheep give us wool that have the same fineness, shine and length.
2. The sliver is a machine that combs loose wool fibres into a sheet.
3. Silk fibres are produced by the silkworm, and are soft and lustrous.
4. The moth stage of the silkworm gives out silk filaments.
5. Continuous exposure to noise made by spinning and winding machines in sericulture leads to diseases like anthrax or sorter's disease.

C. Choose the correct option.

1. Which of these is not a breed of sheep reared in India?
a. Lohi and Nali
b. Marwari and Patanwadi
c. Angora and Merino
d. All of these
2. Which of these do sheep eat?
a. Mixture of grass and leaves
b. Mixture of corn, jowar and pulses
c. Mixture of grass, corn and milk
d. Both a and b
3. Which of these are goats that give us wool?
a. Alpaca and Llama
b. Cashmere and Angora
c. Ankara
d. All of these
4. Which of these is the first step in wool production?
a. Scouring
b. Shearing
c. Sorting
d. Dyeing
5. Which of these are different varieties of silk?
a. Tassar and Sericulture
b. Kosa and Angora
c. Tassar, Moonga and Kosa
d. Angora, Cashmere and Mohair
6. Which hair of sheep is used to make wool?
a. Under hair
b. Beard hair
c. Body hair
d. None of these
7. Which breed of sheep provides wool to make carpets?
a. Lohi
b. Nali
c. Marwari
d. All of these
8. What distinguishes mohair from other wool?
a. Chemical composition
b. Durability
c. Smoother surface
d. Warmth
9. Which of these refers to rearing silkworms to produce silk?
a. Shearing
b. Scouring
c. Combing
d. Sericulture
10. Which of these processes suggests that sericulture is not an eco-friendly activity?
a. Putting cocoons in hot water
b. Passing the filaments through an eyelet
c. Twisting filaments to make a strong threads
d. Dyeing and weaving threads to form a fabric

II. Very short answer type questions

Give one word for the following.

1. A breed of sheep that gives the finest wool
2. Fibre obtained from Angora goat
3. The process of removing fleece from the sheep
4. The stage in the life cycle of silkworms, after hatching of eggs
5. The process by which filaments are taken out from the cocoons of silkworm

III. Short answer type questions

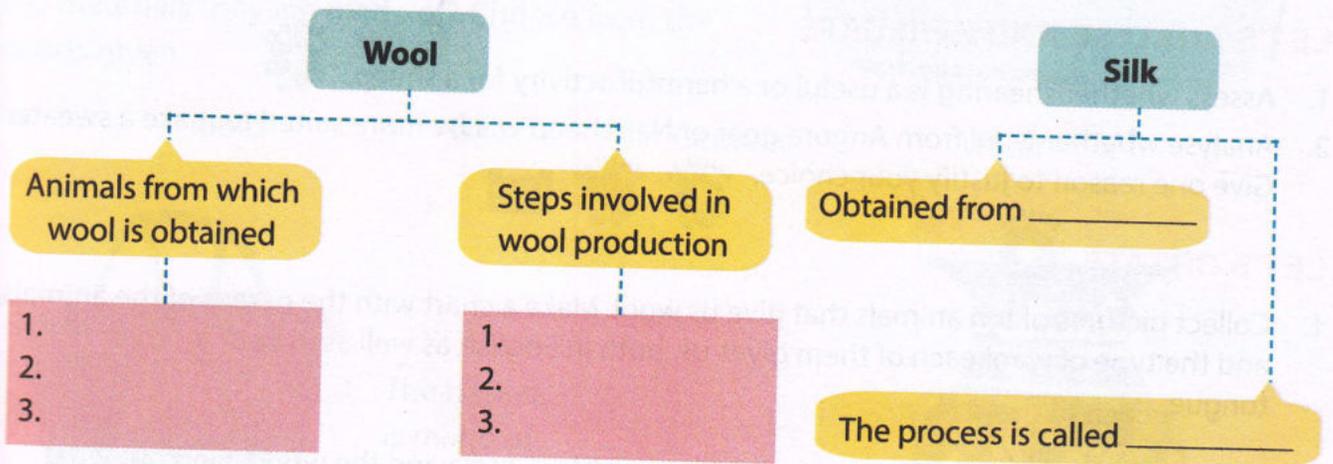
1. What are the two types of fibres on a sheep's coat?
2. What are the various features that make wool different from each other?
3. Define the following: a. Scouring b. Filature c. Sericulture
4. What is sorter's disease? Why were people working in wool industry prone to it?

IV. Long answer type questions

1. Explain the various processes involved in the production of wool.
2. Explain the various stages in the life cycle of a silkworm moth.
3. Explain the processes involved in sericulture.
4. What are the various health hazards involved in sericulture?

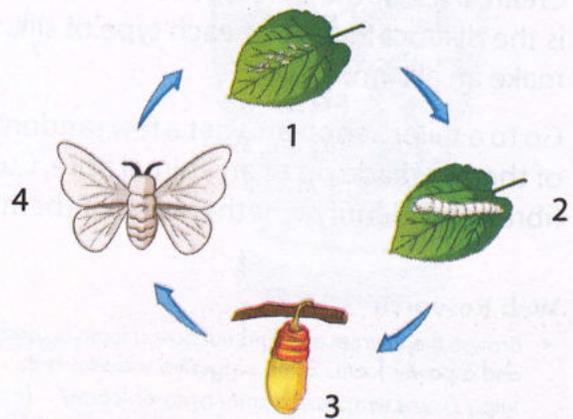
LET'S RECALL

Recall and complete the concept map given below.



LET'S OBSERVE

1. Label the diagram. Circle the stage from which silk is obtained.



2. Make a flow chart of the processes involved in transforming fleece to yarn. 



LET'S CONNECT GEOGRAPHY

1. On an outline map of India, mark the various states where sheep are reared for wool. Label the states.
2. On an outline map of the world, mark the various wool-producing countries.

LET'S APPLY

1. Bakhtiar says that shearing is not an eco-friendly activity because it kills the sheep. Is he right? Why or why not?  LO 4
2. A fabric when brought near a flame, burnt with the smell of burning hair. Which of these could it be?
a. Cotton b. Wool c. Nylon

LET'S ANALYSE AND EVALUATE

1. Assess whether shearing is a useful or a harmful activity for a sheep. 
2. Analyse whether wool from Angora goat or Nali sheep will be more suited to make a sweater. Give one reason to justify your choice.    LO 3

LET'S CREATE

1. Collect pictures of ten animals that give us wool. Make a chart with the names of the animals, and the type of wool each of them gives us, both in English as well as in your mother tongue.  LO 1
2. Create a list of the different varieties of silk available in India and the world. Find out what is the distinct feature of each type of silk. If possible try and get small samples of each and make an album.  LO 13
3. Go to a tailor's shop and get a few random pieces of cloth. Try the flame test and identify which of them is made up of an animal fibre. Cut small swatches of those that are made from animal fibres and identify whether each of them is woven or knitted.  LO 15

Web Research

- Browse the Internet and find out how a loom is used to make a fabric. Find out differences between a handloom and a power loom. Some suggested websites are:
<http://www.warporweft.com/types-of-loom/> (accessed and checked on 28/08/19)
<http://www.differencebetween.net/technology/difference-between-handloom-and-powerloom/> (accessed and checked on 28/08/19)
- Browse the Internet and find out about 'Ahimsa silk' and how it is a more eco-friendly option than normal silk. Some suggested websites are:
<https://www.fibre2fashion.com/industry-article/6932/ahimsa-silk-a-sustainable-and-non-violent-alternative> (accessed and checked on 28/08/19)
http://www.seidentraum.eu/pdf/essay_ahimsa_university_bihar.pdf (accessed and checked on 28/08/19)

4

Chemicals and Chemical Changes

We see many things around us. These things are made of different types of materials.

Look at the objects shown below. Can you name the materials they are made of? Choose from the words given.

You will learn about

- Chemical substances
- Chemical symbols
- Chemical formulae
- Chemical equations
- Chemical changes
- Physical changes

Gold

Plastic

Ceramic

Water



1. The basket is made of _____.



2. The bangles are made of _____.



3. The liquid shown in picture is _____.



4. The vase is made of _____.

All the materials you just named are chemical substances that are either used in or obtained by different processes in chemistry. In this chapter, you will learn about these chemical substances, how they form, and what they are made of.

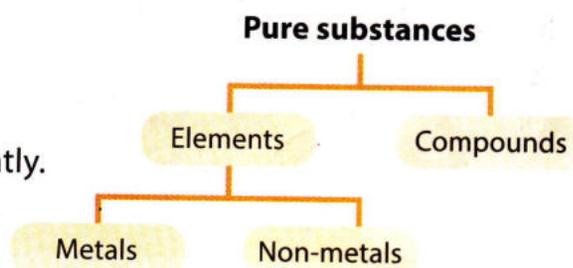
Answers : 1. Plastic; 2. Gold; 3. Water; 4. Ceramic

CHEMICAL SUBSTANCES

Chemical substances are made of atoms and molecules. An *atom* is the smallest particle of a substance. Atoms may or may not exist independently.

Molecules are formed when two or more atoms join together. Molecules can exist independently.

Chemical substances can be divided into two major groups: *pure substances* and *mixtures*. Pure substances can be *elements* or *compounds*.



Elements

An **element** is a substance that is made up of only one kind of atoms and cannot be broken down into simpler substances by chemical means. For example, silver, gold, aluminium, hydrogen, oxygen, etc. Each element has its own distinct set of properties. Thus, the atoms of an element will have all the properties of that particular element.

Fact File

There are over 114 known elements on Earth.

Compounds

A **compound** is a substance that is formed when two or more elements combine chemically.

The smallest particle of a compound is a molecule which shows all the properties of that compound. However, the properties of a compound are entirely different from those of its constituent elements. For example, when hydrogen combines with oxygen (both hydrogen and oxygen are gases) water, a liquid, is formed.

Mixtures

Mixtures consist of two or more substances simply mixed together, but not chemically combined.

For example, air is a mixture of various gases such as nitrogen, oxygen, carbon dioxide, water vapour, argon, and particles of dust, smoke, and many others.

A mixture retains the properties of its components, e.g., in a mixture of iron filings and sulphur, both retain their own characteristic properties, i.e., iron is still attracted by a magnet and sulphur remains as a powder (Fig. 4.1).

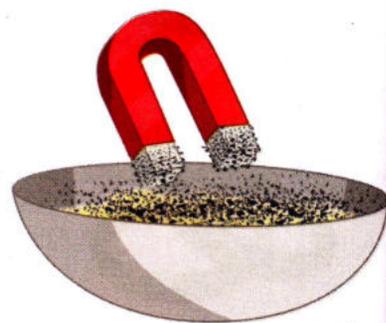


Fig. 4.1 Mixture of iron filings and sulphur can be separated using a magnet.

CHEMICAL SYMBOLS

TD

As there are so many elements, writing their full names would be time-consuming. To avoid this, an abbreviated form has been assigned to each element. The abbreviations used to represent elements are called *chemical symbols*.

In earlier days, Sir John Dalton, an English scientist, created his own set of pictorial symbols for elements known in his time (Fig. 4.2).

The modern system of representation was given by Jons Jacob Berzelius, a Swedish chemist. Instead of pictures, he made use of the letters of the English alphabet to represent various elements.

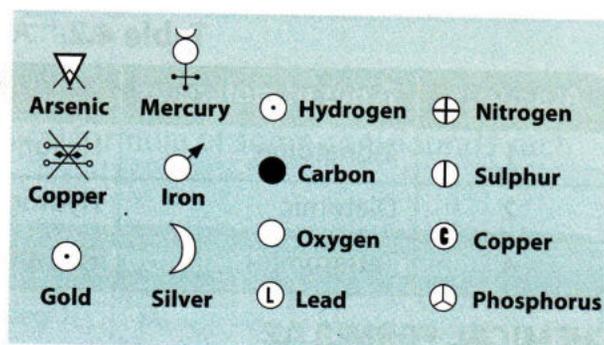


Fig. 4.2 Pictorial symbols

The important features of this system are:

- The first English letter appearing in the name of an element is used as its symbol. For example, the symbol for Hydrogen is H, for Carbon C, Oxygen O, Nitrogen N, etc. Symbols of some elements have also been derived from their Latin names.
- When two or more elements have their names beginning with the same letter, one more letter is added to the symbol. For some elements, the second letter in their name is added, such as for Calcium (Ca), Cobalt (Co), Xenon (Xe), Helium (He), and Bromine (Br).

In some cases, another distinct letter is used, e.g., Chlorine (Cl), Magnesium (Mg), Manganese (Mn), and Zinc (Zn). Table 4.1 lists the symbols of some common elements.

Table 4.1 Symbols of some common elements

Element (Latin Name)	Symbol	Element (Latin Name)	Symbol	Element (Latin Name)	Symbol	Element (Latin Name)	Symbol
Aluminium	Al	Fluorine	F	Potassium (<i>kalium</i>)	K	Sodium (<i>natrium</i>)	Na
Barium	Ba	Gold (<i>aurum</i>)	Au	Silicon	Si	Phosphorus	P
Boron	B	Mercury (<i>hydrargyrum</i>)	Hg	Silver (<i>argentum</i>)	Ag	Lithium	Li
Neon	Ne	Lead (<i>plumbum</i>)	Pb	Iodine	I	Nickel	Ni
Uranium	U	Iron (<i>ferrum</i>)	Fe	Sulphur	S	Copper (<i>cuprum</i>)	Cu
Calcium	Ca	Chlorine	Cl	Helium	He	Hydrogen	H
Magnesium	Mg	Nitrogen	N	Oxygen	O	Zinc	Zn

Atomicity

Many elements exist as molecules because atoms of such elements cannot exist independently. *The number of atoms present in one molecule of an element is known as its atomicity.* Depending on the atomicity, molecules can be monatomic (1), diatomic (2), or tetratomic (4). See Table 4.2.

Table 4.2 Atomicity of elements

Atomicity	Types of molecules	Examples
1	Monatomic	Helium (He), Neon (Ne), Sodium (Na), Potassium (K)
2	Diatomic	Hydrogen (H ₂), Nitrogen (N ₂), Oxygen (O ₂)
4	Tetratomic	Phosphorus (P ₄)

CHEMICAL FORMULAE

Just as an element can be represented by a symbol, a chemical compound can be represented by its chemical formula.

The representation of a molecule of a compound using chemical symbols of its constituent elements is called a **chemical formula**. The chemical formulae of some compounds are given in Table 4.3.

Table 4.3 Chemical formulae of some compounds

Name	Formula	Name	Formula
Water	H ₂ O	Calcium carbonate	CaCO ₃
Common Salt	NaCl	Nitric acid	HNO ₃
Hydrochloric acid	HCl	Sulphuric acid	H ₂ SO ₄

The chemical formula of a compound can be derived if we know the constituent elements (and their symbols) and the valency of the elements. Let us now see what valency means.

Valency

The combining capacity of the atom of an element is called **valency**. The valency of some common elements is given in Table 4.4.

Table 4.4 Valency of some elements

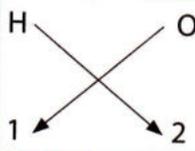
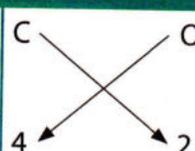
Element (Symbol)	Valency	Element (Symbol)	Valency
Hydrogen (H)	1	Sodium (Na)	1
Carbon (C)	4	Magnesium (Mg)	2
Oxygen (O)	2	Calcium (Ca)	2
Chlorine (Cl)	1	Copper (Cu)	1 or 2
Potassium (K)	1	Nitrogen (N)	3 or 5
Iron (Fe)	2 or 3	Aluminium (Al)	3

Writing a Chemical Formula

Follow the steps given below to write the chemical formula of a chemical compound.

1. Write down the symbols of the constituent elements.
2. Write down the valencies of the elements.

- Cross over the valencies and write them as subscripts.
- If the valency is divisible by a common number, then divide and simplify the formula. Keeping in mind these steps, let us write the chemical formula of some compounds such as water and carbon dioxide.

Formula of water		Formula of carbon dioxide	
Step 1		Step 1	
Step 2	1 2	Step 2	4 2
Step 3	H ₂ O	Step 3	C ₂ O ₄
Step 4	The valencies are divisible by one, so the chemical formula is H ₂ O.	Step 4	The valencies are divisible by two, so the chemical formula is CO ₂ .

Let's Remember



A. Write the chemical formulae of the following compounds.

- Potassium chloride
- Sodium oxide
- Calcium chloride

B. Fill in the blanks with the correct words.

- _____ (Molecules/Atoms) may or may not exist independently.
- _____ (Mixtures/Molecules) are formed when two or more similar or different atoms join together.
- _____ (Element/Compound) is made up of only one kind of atoms.
- _____ (Compound/Mixtures) consist of two or more substances simply mixed together.
- _____ (Atomicity/Valency) is the number of atoms present in one molecule of an element.

CHEMICAL EQUATIONS

A **chemical equation** is the shorthand form of representing a chemical reaction using symbols and formulae.

Chemical reactions involve the conversion of certain chemical substances (elements/compounds) into some other chemical substances (elements/compounds). The elements/compounds involved initially in the reaction are called *reactants* and the new elements/compounds formed are called the *products*.

Writing a Chemical Equation

Follow the steps given below to write the chemical equation of a reaction.

- Identify the reactants and the products of the chemical reaction.
- Write the names of the reactants on the left hand side with a '+' sign between them.

Write the names of the products on the right hand side with a '+' sign between them. Place an arrow (\longrightarrow) between the two sides, with the arrow-head pointing towards the products, i.e., between reactants and products. This equation is called word equation.

3. Replace the names of the products and the reactants with symbols and formulae. This gives the chemical equation.
4. Make sure that the number of atoms of each element on both sides is equal. This is called balancing the equation.

Balancing an Equation

The first step in balancing an equation is to count the number of atoms of each element on both sides of the equation. For example, reactants X and Y_2 react to form a compound XY. The word equation for this reaction would be:



The number of atoms of elements X and Y in the above-mentioned equation is shown alongside.

Element	Number of atoms in LHS	Number of atoms in RHS
X	1	1
Y	2	1

To balance Y on both sides, multiply RHS by 2, i.e.,



Now, the number of atoms of Y is balanced but not the number of atoms of X. Therefore, multiply X on the LHS by 2. Thus, the equation becomes:



This is a balanced equation as the number of atoms of X and Y on both sides is equal.

Keeping these steps in mind, let us now write the chemical equation for the formation of magnesium oxide.

Step 1: Magnesium burns in oxygen to give magnesium oxide (Fig. 4.3). Here, the reactants are magnesium and oxygen. The product is magnesium oxide.

Step 2: Thus, the word equation is:
magnesium + oxygen \longrightarrow magnesium oxide

Step 3: Replacing the names with symbols and formulae, we get the chemical equation as:

Step 4: The number of atoms of the elements are:

Element	Number of atoms in LHS	Number of atoms in RHS
Magnesium	1	1
Oxygen	2	1

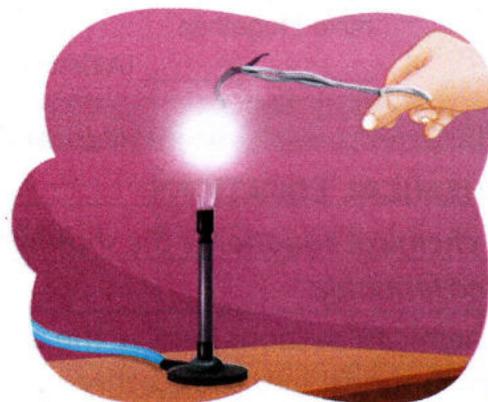


Fig. 4.3 Magnesium burns in oxygen to form magnesium oxide

To balance oxygen on both sides, multiply RHS by 2, i.e.,



Now, the number of oxygen atoms is balanced but the number of magnesium atoms is not. Therefore, multiply magnesium on the LHS by 2. Thus, the equation becomes:



This is the balanced chemical equation.

Let's Remember



Write balanced chemical equations for the following reactions.

1. magnesium + oxygen \longrightarrow magnesium oxide
2. sodium + chlorine \longrightarrow sodium chloride
3. aluminium + chlorine \longrightarrow aluminium chloride

CHEMICAL CHANGES

A **chemical change** (also called *chemical reaction*) occurs when two or more chemical substances react to produce a new substance (or substances) with a different set of properties.

A chemical change is permanent and such changes are occurring all around us, even within our body. Let us look at some examples of chemical changes.

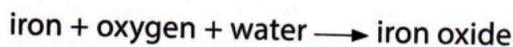
Reddish-brown Deposition on Iron Objects

AN

You must have seen that if you leave an iron object such as a trowel (*khurpi*) or an iron lock out in the rain, a reddish-brown layer is deposited on its surface after a few days (Fig. 4.4). This layer is called rust and the process is called *rusting*. The layer of rust falls off gradually, exposing fresh metal to further rusting. With the passage of time, the iron object becomes weak.

Let us see what actually happens.

Iron reacts with atmospheric oxygen in the presence of moisture to form a substance called iron oxide, which we call rust.



The chemical equation for this reaction can be represented as:

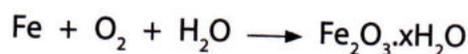


Fig. 4.4 Rusted lock

Rusting is a chemical change because the change is permanent. You cannot get the iron back from the oxide. Oxygen and water are two essential conditions for rusting of iron; absence of either or both of them can prevent rusting. Oiling iron objects protects their surfaces from coming in contact with moisture and air, and prevents rusting.

Tech Specs

Galvanization is a process in which iron objects are coated with zinc to prevent them from rusting. The water pipes used in our homes to carry water are made from galvanized iron.

Activity

Aim: To show that rusting of iron requires both oxygen and water

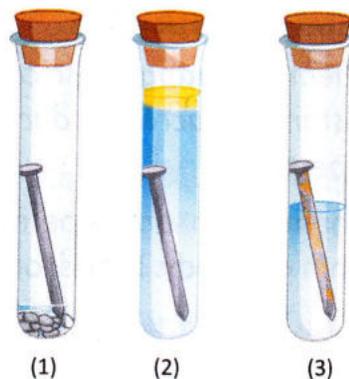
Materials needed: Three wide-mouthed test tubes, iron nails, boiled water, tap water, anhydrous (moisture-free) calcium chloride, vegetable oil, and rubber stoppers

Method:

1. Take three test tubes and label them 1, 2, and 3 and place a clean iron nail in each of them.
2. Add a little anhydrous calcium chloride (dehydrating agent) to dry the air in test tube 1.
3. Pour boiled and distilled water to test tube 2 and add some vegetable oil to it to keep out the air. Boiling the water removes dissolved oxygen.
4. In test tube 3, pour a small amount of tap water.
5. Plug the mouths of all three test tubes using rubber stoppers. Keep them undisturbed for 3–4 days.

Observation: The nails in test tubes 1 and 2 have not rusted, while the one in test tube 3 has rusted.

Conclusion: As test tubes 1 and 2 did not have moisture and oxygen, respectively, there was no rusting in both these tubes. This proves that both oxygen and water are essential for rusting.



Browning of Vegetable and Fruit Surfaces

If you observe the cut surfaces of a brinjal, which have been exposed to the air for some time, you will find that the surfaces have turned brown. This is due to a chemical reaction between certain compounds present in brinjal and atmospheric oxygen. As a result of this reaction, a brown pigment called *melanin* is produced that causes browning of the surfaces.

Soaking cut vegetables and fruits in plain water can reduce the level of browning. Water would restrict the amount of oxygen that comes in contact with the surface of cut vegetables and fruits.

Reaction Between Vinegar and Baking Soda

AN

Dissolve one tablespoon of baking soda powder in 100 mL of water in a beaker. Stir the mixture until all the baking soda has dissolved. Measure out 5 mL of vinegar in a separate test tube. Use a dropper to add five drops of the baking soda solution to the test tube containing vinegar. You will observe bubbles being formed due to the evolution of carbon dioxide gas (Fig. 4.5).

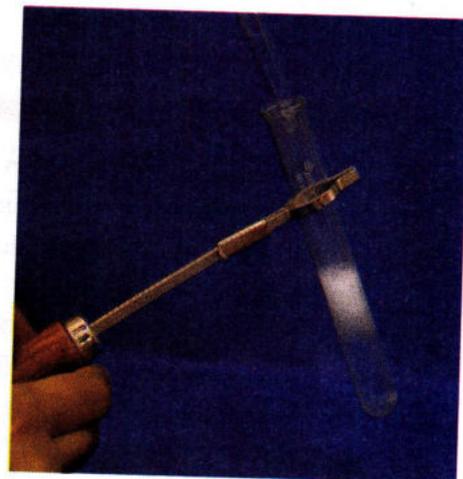
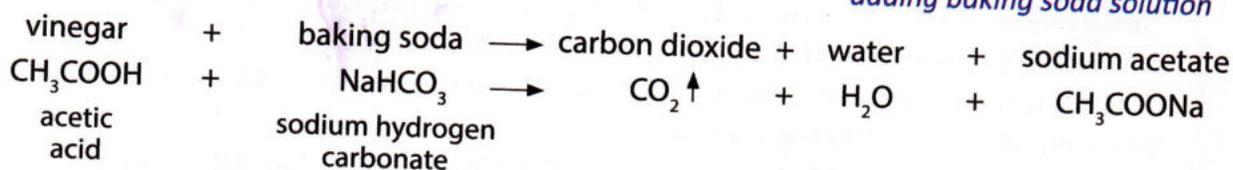


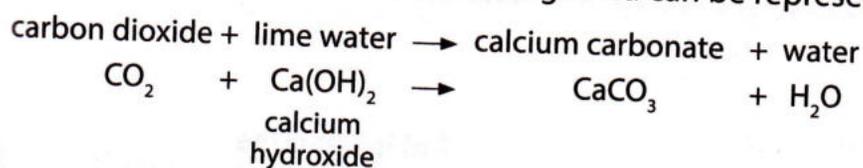
Fig. 4.5 Bubbles observed after adding baking soda solution

This reaction can be represented as:



We can test the gas that is released and find that it is carbon dioxide. Freshly prepared lime water turns milky when carbon dioxide gas is passed through it.

This reaction is also a chemical change and can be represented as:



Reaction Between Copper Sulphate Solution and Iron nails

AN

Copper sulphate (CuSO_4) solution is blue and acquires a sea-green colour when iron nails are dropped into it (Fig. 4.6). The iron nails acquire a brown colour. This is because iron sulphate is formed when copper sulphate reacts with iron. Iron sulphate solution is sea-green in colour. The brown colour deposit on the iron nails is of copper.

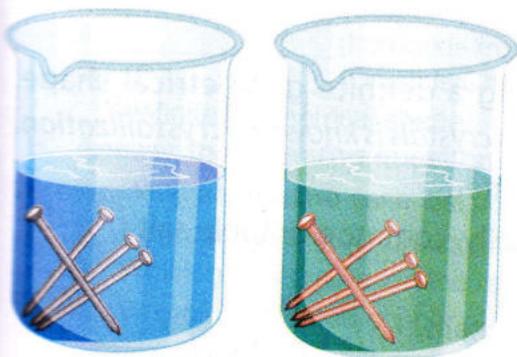
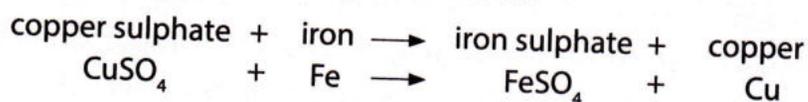


Fig. 4.6 Reaction between copper sulphate solution and iron nails

This reaction can be represented as:



Activity

Aim: To study the deposition of copper from its salt solution

Materials needed: Three test tubes, copper sulphate, water, beaker, zinc metal, magnesium ribbon, and iron filings

Method:

1. Prepare an aqueous solution (solution in water) of copper sulphate in a 250 mL beaker.
2. Take three test tubes and label them as 1, 2, and 3.
3. Pour 10 mL of copper sulphate solution in each of them.
4. Now drop a piece of zinc metal, a magnesium ribbon, and some iron filings in the three test tubes, respectively.

Observation: You will observe that the blue colour of the solution will gradually disappear and ultimately become transparent in case of zinc and magnesium, whereas it will turn sea-green in case of iron. Metals in each case will be coated with a reddish-brown colour.

Conclusion: The solution turns transparent in case of zinc and magnesium due to the formation of zinc sulphate and magnesium sulphate, respectively. As iron turns into iron sulphate, the solution turns sea-green. The reddish coating on the metals is due to the deposition of copper metal.



PHYSICAL CHANGES

Physical changes are the changes in which no new substances are formed. For example, the formation of ice from water kept in a freezer is a physical change because the ice when kept in the open changes back to water.

In most of the physical changes, properties such as colour, shape, size, or physical form of the substance may change. Physical changes may or may not be reversible. An example of physical change is discussed below.

Crystallization

Crystals are the purest solid form of a substance having a definite geometrical shape. The process by which an impure compound is converted into its crystals is known as crystallization.

This process is used in obtaining common salt from seawater.

Let us take common salt (Fig. 4.7) as an example. Chemically, common or table salt is sodium chloride (NaCl). Common salt is obtained by evaporating sea water. The salt thus obtained, contains certain undesirable substances such as magnesium chloride, sand, etc., mixed with sodium chloride. These impurities are removed from common salt through the process of crystallization.

Let's Discuss

Is burning of a candle a physical change, chemical change, or both?



Fig. 4.7 Crystals of sodium chloride

In crystallization, maximum amount of common salt is dissolved in boiling water. The solution is then filtered to remove the insoluble impurities. The filtered solution is left undisturbed for a few hours. Sodium chloride will aggregate and form crystals with well-defined geometrical shapes, leaving behind the undesirable impurities in the solution.

Activity

Aim: To prepare crystals of copper sulphate from an impure sample of copper sulphate

Materials needed: A beaker, distilled water, powdered copper sulphate, stirrer, and dil. sulphuric acid

Method:

1. Take a beaker and fill it half with distilled water. Now keep on adding powdered copper sulphate into the water with constant stirring till no more of it dissolves.
2. Add half a test tube of sulphuric acid to it.
3. Start heating and again add copper sulphate till a saturated solution is produced.
4. Filter the hot solution immediately to remove insoluble impurities and keep the saturated solution of copper sulphate undisturbed for a few hours.

Observation: Well-shaped crystals of copper sulphate are formed.



Let's Remember



A. Fill in the blanks with the correct words.

1. Two or more chemical substances react to produce new substances in a _____ (physical/chemical) change.
2. Rusting being a _____ (chemical/physical) change, is _____ (temporary/permanent).
3. _____ (Carbon dioxide/Oxygen) gas turns freshly prepared lime water milky.
4. _____ (Iron oxide/Iron sulphate) is formed when copper sulphate reacts with iron.
5. _____ (Crystals/Chemicals) are the purest solid form of a substance having a definite geometrical shape.

B. Answer the following questions orally.

1. What are the two essential conditions for rusting?
2. How can rusting of iron objects be prevented?
3. Which gas is evolved in the reaction between baking soda and vinegar?
4. Why blue-coloured copper sulphate solution acquires a green colour when iron filings are added to it?
5. How is common salt obtained?

Key Words

Atom	The smallest particle of a substance is called an atom.
Molecules	When atoms join with other similar or different atoms, molecules are formed.
Element	A substance that is made of only one kind of atom and cannot be broken down into simpler substances by chemical means is called an element.
Compound	A substance that is formed when two or more elements combine chemically is called a compound.
Mixture	Mixtures consist of two or more substances simply mixed together, but not chemically combined.
Chemical symbol	The abbreviations used to represent elements are called chemical symbols.
Chemical formula	The representation of a molecule of a compound using chemical symbols of its constituent element is called a chemical formula.
Chemical equation	The shorthand form of representing a chemical reaction using symbols and formulae is called chemical equation.
Chemical change	A chemical change occurs when two chemical substances react to produce a new substance with a different set of properties.
Physical changes	Those changes in which no new substances are formed are called physical changes.
Crystal	The purest solid form of a substance having a definite geometrical shape is called a crystal.
Crystallization	The process by which an impure compound is converted into its crystals is known as crystallization.

Summary

- A chemical substance is any material substance used in or obtained by a process in chemistry.
- The atoms of an element have all the properties of that particular element.
- The properties of a compound are entirely different from the constituent elements.
- The basic unit of a compound is a molecule.
- A mixture retains the properties of its components.
- Symbols are used to represent elements.
- The number of atoms present in one molecule of an element is known as its atomicity.
- The chemical formula of a compound is specified by writing the symbols of the constituent elements present in a molecule side by side and specifying the number of atoms of various elements as a subscript to each respective symbol.
- The elements/compounds involved initially in a reaction are called reactants and the new elements/compounds formed are called the products.
- There are two types of changes: physical change and chemical change.
- Impure compounds can be converted into their crystal forms by the process of crystallization.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

- _____ (Mixture/Compound) is formed by chemical combination of two or more elements.
- _____ (Hydrogen/Water) is an element and _____ (water/hydrogen) is a compound.
- Chemical _____ (symbols/formulae) are the abbreviations used to represent elements.
- Chemical _____ (abbreviation/formula) is the representation of a molecule of a compound using chemical symbols of its constituent elements.
- _____ (Atomicity/Valency) is the combining capacity of an element.
- _____ (N/Ni) is the chemical symbol of Nickel.

B. Choose the correct option.

- Which out of the following cannot be broken down into simpler substances by chemical means?
a. Element b. Compound c. Mixture d. Molecule
- What is the chemical symbol of iron?
a. Ir b. I c. Fe d. F
- Which of the following represents the chemical formula of a compound?
a. C b. Ca c. Cu d. CO₂
- What are the new substances (elements/compounds) formed in a chemical reaction called?
a. Rust b. Products c. Mixtures d. Reactants
- What is the substance responsible for the browning of cut surfaces of vegetables and fruits called?
a. Zinc b. Melanin c. Rust d. Copper
- Which of the following elements exist as tetratomic molecules?
a. Hydrogen b. Nitrogen c. Potassium d. Phosphorous
- What is the chemical formula for sodium oxide?
a. NaO b. Na₂O c. NaO₂ d. Na₂O₂
- Which gas is released in reaction of vinegar with baking soda?
a. Oxygen b. Nitrogen c. Carbon dioxide d. Carbon monoxide
- Which of the following elements exhibits valency 2?
a. Oxygen b. Sodium c. Aluminium d. Nitrogen
- Which of the following represents an element?
a. NaCl b. Cl₂ c. HCl d. KCl

C. Match the following.

Column A

1. Calcium chloride
2. Sulphuric acid
3. Nitric acid
4. Potassium oxide
5. Calcium oxide
6. Calcium carbonate

Column B

- a. HNO_3
- b. CaCl_2
- c. CaCO_3
- d. CaO
- e. H_2SO_4
- f. K_2O

II. Very short answer type questions

Write the chemical symbol/formula for the following.

1. Sulphur
2. Phosphorous
3. Hydrochloric acid
4. Aluminium
5. Zinc oxide

III. Short answer type questions

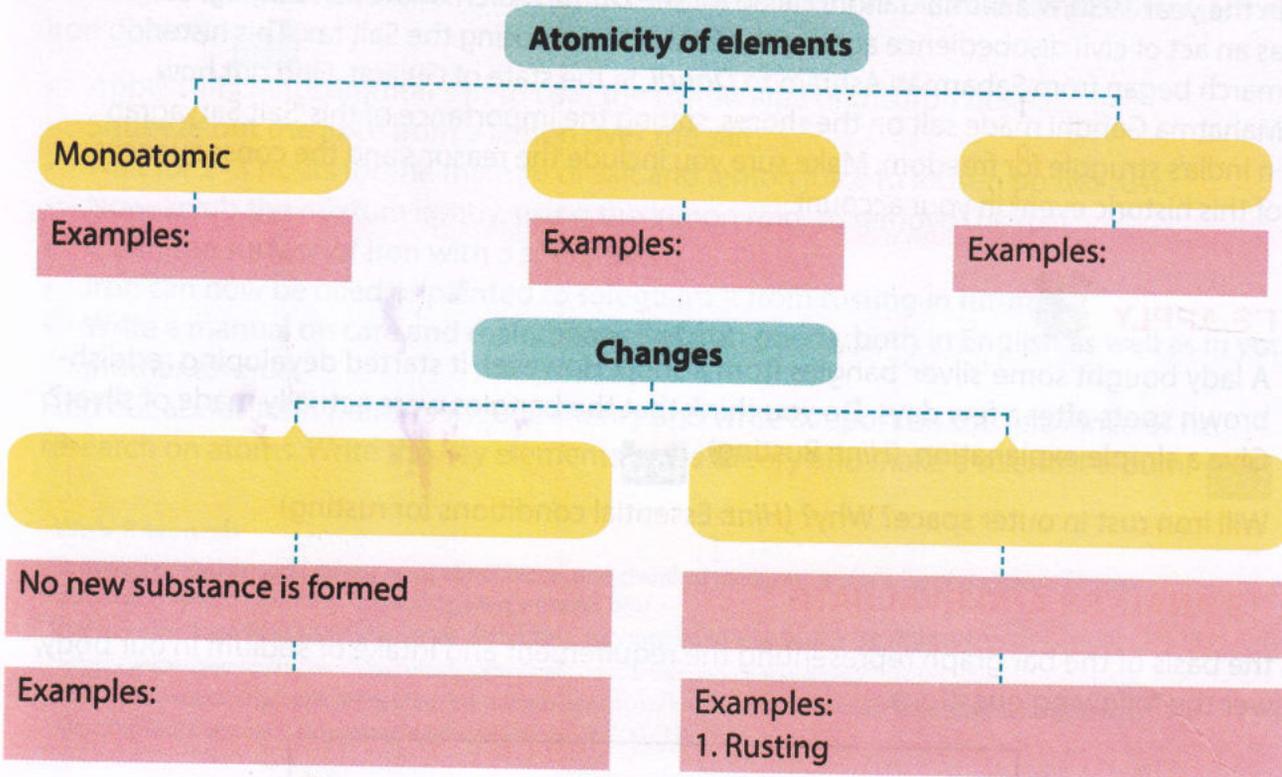
1. Differentiate between an element, a compound and a mixture. Give one relevant example for each.
2. What is atomicity? Give one example each for monoatomic, diatomic and tetra atomic elements.
3. Name all the elements present in the following compounds: SO_2 , PbCl_2 , $\text{Ba}(\text{OH})_2$, LiF
4. Why do the cut surfaces of fruits and vegetables turn brown?
5. Write a short note on crystallization.

IV. Long answer type questions

1. Explain the process used for removing impurities from common salt.
2. Represent the following using chemical symbols/formulae.
 - a. Two atoms of the element neon
 - b. A molecule of the element nitrogen
 - c. A molecule of the compound carbon dioxide
 - d. Three molecules of the compound water
 - e. Four molecules of the compound magnesium oxide
3. Balance the following equations.
 - a. $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$
 - b. $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$
 - c. $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$
 - d. $\text{HCl} + \text{Mg}(\text{OH})_2 \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$
 - e. $\text{K} + \text{H}_2\text{O} \rightarrow \text{KOH} + \text{H}_2$
4. Complete the following word equations. Give their balanced chemical equations also.
 - a. magnesium + oxygen \rightarrow _____
 - b. iron + oxygen + water \rightarrow _____
 - c. vinegar + baking soda \rightarrow _____ + _____ + sodium acetate
 - d. carbon dioxide + lime water \rightarrow _____ + _____
 - e. copper sulphate + iron \rightarrow _____ + _____

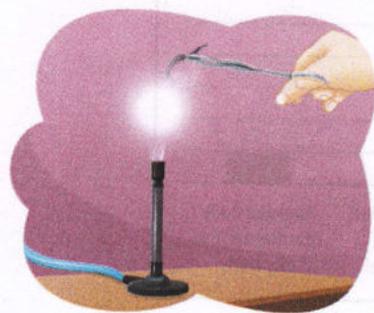
LET'S RECALL 

Recall and complete the concept map given below.



LET'S OBSERVE 

1. Write the word equation for the changes shown below. LO 7

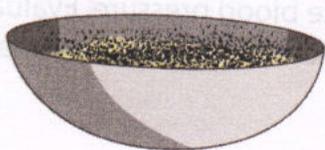


a. _____



b. _____

2. Iron filings and sulphur powder have got mixed together. What can you use to separate them? Draw it in the space provided, to show the process. LO 13



LET'S CONNECT HISTORY

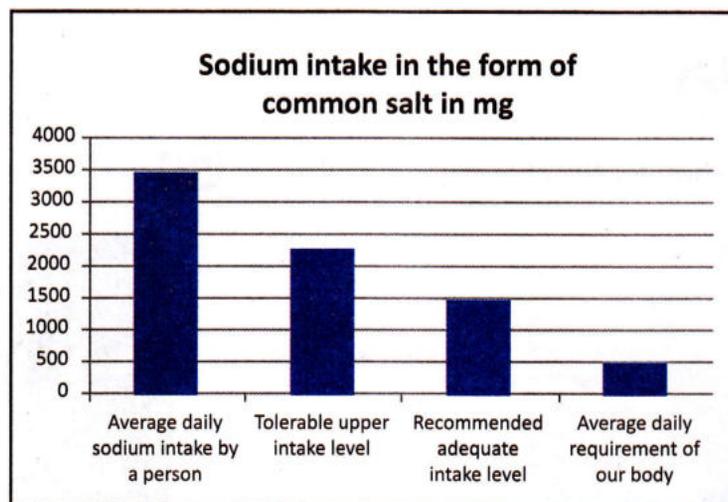
In the year 1930, Mahatma Gandhi called for the **Dandi** March or the Salt **Satyagrah**, as an act of civil disobedience against the British for imposing the Salt tax. This historic march began from Sabarmati Ashram to **Dandi**, in the state of Gujarat. Find out how Mahatma Gandhi made salt on the shores, stating the importance of this 'Salt Satyagrah' in India's struggle for freedom. Make sure you include the reasons and the consequences of this historic event in your account.

LET'S APPLY

1. A lady bought some 'silver' bangles from a shop. However, it started developing reddish-brown spots after a few days. Do you think that the bangles were actually made of silver? Give a simple explanation. (*Hint*: Rusting) 
2. Will iron rust in outer space? Why? (*Hint*: Essential conditions for rusting)

LET'S ANALYSE AND EVALUATE

On the basis of the bar graph representing the requirement and intake of sodium in our body, answer the following questions.



- a. As per the graph, what is the difference in the values of the average daily sodium intake and the recommended adequate intake by a person?  
- b. If a family of four consumes 2kg of salt in a month, calculate the average intake of sodium for a person per day. Compare it with the values given in the bar graph. What according to you does the calculated value corresponds to in the graph?    
- c. Sodium is believed to regulate blood pressure. Evaluate how the salt intake needs to be regulated in the above situation to maintain a normal blood pressure?  

LET'S CREATE



1. Rusting of iron is an undesirable change. Let us learn a simple method to remove rust from iron objects. 
 - Apply sufficient common salt to coat the rusted area of the iron object.
 - Squeeze out the juice from a lemon over the salt.
 - Wait for 2–3 hours for the mixture of salt and lemon juice to loosen up the rust.
 - Now, scrub the mixture lightly, using the lemon rind, to remove the rust.
 - Clean the surface of iron with a soft cloth.
 - Iron can now be oiled or painted to safeguard it from rusting in future.
 - Write a manual on care and maintenance of iron goods, both in English as well as in your mother tongue.
2. Find out about John Dalton's Atomic Theory and write a report on the relevance of his research on atoms. Write the key elements of his theory and make a scientist album. 

Web Research

Browse the Internet and find out more about atoms and chemical reactions. Make a list of equations of some common chemical reactions. Some suggested websites are:

http://www.chem4kids.com/files/atom_intro.html (accessed and checked on 28/08/19)

http://www.chem4kids.com/files/react_intro.html (accessed and checked on 28/08/19)

<https://www.acs.org/content/acs/en/education/resources/k-8/science-activities/chemicalphysicalchange/chemicalreactions.html> (accessed and checked on 28/08/19)

5

Acids, Bases, and Salts

One day, the Science teacher, Ms Rai, was explaining about different types of substances in her class.

Substances can be grouped based on different physical properties, for example, taste. Acidic substances are sour and basic substances are bitter and slippery to touch. Can you think of some examples?

You will learn about

- Acidic substances
- Basic substances
- Indicators
- Salts

I had an orange yesterday. It was extremely sour.

Ma'am, I _____ in the bathroom over a bar of soap!

Lemon! It tastes _____. It must be an acidic substance.

You must not taste any substance without knowing what it is or without an adult supervision.

I accidentally tasted soap while bathing. It tasted _____.

Ananya

Shaurya

Dhruv

Why are some substances sour and others bitter to taste? Substances such as lemon and orange are sour to taste because of the presence of a chemical called acid. Soap is bitter because of the presence of a chemical called base. Bases are also slippery. Let us learn more about these substances.

Answers: Ananya-Sour; Shaurya-bitter; Dhruv-slippery

ACIDIC SUBSTANCES

Substances containing an acid (from Latin *acere* meaning sour) are called *acidic substances*. Acids are of two types: mineral acids and organic acids.

Mineral Acid

Hydrochloric acid (HCl), sulphuric acid (H_2SO_4), and nitric acid (HNO_3) are examples of mineral acids that are used in the laboratory (Fig. 5.1). These acids are produced from chemical substances (minerals) existing in nature.



Fig. 5.1 Mineral acids

Organic Acid

Organic acids occur naturally in animal and plant materials.

Some examples of organic acids with their sources are given in Table 5.1.

Table 5.1 Some organic acids and their sources

Organic acid	Tartaric acid	Acetic acid	Formic acid	Malic acid	Citric acid	Lactic acid	Oxalic acid
Sources of organic acid	Grapes	Vinegar	Sting of ants, bees	Apples	Lemons, oranges	Milk	Spinach

Strong and Weak Acids

Acids can be strong or weak. A *strong acid* is highly corrosive and can cause severe burns. All strong acids are mineral acids. These acids are highly reactive towards metals and for that reason, cannot be stored in metal containers. They are either stored in glass or ceramic containers. The mineral acids also act against clothes and wood. Hydrochloric acid, sulphuric acid, and nitric acid are examples of strong acids.

Weak acids, on the other hand, are not as destructive as strong acids. Weak acids are mostly organic acids. Most of the organic acids are a part of our diet. Acetic acid, which is used to make vinegar, is an example of weak acids. Vinegar is 5–8% solution of acetic acid in water. The fizzy drinks and soda water contain carbonic acid, which gives them a pleasant taste. Carbonic acid is not an organic acid. It is a mineral acid and a weak acid.

Properties of Acids

Some of the characteristic properties of acids are:

Acids are sour to taste and are corrosive in nature

Along with sour taste, acids also have the ability to corrode metals such as iron and aluminium. For this reason, acids are generally stored in glassware.

Mineral acids such as nitric and sulphuric acids can burn human tissues upon contact and damage clothes, paper, etc. Thus, one should handle acids with care.

Word help

Corrosive Tending to destroy slowly by chemical action

Acids are soluble in water Most acids dissolve in water either at room temperature or on heating to form a clear solution.

For example, vinegar is a 3–5% solution of acetic acid in water.

Depending on the amount of water, acids can be either *dilute* or *concentrated*.

If the amount of water is more in an acid, it is called *dilute acid* and if the amount of water is less, it is called *concentrated acid*.

Uses of Acids



Hydrochloric Acid (HCl)

- Dilute hydrochloric acid is used in various industries that use heating applications. It is applied to remove deposits from the inside of the boilers.
- Hydrochloric acid is also used for cleaning sinks and sanitary ware (Fig. 5.2).

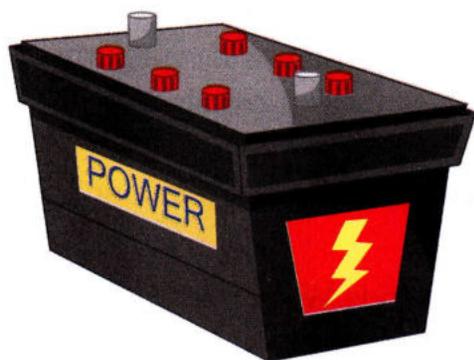


Fig. 5.3 A car battery

Nitric Acid (HNO₃)

- It is used by goldsmiths for cleaning gold and silver ornaments.
- It is also used for the production of fertilizers such as ammonium nitrate.

Acetic Acid (CH₃COOH)

- Acetic acid is the main ingredient of vinegar. Vinegar is used to enhance the flavor of food and as a preservative in pickles.
- It is also used as a cleansing agent in products meant for cleaning windows, floors, utensils, etc. It also helps to remove stains on woodwork, such as furniture and carpets.

Fact File

Hydrofluoric acid is the only known acid that reacts with glass and is therefore stored in plastic bottles.



Fig. 5.2 Sanitary ware cleaners contain hydrochloric acid

Sulphuric Acid (H₂SO₄)

Sulphuric acid is such an important industrial chemical that it is called the *King of chemicals*.

Some of its major uses are as follows:

- Sulphuric acid is used in car batteries (Fig. 5.3).
- It is used in the manufacture of paints, drugs, dyes, and to produce fertilizers.

Most microorganisms cannot live in an acidic environment. An acidic environment either slows down their activities or can also kill them. This is why you will find vinegar in many commonly packaged food items such as pickles, sauce, ketchups.

Green corner

Acid rain is a major effect of air pollution. Pollutants such as sulphur dioxide and oxides of nitrogen present in the air react with atmospheric water and oxygen to form sulphuric acid and nitric acid, respectively. These acids come down along with rain. Acid rains cause great damage to plant and animal life as well as to buildings and monuments.



Let's Remember



A. Write T for the True and F for the False statements. Correct the false statements.

1. Acids can be stored in metal containers.
2. Mineral acids are present in animal and plant materials.
3. A dilute acid has more amount of water than a concentrated acid.
4. Sulphuric acid is used for cleaning sinks and sanitary ware.
5. Nitric acid is used by goldsmiths for cleaning gold and silver ornaments.
6. Hydrochloric acid is used to enhance the flavour of food and as a preservative in pickles.

B. Fill in the blanks with the correct words.

1. Acids are _____ (sour/bitter) to taste.
2. Apples contain _____ (lactic/malic) acid, whereas spinach has _____ (tartaric/oxalic) acid.
3. _____ (Strong/Weak) acids are highly corrosive.
4. Organic acids are _____ (strong/weak) acids.
5. _____ (Carbonic/Acetic) acid is present in fizzy drinks and soda water.

BASIC SUBSTANCES

Substances containing a base are called *basic substances*. Sodium hydroxide (NaOH) and calcium hydroxide [Ca(OH)₂] are examples of bases used in the laboratory (Fig. 5.4). Corn starch, fresh egg white, etc., are other examples of bases.

Bases may have a strong irritating odour and should be used with caution as they can harm the skin and eyes.



Fig. 5.4 Some bases

Strong and Weak Bases

Like acids, bases can be strong or weak.

Strong bases are very corrosive and can burn the skin. These bases should be handled carefully. Caustic soda or sodium hydroxide (NaOH) and caustic potash or potassium hydroxide (KOH) are strong and corrosive bases.

On the other hand, copper hydroxide $[\text{Cu}(\text{OH})_2]$, zinc hydroxide $[\text{Zn}(\text{OH})_2]$, and ammonium hydroxide (NH_4OH) are *weak bases*. Ammonium hydroxide is produced from dissolving ammonia (NH_3) in water.

Properties of Bases

Some of the characteristic properties of bases are:

Bases are bitter to taste A bitter taste is characteristic of all bases.

Solutions of bases are slippery to touch If you apply a drop or two of a very dilute solution of sodium hydroxide or potassium hydroxide on your fingers and then rub them, they will feel slippery.

Bases may or may not be soluble in water Bases that can dissolve in water are called *alkalis*. Some examples of soluble bases or alkalis are sodium hydroxide, potassium hydroxide, and calcium hydroxide.

Uses of Bases

AN

Calcium Hydroxide (Slaked lime) $[\text{Ca}(\text{OH})_2]$

- It is used to neutralize the acidity in soils.
- It is an ingredient in whitewash and mortar.
- It is a component of the Bordeaux mixture used for protecting agricultural crops from pests.
- It is used in the preparation of dry mixes for painting and decorating.

Magnesium Hydroxide (Milk of magnesia) $[\text{Mg}(\text{OH})_2]$

- It is used as an antacid or a laxative. It helps to correct excess acidity in the stomach.

Sodium Hydroxide (Caustic soda) (NaOH)

- It is used in the manufacture of paper and textiles.
- In homes, it is occasionally used to unblock drains.
- It is used in the manufacture of soaps (Fig. 5.5) and detergents.



Fig. 5.5 Sodium hydroxide is used in the manufacture of soaps.

Fact File

There are acids and bases in our body too. HCl is present in the stomach. The saliva in your mouth is basic in nature. Blood, when healthy, is also basic.

INDICATORS

AN

How would you find out whether a substance is acidic, basic, or neutral? Tasting the substance is one way of doing it. But this is not a safe way. To overcome this, certain chemicals called *indicators* have been developed.

Indicators are substances that show a change in colour when brought in contact with acids and bases.

The most common indicator used in the laboratory is the *litmus*. It is extracted from *lichens* and is available either in the form of solutions or in the form of strips of paper known as *litmus paper*. Litmus paper is either *red* or *blue* in colour. It changes colour depending upon whether the compound is an acid or a base. Blue litmus paper turns red under acidic conditions (Fig. 5.6), and red litmus paper turns blue under basic conditions (Fig. 5.7).

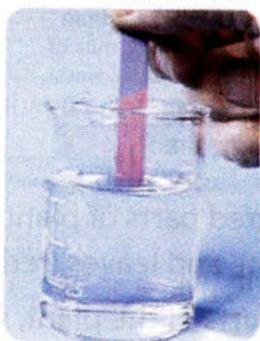


Fig. 5.6 Blue litmus turning red in an acid



Fig. 5.7 Red litmus turning blue in a base

Phenolphthalein and *methyl orange* are also used as indicators. Table 5.2 lists the colour change of phenolphthalein and methyl orange in acidic and basic mediums.

Table 5.2 Other indicators

Indicator	Acid	Base
Phenolphthalein	Colourless	Pink
Methyl orange	Red	Yellow

The solutions that do not show a change in colour in any of the indicators are neither acidic nor basic. These substances, as you already know, are called *neutral substances*. Some examples of neutral substances are water, sodium chloride, sugar, etc.

Universal Indicators

Acids or bases can be either strong or weak. Scientists have made it very easy to know the strength of an acid or a base. Different strengths have been given what is known as a *pH number*, which ranges from 1 to 14. pH 1 is considered strongly acidic, pH 14 strongly basic, and pH 7 is neutral. You can measure pH of a solution by using a universal indicator.

Let's Discuss

A TV advertisement of a shampoo says that their shampoo is the best because it has a very low pH. Will it be as good for the hair as it says?

A **universal indicator** is a mixture of indicators so chosen that it gives a different colour for different pH values. The indicator can be used as a liquid or can be soaked into paper. This paper is called *pH paper*.

When a pH paper is dipped in an acid or a base, the colour obtained can be matched with the chart given below (Fig. 5.8).

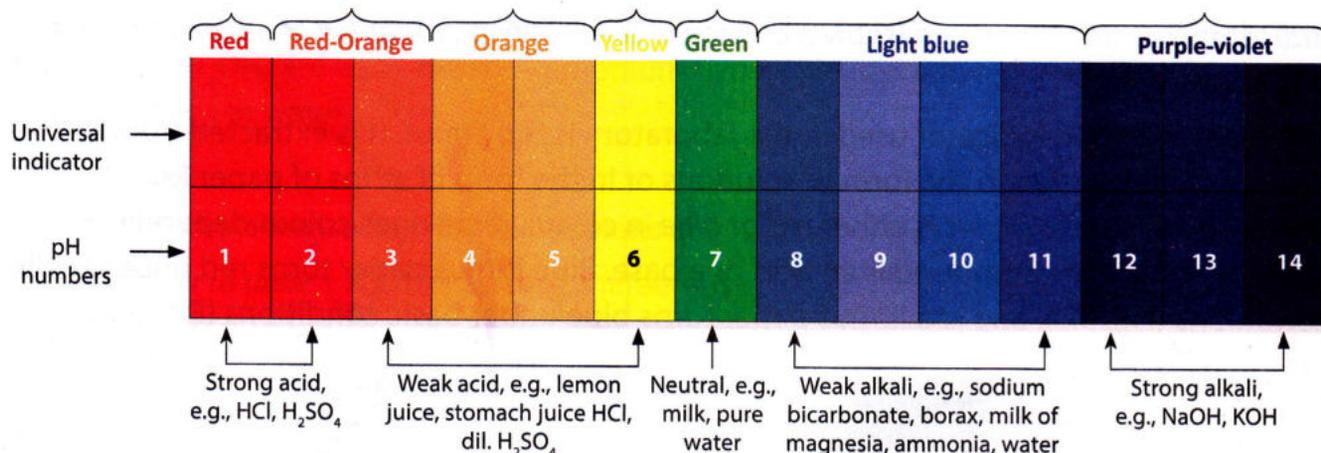


Fig. 5.8 Colour chart for universal indicator

Natural Indicators

Indicators can be prepared very easily from brightly coloured parts of plants such as flowers (china rose, rose), roots (beetroot), stems (turmeric), and leaves (red cabbage).

Indicator solutions can be prepared by boiling coloured parts of the plant, such as petals, in water for sometime and straining out the plant part. This solution gives a different colour in acidic and basic solutions.

For example, red cabbage juice will change to deep red with acids, to purple with neutrals, and to green and yellow with bases. Onion juice also shows similar colour changes. You can directly put some rose petals in a dish containing vinegar or lemon juice and a few petals in soap solution and see the difference in colour.

Activity

Aim: To see the effect of a natural indicator

Materials needed: Turmeric powder, alcohol/water, soap solution, and beaker

Method:

1. Mix $\frac{1}{4}$ th teaspoon of turmeric (haldi) powder in $\frac{1}{4}$ cup of alcohol in a small beaker. You can also mix it with water but turmeric dissolves better in alcohol.
2. Prepare a soap solution in another beaker by dissolving a small piece of washing soap in water.
3. Add a few drops of the turmeric-alcohol solution to the soap solution.

Observation: The soap solution turns red.

Conclusion: Soap is a base, and the compound (called curcumin) that gives turmeric its yellow colour reacts with soap (a base) to form a red compound.

Let's Remember



A. Answer the following questions orally.

1. Name two strong and two weak bases.
2. Give two examples of bases that are alkalis.
3. Which base is called milk of magnesia?
4. Which base is used as an ingredient in whitewash and mortar?
5. What is the range of pH?
6. Which parts of the following plants are used for preparing indicators?
a. China rose b. Turmeric

B. Fill in the blanks with the correct words.

1. _____ (Slaked lime/Caustic soda) is a component of Bordeaux mixture.
2. Methyl orange will turn red in _____ (acidic/basic) medium.
3. Phenolphthalein changes colour from _____ (pink/colourless) to _____ (pink/colourless) in basic medium.
4. _____ (Sodium hydroxide/Sodium chloride) is a neutral substance.
5. pH _____ (6/1) is strongly acidic.
6. Red cabbage juice changes to deep red with _____ (acids/bases) and purple with _____ (bases/neutrals).

SALTS

Salts is a general term used for the substances that are formed when an acid and a base react with each other. This reaction is called a *neutralization reaction*.

The reaction between vinegar and baking soda is a neutralization reaction. Vinegar, as we already know, contains an acid and baking soda contains a base.

When vinegar reacts with baking soda, a salt is formed. Water and carbon dioxide gas are also the products of this reaction.

Similarly, common table salt is formed by the reaction of hydrochloric acid (HCl) with sodium hydroxide (NaOH).



Salts can be acidic, basic, or neutral. *Acidic salts* are formed when a strong acid reacts with a weak base. *Basic salts* are formed when a strong base reacts with a weak acid. When a strong acid reacts with a strong base, *neutral salts* are formed.

Get it Right

In common usage, salt refers to table salt. In chemistry, salt refers to the product of the reaction between an acid and a base.

Neutralization reactions (Fig. 5.9) are quite common in everyday life.



Fig. 5.9 Applications of neutralization reactions

Activity

Aim: To demonstrate a neutralization reaction

Materials needed: Dilute sodium hydroxide solution, dilute hydrochloric acid, and phenolphthalein

Method:

Take 30 ml of dilute sodium hydroxide solution in a conical flask and add a drop of phenolphthalein to it. Now, pour hydrochloric acid to it dropwise, using a dropper, till there is change in the colour of the solution. Ensure that change in colour is due to the addition of one last drop of hydrochloric acid.

Observation: The solution turns pink when phenolphthalein is added to sodium hydroxide. The solution turns colourless when the entire sodium hydroxide has reacted. On testing the colourless solution with litmus paper, there is no change either with red litmus or blue litmus paper.

Conclusion: There is no change in the colour of the litmus paper indicating that the solution has turned neutral.

S. No.
1
2
3
4
5
6
7

Properties of Salts

Some of the characteristic properties of salts are:

Melting and boiling points Salts are mostly solids, which melt as well as boil at high temperatures.

Solubility in water Salts are generally soluble in water. For example, sodium chloride, potassium sulphate, aluminium nitrate, ammonium carbonate, etc., are soluble salts while silver chloride, lead chloride, copper carbonate, etc., are insoluble in water.

Water of crystallization Generally, salts are found as crystals with water molecules present in them. This water is called the *water of crystallization* and such salts are called *hydrated salts*.

For example, copper sulphate crystal has five molecules of water for each copper sulphate molecule. This is written as $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. This water of crystallization gives the crystal its shape. It also gives colour to some crystals. For example, copper sulphate is also called blue vitriol due to its blue colour. On heating, hydrated salts lose their water of crystallization and, as a result, the crystals lose their shape and colour and change to a powdery substance.

*The hydrated salts that have lost their water of crystallization are called **anhydrous salts**.*

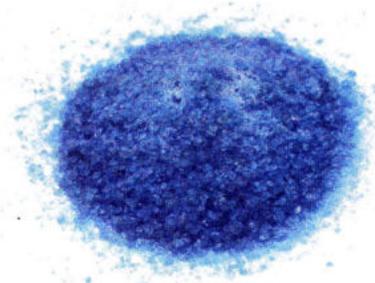
When hydrated copper sulphate is heated, it gives out water molecules to form white powdery anhydrous copper sulphate. On addition of water, this substance can convert back to a hydrated copper sulphate solution again.

Uses of Salts

Some examples of salts and their uses are given in Table 5.3.

Table 5.3 Uses of some salts

S. No.	Name of the salt/Chemical formula	Uses
1	Calcium carbonate (marble, limestone, chalk)/ CaCO_3	Flooring in the form of marble, to make lime (CaO), cement, and for extraction of iron
2	Sodium carbonate (washing soda)/ $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	In cleaning, in detergents, for water softening, and in the manufacture of glass
3	Sodium bicarbonate (baking soda)/ NaHCO_3	In bakery and medicines
4	Silver nitrate/ AgNO_3	In photography for developing films
5	Ammonium nitrate/ NH_4NO_3	Fertilizers and explosives
6	Potash alum (phitkari)/ $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$	In purification of water
7	Sodium chloride (Common salt)/ NaCl	As seasoning for food, in manufacture of chlorine and sodium carbonate



Copper sulphate (CuSO_4)

Fig. 5.10 Blue Vitriol

Let's Remember



A. Answer the following questions orally.

1. Identify the salts in the following substances.
 - a. Baking soda
 - b. Marble
 - c. Common salt
2. Give a use of the following salts.
 - a. AgNO_3
 - b. NH_4NO_3
 - c. $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
 - d. CaCO_3
 - e. NaHCO_3
 - f. NaCl

B. Fill in the blanks with the correct words.

1. _____ (Hydrated/Anhydrous) salts have lost their water of crystallization.
2. _____ (Neutralization/Crystallization) reaction is a reaction between an acid and a base to form a salt.
3. _____ (Sodium chloride/Sodium carbonate) is formed in the reaction between hydrochloric acid and sodium hydroxide.
4. _____ (Washing soda/Potash alum) is used for the purification of water.
5. _____ (Sulphur/Slaked lime) is used to neutralize liquid waste from factories.

Key Words

Acidic substances	Substances containing an acid are called acidic substances.
Basic substances	Substances containing a base are called basic substances.
Organic acids	Acids that occur naturally in plant and animal materials are called organic acids.
Dilute acids	Acids in which the amount of water is more are called dilute acids.
Concentrated acids	Acids in which the amount of water is less are called concentrated acids.
Indicators	Substances that show a change in colour when brought in contact with acids and bases are called indicators.
Neutralization reaction	The reaction in which an acid reacts with a base to form salt is called a neutralization reaction.
Water of crystallization	The water molecules present in solid crystals of salts is called the water of crystallization.
Hydrated salts	Salts with water of crystallization are called hydrated salts.
Anhydrous salts	Salts which have lost their water of crystallization are called anhydrous salts.

Summary

- Acidic substances have a sour taste, are corrosive in nature, and are soluble in water.
- Depending on the amount of water, acids can be either dilute or concentrated.
- A strong acid is highly corrosive.
- Basic substances are bitter to taste and soapy to touch.
- Bases that dissolve in water are called alkalis.
- Bases form a part of many household cleaners.
- Neutral substances are neither acidic nor basic.
- Water is neither acidic nor basic.
- Indicators are substances that show a change in colour when brought in contact with acids and bases.
- Salts are formed when an acid reacts with a base.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

- _____ (Strong/Weak) acids are highly corrosive and can cause severe burns.
- _____ (Acids/Bases) are slippery to touch.
- _____ (Nitric/Sulphuric) acid is used in the manufacture of paints, dyes and drugs.
- _____ (Sodium hydroxide/Milk of magnesia) is used to unblock drains.
- _____ (Red/Blue) litmus changes to _____ (red/blue) in acids.

B. Choose the correct option.

- Which acid is called the 'King of chemicals'?
a. Acetic acid b. Hydrochloric acid c. Nitric acid d. Sulphuric acid
- Which acid is present in vinegar?
a. Nitric acid b. Sulphuric acid c. Acetic acid d. Hydrochloric acid
- Which of the following is a weak mineral acid?
a. Carbonic acid b. Acetic acid c. Lactic acid d. Hydrochloric acid
- Which of the following is used to neutralize bee stings?
a. Vinegar b. Calamine lotion c. Quicklime d. Baking soda
- Which of the following cannot be used as an indicator?
a. Turmeric b. Onion c. Sugar d. Beetroot
- Which of the following is a salt?
a. Potash alum b. Potassium hydroxide
c. Silver nitrate d. Both a and c
- Which acid is used to remove deposits from the inside of the boilers?
a. Acetic acid b. Hydrochloric acid c. Sulphuric acid d. Carbonic acid
- Which of the following is a strong base?
a. $\text{Cu}(\text{OH})_2$ b. $\text{Zn}(\text{OH})_2$ c. KOH d. NH_4OH
- Which of the following pH values represents a strong alkali?
a. $\text{pH} = 2$ b. $\text{pH} = 7$ c. $\text{pH} = 10$ d. $\text{pH} = 13$
- Which of the following is a characteristic property of most of the salts?
a. High melting point b. Insoluble in water
c. Liquid at room temperature d. Low boiling point

C. Match the following.

Column A

1. CH_3COOH
2. AgNO_3
3. NH_4NO_3
4. Ca(OH)_2
5. CaCO_3

Column B

- a. Silver nitrate
- b. Calcium carbonate
- c. Acetic acid
- d. Ammonium nitrate
- e. Calcium hydroxide

II. Very short answer type questions

Give one word for the following.

1. Bases that dissolve in water _____
2. A substance that shows a change in colour when brought in contact with an acid or a base _____
3. Universal indicator that is soaked into paper _____
4. Substance formed when a strong acid reacts with a strong base _____
5. Salts with water of crystallization _____

III. Short answer type questions

1. State any two properties of acids and bases.
2. Why acids or bases are sometimes added to soil?
3. What is a neutralization reaction? Give an example.
4. How can a hydrated salt be converted into anhydrous salt? Give an example.
5. Complete the following table by filling the colour of the indicator in the given solutions.

Substance	Blue litmus	Red litmus	Phenolphthalein	Methyl Orange
Hydrochloric acid	Red			
Sodium hydroxide solution				
Sodium chloride solution				

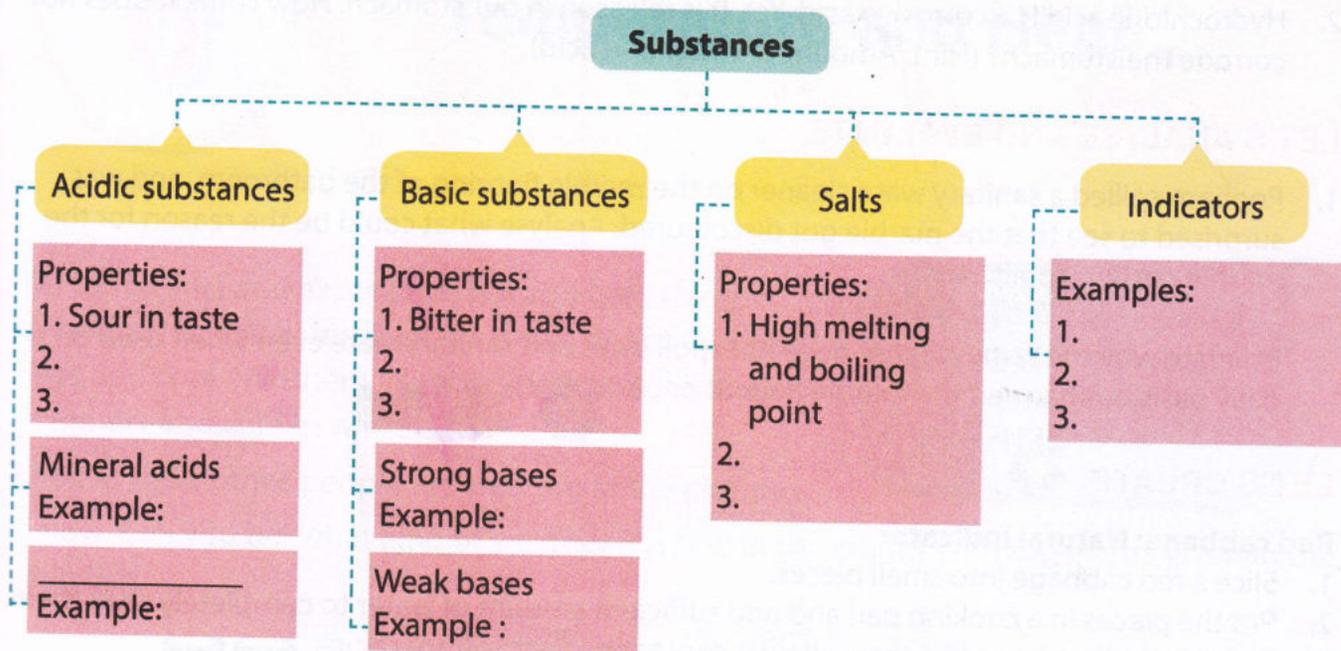
IV. Long answer type questions

1. How are natural indicators prepared? Give examples of a flower, root, stem and leaf that can be used as an indicator. What are the colour changes observed with red cabbage juice in acidic, neutral and basic medium?
2. Explain the following:
 - a. Vinegar is used in packaged food items.
 - b. Slaked lime is added to factory waste.
 - c. Magnesium hydroxide is used as an antacid.
 - d. Strong acids and bases should be handled carefully.
3. What is water of crystallization? Explain with the help of an example.

LET'S RECALL



Recall and complete the concept map given below.



