OXFORD
SCHOOL EDUCATION

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REVISED

# NEW SCIENCE IN EVERYDAY LIFE

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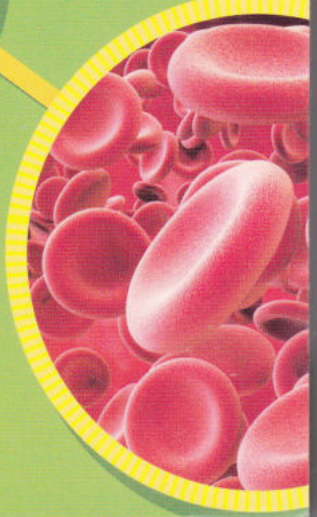


INTERACTIVE RESOURCES FOR TEACHERS AND STUDENTS

With Oxford Areal

# Contents

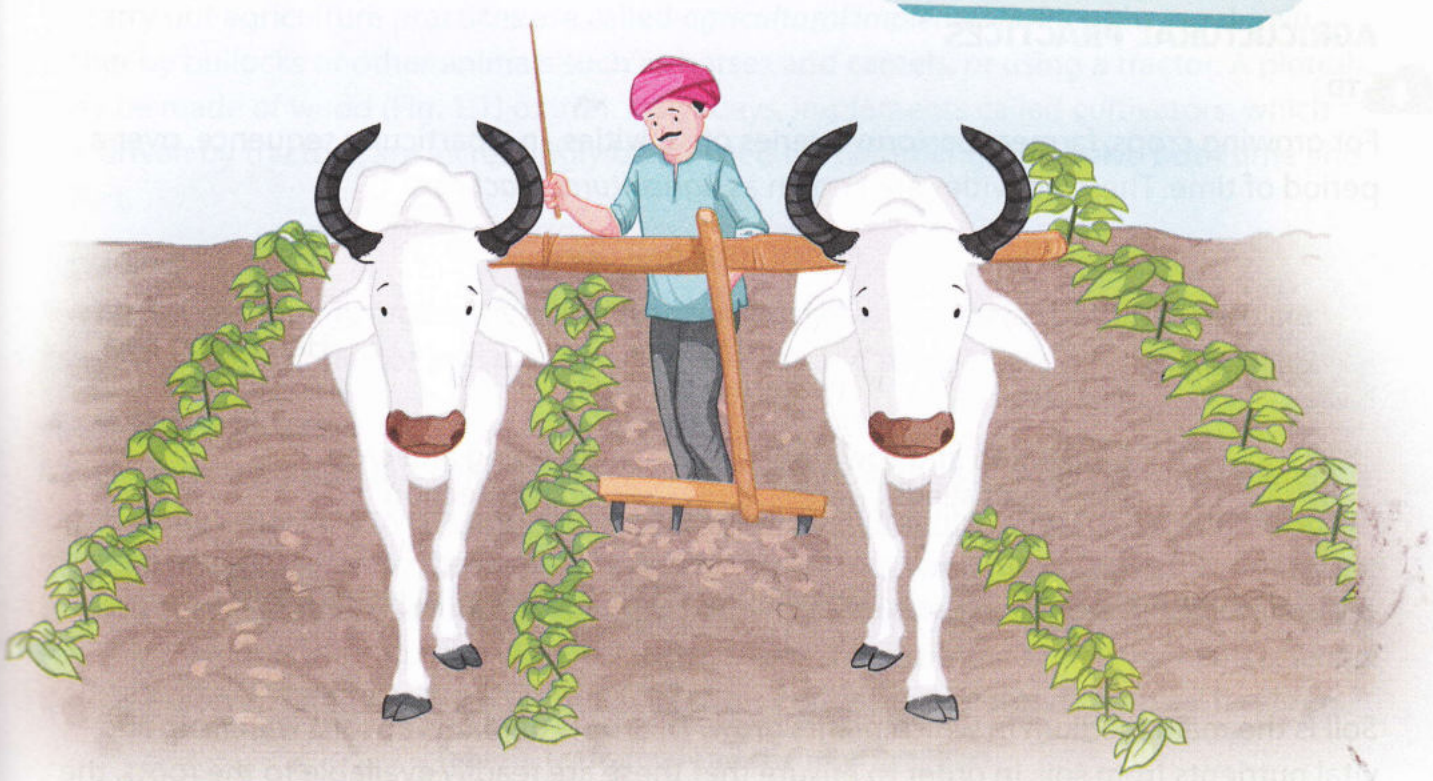
Unit 1: Food

# 1 Crop Production and Management

Food is essential for our survival. We get food from plants and animals. As the human population is increasing day by day, food needs to be produced on a large scale to meet the increasing demands.

**You will learn about**

- Food from plants
- Agricultural practices
- Increasing crop yield
- Food from animals



1. What is the farmer doing in the fields?

   a. Ploughing  b. Sowing  c. Harvesting  d. Irrigating

2. How would this help the soil?

   a. Increase amount of water in the soil  b. Increase humus content

   c. Increase aeration  d. Decrease aeration

Proper management and distribution of food produced on large scale is also essential. In this chapter, we will mainly discuss production and management of food.

Answers: 1. a. Ploughing, 2. c. Increase aeration

## FOOD FROM PLANTS

*Growing plants and rearing animals for food, clothing, and other useful products is called* ***agriculture****. Plants of the same kind grown on a large scale for food, clothing, etc., are called* ***crops***. For example, several plants of maize grown in a large field form a crop of maize. Examples of food crops are cereals (e.g., rice, wheat, and maize), pulses (e.g., *urad*, *arhar*, and *mung* bean), fruits (e.g., mango, apple, and banana), and vegetables (e.g., spinach, potato, and onion).

Based on the growing season, the crops grown in India can be classified as *kharif* and *rabi*. *Kharif crops* are generally planted in June and harvested in October. Rice, maize, cotton, and groundnut are examples of *kharif* crops.

*Rabi crops* are generally planted in November and harvested in April. Wheat, barley, pea, and gram are examples of *rabi* crops.

## AGRICULTURAL PRACTICES

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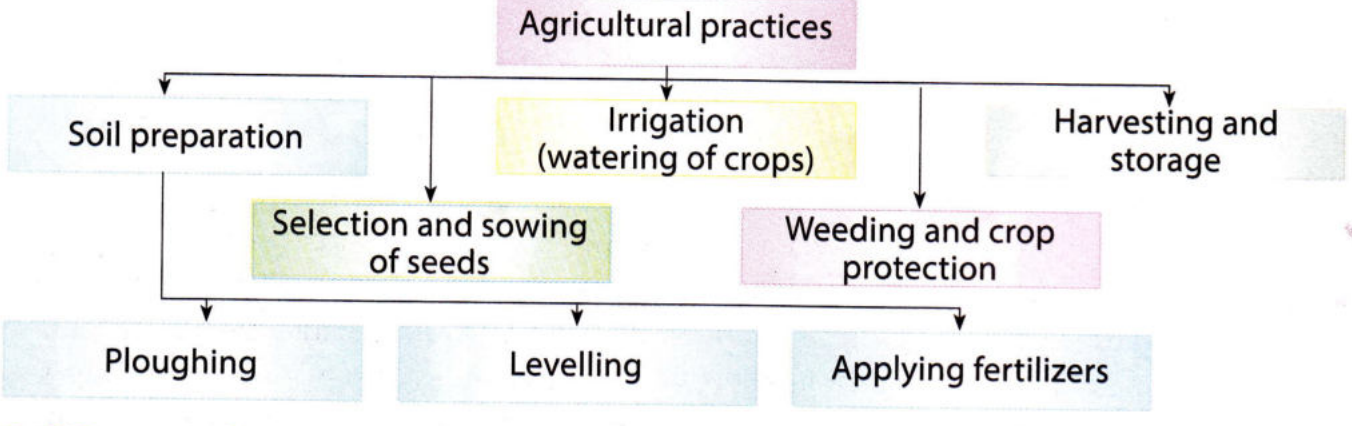
For growing crops, farmers perform a series of activities, in a particular sequence, over a period of time. These activities are known as *agricultural practices*.




### Soil Preparation

Soil is the main medium in which plants grow. The roots of plants absorb water, air, and vital nutrients from soil. In order to ensure that these are readily available to the roots, the soil is 'prepared' before growing a crop. Soil preparation involves ploughing, levelling, and applying fertilizers.

#### Ploughing

*The process of loosening and turning the soil is called* ***ploughing*** *or* ***tilling***. This process is important because of the following reasons.

- It allows the roots to reach deeper into the soil. This helps to fix the plant more firmly to the ground.
- It helps in trapping air in the soil, which is necessary for roots.
- It helps the soil to retain moisture for a longer duration.

- It helps in bringing nutrient-rich soil to the top.
- It helps the soil to mix well with fertilizers.
- It helps in the removal of undesirable plants called weeds.

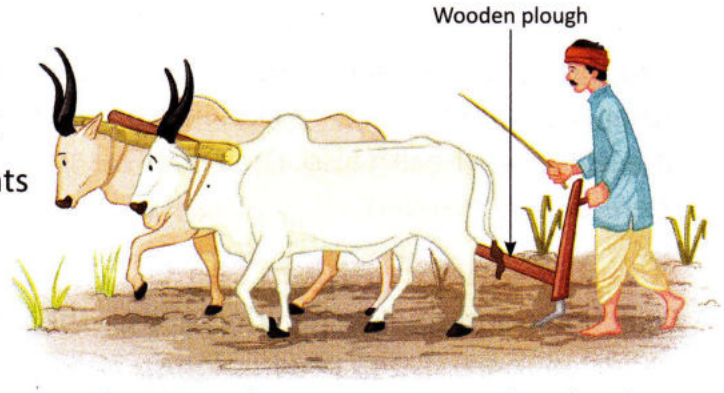



**Fig. 1.1** *A farmer using a wooden plough*

The burrowing action of organisms such as earthworms also helps in loosening and turning the soil. These organisms also help in the decay of dead plants and animals in the soil. This process leads to the formation of a substance called *humus*, which is rich in nutrients for plants.

Soil is ploughed with the help of a tool called a *plough*. The plough and other tools needed to carry out agriculture practices are called *agricultural implements*. Ploughs are drawn either by bullocks or other animals such as horses and camels, or using a tractor. A plough may be made of wood (Fig. 1.1) or iron. Nowadays, implements called cultivators, which are driven by tractors, are increasingly being used for ploughing. They save both time and effort.

### Levelling

Even after ploughing, big lumps of soil (called clods) may remain in the field. These are crushed using wooden or iron planks called *levellers* and this process is called *levelling*.

### Applying fertilizers

When crops are grown in a field, they absorb nutrients from the soil. After growing different crops in the same field over a period of time, the level of nutrients in the soil may decrease as they are being used up by the crops. Eventually, the soil may even turn infertile (i.e., not allow growth of crops at all). To avoid this situation, farmers often add substances called fertilizers to the soil. ***Fertilizers*** *are natural or chemical substances that contain one or more nutrients essential for plant growth*. Table 1.1 describes the differences between natural and chemical fertilizers.

**Table 1.1** Natural and chemical fertilizers

| Natural fertilizers | Chemical fertilizers |
|---|---|
| 1. These are obtained from plant and animal wastes. | 1. These are chemical substances produced in factories. |
| 2. These increase the humus content of the soil. | 2. These do not increase the humus content of the soil. |
| 3. Examples are manure, compost, bone meal (a mixture of crushed and coarsely ground bones), and bark of *neem*. | 3. Examples are urea, ammonium sulphate, potash, and NPK (nitrogen, phosphorus, potassium) fertilizers. |

Chemical fertilizers may get washed into water bodies through a process called *leaching* and harm fish and other aquatic animals. Seepage into groundwater affects human health also. Their overuse should, therefore, be avoided.

**Green corner**

These days, farmers are shifting to environment-friendly green manure because of the harmful effects of chemical fertilizers. Green manure refers to crops such as clover and mustard that are ploughed into the soil to improve its nutrient content.

## Selection and Sowing of Seeds

Selecting good-quality, healthy seeds is the next important part of crop production. In India, a government body called the National Seeds Corporation (NSC) is involved in the production of good-quality agricultural seeds. NSC has also helped in setting up seed-testing laboratories in different parts of the country.

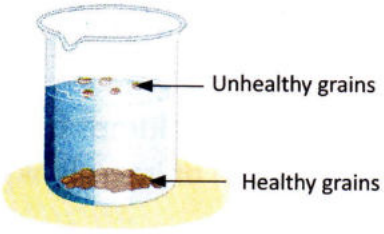
### Activity

**Aim:** To separate healthy grains from spoiled ones

**Materials needed**: A beaker or glass bowl, water, and wheat grains

**Method:**

1. Fill the beaker with water.
2. Put some wheat grains in the beaker. Stir them and leave them undisturbed for some time.
3. Observe the grains inside the beaker.




**Observation:** Some grains settle down at the bottom of the beaker while some float on the surface of the water (see figure).

**Conclusion:** Grains that have been damaged by insects tend to be lighter and float on the surface. Healthy grains are heavier and settle down at the bottom.

After the seeds have been selected, they need to be sown in the field. ***Sowing** is the process of planting seeds in the soil.* The following points must be kept in mind while sowing seeds.

- Seeds should be sown at appropriate distance from one another. Overcrowding may result in competition for air, sunlight, and nutrients among the young plants that emerge from these seeds. Such competition is harmful for the young growing plants.
- Seeds should be sown at the correct depth, neither too shallow nor too deep.

Sowing can be done manually (i.e., by hand) or with the help of an implement called seed drill.

### Manual sowing

This process (also called *broadcasting*) involves direct sprinkling of seeds into the soil or digging the soil and planting the seeds. Seeds sown in this manner are distributed unevenly (which may result in overcrowding). Also, this method may not ensure that all seeds are sown at the correct depth.

**Fig. 1.2** *Seed drill attached to a tractor*

### Using a seed drill

A seed drill can be pulled across the field using bullocks or a tractor (Fig. 1.2). Seeds sown using a seed drill are distributed evenly and placed at the correct depth in the soil.

## Irrigation

Seeds sown in the soil require water for their growth. Water requirements differ from crop to crop. For instance, paddy needs a constant supply of water whereas wheat requires water at regular intervals. Rainfall is one of the sources of water for crops. As one cannot always depend on rainfall, other ways of supplying water to crops have been devised. ***Irrigation*** *refers to artificial application of water to the soil for assisting the growth of crops.*

Water for irrigation is obtained from wells, rivers, lakes, reservoirs, and tube wells. Methods of irrigation can be considered under two broad categories: traditional and modern.

***Traditional methods*** Canal irrigation, furrow irrigation (Fig. 1.3), chain pump, moat (pulley system), *dhekli*, and *rahat* (water wheel) are some of the traditional methods of irrigation. These methods are cheaper, but often lead to wastage of water.

***Modern methods*** Sprinkler irrigation and drip irrigation are examples of modern methods of irrigation. These methods help in saving water.

**Fig. 1.3** *Furrow irrigation*

Sprinkler irrigation is a method that involves pumping water under pressure through nozzles and spraying it over soil like artificial rain. This method is particularly effective for irrigating uneven land and areas having sandy soil.

Drip irrigation is a method that involves the use of pipes or tubes with very small holes to deliver water drop-by-drop directly at the base of each plant. This method is very useful for areas having a shortage of water.

### Word help

**Furrow** A long narrow cut made in the ground using a plough; holds water for crops

### Let's Discuss

Which method of irrigation would you recommend for a region that frequently experiences shortage of water? Why?

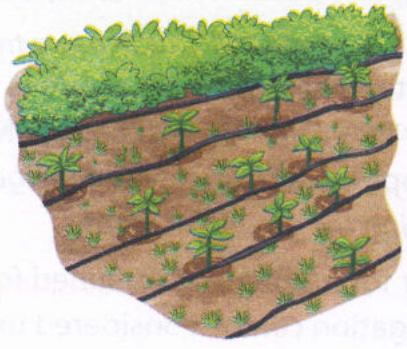
Care must be taken not to water the field excessively. Excess water on the field may cause a condition called *waterlogging*, which may harm the crops by

- decreasing the amount of air available to the roots and
- leading to an increase in the salt content of the soil.

## Let's Remember

**I. Look at the picture given alongside and answer the questions.**

1. Which stage of growing crops is shown here?
   a. Sowing b. Ploughing
   c. Irrigation d. Harvesting
2. Name one traditional and one modern method used for this stage.
   a. Traditional: _____
   b. Modern: _____



**II. Cross the odd one out. Give one reason for your choice.**

1. Broadcasting, seed drill, tractor, harvester
2. Canal, tube well, Seed drill, furrows
3. Moat, dhekli, rahat, seeds

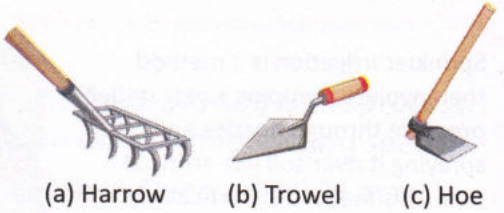
## Weeding and Crop Protection

Sometimes, undesirable plants called *weeds* grow along with the crop. *Amaranthus* (*chaulai*), wild oat, grass, and *Chenopodium* (*bathua*) are examples of weeds. Weeds need to be removed as they start competing with the crops for air, sunlight, and nutrients. Some of them may even be poisonous to human beings and animals.

*The process of removing weeds is called* ***weeding***. Weeding can be done either manually or by using chemicals called *weedicides*.

### *Manual weeding*

Weeds can be uprooted either by hand or with the help of implements such as harrow, trowel, and hoe (Fig. 1.4).



(a) Harrow (b) Trowel (c) Hoe

**Fig. 1.4** *Implements used for weeding*

**Green corner**

These days, natural, environment-friendly weedicides called bioweedicides are being used. Bioweedicides use organisms such as fungi and bacteria to destroy weeds.

Manual weeding has the following disadvantages.

- It is time-consuming and may even lead to accidental removal of desired crops.
- The implements used (such as trowel, harrow, and hoe) are made of iron and need regular maintenance to prevent rusting.

### Using weedicides

A ***weedicide*** *is a chemical that is used to destroy weeds*. Weedicides destroy the weeds without affecting the crops. Dalapon, metachlor, and siziazine are examples of weedicides.

Animals such as rats and insects also damage crops. Such animals are called *pests*. Most pests can be destroyed by using chemicals called *pesticides*.

Weedicides and pesticides have the following disadvantages.

- Accidental contact with these chemicals may adversely affect the health of farmers.
- Traces of these poisonous chemicals may remain in crops themselves, which can be very harmful to human life. It is, therefore, very important to wash grains and vegetables thoroughly before consumption.

## Harvesting

*The process of cutting and gathering of crops is called* ***harvesting***.
Harvesting of cereal crops is either done manually with the help of a sickle (Fig. 1.5), or with the help of a machine called harvester. After harvesting, the grains of cereal plants are separated from rest of the plant. This is done by threshing and winnowing.

**Fig. 1.5** *Sickle*

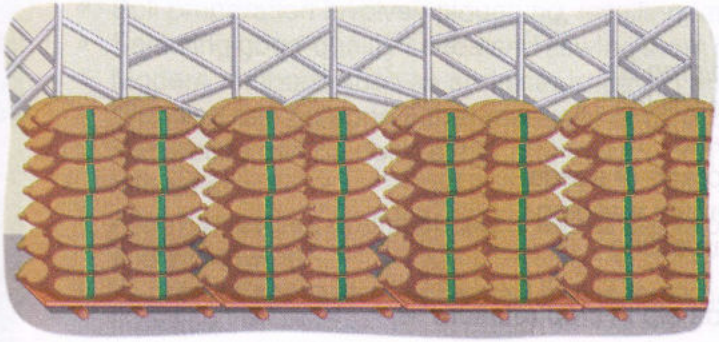
Threshing is done either manually, or with the help of a machine called a thresher. A machine called a *combine harvester* can be used for both harvesting and threshing. *Winnowing*, which involves the separation of the grain from chaff (seed coverings and tiny pieces of leaves or stem), can be done manually, or using a winnowing machine.

## Storage

Harvested grains need to be stored before they are made available for consumption. To prevent their spoilage, it is necessary to ensure that both the grains and the storage area are free of moisture. The grains are dried in the sun to remove as much moisture as possible. They are then weighed and packed in gunny bags [Fig. 1.6(a)] or bins. Bulk storage of grains is done in granaries and silos [Fig. 1.6(b)].

**Fact File**

The oldest granary is located in the Jordan Valley and dates back to 9500 BC.



(a) Grains stored in gunny bags

(b) Grains stored in silos

**Fig. 1.6** *Storage of grains*

### Case Study: Wheat

Wheat is grown mostly in the Northern and Central parts of India and accounts for as much as three and a half percent of wheat production globally. People grow wheat as an important food crop in the states of Uttar Pradesh, Punjab, Madhya Pradesh, Maharashtra, Bihar, and Rajasthan. Historians have found traces of wheat grains in the various excavations of Indus valley civilizations at Mohenjo-Daro. Indian wheat has a very short life cycle as compared to other varieties of this crop, making it ripe for harvesting in less than 6 months after sowing.

The storage area should be kept clean and dry. Pesticides should be sprayed beforehand to keep pests away. Periodic inspection of the storage area is necessary to ensure the safety of grains.

## INCREASING CROP YIELD

Carrying out the basic agricultural practices systematically can substantially increase crop yield. Techniques such as mixed cultivation and crop rotation can increase crop yield further.

**Word help**

**Cultivation** Preparation and use of land for growing crops

### Mixed Cultivation

*In this type of cultivation, two or more different types of crops are sown in a particular field at the same time.* The crops chosen are such that the nutrient needs of one crop are fulfilled by the other. For example, a leguminous plant (i.e., a plant having seeds in long pods) such as chickpea or *mung* can be grown in the same field, along with a cereal such as wheat.

### Crop Rotation

*The practice of growing two or more dissimilar crops in the same field, one after the other, is called* ***crop rotation***. This is done keeping in mind the nutrient requirements of a particular crop. For example, crops such as wheat and paddy use up a lot of nitrogen from the soil. This lost nitrogen can be replaced naturally if leguminous plants such as pea, soya bean, or green beans are sown after wheat or paddy.

Leguminous plants have a special kind of bacteria called nitrogen-fixing bacteria in their roots that help in restoring the nitrogen content of the soil. This is done by a process called *nitrogen fixation*.

## Let's Remember

REMEMBERING UNDERSTANDING

**I. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Wild oat | a. Weedicide |
| 2. Harrow | b. Weed |
| 3. Dalapon | c. Storage of seeds |
| 4. Sickle | d. Manual weeding |
| 5 Silos | e. Harvesting |

**II. Correct the following statements.**

1. All weeds are good for the crops and help in crop rotation.

   _____

2. Mixed cultivation is a good practice for increasing the weeds.

   _____

## FOOD FROM ANIMALS

We obtain many kinds of food items from animals. *Rearing animals on a large scale, for food and other needs, is called* ***animal husbandry***. Here are some examples of food products obtained from animals.

- *Milk* is obtained from animals such as cows, buffaloes, and goats. It is used to prepare a variety of products such as butter, ghee, curd, and cheese.
- *Meat* is obtained from animals such as goats and chickens. People also eat many kinds of fish, shrimps, prawns, lobsters, and other sea animals.
- *Eggs* are obtained from birds such as hens, turkeys, and geese.
- *Honey* is obtained from honeybees.

*The practice of rearing honeybees for honey is known as* ***apiculture.***

## Key Words

| | |
|---|---|
| **Agriculture** | Growing plants and rearing animals for food, clothing, and other useful products is called agriculture. |
| **Crops** | Plants of the same kind grown on a large scale for food, clothing, etc., are called crops. |
| **Ploughing** | The process of loosening and turning the soil is called ploughing. |
| **Fertilizers** | Natural or chemical substances that contain one or more nutrients essential for plant growth are called fertilizers. |
| **Irrigation** | Artificial application of water to soil for assisting the growth of crops is called irrigation. |
| **Weeding** | The process of removing weeds is called weeding. |
| **Weedicides** | Chemicals used to destroy weeds are called weedicides. |
| **Pesticides** | Chemicals used to destroy pests are called pesticides. |
| **Harvesting** | The process of cutting and gathering of crops is called harvesting. |
| **Animal husbandry** | Rearing animals on a large scale, for food and other needs, is called animal husbandry. |

## Summary

- Farmers perform a series of activities known as agricultural practices in a particular sequence over a period of time for growing crops.
- Soil preparation involves ploughing, levelling, and applying fertilizers.
- Selecting good-quality seeds and sowing them properly is an important part of crop production.
- Modern methods such as sprinkler irrigation and drip irrigation help in saving water.
- Weeding can be done either manually or by using chemicals called weedicides.
- Harvesting can be done either manually (using a sickle) or with the help of a machine called harvester.
- After harvesting, grains of cereal plants are separated from the rest of the plant by threshing and winnowing.
- To prevent spoilage of harvested grains, both grains and the storage area should be free of moisture.
- Techniques such as mixed cultivation and crop rotation can help increase crop yield further.
- We obtain food items such as milk, meat, eggs, and honey from animals.

# Exercises



## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Fill in the blanks with the correct words.**

1. To grow crops, farmers perform a series of activities in _____ (any/a particular) sequence.
2. _____ (Ploughing/Levelling) allows the roots to reach deeper into the soil.
3. To avoid the soil from becoming infertile, farmers often add _____ ( seeds/ fertilizers).
4. Chemical fertilizers sometimes get washed away into water bodies by the process of _____ (leaching/irrigation).
5. Seeds sown by _____ (broadcasting/using a seed drill) are distributed unevenly and may not ensure that all seeds are sown at the correct depth.
6. We should use _____ (sprinkler/drip) irrigation method in places that have a shortage of water.
7. Excess water on the field may cause a condition called _____ (leaching/ waterlogging) which may harm the crops.
8. Animals like rats and insects damage the crops and can be destroyed by using _____ (weedicides/pesticides).
9. A machine called the _____ (combine harvester/combine winnower) is used for both harvesting and threshing.
10. Bacteria in roots of _____ (leguminous/all cultivated) plants help in restoring the _____ (oxygen/nitrogen) content of the soil.

**B. Choose the correct option.**

1. Which of these involves preparing the soil for sowing seeds?
   a. Ploughing, weeding, and threshing
   b. Ploughing, levelling, and adding fertilizers
   c. Weeding, sowing, and harvesting
   d. None of these
2. Which of these helps to trap air into the soil?
   a. Tilling
   b. Burrowing action of earthworms
   c. Levelling
   d. Both a. and b.
3. Which of these processes involve separation of grain from the chaff?
   a. Weeding
   b. Harvesting
   c. Threshing
   d. Winnowing
4. In which of these places will you store harvested grains?
   a. Outside in the rain
   b. In dry and clean rooms
   c. In a storehouse that is humid and clean
   d. In a dry room that is clean but has rats
5. Which of these best refers to the practice of rearing honeybees?
   a. Agriculture
   b. Sericulture
   c. Apiculture
   d. Mixed cultivation
6. Which of these crops are generally planted in November and harvested in April?
   a. Wheat and rice
   b. Pea and gram
   c. Maize and cotton
   d. Cotton and Barley

7. Which of these should be kept in mind while sowing seeds?
   a. The distance between one another
   b. The depth at which seed is sown
   c. It cannot be done manually
   d. Both a. and b.
8. Which of these irrigation methods does not lead to wastage of water?
   a. Dhekli and Rahat
   b. Sprinkler irrigation
   c. Chain pump and moat
   d. All of these
9. Which of these are common implements used for removing weeds from fields?
   a. Plough and leveller
   b. Combine harvester
   c. Trowel and hoe
   d. Tractor and seed drill
10. Which of these processes is usually done with the help of a sickle?
    a. Levelling  b. Weeding  c. Harvesting  d. Winnowing

## II. Very short answer type questions

### A. Give one word for the following.

1. Plants of the same kind grown on a large scale for food, clothing etc _____
2. The process of loosening and turning the soil _____
3. Tools needed to carry out agricultural practices _____
4. Natural or chemical substances that contain one or more nutrients for plant growth _____
5. Artificial application of water to soil _____
6. A chemical used to destroy weeds _____
7. The process of removing weeds _____
8. The process of cutting and gathering of crops _____
9. A place where bulk storage of grains is done _____
10. Rearing animals on a large scale for food and other needs _____

### B. Give two examples for the following.

1. Kharif crops _____ _____
2. Cereal crops _____ _____
3. Rabi crops _____ _____
4. Traditional methods of irrigation _____ _____
5. Implements used for manual weeding _____ _____
6. Common weeds _____ _____
7. Commonly used weedicides _____ _____
8. Leguminous plants _____ _____
9. Animals from which we get milk _____ _____
10. Birds from which we get eggs to eat _____ _____

## III. Short answer type questions

1. Define agriculture.
2. What are crops? Name two types of crops on the basis of their growing season.
3. Why do we need to prepare the soil before growing a crop?
4. Why does the soil need levelling?
5. What does NSC stand for? What role does it play in agriculture?

6. What should we keep in mind while sowing seeds?
7. What are two most common disadvantages of manual weeding?
8. Why should we not use chemical weedicides and pesticides?
9. What kind of a place is ideal for storage of harvested grains?
10. What is animal husbandry?