LET'S OBSERVE



1. Carefully observe the picture and answer the following questions. LO 13
 - a. Identify the food items in the given picture.
 - b. Identify the process being shown in the picture.
 - c. Which chemical is commonly used in the process shown here? Why?
2. Observe the change in colour of the litmus paper. Which of the solutions in the beaker is acidic and which one is basic? Write in the space given below the pictures. LO 1



LET'S CONNECT



List a few fruits, vegetables, dairy products, etc. Research from the Internet and find out their pH values. Categorize them as acidic, basic, or neutral. Make an integer number line and mark the pH values of each on it.

LET'S APPLY



1. Why are pickles and sauces not packaged in metal containers? (Hint: Preservative used) **LO 13**
2. Hydrochloric acid is a corrosive acid. Yet, it is released in our stomach. How come it does not corrode the stomach? (Hint: Amount of water and acid)

LET'S ANALYSE AND EVALUATE

1. Poonam spilled a sanitary ware cleaner on the marble flooring of the bathroom, and was surprised to see that the marble got discoloured. Analyse what could be the reason for the marble getting spoilt. **ANALYSING**
2. Evaluate why the same cleaner does not spoil sinks and sanitary ware even when used on a daily basis but harmed the marble floor at once. **ANALYSING** **EVALUATING** **LO 13**

LET'S CREATE

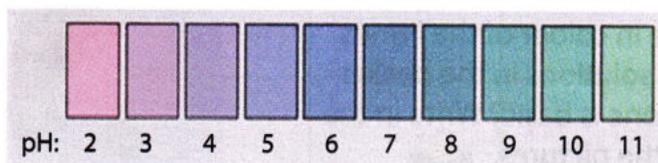


Red cabbage: Natural indicator

1. Slice a red cabbage into small pieces.
 2. Put the pieces in a cooking pan and add sufficient amount of water to completely soak them.
 3. Boil it for half an hour and then, allow it cool to the room temperature. **LO 11** **LO 15**
 4. Strain out the blue-violet liquid into a separate container.
 5. Take some thick absorbent paper (e.g., blotting paper or filter paper) and soak it in the strained liquid.
 6. After some time, remove the paper from the liquid and keep it for drying.
 7. Cut the above paper into thin strips and store them in a closed envelope.
- These strips can be used to determine the pH of different solutions. A strip can be dipped in a particular liquid solution and the colour change can be matched with colours given in the chart below.



Red cabbage strips



Colour chart for red cabbage extract

Red cabbage extract shows different colours with acids, bases and neutrals. The pH of household substances can be noted using the red cabbage strips and they can be classified as acidic, basic or neutral.

Web Research

Browse the Internet and find out more about acids, bases, and salts used in our everyday life. Some suggested websites are:

https://www.ducksters.com/science/acids_and_bases.php (accessed and checked on 28/08/19)

http://www.funsci.com/fun3_en/acids/acids.htm (accessed and checked on 28/08/19)

<https://www.thoughtco.com/making-red-cabbage-ph-indicator-603650> (accessed and checked on 28/08/19)

6

Temperature and Heat

We touch, feel and experience hot and cold things every day. Our surroundings are warm or hot on some days and cool on others. We also know that it is hot in summers and cold in winters.

Look at the clothes people are wearing in the pictures below. Can you tell what kind of weather it is? Fill in the blanks with the words given in the help box.

You will learn about

- Temperature
- Heat—A form of energy
- Modes of heat transfer

Hot Very cold Pleasant Cold



1. _____



2. _____



3. _____



4. _____

We can also name a number of objects that are hot or cold. For example, ice cream is cold and a steaming cup of coffee or tea is hot. But what exactly is 'hot' or 'cold'? Can we measure a quantity that would give an indication of how hot or cold something is?

Answers: 1. Cold; 2. Hot; 3. Pleasant; 4. Very cold

TEMPERATURE

The degree of 'hotness' or 'coldness' of a body or a place is called **temperature**.

One of the methods of measuring the degree of hotness and coldness is by the sense of touch. But our sense of touch can sometimes be misleading. Let us look at the following experiment to understand why.

Activity

Aim: To show that the terms 'hot' and 'cold' as we feel them are only relative terms

Materials needed: Three glasses, hot water (as hot as you can bear to dip your finger in), ice-cold water, and water at room temperature

Method:

1. Pour hot water, water at room temperature, and the ice-cold water into three separate glasses.
2. Keep the three glasses side by side on a table with the glass containing water at room temperature in the middle.
3. Dip the index finger of one hand in the ice-cold water and that of the other hand in the hot water. Hold the fingers in the water for a minute.
4. Then dip both the index fingers into the water at room temperature.



Observation: You will find that to one finger, the water feels hot and to the other it feels cold.

Conclusion: This is because the finger that was in ice-cold water has become cold, and when it was placed in the water at room temperature, it felt that the water was warm, relative to the earlier experience of ice-cold water.

Similarly, the finger that was first in hot water will feel the water at room temperature to be relatively cold.

So, you see the terms 'hot' and 'cold' are only relative terms. There must always be a reference body with respect to which we can say a given body is hot or cold.

Therefore, it is important that we use an instrument, rather than our own judgement, to measure temperature.

Measurement of Temperature



We measure temperature with an instrument called the *thermometer*. All thermometers measure temperature by making use of some property of a substance that varies with temperature. One such property is the change in volume of a substance (expansion and contraction) with temperature.

Temperature Scales

Just as we use different units to measure length (inches, centimetres, etc.), we use different units to measure temperature. These different units are represented by different temperature scales.

Here is a simplified description of how a temperature scale is defined. Two reference temperatures are chosen and the difference between these two temperatures are further broken down into a certain number of divisions. Each division is called one *degree*.

The most commonly used reference temperatures are the melting point of pure ice and the boiling point of pure water.

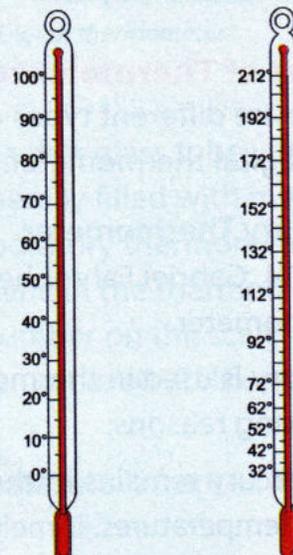
The two commonly used scales are the *Celsius* and the *Fahrenheit* scales. There is a third scale, the *Kelvin* scale, which you will learn about in higher classes.

Celsius Scale

This scale is indicated by °C [read as degree Celsius (in honour of Anders Celsius) or degree centigrade]. On this scale, the melting point of pure ice is taken as 0°C and the boiling point of pure water, as 100°C. The difference between these two points is divided into 100 degrees [Fig. 6.1(a)].

Fahrenheit Scale

This scale is indicated by °F (read as degree Fahrenheit). On this scale, 32°F is taken as the melting point of pure ice and 212°F as the boiling point of pure water. The difference between these two points is divided into 180 degrees [Fig. 6.1(b)].



(a) Celsius scale

(b) Fahrenheit scale

Fig. 6.1 Common scales used to measure temperature

Know your Scientist

Anders Celsius was born into a family of illustrious mathematicians and scientists in Sweden in the year 1701. He is credited with the construction of the 'Celsius Scale' for measuring temperature that is used even today (with some minor changes). The unit of temperature, the degree Celsius is named in his honour. He was a brilliant scientist and astronomer, and made several contributions to astronomy, meteorology (the study of weather and weather forecasting) and geography. He was part of an expedition that made measurements to confirm that the Earth was indeed flatter at the poles as compared to the equator. He was instrumental in building an astronomical observatory in Uppsala (in Sweden) in 1741, called the Celsius Observatory.



Conversion Formula

Two simple equations given below will help us to convert one temperature scale into another.

$F = (C \times 9/5) + 32$, and $C = 5(F - 32)/9$, where F is for Fahrenheit and C is for Celsius.

Let us look at the following examples to understand the conversion properly.

Example 1: Convert 86°F to $^{\circ}\text{C}$.

Solution

$$\begin{aligned}\text{We know that } C &= 5(F - 32)/9 \\ \text{Therefore, } 86^{\circ}\text{F} &= 5(86 - 32)/9 \\ &= 5(54)/9 = 30 \\ &= 30^{\circ}\text{C}\end{aligned}$$

Example 2: The temperature during a hot day in Delhi was 45°C . Express this temperature in degree Fahrenheit.

Solution

$$\begin{aligned}\text{We know that } F &= (C \times 9/5) + 32. \\ \text{We are given that } C &= 45^{\circ}\text{C}, \\ \text{Therefore, the day temperature in degree Fahrenheit} \\ &= (45 \times 9/5) + 32^{\circ}\text{F} = (81 + 32)^{\circ}\text{F} = 113^{\circ}\text{F}\end{aligned}$$

Types of Thermometers

There are different types of thermometers: mercury thermometer, alcohol thermometer, and digital thermometer.

Mercury Thermometer

In 1714, Gabriel Fahrenheit invented the first mercury thermometer.

Mercury is used in thermometers because of the following reasons:

- Mercury remains in the liquid state for a wide range of temperatures. It melts at -38.87°C and boils only at 356.58°C .
- It is relatively easy to see because of its silvery grey colour.
- It does not stick to glass.
- It has a fairly uniform rate of expansion for a wide range of temperatures.

Alcohol Thermometer

Thermometers using alcohol have some advantages over mercury thermometers.

- Alcohol is cheaper and less harmful than mercury.
- Alcohol thermometers can measure much lower temperatures (up to -115°C) than mercury.

However, the main disadvantage is that alcohol thermometers cannot measure temperatures higher than 78°C , whereas mercury thermometers can measure much higher temperatures. An alcohol thermometer, therefore, cannot be used to measure the temperature of boiling water.

Digital Thermometer

These days, digital thermometers are used to measure body temperature. Digital thermometers do not use mercury. They contain a 'thermistor'. The current passing through a thermistor depends on its temperature. Another small device inside a digital thermometer measures the current passing through the thermistor and sends this information to a liquid crystal display (LCD) where the temperature is displayed in digits.

Green corner

Mercury thermometers are being phased out as they are an environmental hazard. Waste from mercury manufacture is highly toxic and is difficult to recycle or dispose of.

Reading a Conventional Thermometer

The thermometers we use in the laboratory are called *laboratory thermometers* and the ones used to check body temperature are called *clinical thermometers*.

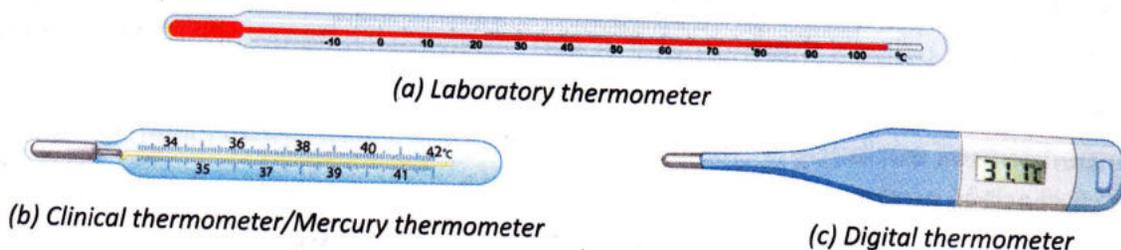


Fig. 6.2 Types of thermometer

A laboratory thermometer is shown in Figure 6.2 (a). It consists of a thin glass tube which is sealed at one end and has a bulb at the other end. The bulb is generally filled with mercury or alcohol, depending on whether it is a mercury or an alcohol laboratory thermometer. Mercury appears as a silvery grey line and alcohol looks like a red line in the thermometer. To read the temperature on this thermometer, you just read the number on the scale at the tip of the red or silvery-grey line. Remember to mention the unit used (Celsius or Fahrenheit).

The range of temperatures which a laboratory thermometer can measure is from -10°C to 110°C .

A clinical thermometer [Fig. 6.2 (b)] is generally a mercury thermometer though digital thermometers [Fig. 6.2(c)] are becoming quite popular.

There are two characteristic features of a mercury clinical thermometer:

- There is a little arrow (at 98.4 or 98.6°F) showing the normal body temperature.
- There is a constriction or 'kink' in the tube near the bulb. This kink has been made to ensure that the mercury in the thermometer does not contract (and flow back into the bulb) before the temperature has been read.

To read the body temperature of any person with a clinical thermometer, follow the steps given below:



First shake the thermometer a few times so that the mercury (the silvery grey line) goes below the 'normal' (body temperature) mark.



Place the thermometer in the arm pit or under the tongue of the person whose temperature is to be taken. Wait for two minutes.



Take out the thermometer and read the temperature at which the silver line (of mercury) ends. Keep the thermometer at your eye level for an accurate reading.

Here are some precautions that one must follow while handling a mercury clinical thermometer.

- Wash the thermometer well and dip it in an antiseptic liquid before and after using it.
- While handling the thermometer, do not hold it by its the bulb.
- Be careful while using a thermometer. It can break easily. Remember, mercury is a toxic substance.

The temperature of our body is closely related to a physical quantity called 'heat' or 'heat energy' possessed by the body. Let us learn more about this physical quantity.

Let's Remember



A. Answer the following questions orally.

1. Name two common temperature scales.
2. What is the boiling point of water in the Celsius scale?
3. Give one advantage of using an alcohol thermometer.

B. Fill in the blanks with the correct words.

1. We measure temperature with an instrument called a _____ (Celsius/thermometer).
2. Degree Fahrenheit is a unit of _____ (temperature/heat).
3. A clinical thermometer is used to measure _____ (human body/room) temperature.
4. The melting point of ice is _____ ($32^{\circ}\text{F}/32^{\circ}\text{C}$).
5. _____ (Mercury/Alcohol) is used in a clinical thermometer.

HEAT—A FORM OF ENERGY

Have you stirred hot tea or milk with a stainless steel spoon? Next time you do this, leave the spoon in the hot liquid for a little while. Now, touch the handle of the spoon. What do you notice? The handle of the spoon would have got a little warm. Why did the handle of the spoon become warm?

When there is a difference in temperature between two bodies, a certain type of energy flows between them. This energy is called *heat energy*.

When this heat energy flows into a body, it warms the body. When it flows out of the body, it cools the body.

When a hot body and a cold body are in contact, the hot body loses heat energy while the cold body gains heat energy.

Get it Right

Temperature is not energy. However, if we know the temperature of a substance, we can calculate the amount of heat energy it contains.

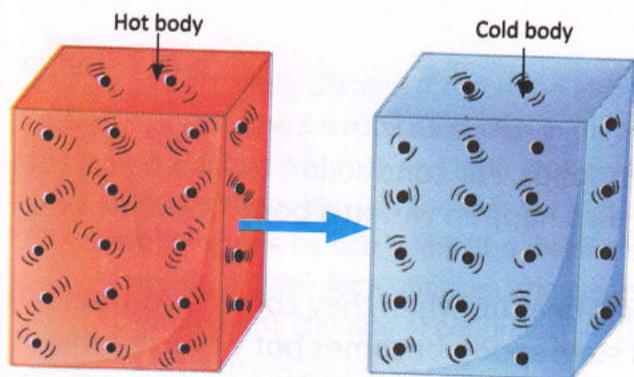


Fig. 6.3 Direction of flow of heat energy

The point to note is that, left to itself, heat energy flows from a region of higher temperature to a region of lower temperature and never in the other direction (Fig. 6.3). Heat flow continues till the temperatures of both the hot and the cold body become the same (whose value will be somewhere in between the temperatures of the hot body and the cold body).

Activity

Aim: To show that heat energy flows from a hot body to a cold body

Materials needed: A coin, tongs, boiling water, cold water, and two glasses

Method:

1. Take two glasses and fill them to three-fourths of the capacity with cold water.
2. Boil water in a vessel and drop a coin in the boiling water. Leave it for some time so that the coin gets really hot. Ask an adult to use the pair of tongs to pick up the hot coin and drop it in one of the glasses filled with water.
3. After about 2 minutes, dip your finger in the two glasses, first in the glass without the coin and then in the glass with the coin.

Observation: You will observe that the water in the glass in which the hot coin was dropped will be warmer.

Conclusion: Heat energy has been transferred from the hot body (coin) to the cold body (water).



Measuring Heat

Just as we measure length in centimetres and metres, heat energy (and any other form of energy for that matter) is measured in *calories* or *joules*. In SI system (the international standard of the system of units), heat energy is measured in joules. The symbol used to represent 'joule' is 'J'.

Let's Discuss

Heat and temperature are two different things, but they are closely related to each other. How?

MODES OF HEAT TRANSFER

The methods by which heat is transferred from one region to another are called the *modes of heat transfer*. There are three modes of heat transfer: *conduction*, *convection*, and *radiation*.

Conduction of Heat

AN

Conduction is the primary mode of heat transfer in solids. For conduction to take place, the two bodies should be in contact. Conduction can also happen within a body from one end to the other.

We have seen in earlier examples that metal objects heat up when they come in contact with hot solids or liquids. For example, a stainless steel spoon becomes hot when left in a hot liquid. How do you think this happens? The heat from the hot liquid is transferred to the spoon and is then conducted to the edge of the spoon.

How does Conduction occur?

To understand how conduction occurs, we need to understand that **matter** (which may be solid, liquid or gas) is made up of tiny particles called molecules. These molecules are never still; they are in constant motion. Molecules in a solid are tightly packed and are unable to move around freely. However, they vibrate around a fixed point (Fig. 6.4).

Let us take the example of a solid rod being heated at one end by a candle flame (Fig. 6.5). Heat causes the particles to vibrate faster at the end of the rod in contact with the flame. These particles bump with each other and transfer energy to neighbouring slow-moving particles, which are further away from the flame. The neighbouring particles start vibrating faster and, in turn, pass on energy to their neighbours on the other side. In this way, heat energy gets transferred from one particle to the other. It should be noted that each vibrating particle remains in its original position. This form of heat transfer by actual physical contact is called conduction. It occurs by collisions of neighbouring particles of the body.

Conductors and Insulators of Heat

*Materials that allow heat to pass through them easily are called **conductors**.* All metals are good conductors of heat. However, the rate at which they conduct heat may differ. Let us perform an activity to understand this.

Activity

Aim: To demonstrate that the rate of conduction of heat is different for different metals

Materials needed: Rods of equal diameters and equal lengths made of aluminium and iron (you will find these in your school lab), two wooden slabs, small metal balls, wax, and flame

Method:

1. Take the aluminium rod, and glue the metal balls on it at equal distances, using wax.

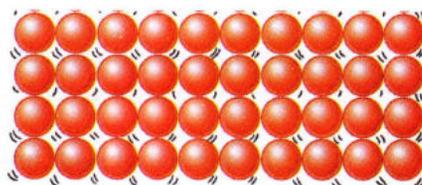


Fig. 6.4 The particles of a solid vibrate about a fixed point

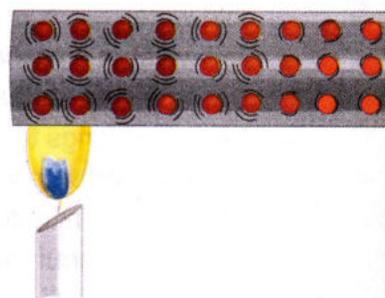
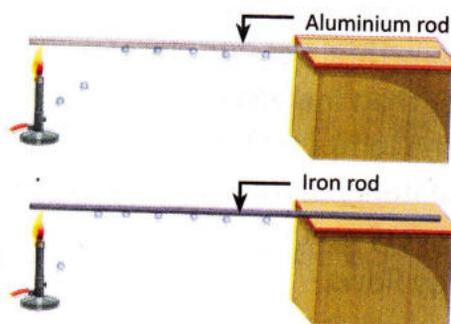


Fig. 6.5 A solid rod being heated at one end

2. Similarly, prepare the iron rod also.
3. Arrange the rods as shown in the figure.
4. Light the burner and note your observations.

Observation: You will see that the metal balls start dropping one by one due to the melting of the wax. The balls drop faster for aluminium and slower for iron.

Conclusion: The rate of conduction of heat is higher for aluminium and lower for iron.



To further understand how conduction takes place in metals, let us go deeper into the structure of the atoms and molecules that make up the metals. We know that molecules of any substance are made up of tiny particles called atoms. Each atom is further made up of a nucleus (*plural: nuclei*) and one or several electrons. A nucleus is positively charged, while electrons are negatively charged. In a metal, the nuclei of the atoms are firmly held in position, and cannot move around freely, though they can vibrate in their positions. Some electrons, however, are loosely held and can move about freely.

Armed with this knowledge, let us again see what happens when one end of a metal is heated. The nuclei and electrons closest to the heat source begin to vibrate faster. The electrons bump with neighbouring electrons and nuclei, and transfer energy to them. This is how conduction of heat takes place in metals. All solids (for example, non-metals) do not have the advantage of loose, free-moving electrons and, therefore, do not conduct heat very well.

*Materials that do not allow heat to pass through them are called **insulators**.* Substances such as wood, straw, clay, rubber, glass and bakelite (a kind of plastic) do not conduct heat very well and are called *insulators*. Air and water are also good insulators. Some materials such as wool, fur, and bird feathers become better insulators by trapping air between their fibres.

Activity

Aim: To show that some materials allow heat to flow through them easily whereas some materials do not (adult supervision required)

Materials needed: Very hot water, tumblers/containers of various materials like glass, plastic, ceramic, stainless steel, copper and paper

Method:

1. Take the help of an adult to pour hot water into cups of different materials.
2. Very lightly, touch each of the cup from the outside. Make sure you do not burn yourself. What do you observe?

Observation: You will find that the stainless steel and copper cups are really hot from the outside. The other cups are warm and quite bearable to touch.

Conclusion: This shows us that even though water in the different cups is at the same temperature, stainless steel and copper allow heat from within the cup to be transferred easily, while other materials, such as glass, plastic, ceramic and paper, do not transmit much heat. So, there are certain materials that allow heat to pass through easily and others that do not.

Have you noticed that you can hold a hot cup of water in a ceramic cup quite easily, but the same hot water in a metal cup will be too hot to touch? Why is this? In general, solids (other than metals) do not conduct heat very well. We have to understand that for us to feel the temperature of the hot water, heat energy has to flow from the hot water through the material of the cup to our hand. Since metals are good conductors of heat, heat energy flows very quickly. However, since ceramic is a bad conductor of heat, not much heat energy flows.

Let us understand another situation. If we pour a very hot liquid like coffee or tea into a thick glass cup, it will crack. This is because glass is an insulator, and when a hot liquid is poured into the glass cup, the inner surface of the cup gets hot and expands, while the outer surface does not (because it is still cold). The uneven heating of the inner and outer surfaces of the glass cup makes it crack. There are, of course, special types of glass and ceramics that can withstand high temperatures. Therefore, when you pour a hot liquid in a thick glass cup or tumbler, make sure it can withstand the high temperature of the liquid.

Practical Applications of Conduction

Both conductors and insulators are useful to us, depending on our needs. We use good conductors (like metals) to make cooking utensils and heat-resistant plastic to make the handles for these vessels. Copper is a better conductor of heat than stainless steel. So, stainless steel vessels are given a copper bottom to make the heating more efficient.

We wear woollens in winter because wool is a bad conductor of heat. Thus, it helps in retaining body warmth. The wool fibre has a series of curls and these are called 'crimps'. These crimps create small air pockets. The greater the number of crimps, the greater is the number of air pockets, which can hold and trap air. Thus, a thin layer of air is created, which insulates us from the cold weather and also prevents body heat from escaping into the surroundings.

Convection of Heat

This mode of heat transfer is seen in liquids and gases in which the molecules are less densely packed and are free to move. Thus, convection is the primary mode of heat transfer in fluids.

Let us see the following example and learn how heat is transferred by convection.

The bottom of a vessel containing water is heated. After sometime, the water at the top of the vessel also becomes hot. How does this happen?

If a vessel containing water is kept on a flame, the water at

Tech Specs

Special insulating materials are used to make jackets for fire fighters and race car drivers.

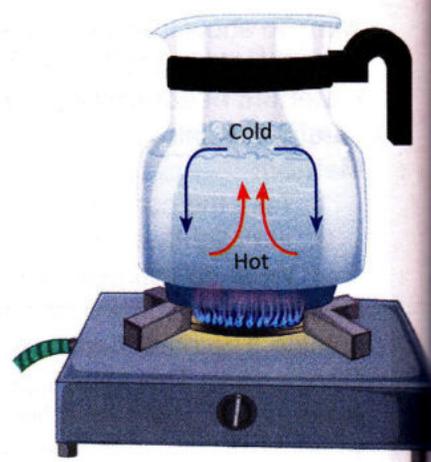


Fig. 6.6 The hot water (red) rises up and the cold water (blue) falls to the bottom

During the day, the warm air above the land rises. The cooler air over the sea flows in to take its place. This gives rise to the *sea breeze* (sometime in the afternoon), which cools the land. In the night, the land cools down much faster than the sea. The warm air above the sea rises up. The cooler air above the land rushes in to take its place. This results in *land breeze*.

Radiation of Heat

Heat energy can travel in the form of waves, just like light. These waves (both heat and light, and many other types of waves) are called *electromagnetic waves*. Energy travelling in this form is called *radiation*. Just like light can travel in different media (such as air and water) and in vacuum, heat radiations can also travel in different media and in vacuum.

All bodies give out energy that travels in the form of radiation (much like light) through space. Energy from the sun reaches us through radiation. Bodies that absorb this radiation become hot.

The amount of heat energy that is absorbed by a body depends on its colour. Bodies that are black absorb more of the radiated heat than white bodies. We feel more comfortable wearing white and light-coloured clothes in summer. This is because white clothes absorb a lesser amount of heat than dark clothes, and therefore keep us cooler.

The reverse applies in winter; we are more comfortable in dark clothes. This is because we need to absorb as much heat as possible from our surroundings to keep ourselves warm, and dark clothes absorb more heat than the light-coloured ones. The reverse is also true. Black and dark bodies radiate more heat than light-coloured bodies.

Activity

Aim: To show radiation of heat (adult supervision required)

Materials needed: A source of heat (such as a room heater or an electric bulb)

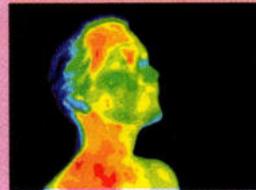
Method:

1. Switch on the room heater or the electric bulb.
2. Wait for a few minutes, and put your hand close to it without touching.

Observation: You will be able to feel the heat of the heater/bulb even when you do not touch it.

Conclusion: Heat energy is reaching your hand from the heater/bulb in the form of radiation.

Fact File



An infrared image

All objects radiate heat energy, and this property is used in infrared photography. This helps us 'see' objects in complete darkness. Some animals can 'see' in the infrared. For example, rattle snakes have special detectors with which they can 'see' in absolute darkness by detecting the heat radiated by warm-blooded animals.

In the above activity, you can confirm that the heat energy reaching your hands is being carried by radiation and not convection. Hold your hand a little below the bulb. The heat that you feel below the bulb is mostly due to radiation as hot air always rises up.

Practical Applications of Radiation

Heat radiations travel in vacuum and in air just like light rays. That is why electric room heaters have mirrors behind the heating coil (Fig. 6.7). This reflects the heat radiated by the heating coil to the front of the heater. This way the heat radiated in the direction behind the heater is not wasted, but redirected to the front.

Solar panels (Fig. 6.8), used in households for heating water, are designed to maximize the absorption of heat from the sun. A black metal sheet is used to increase heat absorption.

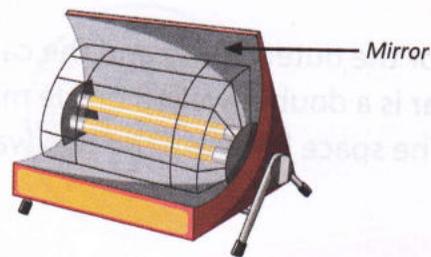


Fig. 6.7 Room heater



Fig. 6.8 Solar panel

Case Study: Solar Energy Initiative in India

A major part of India receives a tremendous amount of energy from the sun almost all through the year. This energy from the sun, called Solar Energy can be used as heat and also converted to Electric Power, which can be used for lighting and other purposes for both rural and urban use. The government of India has initiated several schemes to encourage small businessmen, industries, farmers who can spare large areas of land for solar panels and also to the common man who can use the rooftop of his house for setting up solar panels.



Let's Remember

A. Answer the following questions orally.

1. Which thermometer would you use for measuring the temperature of boiling water—an alcohol thermometer or a mercury thermometer?
2. Does 'land breeze' blow in the morning or in the night (in a place located at the sea coast)?
3. In summers, should we wear dark-coloured or light-coloured clothes to keep cool?

B. Circle the odd one.

1. Radiation, Fire, Convection, Conduction (Hint: Not a mode of transfer)
2. Air, Water, Wool, Stainless steel (Hint: Ability to conduct heat)
3. Alcohol, Mercury, Digital, Celsius (Hint: Not a thermometer)

Preventing Loss of Heat

A thermos flask (Fig. 6.9) is a good example of how heat loss by all three modes of heat transfer, namely, conduction, convection, and radiation is minimized. Let us see how this is done.

Heat loss due to conduction is minimized by using insulating materials (such as plastic)

for the outer casing and the cap of the thermos flask. The inner jar is a double-walled bottle made of glass or stainless steel. The space between the two walls is a vacuum, so that heat

loss due to conduction is minimized. This also reduces heat loss due to convection as there are no air molecules to carry the heat away. Heat loss due to radiation is minimized by making the surface of the jar highly reflective, so that heat radiations are reflected back into the jar.

Fact File

Since the design of the thermos flask is such that it reduces the exchange of heat between the liquid inside the flask and the surroundings, cold liquids in the flask will remain cold for a very long time.

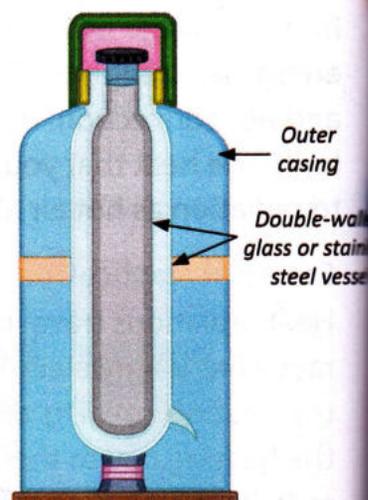


Fig. 6.9 Diagrammatic representation of a thermos flask

Key Words

Temperature	The degree of 'hotness' or 'coldness' of a body is called temperature.
Heat energy	The form of energy that flows from a hot body to a cold body is called heat energy.
Conduction	The primary mode of heat transfer in solids in which heat is transferred within a body or when two bodies are in contact with each other is called conduction.
Conductors	(in this chapter) Substances that conduct heat are called conductors.
Insulators	(in this chapter) Substances that do not conduct heat very well are called insulators.
Convection	The method by which heat is transferred via the mass movement of the liquid or gas itself is called convection.
Radiation	This is a mode of heat transfer that takes place in the form of electromagnetic waves.

Summary

- The thermometer is a device used to measure temperature.
- Generally, mercury is used in thermometers. Liquids such as alcohol are also used.
- Modern digital thermometers are quite accurate and much easier to read.
- Heat is a form of energy. It flows from a body (or region) at a higher temperature to a body (or region) at a lower temperature.
- Heat will continue to flow from the hot body to the cold one till both are at the same temperature.
- Heat energy is measured in calories or joules.
- There are three modes of heat transfer: conduction, convection, and radiation.
- Conduction is the primary mode of heat transfer in a solid.
- Substances that conduct heat easily are called conductors, whereas those that do not, are called insulators.
- The primary mode of heat transfer in a fluid is convection.
- Radiation is the only form of heat transfer that does not necessarily need a medium.
- Bodies that are black absorb more of the radiated heat than white bodies.

Exercises



LET'S UNDERSTAND



QT

I. Objective type questions

A. Write T for the True and F for the False statements. Correct the false statements.

1. The terms 'hot' and 'cold' are relative.
2. On the Fahrenheit scale, the difference between the boiling point of water and the melting point of ice is divided into 100 degrees.
3. Digital thermometers use mercury to measure temperature.
4. Mercury is used in thermometers because it is relatively easy to see because of its red colour.
5. Heat energy is measured in degree centigrade.

B. Choose the correct option.

1. What does temperature measure?
 - a. Degree of hotness of a body
 - b. Degree of coldness of a body
 - c. Volume of a body
 - d. Both a and b
2. What are the commonly used reference temperatures for constructing temperature scales?
 - a. Melting point of wax and boiling point of alcohol
 - b. Melting point of wax and boiling point of water
 - c. Melting point of ice and boiling point of wax
 - d. Melting point of ice and boiling point of water
3. Which of the following statements is true?
 - a. Copper has a higher rate of conduction than iron.
 - b. Iron has a higher rate of conduction than copper.
 - c. Aluminium has a higher rate of conduction than iron.
 - d. Both a and c
4. Which of the following is the reason for sea breeze and land breeze to blow?
 - a. Water heats up much faster than land
 - b. Land heats up much faster than water
 - c. Water and land get heated up equally fast
 - d. None of these
5. Why does an electric heater have a mirror fitted behind its heating coil?
 - a. Mirror is a good conductor of heat
 - b. Mirror is a bad conductor of heat
 - c. To improve convection of heat
 - d. Mirrors reflect heat radiation to the front of the heater

6. What are 'Celsius' and 'Fahrenheit'?
 - a. Scales to measure heat
 - b. Temperature scales
 - c. Different types of thermometers
 - d. Temperature scales used only for mercury thermometers
7. In which thermometer is a 'kink' added?
 - a. Clinical thermometer
 - b. Alcohol thermometer
 - c. Laboratory thermometer
 - d. All of these
8. 'Heat' is a form of what?
 - a. Energy
 - b. Thermometer
 - c. Temperature
 - d. Scale
9. 'Conduction' is the primary mode of heat transfer in which of the following?
 - a. Water
 - b. Solids
 - c. Liquids
 - d. Gases
10. 'Convection' is the primary mode of heat transfer in which of the following?
 - a. Solids and liquids
 - b. Liquids and gases
 - c. Gases and solids
 - d. Only liquids

II. Very short answer type questions

Give one word for the following.

1. The scale in which the melting point of ice and the boiling point of water are taken as 0 and 100, respectively _____
2. The silvery grey liquid used in clinical thermometers _____
3. The breeze that flows from the land to the sea during night time _____
4. The type of waves via which heat and light energy travel _____
5. A unit for measuring heat energy _____

III. Short answer type questions

1. Under what conditions does heat flow from a hot body to a cold body by conduction?
2. Give one advantage of using alcohol as the liquid in a thermometer as compared to using mercury.
3. List two characteristic features of a mercury clinical thermometer.
4. Why wool is a bad conductor of heat?

IV. Long answer type questions

1. Describe a simple experiment which can demonstrate that the terms 'hot' and 'cold' as we feel them are only relative.
2. What are temperature scales? Explain how Celsius and Fahrenheit scales are defined.
3. With the help of diagram, explain the working of a thermos flask.

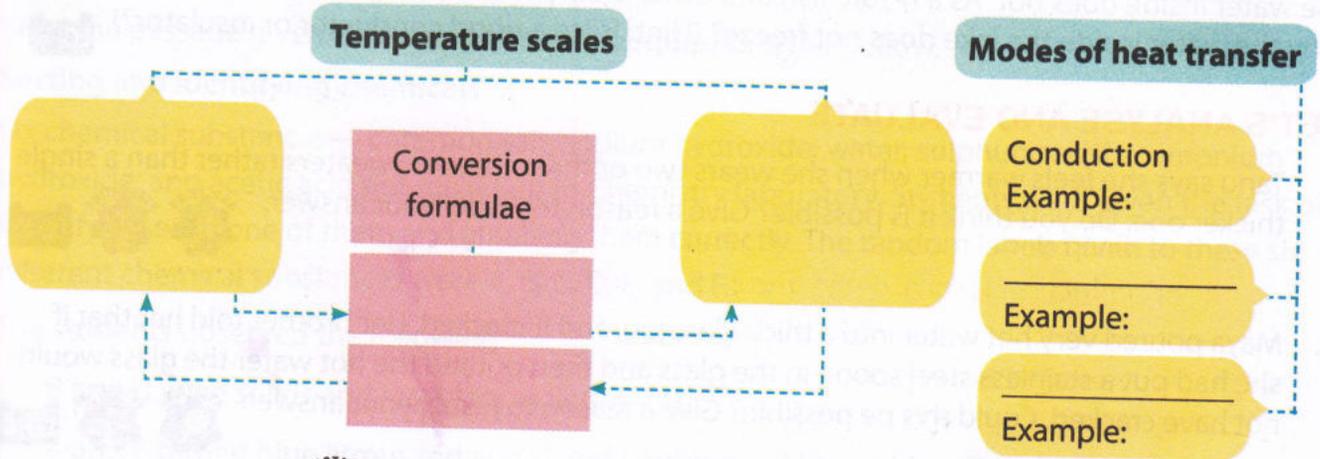
V. Numerical-based questions

1. Express the following temperatures in the Fahrenheit scale.
 - a. 110°C
 - b. 85°C
 - c. 225°C
 - d. 30°C
 - e. 0°C
2. Express the following temperatures in the Celsius scale.
 - a. 131°F
 - b. 77°F
 - c. 149°F
 - d. 32°F
 - e. 23°F

LET'S RECALL



Recall and complete the concept map given below.



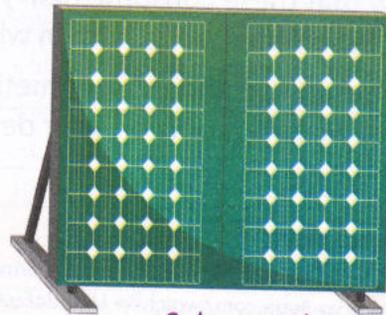
LET'S OBSERVE



Identify what is wrong with the following pictures. Write your answer in the space provided. **LO 13**



Convection current



Solar panel

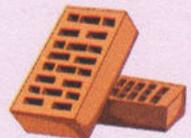


Clinical mercury thermometer

LET'S CONNECT



The clothes that people wear depends on the climate of the place in which they live. In the same way, while designing a building, architects take a lot of special care to take into account the climate of a place. For example, hollow bricks (with air trapped inside) could be used in the construction. This is done as air acts like an insulator and reduces heat transfer across the wall. Can you think of one other material that can be used in the place of air?



What climatic conditions do you think we could address with a clever design of buildings?

LET'S APPLY



In very cold places, when the temperature becomes very low, the surface of lakes freezes while the water inside does not. As a result, fish and other animals can still live in the lake. Can you tell why the water inside the lake does not freeze? (Hint: Is ice a good conductor or insulator?) 

LET'S ANALYSE AND EVALUATE

1. Tanu says she feels warmer when she wears two or three thinner sweaters rather than a single thicker one. Do you think it is possible? Give a reason to justify your answer.   
2. Maya poured very hot water into a thick glass jug, and it cracked. Her brother told her that if she had put a stainless steel spoon in the glass and then poured the hot water the glass would not have cracked. Could this be possible? Give a reason to justify your answer.   

LET'S CREATE





Air conditioners and room heaters seem to have become an integral part of our lives today. But do you know that these consume heavy electricity. How about redesigning a room so that it will remain cool in summers and warm in winters.

Get into groups of five and think of methods to help minimize the use of air conditioners and room heaters. Make a report on your designed model and discuss in the class.

Web Research

Browse the Internet and learn more about thermometers and their working. A suggested website is:
<https://www.youtube.com/watch?v=HPKn14FoXJQ> (accessed and checked on 28/08/19)

Worksheet 2

Skills assessed:

Problem solving, and qualitative analysis

Read the passage given below and answer the questions that follow.

Sorting and identifying chemicals

Six chemical substances— common salt, sodium hydroxide, water, sulphuric acid, ammonium hydroxide, and acetic acid got mixed up in Chemistry laboratory. Students were given the task of identifying each one of them and labelling them correctly. The random labels given to these six different chemical substances were A, B, C, D, E, and F.

The students observed the following:

- B and D were solids and rest were in liquid state.
- A and F turned blue litmus red and D and E turned red litmus blue. B and C did not have any effect on either of the litmus solutions.
- The pH values of these substances were: A—6, B—7, C—7, D—12, E—9, and F—2.

1. Which of the substances were acidic in nature?

2. Which of the substances were basic in nature?

3. Which of the substances were neutral in nature?

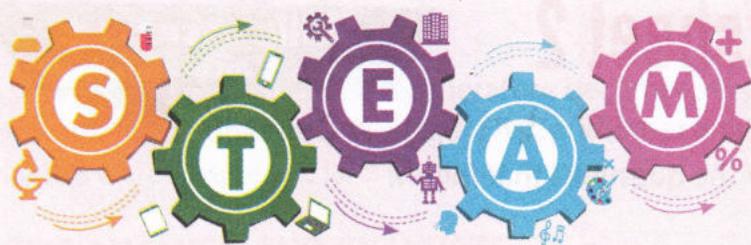
4. Which of them is a:

a. strong acid _____ b. weak acid _____

c. strong base _____ d. weak base _____

5. Identification of these six chemical substances based on observations:

A _____	D _____
B _____	E _____
C _____	F _____



Activity

Skills learnt:

Collaborating, communicating, and critical thinking

Aim: To understand the neutralization reaction between an eggshell and vinegar, and how a coating of wax on the eggshell protects it from reacting with the acid

Materials required: An egg, wax crayons, water, a saucepan, a beaker, burner, and vinegar

Method: In your groups, use the materials given and observe how an acid can dissolve an eggshell but does not react with wax.

Answer the following questions after discussion with your group.

1. Compare the egg that was before the reaction with vinegar and the egg after the reaction.

	Before reaction	After reaction
Appearance		
Is it rigid or flexible		
Can you see the contents that are present inside		

2. Why was vinegar able to dissolve the egg shell?

3. Eggshell is made of calcium carbonate. Complete the word equation for the above reaction.

calcium carbonate + _____ → _____ gas + water + other substances

4. How can we identify the gas released when vinegar reacts with the eggshell?

5. The reaction between eggshell and vinegar is an example of a _____ reaction.

6. The total volume of vinegar required to completely dissolve the shell of an egg is

_____ mL.

7. Explain the process.

*For the Teacher: Please refer to the teacher's manual for more details

7

Unit 3: The World of the Living

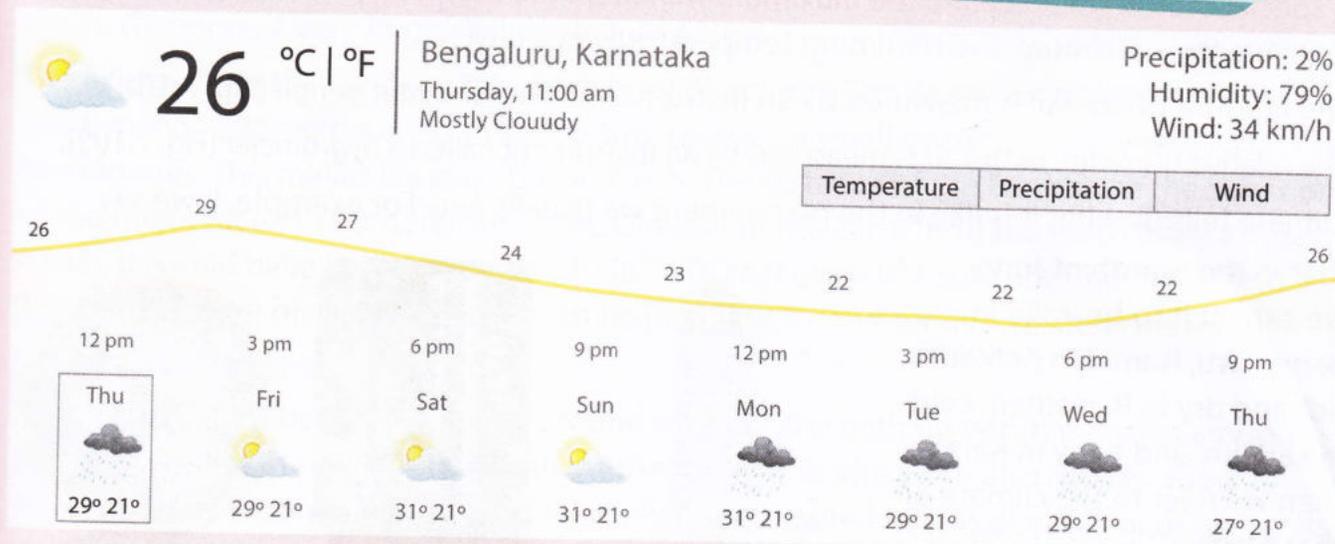
Climate and Adaptation

How is the weather today? Is it hot, cold, rainy or sunny? The weather conditions and forecasts are reported every day in newspapers, TV and on the Internet.

A typical weather report is shown in the figure below. Study the weather report carefully, and answer the questions that follow.

You will learn about

- Weather and climate
- Factors that affect the climate of the Earth
- Adaptations of animals for different climates



1. What place, day and time is the weather report for?
2. What is the prediction for weather?
3. What are the maximum and minimum temperatures for the day?
4. What is the wind speed?
5. What is the humidity recorded in the weather report?

Weather tells us about the changes that take place in the atmosphere at a given place and time. The weather of a place can change within a very short span of time. For example, you could wake up to a very bright and sunny day, and end up with heavy rains in the afternoon.

The climate of a place represents the weather condition of a place over a long period of time. In this chapter, you will learn about weather, climate, the factors they depend on, and how animals adapt to the climatic conditions of their natural habitats.

Answer: 1. Bengaluru, Thursday, 11:00 am. 2. Mostly cloudy. 3. 29°C, 21°C. 4. 34 km/h. 5. 79%

WEATHER AND CLIMATE

The state of the atmospheric conditions such as temperature, humidity, rainfall, snow, cloud cover, and wind at a given place and time is called the **weather** of the place at that time. Temperature, humidity, rainfall, snow, cloud cover, wind, etc., are called *weather elements*. The characteristic pattern of weather elements in a place over a period of time is called the *climate* of the place.

Both weather and climate affect our lives in many ways. Our way of living, the clothes we wear, the crops we grow, the food we eat, and many other things depend on the weather, and subsequently, the climate of the place that we live in.

Weather forecast is a prediction of the weather conditions for a place over a short period of time, say, the next few days. In order to make weather forecasts, scientists known as meteorologist need to monitor the weather elements every day.

A special thermometer called the *maximum-minimum thermometer* [Fig. 7.1(a)] is used to measure the maximum and minimum temperatures in a day.

The amount of rainfall is measured by an instrument called the *rain gauge* [Fig. 7.1(b)].

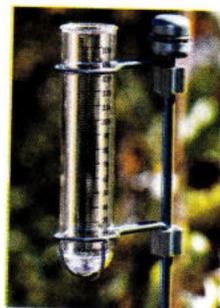
The relative humidity of the air is measured by an instrument called a *hygrometer* [Fig. 7.1(c)].

Climate tells us what it is like in the place where we usually live. For example, if we say that in the month of June, we expect it to be mild in Bengaluru, humid in Kolkata, hot and dry in Rajasthan, cold in Ladakh, and rainy in Kerala, then we refer to the climate of that place.

Let us take a look at some of the factors that affect the climate of the Earth.



(a) Maximum-minimum thermometer



(b) Rain gauge



(c) Hygrometer

Fig. 7.1 Specially designed instruments for weather forecast

FACTORS THAT AFFECT THE CLIMATE OF THE EARTH

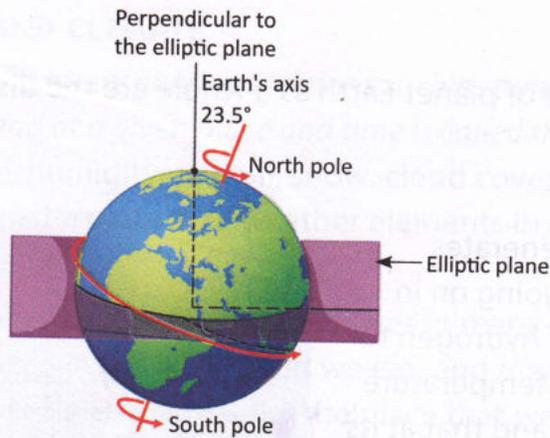
AN

The climate of the Earth has not remained the same through the ages. There have been periods when it has been extremely cold, as in the Ice Ages, when large areas of the Earth's surface were covered with ice.

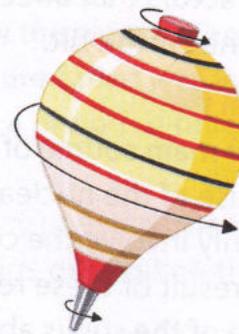
With the advance in science and technology and powerful computers, scientists are now able to **simulate** the Earth's climate using a simplified model and study how various factors affect it. The study of climate is fast emerging to be a very exciting and challenging field of science.

Word help

Simulate To create a similar model or situation



(a) Earth with its axis of rotation



(b) Spinning top

Fig. 7.2 Rotation of Earth can be compared to a spinning top

It is important to understand that it is because of this tilt and the Earth's revolution around the sun that we have seasons on the Earth (Fig. 7.3).

From 21st March to 23rd September, the northern hemisphere is closer to the sun. So, it is hotter than the southern hemisphere, which is farther away from the sun. The reverse happens in the next half of the orbit.

Tech Specs

The longest day of the year falls on the summer solstice. It happens on the 21st or the 22nd of June. The shortest day of the year falls on the winter solstice. It comes on 21st or 22nd December. When the Sun's rays illuminate both the northern and southern hemisphere equally, it is called an equinox.

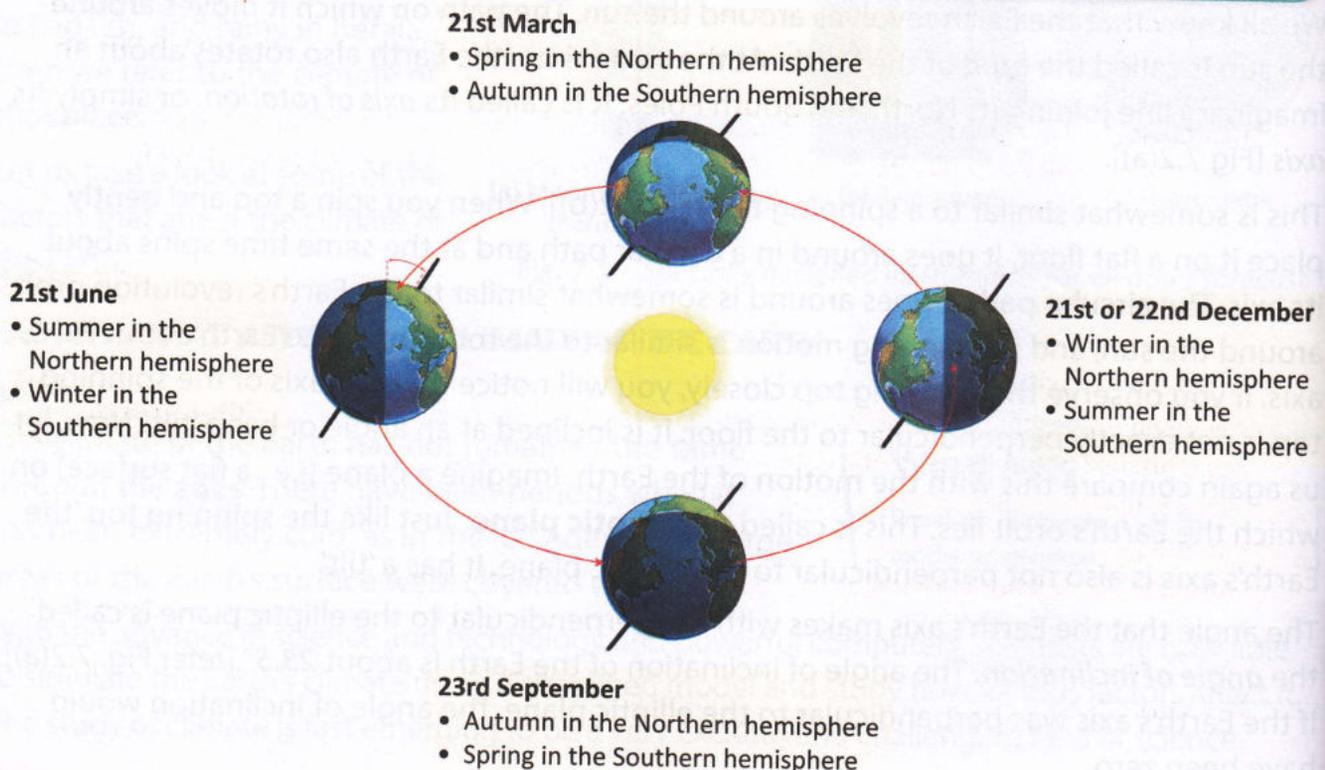


Fig. 7.3 Change of seasons on Earth

Sunrise and Sunset

The length of a day is given by the difference in the times of the sunrise and sunset. It does not remain the same throughout the year because the area of the Earth's surface lit by the sun varies due to the Earth's tilt and its position in its orbit around the sun. In the Northern hemisphere, the longest day of the year is around 22nd June and the shortest day is around 22nd December.

Fact File

There is only one sunrise and one sunset per year at the Poles. The approximate dates are as follows.

North Pole

Sunrise: 21st March,

Sunset: 21st September

South Pole

Sunrise: 21st September,

Sunset: 21st March

Activity

Aim: To plot a graph of changes in the length of the day

Materials needed: A centimetre graph sheet, data from your local newspaper for at least a month, a sharp pencil, and an eraser

Method:

1. Note the times of sunrise and sunset every day from the daily newspaper for at least a month.
2. Plot the sunrise and the sunset times on the y-axis and the date on the x-axis.
3. Join the points plotted for the sunrise times by hand (you will get a slightly curved line), and separately join the points for the sunset times.
4. Colour the space between the sunrise and sunset lines with yellow- or orange-coloured pencil.
5. You can use the Internet to choose any city on the globe and plot the sunrise-sunset graph for it. Choose a city close to the Equator and a city close to the North/South Pole and plot the graphs.

Observation: You will find that through the year, the sunrise and sunset times vary. The places closer to the poles have a larger variation in sunrise and sunset times as compared to places closer to the equator.

Conclusion: This large variation in the length of the day that you see between the places close to the poles and places close to the equators happens because of the Earth's tilt.

Let's Remember



Fill in the blanks with the correct words.

1. The weather forecast predicts the weather of a place for the next few _____ (days/years).
2. The diameter of the Earth is about twelve _____ (thousand /million) kilometres.
3. Temperature, humidity, rainfall, cloud cover, etc. are called _____ (Earth/weather) elements.
4. A hygrometer is used to measure _____ (rainfall/relative humidity).
5. The climate of the Earth _____ (has/has not) remained the same through the ages.
6. The Earth's tilt is about _____ (23.5°/90°).
7. The Earth rotates about its _____ (equator/axis).

the bottom of the vessel gets hot. Since, hot water is lighter than cold water, it rises up carrying the heat energy with it (Fig. 6.6). The colder and denser water on the top falls to the bottom of the vessel and gets heated in its turn. This process continues and results in a circulating stream of hot and cold water. As a result, all the water in the vessel gets heated. This method by which heat is transferred by the mass movement of the liquid or gas itself is called *convection*.

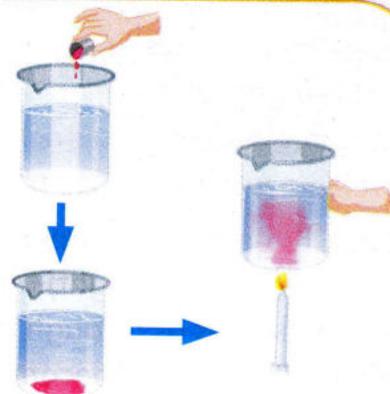
Activity

Aim: To show that heat transfer in water is due to convection

Materials needed: A beaker made of heat-resistant glass/glass test tube, candle, match box, potassium permanganate crystals/artificial food colouring, and a spoon

Method:

1. Fill the beaker to the halfway mark with clear water.
2. Take a pinch of the potassium permanganate crystals/food colouring and drop it gently to the bottom of the beaker.
3. Let it settle for a few minutes.
4. You will see that the water at the bottom of the beaker is coloured, but the water at the top is quite clear. Light the candle and pick up the beaker very gently and hold it on top of the candle flame.



Observation: You will see columns of coloured liquid rise up in the beaker.

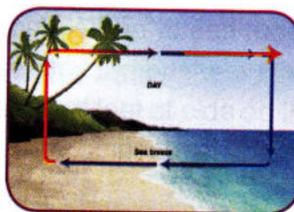
Conclusion: This is due to convection. Water molecules at the bottom get heated and rise up, carrying the heat energy with them.

Practical Applications of Convection

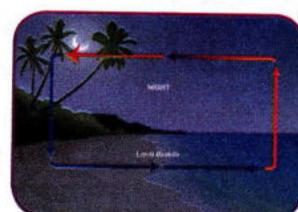
The principle of convection of heat can be used in many applications. When you want to warm a fluid, you should warm it from below. If a room has to be warmed with a room heater, the heater should be placed at a lower level, so that the room gets warmed evenly. Similarly, an air conditioner used for cooling a room should be placed at a higher level. In earlier times, windows and ventilators were designed such that the buildings were kept cool in summers. If you visit any old building, look out for these special features.

Sea breeze and Land breeze

Convection plays a major role in maintaining a moderate temperature in places near the sea. Land masses (beaches, coastal towns, or cities) heat up much faster than water bodies (seas, oceans) during daytime, and cool down much faster during the night. This difference in temperature sets up a wind pattern.



Sea breeze



Land breeze

Climate of a Place

On the Earth, the climate of a place depends on many factors such as the distance from the equator (latitude), height above the sea level, distance from the sea and mountains, and so on.

Distance from the Equator (Latitude)

Places closer to the equator are warmer than the places closer to the poles. For example, it is much warmer in India (on an average, not taking into account exceptions such as the higher reaches of the Himalayas) than Greenland. This is because the sun's rays fall directly on the equator and at an angle on the poles. See Figure 7.4.

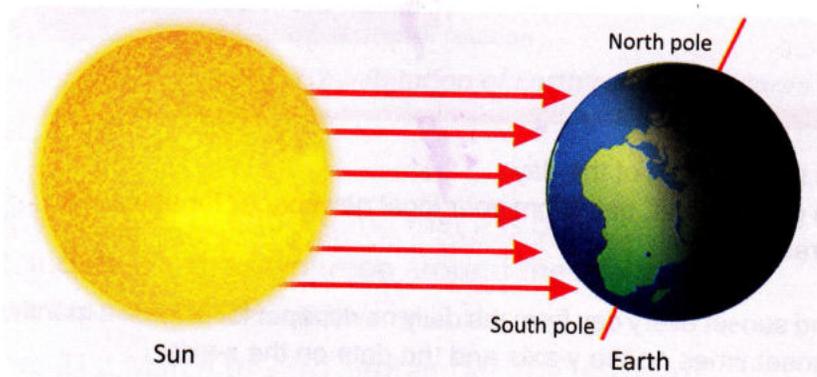


Fig. 7.4 Sun's rays falling on the Earth

Tech Specs

The Earth's climate is extremely complex. Places at higher latitude are not always colder than places at lower latitude. Wind and ocean currents also play a role in determining the climate of a place.

Height Above Sea Level and Distance from the Sea and Mountains

Why do people visit hill stations during summer? They do so because hill stations have a cooler climate than the plains. The higher a place is, the cooler it is. *The height of a place above sea level is called altitude.*

The sea has a moderating influence on the climate of a place. The places near the coast, such as Mumbai, Chennai, and Kolkata, are neither too hot nor too cold. On the other hand, places far away from the sea tend to have extreme climates with very hot summer and very cold winter. The Himalayas also affect the climate of North India.

Mountains can change or even stop winds and also influence the rainfall in a place.

Weather of a Place

Among other factors, the weather of a place is influenced by the temperature and humidity of that place.

Temperature

The temperature on any day depends (among other factors) on the amount of sunlight received. It is generally cooler during the nights than in the day time. One of the main reasons for this is that during the day, the rays of the sun heat up the Earth. Temperatures may be many degrees higher in urban areas than in rural areas because of various factors such as pollution, higher density of people and houses, less number of trees, etc.

Activity

Aim: To plot a graph of daily changes in temperature

Materials needed: A centimetre graph sheet, temperature data from your local newspaper for at least ten days, and red and blue pencils

Method:

1. Note down the date and the maximum and minimum temperatures from the newspaper for ten days.
2. On a graph sheet, plot the date on the x-axis and the corresponding maximum temperatures on the y-axis.
3. Join these points with a red pencil to get the maximum temperature graph.
4. Repeat Step 2 for the minimum temperatures. Now join the points with the blue pencil to get the minimum temperature graph.

Observation: A curved graph is obtained.

Conclusion: The curved graph indicates that the maximum and minimum temperatures vary from one day to the next. Sometimes, it may be about the same for a few days, but it definitely varies. Also, make a note of the season during which you are collecting the data. How do you think the maximum and minimum temperature will vary during the course of the year?

Humidity

The amount of water vapour present in the atmosphere determines *humidity*. A drier place will have lower humidity. Places near the sea coast, such as Kolkata and Mumbai, generally have greater humidity than places far away from the sea, such as Delhi and Uttar Pradesh. Humidity of a region is usually higher in the rainy season than during summer and winter.

Activity

Aim: To plot a graph on daily changes in humidity

Materials needed: A centimetre graph sheet, data from your local newspaper for at least ten days, a sharp pencil, and an eraser

Method:

1. Note the humidity content given in the weather report of your daily newspaper for ten consecutive days.
2. Plot the date on the x-axis and the humidity on the y-axis.
3. Note down the trend that you observe in your graph.

Observation: A curved graph is obtained.

Conclusion: Humidity is not the same every day. Sometimes it is low and sometimes high. Now, browse the Internet and find out the value of the humidity on a particular day for about ten different cities. Try to choose cities from different locations, like a coastal city, a city at a high altitude, a city in a desert, etc.

Climate of the Earth as a Whole

Some of the factors that affect the climate of planet Earth as a whole are the distance from the sun and the Earth's tilt.

Distance from the Sun

The sun is our main source of energy. It generates energy because of the nuclear reactions going on in it, which mainly involve the conversion of hydrogen to helium. As a result of these reactions, the temperature at the surface of the sun is about 5000°C , and that at its core is much more, at around 15 million $^{\circ}\text{C}$. This makes it very hot and very bright. The sun has a diameter of about 1.39 million kilometres. Compare this with the diameter of the Earth, which is around 12,700 km. The sun is, therefore, a very huge and hot ball of gases!

Get it Right

Distance from the sun alone does not determine the hotness and coldness of a planet. For example, even though Venus is farther away from the sun than Mercury, it is hotter than Mercury. This is because Venus has a thick atmosphere of carbon dioxide.

The energy from the sun is radiated out in all directions. The Earth, which is about 149.6 million kilometres away from the sun, receives a small portion of the energy that the sun radiates. This makes life possible on Earth. The distance of the Earth from the sun is one of the major factors that determines the climate on the Earth. Had the Earth been a little closer, it would have been too hot and a little farther away it would have been too cold. The temperature on the Earth seems to be just right for the survival of lifeforms on it.

Earth's Tilt (or Inclination)

We all know that the Earth revolves around the sun. The path on which it moves around the sun is called the *orbit* of the Earth. At the same time, the Earth also rotates about an imaginary line joining its North and South Poles. It is called its *axis of rotation*, or simply its *axis* [Fig 7.2(a)].

This is somewhat similar to a spinning top [Fig 7.2(b)]. When you spin a top and gently place it on a flat floor, it goes around in a circular path and at the same time spins about its axis. The circular path it goes around is somewhat similar to the Earth's revolution orbit around the sun, and its spinning motion is similar to the rotation of the Earth about its axis. If you observe the spinning top closely, you will notice that the axis of the spinning top is not exactly perpendicular to the floor. It is inclined at an angle or has a 'tilt'. Now, let us again compare this with the motion of the Earth. Imagine a plane (i.e., a flat surface) on which the Earth's orbit lies. This is called the **elliptic plane**. Just like the spinning top, the Earth's axis is also not perpendicular to the elliptic plane. It has a 'tilt'.

The angle that the Earth's axis makes with the perpendicular to the elliptic plane is called the **angle of inclination**. The angle of inclination of the Earth is about 23.5° [refer Fig. 7.2(a)]. If the Earth's axis was perpendicular to the elliptic plane, the angle of inclination would have been zero.

Present your data in the form of a table as shown below.

Date and time	Place	Humidity	Season	Type of place
05-04-19, 7:00 pm	New Delhi	25%		
05-04-19, 7:00 pm	Chennai	69%		
05-04-19, 7:00 pm	Jaipur	8%		

You can add as many places as you want, and also any city in the world! You can make a similar table for temperature too!

What are your observations? What conclusions can you draw from your observations?

We have seen that the weather and climate vary from place to place. While some places on the Earth have mild and comfortable climate, other places can have harsh climatic conditions. Despite this, we see that people, animals and plants live under these different climatic conditions. This is because the organisms 'adapt' themselves to live under the climatic conditions of their locations.

ADAPTATIONS IN ANIMALS FOR DIFFERENT CLIMATES

LL

Climate differs from place to place. That is why, animals have special characteristics that enable them to live in a particular climate. These special characteristics are called adaptations.

Adaptations can be defined as changes in the structure or behaviour of an organism that allow it to survive in a particular habitat.

Hot and Dry (Desert-like) Climates

In hot and dry climates, water is scarce, and animals need adaptations to conserve water. Here, most animals get water from the plants they eat, particularly *succulent* (fleshy and juicy) ones such as cactus. Some animals also get water from fluids of the bodies of animals they eat. Let us look at some of the ways by which animals adapt to the hot and dry climate.

Camels

- Camels have long eyelashes, ear hair, and nostrils that they can close, to keep the sand out when the wind blows.
- They have thick eyebrows that provide shade from the bright Sun.

Migration

Migration is an interesting activity observed in certain birds and animals. It involves mass movement of birds or animals from one place to another in response to a seasonal change. They migrate to avoid unfavourable climatic conditions or food availability. They come back to their native place once the favourable conditions return. Some birds and animals even migrate to breed.

- Their wide feet help them to walk on sand without sinking into it (Fig. 7.5).
- The hump of a camel is a reservoir of fatty tissue. A camel can go a week or more without water, and it can last for several months without food.
- Camels have thick lips which help them to feed on prickly desert plants without hurting themselves.
- Unlike most mammals, a camel can withstand body temperature changes throughout the day from 34°C to 41.7°C (93°F–107°F). This allows the camel to conserve water by preventing sweating as the environmental temperature rises.

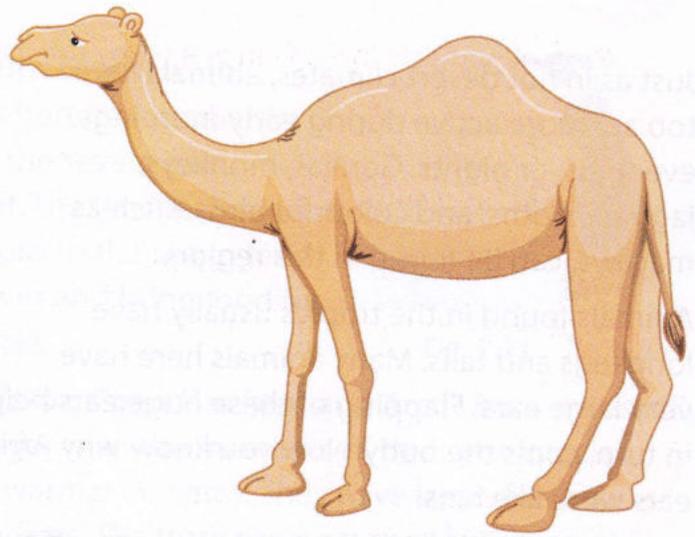


Fig. 7.5 Camel

Reptiles and birds excrete metabolic wastes in the form of uric acid, an insoluble white compound, wasting very little water in the process.

Kangaroo rats (Fig. 7.6) live in burrows, which they seal off to block out midday heat and to recycle the moisture from their own breathing. They are active only during the morning and evening to escape the scorching heat. The amazing fact about these animals is that they do not drink water. They get all their food and water requirements by digesting dry seeds.

Green corner

Some scientists believe that dinosaurs, which once roamed the Earth, died and became extinct because they could not adapt to the changing climate. We should work to keep the climate stable or other species might go extinct.



Fig. 7.6 Kangaroo rat

Various species of desert-dwelling ground squirrels and toads remain dormant, sleeping away the hottest part of the summer.



Fig. 7.7 Fennec

Fennecs (Fig. 7.7) are *nocturnal* in nature, only searching for food at night when it is less hot. During the day, the fennec keeps to its den with other foxes. Its long ears help it to dissipate heat.

Hot Tropical and Temperate Climates

It is hot and humid in the tropics and quite warm in the temperate regions. Hence, animals found in the tropics have adaptations mainly for regulating temperature and for faster evaporation of water, so that it does not get too sticky and uncomfortable. Evaporation of water from the body leaves a cooling effect. These animals induce faster evaporation by active sweating, panting, and licking.

Just as in hot desert climates, animals here too are more active during early mornings, evenings, or nights. Gorillas, monkeys, jaguars, sloths, and colourful birds, such as macaws, can be found in this region.

Animals found in the tropics usually have long legs and tails. Many animals here have very large ears. Flapping of these huge ears helps blow air that cools the blood and that, in turn, cools the body. Now you know why African elephants have such huge ears. These ears work like fans.

Leaf insects (Fig. 7.8) and stick insects (Fig. 7.9) are shaped or coloured to match their surroundings. This is called *camouflage*. It makes them harder to spot.

Let's Discuss

Most animals found in the tropics have large ears. Why?

As there are many types of animals in this region, the competition for food is intense. Many animals have adapted by learning to eat food rarely eaten by others thus reducing competition. Several animals, such as monkeys, live on trees. This keeps them safe from the predators that live on the ground.

Extremely Cold Climates

Animals that live in cold areas usually have adaptations to keep their bodies warm by layers of fat deposits. They take on the temperature of the water, which is usually stable. Some large fish and mammals keep their bodies warm by excessive muscular activity and thick, waterproof fur.

Polar bears

- Polar bears (Fig. 7.10) and many other animals, such as seals, whales, and walruses, have a thick layer of fat called *blubber* under their skins, which keeps their bodies warm and insulated from the cold.
- The white fur of the polar bear acts as a good insulator against the cold. It further helps the animal to camouflage itself from its prey, thus enabling it to hunt well both on land and in the water.
- Female polar bears dig dens in the snow where they might *hibernate*, i.e., remain inactive or dormant, during the worst part of the winter. This allows them to survive without food or water during the cold winter season. The fat stores of the body get converted into energy for the body to function during hibernation. The cubs are born in the den.



Fig. 7.8 Leaf insect



Fig. 7.9 Stick insect

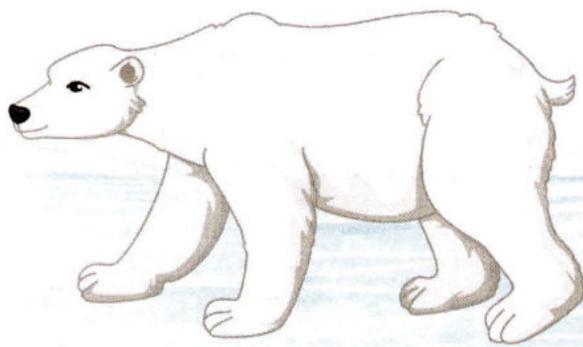


Fig. 7.10 Polar bear

Penguins (Fig. 7.11) huddle together in groups to stay warm and fight their enemies. The male penguins huddle together to protect the eggs (laid by the females) from the severe cold. If exposed to the cold, the eggs get destroyed. The female penguins



Fig. 7.11 Penguin

Let's Discuss

Bring pictures of different animals and have a discussion in class about the various features that have helped them adapt to their environment.

then return to the sea to feed themselves and bring food for their chicks.