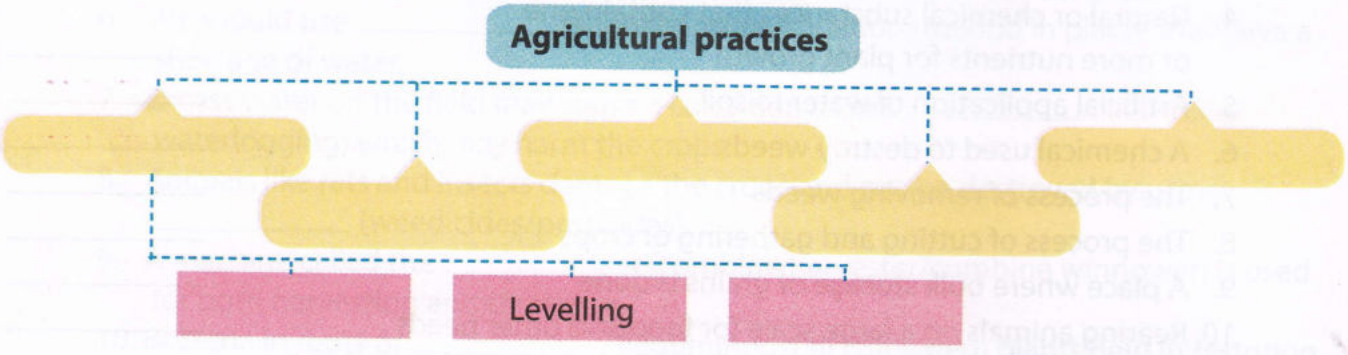
## IV. Long answer type questions

1. Describe the various steps involved in preparing the soil.
2. What are fertilizers? Why is it important to add them to soil? Differentiate between natural and chemical fertilizers.
3. Explain the various methods of irrigation involved in agriculture.
4. What are the various ways in which we protect crops from weeds and pests?
5. How can we ensure increase in crop yield?

## LET'S RECALL

REMEMBERING

Recall and complete the concept map given below.




## LET'S OBSERVE

UNDERSTANDING

1. What has happened to the fields here? _____
   (waterlogging/ leaching/ crop rotation)
2. Which of these would happen that will affect the roots here? LO 3
   a. Lack of air in soil
   b. Lack of nitrogen in soil
   c. Lack of seeds in soil

3. Identify the agricultural implements and mention the stage of farming when each is used.


a. _____


b. _____


c. _____


d. _____

## LET'S CONNECT

GEOGRAPHY

Find out the cash crops grown in each state of India. On a map of India, mark and label the various canals and dams that have been the main source of irrigation.

## LET'S APPLY

1. The salt content of soil has increased in Kabir's farm and is harming the crops. What could be the main reason for this, even though he is not spraying salty water? LO 3
   (*Hint:* This process also decreases the amount of air available to the roots of plants)
2. Maya is confused why Kishan always grows soya bean plants after wheat every year. Can you tell her why? (*Hint:* Soya bean is a leguminous plant)

## LET'S ANALYSE AND EVALUATE

1. Look at the picture given alongside. Analyse why the farmer needs to spray these chemicals?
2. Judge how eating vegetables from this farm could affect us. Recommend an alternate solution to this. LO 13

## LET'S CREATE

1. Collect dried leaves and flowers of a few plants. Make a herbarium file by pasting them on art sheets. Dedicate one page to each plant and write the name, type of plant (herb, shrub, etc.), and scientific name (if any), and the commercial use for each specimen. LO 14
2. In groups of five, find out the various types of implements used in agricultural practices in India. Sort them as *manual* or *machine operated* tools. Collect pictures and make a chart with their names and the kind of maintenance required for each. LO 2 LO 11
3. Go to the laboratory and view a slide of the root nodules of leguminous plants under a microscope and draw labelled diagrams of what you saw. LO 9
4. In groups of five, make a model from local materials to show any one kind of traditional irrigation methods: (a) canal irrigation, (b) furrow irrigation, (c) chain pump, (d) moat, (e) dhekli, and (f) rahat. LO 10

### Web Research

- Browse the Internet and find out how dams play an important role in agriculture in India. Then make a list of all major dams in India and the rivers on which they are made. Some suggested websites are:
  https://www.onlinegk.com/geography/indian-irrigation (accessed and checked on 12/08/2019)
  https://www.indiawaterportal.org/topics/large-dams-barrages-reservoirs-and-canals (accessed and checked on 12/08/2019)
- Find out about the Green Revolution in India. Prepare a case study using information collected. Some suggested websites are:
  https://www.encyclopedia.com/plants-and-animals/agriculture-and-horticulture/agriculture-general/green-revolution (accessed and checked on 12/08/2019)
  https://futureofworking.com/6-advantages-and-disadvantages-of-the-green-revolution/ (accessed and checked on 12/08/2019)

# 2 Microorganisms

**You will learn about**

- Microscope
- Types of microorganisms
- Useful microorganisms
- Harmful microorganisms

There are a variety of organisms on our planet. Some, such as the blue whale are extremely large, whereas some, such as *Amoeba*, are very tiny and cannot be seen with our naked eye.

Look at the picture below and answer the questions that follow.

1. Name the instrument the child is using to see. _____
2. Name the organism that the child could be viewing. _____ ( Amoeba/Insect)
3. Name one such organism that we might see if we view the root nodule of a pea plant under a microscope. _____ (Bacteria/Virus)

Many of these extremely tiny organisms can be seen and photographed with the help of an instrument called a *microscope*.

In this chapter, we will discuss the microscope and the different kinds of tiny organisms.

Answer: 1. Microscope, 2. Amoeba and 3. Bacteria

## MICROSCOPE

*A **microscope** is an instrument that makes use of lenses to make smaller objects appear larger.* Usually a compound microscope is used for viewing tiny organisms. The different parts of a compound microscope are shown in Figure 2.1.

*The object to be viewed under the microscope is referred to as the **specimen.*** A thin sheet of glass called a microscopic slide is used to hold a small sample of the specimen. A second, much thinner, sheet of glass called coverslip is placed over the sample. The coverslip protects the microscope's objective lens by preventing it from coming into contact with the specimen sample. It also helps to create an even thinness for the sample.

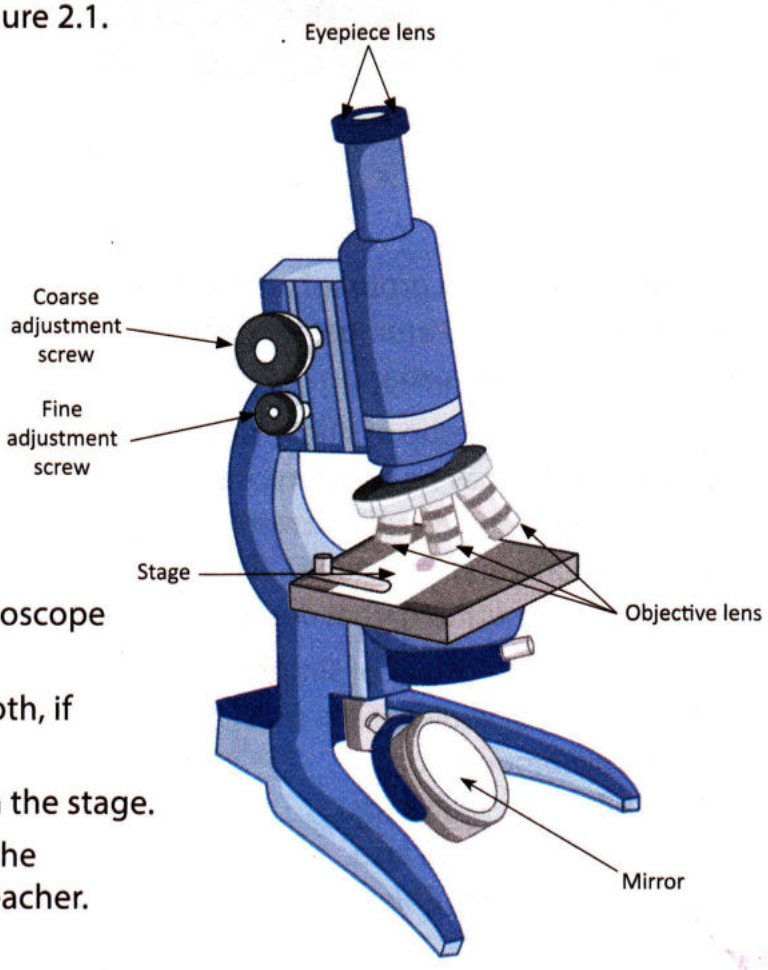



**Fig. 2.1** *Compound microscope*

The basic steps to use a compound microscope are as follows.

1. Clean the mirror using a soft, clean cloth, if required.
2. Place the slide (with the specimen) on the stage.
3. Adjust the focus of the eyepiece and the objective lens with the help of your teacher.
4. View the slide through the eyepiece.

## TYPES OF MICROORGANISMS

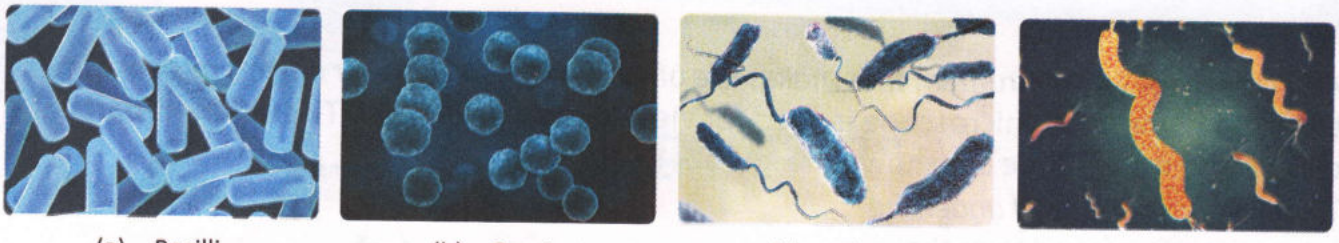
LL

*Organisms that are visible only through a microscope are called **microorganisms** (micro means very small) or **microbes**.* Microorganisms are the most abundant organisms on our planet. They are found almost everywhere—in ice-cold regions, hot springs, and deserts, and even inside the bodies of animals and human beings. Some live alone, while others grow in groups called *colonies*. They may be unicellular or multicellular organisms. Microorganisms can be divided into five major groups: bacteria, protozoa, fungi, algae, and viruses.

***Bacteria*** They are among the smallest and oldest organisms on our planet. Bacteria are unicellular organisms. Different bacteria have different shapes: rod-shaped (bacilli), spherical (cocci), comma-shaped (vibrio), and spiral (spirilla) (Fig. 2.2). *Lactobacillus* and *Streptococcus* are examples of bacteria.

**Fact File**

A gram of soil contains about 40 million bacteria!



(a) Bacilli (b) Cocci (c) Vibrio (d) Spirilla

**Fig. 2.2** *Different shapes of bacteria*

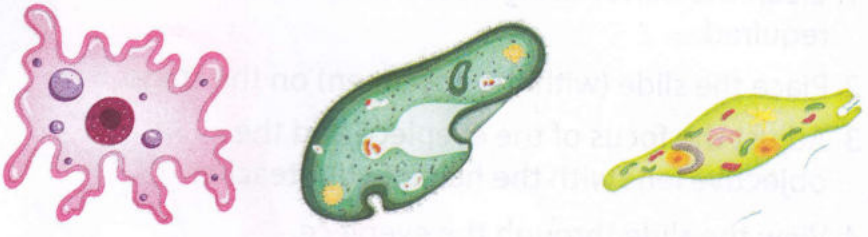
***Protozoa*** They are a group of animal-like, unicellular organisms. *Amoeba*, *Paramoecium*, and *Euglena* (Fig. 2.3) are examples of protozoa.

***Fungi*** They are a group of single-celled or multi-celled organisms. Fungi may be either microscopic and unicellular (e.g., yeasts and moulds), or macroscopic and multicellular (e.g., mushrooms and toadstools). All fungi lack chlorophyll and derive their nutrition from decaying matter.

**Get it Right**

Not all fungi and algae are microscopic. Some of them are quite large (e.g., mushroom and seaweed).

***Algae*** They are a group of simple plant-like organisms that contain chlorophyll. They may be unicellular (*e.g. Chlamydomonas*) or multicellular (e.g. seaweeds). Some unicellular algae also exist in colonies (e.g. *Chlorella* and diatoms).



(a) *Amoeba* (b) *Paramoecium* (c) *Euglena*

**Fig. 2.3** *Examples of protozoa*

***Viruses*** They are so small that they cannot be seen using ordinary compound microscopes. They are usually studied with the help of powerful microscopes called electron microscopes. Viruses (Fig. 2.4) are hard to classify as living or non-living as, on their own, they show no signs of life. However, they reproduce inside the cells of organisms such as plants, animals, or bacteria. Tobacco mosaic virus (TMV) and Human Immunodeficiency Virus (HIV) are examples of viruses. The widely feared avian flu and swine flu are also caused by viruses.

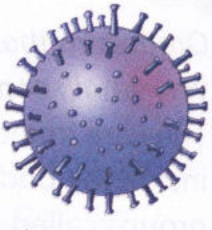


**Fig. 2.4** *Virus*

## USEFUL MICROORGANISMS

Microorganisms benefit us in a number of ways. Their uses can be divided into four categories: commercial, medicinal, agricultural, and environmental. Let us discuss each of these in detail.

## Commercial Uses

Some of the commercial uses of microorganisms are given below.

***Making curd and cheese*** Do you know how curd is made at home? Usually, a spoonful of curd is added to warm milk, which turns into curd overnight. This happens because a protein called *casein* present in milk coagulates to form curd. For casein to coagulate, the milk has to be made acidic. A bacterium called *Lactobacillus*, present in the spoonful of curd added to the milk, converts the lactose sugar present in milk to lactic acid. This creates the acidic environment needed for casein coagulation.

**Word help**

**Coagulate** To become thick and partly solid

*The process of conversion of a sugar into an acid or an alcohol by the action of microorganisms is called* ***fermentation.***

### Activity

**Aim:** To prepare curd
**Materials needed**: Milk (one glass), a teaspoon of curd, a bowl, and a lid
**Method:**

1. Ask an adult to warm the milk.
2. Transfer the milk to the bowl and add a spoonful of curd to it. Stir well and cover the bowl with a lid. Leave the bowl undisturbed overnight.

**Observation:** The milk has transformed into curd.
**Conclusion:** The bacterium *Lactobacillus* present in the spoonful of curd added to the milk converts milk into curd.
***Note***: Adult supervision required.

The production of cheese and paneer (cottage cheese) also involves the use of bacteria such as *Lactobacillus* and *Streptococcus*. Curd and cheese manufacturers also add a substance called *rennet* (usually obtained from stomach of young cattle) to milk to make the process faster. Addition of rennet results in the formation of lactic acid, which makes the milk more acidic.

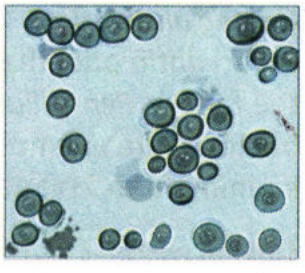


**Fig. 2.5** *Yeast cells (magnified)*

***Making alcoholic beverages*** Production of alcoholic beverages such as beer and wine involves fermentation of sugar present in barley and grapes, etc., by a microscopic fungus called yeast (Fig. 2.5). Fermentation by yeast produces alcohol and carbon dioxide.

***Making bread*** The process of making bread involves kneading a mixture of flour, salt, sugar, yeast cells, and water into a dough. Yeast converts sugar to alcohol and carbon dioxide. As more and more carbon dioxide is produced, the dough rises in volume. This makes the bread porous and spongy. Baking the expanded dough at 180°C kills the yeast and stops fermentation. The alcohol evaporates during the baking process.