The **Arctic fox**, **Canadian lynx**, and **Arctic hare** are usually much larger than the members of the same species living in warmer climates. They have large, furry paws and furry ears. The furry paws act as snow shoes and help them to move in the snow easily. The furry ears

help to keep the cold out.

Arctic birds such as the *ptarmigans* (Fig. 7.12) have feathers up to their feet, to keep their bodies warm. These ptarmigans stay in the Arctic all year, whereas, some birds such as snow geese and Arctic terns migrate to warmer regions during the winter and return only after the summer begins to settle in.



Fig. 7.12 Ptarmigan

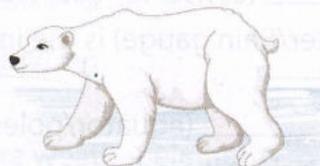
Let's Remember



Name the habitat and one adaptation of each of the following animals.



Habitat: _____
Adaptation: _____



Habitat: _____
Adaptation: _____



Habitat: _____
Adaptation: _____

Key Words

- Weather** Changes that take place in the atmosphere at a given place and time make up the weather of that place.
- Climate** The characteristic pattern of weather elements over a period of time is called climate.
- Angle of inclination** The angle that the Earth's axis of rotation makes with the direction perpendicular to the plane of the Earth's orbit around the sun is called the angle of inclination.
- Adaptations** Adaptations are changes in the structure or behaviour of a species that allow it to survive in a particular habitat.

Summary

- The climate of the Earth depends on the distance from the sun, altitude, latitude, and humidity.
- The tilt of the Earth's axis of rotation with respect to the plane of its orbit around the sun causes seasons on the Earth.
- The climate is warmer at places closer to the equator than the places closer to the poles.
- Many animals in hot and dry climates remain dormant, sleeping away during the hottest part of the summer.
- It is hot and humid in the tropics and quite warm in the temperate regions.
- Animals that live in cold areas usually have adaptations to keep their bodies warm by layers of fat deposits, etc.
- Some large fish and mammals in cold climates keep their bodies warm by excessive muscular activity and thick, waterproof fur.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

1. In hot and dry climates, water is _____ (scarce/abundant) and animals need adaptations to _____ (conserve/ use) water.
2. _____ (Hygrometer/Rain gauge) is the instrument used to measure the amount of rainfall.
3. Places closer to the _____ (equator/poles) are generally hot.
4. Fennecs have long ears to help it in _____ (conserving /dissipating) heat.
5. In Polar Regions, animals adapt to conserve _____ (water/body heat) to stay warm.

B. Choose the correct option.

1. What are humidity, rainfall, snow, cloud cover, etc. called?
 - a. Weather predictions
 - b. Weather
 - c. Weather elements
 - d. Weather and climate
2. What is the climate of the Earth as a whole (as against different points on the Earth) determined by?
 - a. Distance of the Earth from the sun
 - b. The distance from the Earth's equator
 - c. The Earth's tilt
 - d. Both a & c
3. Which of these places could be expected to have a lower humidity?
 - a. Chennai
 - b. Kolkata
 - c. Jaipur
 - d. Mumbai

4. What is the approximate distance of the sun from the Earth?
 - a. 149 million km
 - b. 149 km
 - c. 149 thousand km
 - d. 149 thousand m
5. What does a maximum-minimum thermometer measure?
 - a. Maximum and minimum humidity
 - b. Maximum and minimum temperature
 - c. Maximum and minimum rainfall
 - d. Maximum and minimum wind speeds
6. What would 69% represent on a weather report?
 - a. Wind speed
 - b. Temperature
 - c. Humidity
 - d. Time of sunrise
7. Which of these help to induce a faster evaporation from the animal body for a cooling effect?
 - a. Active sweating
 - b. Panting and licking
 - c. Flapping long ears
 - d. All of these
8. Which of these animals are shaped or coloured to match their surroundings?
 - a. Leaf and stick insects
 - b. Monkeys and gorillas
 - c. Fennecs and kangaroo rats
 - d. All of these
9. In which of these ways do animals get adapted to their habitat?
 - a. Body shape and size
 - b. Body functions
 - c. Animal behavior
 - d. All of these
10. Which of these is the main reason why penguins huddle together?
 - a. To survive without food or water during the cold winter season
 - b. To help them move in the snow easily
 - c. To stay warm and fight their enemies
 - d. To lay eggs

II. Very short answer type questions

Give two examples for the following.

1. Weather elements _____
2. Instruments used to measure weather elements _____
3. Places that have extreme climates _____
4. Animals found in tropical and temperate climates _____
5. Arctic birds that migrate to warmer regions during winter _____

III. Short answer type questions

1. Name two factors that affect:
 - a. the climate of a planet as a whole
 - b. the temperature of a place
2. What are the factors of climate that could be affected by the presence of a mountain near a place?
3. What would be the climate of a place if it is located close to the sea?
4. Why do some birds living in extremely cold climates show migration?

IV. Long answer type questions

1. How does the distance from the equator of a place affect its climate?

- Give any five adaptations that help the camel to survive in hot and dry climates.
- What helps polar bears survive in extremely cold climates?

LET'S RECALL



Recall and complete the concept map given below.

Factors that affect the climate of the Earth

Climate of the Earth as a whole

- _____
- _____
- _____

Climate of a place

- _____
- _____

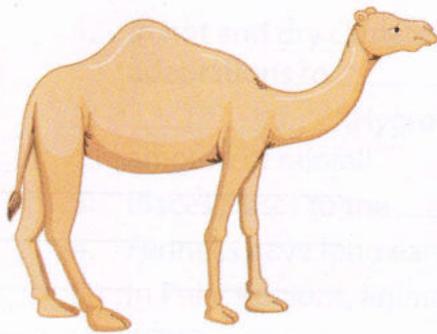
Weather of a place

- _____
- _____

LET'S OBSERVE



- Name the animal and write one characteristic adaptation that each of them shows to survive in its habitat.







- Look at the pictures and answer the questions. **LO 4**

- Which of these is better suited to live in the Arctic? Circle it.
- How does its feet help it to survive in the Arctic?
- How does its coat help it to survive in the Arctic?



8

Soil

Radha took a handful of soil and placed it under a lit table lamp. List any six different things that are found in soil.



You will learn about

- Soil formation
- Soil profile
- Composition of soil
- Types of soil
- Properties of soil
- Soil suitability for crops
- Soil erosion
- Soil pollution

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

As you can see from the picture above, soil is not just a layer of dirt and mud. It is actually filled with life. There are a variety of insects, reptiles, and many other animals living right under our feet! Soil also provides the vital nutrients required for plants to grow and thrive. Thus, all living organisms depend directly or indirectly on soil. Let us learn more about soil.

Answers: Ants, beetle, earthworm, small stones, dried leaves, small twigs

SOIL FORMATION

AN

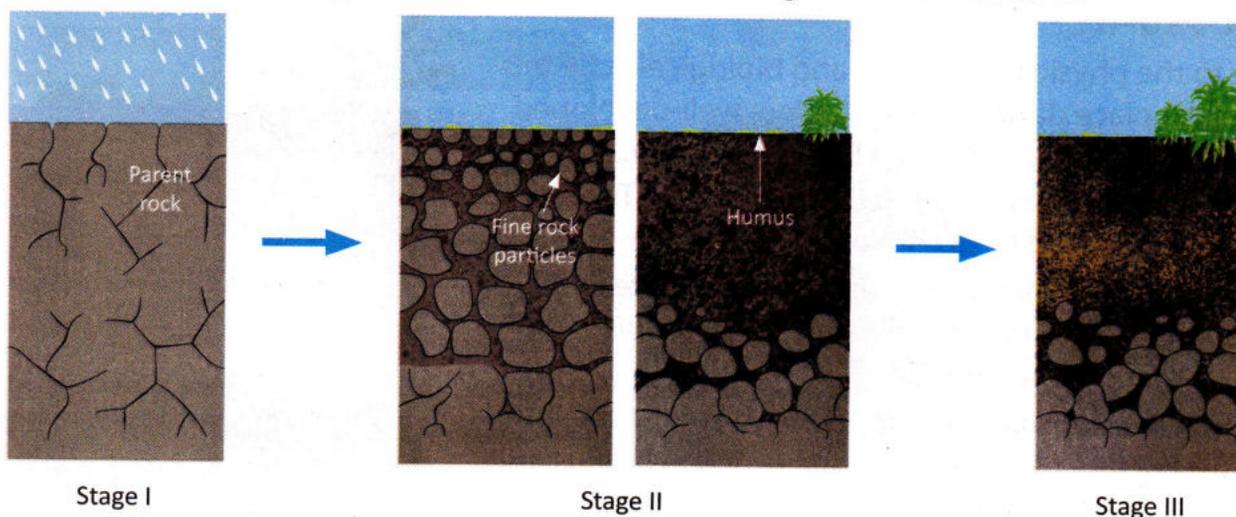
The uppermost layer of the Earth's surface is called **soil**. It is usually composed of a thin layer of sand, mud, and rock particles. Soil contains minerals and a layer of dead and decayed plant and animal remains called **humus**.

Soil formation (Fig. 8.1) is a slow, stepwise process. It takes thousands of years to form a thin layer of soil. It is a result of continuous breaking down of rocks by a process called weathering. **Weathering** is the disintegration (breakdown) of rocks on the Earth's surface caused by exposure to natural forces such as wind, water, frost, roots of plants, etc. Weathering is of two types: *physical* and *chemical*.

Physical Weathering In this process, rocks are broken down to form smaller pieces. It is a mechanical process and does not involve any change in the characteristics of the original rock. It may be caused by temperature differences, frost, growing roots of plants, movement of animals, etc.

Chemical Weathering It is a process in which the existing minerals are broken down into new mineral components. In this process, the chemical nature of the rock changes. Water is one of the main agents of chemical weathering.

The process of weathering can be divided into three stages as shown below.



Weathering, be it physical or chemical, causes large pieces of parent rock near the surface to disintegrate into smaller ones.

Smaller rocks continue to undergo further weathering, thus allowing a very fine layer of rock particles to form at the surface of the Earth. Bacteria and other microorganisms break down plant and animal remains to add humus to it. This makes the soil fertile and rich in organic materials and minerals, which are vital to plant growth.

Minerals and salts seep deeper into the ground along with water to complete the formation of soil and make it favourable for plant growth.

Fig. 8.1 Stages of soil formation

Factors Affecting Soil Formation

There are a number of factors that affect soil formation, namely, climate, characteristics of the parent rock, and slope of land.

Climate Climatic factors or agents of weathering, such as temperature, rain, and wind, play an important role in loosening and breaking up rocks (physical weathering). Water in rock crevices expands when it freezes, hence, increasing the pressure and causing the rocks to crack. Rocks are also worn down by wind.

Soil formation is fastest in hot, moist climates and slowest in cold, dry climates. In the warm and wet tropics, bacterial activity is high. As a result, soil in these areas have a rich content of humus. On the other hand, desert regions have very little vegetation and animal life, and so limited decaying material is available for the soil. The lack of rainfall leads to the formation of coarse-textured soil in dry and arid regions. In areas that experience severe winter, bacterial activity is very slow causing dead plant and animal matter to build up. Therefore, soil in such places forms very slowly. Thus, the rate of soil formation and the type of soil formed depends on the climate of a place.

Characteristics of the parent rock The composition of the parent rock also determines the kind of soil formed. For example, if the parent rock is rich in calcium, the soil formed by its weathering would be rich in calcium, too.

Slope of land The physical features of a place play an important role in the formation of soil. Hilly areas generally have a thin layer of soil because running water and wind tend to carry the soil down the slope. On flat plains, soil remains relatively undisturbed leading to the formation of a thick layer.

SOIL PROFILE

Due to the physical, chemical, and biological activities that take place during soil formation, well-developed layers of soil are formed, one below the other. Typically, four distinct soil layers can be seen (Fig. 8.2). These layers are referred to as *horizons*.

A vertical section of soil from the ground surface to the parent rock that shows the different layers of soil or the horizons is called **soil profile**.

A horizon or topsoil is the uppermost layer of soil. It consists of fine particles. It is usually rich in humus and, therefore, dark in colour. It is soft, porous, and can hold water. *O horizon* lies just above the topsoil and is rich in organic matter.

B horizon or subsoil is rich in minerals that seep down along with water. It also contains compactly packed fine particles of soil.

C horizon contains partly weathered pieces of rock. It is usually characterized by cracks and crevices. It is very difficult to dig beyond this layer.

R horizon or bedrock is the lowermost layer and mainly consists of the parent rock. The properties of this rock greatly determine the composition of the soil.

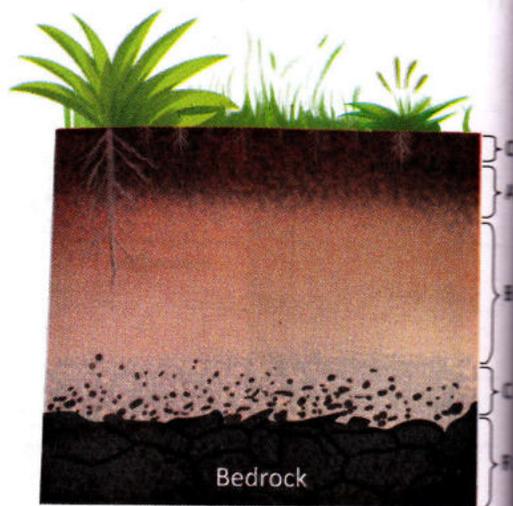
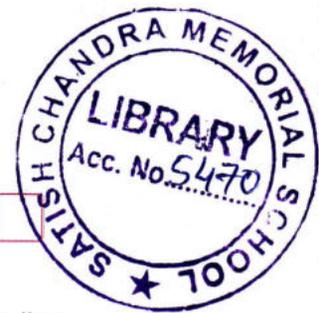


Fig. 8.2 Soil profile

Let's Remember



A. Number the pictures from 1 to 3 to arrange the stages of soil formation in order.



B. Give one word for the following.

1. This process causes large pieces of parent rock to break into smaller pieces of rock _____
2. Dead and decayed plant and animal remains that get mixed with the soil _____
3. In this process the existing minerals are broken down into new mineral components _____

COMPOSITION OF SOIL

The main constituents of soil are *water, sand, clay, silt, pebbles,* and *humus* (Fig. 8.3). Table 8.1 gives the particle size of some of these constituents. The differences in the proportion of these constituents leads to the formation of different kinds of soils.

Table 8.1 Particle size of constituents

Particle	Diameter (in mm)
Clay	Less than 0.002
Silt	0.002–0.05
Sand	0.05–2.00
Fine pebbles	2.00–5.00
Medium-sized pebbles	5.00–20.00
Coarse pebbles	20.00–75.00

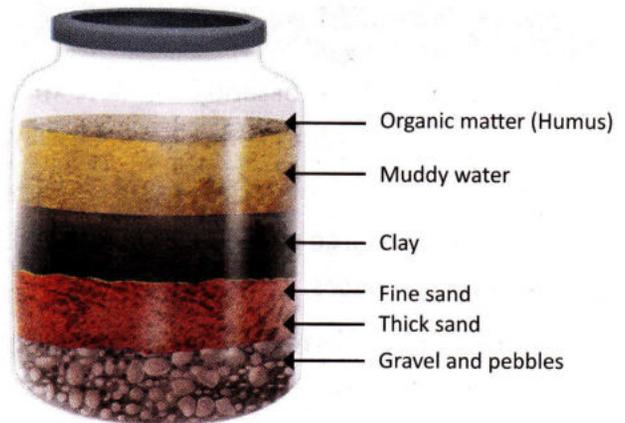


Fig. 8.3 Composition of soil

Activity

Aim: To separate the various constituents of a soil sample into different layers

Materials needed: Soil sample, beaker, glass jar, and water

Method:

1. Take two-three handfuls of soil from a nearby garden. Mix it with a glass of water in a beaker.
2. Stir the mixture well and pour it into a glass jar.
3. Allow it to stand undisturbed for one or two hours. Observe the jar.

Observation: Formation of different layers of soil can be observed.

Conclusion: Soil is made up of various constituents that occur in layers.

The table below gives the maximum temperature for a week. Represent the data in the form of a bar graph.

Day	Temperature (in degrees Centigrade)
Monday	29
Tuesday	31
Wednesday	27
Thursday	25
Friday	24
Saturday	30
Sunday	31

LET'S APPLY

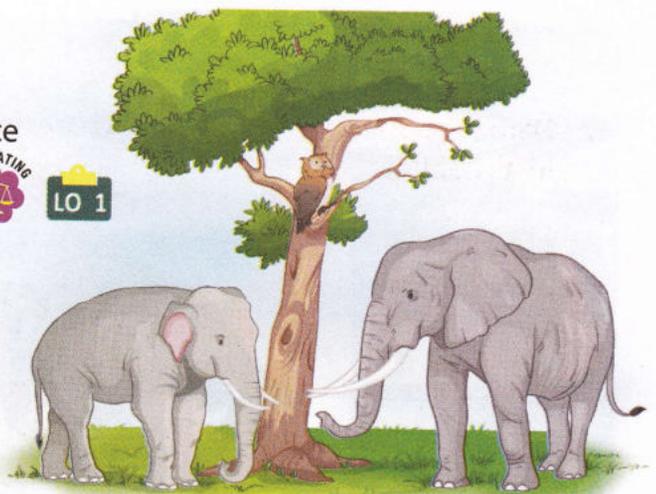


1. What would happen to the seasons, sunrise, and sunset if the Earth's axis had a tilt of 90° ?
2. Which of these, a camel or a polar bear, will be able to eat a cactus with thorns? Justify your answer.



LET'S ANALYSE AND EVALUATE

1. Analyse and give one evident physical difference between the two elephants. Justify it.
2. Can you spot an owl on the tree? Evaluate how this ability of animals to hide helps them survive in their habitat.



Asian elephant

African elephant

LET'S CREATE



Get into groups of five. Each group should choose any one animal that is found in each of the following habitats:

- a. Deserts b. Hot tropical and temperate climates c. Extremely cold climates

Collect their pictures and make a chart, along with a key adaptation of each, which helps it to survive in that habitat. Write the names of the animals in any five local languages that you can.

Web Research

- Browse the Internet to learn more about the Earth's tilt and seasons. A suggested website is: <https://www.youtube.com/watch?v=Pgq0LThW7QA> (accessed and checked on 28/08/19)
- Browse the Internet to learn about sunrise and sunset at the poles. A suggested website is: <https://www.youtube.com/watch?v=eUsWUiVCq5U> (accessed and checked on 28/08/19)
- Browse the Internet to gather information on how animals show camouflage by physical features and with the help of chemicals inside their bodies. Some suggested websites are: <https://animals.howstuffworks.com/animal-facts/animal-camouflage.htm> (accessed and checked on 28/08/19) <http://www.animalplanet.com/wild-animals/camouflage/> (accessed and checked on 28/08/19)

Air and Water in Soil

Soil particles have empty spaces between them, called pore spaces, which are filled with air or water. The amount of pores that a soil has is called porosity. Porosity depends on the size and number of pores in the soil. Larger the size of particles, larger will be the pore spaces between soil particles.

TYPES OF SOIL

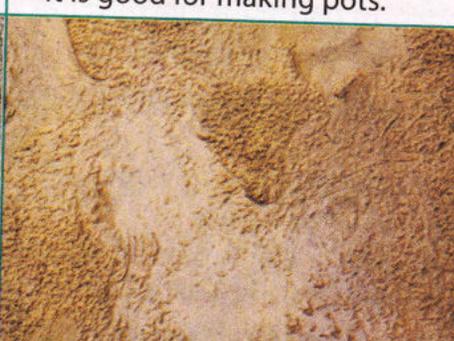
LL

The difference in particle size of the various soil constituents gives rise to a property called texture. The easiest way to identify the type of soil is to take some soil in hand, wet it, and roll it between your fingers.

- If it is very gritty and pale brown, then it is *sandy*.
- If it makes a shiny, smooth coating on your fingers and is greyish-brown, then it is *clayey*.
- If it is flaky and dark, then it is *loamy*.

Based on the proportion of sand, silt, clay, and humus present, soil can be sandy, clayey, or loamy. The differences between them are given in Table 8.2.

Table 8.2 Differences between sandy, clayey, and loamy soil

Sandy soil	Clayey soil	Loamy soil
<ul style="list-style-type: none">• More than two-thirds of sandy soil is sand, and about one-tenth is clay.• It is made up of large particles with large air spaces.• Its porosity prevents retention of water. So it dries up very easily.• It is well suited for fruit and vegetable cultivation.	<ul style="list-style-type: none">• More than two-thirds of clayey soil is clay.• It is made up of fine particles with small air spaces.• It retains moisture and becomes very sticky when wet. When dry, it becomes hard and forms deep cracks. To improve this soil, chalk can be added.• It is good for making pots.	<ul style="list-style-type: none">• Loamy soil has sand and silt in equal amounts, about two-fifths each. One-fifth of loamy soil is clay.• It has high humus content.• It has the required porosity for plants to grow.• It is good for cultivation of crops and gardening.
		

PROPERTIES OF SOIL

LL

Soil has special properties that determine its types. These properties are (a) absorption of water in soil, (b) moisture in the soil, and (c) percolation rate of water in soil.

Absorption of Water in Soil

The plants that grow in soil require water to grow. If the soil can hold water, the plants will grow well. If the soil does not hold water, the plants would need frequent watering or they would die. The amount of water a particular type of soil can absorb is its water absorption tendency. Higher the absorption of water by soil, higher is its availability to plants.

Activity

Aim: To find out the amount of water absorbed by soil

Materials needed: Two conical flasks of equal capacity, two funnels, sand, clay, filter paper, and water

Method:

1. Place the funnels over the conical flasks as shown.
2. Line the funnel with filter paper.
3. Place sand in one funnel and clay in another.
4. Pour 500 mL of water in each funnel.
5. Observe and note down the amount of water collected in each flask in 5 minutes.
6. Find out water absorbed by the formula:

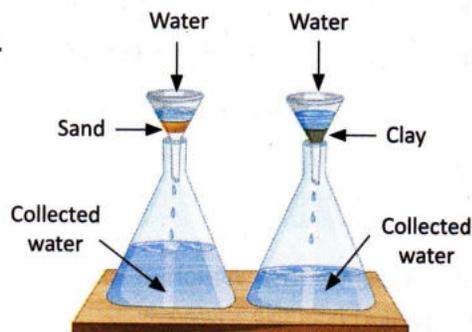
$$A = \text{Initial water} - \text{Final water collected}$$

$$A = 500 \text{ mL (in this case)} - \text{Water collected}$$

$$\text{Percentage of water absorbed} = (A/\text{Volume of water taken}) \times 100$$

Observation: Clay absorbs more water than sand.

Conclusion: The water absorption capacity of clay is more than sand.



Moisture in the Soil

When you take a bit of soil and heat it in a test tube, you will see tiny droplets of water condensing near the mouth of the test tube. Soil contains some amount of water in the form of moisture. We can estimate the moisture content of the soil by the look and feel of it. Soil moisture helps to determine when it needs to be irrigated and how much water it needs.

Percolation Rate of Water in Soil

The rate at which water exits the soil is known as its **percolation rate**. Different soils have different percolation rates. For proper plant growth, it is important to check percolation rate of water in soil. In well-drained soil, water will pass rapidly after it is irrigated. On the other hand, soil with a poor percolation will hold too much water for too long a time. That can be harmful to plants.

Activity

Aim: To find out the percolation rate of water

Materials needed: A watering can, a measuring jar, a trowel, three transparent plastic pipes each approximately 1 foot long/cold drink bottles cut from both sides, water, samples of different kinds of soils kept separately, and a stopwatch

Method:

1. Dig three holes (say, in the garden) and place the three plastic pipes upright in them.
2. Fill three-fourths of each pipe separately with a soil sample (clay, sand, and loam).
3. Now fill the remaining one-fourth of each pipe with water and measure the amount of water. Pour the same amount of water in each of the samples.
4. Note the time when you pour water into the soil sample and the time it takes for all the water to be absorbed. Now fill up the table below.

Soil Sample	Amount of water (in ml) poured (W1)	Time (in min) when water is poured (T1)	Time (in min) when all the water is absorbed/ disappears (T2)
Sample A			
Sample B			
Sample C			

5. Find out the percolation rate of water using the formula:
Percolation Rate = Amount of water in ml/ Percolation time in min
= $W1/(T2 - T1)$

Observation: Which of the three have the highest percolation rate? _____
Which has the lowest? _____

Conclusion: The percolation rate of water is inversely proportional to the time taken.

SOIL SUITABILITY FOR CROPS

Soil does not have the same properties everywhere, and therefore different varieties of plants can grow in different areas. That is why some places grow a particular crop more than the others. Wheat primarily comes from Punjab, Uttar Pradesh, and Haryana. The major rice-producing states are Punjab, Andhra Pradesh, and Uttar Pradesh. A soil suitable for growing crops has to be *fertile*. **Soil fertility** refers to the capacity of the soil to provide nutrients in adequate amounts and in proper balance for the growth of plants. For plants to grow well, factors such as light, moisture, and temperature should also be favourable.

What happens to water when it falls on cemented ground?

Cemented ground is porous to some extent. But the porosity of a cemented floor is very low as compared to soil and, therefore, water absorption is very slow. Most of the water that falls on a cemented floor evaporates or runs off, and only a very small amount seeps through it. Cemented ceilings have to be specially treated to make them waterproof, otherwise waterlogging would result in seepage.

To make the soil more fertile, some adjustments are done to its property. These adjustments are (a) alteration of pH, (b) alteration of air content (aeration), and (c) addition of fertilizers.

Acidity or alkalinity (pH) affects the ability of plant roots to take up minerals from the soil. A fertile soil should have a somewhat neutral pH. Lime (calcium carbonate) is added to acidic soils to raise the pH (make soil more alkaline). Peat is added to alkaline soil to lower the pH (make soil more acidic). Soil with a low air content has high water content, and so is heavy and difficult to work with. It can be improved by drainage of water from the soil by ploughing. Fertilizers are added to a soil that has low mineral contents such as nitrate, phosphate, potassium, and magnesium.

SOIL EROSION

Sometimes, wind and water remove the fertile topsoil reducing the productivity of the soil in that area. *This removal of soil by running water and wind is known as soil erosion.*

The major causes of soil erosion are:

- **Deforestation:** *The removal of trees on a large scale is known as deforestation.* When trees are removed, soil particles are left loose and can easily be carried away by running water and wind (Fig. 8.4).
- **Overgrazing:** Repeated grazing by animals on the same patch of land without sufficient recovery periods, leads to the removal of grass on a large scale. This makes it easy for wind and running water to erode the soil.
- **Floods and heavy rainfall:** Floods and heavy rainfall wash off soil, especially when there are no trees and the land is lying bare.
- **Improper farming:** Improper farming on hills makes it easy for wind and water to erode soil.

Prevention of Soil Erosion

Reduction or prevention of soil erosion is called soil conservation.

The following are some of the measures that help in conserving soil:

Let's Discuss

Why should industries not be present near agricultural lands?

Tech Specs

Hydroponics is a technique with the help of which plants are grown in mineral nutrient solutions, not soil.



Fig. 8.4 Deforestation

- Planting of trees in large numbers on deforested land (*reforestation*) or planting of trees in large numbers in an area where there was no forest previously (*afforestation*). Grasses and herbs can be used to cover large patches of loose soil. Overgrazing by animals should be avoided. Animals should be moved to a different area for grazing after some time.
- Floods can be controlled to a large extent by building dams. Embankments or mud walls should be constructed around hill slopes or fields to stop the flow of water.
- *Terrace farming* (Fig. 8.5) should be adopted in hilly areas. In this method, suitable crops are grown on a slope, which is cut into large steps called terraces. This reduces the speed with which water flows down, thereby reducing soil erosion.

Let's Discuss

Terrace (or Step) farming is the most effective method of growing crops in hilly areas. Why?



Fig. 8.5 *Terrace farming*

SOIL POLLUTION

Soil is one of the most valuable natural resources on Earth. When it gets polluted by various means, including careless human activities, necessary measures must be adopted to control the pollution.

The major sources of soil pollution are:

- Acid rain and acid water from factories, mines, and industries
- Improper dumping of garbage and sewage wastes in soil
- Excessive use of pesticides and fertilizers, which get accumulated in soil
- Waste materials, such as plastic and metals, which do not decay easily
- Spilling or leakage of chemicals

Control of Soil Pollution

The following measures will help to control soil pollution.

- Solid wastes should not be dumped on land. They should be recycled and proper measures for disposal of sewage should be adopted.
- Animal and domestic wastes should be used to produce biogas (an eco-friendly fuel).
- Instead of excessive chemical pesticides and fertilizers, organic pesticides should be used.
- Liquid wastes from factories and mines should be properly treated before they are released into water bodies such as rivers and lakes.

Let's Remember



Identify the different types of soil.



1. It is good for making pots.



2. It has high humus content and the required porosity for plants to grow.



3. It is very gritty and pale brown.

Key Words

Soil

The uppermost layer of the Earth's surface, made up of tiny particles of sand, mud, and rock is called soil.

Weathering

The disintegration of rocks on the Earth's surface due to exposure to natural forces such as wind, water, frost, roots of plants, etc., is called weathering.

Soil profile

A vertical section of soil from the ground surface to the parent rock that shows the different layers of soil or the horizons is called soil profile.

Soil erosion

The removal of soil by running water and wind is called soil erosion.

Terrace farming

A method of farming generally adopted in hilly areas where sloping ground is cut into large steps called terraces on which crops are grown is called terrace farming.

Summary

- The continuous weathering of rock forms soil.
- The formation of soil depends on several factors such as climate, parent rock, and the slope of land.
- There are four distinct layers of soil, namely topsoil, subsoil, weathered rock, and bedrock.
- Soils are of different types, depending on the colour and texture of the constituent particles.
- The three main types of soil are sandy soil, clayey soil, and loamy soil.
- The main causes of soil erosion include deforestation, floods and heavy rainfall, overgrazing, and improper farming techniques.
- The major causes of soil pollution include acid rain, improper dumping of sewage wastes, and excessive use of pesticides and fertilizers.
- Measures should be taken to avoid soil erosion and soil pollution.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

1. Soil erosion is fastest in _____ (hot and moist/cold and dry) climates.
2. _____ (Subsoil/Bedrock) is rich in minerals that seep down along with water and contains compactly packed fine particles of soil.
3. Soil particles have empty spaces between them that are called _____ (spores/pore spaces).
4. The rate at which water exits the soil is called soil _____ (percolation/fertility)
5. A soil suitable for growing crops has to be _____ (fertile/ dark in colour).
6. _____ (Terrace/Limited) farming should be adopted in hilly areas.

B. Write T for the True and F for the False statements. Correct the false statements.

1. All soils are tight and compact.
2. The physical features of a place play a very important role in soil conservation.
3. The topsoil contains partly weathered pieces of rock.
4. Larger the soil particles, lesser will be the pore space.
5. Loamy soil is good for cultivation of crops and gardening.
6. Acid rain and acid water from factories and industries help in conserving the soil.

C. Choose the correct option.

1. Which of these factors affect soil formation?
a. Climate
b. Slope of land
c. Characteristics of the parent rock
d. All of these
2. Which of these layers of soil is usually characterized by cracks and crevices, and difficult to dig beyond it?
a. Topsoil
b. Subsoil
c. C Horizon
d. R Horizon
3. Which of these soils retains moisture and becomes very sticky when wet?
a. Sandy soil
b. Clayey soil
c. Loamy soil
d. Both a and b
4. Which of these adjustments help to make the soil fertile?
a. Alteration of pH
b. Aeration
c. Addition of fertilizers
d. All of these
5. Which of these measures will help to control soil pollution?
a. Acid rain and acid water
b. Improper dumping of garbage in soil
c. Using organic pesticides
d. Spilling or leakage of chemicals

6. In which of these weathering processes, the characteristics of the original rock does not change?
 - a. Physical weathering
 - b. Chemical weathering
 - c. Biological weathering
 - d. All of these
7. In which of these climates is soil formation the fastest?
 - a. Hot and dry
 - b. Hot and moist
 - c. Cold and dry
 - d. Cold and dry
8. In which of the following stages of soil formation does humus get formed by break down of plant or animal remains?
 - a. Stage I
 - b. Stage II
 - c. Stage III
 - d. None of these
9. Which of these special properties determine the soil type?
 - a. Absorption of water in soil
 - b. Moisture in the soil
 - c. Percolation rate of water in soil
 - d. All of these
10. A soil sample is crumbly and dark, but not especially gritty or smooth and shiny. Which of these soils could it be?
 - a. Sandy
 - b. Clayey
 - c. Loam
 - d. Gravel

II. Very short answer type questions

Give one word for the following.

1. Breakdown of rocks due to exposure to natural forces _____
2. Dead and decayed plant and animal remains that increase fertility and porosity of soil _____
3. A vertical section of soil that shows the different layers of soil or horizons _____
4. The capacity of soil to provide nutrients in the right quantity for growth of plants _____
5. The removal of soil by running water and wind _____
6. Reduction or prevention of soil erosion _____

III. Short answer type questions

1. What is soil? List five main things that make up soil.
2. What is porosity of soil? What does it depend on?
3. Define percolation rate of soil.
4. What is soil fertility?
5. Define soil conservation.

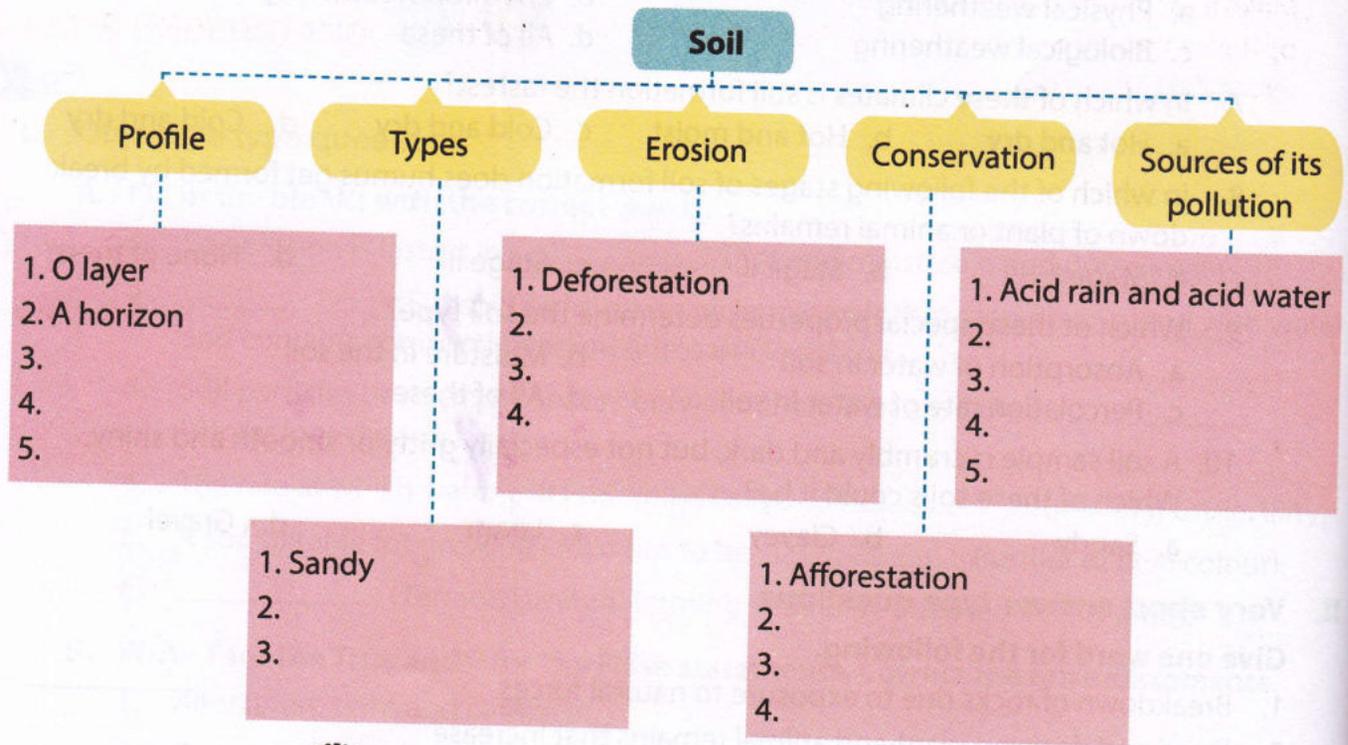
IV. Long answer type questions

1. Define weathering. Describe the different ways in which rocks undergo weathering and form soil.
2. Discuss the different kinds of soils
3. Describe the three special properties of soil that determine its types.
4. Explain the causes and prevention of soil erosion.
5. What is soil pollution? Describe the various measures that will help control soil pollution.

LET'S RECALL



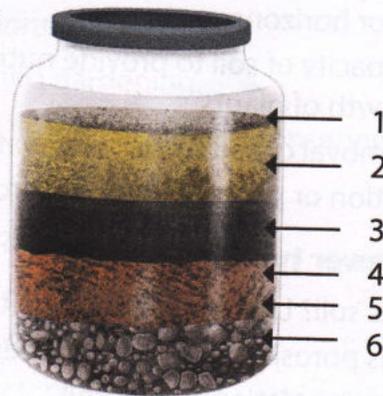
Recall and complete the concept map given below.



LET'S OBSERVE

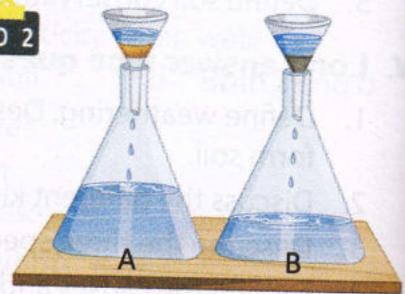


1. Label the various constituents of the soil. **LO 1**



2. a. Which of these shows sandy soil? _____
- b. Which of these shows clayey soil? _____
- c. Give one reason for your choice.

LO 2



LET'S CONNECT GEOGRAPHY

Make a list of any three crops grown in your state. Write the kind of soil needed for the optimum growth of each of them. Then, on a map of India, mark the main crops grown in every state of India.

LET'S APPLY

1. Why don't we find the same type of crops growing everywhere?  LO 4
(Hint: Different crops need different soil conditions)
2. Is humus content of soil the most important factor for plants to grow well? Will anything else be needed?

LET'S ANALYSE AND EVALUATE

1. Analyse which of the three soils will be the most suitable for growing plants. Give one reason for your choice. 
2. If you have peat and lime available to you, estimate how you could use them to make the soils fertile. 



LET'S CREATE

1. Get into groups of five. Brainstorm and then make a poster to spread awareness on human activities that result in soil pollution, and what measures can be taken to reduce it. Write a catchy slogan too.  LO 14  LO 16
2. Observe any place or area in your school or in your neighbourhood that is being dug out. Draw a soil profile of the place on a chart paper.  LO 9  LO 13
3. Take some garden soil. How does it look and feel, i.e., what is its colour and texture?  LO 15
 - a. Fill a sieve with that soil to the brim and pour 50 ml water over it. Place a graduated cylinder under it. See how much water seeps out after a minute. Estimate how much is held back by the soil.
 - b. Mix one tablespoon of soil in half a beaker of water and see air bubbles.
 - c. Find out the pH of the soil using the litmus paper.

Now, write a report describing the various properties of the garden soil.

Web Research

- Browse the Internet and find out the different colours of soil found in different parts of India and what affects their colour and mineral content. Some suggested websites are:
<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-color> (accessed and checked on 28/08/19)
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054286 (accessed and checked on 28/08/19)
- Browse the Internet and find out how soil erosion causes landslides on the mountains. Check what we can do to control these landslides. Some suggested websites are:
<https://www.diamondcertified.org/three-ways-reduce-soil-erosion-landslide-risk/> (accessed and checked on 28/08/19)
<https://pmm.nasa.gov/education/lesson-plans/landslides-erosion> (accessed and checked on 28/08/19)

9

Respiration in Organisms

If you observe your breathing movements, you will feel a slight but regular upward and downward movement of the chest. The movements indicate breathing in and breathing out. There are a number of organs involved in it. These organs together make up a system called the *respiratory system*.

Look for the names of five animals in the grid below. Then write the respiratory organ of each.

You will learn about

- Respiratory system
- Respiratory system in animals
- Respiratory system in humans
- Respiratory system in plants
- Aerobic and anaerobic respiration



L	E	E	C	H	R	S	A
F	R	O	G	O	P	Y	N
I	O	R	X	V	Q	L	T
S	S	T	R	O	P	I	I
H	O	R	S	E	I	O	P



1. Animal: _____; Respiratory Organ: _____
2. Animal: _____; Respiratory Organ: _____
3. Animal: _____; Respiratory Organ: _____
4. Animal: _____; Respiratory Organ: _____
5. Animal: _____; Respiratory Organ: _____

The respiratory system is found in all living organisms, though with varying levels of complexity. Let us learn more about it.

Answers: Leech-skin; Frog-moist skin and lungs; Horse-lungs; Fish-gills; Ant-spiracles

RESPIRATORY SYSTEM

All living organisms are made up of a number of cells. Each of these cells requires *oxygen* to break down food and obtain energy. The intake of air rich in oxygen is the first step. This is called *inhalation* or breathing in. The next step involves a series of chemical reactions, which help in the release of energy. Several enzymes and *catalysts* (substances that speed up reactions) are also involved in this process. When food is broken down, the reaction produces water and carbon dioxide. Carbon dioxide is toxic to the body, so it has to be moved out. The removal of air rich in carbon dioxide is called *exhalation* or breathing out. This step completes the cycle. The fundamental difference between breathing and respiration is the following.

Breathing is the process of intake of air rich in oxygen (*inhalation* or *breathing in*) and giving out air rich in carbon dioxide (*exhalation* or *breathing out*).

Respiration is the process of releasing energy from the breakdown of food.

Table 9.1 lists some more differences between breathing and respiration.

Table 9.1 Differences between breathing and respiration

Breathing	Respiration
1. It is the process of inhalation and exhalation. It is a physical process. No chemical reaction takes place; only an exchange of gases is involved.	1. It is a series of chemical reactions that result in the release of energy by the oxidation of food molecules.
2. No enzymes or other catalysts are involved.	2. Enzymes and other catalysts are involved.
3. It takes place outside the cells.	3. It takes place inside the cells.
4. No energy is released during this process.	4. Energy is released during this process.

RESPIRATORY SYSTEM IN ANIMALS

The basic process of respiration is similar in all plants and animals, and results in the release of energy. In unicellular animals, oxygen is directly absorbed from the water or air and carbon dioxide is released by diffusion. About 21% of air is oxygen, but in water there is only about 0.5% of oxygen at normal temperatures. In higher animals, there are special organs that help in respiration:

Through skin In animals such as earthworms and leeches, exchange of gases takes place through the moist and slimy surface of the skin. In amphibians such as frogs, newts, and salamanders, the exchange of gases takes place through the skin (when in water), and through the lungs (when on land).

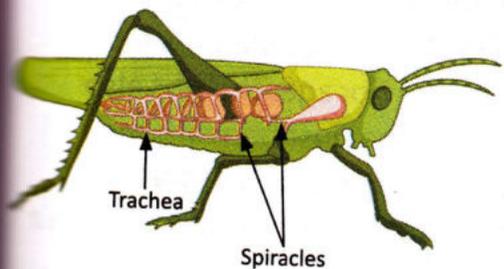


Fig. 9.1 Diagrammatic representation of spiracles in grasshopper

Through air holes In animals such as insects, there are several holes called *spiracles* (Fig. 9.1) in the body. Air enters an insect body through these spiracles and is carried through tubes called *tracheal tubes*. Oxygen is

absorbed inside the body and carbon dioxide-rich air is sent out through these spiracles.

Through gills Most aquatic animals such as fish use special organs called *gills* (Fig. 9.2) for respiration. These gills are like slits and are made up of a large number of thread-like structures called *filaments*. These filaments are richly supplied with tiny blood vessels called *capillaries*. When water enters the body of the fish through the mouth, it flows over the gills. The blood in the capillaries absorbs oxygen from the water, and gives out carbon dioxide. This oxygen is transported by the blood.

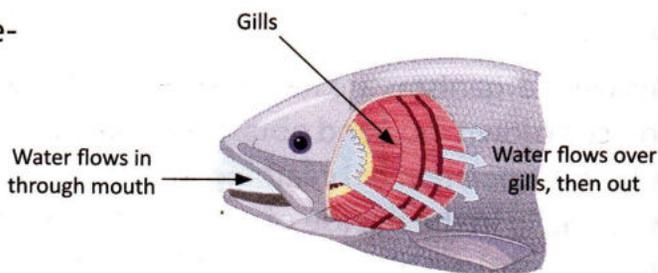


Fig. 9.2 Diagrammatic representation of gills in fish

Let's Discuss

Why do fish die when taken out of water?

Through lungs Most mammals such as cats, dogs, monkeys, horses, human beings, etc., respire through special sac-like, spongy organs called *lungs*. Baby frogs (tadpoles) also breathe through gills, though they breathe through skin and lungs when they grow up to become frogs.

Let's Remember



Match the following. Write one reason for each match. One is done for you.

Column A	Column B	Reason
1. Breathing	a. Filament	_____
2. Respiration	b. Physical process	_____ No chemical reaction is involved
3. Unicellular organism	c. Tracheal tubes	_____
4. Spiracles	d. Chemical reactions	_____
5. Gill	e. Sac-like, spongy organs	_____
6. Lungs	f. Diffusion	_____

RESPIRATORY SYSTEM IN HUMANS



Humans, like many other land animals with backbones, breathe in oxygen-rich air and breathe out carbon dioxide-rich air with the help of lungs (Fig. 9.3). Lungs are present inside our chest (also called the *thorax*). They are protected by the ribcage. The ribs also support the lungs and help to pump air in and out when we breathe. Just beneath the lungs is a dome-shaped muscle called the *diaphragm*. When the diaphragm contracts, oxygen-rich air is taken into the lungs. When the diaphragm relaxes, carbon dioxide-rich air is pumped out of the lungs.

Passage of Air

As we inhale, the oxygen-rich air enters the nose through a pair of *nostrils*. Tiny hair and mucus present in the nose prevent dust and other foreign particles from entering our body. Air passes through the *nasal cavity* and enters the *larynx*. The wind pipe, called the *trachea*, is made up of several ring-like structures, held together by cartilage. Air enters the trachea, which then divides into two *bronchi* (singular: *bronchus*). The bronchi break down into several thinner tubes called *bronchioles*. These bronchioles carry the inhaled air into tiny air bags called *alveoli*.

The exchange of gases actually takes place inside these alveoli. Once the inhaled, oxygen-rich air reaches the alveoli, the oxygen is absorbed into the blood, and carbon dioxide is given out. The carbon dioxide-rich air now needs to be removed from the lungs. The air then retraces its journey back from the alveoli to the nose—through bronchioles, bronchi, trachea, larynx, and the nose. The carbon dioxide-rich air is then exhaled out of the nose.

Let's Discuss

We should try and breathe through the nose and not through the mouth. Why?

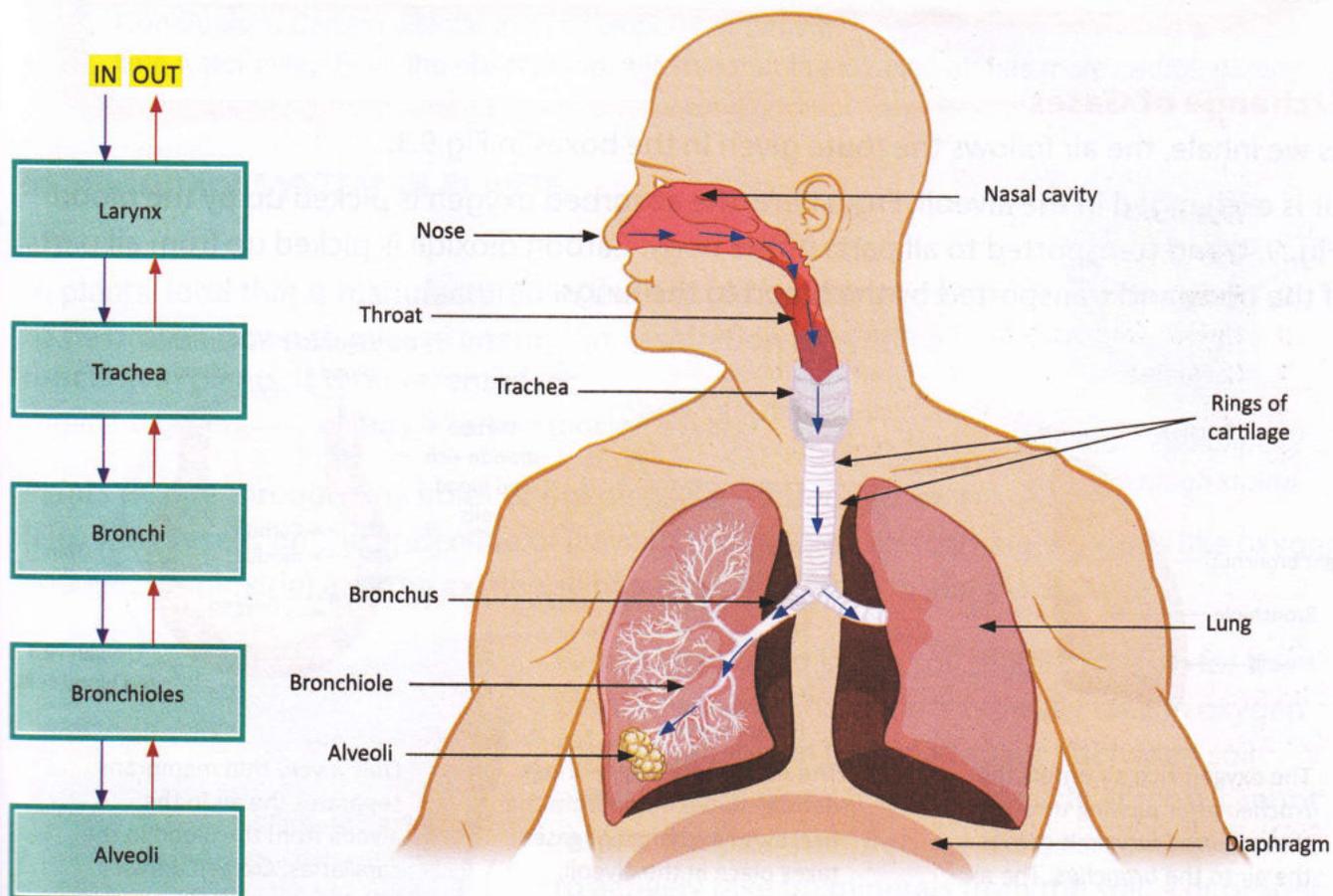


Fig. 9.3 Diagrammatic representation of the human respiratory system (blue arrows represent the path of inhaled air)

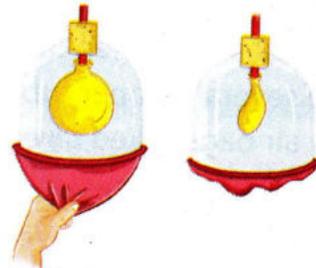
Activity

Aim: To demonstrate how the diaphragm works during the process of breathing

Materials needed: A bell jar with a cork, straws, a rubber sheet, thread for tying, and a balloon

Method:

1. With the help of the thread, tie the rubber sheet to the bottom of the bell jar. This represents the diaphragm.
2. Now set up the arrangement with the straws and the balloon as shown in the figure such that the balloon depicts the lungs. Cork the bell jar.
3. Now pull the rubber sheet down. What happens to the balloon?
4. Then push the rubber sheet inside. Now observe what happens to the balloon.



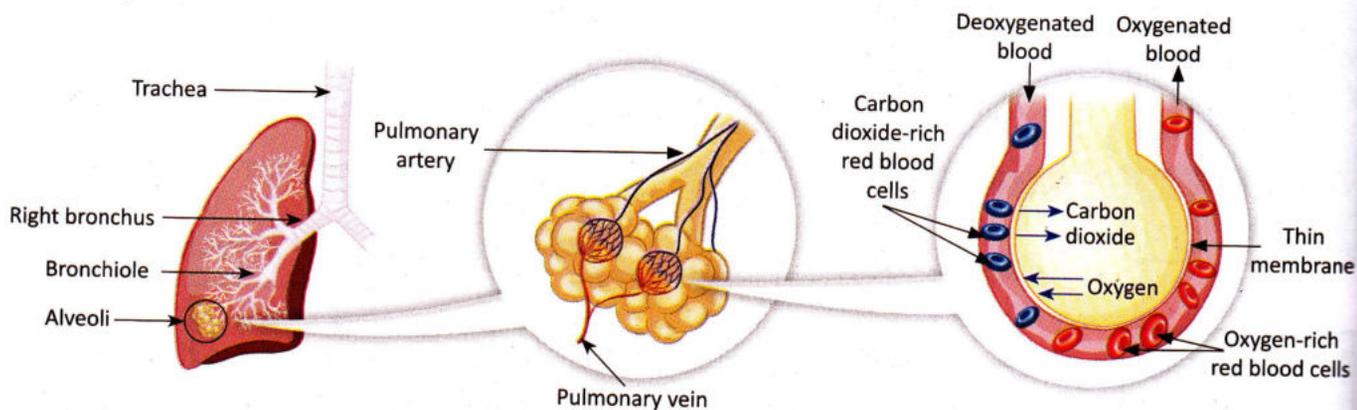
Observation:

1. When the rubber sheet is pulled down, the balloon gets filled with air because the cavity increases and air rushes in. This is exactly what happens during inhalation. The diaphragm contracts and the air rushes into the lungs.
2. When the rubber sheet is pushed up, the balloon collapses again. This is similar to exhalation. When the diaphragm relaxes, the air rushes out of the lungs.

Exchange of Gases

As we inhale, the air follows the route given in the boxes in Fig 9.3.

Air is exchanged in the alveoli. From here, the absorbed oxygen is picked up by the blood (Fig. 9.4) and transported to all parts of the body. Carbon dioxide is picked up from all parts of the body and transported by the blood to the lungs.



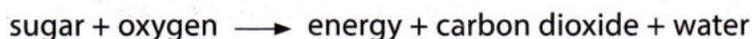
The oxygen-rich air enters the *trachea* after passing through the nose and *larynx*. It carries the air to the *bronchus*. The air then moves into the *bronchioles* and then into the *alveoli*.

The *pulmonary artery* brings deoxygenated blood from the heart and exchange of gases takes place in the alveoli. The *pulmonary vein* returns oxygenated blood to the heart.

Only a very thin membrane separates the air in the alveoli from the blood in the capillaries. Oxygen diffuses into blood and carbon dioxide diffuses out.

Fig. 9.4 Diagrammatic representation of the passage of air and exchange of gases

The oxygen absorbed in the alveoli combines with haemoglobin in the blood, to form a compound called *oxyhaemoglobin*. Blood carries oxyhaemoglobin to all cells of the body. In the cells, oxyhaemoglobin releases the oxygen, which helps to break down food (glucose or sugar) to generate energy. Along with energy, carbon dioxide, water, and heat are also generated. The chemical reaction involved in this breakdown of sugar is:



Activity

Aim: To show that exhaled air has more carbon dioxide

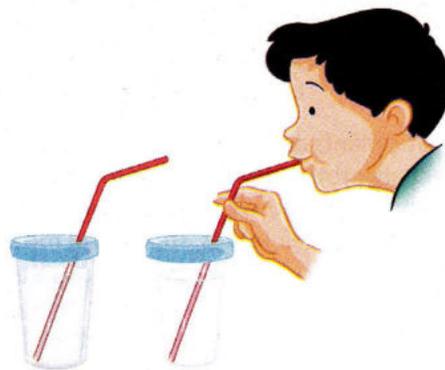
Materials needed: Two disposable glasses with covers and a hole on top, two straws, and lime water

Method:

1. Fill both the glasses with lime water.
2. Put straws in both the glasses. Let air enter one of them through the straw.
3. In the second, blow out some air (exhaled air).

Observation: The lime water in the first glass is only slightly milky, while in the second glass it is very milky.

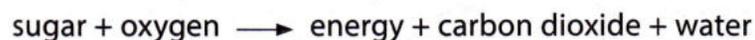
Conclusion: Carbon dioxide has the property of turning lime water milky. From the observation, it is true that the exhaled air has more carbon dioxide.



RESPIRATORY SYSTEM IN PLANTS

AN

In plants, food that is manufactured in the form of starch needs to be broken down to release energy. So, respiration is a vital function in plants. It is represented as:



Plants respire through tiny holes or openings called *stomata*

(Fig. 9.5) present on the underside of leaves. Stomata trap air (containing gases like oxygen and carbon dioxide) and the exchange of gases takes place inside plant cells.

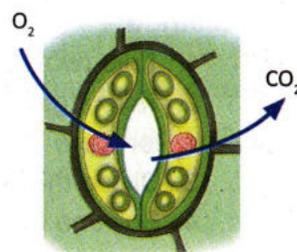


Fig. 9.5 Exchange of gases through stoma

Get it Right

Respiration occurs throughout day and night, whereas photosynthesis occurs only during the day when light is present.

Even roots buried in the soil require oxygen for the plant to survive. Plant roots typically take in oxygen that is available in the small spaces between soil particles, and give off carbon dioxide. If roots cannot respire, they cannot produce the energy necessary to actively take up minerals from the soil. For proper root respiration, farmers plough or till the soil so that tiny air spaces are created around the soil particles.

Activity

Aim: To demonstrate that plants respire through stomata

Materials needed: Petroleum jelly, a leafy plant, e.g., Geranium, Dahlia, or rose

Method:

1. Keep the plant in the dark for a few days so that no photosynthesis takes place.
2. Choose two leaves and coat their underside with petroleum jelly.
3. Place the plant on a sunny window sill for a week and observe.

Observation: The two leaves begin to die as time goes by.

Conclusion: Since stomata are covered by the jelly, there is no way for air to enter the leaves.

How do plants/animals live in water?

Aquatic plants and animals survive in water by utilizing dissolved oxygen. The sources of dissolved oxygen are direct absorption from the atmosphere and release during photosynthesis by aquatic plants. Aquatic animals breathe through their skins, whereas many have gills. Aquatic plants directly exchange gases with the water surrounding their leaves, stems, and roots.

Activity

Aim: To show that heat is released during respiration

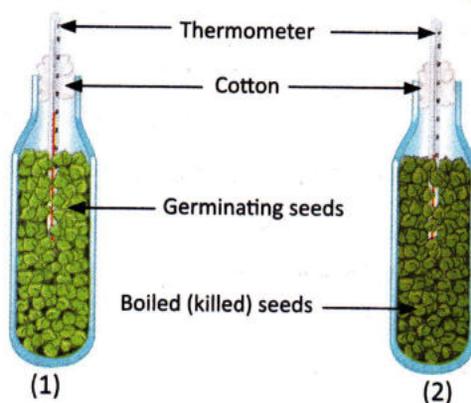
Materials needed: Two thermos flasks, seeds, formalin or carbolic acid, cottonwool, and two thermometers

Method:

1. Take two thermos flasks and mark them 1 and 2.
2. Take a glassful of seeds and soak them in water for more than 24 hours.
3. Divide the seeds into two equal groups.
4. Boil one group of seeds and then wash them with dilute formalin or carbolic acid to prevent decay.
5. Put the live germinating seeds in flask 1 and the killed ones in flask 2.
6. Insert a thermometer in each flask and plug their mouths with cotton wool.

Observation: After a few hours, the thermometer in flask 1 shows a higher reading. The thermometer in flask 2 does not show any rise in temperature.

Conclusion: This indicates that the germinating seeds give out heat because they are alive and are respiring.



AEROBIC AND ANAEROBIC RESPIRATION

Respiration is primarily of two types: *aerobic* and *anaerobic*.

Aerobic Respiration

The process of respiration that takes place in the presence of oxygen is called *aerobic respiration*. This results in the release of energy, and in the formation of carbon dioxide and water.

Aerobic respiration is represented by the equation:



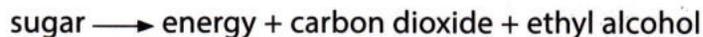
Aerobic respiration is the most efficient form of respiration. The reaction involved in this process is similar to that of combustion or burning. However, there are some differences between the two (Table 9.2).

Table 9.2 Differences between aerobic respiration and combustion

Aerobic respiration	Combustion
1. Energy is given out gradually.	1. Energy is given out suddenly.
2. Energy is given out in the form that can be used by the organism.	2. Energy is given out in the form of heat or light.
3. Energy is stored inside the body in the form of ATP (adenosine triphosphate, energy-rich molecules), which can be used whenever needed.	3. Energy is not stored as ATP.

Anaerobic Respiration

The process of respiration that takes place in the absence of oxygen is called **anaerobic** (“an” means “without”) **respiration**. This results in the release of energy, and in the formation of carbon dioxide and ethyl alcohol (an organic compound). It is represented by:

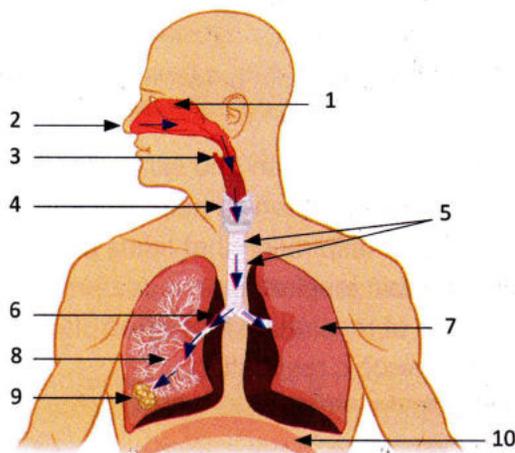


In humans, anaerobic respiration can be carried out only for a short period of time. It occurs in our muscle cells when there is not enough oxygen supply. This happens when we are doing heavy work or exercise, running fast, etc. However, many microorganisms, such as yeast, bacteria, and fungi, can only respire anaerobically.



Let's Remember

A. Label the parts of the human respiratory system.



B. Who am I?

1. I am also known as the chest. _____
2. I protect the lungs. _____
3. I am a dome-shaped muscle that helps to pump air inside and outside the chest. _____
4. I am also known as the wind pipe. _____
5. I am an air bag in the lungs, where the exchange of gases takes place. _____

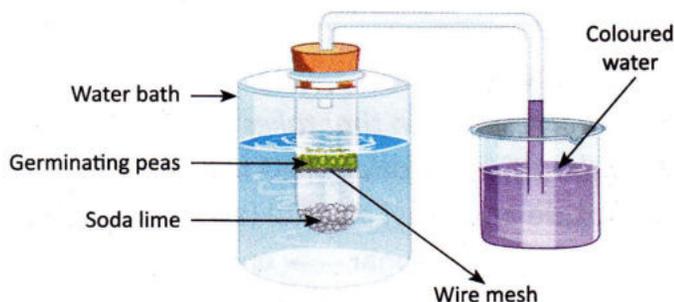
Activity

Aim: To demonstrate that oxygen is required during aerobic respiration

Materials needed: A big beaker, a small beaker, a test tube, a cork with a hole, a U-shaped tube, coloured water, perforated sheet or wire mesh, germinating peas, soda lime, and water

Method:

1. Place some soda lime at the bottom of the test tube.
2. Fix the wire mesh a little above the soda lime and place germinating peas on the mesh or the perforated sheet so that they do not come in direct contact with the soda lime.
3. Set up the experiment as shown in the picture. (The water bath helps to maintain the temperature and does not affect the outcome of the experiment.)
4. See what happens to the level of the coloured water in the separate beaker.



Observation: The coloured water starts moving upwards in the narrow tube after some time.

Inference: Soda lime removes carbon dioxide from the air inside the test tube by absorbing it. As the peas respire, oxygen is used up, and this pulls up the coloured liquid.

Conclusion: Oxygen is required for aerobic respiration.

Key Words

Breathing

The process of inhalation and exhalation is known as breathing.

Stomata

Pores found in leaves which help plants to respire are called stomata.

Aerobic respiration

The process of respiration that takes place in the presence of oxygen is called aerobic respiration.

Anaerobic respiration

The process of respiration that takes place in the absence of oxygen is called anaerobic respiration.

Summary

- Respiration is the process of releasing energy from the breakdown of food.
- There are two types of respiration: aerobic (in the presence of oxygen) and anaerobic (in the absence of oxygen).
- Plants respire with the help of tiny holes called stomata.
- Animals such as frogs and snakes respire through their skins; fish, crabs, etc., respire through gills; insects mostly respire through spiracles.
- The respiratory system of humans comprises the nose, trachea, bronchi, bronchioles, and alveoli.
- Breathing is an essential step for respiration. The diaphragm is a muscular organ that helps in inhalation and exhalation.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

1. A series of _____ (physical/chemical) reactions result in the release of energy by oxidation of food.
2. When the diaphragm _____ (contracts/expands) oxygen-rich air is taken into the lungs.
3. The wind pipe is made up of several ring-like structures, held together by _____ (muscles/cartilage).
4. Plant roots typically take in _____ (oxygen/carbon dioxide) available in small spaces between soil particles and give off _____ (oxygen/carbon dioxide).
5. _____ (Aerobic/Anaerobic) respiration is the most efficient form of respiration.

B. Choose the correct option.

1. Which of these are like slits and are made up of thread-like structures?
a. Gills b. Filaments c. Capillaries d. All of these
2. Which of these carries the inhaled air into tiny air bags in human beings?
a. Trachea b. Bronchi c. Bronchioles d. Larynx
3. Which of these carries oxygenated blood from the lungs to the heart?
a. Bronchus b. Pulmonary artery
c. Pulmonary vein d. Alveoli
4. Which of these is formed as a result of respiration in plants?
a. Energy b. Carbon dioxide c. Water d. All of these
5. Which of these is formed as a result of anaerobic respiration?
a. Energy b. Carbon dioxide
c. Energy and ethyl alcohol d. Energy, carbon dioxide and ethyl alcohol

6. Which of these refers to breathing?
 - a. Intake of air rich in oxygen
 - b. Breakdown of food to produce water and carbon dioxide
 - c. Releasing energy from the breakdown of food
 - d. All of these
7. Which of these do amphibians use to breathe in air on land?
 - a. Trachea
 - b. Spiracles
 - c. Surface of the skin
 - d. Lungs
8. Which of these helps to pull in oxygen-rich air into the lungs?
 - a. Expansion of the diaphragm
 - b. Relaxation of the diaphragm
 - c. Up and down movement of the ribs
 - d. Tracheal tubes
9. Why do farmers plough the soil?
 - a. To increase root respiration
 - b. To decrease root respiration
 - c. To increase respiration through stomata
 - d. To decrease respiration through stomata
10. Which of these is true about anaerobic respiration?
 - a. It is carried out in humans for a short time.
 - b. It takes place in our muscle cells when we are doing heavy work or exercise, running fast, etc.
 - c. It is common in many micro-organisms.
 - d. All of these

II. Very short answer type questions

Give two examples for the following.

1. Animals in which exchange of gases takes place directly from the water or air through diffusion
2. Animals that breathe through spiracles
3. Animals that breathe through their moist skin as well as their lungs
4. Organisms that respire anaerobically

_____	_____
_____	_____
_____	_____
_____	_____

III. Short answer type questions

1. Define respiration. Why is it called a chemical process?
2. How does the diaphragm help in pumping air?
3. What is oxyhaemoglobin?
4. Why do roots of plants need to respire?

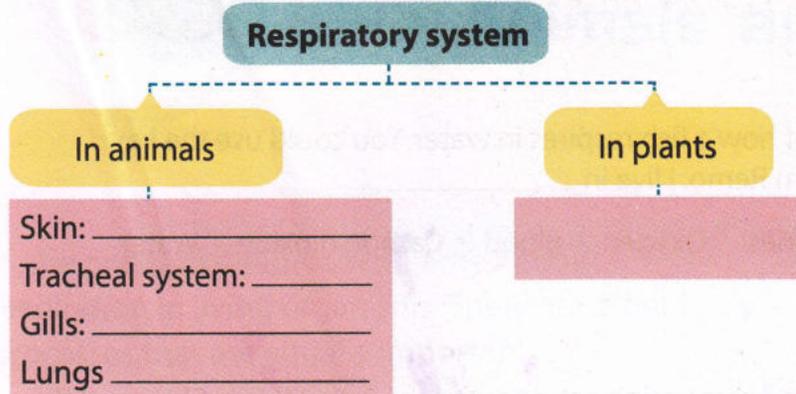
IV. Long answer type questions

1. Explain how a fish respire in water, with the help of gills.
2. Describe how exchange of gases takes place inside the human respiratory system.
3. What is the difference between aerobic and anaerobic respiration? Write the equations to show both the processes.

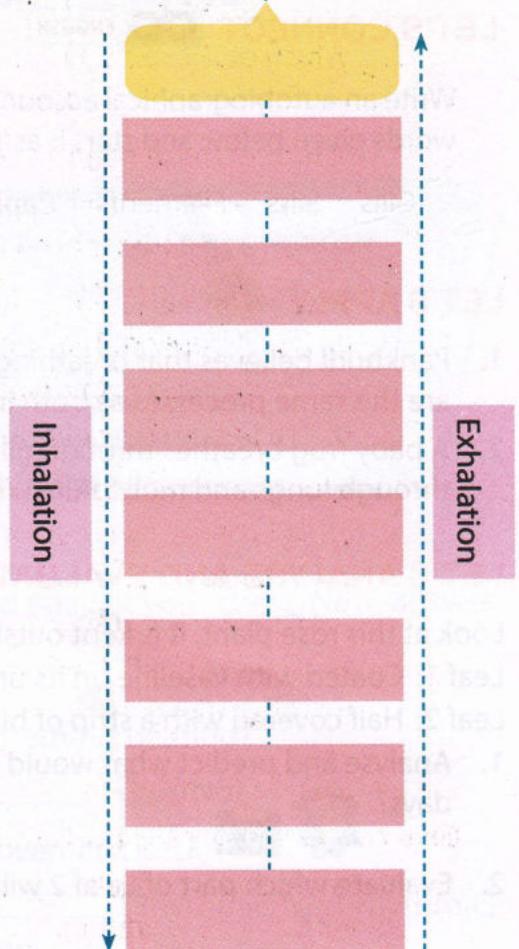
LET'S RECALL



Recall and complete the concept map given below.



Passage of air through the human respiratory system

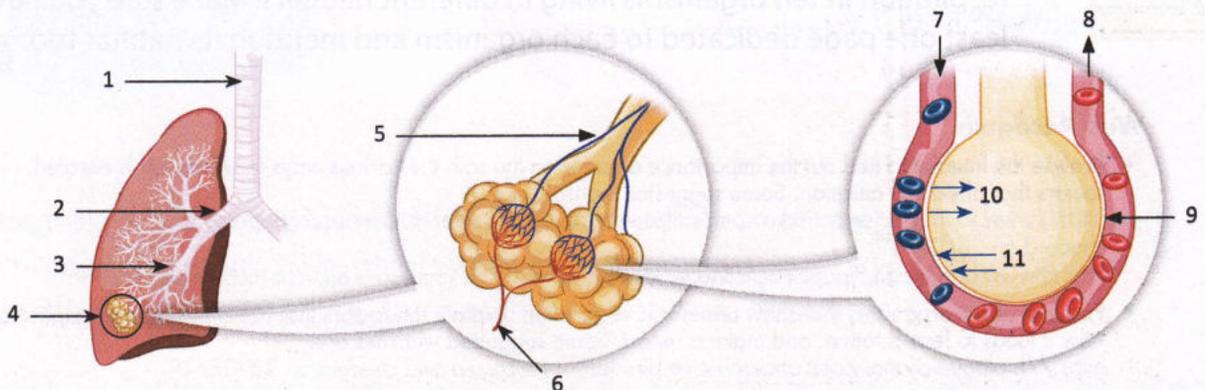


LET'S OBSERVE

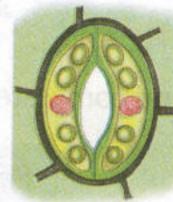


1. Label the diagram using the words given below. **LO 9**

Pulmonary artery Oxygen Thin membrane Trachea Right bronchus
 Bronchioles Alveoli Carbon dioxide Pulmonary vein



2. a. What is shown in the picture?
- b. Draw arrows to show how the exchange of gases takes place.
- c. Write the equation to represent the respiration process that would take place here.



LET'S CONNECT ENGLISH

Write an autobiographical account of how a fish respire in water. You could use the key words given below and start it as 'I am Remo. I live in _____':

Gills Slits Filaments Capillaries Oxygen Blood Carbon dioxide Water

LET'S APPLY

1. Pankhudi believes that breathing and respiration are one and the same thing. She says 'They are the same processes as both involve oxygen'. Is she right?
2. A baby frog breathes through gills, while an adult frog breathes through lungs and moist skin. Why is it so? 

LET'S ANALYSE AND EVALUATE

Look at this rose plant. It is kept outside and is watered regularly.

Leaf 1: Coated with vaseline on its underside

Leaf 2: Half covered with a strip of black paper

1. Analyse and predict what would happen to Leaf 1 after a few days? 

2. Evaluate which part of Leaf 2 will show positive result when tested for starch. Explain why. 



Models of Respiration in Different Organisms	
Organism 1:	_____
Organism 2:	_____
Organism 3:	_____
Organism 4:	_____
Organism 5:	_____
Organism 6:	_____
Organism 7:	_____

LET'S CREATE

1. Find out how any five unicellular animals, like an amoeba, respire and then draw a flow chart to show their respiration process. 
2. Make a flip book using backs of old calendars, describing the modes of respiration in ten organisms living in different habitats. Make sure you have at least one page dedicated to each organism and mention its habitat too. 

Web Research

- Browse the Internet to find out the importance of aerating the soil, the various ways in which soil is aerated, and the factors that affect soil aeration. Some suggested websites are:
<http://www.soilmanagementindia.com/soil/soil-aeration-definition-factors-and-importance/3509> (accessed and checked on 28/08/19)
<http://www.agriinfo.in/?page=topic&superid=4&topicid=285> (accessed and checked on 28/08/19)
- Find out about organisms that show anaerobic respiration. Explain the factors that affect this type of respiration and how it leads to fermentation, and make a report. Some suggested websites are:
<https://biologydictionary.net/anaerobic-respiration/> (accessed and checked on 28/08/19)
<https://www.khanacademy.org/science/biology/cellular-respiration-and-fermentation/variations-on-cellular-respiration/a/fermentation-and-anaerobic-respiration> (accessed and checked on 28/08/19)

10

Transport of Substances in Animals and Plants

In the previous chapter, we learned about respiration in living organisms. There are other body processes that are equally important.

You will learn about

- Transport of substances
- Transport in animals
- Transport in humans
- Transport in plants
- Excretory system



Press your right hand against your chest. Now, answer the questions below.

- Can you feel something beating?
_____ (Yes/No)
- What kind of movement is it?
_____ (Rhythmic/Non-rhythmic)
- Does it become slower or faster after you run a race?
_____ (Slower/Faster)
- Which of these organs do you think is beating in your chest?
_____ (Heart/Brain)

The heart plays a very important role in the transportation of oxygen to different parts of the human body. Similarly, plants and other organisms, too, have their own ways of transporting substances within their bodies. Let us learn about them.

Answers: 1. Yes; 2. Rhythmic; 3. Faster; 4. Heart

TRANSPORT OF SUBSTANCES

The process of transport of substances is very important in a living body. This ensures that the different organ systems of the living organism work efficiently.

The following are some of the substances that need to be transported.

- *Food* to all the cells where it will be broken down/oxidized for the release of energy
- *Oxygen*, which is required for the oxidation process
- *Water and minerals*, which are required for proper functioning of the body of an organism
- *Waste products*, generated as a result of life activities, which need to be removed from the cells and the body

TRANSPORT IN ANIMALS

In *unicellular animals* such as *Amoeba* and *Paramecium*, no special transport system is required. Every part of the organism gets nutrients and oxygen directly through cell **diffusion**. In *Hydra*, water transports food and oxygen to all parts of the body and takes body wastes away from the different organs for excretion. In *multicellular organisms*, the transportation is done by a specialized system known as the *circulatory system*. It consists of the heart, arteries, veins, and capillaries. It forms a broad network, which carries blood to all parts of the body. *Blood* is the medium for transport of all the necessary materials to different parts of the body.

Word help

Diffusion Movement of molecules or gases from a region of higher concentration to that of lower concentration

TRANSPORT IN HUMANS

AN

Humans have a well-developed and efficient circulatory system. It consists of (a) blood, (b) blood vessels: they are of three kinds namely, *arteries*, *veins*, and *capillaries*, and (c) a thick muscular organ called the *heart*.

Blood

Blood is a fluid that flows in the blood vessels. It forms a medium through which nutrients, important gases, water, and waste products are transported inside the organism. It constitutes about 8% of the body weight. Blood consists of several cells floating in a straw-coloured liquid called *plasma*. These cells (Fig. 10.1) are (a) red blood cells (RBCs), (b) white blood cells (WBCs), and (c) blood platelets.

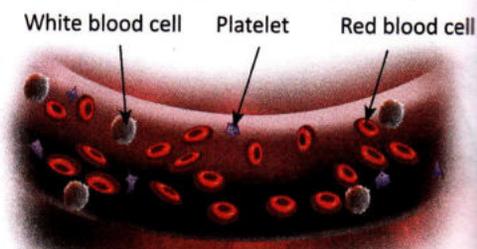


Fig. 10.1 Representation of RBCs (red), WBCs (white), and platelets (purple) in a blood vessel

Know your Scientist

Karl Landsteiner, an Australian biologist, physician and immunologist, discovered the major blood groups in humans. He discovered these blood types between 1900 and 1901 while he was studying why blood transfusions sometimes saved a patient, while sometimes it was the reason for the patient's death. It was an important milestone achieved at the University of Vienna. For this discovery, he even received a Nobel prize in Physiology (or Medicine) in 1930.



Red blood cells are flat and disc-like in shape with a depression in the centre (Fig. 10.1): They contain the red pigment, *haemoglobin*. This pigment combines with oxygen to form *oxyhaemoglobin* that helps in transporting oxygen to all parts of the body. *White blood cells* are larger than RBCs but do not have haemoglobin. They move actively and protect the body against disease-causing microorganisms by destroying them. Whenever you have a cut on your body, blood comes out. The bleeding is stopped after sometime by the *blood platelets* present in the blood. Blood platelets are colourless, irregularly shaped, and much smaller than the RBCs.

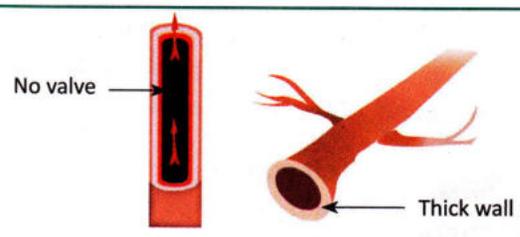
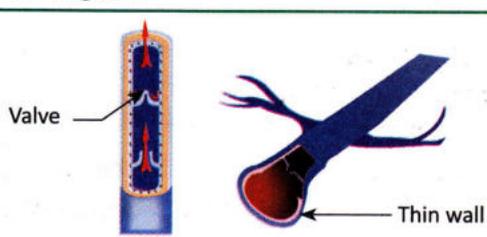
Fact File

Human beings have four types of blood groups: Blood group A, B, AB, and O. These blood groups can be either +ve or -ve.

Blood Vessels

Blood flows through our body in a complex system of tubes called *blood vessels*. There are three types of blood vessels: *arteries*, *capillaries*, and *veins*. *Capillaries* are the thinnest of the blood vessels and connect arteries to veins. Differences between arteries and veins are listed in Table 10.1.

Table 10.1 Differences between arteries and veins

Arteries	Veins
<ol style="list-style-type: none"> 1. They carry blood away from the heart. 2. They are thick-walled tubes. 3. They are deeply placed under the skin, and blood moves under high pressure. 4. There are no valves inside arteries. 	<ol style="list-style-type: none"> 1. They carry blood to the heart. 2. They have thinner walls. 3. They are superficially placed and blood does not move under pressure. 4. There are a series of valves present in the veins. These prevent the blood from flowing back to the organs.
 <p>No valve</p> <p>Thick wall</p> <p><i>Longitudinal section of an artery</i></p>	 <p>Valve</p> <p>Thin wall</p> <p><i>Longitudinal section of a vein</i></p>

Capillaries are thin-walled blood vessels and form a network of extremely tiny blood vessels between arteries and veins (Fig. 10.2). The walls of the capillaries are so thin that diffusion of gases and chemical substances takes place very easily.

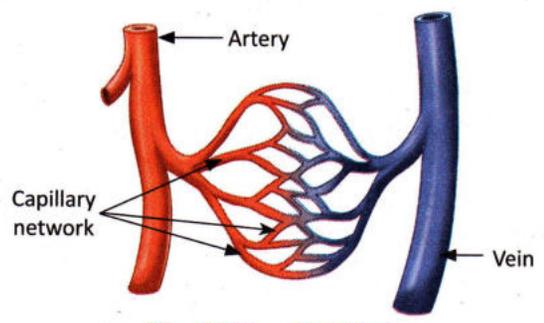


Fig. 10.2 Capillaries

The Heart



The heart (Fig. 10.3) is a *four-chambered* muscular organ that pumps blood into the blood vessels. The pressure that this pumping generates is enough for the blood vessels to carry this blood to all parts of the body. The heart is able to do so by the rhythmic contractions and relaxations of its muscles. These are known as the *heart beats*. A normal heart beats about 60 to 80 times per minute. We can hear our heart beat with the help of an instrument called a *stethoscope*. Blood pressure is measured by using an instrument called a *sphygmomanometer*.

As the heart beats and forces blood through our body, we feel a throbbing sensation at any point where an artery comes close to the surface of our skin, such as the wrist, neck, or upper arm. This throbbing sensation is called the *pulse*. Counting your pulse rate is a simple way to estimate how fast your heart is beating.

The four chambers of the heart are (i) the *right auricle*, (ii) the *left auricle*, (iii) the *right ventricle*, and (iv) the *left ventricle*. The *right auricle* opens into the right ventricle and the left auricle into the left ventricle.

Get it Right

An artery carries pure (oxygenated) blood and a vein carries impure (deoxygenated) blood. The exceptions are the pulmonary artery that carries deoxygenated blood and the pulmonary vein that carries oxygenated blood.

Right auricle It gets deoxygenated (without oxygen) blood from all parts of the body through veins. This blood is pumped into the right ventricle.

Aorta It carries blood to different parts of the body.

Pulmonary artery It takes blood to the lungs for oxygenation.

Pulmonary vein It brings back oxygen-rich blood from the lungs and pours it into the left auricle.

Left auricle It has thinner walls. It pumps blood into the left ventricle.

Bicuspid valve

Valves They separate each of the chambers so that there is no mixing of blood. They allow blood to flow only in one direction.

Left ventricle It has thicker walls. It pumps blood to the farthest part of the body through the aorta.

Tricuspid valve

Right ventricle It pumps deoxygenated blood into the pulmonary artery that takes the blood to the lungs for oxygenation.

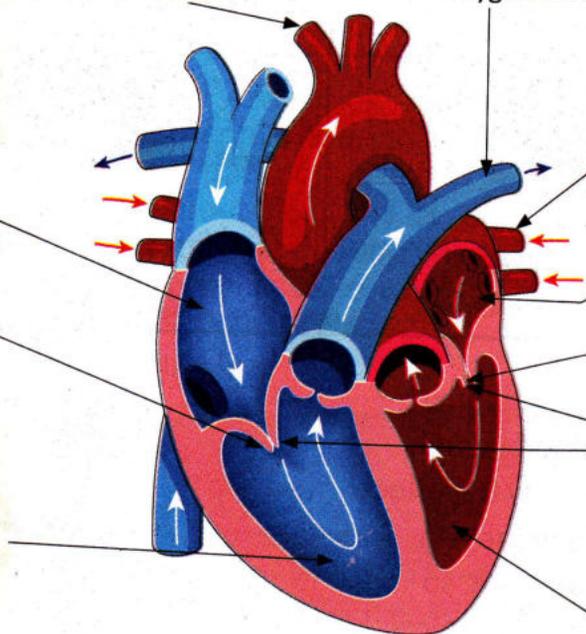


Fig. 10.3 Diagrammatic representation of the four chambers of the heart

Fact File

From ancient times, people have always believed that monitoring the pulse was indicative of the general health of a person. Ancient physicians did not have complex equipment to check the pulse. They checked the pulse by feeling the palpitations. The rate, strength and rhythm of the pulse can tell a lot about a person's health and well-being. Pulse was also known as *naadi* in ancient India.

Activity

Aim: To measure your pulse

Method:

1. Feel your pulse by placing the index and middle finger over the underside of the opposite wrist, below the base of the thumb.
2. Do not use your thumb because it has its own pulse that you may feel.
3. Count the beats for 30 seconds, then double the result to get the number of beats per minute.



Case Study: Terminalia Arjuna (commonly called Arjuna)—A Potential Medicine for Heart Ailments

Arjuna tree is about 60 to 80 feet tall and is commonly found in the sub Himalayan regions of India, especially in the states of Uttar Pradesh, Bihar, Madhya Pradesh, Delhi, Chhota Nagpur and Deccan plateau. The bark of this tree is used to make a herbal medicine that can help in many cardiovascular diseases, especially in heart attacks, high blood pressure and even in controlling heart failure. Since the Vedic age, the bark of Arjuna tree is used as an ayurvedic medicine in ancient India. It also finds its mention in many ancient medicinal texts like the famous Charaka Samhita, Sushruta Samhita, and Astang Hridayam. However, ancient medicine man, Vagabhatta was the first person to start promoting the usage of this bark powder for effective treatment of heart ailments.

Arjuna tree can grow in almost all types of soil. However, a humid loam soil that is well manured is most suitable. This tree can be easily multiplied through germination of its seeds.

Let's Remember

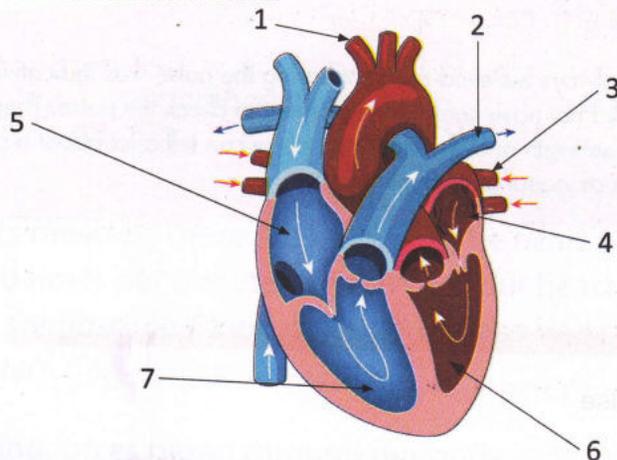


A. Identify the following.

1. This gas is needed for the oxidation of food _____
2. These get generated as a result of life activities inside the human body _____
3. This is the medium for transporting food and oxygen to all parts of the body _____
4. The specialized system in human body that is responsible for transport of substances _____
5. These are the thinnest blood vessels that connect arteries to the veins _____



B. Label the parts of the human heart.



TRANSPORT IN PLANTS

There are different kinds of plants such as herbs, shrubs, and trees. Plants need to transport water from the roots to the leaves. Then the food manufactured in the leaves is transported to different parts of the plant. Though the complexity may vary, the mode of transport in all types of plants is essentially the same.

A tissue called *xylem* acts as a type of pipeline, and takes water and minerals from the roots up the stem, and to the leaves.

Food in plants is manufactured by the leaves. Once the food is prepared, it needs to be sent to all parts of the plant. The process by which this takes place is called *translocation*. Special types of tissues called *phloem* act as pipelines, and carry the prepared food to all parts of the plant.

Transpiration

Absorption of water and minerals is a continuous process. Water is continuously being lost from the leaves by a process called transpiration (Fig. 10.4). *The losing of water from the plant in the form of water vapour is called transpiration.* Transpiration mainly occurs through the stomata present on the underside of the leaves. The opening and closing of stomata controls the amount of water lost during transpiration.

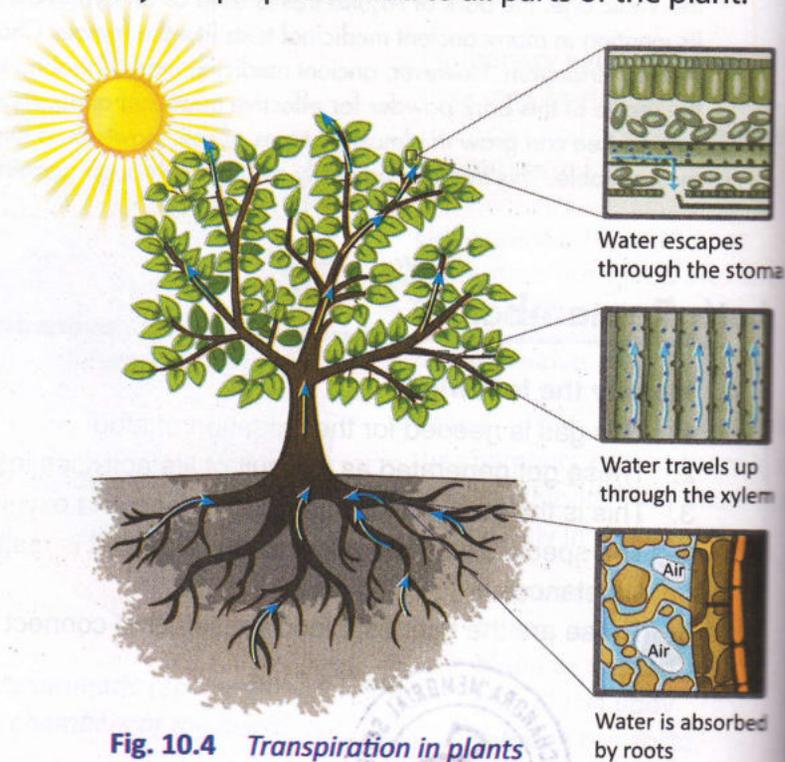


Fig. 10.4 Transpiration in plants

Factors Affecting the Rate of Transpiration

A number of factors affect the rate of transpiration in plants:

- **The condition of air** The warmer the air, higher is the rate of transpiration.
- **The amount of moisture in air** The lesser the amount of moisture in the air, higher is the rate of transpiration.
- **The number of stomata found on the leaves** More the number of stomata, higher is the transpiration.
- **The size of the leaves** The larger the leaf, faster is the transpiration.
- **Importance of transpiration** Transpiration is very important for plants, and has several advantages:
 - **Exchange of gases** Transpiration helps in the opening of stomata. This helps in gaseous exchange, and the plant is able to easily absorb carbon dioxide from the air, which is needed for photosynthesis.
 - **Cooling effect** Evaporation of water vapour given out during transpiration brings down the surface temperature of the plant, thereby cooling it. Transpiration, thus, provides a significant cooling effect that also helps to prevent damage to plant cells due to overheating.
 - **Effect on mineral and water transport** Transpiration creates a low pressure and a pulling force that pulls up the water and minerals. This is similar to what happens when we drink juice or water through a straw. The water and minerals are then transported to different parts of the plant.

Activity

Aim: To demonstrate transpiration

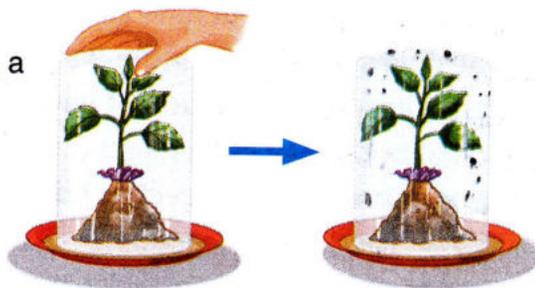
Materials needed: A potted plant, a polythene bag, a glass jar, and a plate

Method:

1. Place the potted plant on the plate, and enclose the soil of the pot in a polythene bag.
2. Now, cover the plant with a glass jar.
3. Leave it undisturbed for some time.

Observation: You will notice tiny droplets of water on the inner surface of the glass cover.

Conclusion: The water comes mainly from the leaves, as the soil has been covered completely. This shows that plants give out water vapour during transpiration.



Activity

Aim: To prove that transportation of water takes place through the xylem

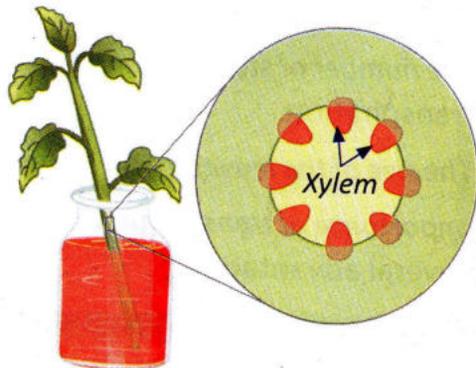
Materials needed: A twig, an empty jam jar, red/blue food colouring, and water

Method:

1. Fill the jam jar three-fourths with water.
2. Add a few drops of red/blue food colouring to the water.
3. Place the twig in this water.
4. Record observations over a period of five days.

Observation: Faint flecks of colour are observed on the leaves gradually over the period of five days. If a cross-section of the stem is cut, tubes coloured with red/blue can be seen towards the centre of the stem. This is where xylem is present.

Conclusion: This shows that xylem transports water and minerals.



EXCRETORY SYSTEM

There are a large number of chemical reactions that take place inside a living body. As a result, a variety of waste products are constantly being generated. The living body needs to remove these wastes. *The process of removal of wastes from the cells of living organisms is called excretion.* The organ system responsible for the removal of wastes is called the *excretory system*.

Excretion in Animals

Animal wastes mainly include carbon dioxide (that is formed during respiration), wastes of the digestive system, and other wastes such as urea and uric acid. Animals such as *Amoeba*, *Paramecium*, *Hydra*, etc., do not have a well-developed excretory system. They get rid of all kinds of body wastes by direct diffusion through the cell membranes. Animals such as earthworms, insects, and leeches have tubular structures that help to get rid of body wastes.

Excretion in Humans



The human body excretes wastes in the following ways:

Through exhaled air Carbon dioxide, formed after respiration, is sent out of the body with the exhaled air.

Through sweat Our skin also acts as an excretory organ. It has small outer openings

Let's Discuss

It is important for living beings to get rid of the wastes produced within them. Why?

called sweat pores. Our body gets rid of a small quantity of urea, salts, and water through sweat secreted by the sweat glands present under the skin. Sweating is important because it helps in regulating body temperature. It helps to keep the body cool by losing body heat, as sweat evaporates off the skin.

Through the kidney A number of nitrogenous wastes such as urea and uric acid are formed inside our body. Urea is a result of the combination of carbon dioxide and ammonia. It is excreted from the body in the form of a pale yellowish-coloured liquid called *urine*. Urine contains almost 95% water and the remaining 5% consists of urea, uric acid, and minerals. Formation of urine takes place inside the kidneys.

The human excretory system (Fig. 10.5) comprises (a) a pair of reddish, bean-shaped organs called *kidneys*, (b) two tubes called *ureters*, (c) a *urinary bladder* that stores urine, and (d) a *urethra* that removes the urine. Waste substances present in the blood are removed with the help of the kidney. When blood enters the kidney, the useful substances are absorbed/filtered back into the blood. Waste substances get dissolved in water and are removed as urine. This absorption/filtration is carried out by the functional unit of the kidneys called *nephrons*. Urine thus formed is collected via the ureters into the urinary bladder. Then, urine is passed out from the body through the opening at the end of the urethra.

Dialysis

Kidneys work in pairs, but they are so efficient that even if one gets damaged, the person can still lead a healthy life. In case both the kidneys are damaged, a person can survive with the help of (a) regular dialysis or (b) a kidney transplant.

Dialysis is a method of removing toxic substances from the blood with the help of a machine when the kidneys are unable to do so. The *dialysis machine* is also called an *artificial kidney*. Blood from an artery of the arm is led through the dialysis machine, where urea and excess salts are removed. The blood is then led back to the patient's body through a vein. In a *kidney transplant*, at least one of the diseased kidneys is replaced with a healthy kidney from a donor.

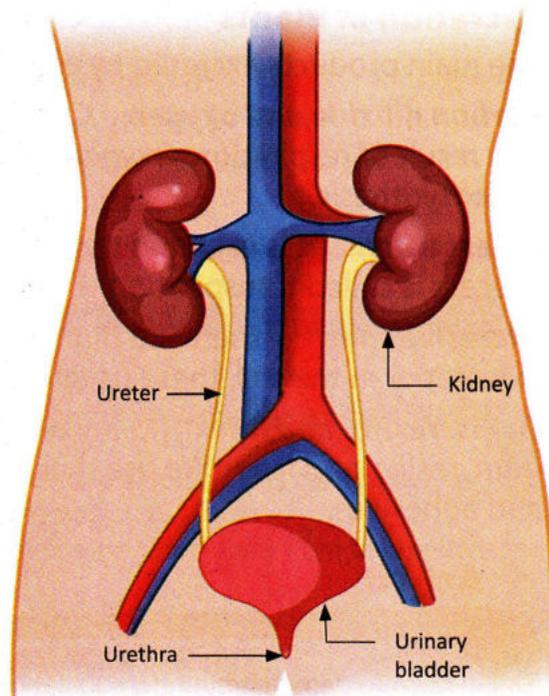


Fig. 10.5 Diagrammatic representation of the human excretory system

Let's Discuss

What is the importance of kidneys in humans?

Excretion in Plants

The main products excreted by plants are:

Carbon dioxide and oxygen Carbon dioxide is formed as a result of respiration. Oxygen is formed as a result of photosynthesis.

Excess water It is excreted through stomata and the process is called transpiration.

Excessive salts If there is a high level of salts present in water or in the soil, these usually get deposited in plants as crystals.

Gums, resins, and latex Many older plants get rid of their toxic wastes in the form of gum, resins, and latex. We use these secretions to manufacture paints, varnishes, rubber, and adhesives.

Fact File

A normal human being excretes about 2 to 3 litres of urine every day. Formation of less urine is a sign of dehydration.

Activity

Aim: To demonstrate how substances move through a semi-permeable membrane, as in dialysis

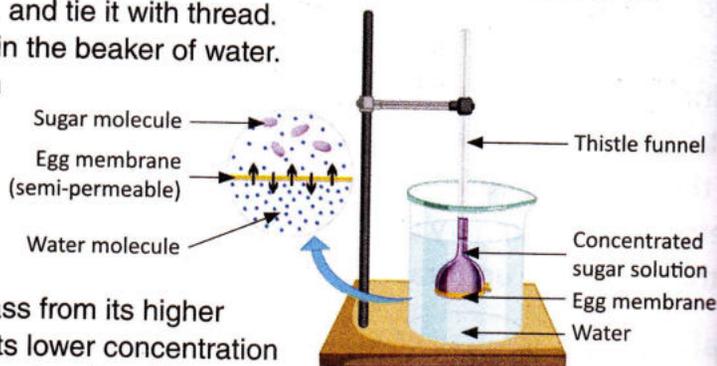
Materials needed: A thistle funnel, a beaker of water, sugar solution, a clamp stand, a piece of thread, and an egg membrane or cellophane paper

Method:

1. Take some concentrated sugar solution in the thistle funnel, cover the mouth of the funnel with the egg membrane, and tie it with thread.
2. Invert this funnel arrangement in the beaker of water. Mark the level of sugar solution in the funnel.

Observation: The level of liquid in the thistle funnel will rise.

Conclusion: This is because the egg membrane is semi-permeable and allows only the solvent molecules to pass from its higher concentration (water in the beaker) to its lower concentration (in the thistle funnel). It does not allow molecules of the solute to pass through. This is exactly how solvent molecules move in dialysis.



Let's Remember



A. Match the following.

- | Column A | Column B |
|-------------|------------------------------|
| 1. Xylem | a. Underside of leaf |
| 2. Phloem | b. Regulation of temperature |
| 3. Sweating | c. Water and minerals |
| 4. Nephrons | d. Prepared food |
| 5. Stomata | e. Functional unit of kidney |

B. Give one word for the following.

1. The process by which the prepared food is sent to all parts of the plant _____
2. The process by which a plant loses water as water vapour _____
3. The process of removal of wastes from cells of living beings _____
4. The process of removing toxic substances from the blood with the help of a machine _____
5. The organs that filter wastes from our body in the form of urine _____

Key Words

Plasma	Straw-coloured fluid that consists of suspended blood cells is called plasma.
Haemoglobin	Red pigment of the blood is known as haemoglobin.
Ventricle	Chamber of the heart with thick walls that pumps blood away from the heart is called ventricle.
Auricle	Chamber of the heart with thinner walls that pumps blood within the heart is called auricle.
Pulmonary artery	Artery that takes deoxygenated blood to the lungs from the heart is called the pulmonary artery.
Xylem	A tissue in plants that takes water and minerals up the stem is called xylem.
Transpiration	The loss of water vapour from the stomata of leaves is called transpiration.
Phloem	A tissue that carries prepared food to all parts of the plant is called phloem.
Translocation	Process by which plants transport prepared food to all parts of the plant is called translocation.
Excretion	The process of removal of wastes from the cells of living organisms.
Nephrons	The functional units of kidneys are called nephrons.

Summary

- Blood is made up of plasma, red blood cells, white blood cells, and blood platelets.
- There are three kinds of blood vessels: arteries, veins, and capillaries.
- Heart is the pumping station of the body. The four chambers of the heart are the right auricle, the left auricle, the right ventricle, and the left ventricle.
- Xylem transports water and minerals from the roots to various parts of the plant.
- Phloem carries the prepared food to all parts of the plant.
- A variety of waste products are generated inside a living body, which must be excreted for efficient functioning of the body and prevention of diseases.
- Human beings excrete their body wastes through lungs (carbon dioxide), skin (sweat), anus (faeces), and through the urinary system (urine).
- The human urinary system comprises the kidneys, ureters, urinary bladder, and urethra.
- Plants excrete their toxic wastes in the form of resins, gums, etc.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

1. In unicellular organisms, every part gets nutrients and oxygen directly through _____ (diffusion/translocation).
2. Blood contains several cells floating in a straw-coloured liquid called the _____ (platelets/plasma).
3. Diffusion of gases and chemical substances takes place through the walls of the _____ (arteries/capillaries)
4. _____ (Valves/Auricles) separate the chambers of the heart so that there is no mixing of blood.
5. _____ (Right/Left) ventricle pumps blood to the farthest parts of the body through the aorta.
6. The larger the leaf, the _____ (faster/slower) is the rate of transpiration.

B. Write T for the True and F for the False statements. Correct the false statements

1. The human circulatory system is made up of the heart and blood.
2. White blood cells contain haemoglobin that helps to transport oxygen.
3. Blood consists of two types of blood cells.
4. Kidneys are always working separately to get rid of wastes.
5. All arteries always carry oxygenated blood.
6. When blood enters the kidney, useful substances are absorbed or filtered back into the blood

C. Choose the correct option.

1. Which of these substances need to be transported within a living organism?
 - a. Food and oxygen
 - b. Water and minerals
 - c. Waste products
 - d. All of these
2. Which of these constitute the blood in human beings?
 - a. Red blood cells
 - b. White blood cells
 - c. Blood platelets
 - d. All of these
3. Which of these increases the rate of transpiration in leaves?
 - a. Warmer air and lesser amount of moisture
 - b. Larger size of the leaf
 - c. Cold and humid air
 - d. Both a and b

4. Which of these parts of the excretory system stores urine?
 - a. Kidneys
 - b. Ureters
 - c. Urinary bladder
 - d. Urethra
5. Which of these does transpiration help in?
 - a. Cooling the plant body
 - b. Helping in exchange of gases
 - c. Creating a low pressure to pull up water and minerals up the stems
 - d. All of these
6. Which of these is not a part of the transport system in human beings?
 - a. Blood and plasma
 - b. Brain and nerves
 - c. Arteries, veins and capillaries
 - d. Four-chambered heart
7. Which of these brings back oxygen-rich blood from the lungs and pours into the left auricle?
 - a. Aorta
 - b. Pulmonary artery
 - c. Pulmonary vein
 - d. Ventricles
8. Which of these helps plants to continuously lose water from their leaves?
 - a. Transportation
 - b. Respiration
 - c. Transpiration
 - d. Translocation
9. Which of these organisms get rid of all kinds of body wastes by direct diffusion through their cells?
 - a. Amoeba and paramecium
 - b. Insects and earthworms
 - c. Amphibians and leeches
 - d. All of these
10. Which of these are common plant wastes?
 - a. Latex
 - b. Gum
 - c. Resins
 - d. All of these

II. Very short answer type questions

Give two examples for the following.

1. Organisms that do not require any special transport system inside them
2. Wastes formed inside the human body
3. Animals that have tubular structures to help them excrete wastes
4. Toxic wastes of plants
5. Things manufactured using plant secretions

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

III. Short answer type questions

1. How do substances get transported in hydra?
2. What is blood? Describe what blood is made up of.
3. Define the following:
 - a. Translocation
 - b. Excretion
4. How do plants get rid of toxic wastes produced in them?

IV. Long answer type questions

1. Explain the main differences between arteries, veins and capillaries.
2. Describe how the heart acts as the pumping station of the body.
3. What is transpiration? Discuss the role that transpiration plays in a plant and the factors that affect the rate of transpiration.
4. With the help of a well-labelled diagram, describe the human excretory system.

LET'S RECALL

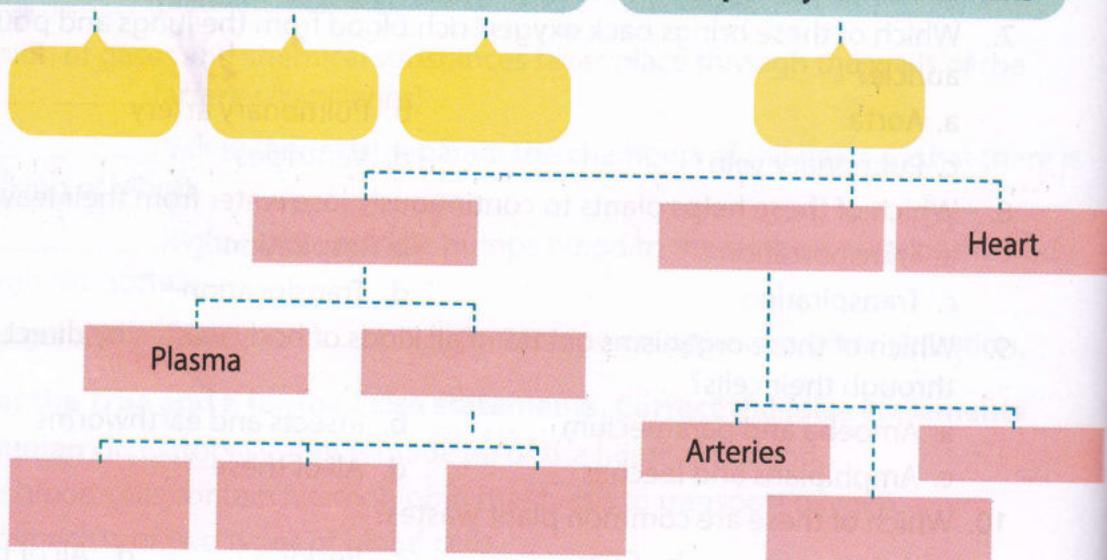


Recall and complete the concept map given below.

Substances that need to be transported in organisms



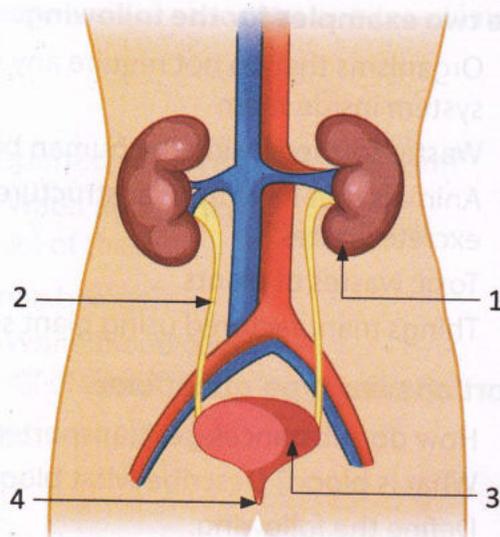
Transport system in humans



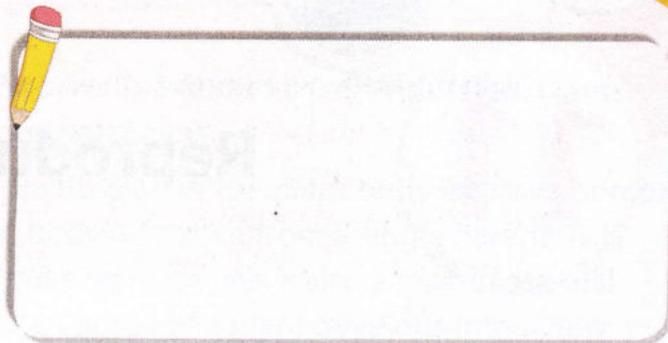
LET'S OBSERVE



1. a. Label the parts of the human excretory system.
- b. In which of these parts does urine gets formed?
- c. Which of these parts releases urine from the body?



2. Draw well-labelled diagrams to show a section of a vein and an artery. 



LET'S CONNECT ART

Paint and varnish are made from excretions of plants. Use paints of different colours and create a wall paper design for 'World Environment Day'.

LET'S APPLY

1. Why do the left ventricles of the heart have thicker walls than the right ventricles? 
2. Mona falls short of breath every time she climbs up a flight of stairs. Can you guess why? 

LET'S ANALYSE AND EVALUATE

1. Examine the set-up and predict what can be expected inside the plastic bag after some time. Give reason. 
2. Evaluate whether the observation will be same or different if the plant had larger leaves. Justify your answer 





LET'S CREATE

1. Make a flip book on the structure and functions of the different parts of 'The Human Circulatory System'. Write the key terms in both English as well as your mother tongue. 
2. With the help of plasticine, make a colourful model of the internal structure of the heart. Then use this model to explain how the heart acts as the pumping station in the human body. 
3. Get into groups of five. Take a cardboard and make models to show the cross-sectional structure of arteries, veins and capillaries. You could use household items like spools of threads and old toilet rolls, etc. for depicting them.  

Web Research

- Browse the Internet and find out the different blood groups of human beings and what causes the difference between them. Also find out about blood transfusion and its importance. Some suggested websites are:
<https://www.redcrossblood.org/donate-blood/blood-types.html> (accessed and checked on 28/08/19)
<https://www.nhs.uk/conditions/blood-groups/> (accessed and checked on 28/08/19)
- Browse the Internet and find out how air pressure works not only in translocation of substances in plants, but also in many other daily activities. Make a report. Some suggested websites are:
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4204789/> (accessed and checked on 28/08/19)
<https://www.encyclopedia.com/science-and-technology/physics/physics/pressure> (accessed and checked on 28/08/19)

11

Reproduction in Plants

Look at the picture. Answer the questions.

1. What is the name of this fruit?

You will learn about

- Reproduction in plants
- Asexual reproduction
- Vegetative reproduction
- Sexual reproduction
- Seed dispersal



2. How many seeds does this fruit have?

3. Give one example for each of the following.

a. A fruit with a few seeds

b. A fruit with many seeds

4. Which part of the plant becomes the fruit?

5. What does a seed need to become a new plant?

_____, _____, _____

6. What is the process by which a seed becomes a new plant called?

In most plants, flower is the reproductive part of a plant. What about plants that do not flower? Such plants use different means to reproduce. In this chapter, we will learn about different methods of reproduction in plants.

Answers: 1. Mango; 2. One; 3. a. Flower; 4. Fruit; 5. Air, water, warmth; 6. Germination

REPRODUCTION IN PLANTS

The process of producing young ones from their parents is known as **reproduction**. Plants reproduce through asexual, vegetative, and sexual means.

Asexual reproduction involves either the simple division of the plant body into two or more parts or the formation of spores. A new plant body is formed from a single parent. This happens under favourable conditions. **Vegetative reproduction** is also a type of asexual reproduction in which a cell, tissue, or part of an organ of a plant develops into a new organism.

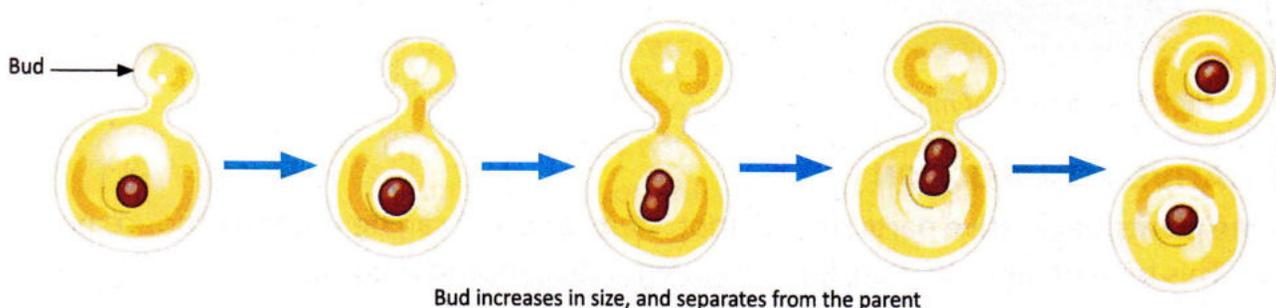
Sexual reproduction takes place by the formation of seeds. It involves two parents and the fusion of male and female reproductive cells called *gametes* to form a single cell called the *zygote*. Let us understand these processes in detail.

ASEXUAL REPRODUCTION

AN

The formation of new plants from the cells of a single parent is called **asexual reproduction**. Asexual reproduction is the simplest form of reproduction found in plants. It is of three common forms: *budding*, *fragmentation*, and *spore formation*.

Budding Microscopic organisms, such as yeasts, reproduce asexually by budding (Fig. 11.1). In this process, a small bulb-like cellular outgrowth, called bud, is formed from the cell. This bud keeps on increasing in size and forms an independent organism which separates from the parent.



Bud increases in size, and separates from the parent

Fig. 11.1 Budding in yeast

Activity

Aim: To observe budding in yeast

Materials needed: A petridish, sugar, baker's yeast (dry), warm water, and a magnifying glass

Method:

1. Put some dry yeast in warm water and some sugar in a petridish.
2. View it using a hand lens.

Observation: When dissolved in warm water and sugar, the yeast cells get activated and bubbles are given out. A certain characteristic smell is also given out.

Conclusion: The yeast cells divide to multiply and increase the volume of the solution.

Fragmentation It is a very common form of asexual reproduction found in algae. Some algae, such as *Spirogyra* (pond silk), *Fucus*, etc., are the slimy, green, and small plants seen floating on the surface of ponds or in dirty drains. In this process, the adult organism just breaks up into two or more pieces called *fragments* (Fig. 11.2). Each of these fragments grows up to become a new plant.

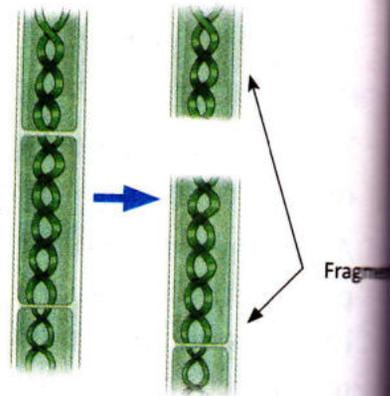


Fig. 11.2 Fragmentation in *Spirogyra*

Spore formation Some plants such as ferns and mosses multiply asexually through spores (Fig. 11.3). Spores are microscopic single-celled or several-celled reproductive bodies that are mostly spherical in shape. They are protected by a thick wall when conditions (such as humidity and temperature) are unfavourable. Once the conditions for germination are favourable, these spores burst out of the thick wall, start multiplying, and grow into new plants.

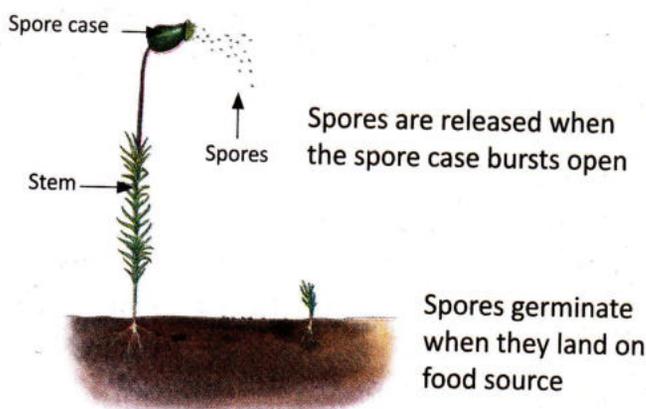


Fig. 11.3 Spores of mosses

Fact File

Ferns and mosses are also known as lower plants. They do not have roots, do not flower, and do not have seeds. So, they multiply with the help of spores.

VEGETATIVE REPRODUCTION

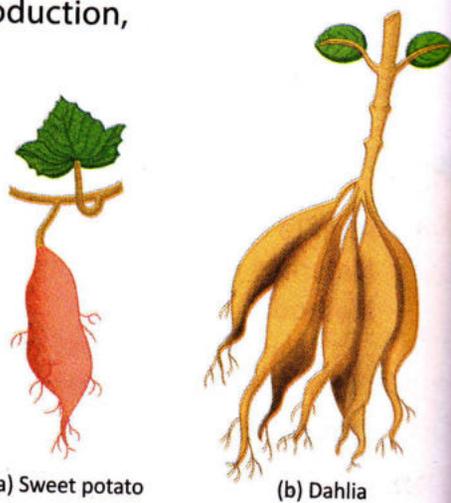
In some plants, vegetative parts such as root, stem, and leaf can be used to produce new plants. This type of reproduction, known as vegetative reproduction, can be done by natural as well as artificial methods.

Natural Methods

Most plants reproduce naturally without the involvement of human beings. They do so with the help of stems, roots, and leaves.

Roots

Tuberous roots of sweet potato [Fig. 11.4 (a)], *Dahlia* [Fig. 11.4 (b)], and *Asparagus* can be set aside for multiplication in the next season. These roots have food stored in them.



(a) Sweet potato

(b) Dahlia

Fig. 11.4 Multiplication by roots

Stems

Stems are the most common parts involved in vegetative propagation.

Vegetative propagation through stems is of the following types:

Plants such as *Oxalis* and grass (Fig 11.5) have horizontal stems growing parallel to the ground, almost touching it. New roots sprout from the nodes (slightly swollen areas occurring at regular intervals on a stem or branch). New shoots also grow upwards forming new plants at frequent intervals.

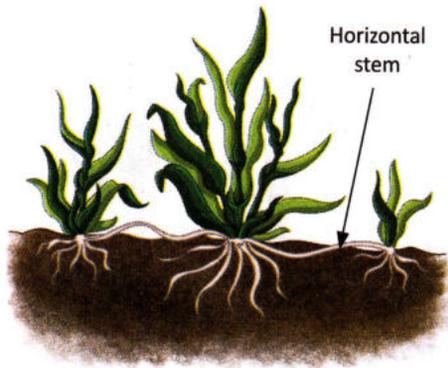


Fig. 11.5 Grass

In plants such as mint and *Chrysanthemum*, horizontal stems arise from the base of the erect shoot, grow horizontally in the soil, and then come out to form new aerial shoots (Fig. 11.6). These shoots become independent plants when stems break away from the parent plants.

Some plants have arched stems which cross over small obstacles and develop small plantlets at their nodes, e.g., *Vallisneria*, wild strawberry.

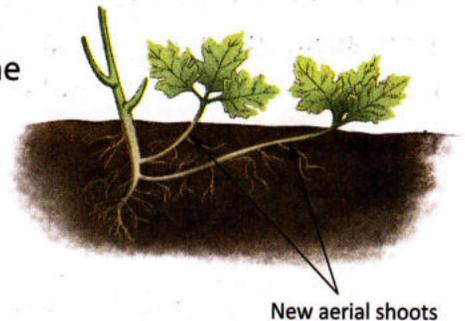


Fig. 11.6 *Chrysanthemum*

Some plants have stems that grow underground. They are mostly swollen because they have food stored in them. This food is used by the new plants to grow. The different types of underground stems are: *rhizomes*, *bulbs*, *tubers*, and *corms*.

Rhizomes They have buds from which outgrowths are produced which give rise to new plants. This is seen in ginger (Fig. 11.7), turmeric, and banana.

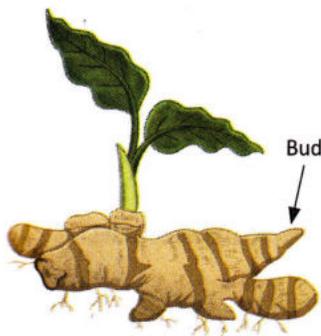


Fig. 11.7 *Rhizome of ginger*

Bulbs They are very short underground stems encased in thickened fleshy bulb scales (which are modified leaves). The scales serve as sites of food storage. This is seen in onions (Fig. 11.8). In the spring, when a new plant shoots up from the centre of the scale cluster, it gets its food from the scales.

Tubers They have buds in the eyes, which give rise to new plants, e.g., potato (Fig. 11.9).

Corms They are lots of rhizomes joined together which develop into new plants, e.g., *Gladiolus* (Fig. 11.10) and *Colocasia*.

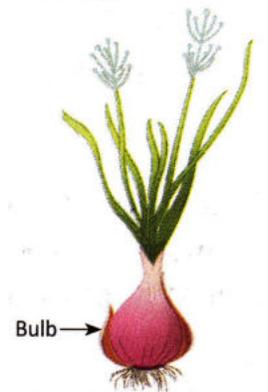


Fig. 11.8 *Bulb of onion*

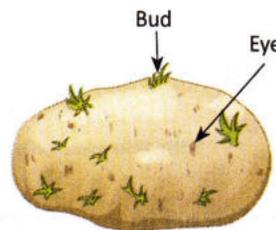


Fig. 11.9 *Tuber of potato*



Fig. 11.10 *Corm of Gladiolus*

Activity

Aim: To study an onion or a potato for vegetative reproduction

Materials needed: An onion or a potato, a glass jar, water, a pot, and soil

Method:

1. Fill an empty pot with soil.
2. Observe the budding points of a potato (eyes) and sow it in the soil.
3. Water the soil regularly.
4. Another method is to fill a glass jar with water and place the onion or potato on the rim such that half of it is in water (see picture). Observe over the next few days.

Observation: Roots and shoots can be seen emerging from the bulb and tuber.

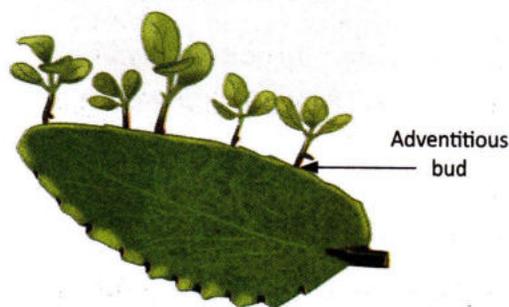
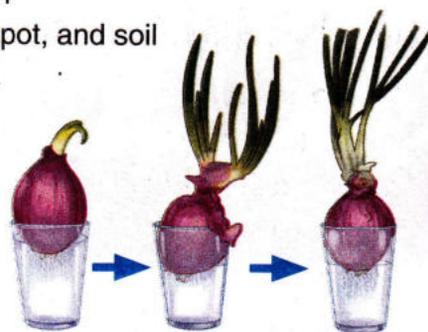


Fig. 11.11 A *Bryophyllum* leaf with adventitious buds

Leaves

Leaves of a number of plants, such as *Bryophyllum*, develop small buds, called *adventitious buds*, on their margin (Fig. 11.11). These buds grow into new plants when the leaf falls from the parent plant and comes in contact with soil.

Artificial Methods

Plants can also be produced vegetatively by artificial means. These methods include cutting, grafting, layering, and tissue culture.

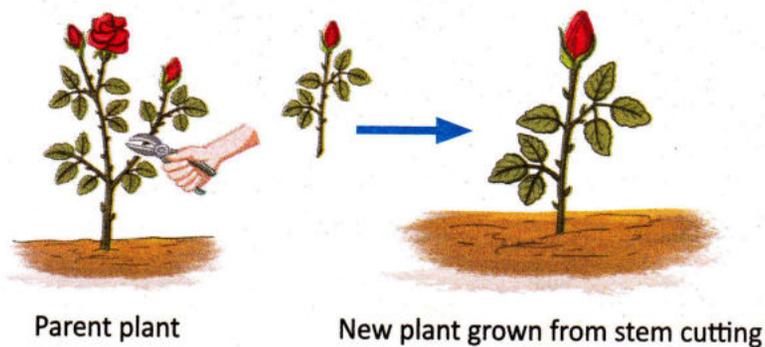


Fig. 11.12 Stem cutting

Cutting

This method is generally used for multiplying sugar cane, rose, *Bougainvillea*, and *Hibiscus*. It involves cutting off part of a stem and placing it in moist soil (Fig. 11.12). After some time, these stems develop roots at the base and grow into a new plant.

Grafting

This is a very common method used in ornamental and fruit plants to develop new varieties called *hybrid varieties*. It involves the following steps:

- A bud, or a cutting that has several buds called the *scion*, of one plant is placed over the cut stem with roots of another plant called the *stock* (Fig. 11.13).
- The scion and the stock are then firmly tied together.
- The stock supplies water and minerals to the scion. In due course, new cells develop in the area where they are joined and a new variety of plant develops. This is common in plants such as the rose, mango, guava, and many other fruit plants.

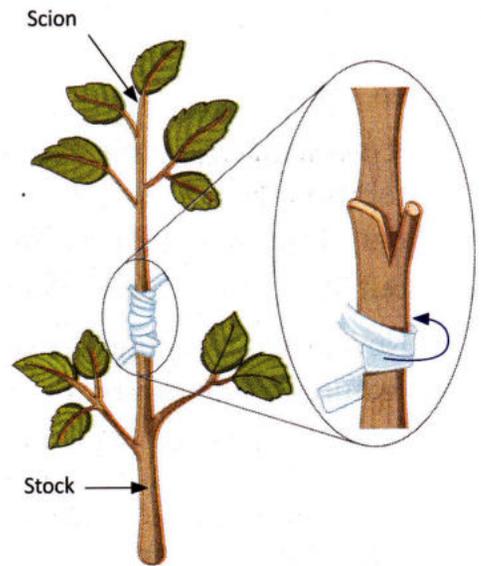


Fig. 11.13 Grafting

Layering

This is a method most commonly used in grapes, jasmine, and *Bougainvillea*.



Fig. 11.14 Layering

- In this process, a young branch is lowered down and bent towards the ground and covered by moist soil forming a layer.

- After some time, roots arise from the branch and grow downwards (Fig. 11.14).
- The branch can then be cut off from the parent plant and allowed to grow into a new plant.

Tissue Culture

This is a method used for large-scale plant multiplication to develop better variety of crops, which are disease-free and have a higher yield, and to conserve endangered and rare breeds of plants. This method is widely used in research work, forestry, and horticulture. Tissue culture involves the following steps (Fig. 11.15).

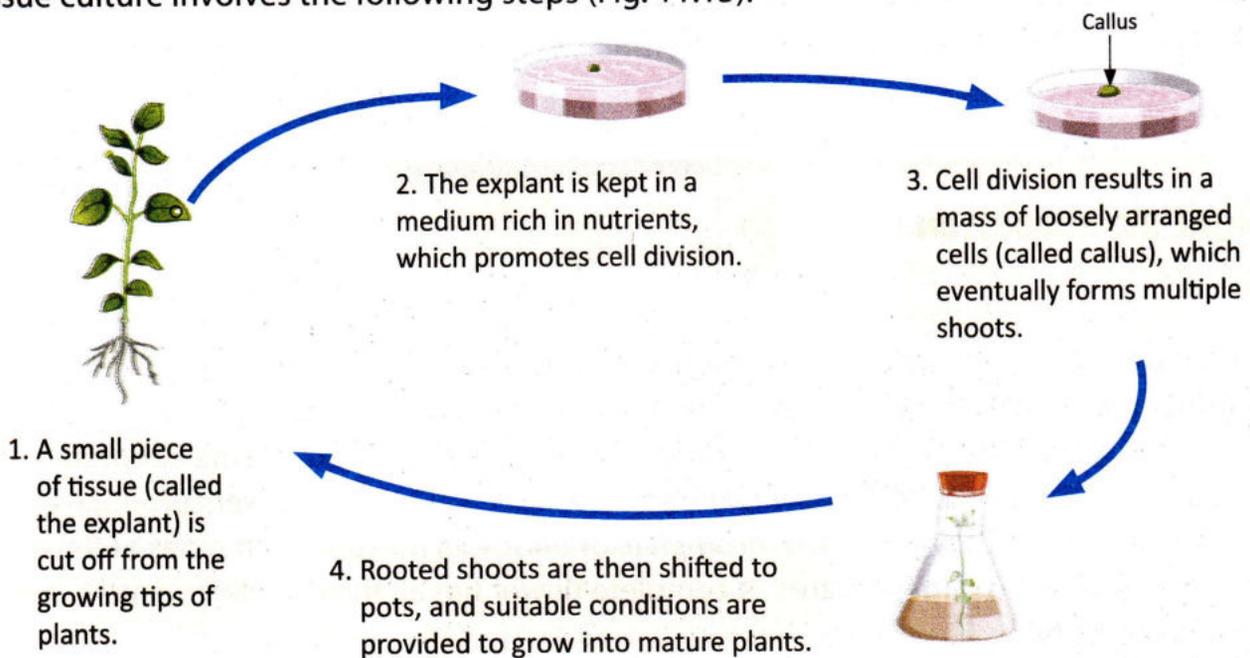


Fig. 11.15 Tissue culture

Advantages of Vegetative Reproduction

The advantages of vegetative reproduction are listed below:

- It is a faster and more certain method of reproduction. Sometimes the seed may not germinate due to unfavourable conditions. But in this case, a new plant directly grows from a part of the parent plant.
- New plants resemble the parent plant exactly. Thus, it helps in conserving characteristic features of the parent plant.
- Plants that do not flower or do not have seeds can reproduce by this method.

Let's Discuss

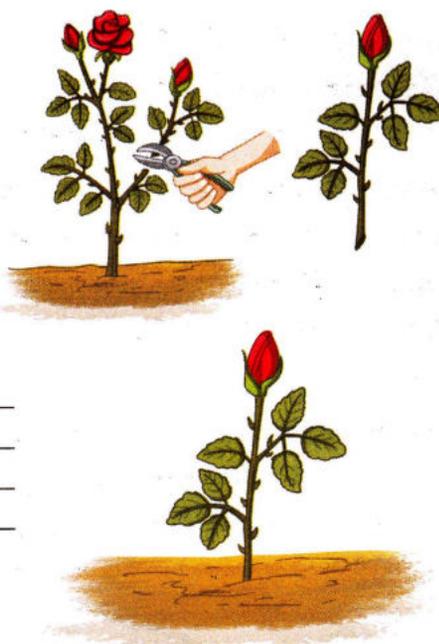
Why is tissue culture the best method for preserving the features of a plant?

Let's Remember



Answer the following questions orally.

1. Name the method of producing new plants shown in the picture. _____
2. Give three examples of plants that multiply by this method. _____, _____, _____
3. Name two other artificial methods of multiplying plants. _____, _____
4. Name the four different types of underground stems and one example of each.
 - a. Type: _____ Example: _____
 - b. Type: _____ Example: _____
 - c. Type: _____ Example: _____
 - d. Type: _____ Example: _____



SEXUAL REPRODUCTION

AN

The formation of new plants through the fusion of male and female gametes is called **sexual reproduction**. Sexual reproduction is carried out only in flowering plants. **Flowers** are the reproductive organs of a plant. Usually a flower contains both male and female reproductive cells. Such flowers are also called *complete* or *bisexual flowers*. When flowers produce either male or female cells, they are called *incomplete* or *unisexual* flowers. Such types of flowers are found in corn and papaya plants. A complete flower has all the four parts: *sepals*, *petals*, *stamens*, and *pistil*.

Let us take a closer look at stamens and the pistil (Fig. 11.16).

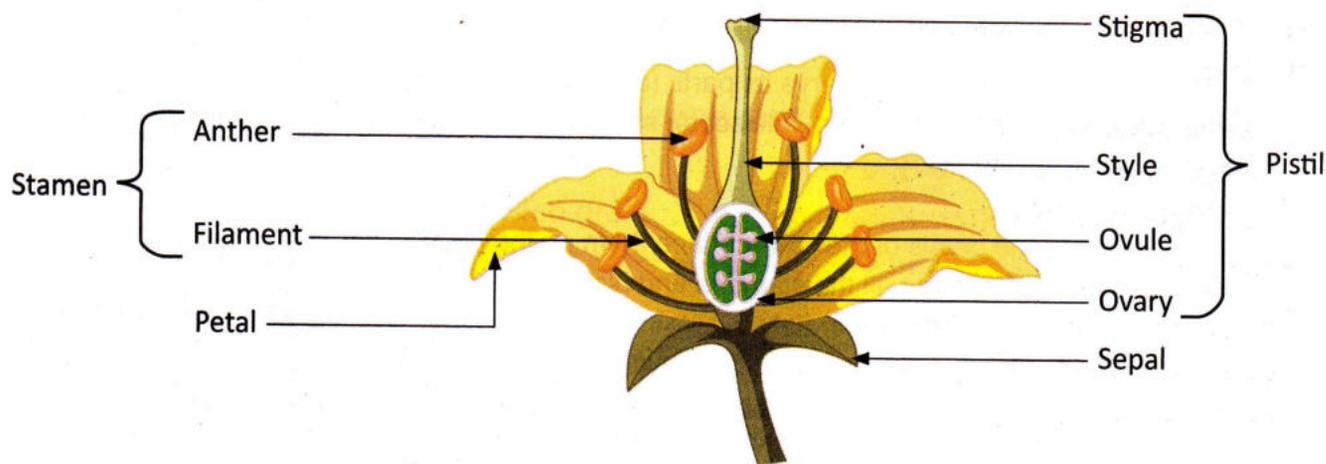


Fig. 11.16 Structure of a complete flower

Stamens (male organ) They bear the *anthers* that contain *pollen grains*. Pollen grains produce male cells (gametes).

Pistil (female organ) The pistil is divided into a *stigma*, *style*, and *ovary*. The ovary produces the female cells (gametes).

Mature plants flower, and after undergoing the processes of pollination and fertilization, the flower becomes a fruit. Fruits may have one or more seeds inside them. New plants develop from these seeds. Let us learn how pollination and fertilization happens, and how fruits and seeds are formed.

Pollination

The transfer of pollen grains from the anther to the stigma is known as **pollination** (Fig. 11.17). This is the first step in the process of seed formation. The male gamete, present in the pollen grains of the anthers,

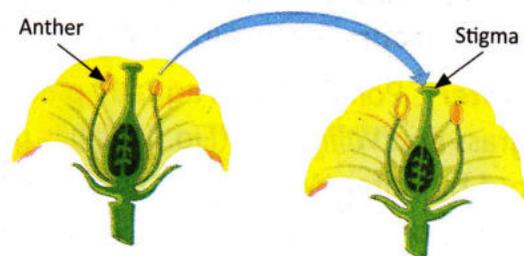
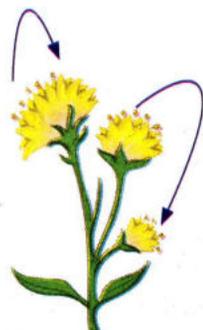
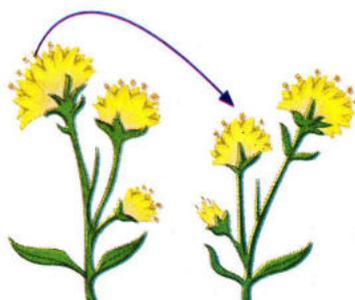


Fig. 11.17 Pollination



(a) Self-pollination



(b) Cross-pollination

The pollen grains are transferred from the anther to the stigma of the same flower or on another flower of the same plant.

The pollen grains are transferred from the anther of one flower to the stigma of another flower of a different plant of the same kind.

Fig. 11.18 Types of pollination

needs to reach the female gamete in the ovary. Only then fertilization can take place.

Pollination is of two types: *self pollination* and *cross pollination* (Fig. 11.18).

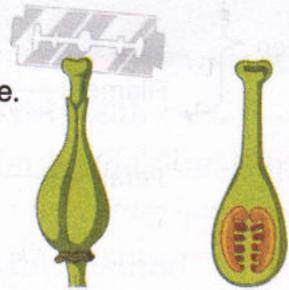
Activity

Aim: To dissect a flower and observe its parts (adult supervision required)

Materials needed: Any flower (e.g., hibiscus), scalpel, glass slides, and a blade for cutting a longitudinal section of ovary

Method:

1. Peel out all the petals of the flower. Place them on the glass slide.
2. Now carefully take out all the stamens and pistil of the flower and place them separately.
3. Observe the kind of stamens that the flower has.
4. Slice off the pistil of the flower lengthwise to reveal the ovary. Can you see the ovules? Note your observations.



Agents of Pollination

The most common agents of pollination are *wind*, *water*, and *insects*.

Wind Wind blows away pollen grains from the anthers of one flower to the stigma of another flower. Such flowers are small, not brightly coloured, and do not produce nectar (a sweet liquid produced by flowers). Pollen grains are very light and produced in large numbers so they are easily blown away by the wind. This type of pollination occurs in wheat, rice, and maize.

Water Pollination in aquatic plants such as sea grass and *Vallisneria* (Fig. 11.19) is usually carried out by water. Water-pollinated flowers release their pollen grains into the water, and are slowly carried to other flowers by water currents.

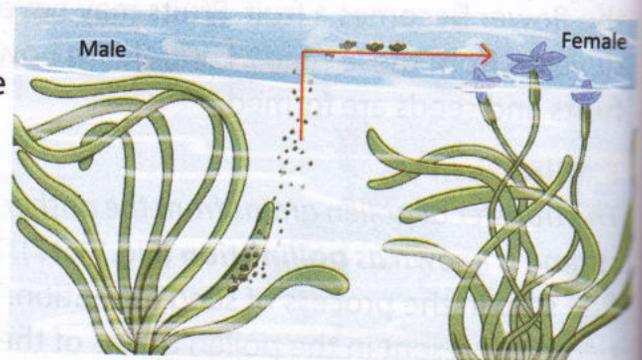


Fig. 11.19 *Vallisneria*

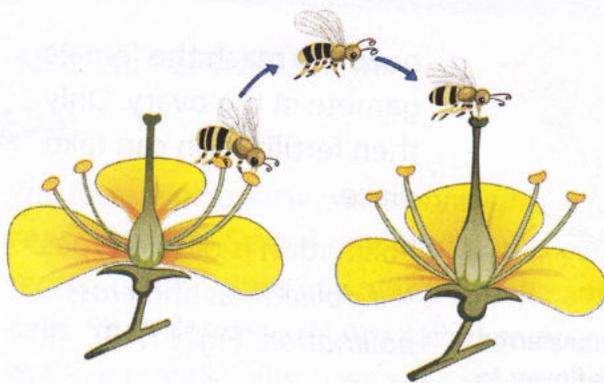


Fig. 11.20 *An insect-pollinated flower*

Insects Many insects visit flowers for nectar (Fig. 11.20). During the process, some pollen grains stick to the body parts of these insects. When these insects visit another flower, the pollen grains fall on the stigma. Insect-pollinated flowers usually have a sweet smell, brightly coloured petals, and are rich in nectar, for example, rose, sunflower, and gulmohar. Flowers visited by nocturnal (active during night) insects have white/light green petals but are often strongly scented, for example, jasmine and cacti.

Fertilization

After successful pollination, the stigma secretes nutrients.

- The pollen grain absorbs these nutrients and starts growing.
- A thin tube grows out of the pollen grain.
- The pollen tube keeps growing till it reaches the ovule inside the ovary and enters it.
- The male gamete is carried inside the pollen tube. Once the pollen tube reaches the ovule, the male gamete fuses with the female gamete (eggs) present there. *The process of fusion of male and female gametes is called fertilization* (Fig. 11.21).
- A zygote is formed after fertilization takes place.

Fact File

Some birds such as sunbirds and hummingbirds have small, narrow beaks to pollinate flowers. Mammals such as bats and rodents also pollinate flowers.



Let's Discuss

What are the features of an insect-pollinated flower?

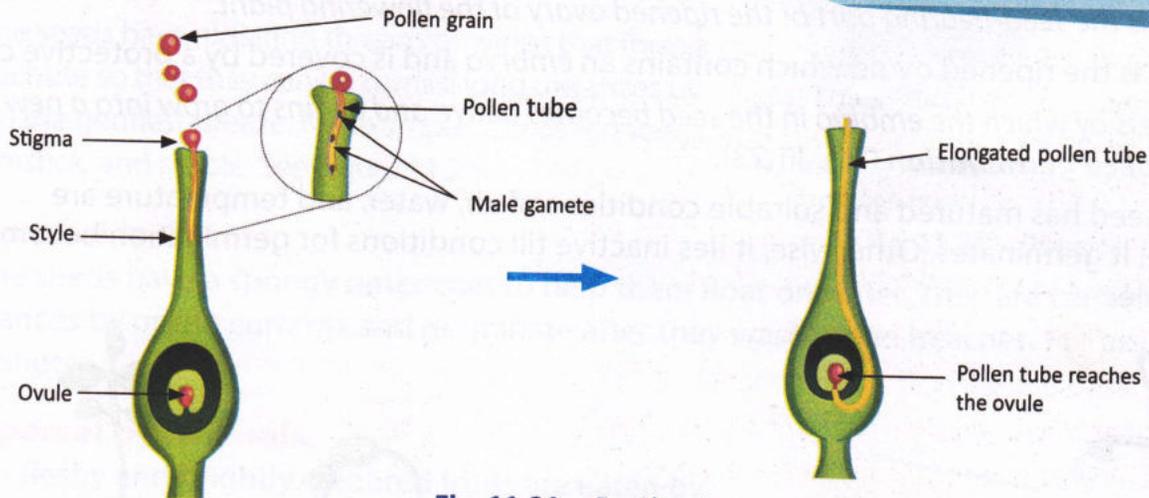


Fig. 11.21 Fertilization

Let's Remember



Answer the following questions orally.

1. Name the male organs of a flower.
2. Name the female organs of a flower.
3. Name the following:
 - a. A flower that contains both male and female reproductive cells
 - b. The transfer of pollen grains from the anther to the stigma of the same flower
 - c. The transfer of pollen grains from anther of one flower to the stigma of the other flower
 - d. The process of fusion of male and female gametes
 - e. This is formed after the fusion of male and female gametes takes place

Fruit and Seed Formation

After fertilization, the ovary enlarges to form the fruit (Fig. 11.22):

- The wall of the ovary becomes the fruit wall.
- The ovules become the seeds.
- A fruit may have one or more seeds.
- Petals, sepals, and other parts of the flower usually dry up and fall off.