## Activity

**Aim:** To observe fermentation of sugar by yeast cells
**Materials needed:** Sugar (two tablespoons), warm water (1 cup), a balloon, empty plastic bottle (1 litre), and active yeast cells
**Method:**

1. Stretch the balloon by blowing it up and deflating it a few times. Keep it aside.
2. Add sugar and yeast cells to the cup of warm water and mix thoroughly.
3. Pour the mixture into the bottle. Attach the balloon to the mouth of the bottle (see Fig. A) and leave it undisturbed.

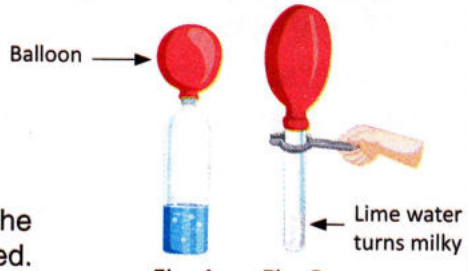


Fig. A Fig. B

**Observation:** The volume of the mixture inside the bottle increases. The balloon inflates and you can smell alcohol in the mixture inside the bottle. If you pass the gas filled inside the balloon through a test tube containing lime water, the lime water will turn milky (Fig. B). This proves that the gas released is carbon dioxide.
**Conclusion:** Fermentation of sugar by yeast produces alcohol and carbon dioxide. As carbon dioxide rises up, we observe an increase in the volume.

***Making vinegar, coffee, and tobacco*** Bacteria are used in the production of vinegar (acetic acid). They are also used in the processing of tea, coffee, and tobacco.

***Making toothpaste*** Shells of diatoms (a type of algae) are used in toothpaste to give it a gritty texture that helps in cleaning teeth. Xanthan gum, obtained from the bacterium *Xanthomonas campestris*, is also used in making toothpaste.

### Fact File

Indian foods such as idli, dosa, and dhokla are prepared using fermentation. The tiny holes seen in these foodstuffs are created by carbon dioxide formed during fermentation.

## Medicinal Uses

Some of the medicinal uses of microorganisms are given below.
***Making antibiotics*** Certain bacteria and fungi are used in the production of medicines called *antibiotics* that destroy certain disease-causing microbes. Penicillin (obtained from the fungus *Penicillium*), streptomycin, and tetracycline (both obtained from *Streptomyces* bacteria) are examples of antibiotics. Antibiotics are also used to control microbial diseases in animals and plants.

***Making vaccines*** When a disease-causing microbe enters our body, our body produces substances called *antibodies*. These antibodies fight and destroy the disease-causing microbe and remain in the body to fight future infections by the same microbe. A *vaccine* is a preparation of killed or weakened disease-causing microbes. When a vaccine is introduced in the body of a healthy person (by swallowing or injection), his/her body produces antibodies against these killed or weakened microbes. Thus, vaccines help in preventing diseases caused by microbes (e.g., polio, cholera, typhoid, smallpox, and hepatitis).

***Making food supplements*** Microbes such as *Chlorella* and *Spirulina* (types of algae) are rich in proteins and other nutrients and are used as food supplements.

***In human body*** Bacteria such as *Lactobacillus acidophilus* and *Escherichia coli* live in human intestines, where they help to digest food and destroy disease-causing microbes.

## Agricultural Uses

Blue-green algae and bacteria such as *Rhizobium* (that live in the root nodules of leguminous plants such as pea and soya bean) help in fixing atmospheric nitrogen and increasing soil fertility.

***Nitrogen Fixation and Nitrogen Cycle*** ***Nitrogen fixation*** *is the process by which free atmospheric nitrogen is converted into nitrogen compounds.* In nature, nitrogen is fixed during lightning or by nitrogen-fixing bacteria and blue-green algae.

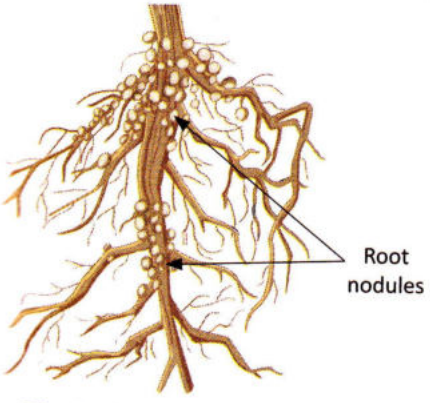



**Fig. 2.6** *Root nodules of a leguminous plant*

Leguminous plants such as pea and soya bean have the nitrogen-fixing bacteria *Rhizobium* present in their root nodules (Fig. 2.6). The nitrogen fixed by these bacteria is taken up by the plants and stored in their tissues as plant proteins. This stored nitrogen passes from these leguminous plants to herbivores, and then to carnivores.

When these plants and animals die, the nitrogen compounds present in their bodies are decomposed and returned to the soil. Some of these compounds are again absorbed by plants, while some are converted into nitrogen and returned to the atmosphere by certain bacteria present in the soil. This cycling of nitrogen, between the atmosphere, soil, and organisms, is called *nitrogen cycle.*

***Nitrogen cycle*** *is a natural cyclic process in which atmospheric nitrogen enters the soil and becomes a part of living organisms, before returning to the atmosphere.*

A simplified representation of this process is shown in Figure 2.7.

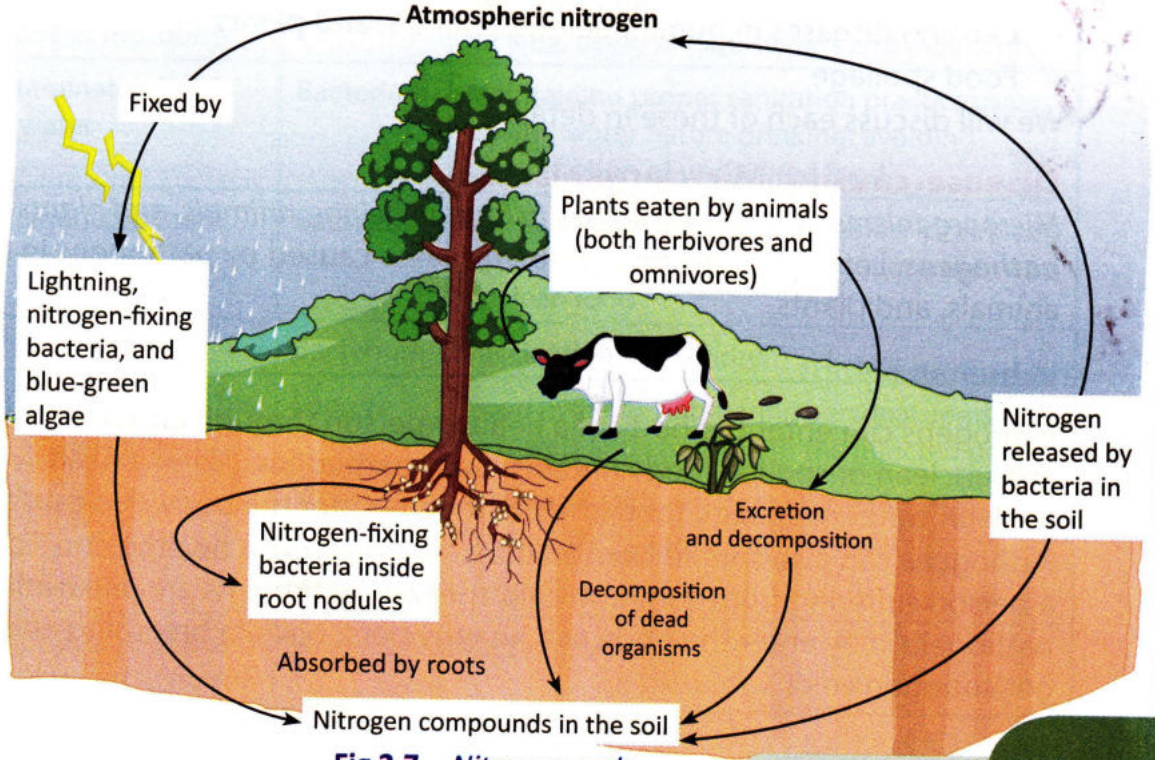



**Fig 2.7** *Nitrogen cycle*

## Environmental Uses

Microbes such as bacteria and fungi act on the bodies of dead plants and animals and convert them into simple substances. These substances are used by other plants and animals. Removal of dead bodies by the action of microbes keeps our planet clean. Bacteria are also used in sewage treatment, where they help in the decay of waste organic matter.

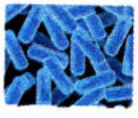
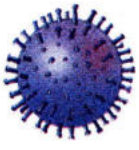
**Word help**

**Organic** Produced by or from living things

## Let's Remember

REMEMBERING UNDERSTANDING

**I. Identify the following correctly and write their names.**

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

Which out of these are bacteria? Circle them.

**II. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Seaweeds | a. Fermentation |
| 2. Virus | b. Curd formation |
| 3. *Streptococcus* | c. Multicellular algae |
| 4. *Lactobacillus* | d. Swine flu |
| 5. Yeast | e. Bacteria |

## HARMFUL MICROORGANISMS

Harmful effects of microorganisms can be divided into the following two categories:

- Causing diseases in human beings, animals, and plants
- Food spoilage

We will discuss each of these in detail.

### Disease-causing Microorganisms

*Microorganisms that cause diseases in human beings, animals, and plants are called* ***pathogens.*** Let us look at some of the diseases caused by pathogens in human beings, animals, and plants.

#### In human beings

Pathogens can enter the body of a healthy person through air, water, and food. Dirty water and unclean or spoiled food contains many pathogens. When a healthy person consumes unclean water or spoiled food, the pathogens enter the body and cause diseases. Pathogens can also spread from an infected person to a healthy one. For example, when a person suffering from common cold sneezes, pathogens are released into the air. These pathogens may enter the body of a healthy person while breathing and he/she may also get common cold.

## Know Your Scientist

A German physician, Robert Koch discovered the bacteria that caused tuberculosis. It was called *Mycobacterium tuberculosis* and was discovered in the year 1882. He also discovered the causative bacteria for cholera.

Pathogens can also spread from an infected person to a healthy one through insects such as the *Anopheles* and *Aedes* mosquitoes and the housefly. For example, when a female *Anopheles* mosquito bites a person suffering from malaria, it sucks in the pathogens along with the blood. When the same mosquito bites a healthy person, the pathogens may enter his/her body and that person may also get infected with malaria. Similarly, when a housefly sits on garbage, pathogens may stick to its body. The same fly may transmit these pathogens to food items, when it sits on them. When a person eats these food items, the pathogens enter his/her body and cause diseases. Insects such as mosuitoes (Fig. 2.8) and the housefly, which transmit pathogens from an infected person to a healthy one, are known as *carriers* of diseases. *Diseases that can spread from one person to another are called* ***communicable diseases.***

**Fig. 2.8** *Mosquitoes are carriers of diseases.*

Some common communicable diseases in human beings, along with their modes of transmission, causative pathogens, and preventive measures, are listed in Table 2.1.

**Table 2.1** Some communicable diseases in human beings

| Disease | Mode of transmission | Causative pathogen | Preventive measures |
|---|---|---|---|
| Malaria | Bite of the female *Anopheles* mosquito | Protozoan | Not allowing mosquitoes to thrive in the locality; using mosquito nets and repellents |
| Cholera | Contaminated food and water | Bacterium | Maintaining proper sanitation practices; boiling water before drinking; avoiding consumption of uncovered food |
| Typhoid | Contaminated food | Bacterium | Maintaining proper sanitation practices; avoiding consumption of uncovered and unclean food |
| Tuberculosis | Air | Bacterium | Vaccination (for children) |
| Ringworm | Direct contact with the infected person | Fungus | Good hygiene; not sharing personal items such as towels and combs with the infected person |
| Common cold | Air | Virus | Washing hands regularly; avoiding close contact with people having common cold |
| Poliomyelitis | Air and water | Virus | Vaccination |
| Chickenpox | Air; physical contact with the infected person | Virus | Vaccination |

### In animals

Some animal diseases caused by pathogens are listed in Table 2.2.

**Table 2.2** Some animal diseases caused by pathogens

| Disease | Affected animal | Mode of transmission | Causative pathogen |
|---|---|---|---|
| Foot and mouth disease | Cattle | Contact with diseased animals; air | Virus |
| Rinderpest | Cattle | Contact with diseased animals; drinking contaminated water; air | Virus |
| Anthrax | Cattle | Grazing | Bacterium |
| Fin rot | Fish | Dirty water/injury | Bacterium/Fungus |

### In plants

Some plant diseases caused by pathogens are discussed below.

**Disease:** Citrus canker
**Mode of transmission:** Air
**Causative pathogen:** Bacterium

**Disease:** Rust of wheat
**Mode of transmission:** Air
**Causative pathogen:** Fungus

**Disease:** Apple scab
**Mode of transmission:** Air
**Causative pathogen:** Fungus

**Disease:** Loose smut
**Mode of transmission:** Air
**Causative pathogen:** Fungus

## MICROORGANISMS AND FOOD SPOILAGE

Microorganisms such as fungi and bacteria are responsible for the spoilage of various foodstuffs, including bread. The main conditions required for the growth of these microorganisms are a moderately warm temperature, air, and moisture. These microorganisms often produce poisonous substances, which make food unfit for consumption. Eating such foodstuffs can cause an illness called *food poisoning*.

Here are a few things, that can help us detect food that has become unfit for consumption because of microbial action:

- foul odour,
- slimy surface or cotton-like growth on the surface [Fig. 2.9(a)],
- surface discolouration [Fig. 2.9(b)],
- sour taste, and
- gas formation.

**Let's Discuss**

Discuss the changes that can be observed when fungus starts growing on food items.

(a) Cotton-like growth (mould) on the surface of bread (b) Surface discolouration caused by mould

**Fig. 2.9** *Microbial action on food items*

## Activity

**Aim:** To observe orange mould under a microscope

**Materials needed:** Fresh orange, a bowl (with lid), glass slide with coverslip, forceps, glycerine, and microscope

**Method:**

1. Take a fresh orange in a bowl. Cover the bowl with a lid.
2. Place the bowl in a warm place and leave it undisturbed for a week.

**Observation:** You would observe a greyish growth (mould) on the orange. Carefully pick up a small sample of the mould with the help of forceps. Put a drop of glycerine on a clean glass slide. Place the sample on the glycerine drop carefully and put the coverslip. Make sure there are no folds. With the help of your teacher, observe the sample under the microscope. Draw what you see.

**Extension:** You could repeat the same procedure with leftover bread slices and observe the structure of bread mould. Record if the structure of bread mould is similar to or different from that of the orange mould.

## Food Preservation

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Now that we know that food items are prone to spoilage by microorganisms, let us understand the methods by which food can be preserved for a longer time.

Food preservation is the process of treating and handling food with an aim to stop or slow down its spoilage while maintaining its nutritional value, texture, and flavour. Since microorganisms are one of the major causes of food spoilage, food preservation involves creating conditions unfavourable for their growth. Food preservation methods either kill microbes or prevent their reproduction. Different methods of food preservation are used for different types of foods (see Table 2.3).

### Tech Specs

Food irradiation is a technology that involves the use of ionizing radiation to destroy harmful microbes in food. Each year, an estimated 500,000 metric tonnes of food is treated using this technique worldwide.

**Table 2.3** Common methods of food preservation

| Method | How it preserves food |
|---|---|
| Boiling | Boiling liquid food items can kill any existing microbes. Milk and water are boiled to kill any harmful microbes that may be present in them. |
| Dehydration | Dehydration involves removal of water, one of the key requirements for microbial growth, from food items. Food items such as cereals and pulses are generally dried under the sun to remove the moisture present in them. |
| Refrigeration and freezing | Refrigerating at low temperatures and freezing help to preserve food for a longer time because microbes such as bacteria and fungi cannot thrive at low temperatures. When fresh fruits and vegetables are frozen, water present in them also freezes. This helps in preventing microbial reproduction. Food items that can be preserved by freezing include meat and vegetables. |
| Canning | Storing food items in airtight cans is an effective way of preserving them. Food items such as jams, vegetables, fish, and even cooked food are canned and sold in the market. |
| Using chemical preservatives | Any substance that helps preserve food or any other item is known as a preservative. Many chemicals help control microbial growth and are used as preservatives. Examples of chemical preservatives are sodium benzoate and potassium metabisulphite. These preservatives are used in squashes, sherbets, and ketchups. |
| Using salt, sugar, oil, or vinegar | Salt, sugar, oil, and vinegar create an environment that prevents microbial growth, and are, therefore, used for preserving foodstuffs such as meat, pickles, jams, jellies, and vegetables. In addition to preserving foodstuffs, these substances also impart flavour to them. |
| Pasteurization | Pasteurization involves heating a foodstuff to a high temperature and then cooling it rapidly. This helps in destroying harmful microbes without changing the composition, flavour, or nutritive value of the foodstuff. This process is named after the French chemist Louis Pasteur, who discovered it in the 19th century. Commercially available milk is first heated to a high temperature for about half a minute and then cooled rapidly. It is then stored at temperatures lower than 10°C. |

## Let's Remember

REMEMBERING UNDERSTANDING

**I. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Anopheles | a. Fungus |
| 2. Rust of wheat | b. Pathogens |
| 3. Communicable disease | c. Milk |
| 4. Chemical preservative | d. Ketchups |
| 5. Pasteurization | e. Malaria |

**II. Identify the causative pathogen and mode of transmission in each of the following diseases.**

| Disease | Causative pathogen | Mode of transmission |
|---|---|---|
| 1. Malaria | | |
| 2. Tuberculosis | | |
| 3. Common cold | | |
| 4. Poliomyelitis | | |

## Key Words

| | |
|---|---|
| **Microscope** | An instrument that makes use of lens to make smaller objects appear larger is called a microscope. |
| **Specimen** | The object to be viewed under the microscope is called a specimen. |
| **Microorganisms/Microbes** | Organisms that are visible only through a microscope are called microorganisms or microbes. |
| **Fermentation** | The process of conversion of a sugar into an acid or an alcohol by the action of microorganisms is called fermentation. |
| **Nitrogen cycle** | A natural cyclic process in which atmospheric nitrogen enters the soil and becomes a part of living organisms, before returning to the environment is called nitrogen cycle. |
| **Nitrogen fixation** | The process by which free atmospheric nitrogen is converted into nitrogen compounds is called nitrogen fixation. |
| **Pathogens** | Microorganisms that cause diseases in human beings, animals, and plants are called pathogens. |
| **Communicable diseases** | Diseases that can spread from one person to another are called communicable diseases. |
| **Food preservation** | The process of treating and handling food with an aim to stop or slow down its spoilage while maintaining its nutritional value, texture, and flavour is called food preservation. |
| **Pasteurization** | The food preservation method that involves heating a foodstuff to a high temperature and then cooling it rapidly is called pasteurization. |

## Summary

- Microorganisms can be divided into five major groups: bacteria, protozoa, fungi, algae, and viruses.
- Uses of microorganisms can be divided into four categories: commercial, medicinal, agricultural, and environmental.
- Harmful effects of microorganisms can be divided into two categories: causing diseases in human beings, animals, and plants and food spoilage.
- Pathogens enter the body of a healthy person through air, water, and food.
- Malaria, cholera, typhoid, and common cold are examples of communicable diseases in human beings.
- Foot and mouth disease, rinderpest, anthrax, and fin rot are examples of animal diseases caused by pathogens.
- Citrus canker, rust of wheat, apple scab, and loose smut are examples of plant diseases caused by pathogens.
- Microorganisms such as fungi and bacteria are responsible for the spoilage of various foodstuffs. Eating such foodstuffs can cause an illness called food poisoning.

- Common methods of food preservation are boiling, dehydration, refrigeration and freezing, canning, using chemical preservatives, using salt, sugar, oil, or vinegar, and pasteurization.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Fill in the blanks with the correct words.**

1. A _____ (microscopic slide/eyepiece lens) is used to hold a small sample of the specimen.
2. Some microbes live alone, while others grow in groups called _____ (specimens/colonies).
3. _____ (Chlamydomonas/Chlorella) is a unicellular algae.
4. Fermentation by yeast produces _____ (water and oxygen/alcohol and carbon dioxide).
5. Shells of _____ (diatoms/Chlorella) give a gritty texture to toothpaste and helps in cleaning teeth.
6. When a disease-causing microbe enters our body, substances called _____ (antibodies/vaccines) are produced.
7. _____ (Bacteria/Fungus) is used in the treatment of sewage.
8. _____ (Citrus canker/Rinderpest) is a plant disease caused by a pathogen.
9. Food _____ (cultivation/preservation) involves killing microbes or preventing their reproduction.
10. In _____ (freezing/canning), food items are stored in air tight cans to preserve them.

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

1. All microorganisms are harmful and cause diseases in plants and animals.
2. Pathogens enter the body of a healthy person through air and water only.
3. When antibiotics are injected within a human body, the body produces substances called vaccines.
4. In nature, nitrogen is fixed during lightning or by nitrogen-fixing bacteria and blue green algae.
5. When plants and animals die, sulphur in their bodies is decomposed and returned to the air.
6. Grazing by cattle causes a disease called fin rot.
7. Foul odour is the only symptom that shows that a food has become unfit for consumption.
8. Boiling involves removal of water from food items.
9. Pasteurization involves heating a foodstuff to a high temperature and then cooling it rapidly.
10. All diseases are communicable diseases, caused by pathogens.

**C. Choose the correct option.**

1. Which of these is a thin sheet of glass that is used to cover the sample viewed under a microscope?
   a. Slide  b. Coverslip  c. Stage  d. Mirror

2. Which of these refers to a spherical bacteria?
   a. Bacilli  b. Cocci  c. Vibrio  d. Spirillum
3. Which of these is the primary causative organism for swine flu?
   a. Protozoa  b. Bacteria  c. Virus  d. Fungi
4. Which of these microorganisms is used in the manufacture of alcoholic beverages?
   a. Bacteria  b. Virus  c. Fungi  d. Yeast
5. Which of these diseases can be prevented by a vaccine?
   a. Cholera and ringworm  b. Poliomyelitis and chicken pox
   c. Malaria and ringworm  d. All of these
6. Which of these is not true about bacteria?
   a. They are unicellular  b. They are of different shapes
   c. They are all harmful to us
   d. They are among the oldest organisms found on the planet
7. Which of these are microscopic plants like organisms with chlorophyll?
   a. Bacteria  b. Virus  c. Protozoa  d. Algae
8. Which of these found in milk coagulates to form curd?
   a. *Lactobacillus*  b. Casein
   c. Acid in milk  d. None of these
9. Which of these gets formed when fermentation takes place by yeast?
   a. Alcohol  b. Carbon dioxide and water
   c. Alcohol and carbon dioxide  d. Oxygen and water
10. Which of these microbes are commonly used in sewage treatment?
    a. Bacteria  b. Virus  c. Fungi  d. Algae

## II. Very short answer type questions

### A. Give one word for the following.

1. An instrument that makes smaller objects look larger _____
2. The object that is viewed under a microscope _____
3. Organisms that are visible only through a microscope _____
4. The protein present in milk _____
5. The process of conversion of a sugar into an acid or an alcohol _____
6. Medicines that destroy certain disease-causing microbes _____
7. The process by which free atmospheric nitrogen is converted into nitrogen compounds _____
8. A natural cyclic process in which atmospheric nitrogen enters the soil and leaves into the atmosphere _____
9. Disease-causing microorganisms _____
10. Disease caused by eating foodstuffs that can cause illness _____

## III. Short answer type questions

1. What is a microscope? What does it help us to view?
2. What are microorganisms? Name five major groups of microbes.
3. Where do fungi derive their nutrition from?
4. What is a virus? Give two examples of viruses.
5. What is an antibiotic?
6. What is a vaccine? Name two diseases that can be prevented by a vaccine.
7. Define nitrogen fixation.
8. What are pathogens? How do they get spread?
9. What are communicable diseases? Give two examples of communicable diseases in animals.
10. Define food preservation. Name any three methods of food preservation.

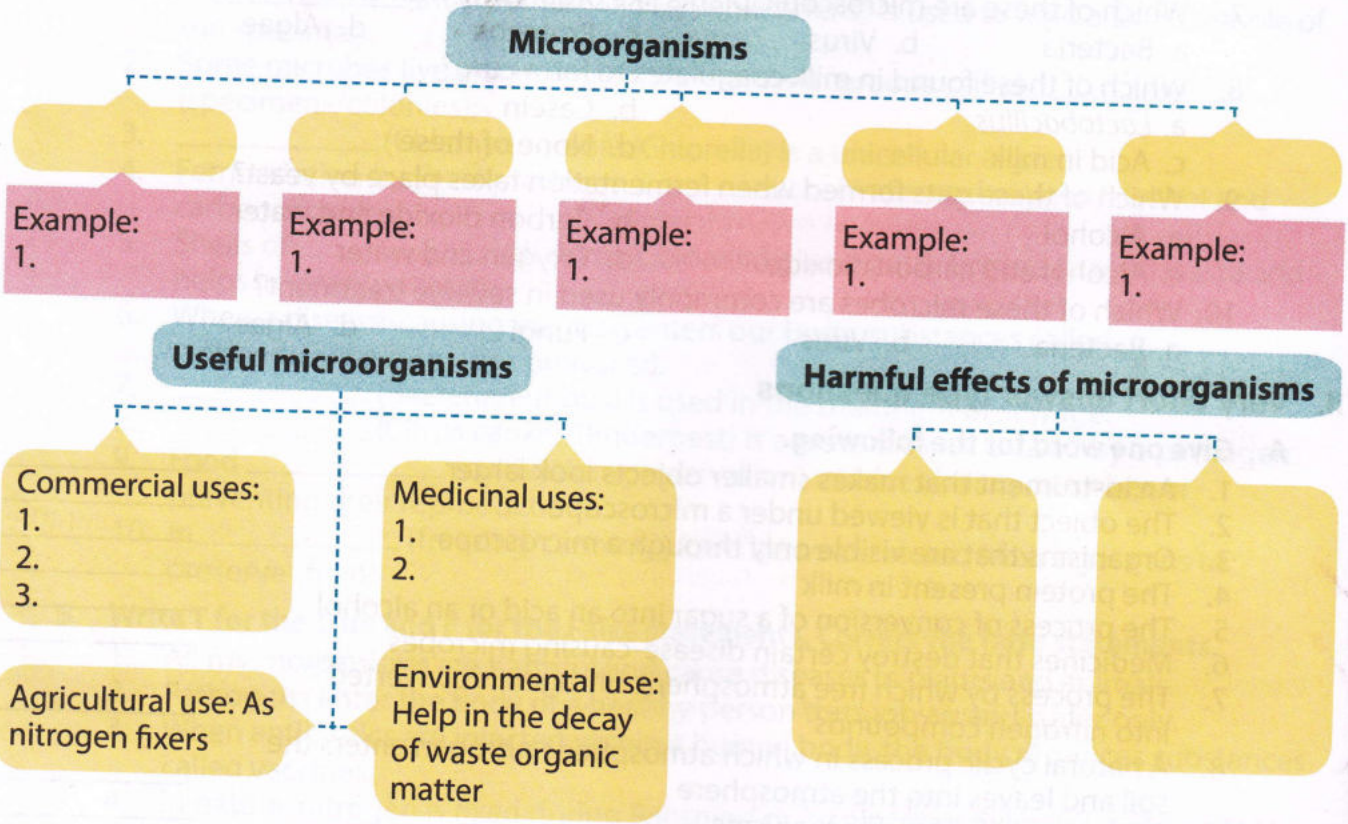
## IV. Long answer type questions

1. Explain how microscopic objects can be viewed under a microscope.
2. Discuss with examples some commercial uses of microorganisms.
3. How are microorganisms useful in the field of medicine?
4. With the help of a labelled diagram, describe the nitrogen cycle.
5. Describe briefly diseases caused by microbes in plants.
6. What is food poisoning? How do we detect whether a foodstuff is fit for consumption or not?
7. Write a short note on some common food preservation methods.

## LET'S RECALL

REMEMBERING

Recall and complete the concept map given below.




## LET'S OBSERVE

UNDERSTANDING

1. Is the orange shown here fit for consumption? Why?
2. Give any five features that help us to identify whether a food is fit for consumption or not.

a. _____ b. _____ c. _____

d. _____ e. _____

## LET'S CONNECT

ENGLISH

Maya forgot a vegetable sandwich and slices of orange in her tiffin box inside the school

bag over the weekend. In your own words, describe in what condition she would find the foodstuffs on Monday.

_____

_____

_____

_____

## LET'S APPLY

1. Pooja forgot a few slices of bread in a bread box for a few days.
   a. What could she expect to grow on the bread? _____
   b. Where did the spores for these microorganisms to grow on them come from? _____
   c. What could she have done to save those slices of bread? _____
2. Mother is trying to make curd at home. Will it be more difficult to make it in summer or winter months? Why?

## LET'S ANALYSE AND EVALUATE


1. Analyse which of the items shown here would the baker need to make his buns. Give a reason for your choice.
2. Assess why the chosen microorganism is first added to warm water and sugar, before using it to make bread.