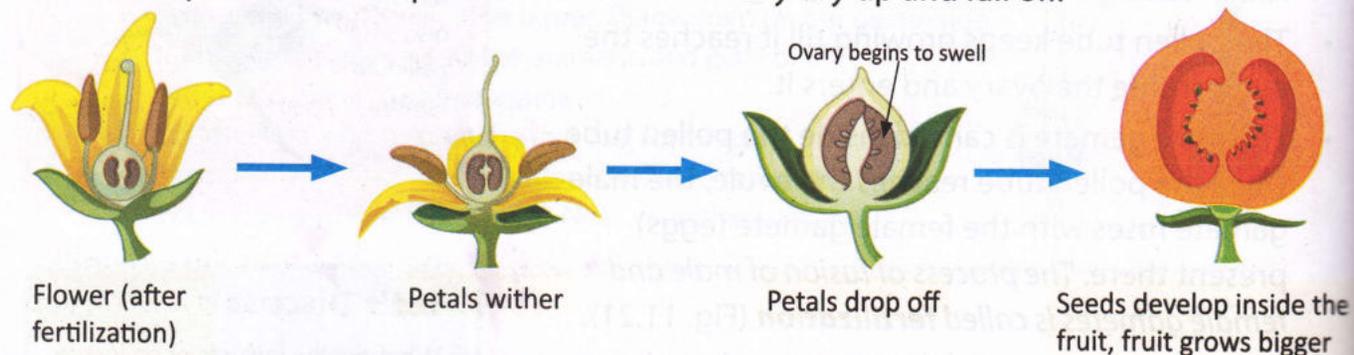


Fig. 11.22 Transformation of a flower to a fruit after fertilization

The **fruit** is the seed-bearing part or the ripened ovary of the flowering plant.

The seed is the ripened ovule which contains an *embryo* and is covered by a protective coat.

The process by which the embryo in the seed becomes active and begins to grow into a new plant is called **germination** (Fig. 11.23).

When a seed has matured and suitable conditions of air, water, and temperature are available, it germinates. Otherwise, it lies inactive till conditions for germination become favourable.

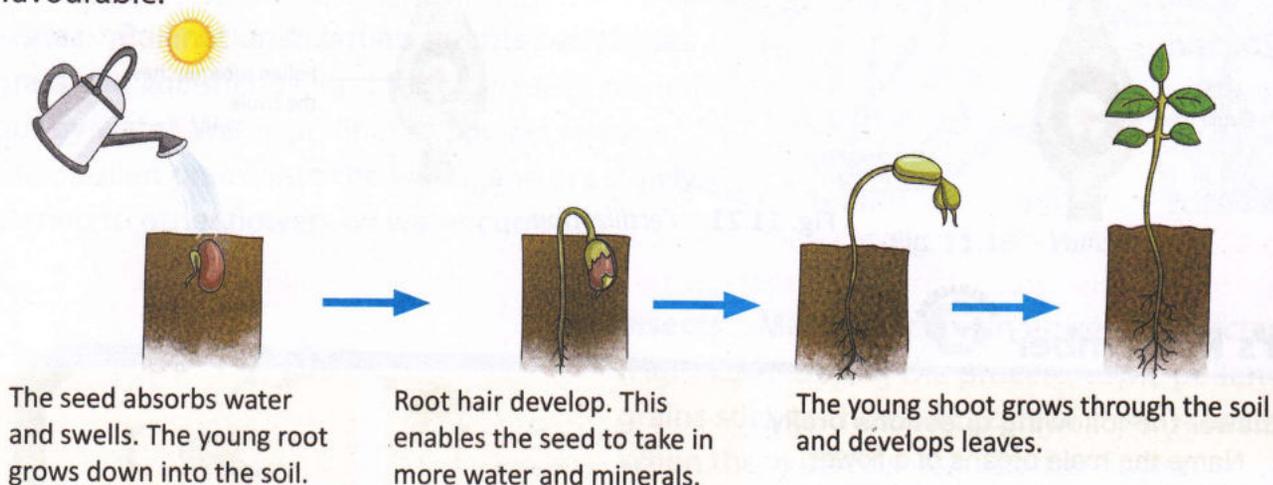


Fig. 11.23 Process of germination

Know your Scientist

Jagadish Chandra Bose was the first Indian who did a detailed study on plants and their responses. He invented a special machine called the crescograph that could measure the growth in plants. His plant experiments had direct connections with an ancient text on plants called '*Vrikshayurveda*'.



SEED DISPERSAL

Have you ever wondered how the same kinds of plants are found at different places? If all plants were to grow at the same place, there would be huge competition for survival. They would not be able to get enough space, light, and water to grow. Scattering of seeds or fruits helps in reducing this competition and also plants get distributed to distant places and thus, enter new habitats. The process by which seeds or fruits are scattered is called *dispersal*.

The seed, enclosed in the fruit, needs to separate from its parent plant before it can develop into a new plant. Fruits are adapted in different ways to help in dispersal. But very often, both fruits and seeds together form the dispersal unit. Dispersal takes place by several mechanisms, including wind, water, and a variety of animals.

Dispersal by Explosion

In the simplest way, seeds are automatically set free by opening of the fruit. An explosive mechanism bursts the fruit open to release the seeds. For example, pea plants, castor, and balsam.

Dispersal by Wind

Some seeds have radiating threads or wings that form a parachute so that they can be carried long distances by even the gentlest breeze. For example, *Dandelion* seeds, drumstick, and maple. See Figure 11.24.

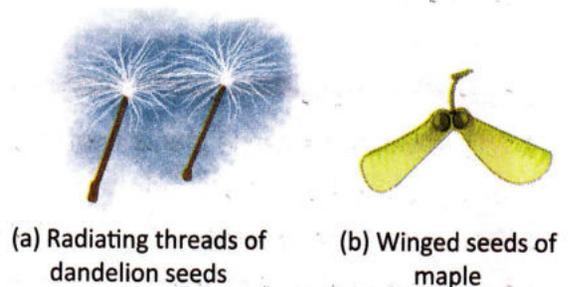


Fig. 11.24 Dispersal by wind

Dispersal by Water

Some seeds have a spongy outer coat to help them float on water. They are carried great distances by ocean currents and germinate after they wash up on beaches. For example, coconuts.

Dispersal by Animals

Most fleshy and brightly coloured fruits are eaten by birds and mammals. These fruits appear tasty and are highly nutritious for these animals, giving them a reason to **forage** for the fruits repeatedly. Seeds of these fruits pass through the digestive tract of animals and get dispersed.

Some birds eat fruits whose seeds stick to their beaks and then are rubbed off somewhere else (Fig. 11.25). Seeds of other fruits pass intact through a bird's digestive tract.

Some fruits are covered with little hooks or sticky substances and get caught in the fur or hide of animals such as sheep. As the animal moves about, fruits or seeds are rubbed off by branches of shrubs or trees.

Ducks may disperse fruits sticking in the mud on their feet.

Word help

Forage To search for food



Fig. 11.25 Dispersal by birds

Key Words

Reproduction	The process of producing young ones from their parents is known as reproduction.
Asexual reproduction	The formation of new plants from the cells of a single parent is called asexual reproduction.
Spore	Microscopic, single-celled, or several-celled reproductive bodies protected by a thick wall is called spore.
Sexual reproduction	The formation of new plants through the fusion of male and female gametes is called sexual reproduction.
Stamen	Male part of a flower which have anthers that contain pollen grains is called stamen.
Pistil	Female part of a flower that contains the ovary with the ovules is called a pistil.
Self-pollination	The process where pollen grains are transferred to the stigma of the same flower is called self-pollination.
Cross-pollination	The process where pollen grains are transferred from the anther of one flower to the stigma of another flower of the same kind is called cross-pollination.
Fertilization	The process of fusion of male and female gametes is called fertilization.
Zygote	The result of the fusion of male and female gametes is called zygote.

Summary

- Reproduction in plants is of three types: asexual, vegetative, and sexual.
- Asexual reproduction is the process in which new plants are produced by involving only one parent.
- Flowerless plants such as algae reproduce by fragmentation; yeasts reproduce by budding, while moulds and mosses reproduce through spores.
- Vegetatively, plants reproduce with the help of roots, bulbs, rhizomes, tubers, corms, and adventitious buds.
- There are many artificial methods by which plants multiply. These include cutting, grafting, and layering.
- In sexual reproduction, the male and female organs produce male and female gametes, whose fusion results in a zygote. This zygote develops into a new individual.
- Sexual reproduction is carried out only in flowering plants.
- After fertilization of the egg, the ovary becomes a fruit and ovules become seeds.
- Seed dispersal is necessary to separate the seed from the parent plant so that the seed can grow into a new plant.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

1. The male and female reproductive cells called _____ (gametes/zygote) fuse to form a single cell called _____ (gametes/zygote).
2. _____ (Spores/Fragments) are microscopic single-celled or several-celled reproductive bodies that are mostly spherical in shape.

3. _____ (Grafting /Tissue culture) is a method used for large scale multiplication to develop better variety of crops and to save endangered species of plants.
4. _____ (Pollination/Fertilization) is the first step in the process of seed formation.
5. The _____ (fruit/flower) is the seed-bearing part of a flowering plant.

B. Write T for the True and F for the False statements. Correct the false statements.

1. Plants can only reproduce by asexual methods.
2. An algae multiplies by the process of layering.
3. The pistil bears the anthers that contain female gametes.
4. After successful pollination, the stigma secretes nutrients.
5. Wind blows away pollen grains from anthers of one flower to the stigma of another flower.

C. Choose the correct option.

1. By which of these processes, does the yeast multiply?
 - a. Budding
 - b. Fragmentation
 - c. Spore formation
 - d. Grafting
2. In which of these processes is a young plant lowered towards the ground and covered by moist soil forming a layer?
 - a. Grafting
 - b. Layering
 - c. Cutting
 - d. Tissue culture
3. Which of these is an underground stem with fleshy scales that serve as sites of food storage?
 - a. Rhizome
 - b. Bulb
 - c. Tuber
 - d. Corm
4. Which of these parts of a flower contain male gametes?
 - a. Anthers
 - b. Stigma
 - c. Style
 - d. Ovary
5. Which of these is known as the ripened ovary?
 - a. Sepals and petals
 - b. Fruit
 - c. Seed
 - d. Embryo
6. Which of these is an example of a bulb?
 - a. Potato
 - b. Onion
 - c. Gladiolus
 - d. Ginger
7. In which of these processes does the adult organism breaks up into two or more pieces?
 - a. Budding
 - b. Grafting
 - c. Fragmentation
 - d. Spore formation
8. Which of these have buds in the eyes that give rise to new plants?
 - a. Bulbs
 - b. Tubers
 - c. Rhizomes
 - d. Corm
9. Which of these is not a part of the pistil of a flower?
 - a. Stigma
 - b. Stamen
 - c. Style
 - d. Ovary
10. Which of these have buds from which outgrowths are produced which give rise to new plants?
 - a. Rhizome
 - b. Bulb
 - c. Corm
 - d. Both a and b

II. Very short answer type questions

Give two examples for the following.

1. Plants that multiply by fragmentation
2. Plants that multiply by their tuberous roots
3. Plants that have corms
4. Plants that multiply by cutting
5. Plants that multiply by layering
6. Plants that pollinate by wind
7. Plants that pollinate by water
8. Plants whose seeds disperse through explosion

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

III. Short answer type questions

1. Why are underground stems swollen?
2. Differentiate between the following:
 - a. Asexual and sexual reproduction
 - b. Self-pollination and cross-pollination
3. Why do seeds need to disperse?

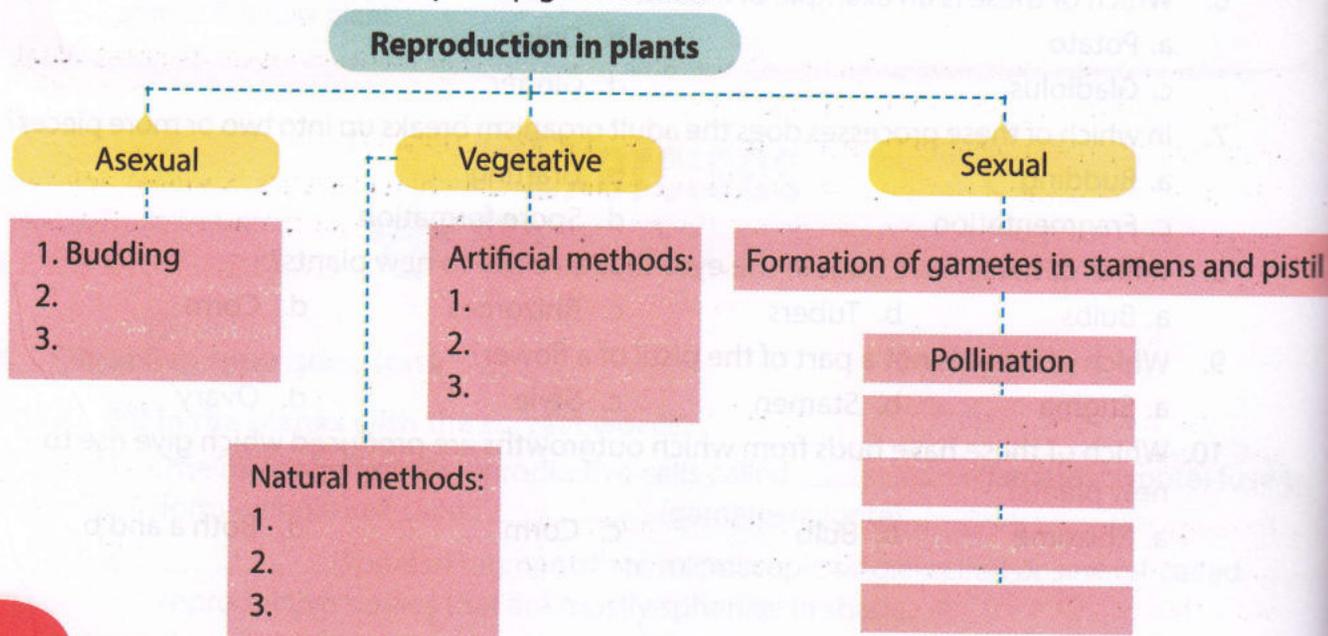
IV. Long answer type questions

1. Describe the various steps involved in tissue culture.
2. What are the advantages of vegetative reproduction?
3. What happens after successful pollination?
4. Explain with examples, the different ways in which seeds disperse.

LET'S RECALL



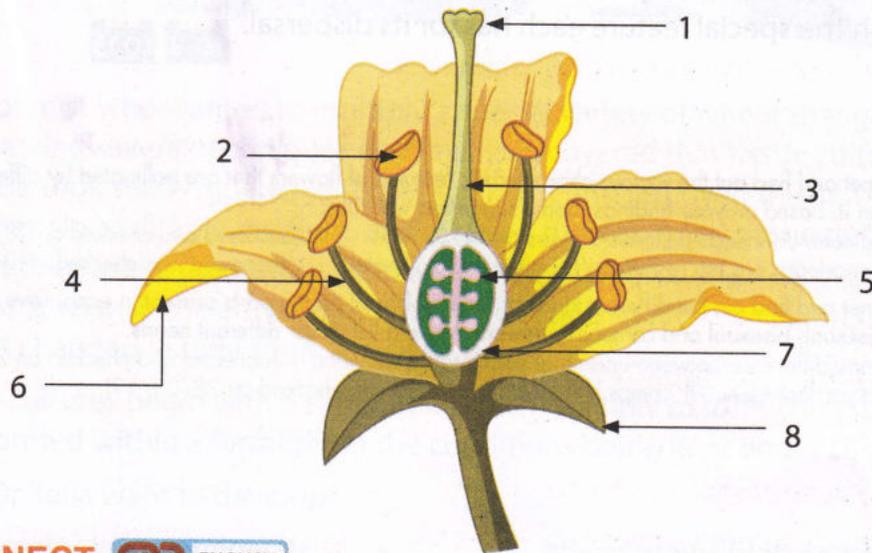
Recall and complete the concept map given below.



LET'S OBSERVE



- Look at the picture and answer the following questions. **LO 3**
 - This is a _____ (bulb/rhizome/tuber).
 - It is an underground _____ (root/stem/leaf).
 - This is a _____ (sexual/asexual) method of reproduction.
- Label the organs in the complete flower given below. Circle the female parts.



LET'S CONNECT ENGLISH

Imagine you are a farmer who wants to preserve the high quality of wheat that he grows. What would you do? Write a descriptive account in your own words.

LET'S APPLY



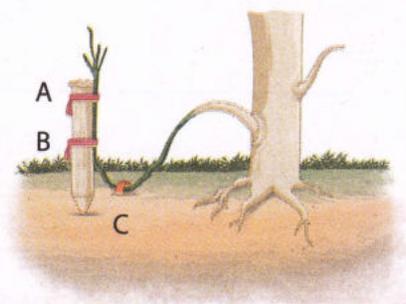
- A certain flower is very colourful but its stamens and stigma are hidden inside its petal. What kind of pollination will it show—self or cross?
(Hint: Will an insect be able to reach the stamens and stigma easily?)
- Manas grows a variety of guavas that have certain special characteristics. Suggest any two ways in which the guava trees can be multiplied to preserve the special characteristic features.
(Hint: Think of various ways that plants reproduce) **LO 4**

LET'S ANALYSE AND EVALUATE

- Analyse and predict what can be expected at each of the points A, B and C.
- Evaluate if this method can be useful for multiplying an onion plant or a grape plant? Give one reason to justify your choice.



LO13



LET'S CREATE



1. In groups of five, collect ten different types of flowers fallen on the ground. Then open out each of them to see whether they have all four parts. See if they are complete or incomplete flowers. Then dry them up and paste them under two columns on a chart paper as: Complete flowers and Incomplete flowers with their names. Also, guess the pollinating agent for each of them.  
2. Make a list of any twenty seeds and guess how each of them will be dispersed. Make a chart with the name of the seed in English as well as in your mother tongue, and its dispersal agent, along with the special feature each has for its dispersal.  

Web Research

- Browse the Internet and find out the various characteristic features of flowers that are pollinated by different animals. Write a report on it, based on your findings. Some suggested websites:
<https://sciencing.com/do-insects-pollinate-flowers-6464153.html> (accessed and checked on 28/08/19)
<https://www.sciencelearn.org.nz/resources/80-attracting-pollinators> (accessed and checked on 28/08/19)
- Browse the Internet and find out the different kinds of flowers, based on the parts present in each. Dive deep and find out what are unisexual, bisexual and composite flowers. Make a list under different heads.
<http://pediaa.com/difference-between-unisexual-and-bisexual-flowers/> (accessed and checked on 28/08/19)
http://www.backyardnature.net/fl_comps.htm (accessed and checked on 28/08/19)

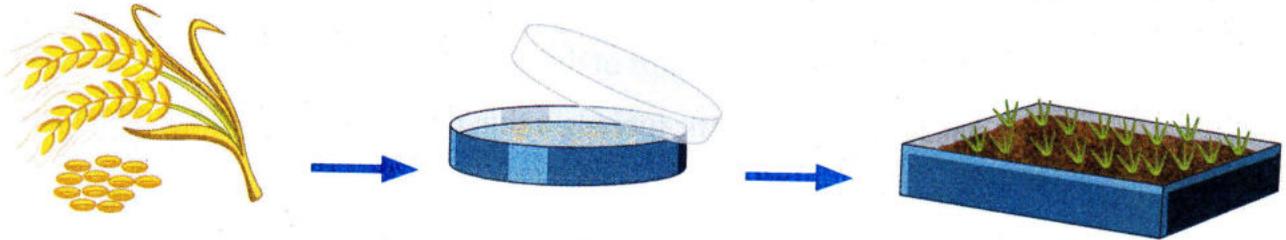
Worksheet 3

Skills assessed:

Problem solving, and qualitative analysis

Read the passage given below and answer the questions that follow.

Tissue culture



Dr Kalia is a botanist who wanted to multiply a special variety of wheat that gave grains high in minerals. He tried several techniques and finally discovered that tissue culture could be the right answer. He took seeds (grains) of the wheat plant and removed the immature embryos. He then placed them in a suitable medium, and allowed them to grow at the right temperature and moisture conditions in the laboratory. Care was taken that the culture did not get contaminated with microbes, otherwise the entire experiment would be spoilt. The cells in the culture then multiplied and changed in their form and size.

Usually, tissue cultures begin with a single cell, which multiply to form colonies of clones. These colonies get formed within a fortnight of the conditions being kept under control.

1. What did Dr Kalia want to develop?
 - a. Wheat grains low on minerals
 - b. Wheat grains high on minerals
 - c. Fast growing microbes
 - d. Slow growing microbes
2. In which of these is the tissue fragment kept to multiply in a laboratory, for tissue culture?
 - a. A medium
 - b. A colony of microbes
 - c. A lot of water
 - d. All of these
3. Which of these gets formed when cells multiply in a tissue culture?
 - a. Seeds
 - b. Colony
 - c. Tissue
 - d. Grains
4. Why do we need to keep temperature and moisture conditions under control for tissue culture?

5. What type of reproduction is discussed here? Asexual/Sexual

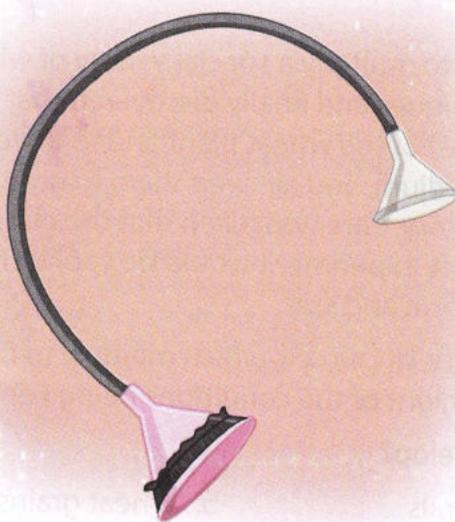
6. Give one advantage of using this technique to multiply plants.

SCIENCE FAIR

Skills learnt:
Conceptual, production, and
interpersonal

Aim: Making a model of a stethoscope in groups of three

Materials required: 1 Balloon, 2 small plastic funnels, a thin plastic pipe, scissors, a paper knife, and an electrical tape



Method:

1. In your groups, cut off the mouth of the balloon. Stretch the balloon over the mouth of one of the funnels. Pull the balloon tightly, so that it is stretched over the funnel, similar to a drum skin. Use electric tape to tightly fasten the balloon rubber.
2. Stick the end of the funnel into one end of the plastic tube. If the funnel is very loose, then use electric tape to fasten it.
3. Attach the second funnel to the other end of the tube. Do not cover it with a balloon. Your stethoscope is ready.
4. In a quiet room, use the stethoscope to check the heartbeat. Place the balloon-covered end over your friend's heart and the other end against your ear.
5. If the room is quiet enough, you should be able to hear the heart beating!
6. Now run for about five minutes, and then try to hear the heartbeat again.
7. In the fair, demonstrate how the stethoscope works, and discuss how a doctor uses a stethoscope to diagnose health issues.

*For the Teacher: Please refer to the teacher's manual for more details

12

UNIT 4: Moving Things, People, and Ideas

Time and Motion

Why do we need to know the time? Look at the pictures below and match them with the words given in the boxes.

You will learn about

- The need to measure time
- Measurement of time
- Slow and fast motion
- Distance and time graphs

1.



a. To go to school on time

2.



b. To catch a train

3.



c. To make sure the cake is properly cooked

4.



d. To see who is driving the fastest

Almost all our actions depend on what time (of the day or night) it is. In this chapter, we will learn about why and how we measure time, and also how it is connected to the study of motion of objects.

Answers: 1-b; 2-d; 3-a; 4-c

THE NEED TO MEASURE TIME

The need to measure time was felt by human beings a long time ago. In every civilization, however ancient, there has been evidence of people keeping track of time. In ancient times, people closely followed the movement of the sun, moon, and the stars. They noticed that once the sun rose in the morning, it would set after a considerable period. They could do many things from sunrise to sunset. This gave them a concept of 'time'. People kept track of the passage of time by keeping track of events that were repeated, such as sunrise, the number of sunrises (days) between two full moons, the number of full moons between two seasons, etc.

As the complexity of their lives increased, people felt the need to split the day into smaller periods. As civilizations grew, more ways of measuring time were devised. Today, we measure time for a variety of applications: we need to meet our clear-cut schedules, the doctor checks how many times our heart beats in one minute, we need to know when a train or plane will arrive, the amount of time a computer will take to perform an operation, and so on. The list is endless.

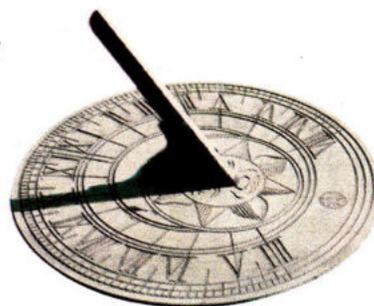
But how do we define time? The dictionary defines time as the period between two events. For example, sunrise and sunset can be taken as two events. Then the period between sunrise and sunset on a particular day would be the 'time' between the sunrise and sunset.

Fact File

The world's largest sundial is located in Jantar Mantar, Jaipur. It is called Virhat Samrat Yantra. This sundial is very accurate and we can read time to an accuracy of a few seconds.

MEASUREMENT OF TIME

In the beginning, people used calendars to keep a track of years, which were divided into months and days (not exactly what we use today, but something similar). Later, people started keeping track of the time of the day. They started building various instruments to divide the day into smaller parts. An instrument used to measure time is called a *clock*. People used instruments such as *sundials* [Fig. 12.1(a)] and *hourglass* [Fig. 12.1(b)] to keep track of time. The movement of the shadow of a rod stuck upright in the ground, whose shadow changed direction with the movement of the sun across the sky, was used to make crude sundials. An hourglass consisted of two rounded glass bulbs connected by a narrow neck of glass. The top bulb was filled with sand and a measured amount of sand particles streamed down from the top bulb into the bottom bulb. The duration taken by sand to stream down from the top bulb into the bottom bulb gave the measure of time. An instrument known as *water clock* was also used in different parts of the world. It worked on the principle of regulated flow of water.



(a) Sundial



(b) Hourglass

Fig. 12.1 Instruments used to measure time

These devices were not very accurate and there was a need to improve accuracy and devise instruments that gave a better measurement of time. A major breakthrough came in 1656, when Christiaan Huygens made the first *pendulum clock*. It consisted of weights and a swinging pendulum. These clocks were much more reliable than the earlier ones.

Another major advancement in timekeeping was the invention of the *atomic clock*, which is very accurate.

Today, clocks do not just tell us the time of the day; they are also used as timers in ovens, in stopwatches, in various athletic events, etc. The SI unit of time is the *second*. Some other units of time are given in Table 12.1.

Table 12.1 Units of time

60 seconds	1 minute
60 minutes	1 hour
24 hours	1 day
365¼ days	1 year
10 years	1 decade
10 decades	1 century
10 centuries	1 millennium

Tech Specs

A timer is a special type of clock. It is used to control the sequences of an event. It is used in traffic signals, appliances like washing machines, and the highly explosive time bombs.

Fact File

The National Physical Laboratory, an institute in New Delhi, maintains standard measurements (such as metre, kilogram, second, etc.) for our country. The national standard of time, the second, is maintained with the help of Caesium atomic clocks. These clocks are linked to clocks in other such institutes all over the world through satellites.

Very Large and Very Small Time Scales

For various applications and research purposes, we need to measure time periods that are very large and also time periods that are very small.

We deal with very large time scales when we study the age of the Earth, Solar system, life cycles of stars and the age of the universe. These large time scales are measured in units such as petaseconds (10^{15} s, i.e., 1000000000000000 s, which is 31.7 million years).

On the other hand, very small time scales are measured in units such as picoseconds (10^{-12} s, i.e., 0.000000000001 s). This is one billionth of the time we take to blink!

Know your Scientist

Christiaan Huygens was born in 1629 in Netherlands. He was from a wealthy and distinguished family and his father was a diplomat. He went on to become a very illustrious scientist. He made very important contributions in the fields of astronomy and light. His interest in astronomy led to his desire to constructing accurate clocks, and he invented the pendulum clock.



Measurement of Time Using Periodic Motion

Any object that is moving is said to be in motion. In order to measure time, we need a motion that repeats itself in equal intervals. Such a motion is called *periodic motion*.

Some examples of periodic motion are the rotation of the Earth about its axis, the revolution of the Earth around the sun, the revolution of the moon around the Earth, the to-and-fro movement of a spring, and the oscillation of a pendulum. These types of periodic events are used to make clocks and calendars. Some of the first accurate clocks were based on the periodic movement of a pendulum.

Simple Pendulum



A setup that contains a small mass suspended from a fixed point and allowed to swing freely under the influence of gravity is called a **pendulum**.

A ideal, simple pendulum consists of a small mass (like a stone or a metal ball) called a bob suspended by a string. See Figure 12.2.

When the bob moves from one position and returns to the same position, it is said to complete one *oscillation*. The time taken to complete one oscillation is called the **time period** of the pendulum. It is measured in seconds. For example, if the bob starts from point A (Fig. 12.2), goes to points B and C, and returns to point A, it completes one oscillation.

By studying the oscillations of a simple pendulum, the observations can be summarized as follows:

- The time taken by a pendulum to complete one oscillation (i.e., its time period) does not depend on the extent to which the bob of the pendulum is displaced.
- The time period does not depend on the mass of the bob used (within reasonable limits).
- The time period depends on the length of the string or wire used; greater the length of the string, greater is the time period (assuming that the string itself has negligible mass).

This means that if the length of the pendulum is fixed, its time period is constant. This was a wonderful discovery. Scientists began to build new clocks based on this property of the pendulum.

Activity

Aim: To show the constancy of the time period of a pendulum

Materials needed: A string, a small stone, a doorknob/handle, and a stopwatch

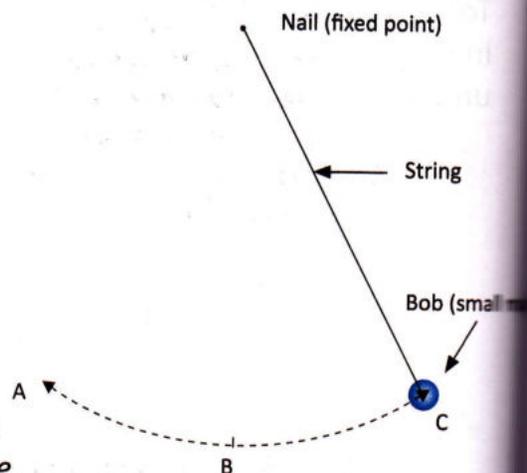


Fig. 12.2 A simple pendulum

Fact File

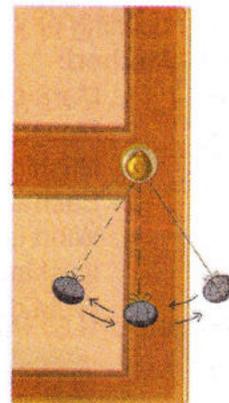
Scientists have found that atoms and molecules of substances vibrate about a mean position. Some clocks (quartz clock) are also based on the oscillation of certain crystals such as quartz.

Method:

1. Take a string of length about 30 cm. Tie the stone to one end. Tie the other end of the string to a doorknob/handle.
2. Displace the stone slightly and let it oscillate. Make sure it oscillates freely and does not rub against any object or the door.
3. Use the stopwatch and note the time taken by the stone to complete ten oscillations. [Take any one point, the extreme position in the oscillation or the mean (middle) position of the stone and count the number of times the stone crosses this point, in the same direction.]
4. Divide the time taken for ten oscillations by 10. This gives the time period of the pendulum.
5. Repeat the experiment many times without changing the arrangement. Compare the value of the time periods obtained.

Observation: The time period is the same in each case.

Conclusion: This shows the constancy of the time period of the pendulum.



Let's Remember



A. Write T for the True and F for the False statements. Correct the false statements.

1. A sundial is used to measure sunrise and sunset.
2. A sand clock is the most accurate of all clocks.
3. One century is equal to ten years.
4. The time period of a pendulum is dependent on the length of the string.

B. Answer the following questions orally.

1. Why do we need clocks?
2. What is periodic motion?
3. Name three units of time.
4. How many seconds are there in an hour?
5. What is the bob of a pendulum?

How fast or slow an object travels depend on the time it takes to travel a certain distance. It is closely related to the measurement of time. We will now discuss slow and fast motion, and how we can measure it.

SLOW AND FAST MOTION

Objects may travel fast or slow. For example, we may observe that an aeroplane travels very fast while a bicycle is slow. What, precisely, do we mean when we use the terms 'fast' and 'slow'?

When we say a body moves fast (or slow) we refer to its speed.

The **speed** of an object is defined as the distance travelled by it in unit time. The SI unit of speed is *metre per second* (m/s). Therefore, an object that moves faster covers more distance in a second (unit time) as compared to an object that moves slower.

Activity

Aim: To study fast and slow-moving objects

Materials needed: As many wind-up/battery-operated toys as you can get, such as cars, animals, dolls, a stop watch, a long smooth surface such as a long corridor in your school building or your house, measuring tape, and chalk piece

Method:

1. Mark a starting line with the chalk piece.
2. Measure a convenient length using the measuring tape (like 5 m or 10 m) and mark the finishing line.
3. Each of you (you and your friends) take turns to place a toy on the starting line.
4. Wind up/start the toy and use the stopwatch to measure the time it takes to reach the finishing line.
5. Write down your measurements in a tabular form as shown below.

Name of toy	Time taken from start to finish line (seconds)

Examine your results. Which toy was the fastest and which was the slowest?

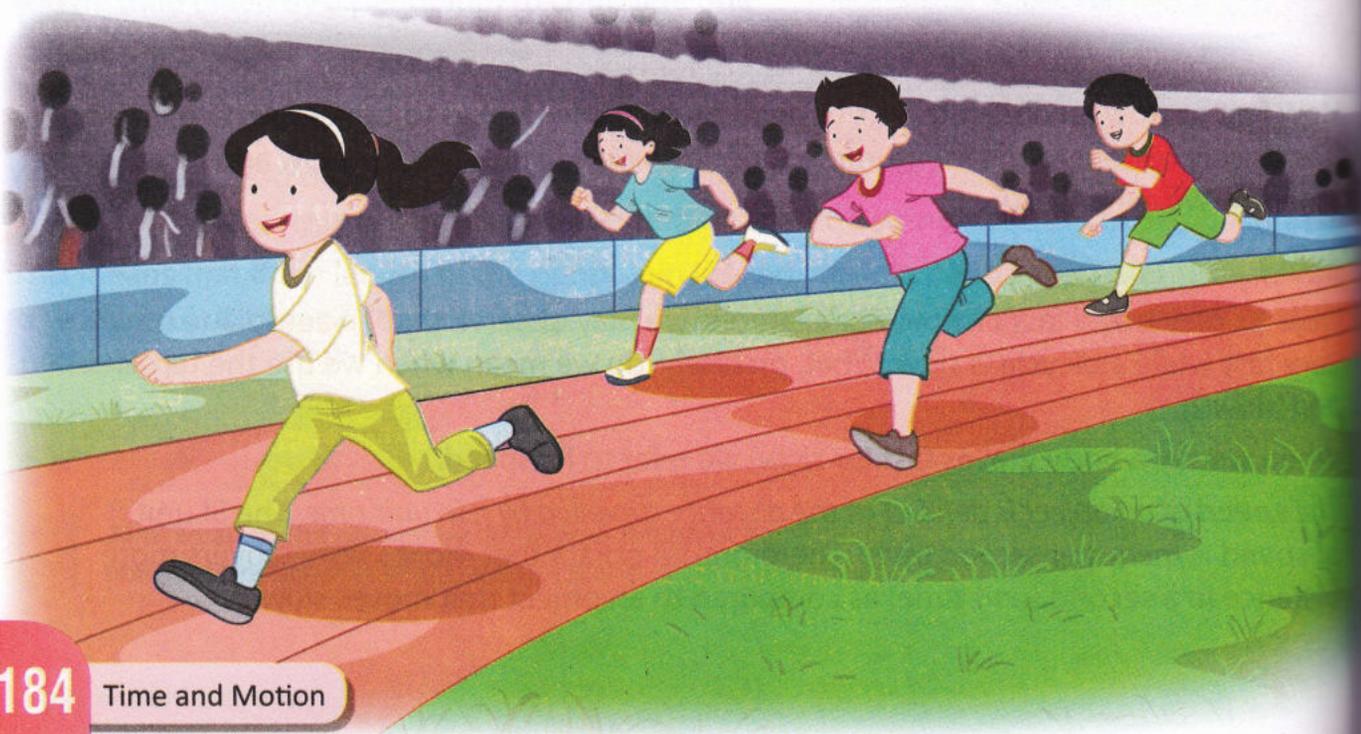
Fastest toy; Time taken

Slowest toy; Time taken

Conclusion: As you can see, the fastest toy covers the same distance in a shorter period of time.

Calculation of Speed

Shreya, Ronald, Sabina, and Kirit participated in a race. They took 20 s, 22 s, 25 s, and 28 s, respectively, to reach the finishing line. Who do you think ran the fastest and who ran the slowest?



We can calculate the speed of an object if we know the distance it travels in a given amount of time. Let us see how this is done.

In the above example, let us say it was a 100 m race. Shreya ran the race in 20 s. What is Shreya's speed? As speed is the distance travelled in unit time, Shreya's speed can be calculated by dividing the distance she ran by the time she took to cover that distance.

$$\begin{aligned}\text{Therefore, Shreya's speed is} &= \frac{\text{Distance travelled}}{\text{Time taken to travel the distance}} \\ &= \frac{100 \text{ m}}{20 \text{ s}} = 5 \text{ m/s}\end{aligned}$$

Similarly, calculate the speed of Ronald, Sabina, and Kirit.

You will notice that, if the distance travelled is the same, the person who takes the shortest time to cover the distance runs the fastest.

Let us consider one more example.

Example 1

A school bus covers a distance of 7200 m in 1800 s. Calculate its speed.

Solution

We know that speed is given by the distance travelled divided by the time taken.

$$\begin{aligned}\text{Given: Distance travelled by the bus} &= 7200 \text{ m} \\ \text{Time taken} &= 1800 \text{ s}\end{aligned}$$

$$\begin{aligned}\text{Speed} &= \frac{\text{Distance travelled}}{\text{Time taken}} \\ &= \frac{7200}{1800} = 4 \text{ m/s}\end{aligned}$$

In practice, very few objects travel at a constant speed for long. Your school bus may speed up and slow down many times on the way to school. To estimate the speed in such cases, we use the concept of average speed. **Average speed** is defined as the total distance travelled divided by the total time taken to travel that distance.

Case Study: Speed Detection Cameras

You must have seen sign boards about speed limits on the roads, and big prominent billboards highlighting the dangers of speeding on roads. Speeding vehicles can cause serious injuries and even death of the passengers in the vehicle and also the pedestrians and other vehicles on the road. In order to discourage speeding, and to penalise and punish drivers for speeding, traffic police all over India have installed 'Speed Detection Cameras' at major roads and junctions. This move is intended to ensure safe driving and reduce the number of accidents and deaths on the Indian roads.



Activity

Aim: To calculate the speed of a vehicle

Materials needed: A stopwatch or a wristwatch with a second hand, a notebook

Note: This activity requires a vehicle to be driven by an adult driver.

Method:

1. Make a table like the one below in your notebook.

Starting km (D1)	Finishing km (D2)	Starting time (t1)	Finishing time (t2)	Distance km (D2-D1)	Time t2-t1	Speed = (D2-D1)/(t2-t1)

2. Select a straight road that is not too crowded to go on a drive.
3. Note the starting kilometre reading from the odometer. Also note the starting time.
4. Let the vehicle move for some time, at a steady speed, as long as straight road and traffic permits. Note the finishing time and finishing distance.
5. At the end of the road, note the finishing time and the finishing distance.
6. Repeat steps 3, 4, and 5 for five or six runs.
7. At the end of the five or six runs, fill in the columns for (D2-D1) and (t2-t1). Calculate the speed for each run and fill in the last column.

Different Units of Speed

Depending on the need and context, speed is measured in different units. As you already know, the SI unit of speed is metre per second (m/s). Other commonly used units are kilometre per hour (km/h) and miles per hour. When we talk about the speed of aeroplanes and cars, it would be more appropriate to use km/h than m/s.

Look at the typical speeds of some moving things given in Table 12.2 below. Find the speeds of the rest of them and fill in the vacant boxes.

Table 12.2 Typical speeds of common moving things

Moving thing	Speed
Elephant (Asian)	
Shark (in the ocean)	
Tortoise	
Horse	70 km/h
Snail	
Leopard	
Reindeer	
Migratory birds	
World record for 100 m dash	

Moving thing	Speed
The Earth around the sun	
Rockets (to escape the Earth's gravity)	Over 40,000 km/h
The moon around the Earth	3683 km/h
Speed of sound	330 m/s
Speed of light	3×10^8 m/s
Car (average speed in the city)	60 km/h
Commercial airplane	
Supersonic fighter jets	

The world record for the men's 100 m dash is 9.58 seconds. Who holds the record for the 100 m dash in your class? Have you measured the time you take for a 100 m dash? Can you calculate the speed? Use a calculator, if necessary. Try it in your school ground. Take the help of your teacher/PT teacher.

When a vehicle is moving, it is interesting to find out how fast it is moving. Have you seen a meter fitted inside a vehicle? In a car, the meter is fitted on the dashboard, and in scooters or motorcycles on the top. This is used to display the speed and distance travelled by the vehicle. *The instrument measuring the speed of the vehicle is called a **speedometer** (Fig. 12.3). The distance travelled by the vehicle is given by an instrument called **odometer** (Fig. 12.3). Both of them are usually fitted together. These instruments will give the reading of speed and the distance travelled at the same time.*

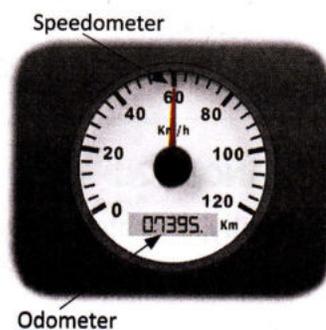


Fig. 12.3 Speed and distance travelled by the vehicle

Speeding on the road is not something to feel proud of. It can lead to accidents. Please make sure that the person driving the vehicle does it within the safe speed limits appropriate for the road. This is essential for the safety of all the people travelling in the vehicle as well as for those using the road. Particular care must be taken to drive slowly close to schools, on winding roads and when visibility is poor. Standing still or going slowly in a speed lane can also be dangerous.

Speed in km/h

Let us see how the speed of the school bus (given in Example 1) can be expressed in km/h.

$$\begin{aligned} \text{Distance travelled by the bus} &= 7200 \text{ m} \\ \text{Distance travelled (in kilometres)} &= 7200 \div 1000 \\ &= 7.2 \text{ km} \\ \text{Time taken} &= 1800 \text{ s} \\ \text{Time (in hours)} &= 1800 \div 3600 \\ &= 0.5 \text{ h} \\ \text{Therefore, speed of the bus} &= \frac{7.2}{0.5} \\ &= 14.4 \text{ km/h} \end{aligned}$$

Fact File

Quick conversions

m/s to km/h

If speed in m/s = M

speed in km/h = $M \times 18/5$

km/h to m/s

If speed in km/h = K

Speed in m/s = $K \times 5/18$

Now, express the speeds of all the moving things in Table 12.2 in the same unit and arrange them in ascending order of their speeds, in your notebook.

Let's Remember



A. Fill in the blanks with the correct words.

- _____ (Time/Speed) is the distance travelled by an object in unit time.
- The SI unit of speed is _____ (km/h, m/s).
- _____ (Hours per mile/Miles per hour) is a unit for speed.
- An odometer is used to measure _____ (speed/distance).

B. Answer the following questions orally.

1. Pinky takes 25 seconds to run 100m and Dinky takes 28 seconds to run the same distance. Who runs faster?
2. After travelling in a car for an hour, Arun finds that he has travelled 65 km, while Varun has travelled 60km in the same time. Whose car was slower?
3. Which is faster—1km/s or 1m/s?

DISTANCE AND TIME GRAPHS

Generally, a vehicle travelling on a road does not travel at a constant speed throughout its journey. If we note the distance travelled by the object at equal intervals of time (e.g., every second or every minute), we will get a clearer picture of its speed at different points of time. The data of the distance travelled and the time taken can be presented in many ways. One method would be to make a table. See Table 12.3. The information given in Table 12.3 can also be represented in a graph as shown in Figure 12.4.

Table 12.3 Tabular representation of distance travelled and time taken

Time (in min)	Distance (in km)
2	2
4	4
6	6
8	7
10	8
12	9
14	9
16	9
18	9

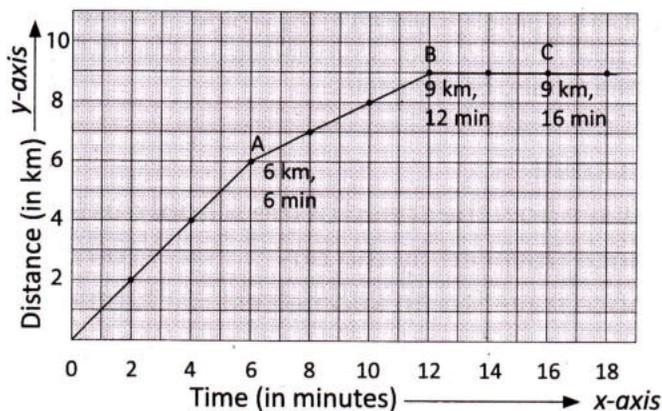


Fig. 12.4 Distance vs time graph

This is called a *distance-time graph*. It is created by plotting a series of data points and connecting them to form a line. In Figure 12.4, we have taken time on the x-axis and the distance on the y-axis.

We can get the following points by examining the distance–time graph:

1. The steepness of the slope of the graph gives the speed. If the slope is greater (i.e., if the slope is steeper as in line OA of Fig. 12.4), the speed is greater than the speed shown by line AB because its slope is flatter.
2. The speed is zero if the graph is flat (i.e., parallel to the ‘time’ axis) as in BC.

If we assume that the vehicle moves at constant speed, i.e., it covers the same distance in equal intervals of time, the data would be as shown in Table 12.4.

Now, if we plot a graph for this data, it will be as shown in Figure 12.5. The graph would be a

Let's Discuss

Why is it necessary to find the distance travelled every few seconds while making the distance-time graph?

steadily rising straight line. A motion that can be represented by a straight line as shown in Figure 12.5 is called 'uniform motion'. In other words, a body is said to be in **uniform motion** if it covers equal distances in equal intervals of time. The motion of a body as shown in Figure 12.4 is non-uniform as it does not cover equal distances in equal intervals of time.

Table 12.4 Tabular representation of distance travelled and time taken

Time (in min)	Distance (in km)
2	2
4	4
6	6
8	8
10	10
12	12
14	14
16	16
18	18

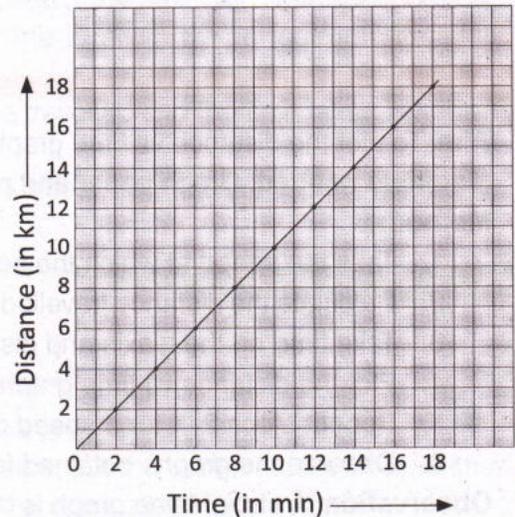
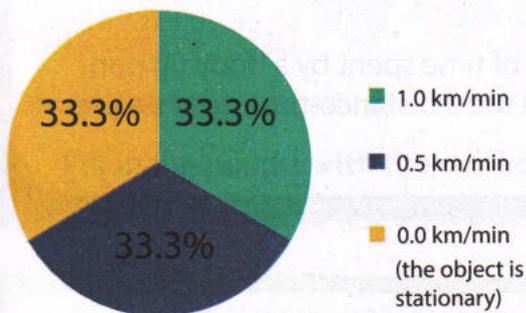


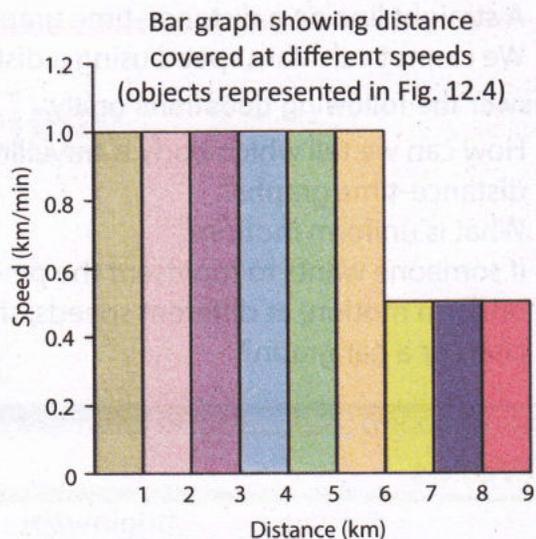
Fig. 12.5 Distance vs time graph

The motion of an object can be analyzed in many different ways. Let us consider the motion of the object represented in Fig. 12.4 again. The graph shows that the object travels at different speeds over time. Now, if we want to find out the fraction (or percentage) of the time for which it travelled at these speeds, we could use a pie chart [Fig. 12.6 (a)]. Another point of view of the motion of the object represented in Figure 12.4 is to study the distance travelled by the object at different speeds. This can be represented in a bar graph [Fig. 12.6 (b)].

Percentage of time spent by the object at different speeds (objects represented in Fig. 12.4)



(a) Pie chart (please note that these are approximate values)



(b) Bar graph (please note that these are approximate values)

Fig. 12.6 Commonly used charts

Note: When we try to locate an object, we usually relate it to some sort of reference point. This point is usually the origin, the zero point of an axis (x or y). We provide a numeric value for an object's location by placing it either in the positive direction (+) or the negative direction (-) in relation to that reference point. We usually take the starting point as the origin ($x = 0$).

Activity

Aim: To plot the distance vs time graphs for uniform motion

Materials needed: Graph paper and pencil

Method:

1. Take the speed at which the body moves as 10 m/s.
2. Calculate the distance travelled by the body at the end of 1, 2, 3, etc. (i.e., every second).
3. Take time on the x -axis and distance travelled on the y -axis.
4. Plot the distance vs time graph on a centimetre graph sheet taking 1 cm = 1 s.
5. Repeat steps 2–4 for a speed of 50 m/s and 5 m/s on the same graph sheet.
6. Observe the graphs obtained for different speeds.

Observation: A straight line graph is obtained.

Conclusion: The body is in uniform motion.

Let's Remember



A. Write T for the True and F for the False statements. Correct the false statements.

1. If an object is undergoing a uniform motion, it will travel unequal distances in equal intervals of time.
2. In a distance-time graph, speed is taken on the y -axis and distance is taken on the x -axis.
3. A straight line on a distance-time graph represents non-uniform motion.
4. We cannot calculate speed using a distance-time graph.

B. Answer the following questions orally.

1. How can we tell which body is travelling faster or slower by looking at their distance-time graphs?
2. What is uniform motion?
3. If someone wants to represent the percentage of time spent by a body (in non-uniform motion) at different speeds, should he use a distance-time graph, a pie chart or a bar graph?

Key Words

Clock
Periodic motion

An instrument used to measure time is known as a clock.
The motion that repeats itself in equal intervals of time is called periodic motion.

Pendulum

A small mass that is suspended from a fixed point and allowed to swing freely under the influence of gravity is called a pendulum.

Time period

The time taken by an oscillating body to complete one oscillation is called its time period.

Speed

The distance travelled by an object in unit time is called speed.

Speedometer

The instrument used to measure speed of the vehicle is called speedometer.

Odometer

The distance travelled by a vehicle is given by an instrument called odometer.

Distance–time graph

A graph representing the distance travelled and the time taken is known as distance–time graph.

Uniform motion

A motion by which a body covers equal distances in equal intervals of time is called uniform motion.

Summary

- Time is defined as the period between two events. It is measured for a variety of applications.
- People have been using clocks for thousands of years, but the earlier clocks were neither as convenient nor as precise in their timekeeping as the ones used today.
- Some instruments used in ancient times for timekeeping were sundials, water clocks, and hourglasses.
- A pendulum consists of a small mass suspended from a fixed point and allowed to move freely.
- When the bob of a pendulum moves from one position and returns to the same position, it is said to have completed one oscillation.
- The time taken to complete one oscillation is called the time period of the pendulum.
- The time period of a pendulum depends only on the length of the pendulum used (within limits).
- The data of the distance travelled can be presented in many ways, e.g., in a tabular form or by plotting distance vs time graphs.

Exercises

LET'S UNDERSTAND



L Objective type questions

A. Fill in the blanks with the correct words.

1. A water clock and a sand clock are two examples of _____ (modern/ancient) clocks.
2. A sundial works only in the _____ (day/night).
3. In a pendulum, the greater the length of the string, the _____ (greater/lesser) is the time period.

4. The speed of an object is defined as the distance travelled by it in _____ (one hour/unit time).
5. Average speed is measured in _____ (minutes per hour/ metre per second).

B. Choose the correct option.

1. Which of these does not measure time?
 a. Timer b. Stopwatch c. Measuring tape d. Wrist watch
2. What does one hour equals to?
 a. 60 seconds b. 60 weeks c. 3600 minutes d. 3600 seconds
3. Which of these is not related to a pendulum?
 a. Bob b. String c. Time period d. Sundial
4. In which unit is the time period of a pendulum measured?
 a. Days b. Metres per second
 c. Seconds d. Years
5. Which of these is correct for a body in uniform motion?
 a. It covers equal distances in unequal intervals of time
 b. It covers unequal distances in equal intervals of time
 c. it covers equal distances in equal intervals of time
 d. Both a and c
6. What is a sundial used for?
 a. Steering a car b. Dialling a telephone number
 c. Measuring time d. Measuring speed
7. What does an hour glass use to measure time?
 a. The angle of the sun b. The to and fro motion of a pendulum
 c. The amount of sand streaming down d. The angle of the moon
8. Under the influence of which of the following does the bob of a pendulum swing?
 a. Time b. Gravity c. Daylight d. Periodic motion
9. How much are ten decades equal to?
 a. One millennium b. One century c. Ten centuries d. Ten years
10. What does the time period of a simple pendulum depend on?
 a. The time of the day b. The length of the string
 c. The mass of the bob d. The size of the bob

II. Very short answer type questions

Give two examples for the following.

1. Units of time smaller than an hour _____
2. Time-measuring instruments in earlier times _____
3. Modern time-measuring instruments _____
4. Factors on which the time period of a pendulum depends _____
5. Factors on which the time period of a pendulum does not depend _____

III. Short answer type questions

1. What is periodic motion?
2. Name the following:
 - a. Instrument for measuring speed in an automobile
 - b. Instrument for measuring distance travelled in an automobile
3. What is the time period of a pendulum?
4. What is one oscillation of a pendulum?
5. What is average speed?

IV. Long answer type questions

1. Why is the measurement of time important to us?
2. How did people in earlier days measure time using the following?
 - a. Sundial
 - b. Hourglass
3. Describe an activity to demonstrate the constancy of the time period of a pendulum.
4. What is a distance-time graph? How can we find the speed of an object from its distance-time graph?
5. Distinguish between uniform and non-uniform motion. Also, give examples of each.

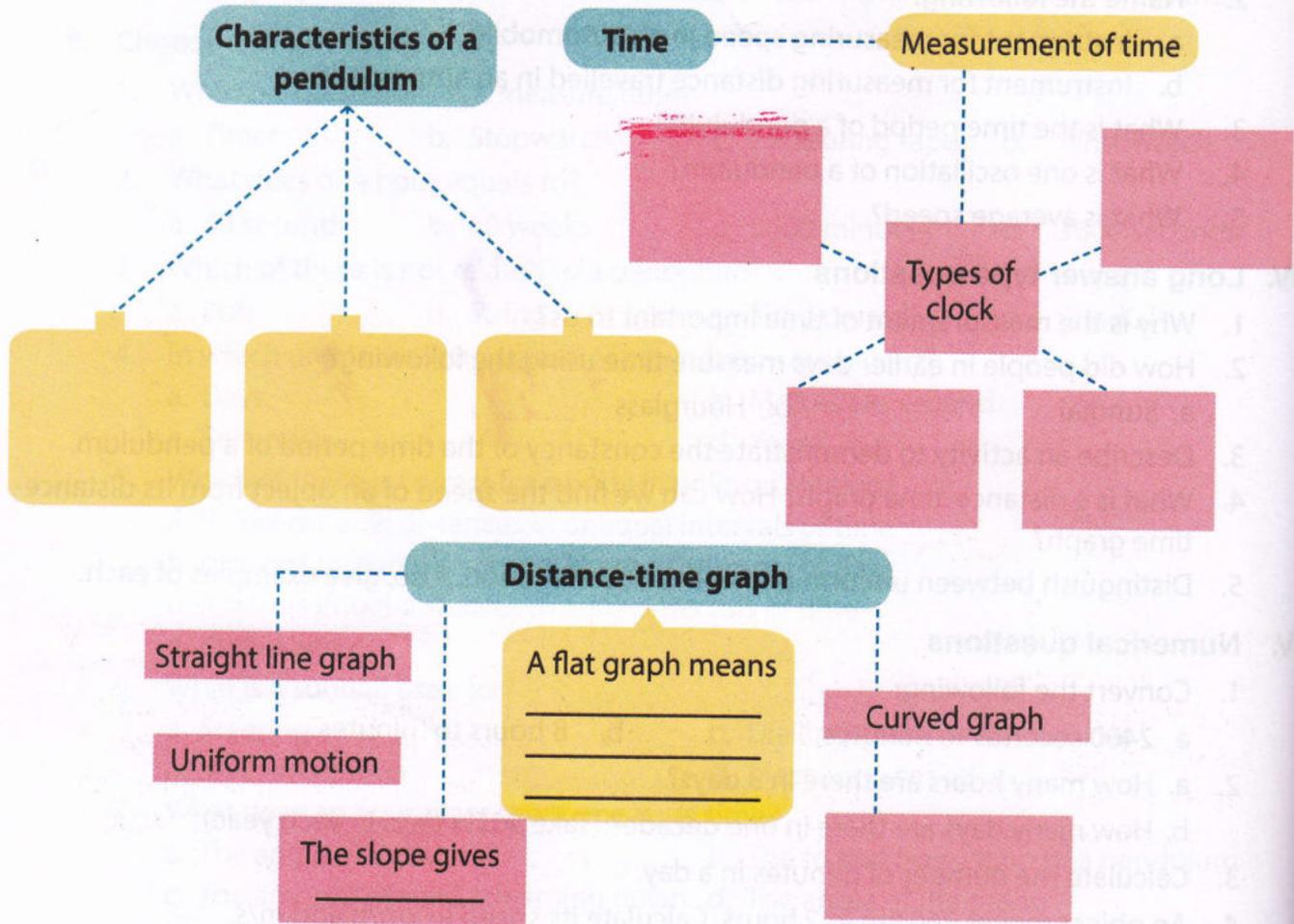
V. Numerical questions

1. Convert the following:
 - a. 2400 seconds to minutes
 - b. 8 hours to minutes
2.
 - a. How many hours are there in 3 days?
 - b. How many days are there in one decade? (Take $365\frac{1}{4}$ days in each year.)
3. Calculate the number of minutes in a day.
4. An object moves 360 km in 2 hours. Calculate its speed in km/h and m/s.
5. A car covers 240 km in 3 hours and a motorcycle covers 360 km in 4 hours. Which vehicle is travelling faster?
6. Plane 'A' travels at 900 km/h and plane 'B' travels at 250 m/s. Which plane travels faster?
7. In a cricket match, on an average, it takes 5 minutes to bowl one over and 1 minute to cross over after each over. How many overs (including the time taken for cross-over) can be finished in 1 hour?
8. Sonu goes for basketball coaching three times a week, and swimming classes two times a week. Each basketball class is for 1 hour and 45 minutes, and each swimming class is for an hour. How much time does she spend in a week in these two classes?
9. If you travel by road, it takes 46 hours to travel from New Delhi to Kanyakumari. How many days and hours would this be?
10. Kushal loves to visit his grandparents every year to spend his summer holidays with them. They live in a remote village. He takes a train, then a bus and then, walks the rest of the journey. The train travels at 60 km/h for 5 hours, the bus travels at 40 km/h for 3 hours and he walks at a speed of 5 km/h for 1 hour. What is the total distance he travels from the railway station to his grandparents' house?

LET'S RECALL



Recall and complete the concept map given below.

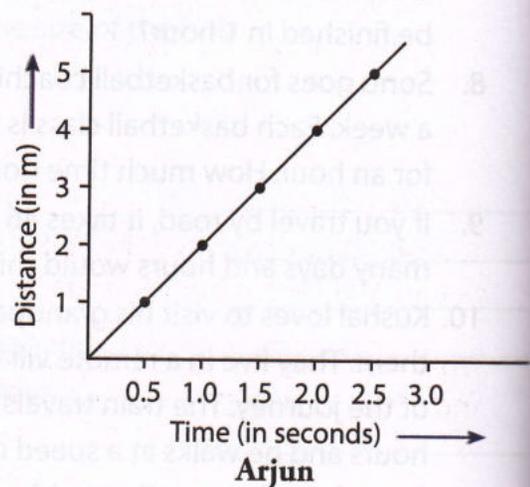
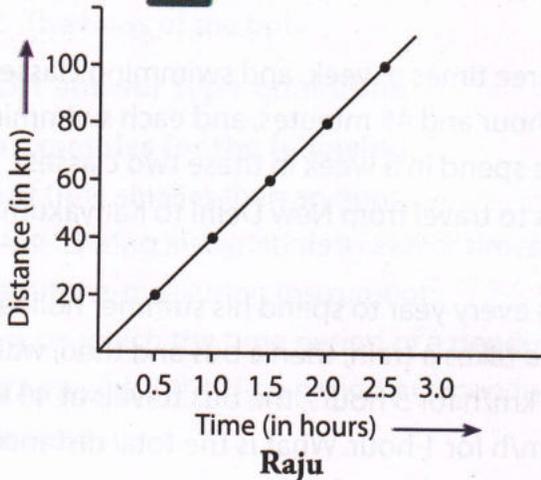


LET'S OBSERVE

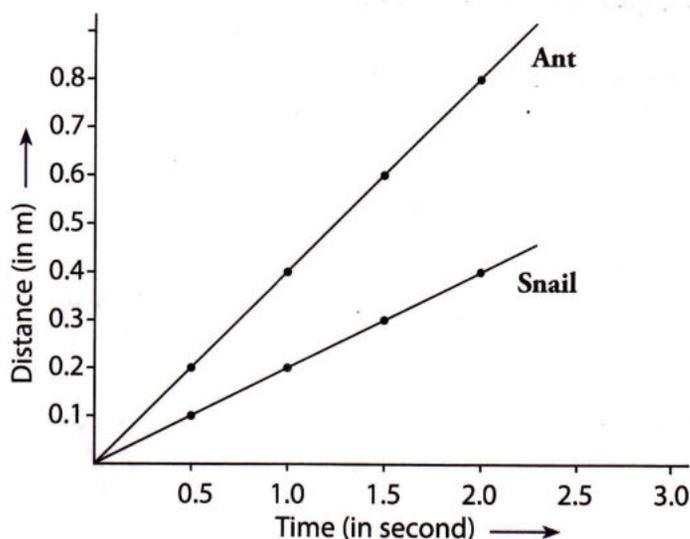


1. Raju and Arjun are both late for school. One is running and the other is going with his father in a vehicle. Look at the distance-time graphs below and identify who is running and who is going in a vehicle.

LO 10



2. An ant and a snail went on a running race. Their distance-time graphs are shown below. Who is faster? 



LET'S CONNECT

The Earth travels approximately 940,000,000 km as it goes once around the sun. It covers this distance in one year (365.25 days). Calculate the number of hours in a year. Using the data of distance travelled and time taken by the Earth for one complete revolution around the sun, calculate the approximate average speed at which the Earth moves in its orbit. Use a calculator to perform these calculations. After you have calculated the speed of the Earth, compare it with the speeds of common moving objects given in Table 12.2. What conclusion do you come to? Is the Earth faster or slower than these objects?

LET'S APPLY

- The distance between the Earth and the moon is 384,400 km. It takes four days for a spacecraft to travel from the Earth to the moon. Calculate the speed of the spacecraft. (Hint: Take 1 day = 24 hours) 
- It takes light from the sun approximately 8 minutes to reach the Earth. The speed of light is 3×10^8 m/s (this is 3 followed by eight zeros). Use this data to calculate the approximate distance of the Earth from the sun. 

LET'S ANALYSE AND EVALUATE

- Make a list of any five different vehicles around you and arrange them in the order of speeds at which they can travel. Use Table 12.2 for reference. Analyse how the physical appearance/design of different bodies relate to their speeds.  
- What would be the speed required to travel the distance of two thousand kilometres in two and a half hours? Which would be the most ideal mode of travel, if cost is not a factor?  

LET'S CREATE



Aim: To make a sundial **LO 11** **LO 15**

Materials needed: Cardboard, compass (to draw a circle), pencil, ball pin/nail, ruler, atlas, protractor, a pedestal (like a stool).

Method:

A. Finding the celestial North-South

1. Make a circle on a piece of cardboard (using a compass) with its radius about twice the length of a ball pin/nail.
2. Fix a ball pin/nail at the centre of the circle (O). Place this setup on a flat raised surface/a pedestal where it can get plenty of sunlight throughout the day.
3. Observe the shadow made by the ball pin/nail through the day. Mark the point where the shadow touches the circle. The shadow will keep moving through the day; sometime in the evening, the shadow will touch the circle, on the other side. Again, mark the point where the shadow touches the circle.
4. Join the two points with a ruler and find the mid-point (M) of the line drawn. Now, join this mid-point (M) to the centre of the circle (O); the line MO gives the North-South line.
5. Extend this line and mark it in on the pedestal on which the cardboard has been placed. A precise line indicating the North-South direction is very important for making an accurate sundial.

B. Making the sundial

1. Now, using an atlas or Internet, find the latitude of your city (suppose this is a°).
2. On a piece of cardboard, draw a right-angled triangle (with one side being about six inches) with one of the angles of the right-angled triangle as a° . We will use this piece as the gammon of the sundial.
3. Draw a circle of about 6-inch radius on another piece of cardboard and cut out the circle. This will be the base of the sundial.
4. Stick the gammon to the base of the sundial such that the angle 'a' of the gammon is at the centre of the circular base.
5. Turn the base of the sundial such that the base of the gammon is on the North-South line and it points to the North.
6. Fix the base of the sundial in this position. Mark where the shadow of the tip of the gammon falls and the time (once every hour will do). Your sundial is ready!

Web Research

Browse the Internet and find out more about atomic clocks and write the story of its scientific discovery. A suggested website is:

<https://www.youtube.com/watch?v=p2BxAu6WZl8> (accessed and checked on 28/08/19)

Worksheet 4

Skills assessed:

Problem solving, and quantitative analysis

Read the passage given below and answer the questions that follow.

Time scales and life spans

Everything in the universe has a lifespan, from the stars to micro-organisms. Stars are formed from clouds of gases and dust, called 'nebulae' and live for a very long time! Big stars burn up fast and live hundreds of thousands of years, whereas smaller stars can last for several billion years. Our sun is a star of average size. It is a little over 4.6 billion years old, and is expected to last another 5 billion years.

Let us compare this with the lifespans of some common life forms on the Earth. An adult 'mayfly' lives only for a few minutes! Common insects like mosquitoes and houseflies live only a few weeks. Elephants live for 5 to 7 decades. There are many animals like the Red Sea Urchin, the Bowhead Whale and the Greenland Shark, which live well over 200 years. On the other hand, sponges (which are animals) can live more than 10,000 years.

Use the information given in the passage above to answer the following questions.

1. Do only animals have a lifespan? _____ (Yes/No)
2. What are stars formed from?

3. Which stars have a longer lifespan—big stars or small stars?

4. Of the life spans mentioned in the passage, which of the following has the longest lifespan?
 - a. A small star
 - b. Sponges
 - c. A big star
 - d. An adult mayfly
5. Which of the following animals can live over 200 years?
 - a. Mayfly
 - b. Elephant
 - c. Sponges
 - d. Both b and c
6. What is the approximate life span of mosquitoes and houseflies?
 - a. A few years
 - b. A few decades
 - c. A few weeks
 - d. A few minutes
7. How much longer is our sun expected to last?
 - a. 10 thousand years
 - b. 5 million years
 - c. 4.6 billion years
 - d. 5 billion years

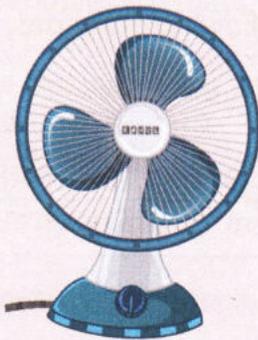


Electric Current and Its Effects

We live in an age where electricity is a necessity. Apart from lighting the bulbs, we also enjoy the benefits provided by various electrical devices and appliances. Write down the names of the appliances shown below.

You will learn about

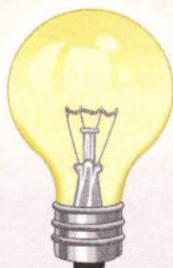
- Electric circuit diagram
- Heating effect of electric current
- Magnetic effect of electric current



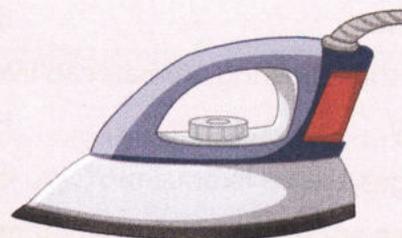
1. _____



2. _____



3. _____



4. _____

Why is the electric bulb hot? What makes the electric iron hot?

There are different types of effects that electric current produces when it flows in a circuit. The working of electrical appliances/devices are based on one or more of these effects. In this chapter, we will study about electric circuit, and a few of the effects of electric current and how these effects can be put to our use.

Answers: 1. Table fan; 2. Mixer grinder; 3. Electric bulb; 4. Electric iron

ELECTRIC CIRCUIT DIAGRAM

TD

As you all know by now, the unbroken path through which an electric current can flow is called an electric circuit.

An electric circuit (Fig. 13.1) can be represented by drawing a simple diagram using standard symbols. A drawing of an electrical circuit with standard symbols is called a **circuit diagram**. In a circuit diagram, the various components of the circuits are represented by standard symbols, some of which are given in Table 13.1.

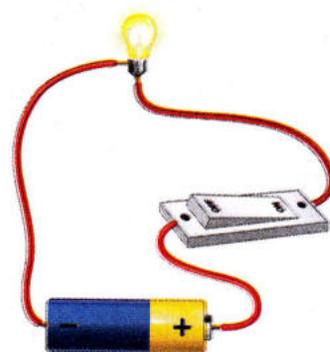
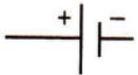
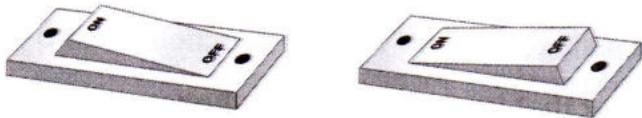
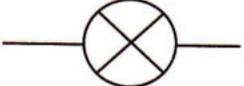


Fig. 13.1 An electric circuit

Table 13.1 Standard symbols used for basic components of electric circuits

Component	Symbol	
 Cell	 The longer line denotes the positive terminal and the shorter line denotes the negative terminal.	
 Battery	 Two or more cells joined together form a battery.	
 (a) Open (b) Closed Switch (also called key)	 Open	 Closed
 Bulb	 	
 Wire		

Using these symbols, the circuit diagram for the circuit given in Figure 13.1 can be drawn as shown in Figure 13.2. This is when the switch is ON. When the switch is on, the circuit is closed and a current will flow through it.