## LET'S CREATE

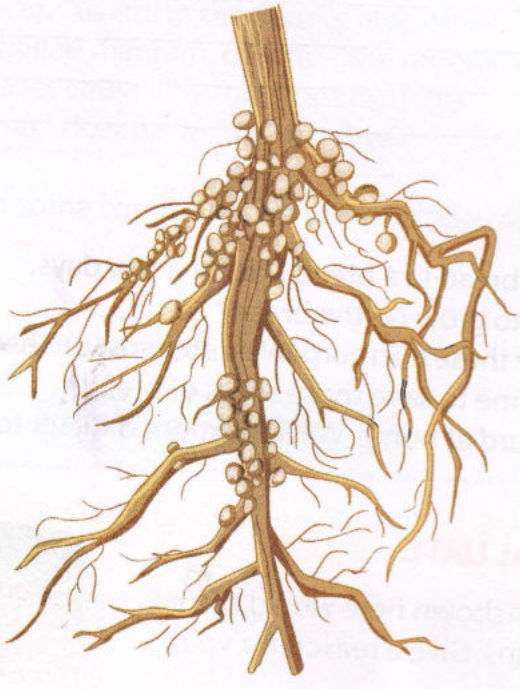
1. Take one drop of water from a vase that has had some flowers over a period of time. With the help of your teacher, make a slide and then view it under a microscope. Draw what all you see. Can you identify what you saw? LO 8 LO 11
2. In groups of five, grow bread mould on a moist slice of bread over a few days. Then pick a small sample of the mould and make a slide. Then view it under a microscope and draw what you see. LO 8 LO 4
3. In groups of five, collect pictures of the various microbes, and make a chart on either their usefulness or harmfulness. LO 4
4. With the help of plasticine, make models to depict bacteria of different shapes. Discuss it in class. LO 14

### Web Research

1. Find out how vaccines help us stay safe from many communicable diseases. Find out how vaccines were discovered and write a story on it, in your own words, using the information collected. Some suggested websites are:
   https://microbiologyonline.org/about-microbiology/microbes-and-the-human-body/vaccination (accessed and checked on 12/08/2019)
2. Find out how microbes find their usage in various industries and are helping in our daily life. Make a PowerPoint presentation to show the information collected. Some suggested websites are:
   http://faculty.ccbcmd.edu/courses/bio141/lecguide/unit1/bgm/bgm.html (accessed and checked on 12/08/2019)
   https://microbiologyonline.org/about-microbiology/introducing-microbes (accessed and checked on 12/08/2019)

# Worksheet 1

**Skills assessed:**
Problem solving and thinking skills



1. Which of these could be the most probable plant shown above?
   a. Cereal
   b. Leguminous plant
   c. Rabi plants
   d. Kharif plants
2. Which of these do the roots of this plant play a role in?
   a. Carbon cycle
   b. Nitrogen cycle
   c. Oxygen cycle
   d. Ozone cycle
3. Prabha says that farmers grow these plants after every harvest of rice plants. Could she be right? _____ What is this agricultural practice known as? _____
4. Which of these is present in the roots of these plants?
   a. Algae
   b. Fungi
   c. Rhizobium
   d. Yeast
5. These organisms help in fixing _____ (carbon dioxide/ nitrogen) from the atmosphere.


Teacher facilitation required*

# Activity

**Skills learnt:**
Collaborating, Critical thinking, Creating, and Communicating

**Aim:** In groups of five, try and understand how onions get spoilt by microbes, and view microbes under a microscope. Then, devise a method by which onions could be preserved for a longer time.

**Materials required:** Onions, a kitchen knife, forceps, slide, coverslip, glycerine, and microscope

**Method:**

1. Clean the onions, and then trim the ends of each.
2. Wash them with water and leave them in a plate overnight.
3. Observe any changes.
4. Keep these onions covered on a plate for a week and see what starts growing on them.
5. Peel a small specimen of the growth and make a slide and observe it under a microscope.

**Observe, discuss, and answer the following questions.**

1. Make a list of all the things that you need to view microbes under a microscope.

   _____

2. What were the challenges you faced while making and viewing the slide?

   _____

3. Draw what you see grown on the onion under a microscope.

4. How could you have preserved these onions at home, for a longer time? Discuss and write the steps.

   _____

   _____

5. Could you have used something already available in the kitchen to store the onions for almost a year? How? Describe the process.

   _____ _____ _____

   _____ _____

6. Can you list any five other foodstuffs you can preserve like this?

   a. _____ b. _____

   c. _____ d. _____

   e. _____

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

UNIT 2: MATERIALS

# 3 Synthetic Fibres and Plastics

**You will learn about**

- Synthetic fibres
- Plastics

Most clothing materials or fabrics we use in our day-to-day lives are made from thin, thread-like fibres. Fibres can be either natural or artificial.

Identify and write the names of different fabrics in the picture given below. Also write **P** for the fabrics obtained from plants and **A** for the those obtained from animals.

1. C_TT_N SCARVES ☐

2. __UT__ BAG ☐

3. W_ _LL_N GLOVES ☐

4. S_ _K TIES ☐

Natural fabrics have been used for clothing since ancient times. But nowadays, synthetic fibres are largely used for clothing and other purposes.

Let us learn about synthetic fibres and their uses.

Answer: 1. Cotton, 2. Jute, 3. Woollen, 4. Silk

## SYNTHETIC FIBRES

LL

*Fibres that are made by human beings are called* ***synthetic fibres***. Most synthetic fibres are obtained from coal, petroleum, and natural gas. A synthetic fibre consists of multiple units (each of which is a chemical substance), which are joined together to form a single unit called a *polymer* (*poly*, many; *mer*, unit). The structure of a polymer can be described as resembling numerous beads on a string, with each bead representing an individual unit that is joined to other such units.

Rayon, nylon, polyester, acrylic, and spandex are examples of synthetic fibres.

### Rayon

Rayon, also called *artificial silk*, is prepared from cellulose (which comes from wood pulp).

#### Properties

- It absorbs sweat. Rayon clothes are, therefore, preferred over other synthetic fibres in summer.
- It is shiny and lustrous and resembles silk in appearance.

#### Uses

Rayon is used for making suits, jackets, scarves, ties (Fig. 3.1), home furnishing (bed sheets, curtains, tablecloths, sofa covers, etc.), and bandages.

**Fig. 3.1** *Rayon ties*

### Nylon

Nylon was the first true synthetic fibre. It was first produced in the early 1930s by the scientists at the DuPont Company from coal, water, and air.

#### Properties

- It is elastic and does not lose strength even after repeated use.
- It is lustrous and easy to wash.
- It is waterproof.

#### Uses

Nylon is used for making socks, stockings, tents, umbrellas, parachutes, and tarpaulins. Nylon fibres are used for making toothbrush bristles. Due to their high strength and elasticity, nylon threads are used for making fishing nets, climbing ropes, and strings of badminton and tennis racquets (Fig. 3.2).

**Fig. 3.2** *Strings of a tennis racquet are made of nylon.*

### Polyester

Polyester is a group of different synthetic fibres. The most commonly used polyester is Terylene. It is blended with natural fibres to improve its properties. Terrycot, a blend of Terylene and cotton, has better absorbing power as compared to Terylene. Terylene is blended with wool to make Terrywool, which is warm in addition to all the characteristics observed in polyesters.

### Properties

- It is strong, lightweight, and has good elasticity.
- It resists wrinkling and springs back into shape when creased.
- Polyester fabrics can be washed and dried easily and quickly.

> **Word help**
>
> **Elasticity** Ability of a material to return to its original shape after it has been stretched or compressed

### Uses

Polyester is used for making lightweight sails (Fig. 3.3). Polyester films (commonly known as Mylar) are used for making magnetic recording tapes in audio cassettes, video cassettes, and floppy disks. Terylene is used for making conveyor belts as it is very elastic. Terrycot is commonly used for making shirts, skirts, and other dress materials. Terrywool is used for making formal suits.

**Fig. 3.3** *Sails made of polyester*

## Acrylic

Acrylic fibres, also known as Orlon and Acrilan, closely resemble wool.

### Properties

- It is warm, soft, light, and flexible.
- It is resistant to moths and chemicals.

### Uses

Acrylic is used for making sweaters, socks, shawls, carpets, and blankets.

## Spandex

Spandex, also known as *Lycra*, was invented by the DuPont chemist Joseph Shivers in 1959.

### Properties

- It has excellent elasticity, which makes it suitable for use in clothes that require snug fitting.

### Uses

Spandex is used for making swimming costumes. It is often mixed with other fibres, such as cotton, to get stretch fabrics, which are used for making caps, T-shirts, shorts, and other sports wear.

## Advantages of Synthetic Fibres

Synthetic fibres have the following advantages.

- Most synthetic fibres have good elasticity.
- Most fabrics made of synthetic fibres do not wrinkle easily.
- Fabrics made of synthetic fibres are generally more durable, less expensive, and more readily available than those made of natural fibres.
- Most synthetic fibres can handle heavy loads without breaking.

## Activity

**Aim:** To compare the strength of different fibres
**Materials needed:** Weight box with different weights (1–100 g), iron stand with clamp, hook or pan, thin threads of nylon, wool, cotton, and silk (of same length and almost equal thickness)
**Method:**

1. Tie one end of the nylon thread to a hook or pan and the other end to the clamp (Fig. A).
2. Put a small weight on the hook/pan (Fig. B).
3. Keep on increasing the weight till the thread breaks (Fig. C). Note the total weight required to break the thread.
4. Repeat the procedure with the other threads.

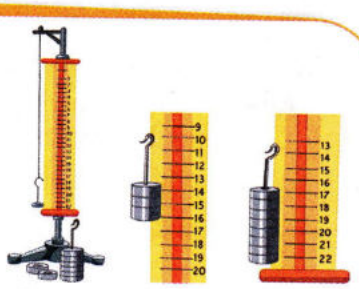


Fig. A Fig. B Fig. C

**Observation:** More weight is required to break the nylon thread as compared to the others.
**Conclusion:** The thread that breaks at the maximum weight (nylon) is the strongest.

## Disadvantages of Synthetic Fibres

Synthetic fibres have the following disadvantages.

- Most fabrics made from synthetic fibres require careful ironing as they melt easily.
- Most fabrics made from synthetic fibres absorb very little moisture. They become sticky when the body sweats, which makes them uncomfortable to wear in hot weather.
- Most fabrics made from synthetic fibres catch fire very easily. Therefore, it is dangerous to wear them near a source of fire (e.g., while working in the kitchen).

## Activity

**Aim:** To compare the water-absorbing capacity of fabrics made from natural and synthetic fibres
**Materials needed:** Two cloth pieces of equal size (one made of cotton and the other of nylon) and two beakers/mugs containing equal amounts of water
**Method:**

1. Soak each cloth piece in a different beaker/mug.
2. After 5 minutes, take out the cloth pieces and observe the water remaining in the beakers/mugs.

**Observation:** More water is left in the beaker/mug in which the nylon cloth was soaked.
**Conclusion:** Nylon absorbs less water as compared to cotton.

## Let's Remember


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

1. A synthetic fibre consists of multiple units, which are joined together to form a single unit called a polymer.
2. Polyester was the first true synthetic fibre.

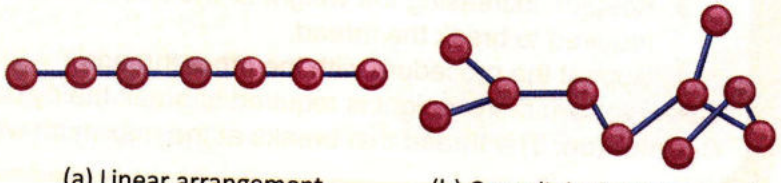
3. Spandex closely resembles wool.
4. Terrycot is a blend of Terylene and wool.
5. Most synthetic fibres can handle heavy loads without breaking.

**II. Answer the following questions orally.**

1. Name the substances used to obtain synthetic fibres.
2. Which fibre is also known as Orlon?

## PLASTICS

Like synthetic fibres, plastics are also polymers. Plastics form an important class of synthetic materials. In plastics, the arrangement of the individual units may be linear or cross-linked (Fig. 3.4).



(a) Linear arrangement (b) Cross-linked arrangement

**Fig. 3.4** *Simplified representation of arrangement of individual units in plastics*

Cross-linked polymers have side chains or cross-links, which connect different polymer chains. These can be of two types: thermoplastics and thermosetting plastics (Table 3.1).

**Table 3.1** Differences between thermoplastics and thermosetting plastics

| Thermoplastics | Thermosetting plastics |
|---|---|
| 1. Linear and lightly cross-linked polymers form a class of plastics called thermoplastics. | 1. Heavy cross-linking polymers after shaping the plastic forms a class of plastics called thermosetting plastics. |
| 2. Thermoplastics can be melted by heating and thereafter moulded into desired shapes. This is a reversible process. | 2. Unlike thermoplastics, thermosetting plastics cannot be remoulded after reheating. |
| 3. PVC (polyvinyl chloride ) and LDPE (low-density polyethylene) are examples of thermoplastics. | 3. Melamine and bakelite are examples of thermosetting plastics. |

### Uses of Plastics

LL

Since most plastics can be easily moulded into any shape after heating, they are used for making a variety of objects of different shapes and sizes.

Different types of plastics that we come across in our daily lives and their uses are mentioned in Table 3.2.

**Table 3.2** Plastics and their uses

| Plastic | Uses |
|---|---|
| PET (Polyethylene terephthalate) | Making containers for microwave cooking, bottles of carbonated beverages, water bottles, and other food containers |
| HDPE (High-density polyethylene) | Making containers for strong and corrosive household and industrial chemicals such as bleaches and acids |
| LDPE (Low-density polyethylene) | Making polybags, grocery bags, and packaging of foods and bread |
| PVC (Polyvinyl chloride) | Making pipes for sanitary fittings (like water pipes) |
| PP (Polypropylene) | Making ketchup bottles, yogurt containers, medicine bottles, and automobile battery casings |
| PS (Polystyrene) | Thermocol, a form of PS, is used for making disposable cups and packaging material for fragile items such as computers and televisions |

## General Properties of Plastics

Although different types of plastics differ in some physical and chemical properties, the following properties are common to most of them.

***Thermal conductivity*** Plastics have low thermal conductivity (i.e., they are poor conductors of heat). This makes them suitable for

- making handles of cooking vessels,
- use in refrigerators (as foam core), and
- making containers used in microwave ovens.

***Electrical conductivity*** Plastics are poor conductors of electricity. This is why they are used as covering materials in electrical appliances, cords, electrical outlets, and wiring.

***Solubility in water*** Plastics are insoluble in water and are, therefore, used for making bottles, buckets, and other containers used for storing water.

***Effect of flame*** Most plastics are inflammable (i.e., they catch fire easily).

***Reactivity*** Plastics do not corrode or rust and are, therefore, used in homes for storing food and in laboratories for storing chemicals such as acids and bleaches.

### Tech Specs

3D printing uses a printer to create three-dimensional objects. 3D printing is being widely used in various fields such as medicine, dentistry, architecture, aerospace modelling, and automobile engineering. Aircraft equipment produced using 3D printers are almost 60–65% lighter and equally strong. In the field of medicine, experts have developed 3D-printed skin for burn victims, facial reconstruction parts for cancer patients, orthopaedic implants, and prosthetics.

## Plastics and the Environment

Despite the many different uses of plastics, there are environmental and health hazards

associated with their disposal. This is because plastics are *non-biodegradable*. That is, they cannot be decomposed by microorganisms. Accumulation of plastics is considered a serious problem because most of the methods used to dispose them result in some type of damage to the environment.

Plastics accumulated on land blocks the rainwater from seeping into the ground. This not only prevents plants from receiving water, but also depletes the groundwater. Plastics can also block water bodies, and harm aquatic organisms. Moreover, burning of plastics releases toxic gases into the atmosphere, which may cause air pollution.