The important points to remember while drawing circuit diagrams are:

1. There should be a source, that is, one or more electric cells.
2. The wires should not have any discontinuity (gaps).
3. The only component that can have a discontinuity is the switch. When it is 'open', there is a discontinuity and current does not flow in the circuit.

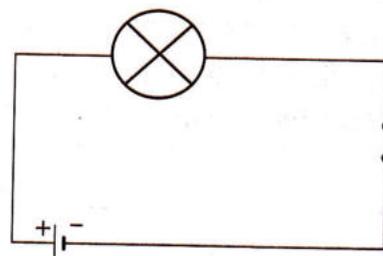


Fig. 13.2 Circuit diagram

How to connect cells to make a battery?

By connecting cells together, we can increase the voltage output. For example, if we have three 1.5 V cells, we can connect them together and form a battery which gives 4.5 V. The cells should be connected in such a way that the positive terminal of one cell is connected to the negative terminal of the next cell. Care should be taken to connect identical cells (they should be identical in all respects).



Cell holder

Most battery-operated devices have a place where the cells are to be placed. This is called a cell holder. Cell holders are also available separately and can be used in electrical circuits as needed. A cell holder is an open box, generally made of plastic, with metal contacts. They are designed to hold one or more cells. They have '+' and '-' signs inscribed inside, where the positive and negative terminals of the cells fit in.

HEATING EFFECT OF ELECTRIC CURRENT

Try touching a torch bulb that is lit and another that is not. Be careful when you touch the lit bulb. Do you feel it is hot to touch? Why do you think it is so?

In an incandescent bulb (Fig. 13.3), electric current passes through a very thin wire made of a special material (such as tungsten) called the *filament*. When the bulb is switched on, the filament gets heated. This is due to the *heating effect of the electric current*.

A disadvantage is an advantage!

Generally, the heating effect of electric current is a bother because it results in a loss of electrical energy and also results in the damage of electrical appliances. However, the same heating effect can be put to good use! Many electrical appliances that we use every day actually make use of the heating effect of electric current. This is a classic example of how a disadvantage can be ingeniously turned into an advantage. This happens very often in Science. When you find a disadvantage in a particular effect or situation, look to see how you can turn it into an advantage!

The heating effect of current is used in several appliances, which include electric toasters, electric irons (Fig. 13.4), hot plates, electric hairdryers, and electric ovens (Fig. 13.5).

These appliances contain tightly wound coils, called *elements*. The element heats up when an electric current passes through it. In many electrical appliances, where the element is not covered, it can be identified by its dull red glow when the appliance is on.



Fig. 13.3 Lit filament in a bulb



Fig. 13.4 Electric iron

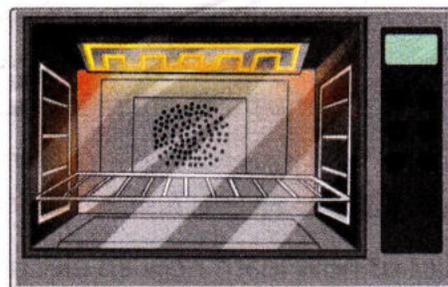


Fig. 13.5 Electric oven

Activity

Aim: To show the heating effect of current (adult supervision required)

Materials needed: 1.5 V cell, two pieces of wire, a small torch bulb, and insulation tape/adhesive tape

Method:

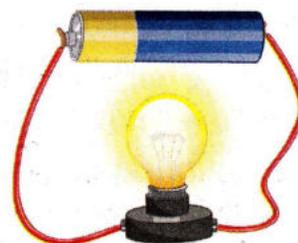
1. Strip the insulation at both ends of the two wires so that about 1 cm of the metal portion is exposed.
2. Connect the negative end of the cell to the threaded portion of the bulb with one of the wires. Secure both ends with the insulation/adhesive tape.
3. Connect the positive end of the cell to the bottom portion of the bulb with the second piece of wire. Secure both ends with the insulation/adhesive tape.
4. You will find that the bulb glows. If it does not, check to see if the connections are tight or need to be tightened. Adjust the connections till the bulb glows.
5. Touch the bulb to see how hot it is just when the connections are complete.
6. Leave this arrangement (with the bulb glowing) for some time and then touch the bulb.

Observation: Bulb is a little warmer now than at the beginning.

Conclusion: This is because the passage of electric current heats it up.

Note: Follow the precautions given below while doing this activity.

- Touch only the insulated parts of the wire connected to the terminals of the cell.
- Do not perform the activity near inflammable materials such as kerosene, petrol, or a gas cylinder.
- Do not use a cell of a higher voltage than specified (1.5 V).
- Do not use the plug points of your house/school.



Electric Fuse

What will happen if a large amount of electric current passes through an appliance? It causes the wires to get overheated, and the appliance gets damaged. This situation arises as a result of some fault in the circuit and can be extremely dangerous as it can lead to fire.

A major safety measure in the case of an electrical fire is to switch off the electric supply. The electric supply to your home can be switched off by switching off the mains. Please identify the switch of the mains in your house and make a note of it, so that it can be used in the case of an emergency. Please take the help of an adult while doing this.

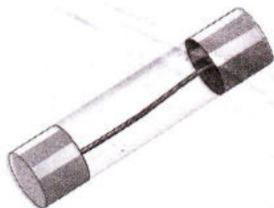


Fig. 13.6 Electric fuse

To prevent electric appliances from getting damaged from an excessive flow of current, a safety device called a *fuse* is used in the electric circuit. Figure 13.6 shows an electric fuse (cartridge fuse). An electric fuse prevents a large amount of current from flowing into any appliance or device as it cuts off the supply of electric current, thus preventing further damage.

Let us now learn how an electric fuse works.

Principle of an Electric Fuse

The electric fuse works on the principle of heating effect of current. The amount of heating caused depends on the amount of current flowing through the wire. The greater the current, the more is the heat produced.

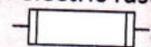
An electric fuse consists of a thin wire usually placed inside a glass or ceramic cartridge. The wire is made of a material that melts easily when heated. Examples of material used for fuse wire are lead, tin, alloys of lead and tin, aluminium, zinc, etc.

It is designed such that only a certain amount of current can flow through it. If the current exceeds this amount, the heating in the wire causes it to melt. We say that the fuse 'blows'. This breaks the circuit and stops the flow of current in the circuit.

Fact File

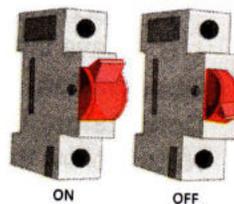
If you look carefully at a cartridge fuse, you will find a number stamped on it. This number signifies the amount of current (in amperes, A) that can flow through the fuse before it melts.

The common symbol used for an electric fuse is



Miniature circuit breaker

A miniature circuit breaker is an automatically operated electric switch that protects an electric circuit during an overload or short circuit. They can be reset (manually or automatically) to restore normal operation, whereas in circuits with fuses, the fuse needs to be replaced after a single use. You can find this on the distribution board or switchboard of your house.



Let's Remember



A. Write T for the True and F for the False statements. Correct the false statements.

1. A source of electric current is not a necessary condition for an electric current to flow in an electric circuit.
2. An electric current will not flow if the switch in the circuit is open.
3. The filament of an incandescent light bulb glows because of the heating effect of electric current.
4. An electric fuse protects the appliances in the circuit.

B. Answer the following questions orally.

1. Why do we need circuit diagrams?
2. Is there any purpose in using standard symbols in circuit diagrams?
3. What are the possible dangers of not using a fuse in an electric circuit?

MAGNETIC EFFECT OF ELECTRIC CURRENT

Can you recall what you studied about magnets in Class 6? You know that magnets can attract certain substances such as iron. So far, you have studied about electricity and magnetism separately. However, did you know that electricity and magnetism are closely related? Perform the following activity to understand this.

Activity

Aim: To see the magnetic effect of current passing through a wire (adult supervision required)

Materials needed: 1.5 V cell, two pieces of insulated wire, a small magnetic compass, and insulation/adhesive tape

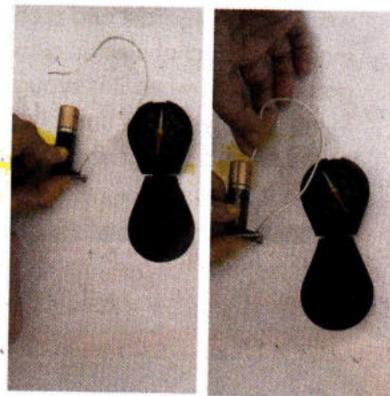
Method:

1. Strip the insulation from the two ends of both the wires.
2. Connect one end of one of the wires to the negative terminal of the cell. Secure the connection with the insulation/adhesive tape.
3. Connect one end of the other wire to the positive terminal of the cell. Secure the connection with the insulation tape.
4. Place the magnetic compass near the wire.
5. Keep an eye on the needle of the magnetic compass and touch the free ends of the wires connected to the positive and negative terminals of the cell.

Observation: When the wires touch, the needle of the magnetic compass gets deflected (moves).

Conclusion: This is because when a current passes through the wire, it behaves like a magnet and, therefore, deflects the magnetic needle of the compass.

Note: Follow the precautions given in the activity on page 201 while doing this activity.



Electromagnet

We have seen in the above activity that a current-carrying conductor behaves like a magnet. As a result, it can deflect a magnetic needle.

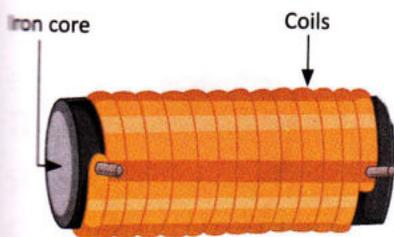


Fig. 13.7 An electromagnet

An *electromagnet* is a device that acts like a magnet when an electric current is passed through it. It loses its magnetic properties when the current is switched off. In the place of a single loop of electric wire, as in the above activity, we could increase the magnetic effect by making many turns of the wire. We could further increase it by wrapping the wire around a piece of magnetic material like soft iron. (See Activity at the end of this section). Generally, electromagnets that are used commercially have a long, insulated wire wound tightly many times around a cylindrical core. A piece of soft iron in the core (Fig. 13.7) increases the strength of the electromagnet.

Solenoid

A solenoid is a long wire that has been wound many times in a tight coil around a hollow or solid core. It has a cylindrical shape. A solenoid is often used as an electromagnet.

Know your Scientist

Hans Christian Oersted was born in Denmark in the year 1777. He was both, a physicist and a chemist. He is known for his discovery of the magnetic effect of electric current. He demonstrated that a magnetic needle gets deflected when it is brought near a current carrying wire. In the CGS system of units, the unit of magnetic field strength is given the name oersted in his honour.



Activity

Aim: To make an electromagnet (adult supervision required) and show that it attracts iron

Materials needed: 1.5 V cell, an iron nail, a safety pin (made of stainless steel), and a piece of wire (the one with a single thick wire)

Method:

1. Take a piece of wire and strip the insulation from the two ends.
2. Wind the wire around the iron nail.
3. Connect the two ends of the wire to the two terminals of an electric cell. This is an electromagnet.
4. Bring this close to a safety pin.

Observation: The safety pin gets attracted to the iron nail.

Conclusion: Passing an electric current in a coil wrapped around an iron piece makes the iron piece magnetic.



The strength of the electromagnet depends on the number of turns of the wire around the core and the amount of current passing through it. The more the number of turns, the more will be the magnetic effect. See Figure 13.8. The iron nail attracts more number of safety pins when wrapped with a coil with more number of turns. What will happen if the current passing through the coil is switched off? The iron piece will lose its magnetic effect, i.e., it will stop behaving like a magnet and thus, will not attract the safety pin.



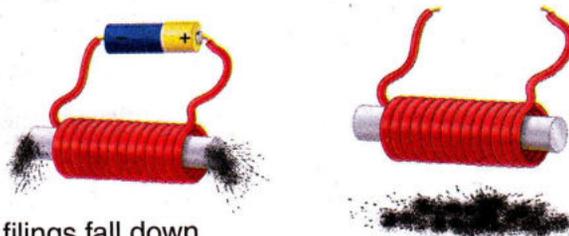
Fig. 13.8 Stronger magnetic effect due to more number of turns

Activity

Aim: To study the behaviour of an electromagnet when the current is switched off (adult supervision required)

Materials needed: An electromagnet, iron filings, wires, cardboard, and a pencil cell

1. Take an electromagnet. Connect the free ends of the wire to the terminals of a pencil cell.
2. Take a cardboard and sprinkle some iron filings on it.
3. Now bring the electromagnet near to the iron filings. Do the filings get attracted to the electromagnet?
4. Now remove the pencil cell from the circuit.



Observation: The filings fall down.

Conclusion: The electromagnet loses its magnetic effect when the source of electric current is removed.



Fig. 13.9 Electric motors

Uses of Electromagnets

Electromagnets have a wide range of uses in all sorts of devices. Can you think of some devices from everyday life where we use electromagnets?

Electromagnets are used in cranes to pick up cars in scrapyards and also to separate iron from garbage dump. They are also used in loudspeakers, telephones, and in electric motors (Fig. 13.9) used in electric fans and washing machines. Electromagnets are also used in electric bells.

Electric Bell

What do you do when you reach your friend's house to let him/her know that you are at the door? You ring the doorbell. Do you know what makes the bell ring? An electric bell has an electromagnet that pulls a strip of iron which makes the hammer hit the gong to ring the bell. The step-wise explanation of how an electric bell works is shown in Figure 13.10.

Steps 1 to 3 repeat in quick succession as long as the switch is on. This is how we hear a continuous ring of the bell.

Electric buzzer

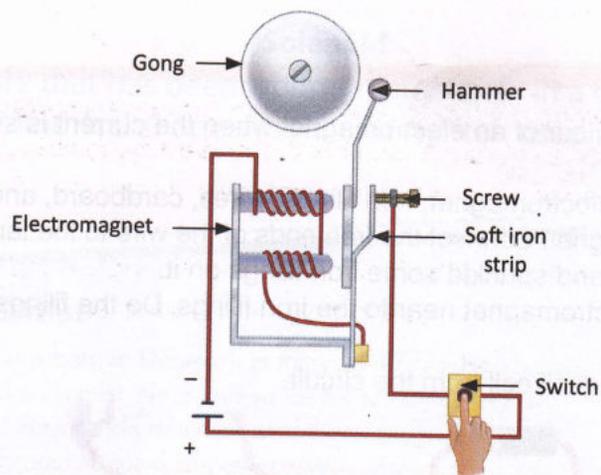
Nowadays, we use electric buzzers and musical bells, which work on a principle different from that of the electric bell described here. Buzzers are of different types. Can you think of some places where you use electric buzzers?

- a. _____ b. _____ c. _____

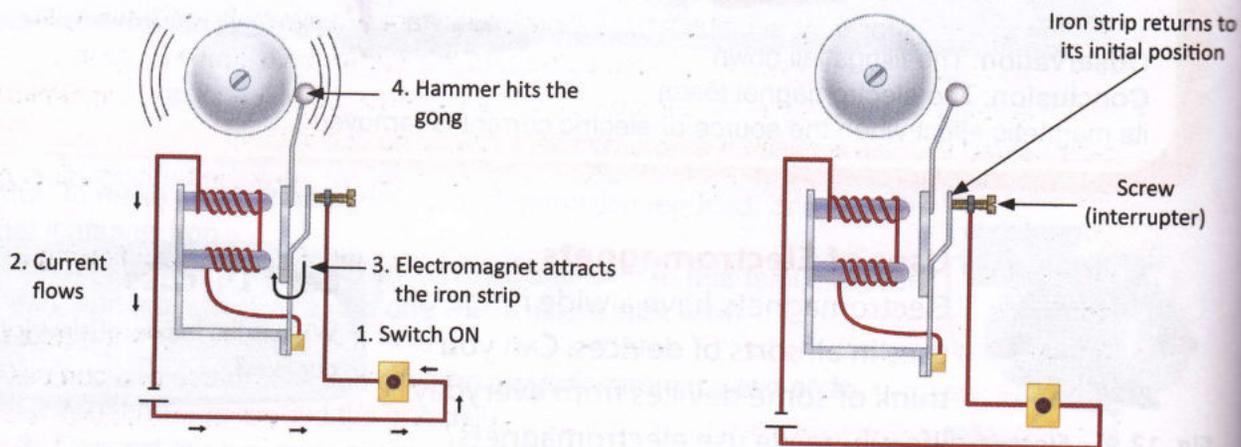
Let's Discuss

What is the impact of electricity in our lives?

Stronger
effect due to
number of turns



Step 1 When you push the switch of the bell, an electric current flows to the electromagnet.



Step 2 The electromagnet attracts the soft iron strip. The hammer attached to the strip then hits the gong, making it ring. When the soft iron strip gets attracted to the electromagnet, it no longer touches the screw (interrupter) and hence the circuit is broken (much like a switch being turned off). This turns off the electromagnet and it can no longer attract the soft iron strip.

Step 3 The soft iron strip returns to its initial position, touching the screw (interrupter). This results in the circuit being complete, and current flows again.

Fig. 13.10 Working of an electric bell

Let's Remember



Write T for the True and F for the False statements. Correct the false statements.

1. A current carrying conductor can deflect a magnetic compass.
2. An electromagnet is based on the heating effect of electric current.
3. The strength of an electromagnet does not depend on the number of turns of the wire around the core.
4. An electromagnet exerts a greater magnetic force on small iron pieces when the current passing through it is switched off.
5. In an electric bell, the hammer strikes the gong because the gong is magnetic.

Key Words

- Electric circuit** The unbroken path through which an electric current flows is called electric circuit.
- Circuit diagram** A drawing of an electrical circuit with standard symbols is called a circuit diagram.
- Electric fuse** A safety device which prevents excessive current from flowing in a circuit is called an electric fuse.
- Electromagnet** A piece of soft iron with an insulated wire wound around it, that acts as a magnet when current flows in the wire, is called an electromagnet.

Summary

- Three conditions are required to make electric current flow in a circuit: a source to provide electric current, an unbroken path for electric current to flow, and a conducting wire.
- For the sake of simplicity, scientists have developed standard symbols for drawing an electrical circuit. Such a drawing of an electric circuit is known as a circuit diagram.
- When an electric current passes through an electric conductor or a wire, the conductor/wire gets heated up. This is called the heating effect of electric current.
- Electric irons, room heaters, electric ovens, water heaters, etc., use the heating effect of current to work.
- An electric fuse is a safety device. It prevents a large amount of current from flowing into any appliance or device.
- An electric fuse consists of a thin wire made of a material that melts easily when heated.
- A wire carrying current can behave like a magnet and deflects the needle of a compass.
- An electromagnet consists of a piece of soft iron (called the core), with an insulated wire wound around it. The soft iron piece acts like a magnet when a current passes through the wire.
- Electromagnets are used in cranes, electric motors, telephones, loudspeakers, electric bells, etc.
- An electric bell consists of a battery, an electric switch, an electromagnet, an adjusting screw (interrupter), a soft iron strip, a hammer, and a gong.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

1. When we connect two cells to form a battery, we should connect the positive terminal of one cell to the _____ (positive/negative) terminal of the other cell.
2. In an electric circuit, the connecting wire should be made of a _____ (conductor/insulator).

3. A device that is used to open or close an electrical circuit is called a _____ (fuse/switch).
4. A _____ (fuse/switch) works on the heating effect of electric current.
5. In an electric bell, the electromagnet is magnetised when the switch is _____ (on/off)

B. Choose the correct option.

1. What is a drawing of an electrical circuit with standard symbols called?
 - a. An electrical circuit
 - b. A battery
 - c. An electrical drawing
 - d. A circuit diagram
2. What happens when the switch is 'on' in an electric circuit?
 - a. The circuit is open and current flows through it.
 - b. The circuit is closed and current does not flow through it.
 - c. The circuit is closed and current flows through it.
 - d. The circuit is open and current does not flow through it.
3. Why does the filament of an incandescent bulb glow?
 - a. It is the heating effect of electric current.
 - b. It is the magnetic effect of electric current.
 - c. An electric fuse is connected to it.
 - d. An electromagnet is connected to it.
4. What is the part of a heating appliance containing a tightly wound coil, that heats up, called?
 - a. Electric iron
 - b. Element
 - c. Electromagnet
 - d. Fuse
5. What is an electric fuse?
 - a. An electromagnetic device
 - b. A safety device
 - c. A source of current
 - d. An element
6. What is the role of an electric switch?
 - a. To open or close an electric circuit
 - b. To produce heat
 - c. To make a magnet
 - d. To provide a path for the flow of current
7. How many electric cell(s) an electric battery consists of?
 - a. Only one
 - b. Only two
 - c. Only five
 - d. Two or more
8. What effect of current do an electric toaster and a filament light bulb use?
 - a. The heating effect of electric current
 - b. The magnetic effect of electric current
 - c. Both a and b
 - d. Neither a nor b
9. What happens when an electric current is passed through a coil wrapped around an iron piece?
 - a. The iron piece becomes rubbery.
 - b. The iron piece becomes hard.
 - c. The iron piece becomes magnetic.
 - d. The iron piece becomes soft.

10. What happens to the magnetic effect on an electromagnet when the electric current is switched off?
- It becomes stronger.
 - It changes the direction.
 - It does not change.
 - It becomes zero.

II. Very short answer type questions

Give one word for the following.

- Two or more cells joined together _____
- Thin wire that glows in an incandescent light bulb _____
- A device that limits the amount of current flowing in a circuit _____
- A long wire that has been wound many times into a tightly packed coil _____
- The part of an electric bell that is attracted to the electromagnet, when switched on _____

III. Short answer type questions

- Name any four components of an electric circuit. Give their electrical symbols.
- Draw a circuit diagram where an electric current will flow. Add a component that will help open and close the circuit and label it.
- Explain 'heating effect of electric current'.
- What is 'magnetic effect of electric current'?
- What is the purpose of having an electromagnet in an electric bell?

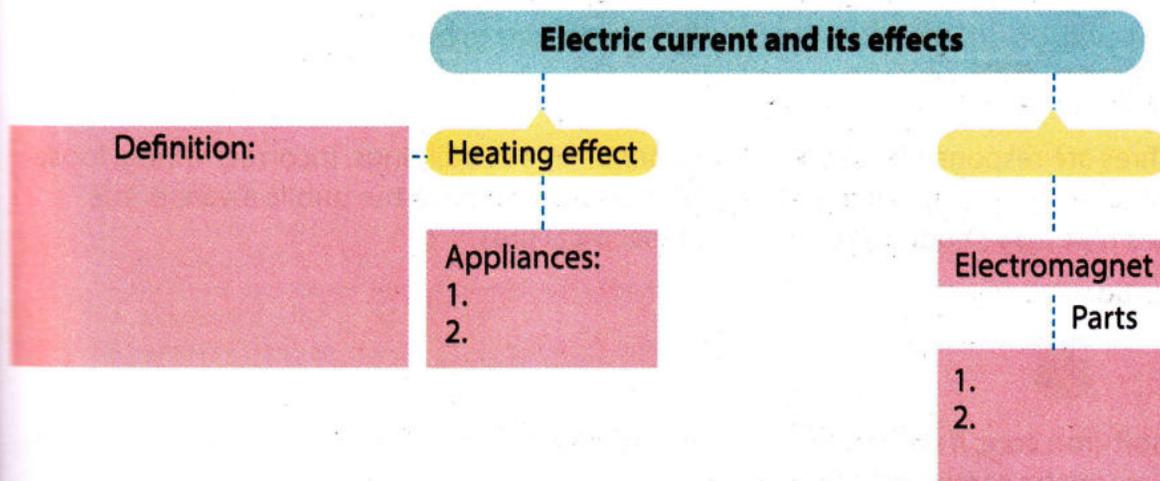
IV. Long answer type questions

- Draw two electric circuits showing two different situations when an electric current will not flow through the circuit. Explain the reason in each case.
- Explain the working of an electric fuse.
- Draw a rough figure of a simple electromagnet. How can we find out if it is magnetic or not?

LET'S RECALL



Recall and complete the concept map given below.





LET'S OBSERVE

1. Draw an electric circuit diagram with an electric cell, a bulb, wires, and an electric switch. **LO 9**



A large rectangular area with horizontal lines for drawing a circuit diagram. A faint purple watermark is visible in the center.

2. Name the effect of electric current that is mainly being used in each of the following.



a. _____



b. _____



c. _____

LET'S CONNECT ART

Electrical fires are responsible for a large number of fires in buildings. Incorrect wiring, loose connections, etc. are responsible for this. Make a poster to make the public aware of the precautions that they should take to prevent electrical fires.



LET'S APPLY

Instead of a soft-iron core, if we wind a current-carrying wire around a wooden pencil, would it still deflect a magnetic compass needle? **LO 4**

LET'S ANALYSE AND EVALUATE

1. Find out three materials that can be used for making fuse wires. Analyse the properties that make them eligible for making a fuse wire. Now, draw an electric circuit diagram with a cell and bulb. Show how you would connect a fuse in this circuit.  
2. Look around and find out any five appliances at home that use the heating effect of electric current. Read the power wattage marked on each of these appliances. Accordingly, arrange the appliances in ascending order of their power consumption, and hence, the cost incurred in running them.   

LET'S CREATE

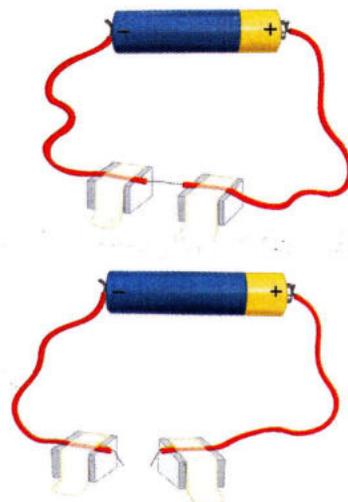


Make an electric fuse (adult supervision required).  

Materials needed: A pencil cell, about 6 to 8 inches length of wire with a single strand, a short piece of wire with multiple strands, a pair of scissors, adhesive tape, a blade, two pieces of paper folded up many times (to hold the cell if it gets very hot), and two small pieces of pencil eraser (you can take one and cut it into two pieces).

Method:

1. Cut the single-stranded wire into two pieces and strip the insulation from all four ends.
2. Take the wire with multiple strands and strip the insulation (about 2 inches) from one end. Cut the strands from the wire and pick out just one strand. We will use this strand as the fuse wire.
3. Take a single-stranded wire. Twist the tip of the wire with one tip of the fuse wire. Take the other single strand wire and do the same with the other tip of the fuse wire.
4. Fix the two single-stranded wires on the two pieces of erasers with the insulation tape. Make sure the fuse wire is held taut between the two wires.
5. Connect the loose end of one of the single strand wires to the negative terminal of the pencil cell. Secure the connection with an insulation tape.
6. Now touch the loose end of the other single-stranded wire to the positive terminal of the pencil cell. Observe the fuse wire. Present your observation and model in your class.



Web Research

Browse the Internet and find out more about different effects of current. Some suggested websites are:

- To see a video of the magnetic effect of current
<https://www.khanacademy.org/science/physics/discoveries/electromagnet/v/electromagnetic-field-forward-vs-reverse>
(accessed and checked on 03/09/19)
- To learn more about CFL bulbs
<https://science.howstuffworks.com/environmental/green-tech/sustainable/cfl-bulb.htm>
(accessed and checked on 28/08/19)

Worksheet 5

Skills assessed:

Problem solving, and qualitative analysis

Read the passage given below and answer the questions that follow.

CFL bulbs

Nowadays, filament light bulbs are being replaced by CFL light bulbs in many households. As you know, in a filament light bulb (also called an incandescent bulb), electric current is passed through a filament, which gets heated and begins to glow. The working of a CFL light bulb is very different.

CFL bulb is the short form for 'Compact Fluorescent Light Bulb'. It consists of a glass tube twisted in a spiral, compact form. The inside of the tube is coated with a material which glows when radiation falls on it. Such a material is called a 'fluorescent material'. The tube is filled with a mixture of argon gas and mercury vapour. When an electric current passes through this mixture its molecules give out a radiation that is not visible to us. This radiation, when it falls on the inner walls of the tube, produces light rays that is visible to us.



Incandescent bulb

CFL bulb

There is a reason why people prefer to use CFL bulbs instead of filament light bulbs. A filament light bulb works on the principle of heating the filament until it glows. In such a design, a lot of electric power is wasted in the form of heat. CFL bulbs, on the other hand, use much less electric power as they do not get as hot as the incandescent bulbs.

Use the information given in the passage above to answer the following questions.

1. What is the full form of 'CFL'?

2. Which part of an incandescent bulb glows and gives out light?

3. What kind of material is coated inside the tube in a CFL bulb?

4. What mixture is filled inside the tube of a CFL bulb? What happens when an electric current passes through this mixture?

5. What is the advantage of using CFL bulbs over incandescent bulbs?

Wind and Storm

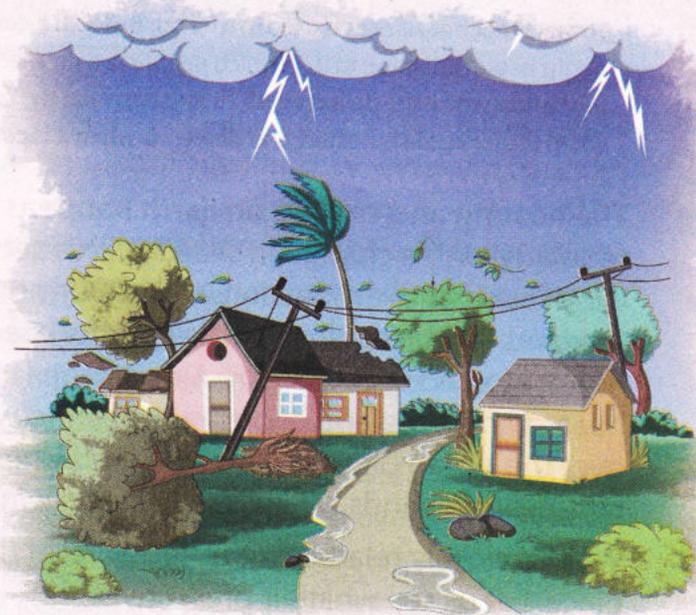
Have you ever been in a storm? Even if you have not experienced a storm first hand, you may have seen one in a TV news or in a movie. What are the things that you associate with a storm?

You will learn about

- Wind is caused by the uneven heating of the Earth
- Air pressure
- Characteristics of wind
- Storms

1. Look at the picture of a storm on the right. Circle the words that you feel are associated with it in any way.

Stars Rain High speed winds
 Uprooted trees Fallen poles
 Destruction Gentle breeze Flowers
 Calm waters



2. Look at the picture of a storm on the left.
 - a. Where do you think this picture was taken from?

 - b. What are the white swirls that you see in the picture?

There are many different types of storms, and they occur all over the world. Severe storms can be quite destructive. In this chapter, we will learn about how storms are formed, the damage a storm can cause to people and property, and the safety measures that we can take to protect ourselves from the fury of a storm.

In this chapter, we will learn more about wind and what causes it.

Answers: 1. Rain, high speed winds, uprooted trees, fallen poles, destruction; 2. a. Space satellite; b. Clouds

WIND IS CAUSED BY THE UNEVEN HEATING OF THE EARTH

Wind is the movement of air (usually in a horizontal direction) in the atmosphere. It is caused by a difference in temperatures between different regions on the Earth (Fig. 14.1). This temperature difference occurs mainly because of the uneven heating of different parts of the Earth's surface by the sun. Thus, the air absorbs different amounts of heat, making it warm in some places and cool in others. As air gets warmer, its particles (molecules) spread out. In other words, air expands on heating. This makes the air lighter, or less dense, so it rises. As air cools, it becomes heavier, or more dense, and sinks. As warm air rises, air from cooler areas flows in to take the place of the rising air. This sets up a current of air and we call it *wind*.

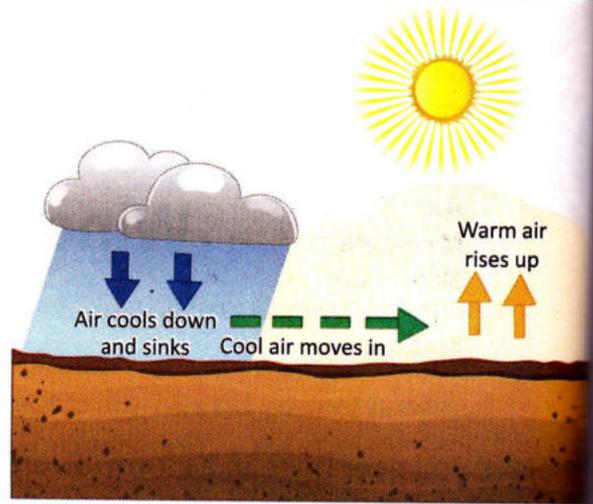


Fig. 14.1 Formation of wind

Hot-air balloons

The fact that hot air rises is used in a hot air balloon. It consists of a huge balloon with a light basket attached to it, in which people can sit. There is a system of fans under the balloon to fill the balloon with air and also heat the air as needed. The balloon rises when the air inside is heated, and descends when it is cooled.



The heating and cooling on Earth happens very regularly with a change in seasons. This sets up seasonal winds such as the monsoon winds. During the summer, the land (in places close to the equator) becomes very hot compared to the ocean. Air over the land gets heated and rises, and cooler rain-bearing winds from over the ocean blow towards the land. These seasonal rain-bearing winds are called *monsoon winds*.

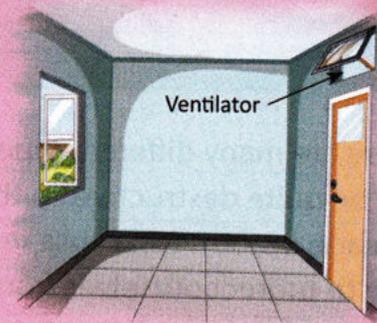
Wind is closely related to the 'pressure' of the air at a place. Let us see what air pressure is.

AIR PRESSURE

The pressure exerted by air is called *air pressure*. The air in the atmosphere exerts pressure on every object and in all directions (up, down, left, right, etc.). The pressure exerted by the atmosphere depends on many factors. For example, it depends on the height of a place and also on the temperature. Generally, places at a lower temperature are at a higher pressure than places at a higher temperature. Air moves from an area of higher pressure to an area of lower pressure. This causes wind. The converse is also true. Moving air causes a variation in pressure.

Fact File

A ventilator is a small window which is placed high up close to the ceiling of a room. It is very useful to have a ventilator in addition to a window because it helps in the proper ventilation of the room. Warm air in the room rises and goes out of the ventilator, and cool (and fresh) air rushes in from the window below to take its place.



Activity



Aim: To show that air exerts pressure (adult supervision required)

Materials needed: A tin/thin metal can with an air tight cap, a stove/Bunsen burner, kitchen sink/washbasin, tongs to hold the hot can, and a small thick towel

Method:

1. Fill the can up to about one-third with water.
2. Heat the can without the cap and let the water boil for some time. Make sure a lot of steam escapes.
3. Take the help of an adult to remove the can from the stove using tongs, and quickly cover the opening and close the cap tightly using the thick towel.
4. Take the can to the kitchen sink/washbasin and hold it under the tap water and see what happens.

Observation: The can slowly crumples up.

Conclusion: This happens because when the can is heated, the steam produced pushes out most of the air in the can. When it cools down, the steam in the can condenses and leaves a near vacuum in the can (except for the remaining water), and the pressure of the air outside the can is large enough to compress and crush it. This shows that air exerts pressure.



Moving Air and Lift

AN

Moving air can provide a lift. There is a variation in pressure when air moves. This variation depends on the speed with which it moves. When air flows in a horizontal direction, the pressure is lower in regions where the air moves faster, and higher where air moves slower. So, if we have a horizontal strip such that air moves faster over its surface and slower (or remains still) under its surface what do you think will happen? The pressure at the top (where air is moving) will be lower than the pressure at the bottom. This will result in the horizontal strip being pushed up, or 'lifted up'. Thus, moving air provides a lift. Here is a simple experiment that you can do to understand this better.

Take a strip of paper and blow over it (Fig. 14.2). Observe what happens. The paper is pushed up. To understand this, let us look at the forces acting on the strip of paper. Firstly, there is gravity which tends to pull it down. So, when you hold the paper near your mouth without blowing air, the paper will hang down due to gravity.

However, when you blow the air above the paper, the pressure on top of the strip of paper is reduced. The pressure below the paper is greater than the pressure above it. This causes the pressure acting on the underside of the paper strip to push the paper up. Thus, moving air provides a 'lift'.



Fig. 14.2 Blowing over a strip of paper lifts it

Why are roofs blown off in the wind?

The drop in pressure also explains why roofs, which are not very firmly fixed, are blown off when there is a very strong wind. When a strong wind blows, the pressure on top of the roof is lower than the pressure below, and as there is an imbalance of the two forces, the roof gets dislodged and is blown away.

Activity

Aim: To show that air expands on heating (adult supervision required)

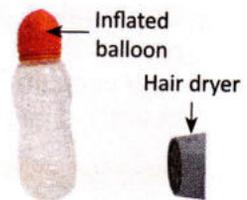
Materials needed: A small plastic bottle, balloons, hair dryer, a plastic mug, and hot water

Method:

1. Cover the mouth of the plastic bottle with the balloon (not inflated).
2. Heat the plastic bottle with the help of the hair dryer.
3. Observe what happens to the balloon.
4. Hold the plastic bottle under the cold water from a tap, or place it in a refrigerator, and observe what happens to the balloon.
5. With the help of an adult, heat some water to almost boiling temperature.
6. Pour the hot water into a plastic mug, and dip the plastic bottle (with the balloon), in an upright position into the hot water.
7. Observe what happens to the balloon.
8. Cool the bottle again with cold water or by placing it in a refrigerator.

Observation: In each case, the balloon inflates when heated, and deflates when cooled.

Conclusion: Air expands when heated, and it contracts when cooled.



CHARACTERISTICS OF WIND

Wind has two important characteristics—*direction* and *speed*. The direction of wind can be gauged using an instrument called the *wind vane*. It is also called a *weather vane*. Every wind vane has two parts, the *Spee* and the *rear*. A very common shape for a wind vane is the shape of an arrow. The tip of the arrow is the 'front', and the tail of the arrow is the 'rear'. This is then mounted on a vertical column that is free to move when the wind blows. The front part has a smaller surface area than the rear.



Fig. 14.3
A wind vane



Fig. 14.4 A cup anemometer

When wind blows, it presses more on the rear part of the wind vane as it has a greater surface area. The arrow, therefore, aligns itself such that its tip points in the direction from which the wind is blowing. Directions, namely, *North*, *South*, *East*, and *West* will be marked on the wind vane. Another common shape used in a wind vane is that of a rooster. The head has a smaller surface area than the tail, and points in the direction from which the wind blows (Fig. 14.3). For an accurate reading, the wind vane should be located well above the ground, beyond trees, and other buildings which may interfere with wind direction.

The speed of wind is usually measured with an instrument called the *anemometer* (*anemos*, wind). In a type of anemometer, called *cup anemometer* (Fig. 14.4), there are three or four cups mounted symmetrically at right angles to a vertical axis. The force exerted by the wind is greater on the inside surface of the cup than on the outside. Due to this, the cups rotate. The rate of rotation is directly proportional to the wind speed. The higher the wind speed, the faster the cups rotate. Cup anemometers are mainly used by meteorological stations.

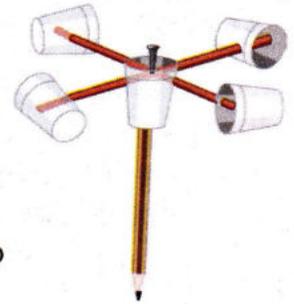
Activity

Aim: To make an anemometer

Materials needed: 5 plastic cups, a paper punch, two light plastic straws, a pencil with an eraser attached, and a ball pin

Method:

1. Take 4 plastic cups and punch two holes in them about $\frac{1}{2}$ inch below the rim, at diametrically opposite points.
2. Take the fifth cup and repeat Step 1, but this time make four holes (i.e., two pairs of equally spaced diametrically opposite holes). Also make one hole at the centre of the base of the cup, big enough for the pencil to go through, but tight enough so that it does not slide.
3. Pass the two straws through the diametrically opposite holes of this (the fifth cup).
4. Pass the pencil (the eraser side in) into the hole in the base (from the bottom), align the straws so that they intersect at the centre, and push in the ball pin through the straws and into the eraser.
5. Now there will be four ends of straw jutting out of the cup, push each of these through one pair of holes of the first four plastic cups.
6. Make sure all the plastic cups face in the same direction (i.e., clockwise or anti-clockwise). The anemometer is ready. Hold it in a windy place and it will rotate.



Let's Remember



Fill in the blanks with the correct words.

1. Moving air produces _____ (gravity/lift).
2. The pressure exerted by air is called _____ (anemometer/air pressure).
3. Roofs can be blown off during a storm because of the _____ (drop/increase) in pressure due to moving air.
4. The direction of a wind can be found with the help of a _____ (wind mill/wind vane).

STORMS

AN

Storms are severe atmospheric disturbances accompanied by very strong, high-speed winds. They are often set off when different types of air masses meet. This could be a dry air mass meeting a moist air mass, or a cold air mass meeting a warm air mass. Storms can range from moderate to very severe. Severe storms can cause large-scale destruction of life and property.

Let us study about two such storms, cyclones and tornadoes.

Case Study: Dust Storms

Over the last few years, there has been an increase in the number of severe dust storms and thunderstorms in Northern India. These phenomena are not restricted to India alone. Storms all over the world are becoming more severe and more frequent. Scientists attribute this increase to climate change and global increase in temperature. In May 2018, a severe dust storm hit parts of Rajasthan and Uttar Pradesh. This resulted in more than 100 people losing their lives and a great amount of damage to property. The wind speeds were more than 125 km/h.



Cyclone

Cyclones develop over the ocean near the equator, where the waters are warm. Such storms are given different names in different regions. They are called *hurricanes* in North America and the Caribbean, *typhoons* in Eastern Asia, and *cyclones* in India.

Here is a simplified explanation of how they occur.

Step 1: Warm air over the oceans (containing a lot of water vapour) rises, leaving behind a region of low pressure.

Step 2: Colder air from the surroundings rushes in to take its place. This cold air comes spinning inwards in a spiral, which is caused by the Earth's rotation. Interestingly, the spiralling winds spin in an anti-clockwise direction in the northern hemisphere and in a clockwise direction in the southern hemisphere.

Steps 1 and 2 continue and the winds spiralling around the eye (centre) of the storm gain very high speeds. This whole storm system, consisting of the eye (centre) and spiralling winds, also moves. It is very difficult to predict the exact path a cyclone will take, just like it is difficult to predict the path of a spinning top. Storm systems can be tracked by satellites (Fig 14.5). In the meantime, the rising moist air forms clouds on the top. Several small storm systems can form and merge to become a much bigger storm. As the wind speeds keep building up, the storm gets bigger and bigger. A full fledged cyclone can have wind speeds ranging from 120 km/h to 280 km/h. These cyclones may spread over hundreds of kilometres. A cyclonic storm becomes stronger if it passes over warmer ocean water and reduces in strength if it passes over cooler water. Some cyclones die down in the ocean itself and some hit land. When the eye of the storm hits the land, it is said to make a *landfall*.



Fig. 14.5 A cyclone

The extent of damage caused by a cyclone depends mainly on the wind speeds. Cyclones are given categories 1 to 5, on what is called the *Saffir-Simpson Scale*. Category 1 is relatively mild compared to Category 5 which is completely devastating.

Case Study: Cyclone Fani

Cyclone Fani is one of the most powerful cyclones to hit India in the last 20 years. It was a cyclone in the Bay of Bengal and struck the eastern coast of India on the 3rd of May 2019. The state of Odisha bore the brunt of the storm. Though it was a devastating storm, the government of Odisha was able to evacuate thousands of people to safer areas with remarkable disaster management planning and execution, keeping the number of deaths to the minimum. The official number of deaths is 64 as compared to over 10,000 in a similar cyclonic storm in 1999. Many organizations from all over the world, have hailed this admirable effort of the government as well as the Indian Meteorological Department for accurate tracking of the storm and advance warning. However, we have to remember that while many lives were saved, significant damage to property could not be avoided and many people have to rebuild their lives having lost their homes, and also their means of livelihood.



Effects of a Cyclonic Storm

Cyclones can be very dangerous to human life and property.

Dangers at sea: Cyclonic storms produce very high waves (as high as a four or five storey building).

Furthermore, the level of sea water rises much above the normal sea level, and the level of the tide is also much higher. These are called *storm surge* and *storm tide*, respectively. It is very dangerous for fishermen to go out into the seas during such a time. Every year a number of fishermen go missing at sea, despite warnings.

Damage on the land: The damage caused by a cyclonic storm depends on the category of the storm. A *Category 1* cyclonic storm is the mildest, in which trees could be uprooted and electric poles and hoardings could fall. There could also be a considerable amount of flooding caused by rain. *Category 5* is the severest, the impact of such a storm is catastrophic. Almost all trees, hoardings, and poles will be blown away and buildings can be damaged or even totally destroyed. People will have to be evacuated from areas likely to be worst affected to safer areas, whenever large-scale destruction is expected in a cyclonic storm. The wind speeds in a *Category-1* storm are about 120 km/h–150 km/h. In a *Category 5* storm, the wind speeds are over 250 km/h.

Let's Discuss

Why does the fury of a cyclonic storm die out after it hits the land?

Safety Measures during a Cyclone

Cyclones can be tracked and a warning can be given well before it comes close to land. Here are a few safety measures that you should take if a storm warning has been issued in your area. Before the storm, you can prepare yourself in the following manner.

- Listen to the news on the TV or radio, about where and when the storm is likely to make landfall and what category it is. You may also receive instructions on whether you should stay indoors or evacuate. News updates about the storm may also be sent over the Internet.
- In case a storm is imminent, stock up enough food and water to last a few weeks. Store enough batteries, emergency lights, drinking water, and candles, and also a battery-operated radio to receive the latest news. Remember there could be a disruption in electrical and water supply and telephone communication as well.
- Remove dead trees and branches in the vicinity. Secure loose roofing and clear out objects kept in the open.
- Fishermen should not venture out to sea.

Tornado

A **tornado** is a spinning air column typically shaped like a funnel with one end (like the snout of a funnel) on the ground and the other in a cloud. Wind speeds in tornadoes are very high and anemometers usually get damaged by the power of the winds. Tornadoes develop from thunderstorms and are formed mostly on land (tornadoes formed over sea are called *water spouts*). They are the most violent small-scale storms on Earth. The fast swirling winds may reach speeds of over 500 km/h, destroying virtually everything in their path. Unlike hurricanes, tornadoes are usually narrow, about 0.5 km wide and rarely do they move beyond 20 km.



Fig. 14.6 A tornado

Safety Measures During and After a Tornado

- Stay indoors.
- Do not take shelter under a tree as it can be uprooted.
- Avoid touching anything that may be exposed to electricity lines.

Tornadoes can develop very fast and a very short warning notice may be given. A tornado warning is generally given just about 10 minutes in advance.

- Never try to outrun a tornado. Take shelter in a building.
- Watch out for flying debris; most injuries in a tornado are due to flying debris.

Let's Remember



A. Fill in the blanks with the correct words.

1. _____ (Pressure/Storms) are severe atmospheric disturbances accompanied by very strong, high speed winds.
2. A _____ (cyclone/gentle wind) would have wind speeds of over 120 km/h.
3. A violent, funnel-shaped spinning storm over land is called a _____ (cyclone/tornado).

B. Answer the following questions orally.

1. Give two differences between a cyclone and a tornado.
2. Which of the two covers a large expanse—a cyclone or a tornado?
3. Give two precautions that we should take if there is a cyclone warning.

Key Words

Wind	A movement (usually horizontal) of air in the atmosphere is called wind.
Wind vane	An instrument used to find wind direction is called wind vane.
Anemometer	An instrument used to measure wind speed is called an anemometer.
Storm	A severe atmospheric disturbance accompanied by strong, high-speed winds is called a storm.
Tornado	A violent spinning storm (typically shaped like a funnel) with the narrow end on the ground is called a tornado.

Summary

- The weather of a region is influenced by the wind patterns of that region.
- As warm air is light, it rises and cold air from the surrounding area rushes in to fill the space it has left. This sets up a current of air and is called wind.
- Wind is generally described by two characteristics—direction and speed.
- Storms are called typhoons in Eastern Asia, hurricanes in the Caribbean and North America, and cyclones in India.
- Tornadoes formed over sea are called water spouts. As a cyclone forms, the pressure falls in the centre of the storm and this is called the eye of the storm.
- Proper safety measures should be taken during a storm to minimize loss of life and property.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

1. _____ (Daily/Seasonal) rain-bearing winds are called monsoon winds.
2. When air expands, its particles move _____ (closer/farther away).
3. A/An _____ (wind vane/anemometer) can be used to measure wind speed.
4. High waves that form when a cyclonic storm moves towards land is called a _____ (storm surge/water spout).
5. You will not be able to outrun a _____ (tornado/breeze) in a car.

B. Choose the correct option.

1. What is true about warm air?
 - a. It contracts and rises.
 - b. It expands and rises.
 - c. It contracts and sinks.
 - d. It expands and sinks.
2. What do monsoon winds bring along with them?
 - a. Warmth
 - b. Winter
 - c. Rains
 - d. Summer
3. How does the movement of air takes place?
 - a. From an area of lower pressure to an area of higher pressure
 - b. From an area of higher pressure to an area of lower pressure
 - c. Between areas of equal pressure
 - d. Both a and c
4. Which of these would have the highest wind speeds?
 - a. A tropical storm
 - b. breeze
 - c. Eye of the tornado
 - d. A cyclone
5. Why does a thin strip of paper rise when we blow air over it?
 - a. The pressure above the strip is higher than the pressure below the strip.
 - b. The pressure above the strip is lower than the pressure below the strip.
 - c. Atmospheric pressure changes with altitude.
 - d. None of these
6. What happens when air cools?
 - a. It becomes heavier and rises.
 - b. It becomes heavier and sinks.
 - c. It becomes lighter and rises.
 - d. It becomes lighter and sinks.
7. What is the low pressure area at the centre of the cyclone called?
 - a. Hurricane
 - b. Breeze
 - c. Rainfall
 - d. Eye of the storm
8. What is a cup anemometer used to measure?
 - a. Rainfall
 - b. Wind speed
 - c. Wind direction
 - d. Humidity
9. What is a wind vane used to find?
 - a. The amount of rainfall
 - b. Wind speed
 - c. Wind direction
 - d. Relative humidity
10. Which of these storms are formed mostly on land?
 - a. Typhoon
 - b. Tornado
 - c. Cyclone
 - d. Hurricane

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II. Very short answer type questions.

Give one word for the following.

1. A movement (usually horizontal) of air in the atmosphere
2. A scale used to represent the category of a cyclone
3. Name for cyclone in East Asia
4. When the eye of storm hits land
5. Tornadoes formed over sea

III. Short answer type questions

1. Why is there an uneven heating of the Earth?
2. Why do rain-bearing winds from over the ocean blow towards the land in summer?
3. Why does warm air rise?
4. Explain why roofs can be blown off during a storm.
5. Why does a wind vane point towards the direction of the wind?
6. On what factors does atmospheric pressure depend upon?

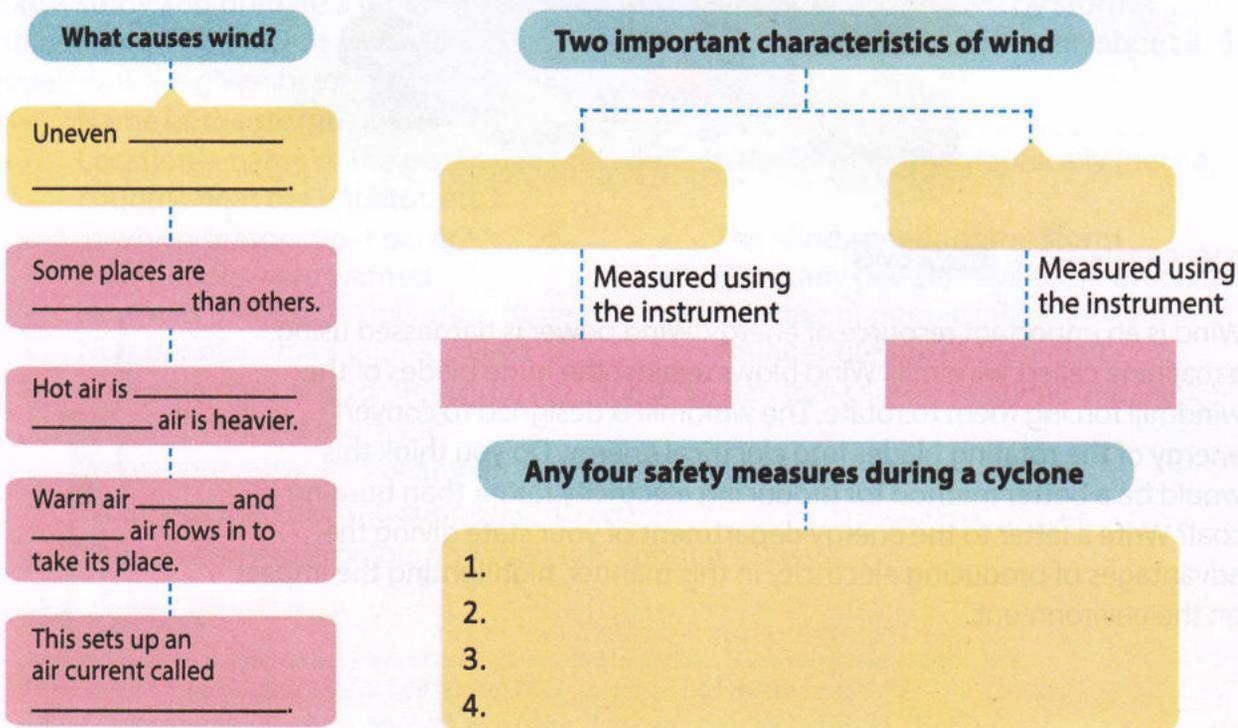
IV. Long answer type questions

1. Explain how a wind is set up in the atmosphere.
2. Describe a simple experiment to show that air in the atmosphere exerts pressure.
3. You are given a fully blown balloon, a tub of hot water, and a tub of ice-cold water. Using these items, explain how you would show that air expands on heating and contracts when it cools down.
4. Draw a diagram and explain briefly how a cup anemometer works.

LET'S RECALL



Recall and complete the concept map given below.



LET'S APPLY



Why do we usually find holes cut into big hoardings and banners? (Hint: Think of blowing wind and pressure.)

LO 13

LET'S ANALYSE AND EVALUATE

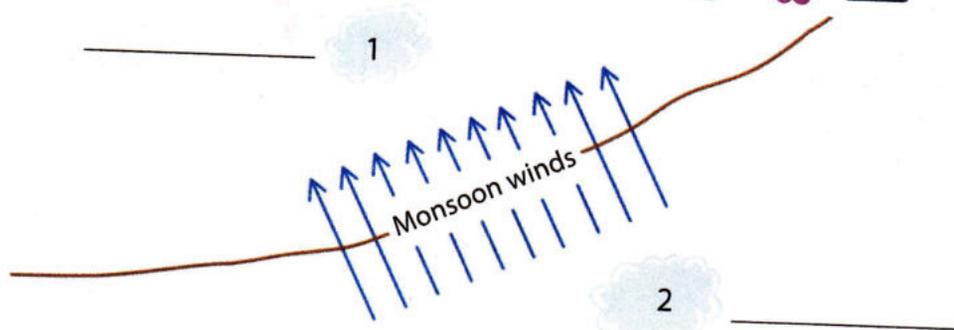
1. Analyse the similarities and differences between sea breeze/land breeze and monsoon winds. Here are a few suggestions.
 - a. When do they occur?
 - b. How are they generated?
 - c. What are the wind speeds?
 - d. What is the result of the winds?
2. a. In the given picture, observe the direction of the monsoon winds in summer. Correctly fill in 'Land' or 'Ocean' in the blanks for clouds 1 and 2.



LO 5



LO 6



- b. Why do some storms die out in the ocean before hitting land, while some intensify further?

LET'S CREATE



LO 16

Make a study and prepare a report (or presentation) on 'Destruction caused by storms'. Find out about one recent storm in India or in any other country. Get information about it. Some suggestions are given below.

- Name of the storm
- Location—name of the ocean/sea and where it was located geographically (near a country, near the equator, etc.)
- In which season did it occur?
- How people were warned
- How was the rescue operation done
- Number of animals injured/killed
- Consequences due to the storm, e.g., flooding, damage caused to telephone lines, railways, roads, airport, etc.
- Were there outbreaks of any disease after the incident?
- What was the help and support received?
- The wind speeds of the storm
- Did many people have to be evacuated
- Number of people injured/killed
- Number of houses damaged

You can add more points and then talk about it in class.

Web Research

Browse the Internet and find out more about cyclones and tornadoes. Some suggested websites are:

<https://www.youtube.com/watch?v=exMSmXqEKko> (accessed and checked on 28/08/19)

<https://www.youtube.com/watch?v=M0pYWXq7dqw> (accessed and checked on 28/08/19)

One of the most important senses that we human beings have is to 'see' the world around us. Light enables us to 'see'. For thousands of years, people have been curious about light, its properties and behavior. The earliest experiments on light involved the study of light using mirrors and lenses.

Study the pictures below carefully and answer the questions that follow.

You will learn about

- Rectilinear propagation of light
- Reflection of light
- Plane mirrors
- Spherical mirrors
- Spherical lenses
- Colours

1.



Aman is hiding behind a door and trying to look around the open door with the help of a bent hollow tube. Do you think he will be successful?

2.



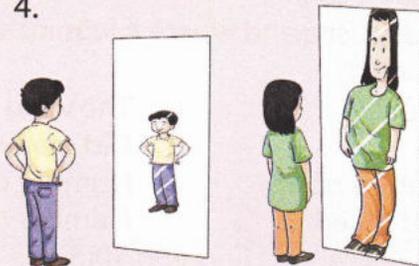
Where do you think the colours in the CD are coming from—is the CD itself coloured?

3.



Nancy is trying to get the sunlight passing through the window to fall on a wall by the side of the window. What do you think she is using to do this?

4.



Why do the images in mirrors in amusement parks appear distorted?

The study of light and its properties is both exciting and rewarding. In this chapter, we will learn about how light propagates (travels), how it behaves when it is reflected by mirrors, and when it passes through lenses and prisms.

Answers: 1. No; 2. No, when the CD reflects light it comes out coloured; 3. A mirror; 4. Because the mirrors have curved surfaces

RECTILINEAR PROPAGATION OF LIGHT

Generally, light travels in a straight line in a uniform transparent medium or in vacuum. This mode of propagation of light is called *rectilinear propagation*.

Let us understand rectilinear propagation of light with the help of the following activity.

Activity

Aim: To verify that light travels in a straight line

Materials needed: A flexible rubber or plastic tube/straw of length 10 inches (used for drinking cold drinks); and a light bulb/candle/lamp

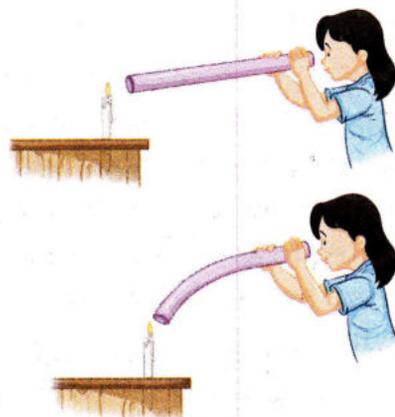
(Note: Do not use sunlight as the source of light in this experiment as it could hurt your eyes.)

Method:

1. Hold the tube absolutely straight and point one open end to the source of light.
2. Put your eye to the other hole. What do you see?
3. Now, bend the tube and look through the hole. What do you see this time?

Observation: When the tube is held straight, the source of light can be seen. However, when the tube is bent, the source of light cannot be seen.

Conclusion: This indicates that light travels in a straight line.



Rectilinear propagation of light explains a lot of phenomena associated with light. One such phenomenon is the formation of shadows.

When you shine a torch in a dark room, you can see a beam of light. If you place a pencil in front of a lit candle, a shadow can be seen on the wall. This shadow is formed when the pencil blocks the light travelling in a straight line. This is possible because of rectilinear propagation of light. See Figure 15.1.

There are many instances in our daily lives where we come across rectilinear propagation of light. Can you see your friend if he/she is hiding behind a chair? You cannot because the light travelling from your friend to you travels in straight lines, and it is blocked by the chair. If light could bend, it would have gone around the chair and you would have been able to see your friend.

Word help

Rectilinear Consisting or bound by straight lines

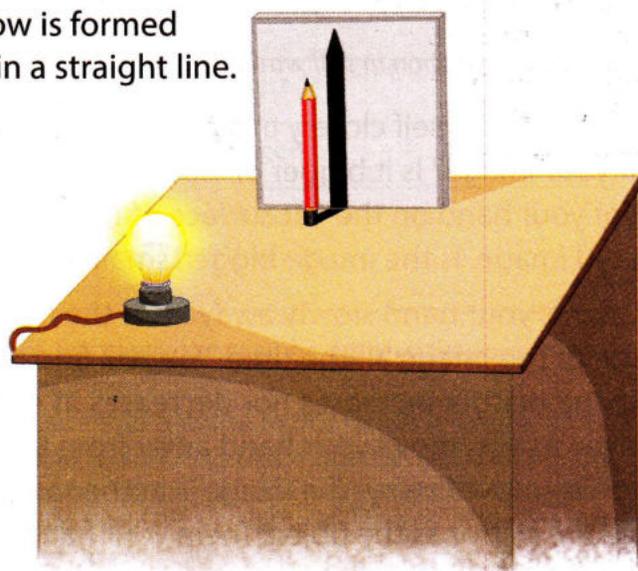


Fig. 15.1 Shadow formation due to rectilinear propagation of light

REFLECTION OF LIGHT

You can see an object when light falls on it. When light falls on a surface, it bounces off the surface. This is called *reflection*.

Reflecting Surfaces

All types of surfaces reflect light. That is why we can see them. When light from the sun or any source falls on an object, we are able to see the object because the light reflected by the object reaches our eyes.

While talking of reflection, we refer to a smooth surface as a *regular surface*, and a rough and wavy surface as an *irregular surface*. A regular surface reflects a parallel beam of light incident upon it in only one direction. Reflection by a regular surface is referred to as *regular reflection* [Fig. 15.2(a)]. A rough surface reflects a parallel beam of light incident upon it in all directions. The small bumps and irregularities on a rough surface cause each of the light rays to reflect in different directions. This kind of reflection is called *irregular or diffused reflection* [Fig. 15.2(b)].



Fig. 15.3 Reflection in still water

PLANE MIRRORS



Can you think of a plane reflecting surface? The mirror on the dressing table is a good example of a plane reflecting surface. Any smooth polished surface that can reflect the rays of light and form a clear image is called a **mirror**. Any highly polished metal surface, e.g., a stainless steel plate, or still water (Fig. 15.3), acts like a mirror.

If you look at yourself closely in a mirror, what do you observe about your image? Is it bigger or smaller than you? Place the palm of your hand on the flat surface of the mirror and study its reflected image. Is the image bigger, smaller, or of the same size? Now, move your hand slowly away from the mirror and observe the size of the image all the time. You will find that the size of the image neither increases nor decreases in size (Fig. 15.4). However, as you move your hand away from the mirror, the image also moves away. The image is at the same distance behind the mirror as the object (here your hand is the object) in front of it.



Fig 15.4 The image formed in a plane mirror is laterally inverted

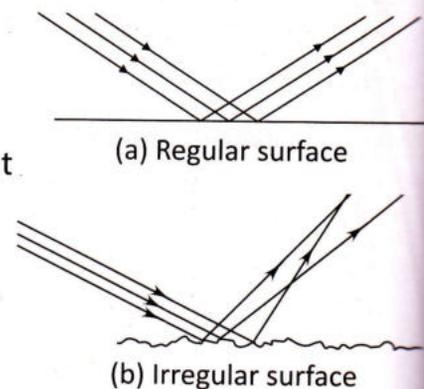


Fig. 15.2 Reflection by different surfaces

Lift your right hand. The image in the mirror appears to lift its left hand. This is called *lateral inversion*.

Now, stand in front of the mirror and see if you can touch your image formed in the mirror. You cannot because the image seems to be behind the mirror. Such an image is called a *virtual image*. A virtual image cannot be formed on a screen. Do you notice anything else about your image? Is the image upside down as compared to you? It is not. Such an image is called an *upright image*. Thus, a reflecting surface produces an image of certain properties. These are called *image characteristics*. To summarize, the image characteristics of a plane mirror are the following.

- A plane mirror produces an upright, virtual image.
- The image is of the same size as that of the object.
- The distance of the image formed from the mirror equals the distance of the object in front of the mirror.
- The image in a plane mirror is laterally inverted.

Activity

Aim: To study reflection by a plane mirror

Materials needed: A plane mirror (dressing mirror), a sheet of paper and a pencil

Method: Stand in front of the mirror and look at your image in the mirror. Fill up the observation table.

Observation:

S.No.	Question	Answer
1.	Is the image upright or inverted?	
2.	Can you touch your image?	
3.	Is the image real or virtual?	
4.	Is the size of the image bigger or smaller than you, the object	
5.	Do your left and right sides seem to be reversed in the image?	
6.	i. When you move closer to the mirror, what happens to your image? ii. What happens to your image when you move farther away from the mirror?	

Look at the answers you have written down in the table. What does it tell you about the characteristics of the image formed by a plane mirror?

Conclusion: From the above activity we can see that a plane mirror forms a virtual, upright image, which is the same size as the object. The distance of the image formed behind the mirror is equal to the distance of the object in front of the mirror. These are called image characteristics of an image formed by a plane mirror.



A. Fill in the blanks with the correct words.

1. A _____ (smooth/rough) surface reflects a parallel beam of light in only one direction.
2. Irregular reflection is also called _____ (granular/diffused) reflection.
3. A mirror is a _____ (regular/irregular) surface.
4. The image formed by a plane mirror is _____ (real/virtual).

B. Answer the following questions orally.

1. Why can't we see a source of light through a hollow bent tube?
2. Which expression is used to convey that 'light travels in straight lines'?
3. How are we able to see things around us?
4. Why can we see our image in some surfaces and not in other surfaces?
5. What property is common between the images of the following letters? 'O', 'I', 'M' and 'A'

Write down another letter and a digit which will follow the same property as found in the letters given above.

SPHERICAL MIRRORS

As the name suggests, a *spherical mirror* is a part of a sphere. If we take a hollow sphere and make a straight cut through it, we get a portion that is hollow and concave inside and bulging and convex outside (Fig. 15.5).

The polished curved surface of spherical mirrors also reflects light, but the images formed by them are different from those formed by a plane mirror. *Concave mirrors* and *convex mirrors* are the two types of spherical mirrors.

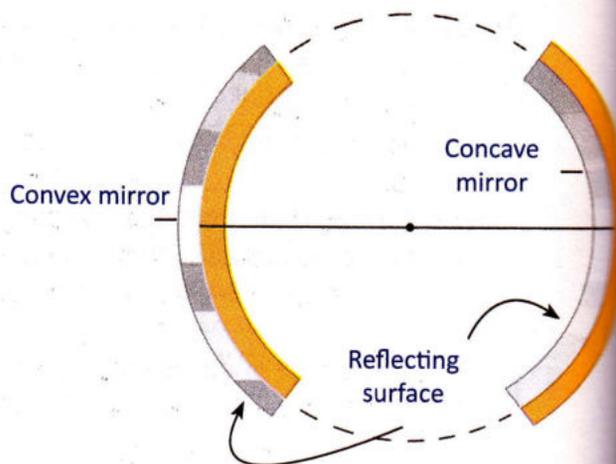


Fig. 15.5 Spherical mirrors

Concave Mirror (or Converging Mirror)

A **concave mirror** is a spherical mirror in which the reflecting surface is the inner surface of the sphere.

Let us conduct an activity to study the type of image formed by concave mirror.

Activity

Aim: To study the types of images formed by a concave mirror (adult supervision required)

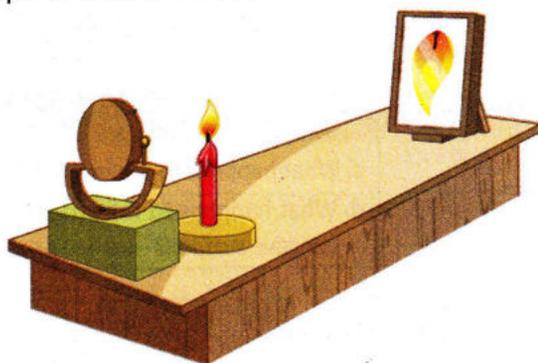
Materials needed: A highly polished concave surface (concave mirror, spoon, or ladle), a candle with a holder, a table top, a thick piece cardboard covered with white paper (screen), a plane mirror (a hand mirror), a well-lit window

Note: Never look at the sun directly or through any type of lens or mirror.

Method:

A.

1. Place the lit candle on the table between the screen and concave surface.
2. Keep the candle close to the concave surface. Keep the concave surface facing the candle and the screen.
3. Move the screen backwards and forwards till you get an image of the candle flame on it. If you do not, increase the distance between the candle and the concave surface, and try again.
4. Do the same with a plane mirror and see what happens.
5. Bring the concave surface very close to the candle and look at the surface from behind the candle. What do you see?
6. Do the same with the plane mirror. Is there any difference in the image that you see?
7. Repeat this activity for different distances between the screen and the candle. What do you observe?



B.

1. As you move the concave surface away from the candle, you will find that you will have to bring the screen closer to the candle to get a sharp image of the candle flame.
2. At one point, the screen is almost at the same point as the candle. (Be careful to hold the screen away from the flame to avoid starting a fire.)
3. After this point, you will have to bring the screen on the same side of the candle as the concave surface (a little to the side so as not to block the light from the candle, falling on the reflecting surface).



C.

1. Hold the concave surface facing a well-lit window.
2. Turn the mirror a little, so that the reflected light forms an image on the adjoining wall. Examine the image closely.
3. Go out on a bright sunny day and hold the concave surface so that it faces the sun.
4. Turn the concave surface a little so that the reflected light falls on the screen. Now move the concave surface back and forth so that a sharp image of the sun is formed on the screen. Based on your observations, fill in the following table.

Observation:

S.No.	Question	Answer
1.	Is the image upright or inverted?	
2.	Can you form the image on the screen?	
3.	Is the image real or virtual?	
4.	Is the size of the image bigger or smaller than the object	
5.	Is there any connection between inverted/upright nature and real/virtual nature of the image?	

S.No.	Question	Answer
6.	a. When you move the object closer to the mirror, what happens to the image? b. What happens to the image when you move the object farther away from the mirror? c. What happens to the image if the object is very close to the mirror? d. What happens to the image when the object is very far from the concave surface?	

A. You will see an image of the candle flame on the screen.

This image is inverted and keeps getting smaller as you increase the distance of the concave surface from the candle.

Furthermore, you will not get an image on the screen when the candle is very close to the concave surface. However, if you look into the concave surface from behind the candle, you will see an **enlarged image** of the candle.

On the other hand, you will not be able to get an image of the candle-flame on the screen with the plane mirror, no matter what you do. However, if you look into the mirror, you will be able to see the image of the candle and the flame, which is the same size as the object.

B. As you increase the distance between the candle and the concave surface, the image (formed in A) gets smaller as the distance increases.

C. Forming the image of the sun with the help of the concave surface is like moving the object to infinity. In this case, the image is extremely small (compared to the object) the light is focussed at a small point. This point is called the **focus** or **focal point** of the mirror.

Word help

Enlarged Image An image that is bigger than the object

Convex Mirror (or Diverging Mirror)

A **convex mirror** is a spherical mirror in which the reflecting surface is the outer surface of the sphere.

Activity

Aim: To study the types of images formed by a convex mirror (adult supervision required)

Materials needed: A highly polished convex surface (convex mirror, spoon, or ladle), a candle with a holder, a table top, a thick piece of cardboard covered with white paper (screen), and a plane mirror

Method:

1. Place a lit candle on the table-top between the screen and the convex surface.
2. Place the convex surface close to the candle and move the screen back and forth to get an image of the candle flame on the screen.



- Repeat this for various distances between the candle and the convex surface. What do you observe?
 - Look into the convex surface from behind the candle. What do you see?
- Based on your observations, fill in the following table.

Observation:

S.No.	Question	Answer
1.	Is the image upright or inverted?	
2.	Can you touch the image?	
3.	Is the image real or virtual?	
4.	Is the size of the image bigger or smaller than the object?	
5.	Is there any connection between inverted/upright nature and real/virtual nature of the image?	
6.	a. When you move the object closer to the mirror, what happens to the image? b. What happens to the image when you move the object farther away from the mirror? c. What happens to the image if the object is very close to the mirror?	

No matter where you place the candle, you will not get an image of the candle-flame on the screen. However, when you look into the convex surface from behind the candle, you will see an upright and **diminished image** of the candle.

Word help

Diminished Image An image that is smaller than the object

In the above activity, you may also observe that as you move the convex surface farther away from the candle, the image of the candle becomes smaller and more objects around the candle come into view. This shows us that a convex surface has a wide field of view.

Uses of Spherical Mirrors

Unlike plane mirrors, curved mirrors form all sorts of images. These can be put to use in a variety of applications. Here are a few examples.

Uses of Concave Mirrors

- The property of a concave mirror by which it forms an enlarged image when the object is very close to the mirror is used in dentist's mirrors, to make it easier for the dentist to examine your teeth. Shaving mirrors (Fig. 15.6) are also based on the same property of concave mirrors.



Fig. 15.6 Shaving mirror

- They are used in solar power projects, in which the sun's rays need to be focussed in a small region.

Uses of Convex Mirrors

- Convex mirrors are used as rear view mirrors and wing mirrors in buses and other vehicles (Fig 15.7) for viewing the entire vehicle as well as the surroundings behind the vehicle.
- They are also used in supermarkets and parking lots.

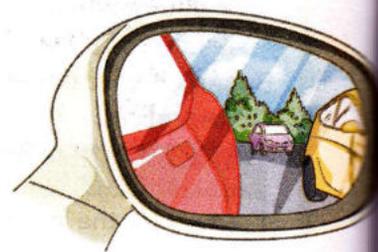


Fig. 15.7 Wing mirror

SPHERICAL LENSES

A **lens** is a curved and polished piece of glass or any other transparent material. Just like mirrors, lenses can also change the direction of propagation of light. Convex and concave lenses are the two common types of lenses.

Convex Lens (or Converging Lens)

A **convex lens** is a lens that bulges in the middle and is thinner at the edges. A common example is a magnifying glass. Another place you will find convex lenses is in spectacles used as reading glasses.

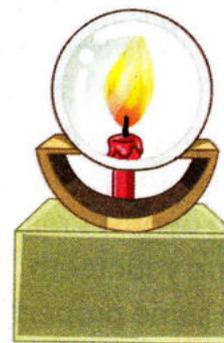
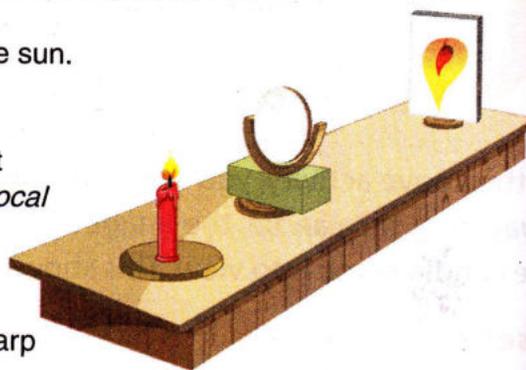
Activity

Aim: To study the images formed by a convex lens (adult supervision required)

Materials needed: A convex lens (a magnifying glass or a pair of spectacles with positive powered lenses), a screen, a candle, table-top, and measuring tape/ruler

Method:

1. Go outdoors and hold the convex lens facing the sun. Keep the screen behind the lens.
2. Move the lens back and forth so that you get a sharp image of the sun on the screen. The point where you get the image is called the *focus* or *focal point* of the lens, represented by F.
3. Place the lens between the screen and candle. Start with the lens very close to the candle and move the screen back and forth till you get a sharp image on the screen.
If the lens is very close to the candle, you may not get an image on the screen. In that case, look through the lens at the candle. You will see an enlarged view of the candle.
4. Repeat the activity by slowly increasing the distance between the candle and the lens and move the screen back and forth each time to get a sharp image.
5. Make a note of the image characteristics like real/virtual, upright/inverted and diminished/enlarged.



Observation: If the lens is very close to the candle, an image is not formed on the screen. Such an image is called a virtual image. If the lens is at a distance from the candle, an image is formed on the screen. An image that can be formed on a screen is called a real image.

Conclusion: A convex lens forms both real and virtual images. It forms a virtual enlarged image when the object (candle) is very close to the lens.

Concave Lens (or Diverging Lens)

A **concave lens** is a lens that is thinner in the middle and smoothly increases in thickness at the edges. Concave lenses are present in spectacles of negative power.

Let's Discuss

How is a convex lens similar to a concave mirror?

Activity

Aim: To study the images formed by a concave lens (adult supervision required)

Materials needed: Concave lens, a screen, and candle

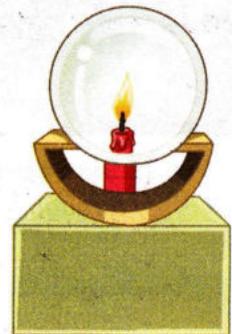
Method:

1. Place the concave lens between the screen and the lit candle. Move the screen back and forth to get an image of the candle flame. What do you observe?

2. Next, look at the candle through the lens. What do you see?

Observation: You will see that no matter where you place the screen, lens or the candle, you will not be able to get an image of the candle-flame on the screen. However, if you look at the candle from behind the lens, you will see a diminished, upright image of the candle.

Conclusion: With a concave lens, no matter where you place the object, you will always get a virtual diminished, upright image.

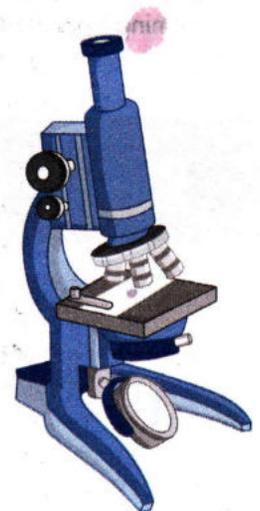


Uses of Lenses

- Both convex and concave lenses are used in spectacles to correct eyesight; convex lenses are used as reading glasses, while concave lenses are used to correct short-sightedness.
- Lenses are used in cameras, magnifying glasses, binoculars, microscopes, and telescopes (Fig 15.8).
- Our eyes also have lenses.



(a) Magnifying glass



(b) Compound microscope

Fig. 15.8 Uses of lenses

Let's Remember



Write T for the True and F for the False statements. Correct the false statements.

1. Spherical mirrors form exactly the same type of images as plane mirrors.
2. A concave mirror can form both real and virtual images.
3. A concave lens can be used as a shaving mirror.
4. A convex mirror is used as a magnifying glass.
5. A convex lens is also known as a diverging lens.

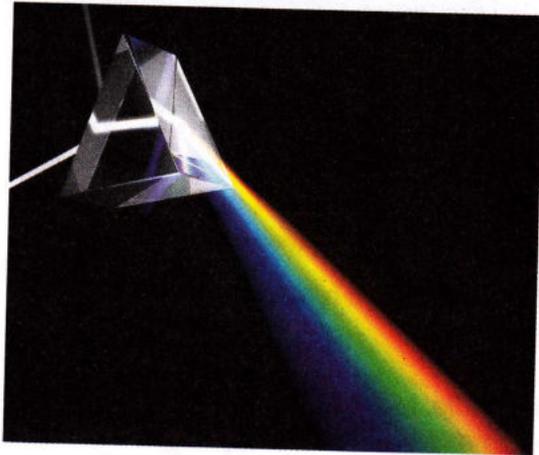


Fig. 15.9 Dispersion of light through a prism

Fact File

The colours, violet, indigo, blue, green, yellow, orange, and red, in a rainbow come from white light coming from the sun.

COLOURS

Take a CD (compact disc) out in the sun and see how light is reflected from its shining surface. What do you see? You will see many colours. These colours actually come from the sunlight.

White light is composed of many colours. When these colours combine, they look white. One way of showing that white light is composed of different colours is to make white light pass through a glass prism. This splits up the white light into its constituent colours. See Fig (Fig 15.9). This is called *dispersion of light*.

If you hold a screen in its path, after the white light passes through a prism, you will see a band of colours. *This band of colours is called the spectrum. As it is visible to the human eye, it is called the visible spectrum* (Fig. 15.10). When light falls on an object, it absorbs a few of these colours and reflects the rest. In case of a green leaf, it absorbs all the colours except green (which it reflects). That is why we see it as green.

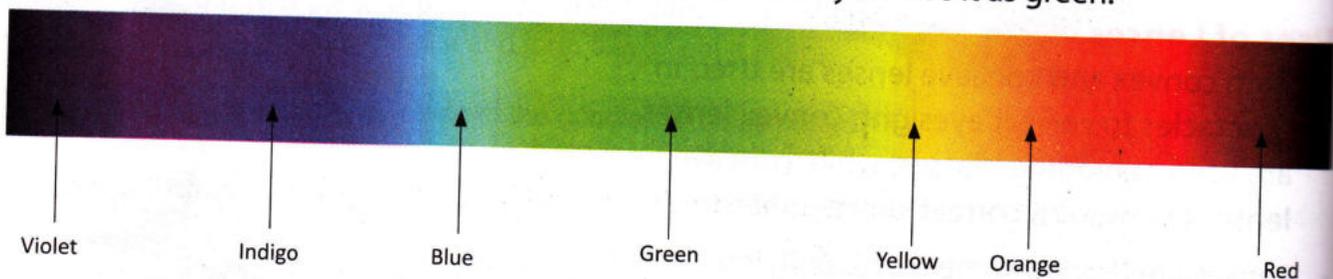


Fig. 15.10 The visible spectrum (VIBGYOR)

Another method which can be used to show that white light is composed of different colours is to show that different colours, when combined, give us white light. This is what happens in a *Newton's disc*. Let us learn about it.

Newton's Disc

AN

Newton's disc is a coloured disc which is painted with the constituent colours of white light [i.e., violet, indigo, blue, green, yellow, orange, and red (VIBGYOR)] in equal proportions so that when it is rotated very fast, the disc appears white (Fig. 15.11). This is because of a property of our eyes called *persistence of vision*. This means that an image formed by the eye remains for a fraction of a second. When the disc is rotated at a high speed, the images of the different colours overlap in our eyes and the brain perceives it as white.

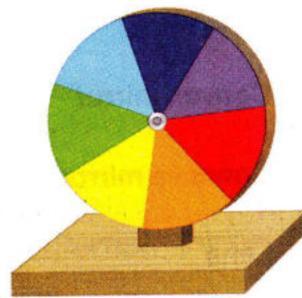
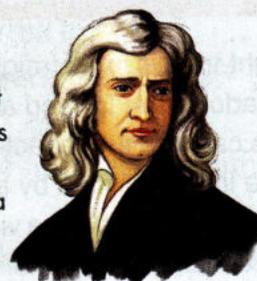


Fig. 15.11
Newton's disc

Know your Scientist

Isaac Newton was born in the year 1643 in England. He was one of the most eminent scientists of his time, and made important contributions in many areas of Physics and Mathematics. His theories and laws in Physics are used even today. Newton's experiments with light led him to propose that white light is a mixture of several colours.



Let's Remember



Fill in the blanks with the correct words.

1. White _____ (prism/light) can be split into its constituent colours.
2. When white light is split, it splits into a band of colours called the _____ (visible/invisible) spectrum.
3. A coloured disc, painted with the constituent colours of white light in equal proportion, appears _____ (white/black) when rotated.

Key Words

Mirror

A highly polished reflecting surface that can reflect the rays of light into the same medium is called a mirror.

Virtual image

An image that cannot be formed on a screen is called a virtual image.

Real image

An image that can be formed on a screen is called a real image.

Inverted image

An image that is upside down as compared to the object is called an inverted image.

Erect image

An image that is upright (the right way up) as compared to the object is called an erect image.

- Convex mirror** A curved mirror with a reflecting surface bulging outward at the middle is called a convex mirror.
- Concave mirror** A curved mirror with a reflecting surface curving inward at the middle is called a concave mirror.
- Lens** A curved and polished piece of glass or any other transparent material is called a lens.
- Convex lens** The type of lens that bulges out in the middle and is thinner around the edges is called a convex lens.
- Concave lens** The lens that is thinner in the middle (as compared to the edges) is called a concave lens.

Summary

- Light travels in a straight line. This is called rectilinear propagation of light.
- Shadows are formed as a result of rectilinear propagation of light.
- We can see the reflected image of an object only if it is reflected by a highly polished surface.
- The image formed by a plane mirror cannot be made to form on a screen.
- A plane mirror forms a virtual, upright image. The image size remains the same as that of the object.
- A convex mirror can only form virtual images, whereas a concave mirror can form both virtual and real images depending on the distance of the object from the mirror.
- A lens is a curved and polished piece of glass or any other transparent material.
- Common lenses are of two types: convex and concave.
- A concave lens always forms a virtual image. A convex lens can form both real and virtual images depending on the distance of the object from the lens.
- Light is composed of many colours. When these colours combine, they look white.
- Newton's disc is a coloured disc painted with constituent colours of white light (VIBGYOR) in equal proportions so that when it is rotated very fast, the disc appears white.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

1. 'Rectilinear propagation of light' means light travels in _____ (rectangles/straight lines).
2. A bumpy, rough surface is also referred to as a _____ (diffused/irregular) surface.
3. A convex mirror can only form _____ (real/virtual) images.

4. A concave lens is a _____ (diverging/converging) lens.
5. A virtual image _____ (can/cannot) be formed on a screen.

B. Choose the correct option.

1. What is bouncing of light from a surface called?
a. Refraction b. Diffusion c. Dispersion d. Reflection
2. Which phenomenon is responsible for the formation of shadows?
a. Rectilinear propagation of light b. Irregular reflection
c. Circular propagation of light d. Regular reflection
3. What is the reflection from an irregular surface called?
a. Spherical reflection b. Diffused reflection
c. Irregular reflection d. Both b and c
4. Which of the following are the characteristics of the image formed by a plane mirror?
a. Real, upright image b. Real, inverted image
c. Virtual, upright image d. Virtual, inverted image
5. At which surface does reflection of light take place?
a. Only mirrors b. Only metals c. All sorts of surfaces d. Both a and b
6. What is correct about a virtual image?
a. It can be formed on a screen. b. It cannot be formed on a screen.
c. It can be formed on a rough surface. d. Both a and c
7. What type of image(s) does a concave mirror form?
a. Only virtual images b. Only diminished images
c. Only real and magnified images d. Both virtual and real images
8. What type of image(s) does a convex mirror form?
a. Only virtual images b. Only diminished images
c. Only real images d. Virtual and diminished images
9. What does a magnifying glass consist of?
a. Convex mirror b. Concave mirror c. Convex lens d. Concave lens
10. Which of these is used as a 'dentist mirror'?
a. Concave mirror b. Convex mirror c. Concave lens d. Convex lens

II. Very short answer type questions

Give one word for the following.

1. A mirror whose reflecting surface is the inner surface of a sphere _____
2. A lens that is thicker at the edges than at the middle _____
3. An image that is upside down _____
4. A band of colours that is formed when white light is passed through a prism _____
5. The property of our eyes that makes us perceive a rotating coloured disc as white _____

III. Short answer type questions

- Here are a few words and numbers. Write down how they will look in a plane mirror.
a. AMBULANCE b. LEFT c. 12345678 d. 8888
- If sunlight is streaming in through a window in a room, how could we make it fall on a wall which is on the same side as the window?
- How can we find out if an image formed (either by a mirror or a lens) is real or virtual?
- Why are convex mirrors used as car wing mirrors?

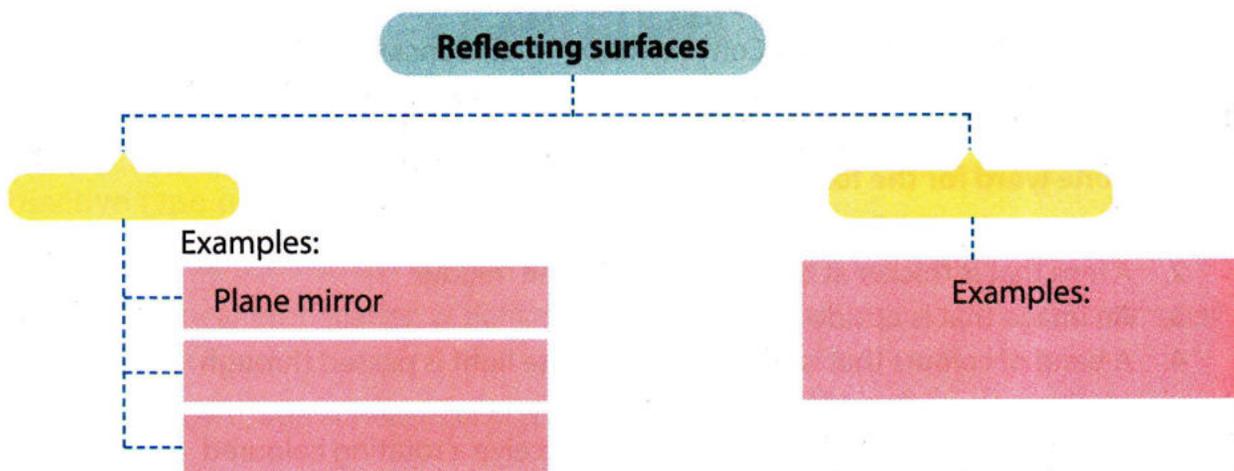
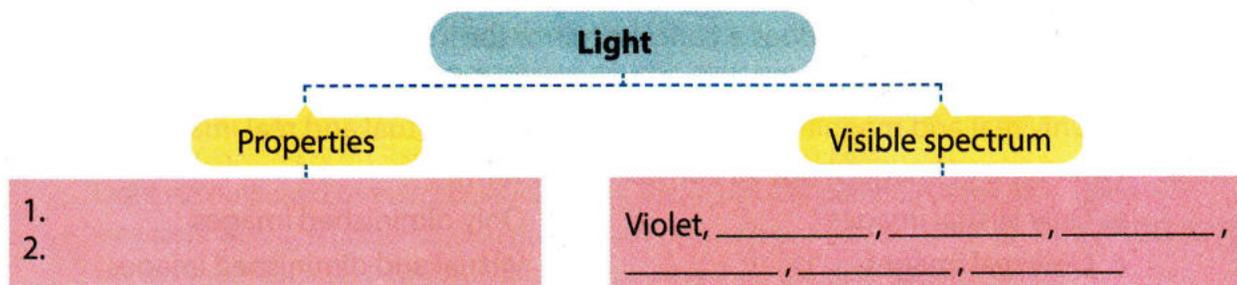
IV. Long answer type questions

- What is the difference between the reflection from a regular surface and that from an irregular surface?
- You are given a plane mirror, convex mirror, concave mirror, convex lens and a concave lens. Give two methods by which you can form diminished images of an object and two methods by which you can form enlarged images.
- What is a Newton's disc? What is it used to demonstrate? Explain how.

LET'S RECALL



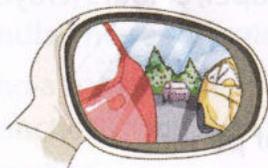
Recall and complete the concept map given below.



LET'S OBSERVE

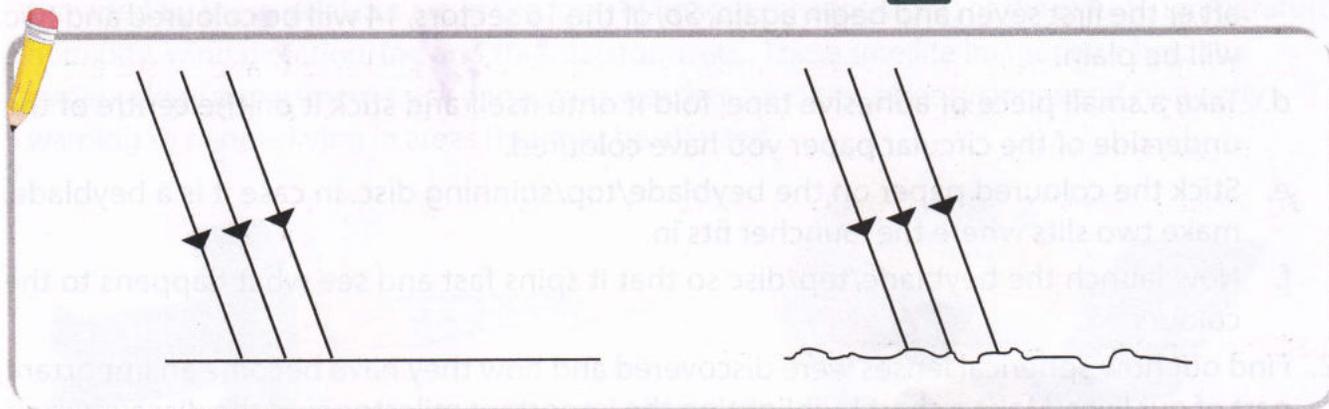


- Look at the pictures below and name the optical component (mirror/lens) used in each case.



- a. _____ b. _____ c. _____ d. _____

- Draw reflected rays to show reflection at the given surfaces. **LO 9**



LET'S CONNECT GEOGRAPHY/ART

In many cases, colours are used to convey a message, or to signify a meaning. For example, a plain white flag represents 'surrender'. The colours in the flags of different countries are chosen carefully to convey a certain meaning. On a chart paper, draw and colour the flag of your country and of four other countries, and write down what each of the colours of the flags signify.

LET'S APPLY



- Look at yourself in two plane mirrors, one big and one small. Will you appear bigger in the bigger mirror? (*Hint: Think of the image characteristics of a plane mirror*) **LO 13**
- Will a Newton's Disc appear white even if it is rotated very slowly? (*Hint: think of what makes the disc appear white*)

LET'S ANALYSE AND EVALUATE

- Yash says that the wing mirrors of the car are convex and not concave. Is he right? Give one reason in support of your answer.   **LO 1**
- Yusuf wants to know the power of the lenses in his grandfather's reading glasses. Suggest a way by which he could do so. (*Hint: The power of a lens is the reciprocal of its focal length expressed in metres.*)  **LO 4** **LO 13**

LET'S CREATE



1. Make a coloured disc and rotate **LO 11** **LO 15**

Materials needed:

You will need a beyblade, a top or any spinning disc, a sheet of white paper, colours (crayons or pencil colours), adhesive tape, and a pair of scissors

Method:

- Cut out a circle (about 2 inches in radius) from the white sheet of paper.
 - Fold the paper into a semicircle, then a quarter, and so on four times. This will give you 16 wedge-like sectors.
 - Now, colour each sector in the order V, I, B, G, Y, O, R. Leave one plain white sector right after the first seven and begin again. So, of the 16 sectors, 14 will be coloured and two will be plain.
 - Take a small piece of adhesive tape, fold it onto itself and stick it on the centre of the underside of the circular paper you have coloured.
 - Stick the coloured paper on the beyblade/top/spinning disc. In case it is a beyblade, make two slits where the launcher fits in.
 - Now launch the beyblade/top/disc so that it spins fast and see what happens to the colours.
2. Find out how spherical lenses were discovered and how they have become an important part of our lives. Make a chart highlighting the important milestones in the discovery and use of lenses from ancient to modern times. Discuss it in class. **LO 12**

Web Research

Browse the Internet and find out more about light and the phenomena related to it. Some suggested websites are:

<https://www.youtube.com/watch?v=5j7wJWhxuWU> (accessed and checked on 28/08/19)

<https://www.youtube.com/watch?v=hLFcf58qD4w> (accessed and checked on 28/08/19)

Worksheet 6

Skills assessed:

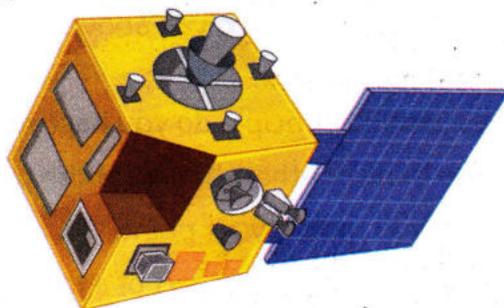
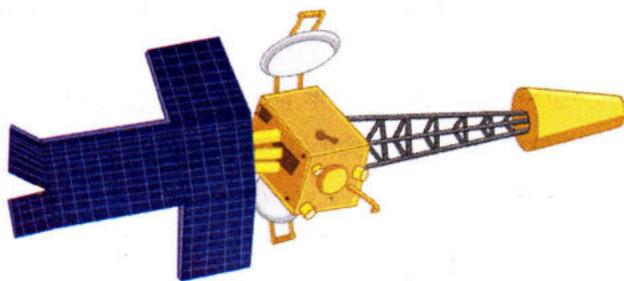
Problem solving, and qualitative analysis

Read the passage given below and answer the questions that follow.

India's meteorological satellites

India has launched several satellites over the last few decades. Satellites perform varied functions. One such function is weather monitoring. Such a satellite is called a 'meteorological satellite'.

Two satellites of India, INSAT 3A and Kalpana-1, are used by the meteorology department to get data to monitor and predict the weather conditions for different regions of the country. Data provided by these satellites are in the form of images (photographs) of the clouds, temperatures, humidity, wind direction, fog and thunderstorm, etc.. These satellite images also help the meteorology department track dangerous weather conditions like cyclones and give early warning to people living in areas that may be affected.



(Information got from the following website <https://www.isro.gov.in/applications/meteorology>)

Use the information given in the passage above and answer the questions that follow.

1. What is a meteorological satellite?

2. Name two meteorological satellites that the Indian meteorological department uses to collect data to predict the weather.

3. What kind of data do we get from these satellites?

4. In what way is this data helpful?

Activity



Skills learnt:

Collaborating, communicating,
critical thinking, and creating

Aim: To design an instrument that will help us find the direction of wind

Materials required: A small plastic mineral water/soft drink bottle, plastic straw (taller than the bottle), cardboard, scissors, adhesive tape, a wide vessel or pan, sand, magnetic compass, and a marker pen

Method: Use the materials given and design an instrument that will show the direction of wind.

Answer the following questions after discussion with your group.

1. Which of the materials given above is the most suitable to make 'pointer' (to show the direction of wind)?
2. What scientific principle do you have to use to design the shape of the 'pointer'?
3. Can you think of other shapes for the pointer based on the above scientific principle?
4. How will you mount your pointer?
5. Can you use any toy or a part of a toy as part of your instrument?
6. What is the purpose of the wide vessel pan and sand?
7. How will you know the direction (North, South, East, West) in which the pointer is pointing?

Make a neat labelled diagram of your design in the box below and write a line describing the function of each part. Find out the cost of each part of the instrument you have constructed and estimate the cost of your instrument.

*For the Teacher: Please refer to the teacher's manual for more details

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Unit 7: Natural Resources

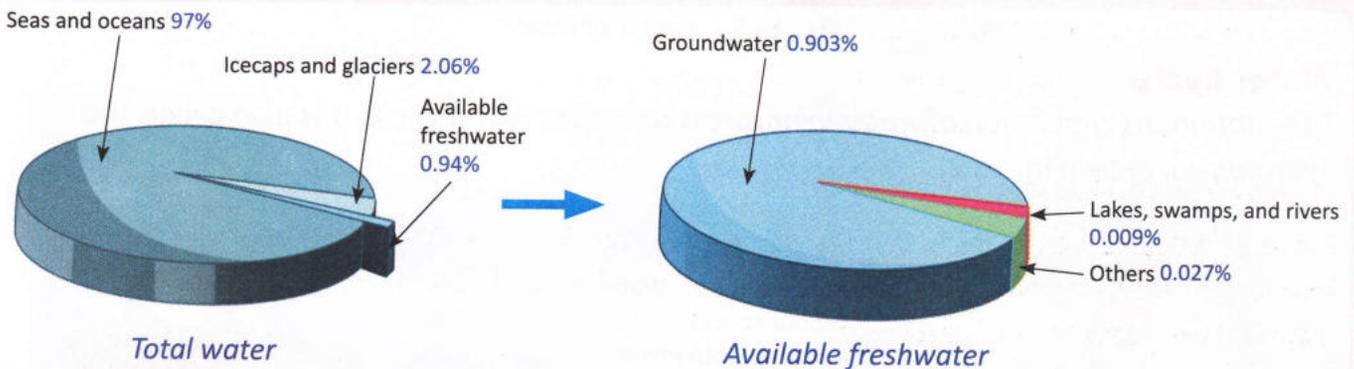
Water: A Precious Resource

Water is a natural resource that is vital to the presence of life on the Earth. Water exists in abundance on our planet Earth. However, only a very small fraction of it is fit for human consumption. Let us first understand the distribution of water on Earth.

You will learn about

- Forms of water
- Uses of water
- Sources of water
- Natural distribution of water in India
- Scarcity of water
- Conservation of water

Study the pie chart given below and answer the questions that follow.



1. Where is most of the water on Earth found? _____
2. What percentage of water on the Earth is freshwater? _____

Most of the water that exists on Earth is in the seas and oceans. Sea and ocean water is highly salty and, hence, unfit for drinking. Most of the freshwater is frozen in the glaciers and in the polar ice caps, and is thus, not readily available.

Only a small fraction of fresh water is readily available for use. Therefore, all of us must make an effort to use water judiciously.

AN

In this chapter, we will learn about different forms of water, its uses and distribution in India, and how to use it efficiently.

Answers: 1. Oceans and seas; 2. 3%

FORMS OF WATER



Water exists in three states, i.e., solid, liquid, and gas (Fig. 16.1). All the three states of water are present in our natural environment at any given time.

Solid Glaciers, icebergs, snow, hail, frost, and ice crystals in the clouds are solid forms of water.

Liquid Rain, dew, and clouds are water droplets or liquid forms of water. Liquid water also covers three-quarters of the surface of the Earth in the form of lakes, rivers, and oceans.

Gaseous Water vapour, fog, steam, and clouds are gaseous forms of water.

Water exists in all the three states because it can change its state in a range of temperatures, i.e., between 0°C (ice) and 100°C (vapour) by heating or cooling. This change also takes place on its own in our environment forming a cycle, which we know as the water cycle.

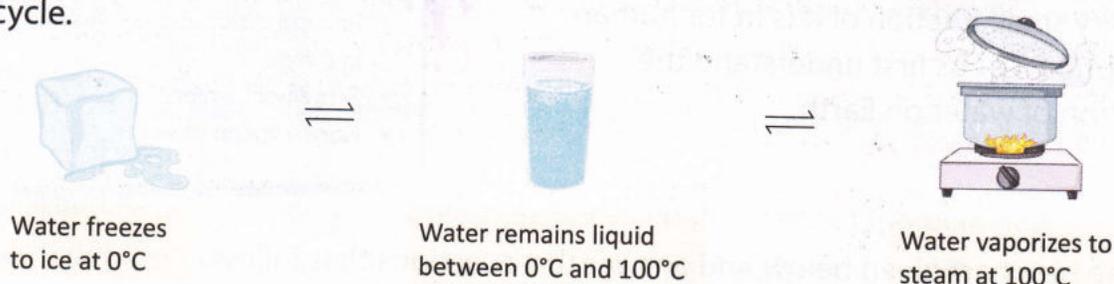
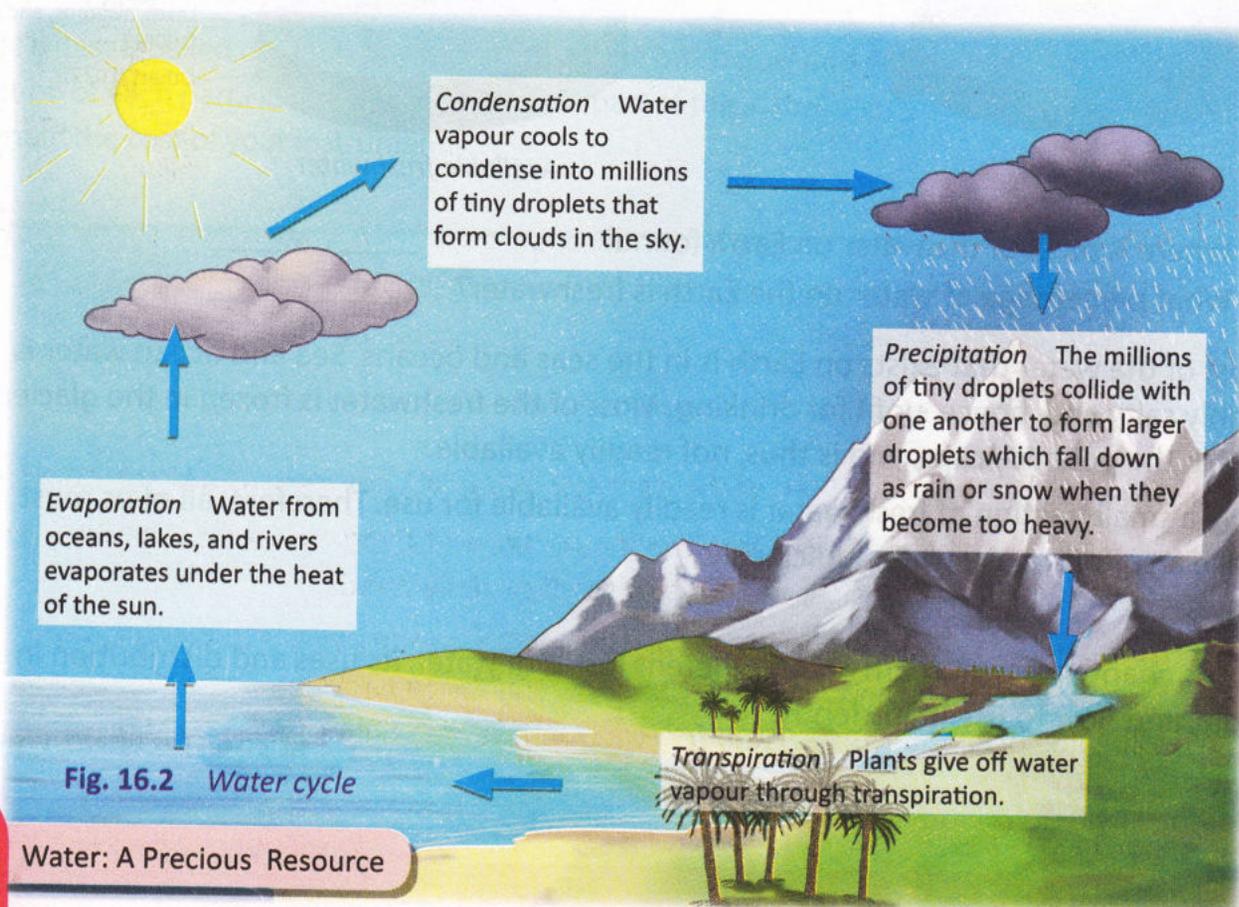


Fig. 16.1 Forms of water

Water Cycle

The continuous circulation of water in nature is called the **water cycle**. It is also called the **hydrological cycle** (Fig. 16.2).



USES OF WATER

The uses of water can be broadly divided into agricultural, domestic, and industrial uses. The major portion of water in India is used in agriculture, as India is mainly an agricultural country.

Agricultural Nearly 60% of the Indian population depends on agriculture for their living, and uses nearly 90% of all water for irrigation. *Irrigation systems* are necessary because the monsoons are unpredictable and in regions where cultivation completely depends on the rain, lack of rain can result in reduced yields or even total crop failure.

Domestic Water required for household use is called *domestic water*. It is required for a variety of purposes such as drinking, preparing food, bathing, washing clothes and dishes, watering plants, etc. We generally get water in our homes in one of the following two ways. It is either delivered by *the municipal water distribution system* (Fig. 16.3), or we extract it from *an underground source* through a motor-driven tube well.

In cities, municipal water treatment plants supply homes with treated water that matches drinking water standards.

Fact File

Each day the sun evaporates 1,000,000,000,000 (a trillion) tonnes of water.

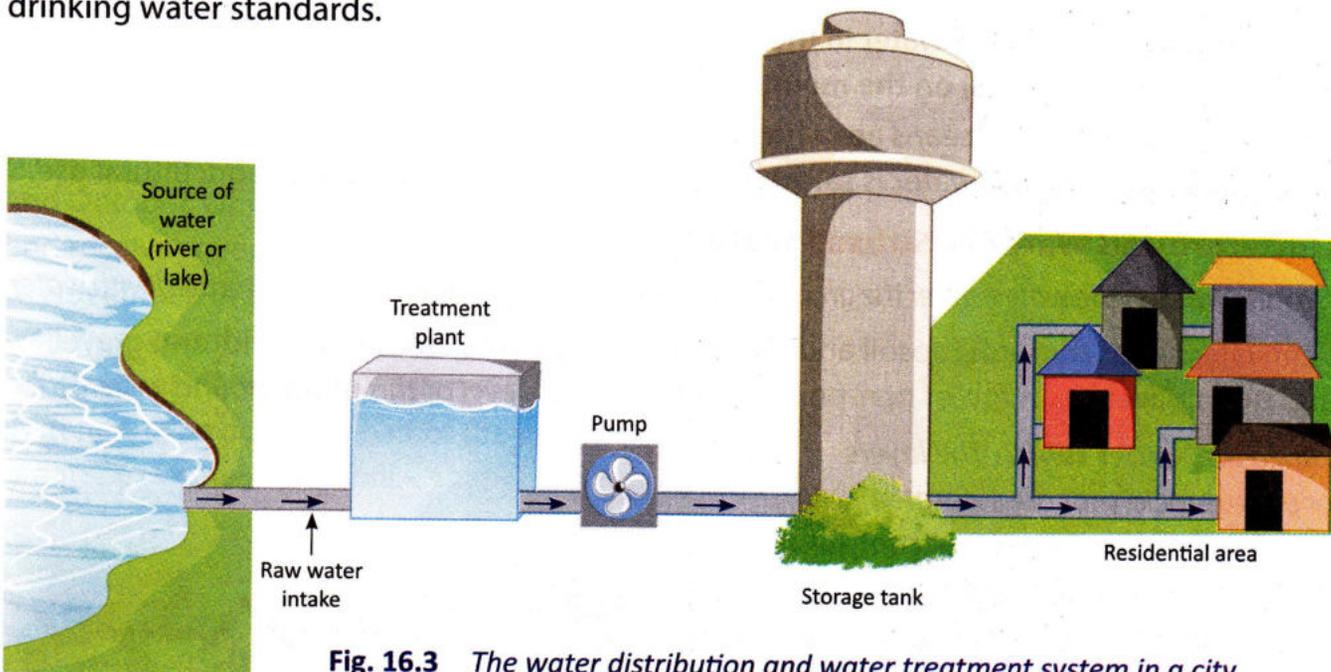


Fig. 16.3 The water distribution and water treatment system in a city

In rural areas, however, over 80% of the domestic water comes from underground sources. In areas where water is scarce or where wells, ponds, and rivers dry up in summers, people have to travel long distances to fetch water for their daily needs.

Industrial Industry depends on water at all levels of production. It is used as a raw material, a solvent, a coolant, a transport agent, and for generating electricity. Due to rapid industrial development, the demand for water in this area has increased in the past several years.

SOURCES OF WATER

AN

Precipitation in the form of rain or snow provides freshwater to our planet Earth. Most of the freshwater returns to the oceans through rivers flowing across the globe. A small portion of it is absorbed by the soil and is stored underground. A still smaller portion is stored in natural water bodies (lakes and ponds) and man-made water bodies (tanks and reservoirs). Thus, the various sources of water can be divided into two main categories:

- Surface water
- Underground water or subsoil water

Surface Water

Water present on the surface of the Earth is called **surface water**.

It can further be classified into three categories depending upon the 'purity' of water.

Rainwater Rainwater is the purest form of water. Why? As water from the seas and rivers evaporate to form water vapour under the heat of the sun, it leaves behind all the impurities. When precipitation occurs, the first showers dissolve certain gases present in air and also bring suspended impurities along with them. Subsequent showers, however, consist of pure water.

River and lake water The water in these water bodies comes either from rainfall or melting of snow (glaciers) on the mountains.

Sea and ocean water Oceans are a huge store of water. Millions of litres of water is present in them. But the water is salty and is not fit for either domestic or agricultural use.

Underground Water or Subsoil Water

Groundwater is the water under the ground where the soil is completely filled or saturated with water.

Rainwater seeps through topsoil and layers of rocks, such as limestone, sand, and gravel, and gets collected on top of non-porous layers. *The top level of this underground water is*

called the 'water table'. The layers of porous rocks that are saturated with underground water, that can be brought to the surface through natural springs or by pumping, are called 'aquifers'. (Fig. 16.4).

The place where the water table meets the land surface, water may come out of the surface in



the form of a natural spring and flow into a lake, stream or an ocean. Groundwater that meets the land surface also keeps rivers, streams, and lakes filled with water. Wells can also be drilled to take out the underground water.

Let's Remember



A. Fill in the blanks with the correct words.

1. The three states of water are _____ (reversible/irreversible).
2. Water exists in solid state in nature as _____ (water vapour/hail) and _____ (frost/fog).
3. Water changes to steam at _____ ($0^{\circ}\text{C}/100^{\circ}\text{C}$).

B. Write T for the True and F for the False statements. Correct the false statements.

1. Fog and steam are liquid forms of water.
2. Water cycle is also called hydrological cycle.
3. Plants give off water through evaporation.
4. India is mainly an industrial country.
5. A natural spring is formed where the water table meets the land surface.

NATURAL DISTRIBUTION OF WATER IN INDIA

Water availability in India depends greatly on the seasonal monsoons. The monsoons bring heavy rain over most of the country between June and October. Only Tamil Nadu is the exception and receives over half of its rain from October to November. India ranges from places having waterless conditions (Thar Desert) to places with rainforest climate (North Eastern States) (Fig 16.5). In general, the northern half of the country sees greater extremes in rainfall.

India has a large network of rivers too. The three major rivers, *Indus*, *Ganga*, and the *Brahmaputra* originate in the Himalayas and drain nearly two-thirds of the land area.

These rivers also account for nearly the same proportion of India's total water resources. Water in these rivers is strongly influenced by the monsoons.

During the monsoons, water levels in rivers rise and may result in floods. On the other hand, during the dry season, water levels go down quite a bit in most large rivers. Smaller tributaries and streams generally dry off completely.

To regulate water flow in these rivers and distribute water more evenly throughout the year, large dams have been built on a number of rivers.

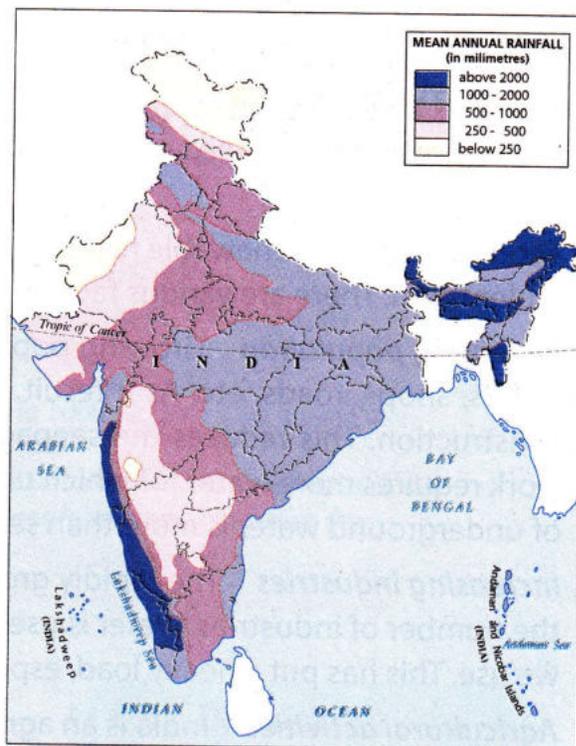
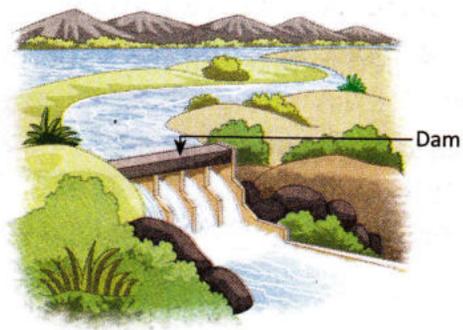


Fig. 16.5 Rainfall map of India

Dams

A dam is basically an artificial wall built across a river, and water is allowed to collect behind this wall in a reservoir. A system of artificial canals channelizes water from the reservoir to the region downstream for irrigation.

The Bhakra Dam, the first project to be taken up after India's independence, is built across the Sutlej river, near the border between Punjab and Himachal Pradesh. The dam is a part of the larger Bhakra Nangal project that aims at preventing floods in the Sutlej-Beas river valley, to provide irrigation to adjoining states, and to provide hydro-electricity.



On the other hand, the mountainous and hilly regions of north and west do not allow adequate seepage. So, groundwater is mostly limited to lower-lying areas such as valleys. The **peninsular** areas of our country also do not allow proper absorption of water, and therefore do not have large continuous aquifers.

Though the coastal plains are a rich source of groundwater, they can be contaminated by saltwater inflow caused by the over-pumping of groundwater. The Gangetic plains are, however, rich in groundwater as the aquifers keep getting recharged and restored.

SCARCITY OF WATER

Scarcity of water is defined as a situation where there is insufficient water to satisfy normal requirements.

Though water is a renewable resource, we humans are using it at a faster rate than it is being replenished. There are various factors contributing to the depletion of the water table.

Increasing population Growing population has resulted in a growing demand for houses, offices, shops, roads, etc. As a result, open areas like parks and playgrounds are used for construction. This reduces the seepage of water into the ground. Moreover, construction work requires more water for which underground water is used. As the rate of consumption of underground water is more than seepage, it results in a depletion of the water table.

Increasing industries The rapidly growing population has also resulted in an increase in the number of industries. Water is used in almost every stage of production of things that we use. This has put a heavy load, especially on the freshwater ecosystem.

Agricultural activities India is an agricultural country and farmers have to depend on rain for irrigating their fields. However, erratic monsoons result in excess use of groundwater thereby decreasing the underground water.

Deforestation Roots of trees have the ability to bind soil and, thus, enable it to hold water. With deforestation, the number of plants decrease, hence the water keeps flowing towards the sea and the groundwater is not recharged.

Word help

Peninsula A piece of land surrounded by water on three sides

In India, some specific causes of water scarcity are:

Uncontrolled use of borewell technology for extracting groundwater Farmers have overexploited groundwater resources in our country due to uncertain monsoons and an unreliable state water supply.

Pollution of freshwater resources This is due to the discharge of untreated domestic sewage, toxic industrial wastewater, and harmful pesticides and insecticides into water bodies.

No effective measures for water conservation Very little has been done for groundwater recharge and for protecting freshwater ecosystems.

Effects of Water Scarcity on Plants

Water is very important for plant growth; its deficiency weakens the plant.

When plants do not get sufficient water, they do not grow to their expected height, have reduced photosynthetic activity, and produce much less harvest than expected. Without enough water, plants will also be susceptible to diseases, which can eventually lead to the death of the plant.

This may result in a lack of food, oxygen, and rain, and eventually end all forms of life on the Earth.

Where do plants go when they die?

A growing plant builds its tissues out of water, carbon, and nitrogen compounds present in the soil, and carbon dioxide from the air. When it dies and falls to the ground, its tissues are broken down into simple compounds by the microbes present in the soil. This decaying plant matter is called *humus*. As humus decomposes, plant residues are converted into usable forms that are stored in the soil, and are taken up by living plants as food.

Case Study: Water Management in Sandharsi, a Village in Patiala, Punjab

Punjab faced a severe drought in 2015; the water level receded to 1000 feet below the ground due to reckless and repeated use of groundwater for irrigation.

The people of Sandharsi, a village in Patiala built ponds within their farmlands, which serves as a reservoir for excess water during monsoons and protects their crops from floods and during dry spells, the water from these ponds is being used for irrigation.

CONSERVATION OF WATER

The amount of available freshwater on Earth is limited. The day is not far when we will be facing a water crisis. We need to think of various ways to strictly avoid wastage. To prevent further shortages, households, communities, and private industries can adopt water saving practices, some of which are given below.

Let's Discuss

Discuss the various water conservation measures including judicious ways to use water at home.

Households can save water by promptly fixing leaks or dripping taps Although the water lost from leaks may not seem like much, it adds up to quite a lot. A dripping tap can result in a loss of upto 72 litres of water every day.

Recycling of water is very important We can start this even in our homes. For example, water used in cleaning utensils can be used to water plants in the garden instead of being poured down the drain.

A lot of water is lost during floods Dams, reservoirs, and embankments will help to check floods and the flow of water.

By improving the methods of irrigating the fields Instead of filling up the entire field with water, farmers can be taught the method of watering the roots of plants drop by drop.

Israel, which is a water-scarce country, has come up with this innovative technique called *drip irrigation* (Fig. 16.6). This type of irrigation employs the method of watering the roots of the plants drop by drop. This saves up to one-third of the water that would otherwise be lost during spray applications.

Further, it enables farmers to double harvests using the same amount of water. In other countries, such as Egypt, some of the solutions suggested include improvements in water efficiency and moving away from water-intensive crops.

Rainwater harvesting systems These help us to use rainwater directly. These structures are designed to help capture and store rainwater during the monsoon season, and serve as a source of drinking and irrigation water during the rest of the year.

In the many states of India, tanks, artificial ponds, and reservoirs have been constructed as part of the water harvesting system. These do not make a significant contribution to the total freshwater resource in India, but water harvesting systems (Fig. 16.7) have a strong impact on a local scale.

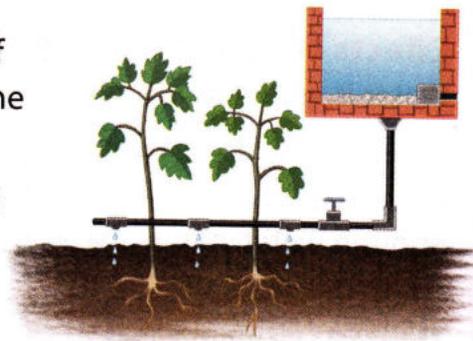


Fig. 16.6 Drip irrigation

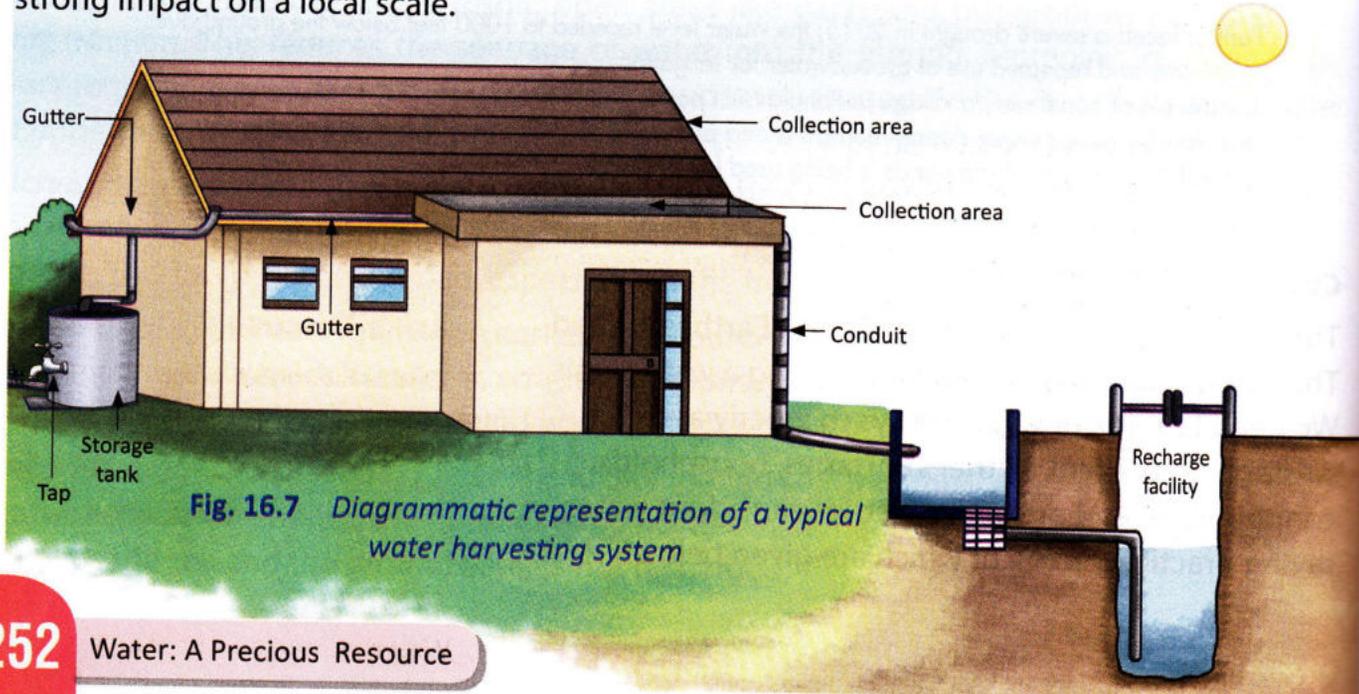


Fig. 16.7 Diagrammatic representation of a typical water harvesting system

Case Study: Rainwater Harvesting at Government School at Untka, Mewat District, Haryana

The government school at Untka has 300 students. This school was without a local source of water till 2013. The water for drinking purposes and preparation of mid-day meal was being extracted from underground, which was a highly saline source.

In 2013, the Roof Water Harvesting (RWH) system was established to recharge aquifer with rainwater with the support from the Department of Science and Technology (Government of India). The RWH unit was set up on the roof area of the school to capture rainwater. Since July 2013, the school has been using the recharged water that is made safe for drinking by filtration through a biosand filter. This filtration process removes microbes from the water and reduces the salinity of the water. By adopting the rainwater harvesting method, a combined storage of 150,000 litres of water is provided, which is sufficient for all the requirement of the school till the next monsoon season, when it gets recharged.

Key Words

Hydrological cycle	The continuous circulation of water in nature is referred to as a hydrological cycle.
Surface water	Water that is present on the surface of the Earth is called surface water.
Groundwater	Water under the ground, where the soil is completely filled or saturated with water, is called groundwater.
Water table	The topmost level of underground water is called the water table.
Aquifer	Underground water is also called an aquifer.
Humus	The decaying plant matter in soil is called humus.
Drip irrigation	The method of watering the roots of plants drop by drop is called drip irrigation.

Summary

- Water exists in the solid state as glaciers, icebergs and snow, hail, and frost, and as clouds formed of ice crystals; as liquid in rain and dew and clouds formed of water droplets; in the gaseous state as water vapour, fog, steam, and clouds.
- The water cycle involves evaporation of water from oceans, rivers, lakes, etc., condensation of water vapour to form clouds and precipitation in the form of rain and snow.
- Water sources can be divided into two categories: surface water and underground water.
- Water availability on the Indian subcontinent is dominated by the seasonal monsoon.
- India has a large network of rivers. A large number of dams have been constructed on these rivers to regulate the water flow in these rivers, and distribute water more evenly throughout the year.
- Water harvesting systems are required in our country because of the unequal distribution of water resources over different areas and time in our country.
- Water can be conserved by not wasting water in our household activities, by recycling water, and through rainwater harvesting.

Exercises

LET'S UNDERSTAND



QT

I. Objective type questions

A. Fill in the blanks with the correct words.

1. Water is used in the industries for _____ (irrigation/generating electricity).
2. _____ (Aquifer/Dams) are built on rivers to regulate the flow of water and distribute it more evenly throughout the year.
3. _____ (Punjab/Tamil Nadu) receives over half of its rain from October to November.
4. _____ (Sea/River) water is not fit for domestic and agricultural use.
5. _____ (Gangetic/Coastal) plains can get contaminated by saltwater inflow caused by the over-pumping of groundwater.
6. Rainwater harvesting systems help in _____ (scarcity/conservation) of water.

B. Choose the correct option.

1. Which of the following is responsible for continuous circulation of water on the Earth?
a. Evaporation b. Condensation c. Water cycle d. Water table
2. At what temperature will water turn into ice?
a. Above 100°C b. 25°C c. 100°C d. 0°C
3. Which of the following is the purest form of water?
a. Rainwater b. Groundwater c. River water d. Sea water
4. Which of the following is a rich source of groundwater?
a. Peninsular areas b. Gangetic plains c. Hilly regions d. Mountainous regions
5. Which of the following has led to scarcity of water?
a. Increase in population b. Deforestation
c. Pollution of freshwater resources d. All of these
6. Which of the following methods employ watering the roots of the plants drop by drop?
a. Rainwater harvesting b. Drip irrigation
c. Root irrigation d. Recycling water
7. Which of the following forms represents water in liquid state in nature?
a. Dew b. Glacier c. Fog d. Frost
8. What is the process by which plants give off water vapour called?
a. Evaporation b. Condensation c. Transpiration d. Precipitation

9. Which of the following can be used to conserve water?
- a. Water pollution b. Uncontrolled use of borewell technology
c. Recycling of water d. Pollution of freshwater resources
10. What is underground water also known as?
- a. Stream b. Spring c. Water table d. Aquifer

II. Very short answer type questions

Give two examples for the following.

1. Usage of water in industry _____
2. Domestic usage of water _____
3. Source of surface water _____
4. Rivers that originate in the Himalayas _____
5. Effluents that pollute water _____

III. Short answer type questions

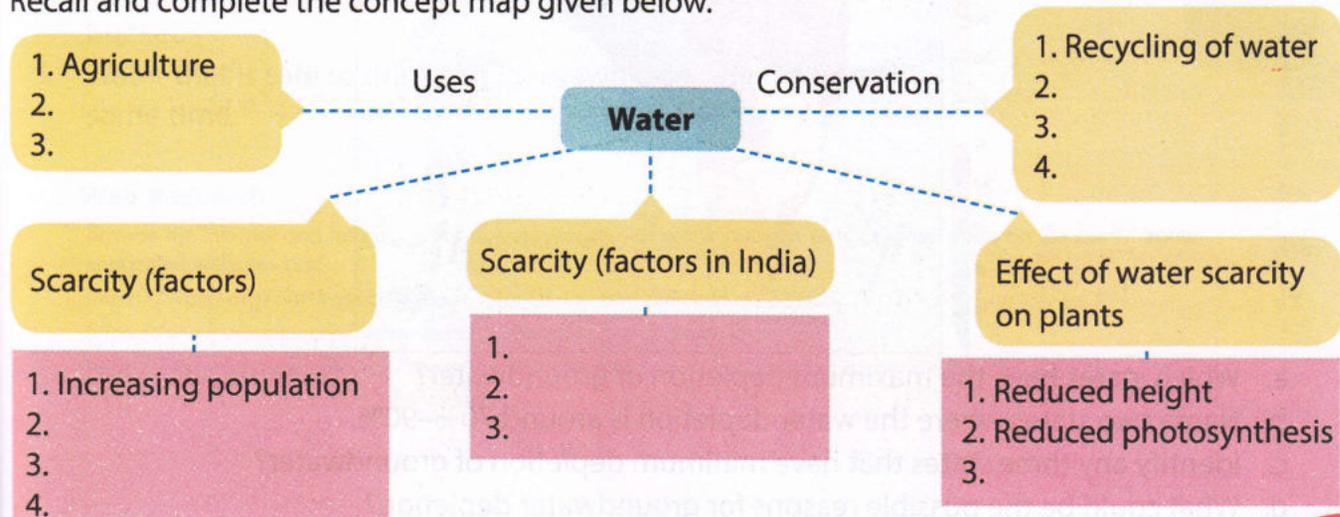
1. Differentiate between the terms surface water and groundwater.
2. What is water table? How is a natural spring formed?
3. Why monsoons are important for our country?
4. How does deforestation contribute to scarcity of water?
5. How does scarcity of water affect plants?

IV. Long answer type questions

1. Discuss various forms in which the three states of water are found in our natural environment.
2. Discuss the various factors that have contributed to the depletion of water table.
3. Explain the various practices that can be adopted to conserve water.

LET'S RECALL 

Recall and complete the concept map given below.



LET'S OBSERVE

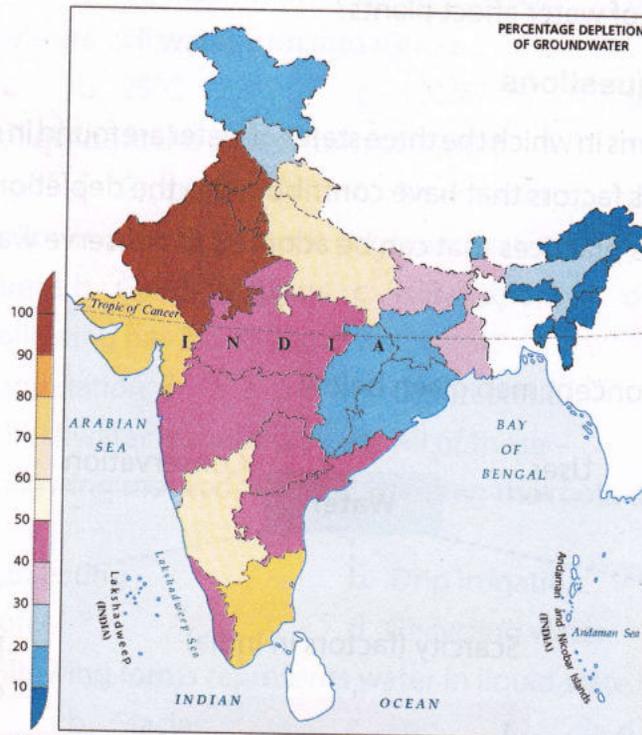


1. Label the water table and aquifer in the picture given below.



2. Look at the map of India shown below. The scale on the left hand side represents percentage depletion of groundwater.

LO 5 LO 14



- Which states have the maximum depletion of groundwater?
- Name two states where the water depletion is around 70%–90%.
- Identify any three states that have minimum depletion of groundwater?
- What could be the possible reasons for groundwater depletion?

Find out the difference between organic farming and commercial farming. Also, find out the amount of water required for growing crops in each case, and the affect they have on groundwater pollution? In which states do farmers grow crops organically?

LET'S APPLY 

1. Why is the groundwater level falling in metropolitan cities like Delhi? (*Hint: Increase in population*) 
2. Why were all the ancient civilizations developed on the banks of rivers? (*Hint: Survival of man*)

LET'S ANALYSE AND EVALUATE

1. 'Life is not possible on the Earth without freshwater.' Analyse and discuss. 
2. Evaluate traditional irrigation methods against modern methods (such as drip irrigation) on the following parameters—water conservation, yield of the crop, cost, effectiveness, groundwater level, etc.  

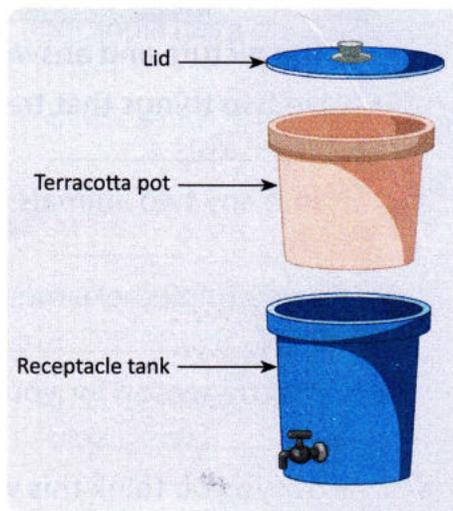
 

LET'S CREATE 

Terracotta pot has micro pores that only allow pure water to flow through its walls. We can create a water filter using a bucket with a tap and lid, a terracotta pot and a piece of cloth.

1. Soak a terracotta pot in clear water for 12 hours before making the filter. Do not use soap to clean the pot.
2. Place the pot inside the bucket and cover it with a piece of cloth.
3. Fill the pot by pouring the water on the cloth, which will strain out big sized impurities.
4. Completely fill the pot with water and close the lid of the bucket.
5. Water that is safe to drink can be drawn from the tap after some time.



Web Research

Browse the Internet and find out more about resources of water and the state of water crisis on the Earth. Some suggested websites are:

<https://water.org/our-impact/india/> (accessed and checked on 28/08/19)

<https://www.unwater.org/water-facts/> (accessed and checked on 28/08/19)

https://www.sciencedaily.com/terms/water_resources.htm (accessed and checked on 28/08/19)

Forest: Our Lifeline

You will learn about

- The profile of a forest
- Uses of forests
- Interdependence of plants and animals
- If forests disappear
- Conservation of forests

Look at the picture and answer the questions.

1. Give two things that trees give us.

2. Name any two animals that live in forests.

3. Do you think these men are doing the right thing? _____ (Yes/No)
4. Give one reason for your answer.

5. How do you think this will affect the air quality of this place? _____

Forests are home to a variety of plants and animals. Several trees, shrubs, mosses and mushrooms, birds and mammals, spiders, frogs, and snakes grow and live in forests. Human beings too, depend on forests for a variety of things. Felling of trees and clearing of forests may have undesirable effects on all life forms on Earth.

Let us learn more about a forest and its usefulness.

Answers: 1. Food, oxygen; 2. Lion, giraffe; 3. No; 5. The quality of air will deteriorate.

THE PROFILE OF A FOREST

About one-third of the world's land surface is covered with forests. Forests are different from one another depending upon where they are located. Climate, topography (physical features), and soil type are some of the main factors that determine the type of trees and animals that grow and thrive in a forest.

A mature forest can be divided into four layers (Fig. 17.1): *canopy*, *crown*, *understorey*, and *forest floor*. The uppermost layer of branches which serves as a dense roof of trees over the ground in a forest is called *canopy*. The layer where trees branch off from the tree trunk is called *crown*. The shaded layer of the forest where low light is available is called *understorey*. Shrubs, ferns, grasses, and weeds grow below this layer. The next layer is the *forest floor*. Litter of plants, remains of dead plants and animals, and decomposers such as bacteria and fungi are found on the forest floor. India has a diverse range of forests and their uses are equally diverse.

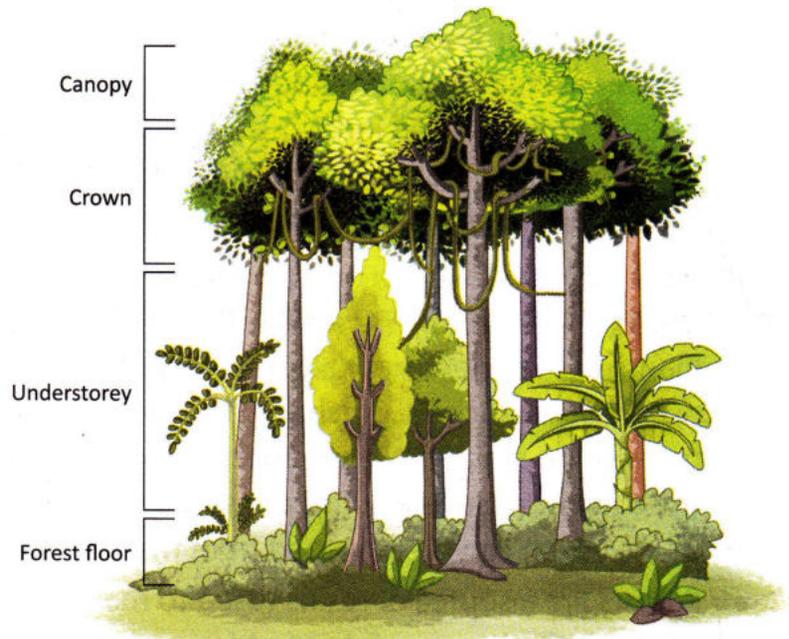


Fig. 17.1 Layers of a forest

USES OF FORESTS

LL

Forests play a major role in our life. Early humans gathered food and were dependent on forests for all their basic needs such as food, clothing, and shelter.

We depend on forests for several other things directly or indirectly.

- Forests prevent soil erosion and floods. Roots of trees bind the soil particles together and prevent the soil from being washed or blown away.
- Trees help to regulate the climate of a place. They absorb water from the ground through their roots, and then release some of it as water vapour. In this way, they manage to keep the surrounding air cool. By raising the water vapour content of the atmosphere, trees are responsible for bringing the rains, too. Trees also help in keeping a check on global warming by using carbon dioxide, the main greenhouse gas for photosynthesis.
- Some trees, such as coconuts and palms, help to break strong winds in coastal areas. They act as shields or windbreakers against incoming storms or strong tidal waves.

Fact File

India is said to be one of the 12 identified mega-biodiversity centres in the world. It has over 45,000 plant species and 1000 animal species.

- We get **timber** from more than a thousand species of trees such as sal, mahogany, teak, and rosewood. Several timber-based industries such as those of plywood, sawmills, paper and pulp, and cardboards are all dependent on these trees. We get firewood from trees.

Word help

Timber Wood from trees that are felled to obtain building materials

- We get several nuts and spices from plants growing in forests.
- Plants such as neem, eucalyptus, and *amla* (Indian gooseberry) are used to make several *Ayurvedic* medicines. Cinchona trees provide quinine, which is an important medicine for treating malaria. Many varieties of grasses such as lemon grass, *kewra*, and *khus* are the sources of several kinds of essential oils. Sandalwood, eucalyptus, and pine also give us oil, which can be extracted from these trees.
- Forests are a source of resins (used to make varnish and paint), latex (used to make rubber), bamboo (useful as fodder, and serves as an important raw material for the manufacture of paper and pulp, basket and other small-scale industries), and cane (used to make walking sticks, furniture, baskets, picture frames, screens, and mats).

Forests Help in Purifying Air

Forests play a vital role in releasing huge amounts of oxygen into the air. Forests are rich in plants and animals. All plants and animals breathe in air to survive. Green plants take in atmospheric carbon dioxide to manufacture their own food (photosynthesis) and release oxygen as a by-product. Forests also serve as a *sink* for carbon dioxide that gets added into the air in the following ways: given out by plants and animals during respiration, produced by burning coal and petroleum, given out as a result of volcanoes and other natural disasters. Thus, forests help to balance the levels of oxygen and carbon dioxide in the atmosphere. Forests, especially rainforests, are referred to as the 'lungs' of the Earth.

INTERDEPENDENCE OF PLANTS AND ANIMALS

A forest is home to many types of plants, animals, and microorganisms. The various organisms are interconnected and together form a *biotic community* or *biota*.

All animals depend on plants for food, directly or indirectly. For example, a rabbit eats carrots and plants, a fox eats a rabbit, which is, in turn, eaten by a leopard. This chain that forms in nature is called a *food chain* (Fig 17.2).

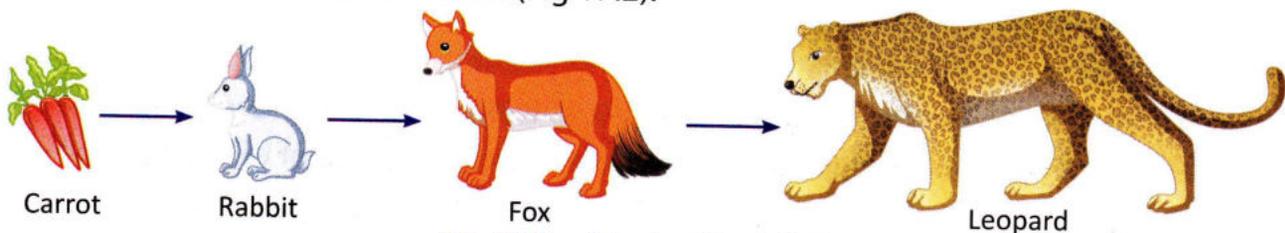


Fig. 17.2 A typical food chain

A rat eats grains and plants, a snake eats a rat, and an eagle eats a snake. This is another example of a food chain.