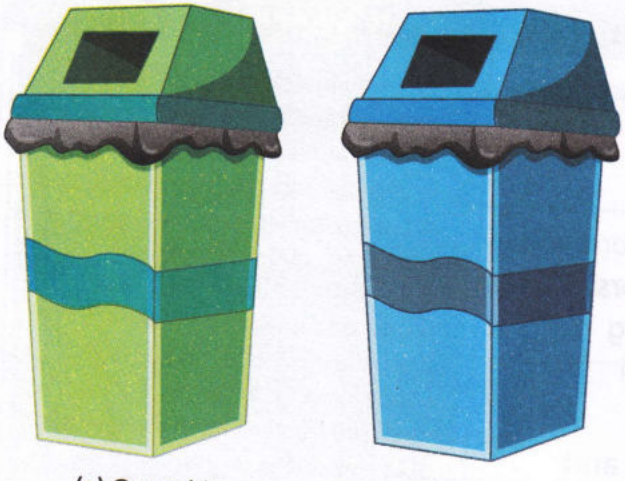
Reducing the usage of plastics and recycling plastic objects are two ways of countering the harmful effects associated with plastic disposal. Recycling of plastic objects involves collecting, sorting, and processing plastic waste with an aim to reuse the material in manufacturing other products. For instance, PET soft drink bottles could be melted down and the resulting material could be spun into fibres to make fabrics for jackets and fibre for sleeping bags.

**Fact File**

Somewhere between 500 million to one trillion plastic bags are consumed worldwide each year. Every piece of plastic made till date has still not begun to decompose as it takes 450 years for plastic to begin decomposing and then up to another 80 years for it to disappear completely.

**Green corner**

Scientists have been able to make environment-friendly biodegradable bioplastics from natural materials such as vegetable oil and corn starch. Bioplastics are especially useful for making disposable items such as packaging and catering items.



(a) Green bin (b) Blue bin

**Fig. 3.5** *Types of bins*

To aid recycling of plastic garbage, two types of bins are made available by the municipality: a green bin and a blue bin (Fig. 3.5). Biodegradable wastes such as food items should be thrown in the green bin. Recyclable wastes such as plastic and glass should be thrown in the blue bin.

**Let's Discuss**

Discuss how minimal use of plastics would help in making the environment better.

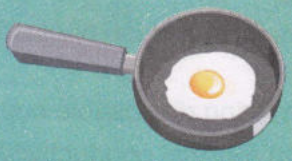
A few things that can be done to limit the harmful effects associated with plastics are as follows.

- Do not accept plastic bags when you go out for shopping. Instead, ask for paper bags or carry a reusable cloth bag with you.
- Reuse the plastic bags that you have at home.
- Do not throw plastic wastes at roadside or in water bodies. Look for proper garbage bins to dispose them.

- Use separate garbage bins at your home and school for biodegradable and non-biodegradable wastes.

The poster (Fig. 3.6) given below briefly discusses the harmful effects of plastic disposal and some ways to limit them.

## Tech Specs

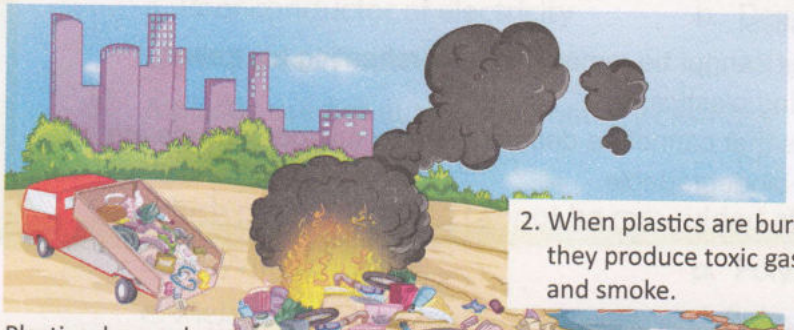


Teflon is the brand name of polytetrafluoroethylene, a type of plastic discovered by Roy Plunkett of Kinetic Chemicals in 1938. It does not stick to materials easily and has a high melting point. Due to these properties, Teflon coatings are widely used in non-stick cooking pans and other cookware.

## Green corner

Plastics are collected from homes and garbage dumps by *kabadiwalas*. This waste plastic is recycled in our country using unscientific techniques that release toxic carcinogens in the atmosphere. Banyan nation is a Hyderabad-based start-up founded by Mani Vajipey and Raj Madangopal that has integrated with all the informal recyclers (*kabadiwalas*). It collects the plastic from them and uses scientific methods to segregate them accurately. Then after the process of separation, plastic is recycled by scientific techniques which produces plastic pellets of high quality and are sold out. The state of Telangana state has tied up with the Banyan nations to adopt effective and cost-efficient waste management platform across the state.

1. Plastics that get buried prevent rainwater from seeping into the ground. This water forms muddy puddles on the surface. This also affects the plants growing in the area as they do not get enough water from the soil.



2. When plastics are burned, they produce toxic gases and smoke.

3. Plastics dumped in water bodies pose a threat to aquatic life as toxic substances present in them can cause reproductive failure in fish and other aquatic organisms.

We should always reduce, reuse, and recycle plastic materials.

4. Most plastic wastes end up littering roadsides and form ugly dumps that harbour many disease-causing organisms.

**Fig. 3.6** *Harmful effects associated with plastic disposal and some ways to limit their harmful effects*

## Let's Remember


**I. Fill in the blanks with the correct words.**

1. Linear and lightly cross-linked polymers form a class of plastics called _____ (thermosetting plastics/ thermoplastics).
2. _____ (PVC/PS) is used for making disposable cups.
3. Plastics have _____ (low/high) thermal conductivity.
4. Plastics are _____ (biodegradable/non-biodegradable).

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

1. Melamine and Bakelite are examples of thermoplastics.
2. Plastics are soluble in water.
3. PET is used for making sanitary fittings.
4. The harmful effects associated with plastic disposal can be countered by recycling and reducing the usage of plastics.

## Key Words

| | |
|---|---|
| **Synthetic fibres** | Fibres that are made by human beings are called synthetic fibres. |
| **Thermoplastics** | Plastics that can be reheated and remoulded are called thermoplastics. |
| **Thermosetting plastics** | Plastics that cannot be remoulded after reheating are called thermosetting plastics. |
| **Non-biodegradable** | Substances that cannot be decomposed by microorganisms are called non-biodegradable. |

## Summary

- A synthetic fibre consists of multiple units joined together to form a single unit called a polymer.
- Rayon, nylon, polyester, acrylic, and spandex are some examples of synthetic fibres.
- Like synthetic fibres, plastics are also polymers. In plastics, the arrangement of individual units may be linear or cross-linked.
- Since most plastics can be moulded into any shape after heating, they can be used for making a variety of objects of different shapes and sizes.
- Some important types of plastics are PET, HDPE, LDPE, PVC, PP, and PS.
- Plastics are poor conductors of heat and electricity, are insoluble in water, inflammable, and do not corrode or rust.
- Disposal of plastics is considered an environmental hazard because plastics are non-biodegradable substances.
- Reducing the usage of plastics and recycling plastic objects are two ways of countering the harmful effects associated with plastic disposal.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. Which of the following is not a synthetic fibre?
   a. Spandex  b. Cotton  c. Nylon  d. Acrylic
2. A synthetic fibre used for making fishing nets and strings of badminton and tennis racquet:
   a. Rayon  b. Spandex  c. Acrylic  d. Nylon
3. Which of the following is a characteristic of a synthetic fibre?
   a. Good conductor of electricity  b. Wrinkle resistant
   c. High moisture absorbing capacity  d. Poor elasticity
4. Which of the following is a property of a plastic?
   a. Poor conductor of electricity  b. Does not corrodes or rusts
   c. Insoluble in water  d. All of these
5. A plastic used as automobile battery casings:
   a. PP  b. LDPE  c. PS  d. PVC
6. Which of the following cannot be remoulded after heating?
   a. Polyvinyl chloride  b. Polypropylene
   c. Melamine  d. Polystyrene
7. Which of the following fibres are used for making conveyor belts?
   a. Rayon  b. Terylene  c. Cotton  d. Acrylic
8. Which of the following fabrics is waterproof?
   a. Nylon  b. Rayon  c. Spandex  d. Wool
9. Polypropylene is used for making
   a. ketchup bottles  b. yogurt containers
   c medicine bottles  d. All of these
10. Which of the following are harmful effects associated with plastic disposal?
    a. Reproductive failure in fish and other aquatic organisms
    b. Burning of plastics produce toxic gases and smoke
    c. Plastics that get buried prevent rainwater from seeping into the ground
    d. All of them

**B. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Rayon | a. Lightweight sails |
| 2. PET | b. Containers for bleaches and acids |
| 3. Polyester | c. Containers for microwave cooking |
| 4. HDPE | d. Polybags |
| 5. Acrylic | e. Home furnishing |
| 6. LDPE | f. Sweaters, carpets, and blankets |

## II. Very short answer type questions

**A. Give one word for the following.**

1. A fibre also known as artificial silk _____
2. A synthetic fibre used for making swimwear _____
3. Lycra is the other name of _____
4. Plastic that have heavy cross-linking _____
5. Substances that cannot be decomposed by microorganisms _____

## III. Short answer type questions

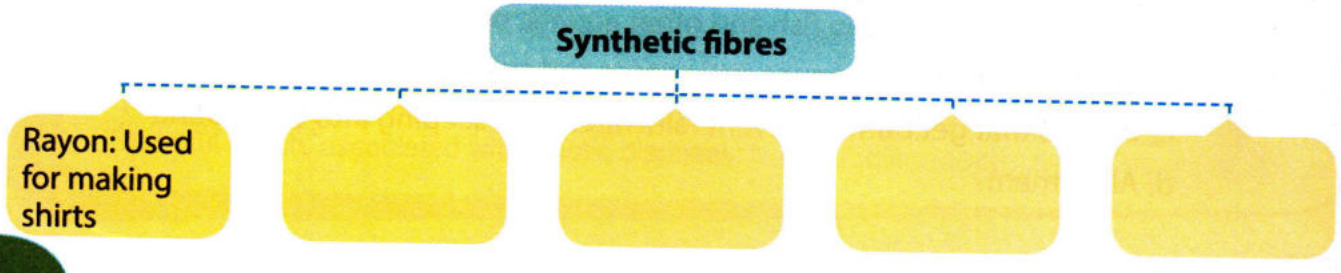
1. What are synthetic fibres? Give two examples.
2. State the relevant property of the fibre used in the following:
   a. Nylon threads are used for making fishing nets and climbing ropes.
   b. Spandex is used in clothes that require snug fitting.
3. What do the following stand for: PVC, LDPE, and PS? Write two uses of each.
4. State any two harmful effects associated with the disposal of plastics.
5. Suggest any two ways for reducing the harmful effects associated with plastic disposal.

## IV. Long answer type questions

1. Write any three advantages and disadvantages of synthetic fibres.
2. Differentiate between thermoplastics and thermosetting plastics. Give two examples of each.
3. Discuss the general properties of plastics with relevant applications of the property in daily life.

## LET'S RECALL


Recall and complete the concept map given below.



**Types of plastics**

**General properties of plastics**

1. Plastics are poor conductors of heat.
2.
3.
4.
5.

## LET'S OBSERVE

UNDERSTANDING LO 1

Which fibre would commonly be used in making each of the following things? Write in the space provided.

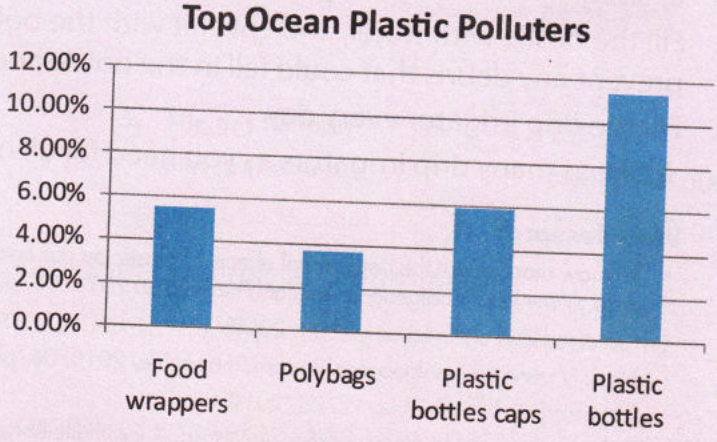
1. _____ 2. _____ 3. _____

## LET'S CONNECT

MATHS

The top plastic polluters of the oceans are represented with the help of the bar graph given here. On the basis of the bar graph, answer the following questions.

1. Which form of plastic is the major contributor to the ocean pollution?
2. Arrange the various plastic polluters in order of increasing percentage.
3. How is aquatic life affected by plastics dumped in the oceans?
4. How do you think plastic objects reach the oceans?



## LET'S APPLY

1. Why are HDPE containers used for storing acids and bleaches instead of metal containers? (*Hint:* characteristics of plastics)
2. Why are plastics preferred for making toasters, electric kettles, and hair dryers? (*Hint*: characteristics of plastics)

## LET'S ANALYSE AND EVALUATE

1. Every country in the world is facing problems due to the pollution and degradation of environment. Analyse how plastic has become one of the major contributors to this problem?
2. Evaluate paper bags versus polybags on the following parameters: strength, cost, reusability, impact on environment, and pollution, and then choose which of the two could be a better choice for fruits and vegetable vendors. LO 11

## LET'S CREATE LO 10

**Drip Irrigator**

*The method of watering roots of the plants drop by drop is called drip irrigation.*

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.

**Method**

1. Take a 2-litre PET bottle and wash it thoroughly with water.
2. Remove the cap of the bottle. Make several holes into it using a nail and hammer. The flow of the water will depend on the size and number of holes.
3. Cap the bottle and cut approximately an inch of the bottom of the bottle.
4. Dig the soil close to the plant (4 to 6 inches away) to fit the bottle halfway into it. Be careful not to cut through the roots of the plant.
5. Place the bottle cap-side down into the dug area and add soil around bottle to snugly fit it into the dug area.
6. Fill the bottle with water, and cover it with the bottom of the bottle to prevent any debris that could fall in the bottle and clog the system.
7. Fill the drip irrigator every day.
8. Make as many drip irrigators as you need for all of your plants.

**Web Research**

- To know more about the detrimental effects of plastic on our environment, browse through the following websites:
  https://www.nationalgeographic.com/magazine/2018/06/plastic-planet-solutions-waste-pollution/
  (accessed and checked on 12/08/2019)
  https://www.nationalgeographic.com/magazine/2018/06/plastic-planet-waste-pollution-trash-crisis/
  (accessed and checked on 12/08/2019)
- To know more about the properties of Natural & Synthetic fibres, browse through the following website:
  https://hubpages.com/living/Truth-About-Fabrics
  (accessed and checked on 12/08/2019)

# 4 Metals and Non-Metals

Different elements have different properties. These properties can make these elements suitable for various purposes.

Look at the pictures given below. Fill in the missing letters to identify the various elements that are present in our surroundings.

**You will learn about**

- Physical properties of metals and non-metals
- Chemical properties of metals and non-metals
- Uses of metals and non-metals

1. The pencil lead is made of G__ __P__ __T__.
2. The earrings are made of G__ __ __.
3. The gas balloon flies in the air due to H__ L__U__ gas.
4. The green plants give out O__ Y__ __ N gas.

Elements can be classified into two broad categories: *metals* and *non-metals*.

Aluminium, mercury, and gold are examples of metals. Diamond, graphite, helium, and oxygen are examples of non-metals.

Let us learn about physical and chemical properties of metals and non-metals.