Green plants are called the *producers* as they can produce their own food. Animals are called *consumers* as they cannot produce their own food and depend on plants and other animals for food.

When animals die, their bodies are broken down (by *decomposers* such as bacteria and fungi) and they become a part of the soil. This makes the soil fertile for the growth of plants. These plants again become food sources for the animals. Thus, the food chain goes on and on. Food chains are simple representations of *energy flow* in nature. They exist everywhere, be it in the pond or the ocean, the grassland, desert, or the mountain.

Several food chains that exist in nature are interconnected. For example, both a rat and a hen eat grains. Both of them can be eaten by a cat. A cat can be eaten by a bigger animal such as a wolf. However, a wolf can also eat a hen and a rat directly. See Figure 17.3.

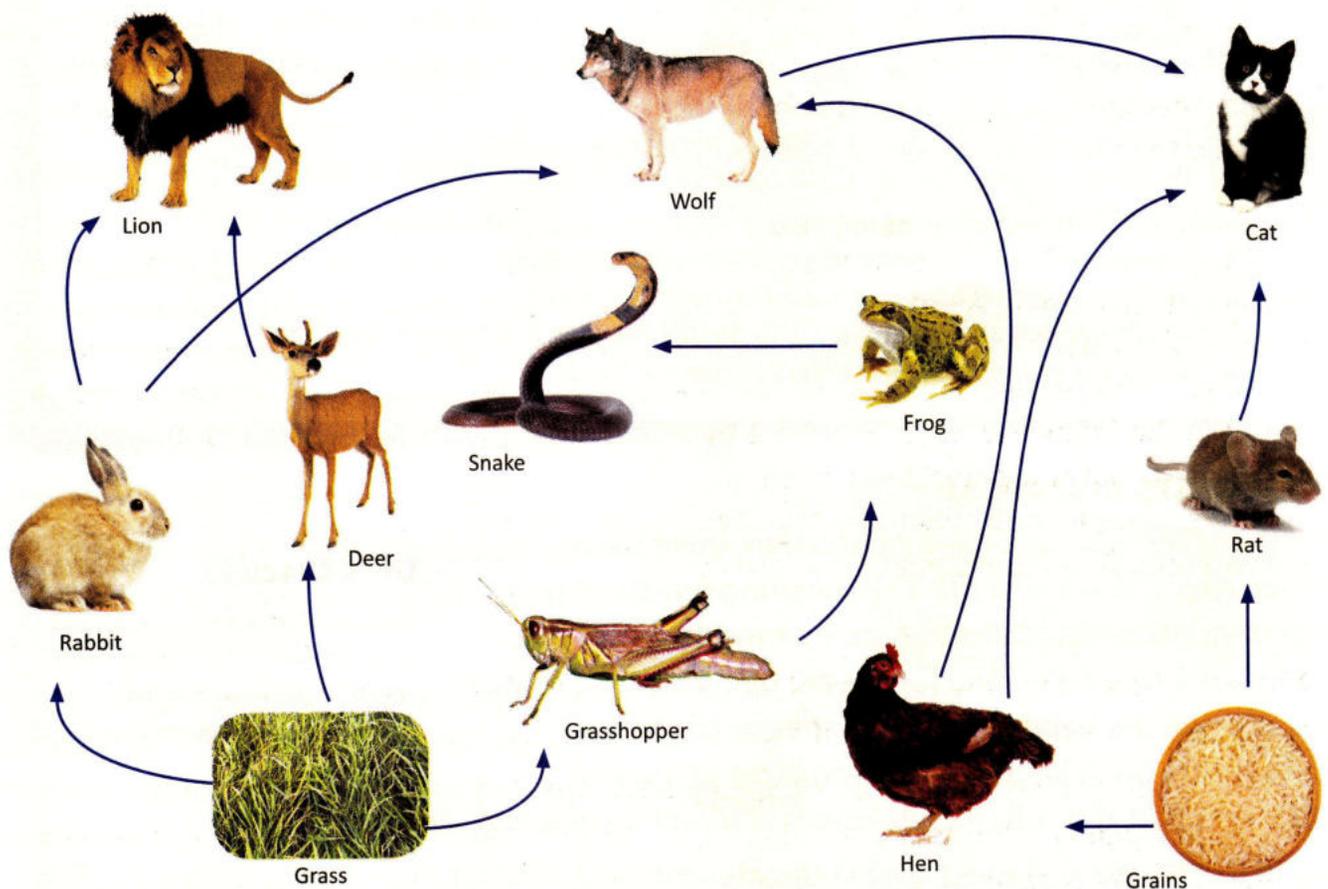


Fig. 17.3 A typical food web

There also exists a more complex representation of energy flow in nature which is called *food web*, as it appears like a web that a spider spins. You too are a part of the food web.

- Trees in forests provide shelter to animals such as chimpanzees, monkeys, gorillas, snakes, chipmunks, birds, and squirrels. Trees absorb the harmful effects of natural elements such as wind, sunlight, and rainfall, thus protecting animals.

- Several insects and birds become agents that bring about pollination of flowers, thereby assisting in fruit formation. Butterflies, bees, wasps, and hummingbirds are important pollinators.
- Seeds of several plants depend on animals for dispersal, which is important for the survival of those at far-off places. Animals such as monkeys, chimpanzees, and birds eat fruits along with the seeds. These animals keep moving from one place to another. The seeds of the fruits that they eat come out with the excreta and get scattered to distant places. Thus, animals help in dispersal of seeds.



Let's Remember

A. Match the following.

Column A

1. Neem
2. Cinchona
3. *Kewra*
4. Rubber
5. Bamboo

Column B

- a. Fodder
- b. Latex
- c. Quinine
- d. Ayurvedic medicines
- e. Essential oils

B. Identify the forest layer being talked about in each of the following.

1. The second layer of forest shaded under the top layer _____
2. This layer serves as a dense roof of trees in the forest _____
3. Decomposers and dead plant and animal remains are found in this layer _____
4. The layer in which trees branch off from the trunk _____

IF FORESTS DISAPPEAR

With the increase in human population, there have been ever-rising demands for converting forests into residential and agriculture areas. As a result, lots of trees are being felled and forests are being cleared, thus destroying the habitat of several species of animals and plants. Such large-scale felling of trees is called *deforestation*. It results in permanent destruction of forests and woodlands.

Let's Discuss

Deforestation is leading to global warming, which is causing many environmental issues. How?

- If forests are destroyed, global climate and local weather may change drastically. This will result in the loss of many species of animals and plants, and biological diversity.
- Large amounts of greenhouse gases such as carbon dioxide, methane, etc., are released into the atmosphere due to deforestation.
- Natural resources such as timber, medicinal plants, fruits, and nuts are depleted due to deforestation.
- Deforestation can cause severe flooding, soil erosion, landslide, etc., affecting our daily lives. Our forests need to be protected from further depletion.

Case Study: Decline in the forest cover of the North-eastern states of India

The forests of north-east India constitute about a quarter of the forest cover in India and are very rich in biodiversity. Unfortunately, as per the forest assessments, there has been a decline in this forest cover, despite Assam and Manipur registering an increase in their forests. The bamboo and rubber plantations in pockets have added to the forest cover. However, the top five states—Mizoram, Tripura, Arunachal Pradesh, Nagaland and Meghalaya have showed a huge decline, due to shifting cultivation and development activities. Extensive deforestation for developmental activities have led to an overall decrease in the forests. This loss of forests is also leading to a loss in biodiversity.

CONSERVATION OF FORESTS

Prevention of further depletion of forests is called *conservation* of forests. Few measures that could be followed to conserve our forests are given below.

Afforestation People should be made aware of the damages caused by felling of trees. Governments and communities should take steps to plant trees on a large scale (Fig. 17.4). **Afforestation** is the large-scale planting of trees on lands where there were no forests previously.

Planned cultivation A forest should not be cleared of all its trees and converted into an agricultural land; this can lead to soil erosion.

Prevent illegal logging Illegal logging has led to the decrease of a lot of trees over the years. The Indian government has laid out rules to prevent illegal logging by making it punishable under law.

Prevent overgrazing Provision of sufficient pastures should be made, especially in areas adjoining forests, to prevent overgrazing and trampling of growing plants by cattle.

Protection from forest fires Forest fires are considered beneficial for plants, but they might have devastating effects on animal life and people living nearby. These forest fires can be prevented by being careful while burning debris. Fire retardants and water bombs are also used to prevent forest fires.



Fig. 17.4 Afforestation

Word help

Logging The activity of cutting down trees for timber

Fact file

In the 1970s, an organized resistance to the destruction of forests spread throughout India and came to be known as the Chipko movement. The movement was initiated when the government allowed commercial contractors full access for cutting down trees. It was one of the first movements that involved the active participation of women.

Indian Forests

Do you know the different kinds of forests that we have in India? We can classify the Indian forests into five categories: Open forests, Dry forests, Scrublands, Mangroves, and Dense forests.

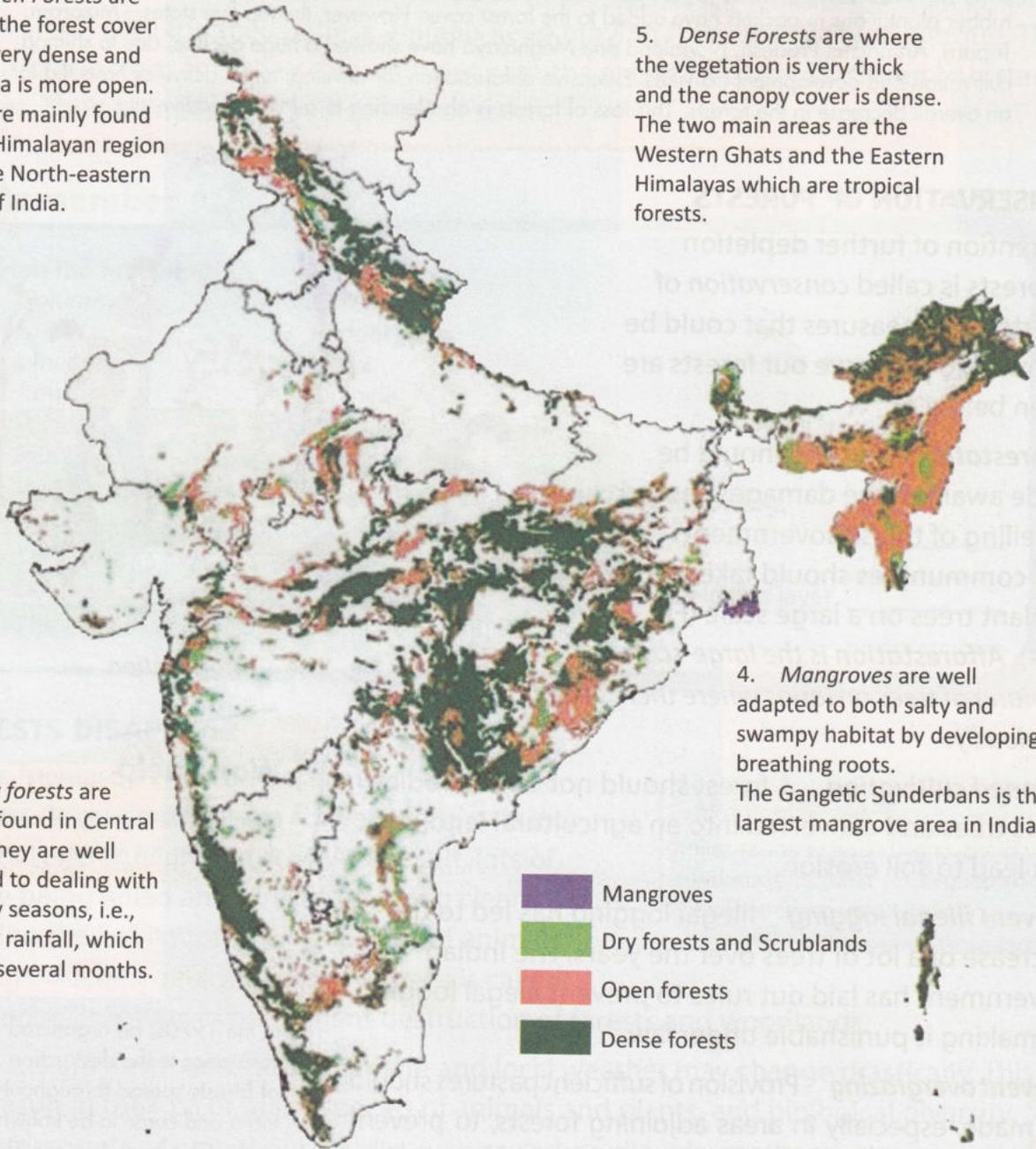
1. *Open Forests* are where the forest cover is not very dense and the area is more open. They are mainly found in the Himalayan region and the North-eastern parts of India.

2. *Dry forests* are mainly found in Central India. They are well adapted to dealing with long dry seasons, i.e., without rainfall, which last for several months.

3. *Scrublands* are the areas covered by grass or thorn scrubs. These lie mainly in the Deccan Plateau, extending across Maharashtra, Karnataka, Andhra Pradesh, and Tamil Nadu. Scrublands, commonly known as alpine tundra, are found lining the Himalayan region.

5. *Dense Forests* are where the vegetation is very thick and the canopy cover is dense. The two main areas are the Western Ghats and the Eastern Himalayas which are tropical forests.

4. *Mangroves* are well adapted to both salty and swampy habitat by developing breathing roots. The Gangetic Sunderbans is the largest mangrove area in India.



-  Mangroves
-  Dry forests and Scrublands
-  Open forests
-  Dense forests

Case Study: Forest Fires in India

In May 2018, several hectares of forest cover was lost in Uttarakhand due to massive forest fires that took place in this region. As many as 1500 forest fire incidents took away almost 3500 hectares of forests of Uttarakhand. The Shivalik and Garhwal regions were most affected. Most of these fires were reported to be in the Almora, Uttarkashi, Haridwar and Chamoli regions of Uttarakhand.

Besides financial loss, a lot of biodiversity loss took place.

Reports suggest that global warming is one of the prime reasons for forest fires. In turn, forest fires lead to a rise in temperature and release of excessive carbon dioxide in the air, leading further to global warming, thus, creating a vicious cycle. Most forest fires, however, are caused due to human negligence, climate change and excessive deforestation. Dried pine needles and dried eucalyptus leaves are rich in oil content and are highly inflammable, facilitating the propagation of forest fires.



Let's Remember

A. Give one reason for the following.

1. Forests serve as a sink for carbon dioxide.
2. The increase in population is leading to deforestation.
3. Deforestation leads to global warming.

B. Give one word for the following.

1. Large scale felling of trees _____
2. Large scale planting of trees on clear lands _____
3. Preventing forest depletion _____
4. The forests in which plants have breathing roots _____

Key Words

Topography	Physical features of a place are called its topography.
Food chain	Simple representation of energy flow in nature is called food chain.
Food web	Interconnected food chains depicting the complex representation of energy flow in nature is called food web.
Deforestation	Large-scale felling of trees is called deforestation.
Afforestation	Afforestation is the large-scale planting of trees on lands where there were no forests previously.

Summary

- Forests are an important natural resource.
- Climate, topography, and soil type determine the type of trees and animals that live in a forest.
- We get several things such as medicines, firewood for fuel, timber, oil, fruit, nuts, and spices from forests.
- All animals depend on plants for food directly or indirectly.
- Plants and animals form a food chain and a food web.
- Green plants are called producers as they can produce their own food.
- Animals are called consumers as they cannot produce their own food and depend on plants and other animals for food.
- Forests help to maintain the atmospheric levels of oxygen and carbon dioxide.
- Afforestation, planned cultivation, prevention of illegal logging, and prevention of overgrazing and forest fires are a few ways to conserve our forests.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

1. _____ (Roots of trees/Animal grazing) help to bind soil together and prevent its erosion.
2. Animals are called _____ (producers/consumers) because they depend on plants and other animals for their food.
3. Trees help to regulate the _____ (soil type/climate) of a place.
4. _____ (Food chain/Food web) is a complex representation of energy flow in nature.
5. Forests play a vital role in releasing large amounts of _____ (oxygen/carbon dioxide) in the air.

B. Choose the correct option.

1. Which of these affects the type of trees and animals found in a forest?
a. Climate b. Topography c. Soil type d. All of these
2. Which of these are timber-based industries?
a. Paper, pulp and cardboard b. Resins, paint and varnish
c. Essential oils and Ayurvedic medicines
d. None of these
3. Which of these is a producer in a food chain?
a. Herbivores b. Sun and soil c. Green plants d. Carnivores
4. Which of these gives us Ayurvedic medicines?
a. Sal, mahogany and teak b. Rubber and bamboo
c. Eucalyptus, amla and cinchona d. Coconut and palm
5. Which of these does deforestation lead to?
a. Flooding and soil erosion b. Global warming
c. Landslide d. All of these
6. Which forest layer is a shaded layer where the available light is low?
a. Canopy b. Crown c. Understorey d. Emergent
7. Which of these do trees help in?
a. Controlling soil erosion b. Regulating the climate of a place
c. Providing essentials like timber, food and medicine
d. All of these
8. Which of these fibres do we not get from plants?
a. Cotton and jute b. Flax and linen
c. Ramie and hemp d. None of these

9. In a food chain, what are bacteria and fungi referred as?
 - a. Producers
 - b. Consumers
 - c. Decomposers
 - d. Scavengers
10. Which of these can help in conserving forests?
 - a. Afforestation
 - b. Planned cultivation
 - c. Preventing illegal logging and overgrazing
 - d. All of these

II. Very short answer type questions

Give two examples for the following.

1. Trees that give us timber
2. Things made from resins
3. Animals that depend on forests for shelter
4. Common pollinators
5. Natural disasters commonly caused by deforestation

_____	_____
_____	_____
_____	_____
_____	_____

III. Short answer type questions

1. How do trees help in regulating the climate of the place?
2. What is a biotic community?
3. What role do coconut and palm trees play in providing protection in coastal areas?

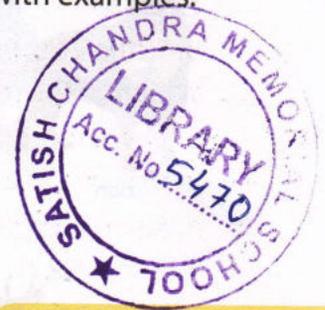
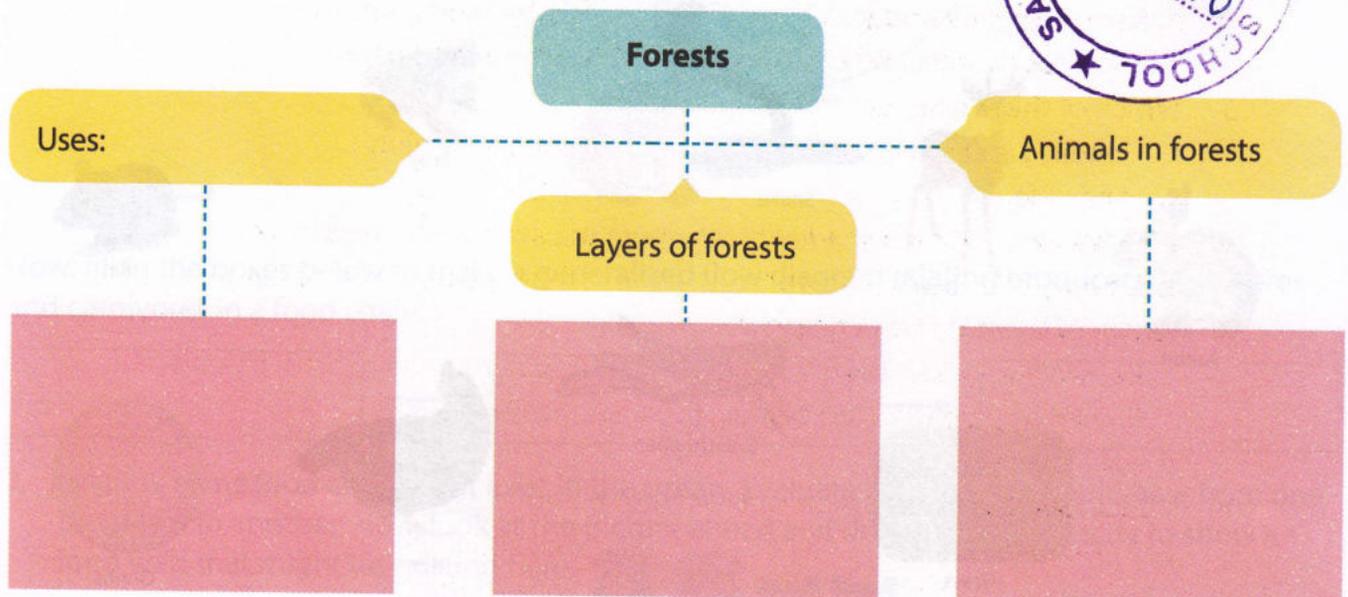
IV. Long answer type questions

1. What would happen if forests disappeared?
2. Explain some measures that can help us conserve our forests.
3. What is a food chain and a food web? Illustrate the difference with examples.

LET'S RECALL



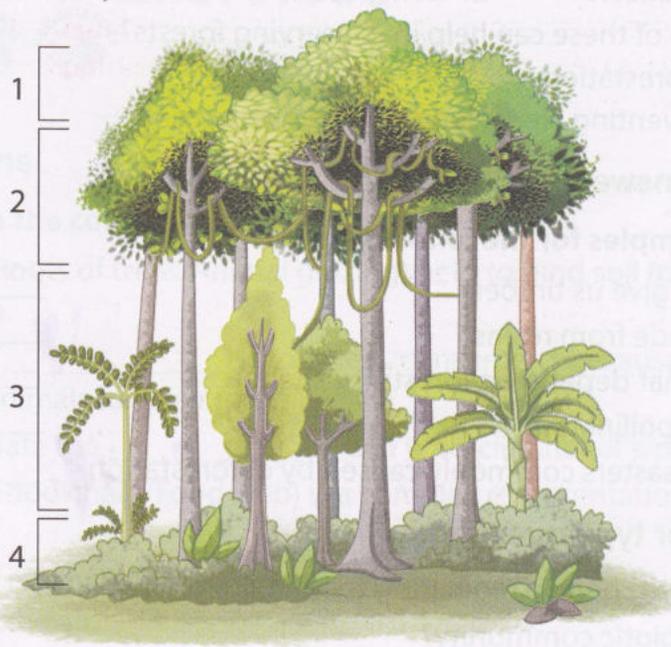
Recall and complete the concept map given below.



LET'S OBSERVE

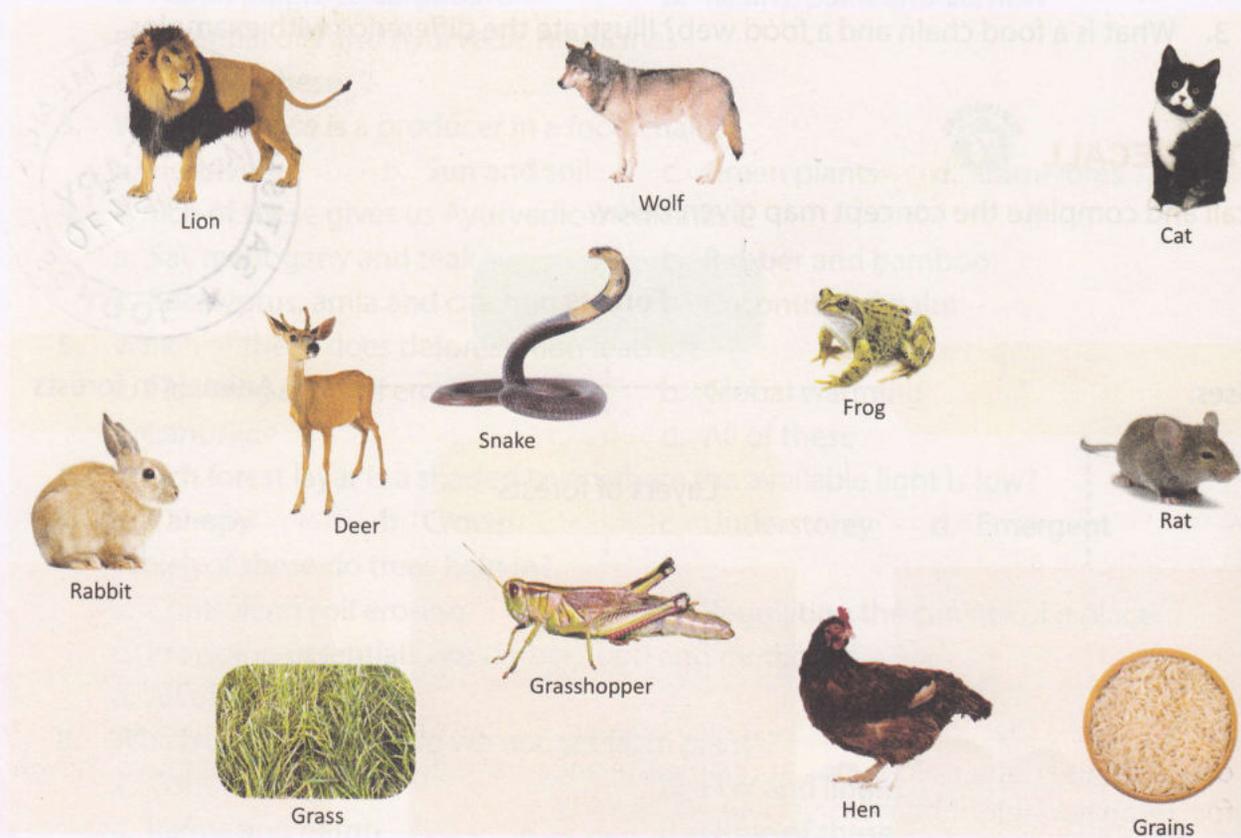


1.



- a. Label the layers of the forest.
- b. In which of these layers does humus gets formed?

2. Draw arrows to indicate flow of energy in the food web given below. **LO 13**



Write a formal letter to the commissioner of forests pointing out the increase in illegal logging in your state. Write about the effects that it is leading to, and suggest measures that should be taken to stop it.

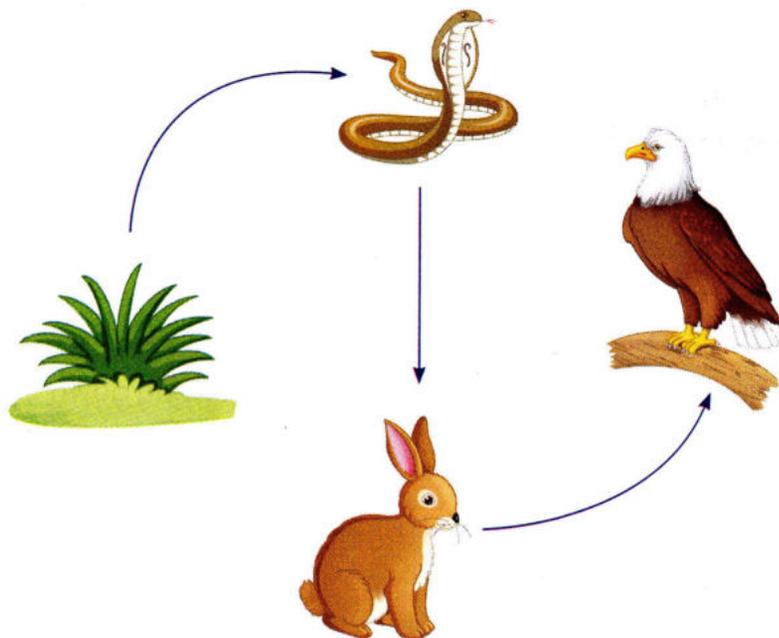
LET'S APPLY 

1. Why do plants found in the understorey of a forest have broader leaves than the trees forming the canopy layer? 
2. What do you think would happen to the number of lions in a forest if all the herbivores disappeared from there? 

LET'S ANALYSE AND EVALUATE

1. Simran has connected the following animals to show the flow of energy. Is it correct? If not, analyse what is wrong in it. 

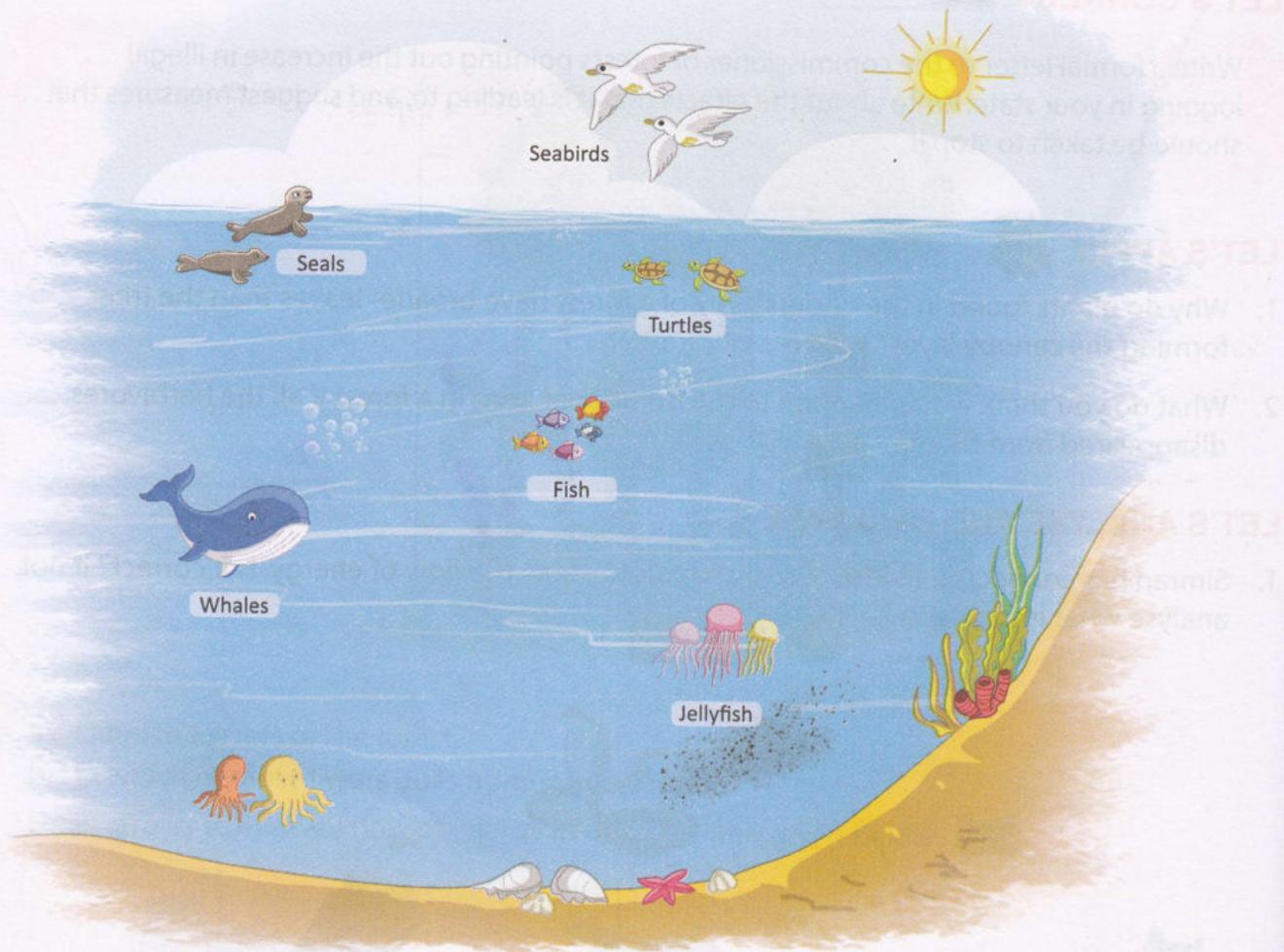


Now, fill in the boxes below to make a generalized flow diagram relating producers, herbivores and carnivores in a food chain.



2. Analyse some food chains that exist in the ocean. Evaluate how energy would flow from one organism to another. Now, look at the picture ahead and draw arrows correctly to show a food web that might be existing here. 



LET'S CREATE



1. Make a poster to spread awareness on preventing illegal cutting down of trees. Also write a slogan for the poster in your mother tongue. **LO 14**
2. In groups of five, make a chart on the dependence of tribals/adivasis on forests. Collect/Draw pictures to show the various things they get from forests and how cutting down of forests is becoming a threat to their existence. **LO 16**

Web Research

- Browse the Internet and find out the different kinds of trees that commonly grow in large numbers in different forests in India. Make a list. Some suggested websites are:
<http://www.ecoindia.com/flora/trees/> (accessed and checked on 28/08/19)
<https://www.civildaily.com/the-5-types-of-natural-vegetation-in-india-and-their-characteristics/> (accessed and checked on 28/08/19)
- Browse the Internet and find out the different tribals that are found in forests of India. Mark them on the map of India. Some suggested websites are:
<https://www.clearias.com/major-tribes-in-india/> (accessed and checked on 28/08/19)
http://factsanddetails.com/india/Minorities_Castes_and_Regions_in_India/sub7_4h/entry-4216.html (accessed and checked on 28/08/19)

Water is a precious resource that we use for various activities. However, most of these activities are making our water resources dirty and unfit for further use.

Look at the picture and list any four sources that are generating dirty water.

You will learn about

- Sources of wastewater
- Where does domestic wastewater go?
- Controlling sewage generation
- Alternative methods of sewage disposal
- Improper management of sewage



1. _____
2. _____
3. _____
4. _____

Ever wondered what happens to the dirty water that is generated and where it goes? Is it dumped carelessly in water bodies, thus making them unfit for use too? Is it somehow put back into use? Let us find out. In this chapter, we will learn about how the dirty water is generated and how it can be put to use after treatment.

Answers: 1. Industry, 2. Household, 3. Laundry, 4. Bathing of livestock

SOURCES OF WASTEWATER

AN

Water that has been used and has become dirty is called **wastewater**. It is generated as a result of numerous human activities (Fig. 18.1).

Agriculture Wastewater generated from farms contains harmful pesticides, biocides, animal waste, etc.

Construction of buildings Large amount of wastewater is generated from construction of buildings.

Industries Wastewater generated from paint and dye industries contains harmful chemicals such as lead, chromium, etc. The discharge of liquid wastes into a river or the sea is called effluent.



Fig. 18.1 Sources of wastewater

Hospitals, hotels, offices Wastewater from hospitals contains disease-causing germs.

Domestic activities The wastewater generated from our houses contains detergents, food wastes, human faeces, plastics, paper, metal objects, etc.

Mining Wastewater is also generated as a result of mining operations.

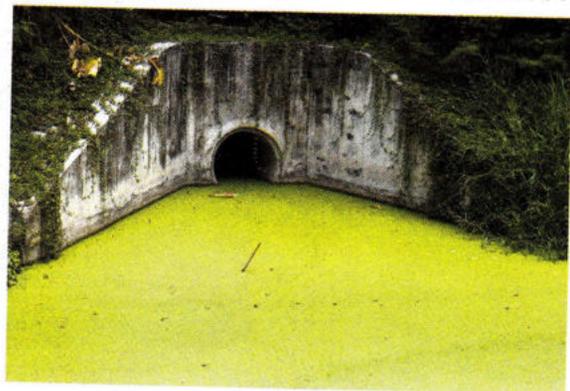
All the wastewater that is released from various sources contains **suspended** impurities. This wastewater, containing suspended impurities, is called **sewage**. These impurities are called **contaminants**.

Word help

Suspended All the light materials that are floating in the water

Eutrophication

An excessive growth or 'blooms' of algae in lakes rich in nutrients such as phosphates is called **eutrophication**. Normally it takes thousands of years to progress, but human activities have enhanced this process greatly. Humans add excessive amounts of plant nutrients (primarily phosphorus, nitrogen, and carbon) to streams and lakes in various ways. Runoff from agricultural fields and urban lawns, and untreated domestic sewage discharged into lakes are major sources of these nutrients. These nutrients speed up the algal blooms which, in turn, lead to oxygen depletion. As a result of this, many fish, birds, and other animals die and the water begins to stink.



Among the sources of liquid waste discussed above, which do you think is in our direct control? Domestic wastewater. Now we will learn where the domestic wastewater goes and how it is treated before releasing it into rivers, streams, and other water bodies.

WHERE DOES DOMESTIC WASTEWATER GO?

Each time we wash something or flush our toilets, water containing paper, cloth, soap, detergent, oil, grease, food scrap, faeces, etc., goes down the drain. This water accumulates and forms sewage. In large cities, this is known as *municipal wastewater*. Let us take a look at the journey it makes before flowing into a water body.

The Sewer System

A channel system of pipelines used to carry sewage is called the *sewer system*. The sewage leaves houses through drain pipes and flows to the sewer mains of the city. The sewer mains flow into progressively larger pipes until they reach the *wastewater treatment plant*. Waste flows easily through sewers due to a slight slope given to the drainage system. Most sewer pipes are underground. So, what does one do if there is a leak or blockage in any of these pipes? For this purpose, there are manholes (a hole, usually with a cover) through which a person may enter a sewer or drain to fix the faulty pipes.

Wastewater Treatment Plant



A facility that treats wastewater from domestic as well as industrial sources is called a *wastewater treatment plant*. There are basically three stages involved in treating wastewater: primary, secondary, and tertiary.

Primary Treatment

This is a *mechanical process* which involves screening and settling of large particles. First, the sewage is passed through screens of *vertical bars* to remove larger impurities such as metal cans, plastic bags, cloth pieces, etc. (Fig. 18.2).

The wastewater is then passed through a grit and sand removal tank called the *grit chamber* (Fig. 18.3). The speed of the incoming wastewater is reduced so that sand, grit, pebbles, etc., settle down.

The water is then passed through huge *sedimentation tanks* (Fig. 18.4).



Fig. 18.2 Vertical bars



Fig. 18.3 Grit chamber

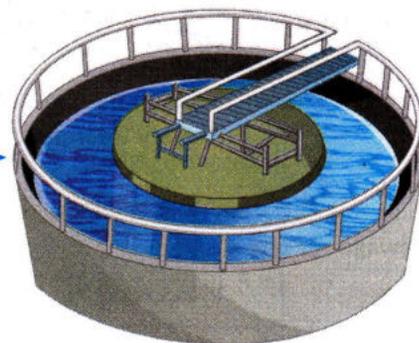


Fig. 18.4 Sedimentation tank

Here solid wastes such as faeces is allowed to settle down and the light floatable waste such as soaps, oils, plastics, and grease rise. Solid waste that settles at the bottom in the primary treatment of wastewater is called the *sludge*. Light waste that rises to the top and floats, during wastewater treatment, is called the *scum*. The water that comes out of the sedimentation tanks is called *clarified water*.

Secondary Treatment

This is a *biological process* in which the organic matter in the clarified water is broken down with the help of bacteria. This process is called *digestion* and as a result of it, *biogas* is produced. The biogas can be used either as a fuel or to produce electricity. The treatment at this stage can be speeded up by allowing water to flow into large *aeration tanks* (Fig. 18.5), where air is blown onto the sewage.

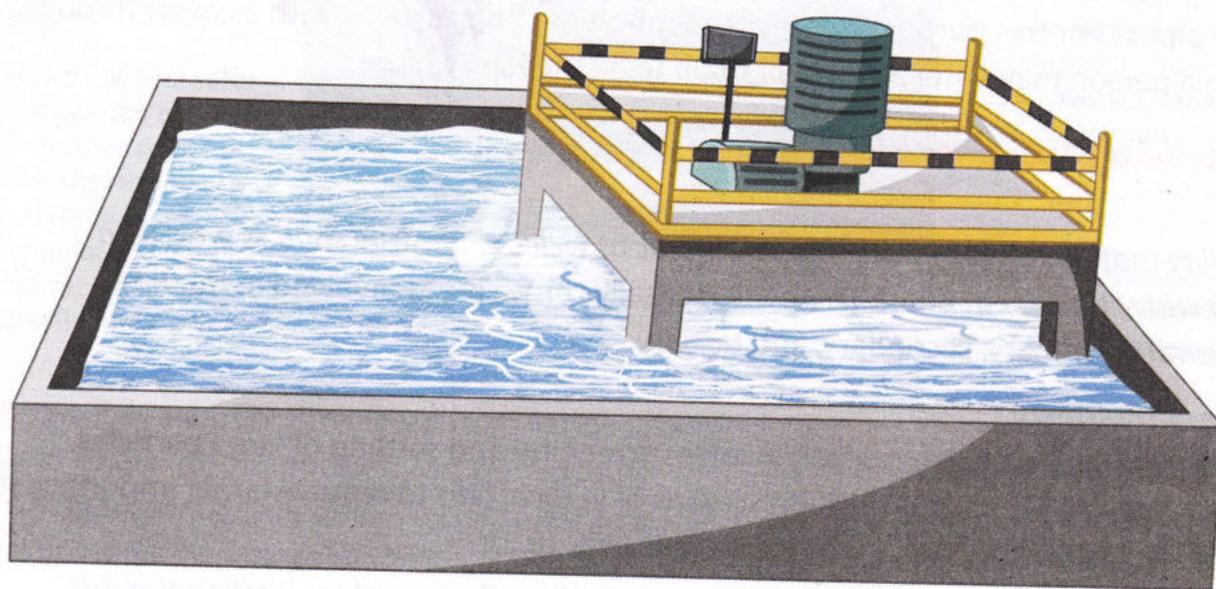


Fig. 18.5 Aeration tank

Tertiary Treatment

This is basically a *chemical process* in which chemicals are used to remove phosphorus and nitrogen from the water. Addition of chlorine and exposure to ultraviolet light kills any remaining bacteria and disinfects the water. The water is then discharged into water bodies.

A schematic representation of a wastewater treatment plant is shown in Figure 18.6.

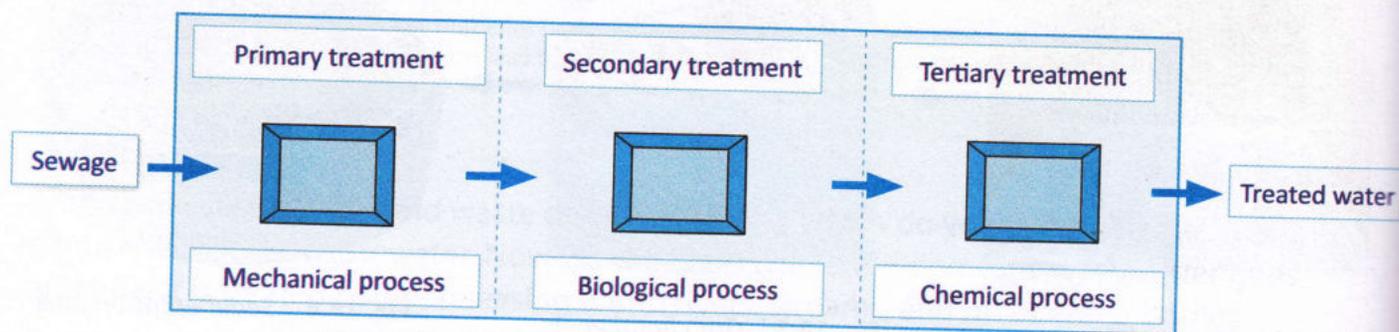


Fig. 18.6 Schematic diagram of wastewater treatment plant

Let's Remember



Fill in the blanks with the correct words.

1. Wastewater generated from paints and dyes industries contains harmful _____ (chemicals/germs)
2. _____ (Clarified water/Sewage) is the wastewater containing suspended impurities.
3. _____ (Effluent/Contaminants) is the liquid waste that is discharged into a river or the sea.
4. Sand, grit and pebbles are removed in _____ (aeration tank/grit chamber).
5. _____ (Secondary/Tertiary) treatment of wastewater involves addition of chlorine and exposure to ultraviolet light.

What happens to the treated water?

The treated water is released into water bodies such as streams and rivers. This water can be used again for a number of purposes such as supplying drinking water, fertilizers for growing crops, and for aquaculture.

What Happens to the Sludge?

What happens to the sludge that is produced after the wastewater passes through the sewage treatment plant? Sludge consists of human faeces and other organic matter. It also has large amounts of water and needs to be thickened so that it can be transported easily and used as compost in farmlands. There are three methods to do so, as shown in Figure 18.7.



Fig. 18.7 Methods of sludge disposal

CONTROLLING SEWAGE GENERATION

A few measures that can be adopted to control the generation of sewage are given below.

- Use flushes with low capacity.
- Never pour household products such as cleansers, beauty products, medicine, automobile oil, and paint down the drain. These contain chemicals which the wastewater treatment plants may not be able to remove. These should be properly disposed.
- Excess cooking oil, butter, meat fats, and plastic should be disposed off in the garbage can. These materials can clog pipes, and could cause sewage to overflow in your home or in public areas.
- Fix leakages in sewer pipes. These leaks can contaminate drinking water, and seep into the water table. It can also stagnate in certain areas on the ground and become the breeding place of disease-causing insects like flies, cockroaches, and mosquitoes.

Green corner

As cleaning wastewater requires great effort, is time-consuming and costly, one must strive to avoid discharging pollutants into water bodies. Next time you go for shopping, carry your own bag and do not accept things in plastic bags. Moreover, try to choose items that contain the least amount of packaging.

ALTERNATIVE METHODS OF SEWAGE DISPOSAL

Some alternative methods of sewage disposal are septic tanks, biogas plants, and vermi-composting trilets.

Septic Tanks

In semi-urban areas, low-cost septic tanks (Fig. 18.8), also known as *onsite disposal system*, are encouraged to manage the waste. In this method, household wastewater is allowed to flow into an underground septic tank.

Inside the tank, the sludge settles down at the bottom and the lighter waste float on the surface. Bacteria present in the sewage help in partially decomposing the solid waste. The liquid waste is then allowed to flow out of the tank through pipes and into the ground where it mixes with the soil below.

Biogas Plants

Another method of waste disposal, which is prevalent especially in village and small towns in India, is setting up of biogas plants. In this method, human and animal excreta flow through covered drains into biogas plants. Microorganisms break down the materials present in the waste and produce biogas. This biogas is then used to produce electricity.

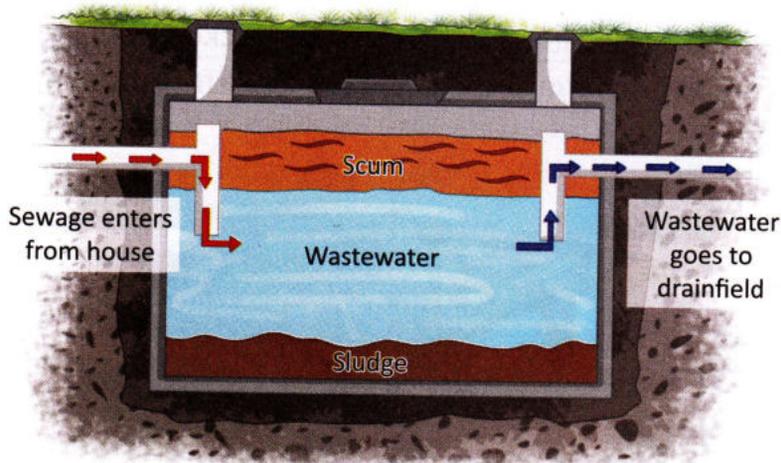


Fig. 18.8 Septic tanks

Vermi-composting Toilets

Recently vermi-composting toilets have been developed in India as an alternative method for proper disposal of waste. It is based on an innovative design in which earthworms are used to convert human excreta into compost. There is minimal use of water, and it is a safe and hygienic way of processing human waste.

IMPROPER MANAGEMENT OF SEWAGE

One of the most common sources of water pollution is the discharge of untreated or partly treated sewage into water bodies; sometimes due to improper sewage handling processes of municipal bodies (Fig. 18.9). This is very common in major cities. Many of our major rivers such as Ganges and Yamuna receive tones of untreated sewage daily, thereby making the water unfit for drinking and other domestic uses. These rivers are regarded as open sewers as large quantities of waste are dumped in them every day. This contamination is responsible for major water-borne epidemics such as jaundice, cholera, and hepatitis.

Another problem which can occur is leakages in several places in the main water supply line, where the water gets mixed with sewage. Due to faulty sewer lines, the dirt often flows into the open, enters the water pipelines, and contaminates the water supply. People consuming contaminated water may suffer from diseases like gastroenteritis, dysentery, and typhoid.

Let's Discuss

Is incineration a better option than burning of wastes? Why?

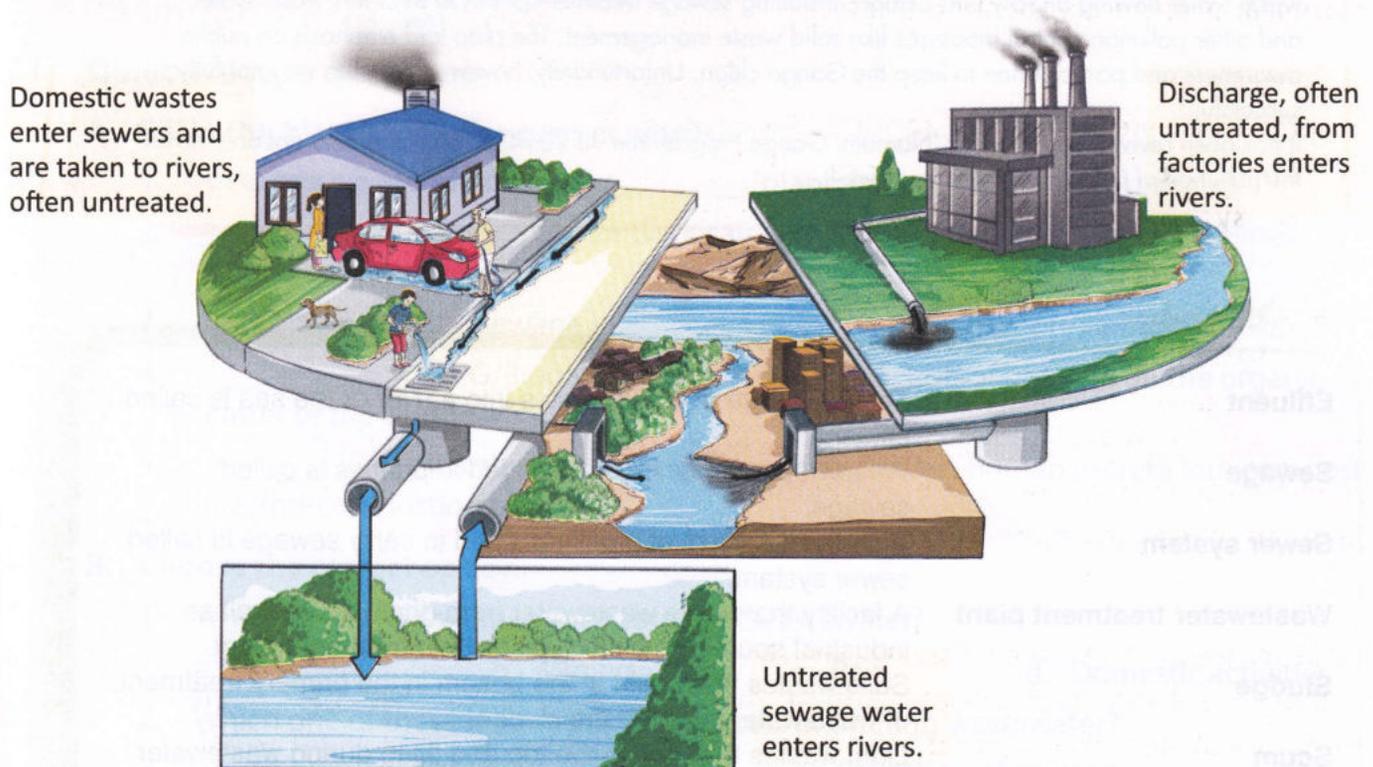


Fig. 18.9 Improper management of sewage

Sanitation in Public Places

Proper sanitation should be maintained at public places such as bus depots, railway stations, airports, malls, fairs, etc. As a large number of people gather at these places, the waste generated is subsequently large, too. This must be disposed off properly. Public conveniences and dustbins have been built by the government that help in maintaining sanitation in public places.

As a responsible citizen, we should maintain cleanliness even outside our homes. Plastic bags, metal cans, and other wastes should be thrown in the bins meant for them. This becomes necessary because these wastes can, otherwise, find their way to the underground drainage system and clog them up. This would result in blockage of sewage pipes and the sewage would flow back onto the streets and colonies. During the monsoon season, it will lead to flooding of streets and traffic jams.



Green corner

Help Us Green, an initiative started in 2015 by Ankit Agrawal and Karan Rastogi, collects floral waste from temples, mosques, and gurudwaras situated on the banks of Ganges. Around 80% of the waste is converted into vermi-compost and rest into natural and chemical-free lifestyle products such as incense sticks and scents.

Case Study: Ganga Action Plan (GAP) and Namami Gange Programme

In 1986, the Ganga Action Plan was launched by the government of India in order to improve the water quality of river Ganga, one of the most significant rivers of the country. The principal sources of pollution in the river Ganga are domestic and industrial wastes. Approximately, 1.7 billion litres of effluents flow into Ganga each day, out of which 1.4 billion litres is untreated. The GAP plan included diversion of waste water flowing directly into Ganga, installing sewage treatment plants to treat this waste water, and other pollution control measures like solid waste management. The plan laid emphasis on public awareness and participation to keep the Ganga clean. Unfortunately, however, the plan was not fully successful.

It has been revived again under 'Namami Gange Programme' in 2014. Its objective is to not only arrest the pollution of Ganga, but also to revive it.

Key Words

Effluent	The discharge of liquid wastes into a river or the sea is called effluent.
Sewage	Wastewater containing suspended impurities is called sewage.
Sewer system	A channel system of pipelines used to carry sewage is called sewer system.
Wastewater treatment plant	A facility that treats wastewater from domestic as well as industrial sources is called wastewater treatment plant.
Sludge	Solid wastes that settle at the bottom in the primary treatment of wastewater is called the sludge.
Scum	Light wastes that rise to the top and float, during wastewater treatment, is called the scum.

Summary

- Sources of wastewater are households, industry, mining, and agriculture.
- Sewage is carried out of our houses through sewers or drains.
- A channel system of pipelines, known as the sewage system, carries sewage out of our homes to treatment plants.
- Inside the water treatment plant, wastewater is treated in three stages: primary, secondary, and tertiary.
- The treated water is released into water bodies such as streams and rivers.
- There are three ways of treating sludge, namely, incinerating, dewatering, and composting.
- Water pollution can be caused as a result of the discharge of untreated or partly treated sewage in water bodies, sometimes due to improper sewage handling processes of municipal bodies.
- Leakages in several places in the main water supply line cause drinking water to get mixed with sewage. Due to this, the water supply gets contaminated.
- People consuming contaminated water may suffer from diseases like gastroenteritis, dysentery, and typhoid.

Exercises

LET'S UNDERSTAND



I. Objective type questions

A. Fill in the blanks with the correct words.

1. An excessive growth of _____ (plants/algae) causes eutrophication.
2. _____ (Sewer/Onsite disposal) system is a channel system of pipelines used to carry sewage.
3. Air is blown into the sewage in _____ (sedimentation/aeration) tanks.
4. _____ (LPG/Biogas) is produced by the action of bacteria on the organic matter of the sludge.
5. _____ (Earthworms/Ants) are used to convert human excreta into compost in vermi-composting toilets.

B. Choose the correct option.

1. Which of the following is not a source of wastewater?
a. Hospitals b. Mining c. Rain d. Domestic activities
2. Which one of these is a mechanical process of treating wastewater?
a. Screening of sewage b. Digestion of sewage
c. Aeration of sewage d. Addition of chlorine to water

3. Which out of the following methods can be used to dispose sludge?
 - a. Incineration
 - b. Addition of chlorine
 - c. Aeration
 - d. Sedimentation
4. Which of the following is a water-borne disease?
 - a. Tuberculosis
 - b. Asthma
 - c. Cancer
 - d. Cholera
5. Which out of the following is an alternative method of sewage disposal?
 - a. Sewer system
 - b. Vermi-composting toilets
 - c. Biogas plants
 - d. Both b and c
6. Which of the following is the result of improper management of sewage?
 - a. Biogas
 - b. Water pollution
 - c. Clean water
 - d. Vermi-composting
7. What is the solid waste that settles at the bottom in the primary treatment of wastewater called?
 - a. Sludge
 - b. Clarified water
 - c. Scum
 - d. Compost
8. Which one of these is a biological process of treating wastewater?
 - a. Screening of sewage
 - b. Exposure to ultraviolet light
 - c. Aeration of sewage
 - d. Addition of chlorine to water
9. Which of the following treatments involves addition of chlorine?
 - a. Primary treatment
 - b. Secondary treatment
 - c. Tertiary treatment
 - d. Initial treatment
10. Which of the following can be used to control the generation of sewage?
 - a. Fix leakages in sewer piper
 - b. Use flushes with low capacity
 - c. Dispose plastics in garbage can
 - d. All of these

II. Very short answer type questions

Give one word for the following.

1. A channel system of pipelines used to carry sewage _____
2. Facility that treats wastewater from domestic as well as industrial sources _____
3. Light waste that rises to the top and floats in sedimentation tanks during primary treatment of wastewater _____
4. The water that comes out of the sedimentation tanks after the completion of primary process _____
5. Burning of sludge to ashes _____

III. Short answer type questions

1. List the different sources of wastewater.
2. How does a sewer system function?
3. How can we convert sludge into useful substances?
4. Why is it important to maintain proper sanitation in public places?

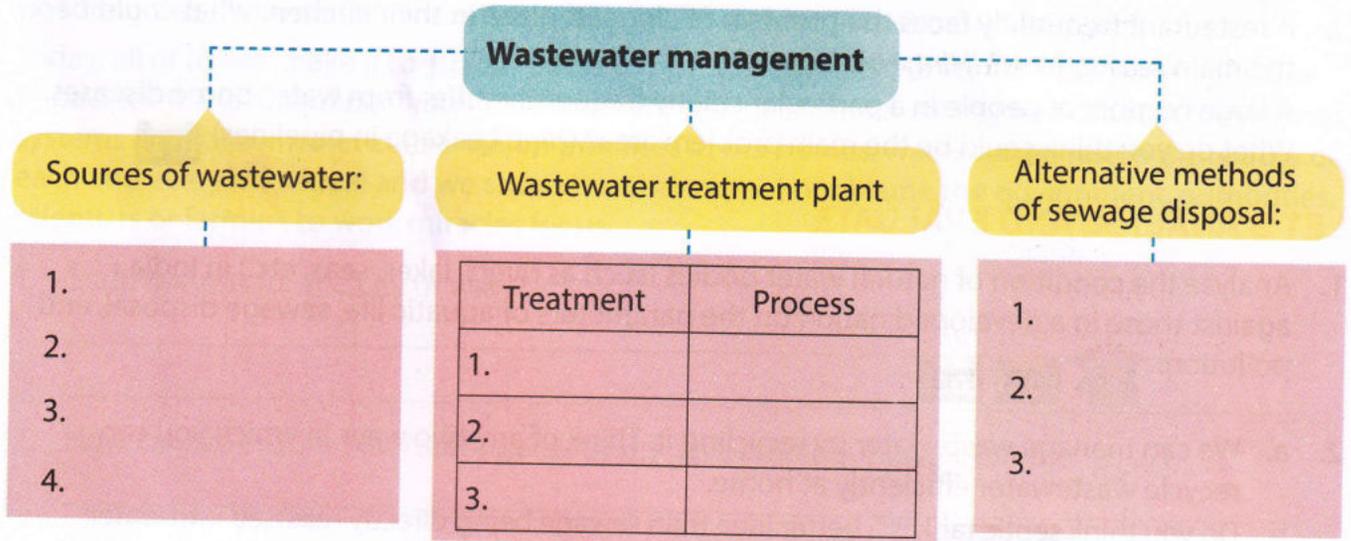
IV. Long answer type questions

1. Suggest measures to control the generation of sewage.
2. Discuss the problems faced due to improper management of wastes.
3. Explain alternative methods of sewage disposal.



LET'S RECALL

Recall and complete the concept map given below.

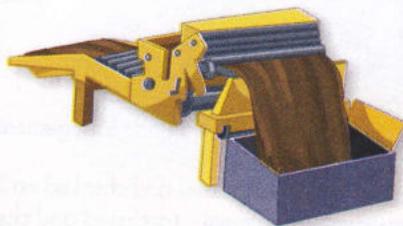
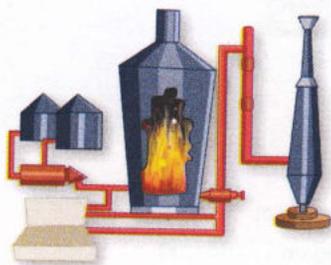


LET'S OBSERVE

1. Look at the picture and answer the following questions. LO 14
 - a. What does this illustration portray?
 - b. What will be the possible repercussions of this situation on aquatic organisms?
 - c. How could this affect human life?



2. Name and write about the different methods of sludge disposal given below. LO 13



LET'S CONNECT ENGLISH

Write a newspaper article of about 600 words on the effect of sewage backup in a particular area of your city during heavy rains. Highlight the effects it is having on the day to day life of residents of that area.

LET'S APPLY

1. A restaurant frequently faces the problem of clogged pipes in their kitchen. What could be the main reason for it? (*Hint: Food waste*)
2. A large number of people in a particular colony frequently suffer from water-borne diseases. What do you think could be the main problem area? (*Hint: Leakage in pipelines*) 

LET'S ANALYSE AND EVALUATE

1. Analyse the condition of natural water bodies (such as rivers, lakes, seas, etc.) in India against those in a developed nation on the parameters of aquatic life, sewage disposal, and pollution.   
2. a. We can manage wastewater by recycling it. Think of any two ways in which you can recycle wastewater efficiently at home.
b. Do you think septic tank is a better idea than sewage being directly released into water bodies? Give at least one reason to support your choice.   

LET'S CREATE

1. Visit the local sewage treatment plant of your city/town and then collect information on how sewage is being treated and managed there. Then in pairs, collate data and draw a flowchart on the computer to show the process of sewage management. Analyse how effectively sewage is being managed and present a report.   
2. Conduct a survey in any five public places in and around your neighbourhood for the level of sanitation being maintained there. As a responsible citizen prepare a report identifying the gap areas and a few suggestive methods for local bodies to intervene and fill those gaps so that proper hygiene and sanitation levels are maintained.  

Web Research

Browse the Internet and find out more about wastewater treatment and management.

Some suggested websites are:

https://en.wikipedia.org/wiki/Wastewater_treatment (accessed and checked on 28/08/19)

<https://www.britannica.com/technology/wastewater-treatment> (accessed and checked on 28/08/19)

<https://www.greenfacts.org/en/wastewater-management/index.htm#1> (accessed and checked on 28/08/19)

<https://www.greenfacts.org/en/wastewater-management/l-2/index.htm#0> (accessed and checked on 28/08/19)

Worksheet 7

Skills assessed:

Problem solving, and qualitative analysis

Read the passage given below and answer the questions that follow.

Water scarcity and its conservation

Water is becoming scarce with each passing day. There is nobody to blame except the greed of human race. We have been indiscriminately cutting down trees, extracting groundwater and polluting the environment. The day is not far when water will cost more than gold.

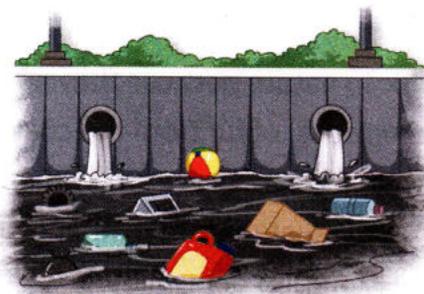
Today, all of us can make a conscious effort to not waste water. Our choices can have a positive impact for the future of our water resources. We can install water-saving devices, rain harvesting systems and follow water conservation practices in our homes. Water conservation is the duty of each and every individual and we should neither expect nor blame the government, authorities, scientists or farmers to work miracles for us.

1. State reasons for scarcity of water.

2. How can we ensure that future generations have ample supply of water?

3. State four practices that should be followed by us at home to conserve water?

4. Imagine, visualize and describe in your words a world without freshwater.



Semester 1 Test Paper

(Chapters 1 to 10)

Time: 3 hours
Maximum marks: 80

A. Fill in the blanks with the correct words.

(7x1 marks)

1. The _____ (xylem/phloem) carries water from the roots to the leaves.
2. Animals that bring swallowed food back into their mouth to chew on it again are called _____ (rodents/ruminants).
3. _____ (Element/Compound) is a substance that is made up of only one kind of atoms.
4. In vacuum, heat energy is transferred through _____ (conduction/radiation).
5. _____ (Mineral/Organic) acids occur naturally in animals and plants.
6. In _____ (physical/chemical) weathering, the chemical nature of the rock is not altered.
7. Blood present in the right side of the heart is completely separated from the left side with the help of _____ (valves/veins).

B. Give one word for the following.

(8x1 marks)

1. Plants that live in association with other species for food _____
2. Finger-like projections in amoeba's body _____
3. A thermometer used to check body temperature _____
4. Substances that do not conduct heat very well _____
5. Water molecules present in solid crystals of salts _____
6. Process of respiration that takes place in the absence of oxygen _____
7. The removal of soil by running water and wind _____
8. Process by which plants transport prepared food to all parts of the body _____

C. Write T for True and F for False statements. Correct the false statements. (8x2 marks)

1. All plants are heterotrophic in nature because they are unable to make their own food.
2. The process of superficial removal of fur from the coat of an animal is called scouring.
3. Acidic salts are formed when a weak acid reacts with a strong base.
4. Conduction, convection, and radiation are weather elements.
5. Rubber, clay, and glass are examples of insulators.
6. Rusting is a chemical change because this change is temporary.
7. Planting of trees in large numbers on deforested land is called erosion.
8. Inhalation is the process of releasing energy from the breakdown of food.

D. Choose the correct option.

(7x2 marks)

- Which of these plants live off rotting material?
a. Parasitic b. Saprophytic c. Insectivorous d. Symbiotic
- Which of these chambers in a ruminant help to secrete digestive juices that help in digestion?
a. Rumen b. Reticulum c. Omasum d. Abomasum
- Which of these processes helps to take out filaments from cocoons in silk production?
a. Sericulture b. Reeling c. Filament removal d. Spinning
- This gas turns lime water milky.
a. Water vapour b. Oxygen c. Helium d. Carbon dioxide
- The characteristic pattern of weather over a long period of time is called
a. weather elements b. climate c. rainfall d. weather report
- Which of these help fennecs to adapt to the desert climate?
a. Long ears b. Nocturnal nature c. Small ears d. Both a and b
- Which of these blood cells help to stop bleeding in human beings?
a. RBC b. WBC c. Blood platelets d. Both a and c

E.. Give two examples for the following.

(5x2 marks)

- Insectivorous plants _____
- Body outgrowths that help some animals to ingest food _____
- Acid-base indicators _____
- Diatomic molecules _____
- Weather elements _____

F. Short answer type questions

(5x2 marks)

- Differentiate between autotrophic and heterotrophic nutrition.
- Name the secretion of the liver. What component of food does it digest?
- How would you show that the terms 'hot' and 'cold' are relative?
- What is valency? Give the valencies of magnesium and chlorine.
- Distinguish between phloem and xylem in plants.

G. Long answer type questions

(3x5 marks)

- What is a neutralization reaction? Explain with the help of an example.
- Draw a neat, labelled diagram of a thermos flask. Explain how the loss of heat by all three modes of heat transfer is minimized in a thermos flask.
- How does the human body get rid of its wastes? Draw a well-labelled diagram to show the human excretory system.

Semester 2 Test Paper

(Chapters 11 to 18)

Time: 3 hours
Maximum marks: 80

A. Fill in the blanks with the correct words.

(7x1 marks)

1. In sexual reproduction, the male gamete fuses with the female gamete to form a/an _____ (embryo/zygote).
2. The time taken by a pendulum to complete one oscillation is called _____ (time period/frequency).
3. The drawing of an electric circuit using standard symbols is called a/an _____ (electrical circuit/ circuit diagram).
4. The speed of wind is measured with an instrument called _____ (anemometer/hygrometer).
5. Underground water is also known as _____ (aquifer/water table).
6. _____ (Secondary/Tertiary) treatment of wastewater is a chemical process.
7. When animals die, their bodies break down with the help of _____ (bacteria/algae).

B. Give one word for the following.

(8x1 marks)

1. The process in which new plants are formed from the cells of a single parent _____
2. The method of watering the roots of plants drop by drop _____
3. An instrument in a vehicle that shows the distance travelled _____
4. The part of an incandescent light bulb that heats up when an electric current passes through it _____
5. A safety device used in an electric circuit _____
6. A violent spinning storm, typically shaped like a funnel, with its narrow end on the ground _____
7. Wastewater containing suspended impurities _____
8. Simple representation of energy flow in nature _____

C. Write T for True and F for False statements. Correct the false statements. (8x2 marks)

1. Mistletoe is a heterotrophic plant.
2. Speed equals time taken divided by the distance travelled.
3. This symbol  represents an open switch.
4. A wind vane is used to find wind direction.
5. Water levels in rivers increase greatly during winter season.
6. A coloured disc will appear white if we rotate it very fast.
7. No living organism is dependent on any other organism for its survival.
8. Light waste that rise to the top and float during wastewater treatment is called sludge.

D. Choose the correct option.

(7x2 marks)

1. Wind-pollinated flowers are likely to have
 - a. loosely attached and large anthers
 - b. brightly-coloured petals
 - c. very light pollens
 - d. all of these
2. If an object travels 200 km in 2 hours, then its speed is
 - a. 2 km/h
 - b. 200 km/h
 - c. 100 km/h
 - d. 10 km/h
3. Which of the following is responsible for the depletion of the water table in India?
 - a. Conservation of water
 - b. Rainwater harvesting
 - c. Agricultural activities
 - d. Dams
4. During a storm, roofs can be blown off because
 - a. of rainfall
 - b. of atmospheric pressure
 - c. pressure over the roof is greater than the pressure under it
 - d. pressure over the roof is lower than the pressure under it
5. An image that cannot be formed on a screen is called a/an
 - a. real image
 - b. upright image
 - c. virtual image
 - d. inverted image
6. Which of these trees act as windbreakers?
 - a. Coconut and palm
 - b. Teak and sal
 - c. Mango and coconut
 - d. Guava and Lemon
7. Treatment of sewage leads to
 - a. water pollution
 - b. diseases
 - c. floods
 - d. none of these

E. Give two examples for the following.

(5x2 marks)

1. Plants that multiply through layering
2. Clocks used in ancient times
3. Electrical appliances that work on the heating effect of electric current
4. Water present in solid state in our natural environment
5. Things made from plant resins

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

F. Short answer type questions

(5x2 marks)

1. Define pollination. What are the two kinds of pollinations?
2. Express the following as directed: a. 72 km/h in m/s b. 35 m/s in km/h
3. What are electromagnets? Name two appliances/devices that use electromagnets.
4. Why is it important to maintain proper sanitation in public places?
5. List two measures that we could follow to conserve our forests.

G. Long answer type questions

(3x5 marks)

1. Describe the methods that can be adopted to conserve water.
2. Draw a neat, labelled diagram of an electric bell and explain briefly how it works.
3. What is a food web? Explain briefly with the help of an example.