Answers: 1. Graphite 2. Gold 3. Helium 4. Oxygen

## PHYSICAL PROPERTIES OF METALS AND NON-METALS

LL

Physical properties include physical state, lustre, colour, hardness, malleability, ductility, thermal conductivity, electrical conductivity, and sonority.

### Physical State

***Metals*** Almost all metals are solids at room temperature. Mercury is an exception because it is known to occur in a liquid state at or near room temperature.

***Non-metals*** Almost all non-metals are solids or gases at room temperature. *Bromine* is the only non-metal that exists as a liquid at room temperature.

### Lustre

***Metals*** 'Lustre' or a shiny surface is a property of most metals. This is because metals can be polished. Because of their ability to shine and reflect light, metals such as gold, silver (Fig. 4.1), and platinum are used for making jewellery and other decorative articles.

(a) Objects made of silver (b) Gold jewellery

**Fig. 4.1** *Metals with lustre*

***Non-metals*** Almost all non-metals have a dull surface. As most of them occur as powders and gases, they cannot be polished like metals. *Graphite* (a form of carbon) and *iodine* do show some lustre.

### Colour

***Metals*** Most metals are white or silvery-grey. There are, however, a few exceptions. For example, *gold* is yellow and *copper* is reddish-brown.

***Non-metals*** Some non-metals are colourless while some are coloured. For example, chlorine is a greenish-yellow gas, bromine is a brown liquid, iodine is a violet solid, and oxygen and nitrogen are colourless gases.

### Hardness

***Metals*** Most metals are hard but some (e.g., *sodium* and *potassium*) are so soft that they can be cut with a knife.

***Non-metals*** Non-metals are generally soft. Diamond, a form of carbon, is an exception. It is the hardest substance known (Fig. 4.2).

**Fact File**

An ounce of gold can be hammered to an unimaginable thinness of one hundred thousandth of an inch!

### Malleability

***Metals*** Most metals can be beaten into thin sheets or foils. *The property by virtue of which metals can be beaten into thin sheets is called* ***malleability***. Gold and silver are the most malleable metals known. This is what helps jewellery

**Word help**

**By virtue of** On the basis of

designers create intricately carved bangles, chains, and decorative articles in gold and silver. Other metals that can be beaten into sheets include aluminium (Fig. 4.3), iron, copper, and tin.

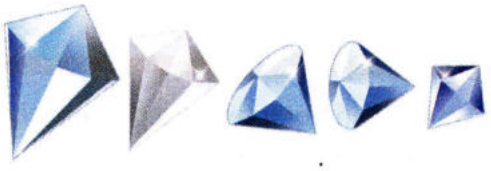


**Fig. 4.2** *Diamond is the hardest substance known.*

**Fig. 4.3** *Aluminium foil*

***Non-metals*** Non-metals are brittle and cannot be beaten into sheets or foils.

**Word help**

**Brittle** Easily broken

## Activity

**Aim:** To show that metals are malleable and non-metals are brittle
**Materials needed:** Small samples of easily available metals (e.g., aluminium wire, iron nail, copper wire, etc.) and non-metals (e.g., graphite and charcoal) and a hammer
**Method:** Pound the objects one by one with the help of the hammer.
**Observation:** Metal objects get flattened upon hammering while non-metals break.
**Conclusion:** Metals are malleable, whereas non-metals are brittle.
***Note:*** Adult supervision required.

## Ductility

***Metals*** Most metals can easily be drawn into thin wires. *The property by virtue of which metals can be drawn into thin wires is called* ***ductility***. Gold and silver are two of the most ductile metals known. Other metals that can be drawn into wires include copper, aluminium, and tungsten.

***Non-metals*** Non-metals are brittle and cannot be drawn into wires.

## Thermal Conductivity

***Metals*** Metals are good conductors of heat and are, therefore, used for making cooking utensils. Silver is the best conductor of heat, followed by copper.

***Non-metals*** Non-metals are generally poor conductors of heat. Diamond, which is a good conductor of heat, is an exception.

**Let's Discuss**

Can a wire be drawn out of wood? Give reasons for your answer.

## Electrical Conductivity

***Metals*** Metals are good conductors of electricity and are, therefore, used for making electrical wires and cables.

***Non-metals*** Non-metals are generally poor conductors of electricity. Graphite, which is a good conductor of electricity, is an exception.

## Activity

**Aim:** To show that metals and graphite are good conductors of electricity and other non-metals are poor conductors

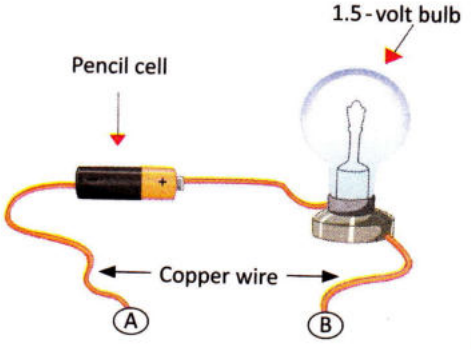
**Materials needed:** Small samples of easily available metals (e.g., aluminium wire, iron nail, and copper wire) and non-metals (e.g., graphite and charcoal), a copper wire cut into three pieces, a pencil cell, and a 1.5-volt bulb

**Method:**

1. Set up the apparatus as shown in the figure.
2. Connect the two free ends (A and B) of the copper wire to the objects, one by one.

**Observation:** The bulb glows when metals and graphite are connected to the free ends of the copper wire, but not for other non-metals.

**Conclusion:** Metals and graphite are good conductors of electricity whereas non-metals are poor conductors.




## Sonority

***Metals*** When metal pipes strike each other, they produce a ringing sound. *The property by virtue of which metal objects produce a ringing sound when struck with a hard object is called* ***sonority***. Objects such as wind chimes and bells make use of this property of metals.

***Non-metals*** Non-metals produce a dull sound when struck with a hard object.

## Let's Remember

REMEMBERING UNDERSTANDING

**I. Fill in the blanks with the correct words.**

1. _____ (Iodine/Bromine) is a metal that exists as a violet solid at room temperature.
2. Non-metals are generally _____ (good/poor) conductors of heat.
3. Metals are _____ (malleable/brittle).

**II. Answer the following questions orally.**

1. What is malleability?
2. Which property of metals enables them to be used for making objects such as wind chimes and bells?
3. Which metal is the best conductor of heat?
4. Which non-metal is a good conductor of electricity?

## CHEMICAL PROPERTIES OF METALS AND NON-METALS

TD

Chemical properties of metals and non-metals can be divided into five categories: reaction with oxygen, reaction with water, reaction with acids, reaction with bases, and displacement reactions.

## Reaction with Oxygen

### Metals

Most metals combine with oxygen to form metal oxides.

**metal + oxygen ⟶ metal oxide**

- Sodium reacts vigorously with the oxygen present in air to form sodium oxide. As a result, it catches fire if left in open. It is, therefore, kept immersed in kerosene.

$$\underset{\text{sodium}}{4Na} + \underset{\text{oxygen}}{O_2} \longrightarrow \underset{\text{sodium oxide}}{2Na_2O}$$

- Magnesium, on heating, burns in air (oxygen) with a dazzling white light to form magnesium oxide.

$$\underset{\text{magnesium}}{2Mg} + \underset{\text{oxygen}}{O_2} \longrightarrow \underset{\text{magnesium oxide}}{2MgO}$$

The metallic oxides formed are basic in nature and turn red litmus solution blue.

### Non-metals

Non-metals such as carbon, sulphur, and phosphorus react with oxygen to form non-metallic oxides. These oxides are also called acidic oxides as they form acids when dissolved in water.

**Word help**

**Pungent** Having a strong, sharp smell

**non-metal + oxygen ⟶ non-metallic oxide**

- Carbon burns in air (oxygen) to form carbon dioxide.

$$\underset{\text{carbon}}{C} + \underset{\text{oxygen}}{O_2} \longrightarrow \underset{\text{carbon dioxide}}{CO_2}$$

- Sulphur burns in air (oxygen) to form a pungent, suffocating gas called sulphur dioxide.

$$\underset{\text{sulphur}}{S} + \underset{\text{oxygen}}{O_2} \longrightarrow \underset{\text{sulphur dioxide}}{SO_2}$$

These oxides dissolve in water to form acids. They turn blue litmus solution red.

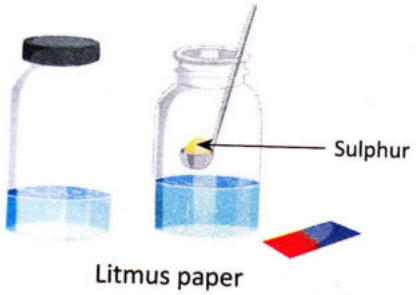
$$\underset{\text{carbon dioxide}}{CO_2} + \underset{\text{water}}{H_2O} \longrightarrow \underset{\text{carbonic acid}}{H_2CO_3}$$

$$\underset{\text{sulphur dioxide}}{SO_2} + \underset{\text{water}}{H_2O} \longrightarrow \underset{\text{sulphurous acid}}{H_2SO_3}$$

## Activity

**Aim:** To synthesize a non-metallic oxide and test its solution using litmus paper
**Materials needed:** Sulphur, a long-handled spoon or a deflagrating spoon, burner, water, gas jar with a lid, and blue litmus paper
**Method:**

1. Take a small amount of sulphur in the long-handled spoon/deflagrating spoon and heat it over the flame of a burner.
2. When sulphur starts burning, lower the spoon into the gas jar. Cover the jar partly with the lid while the sulphur is still burning.
3. The jar will be filled with sulphur dioxide gas. Remove the spoon and cover the gas jar with a lid.
4. Add 20 mL water to the gas jar and test this solution with blue litmus paper.




**Observation:** Blue litmus paper turns red, indicating that the solution is acidic.
**Conclusion:** Water dissolves the gas (sulphur dioxide) to form an acid (sulphurous acid), which turns blue litmus red.
***Note:*** Adult supervision required.

## Reaction with Water

### Metals

Most metals react with water to produce a metal hydroxide or metal oxide and hydrogen gas.

**metal + water** ⟶ **metal hydroxide + hydrogen gas**

*Or*

**metal + water** ⟶ **metal oxide + hydrogen gas**

- Sodium reacts violently with cold water to form sodium hydroxide along with hydrogen gas. A large amount of heat is evolved in this reaction, which results in hydrogen catching fire.

$$\underset{\text{sodium}}{2Na} + \underset{\text{water}}{2H_2O} \longrightarrow \underset{\text{sodium hydroxide}}{2NaOH} + \underset{\text{hydrogen gas}}{H_2}$$

- Metals such as copper, silver, and gold do not react with water under any conditions.

### Non-metals

Non-metals do not react with water.

## Corrosion

Iron and many other metals react with oxygen and moisture present in the atmosphere. This phenomenon is called corrosion. *The process of slow wearing away of a metal due to the attack of atmospheric gases and moisture on its surface is called* ***corrosion.***

- Iron reacts with oxygen and moisture present in the atmosphere to form a brown, flaky

substance called *rust* (Fig. 4.4). Rusting of iron is an undesirable reaction because the layer of rust formed falls off, exposing the metal to further rusting. As a result, iron objects become weak with the passage of time.

- Copper objects get coated with a green substance called basic copper carbonate with the passage of time (Fig. 4.5). This green substance is formed due to the reaction of copper with carbon dioxide and moisture present in the atmosphere.

**Fact File**

The iron pillar near Qutub Minar in Delhi is considered a metallurgical wonder by archaeologists and metallurgists all over the world. It has withstood corrosion for over 1600 years despite harsh weather conditions.

**Fig. 4.4** *Reaction of iron with oxygen and moisture produces brown rust.*

**Fig. 4.5** *Reaction of copper with carbon dioxide and moisture produces green copper carbonate.*

**Fact File**

The Statue of Unity is the world's tallest statue with a height of 182 metres. It is located in the state of Gujarat on a river island facing the Sardar Sarovar Dam on Narmada River. It is made of cement–concrete, 18,500 tonnes of reinforced steel, 6,500 tonnes of structured steel, 1,700 tonnes of bronze, and 1,850 tonnes of bronze cladding.

- Silver objects become blackened (Fig. 4.6) and lose their sheen with the passage of time. This happens due to the reaction of silver with hydrogen sulphide gas present in the atmosphere.

**Fig. 4.6** *Reaction of silver with hydrogen sulphide produces black silver sulphide.*

## Reaction with Acids

### Metals

When a metal reacts with an acid, a salt and hydrogen gas are produced.

**metal + acid ⟶ salt + hydrogen gas**

***Salts** are compounds formed when a metal replaces hydrogen in an acid.* Different acids and metals react to form different salts.

- Zinc reacts with sulphuric acid to form zinc sulphate and hydrogen gas.

$$\underset{\text{zinc}}{Zn} + \underset{\text{sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{zinc sulphate}}{ZnSO_4} + \underset{\text{hydrogen gas}}{H_2}$$

- Magnesium reacts with sulphuric acid to form magnesium sulphate and hydrogen gas.

$$\underset{\text{magnesium}}{Mg} + \underset{\text{sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{magnesium sulphate}}{MgSO_4} + \underset{\text{hydrogen gas}}{H_2}$$

- Aluminium reacts with hydrochloric acid to form aluminium chloride and hydrogen gas.

$$\underset{\text{aluminium}}{2Al} + \underset{\text{hydrochloric acid}}{6HCl} \longrightarrow \underset{\text{aluminium chloride}}{2AlCl_3} + \underset{\text{hydrogen gas}}{3H_2}$$

With some metals, the reaction is very fast and vigorous, while with others it may be slow. Some metals do not react with acids at all.

### Non-metals

Generally, non-metals do not react with acids.

### Activity

**Aim:** To show that hydrogen is produced when magnesium reacts with dilute sulphuric acid
**Materials needed:** Magnesium ribbon, dilute sulphuric acid, test tube, dropper, and a matchstick
**Method:**

1. Take a piece of magnesium ribbon in the test tube.
2. Using a dropper, carefully add a few drops of dilute sulphuric acid from the sides of the test tube.
3. Bring a burning matchstick near the mouth of the test tube.

**Observation:** Bringing a burning matchstick near the mouth of the test tube produces a 'pop' sound.
**Conclusion:** The gas produced in the reaction is hydrogen.
***Note:*** Adult supervision required.

## Reaction with Bases

### Metals

Most metals do not react with bases. Only a few, such as aluminium, zinc, and lead, react with solutions of strong bases such as sodium hydroxide to produce a compound of that metal and hydrogen gas. You could perform the above activity using small pieces of zinc and sodium hydroxide solution (instead of magnesium ribbon and dilute sulphuric acid) to test that hydrogen is evolved in the reaction.

### Non-metals

The reactions of non-metals with bases are complex. You will learn about them in higher classes.

## Displacement Reactions

In a displacement reaction, a metal reacts with a salt solution and 'displaces' (or replaces) the metal present in it. Displacement reactions are explained on the basis of the reactivity series of metals.

*The **reactivity series of metals** is a list of common metals arranged in the decreasing order of reactivity.*

This means that a metal which is placed higher in the reactivity series is more reactive than those placed below it. The reactivity series of metals is shown in Figure 4.7. You can predict whether or not a displacement reaction will take place by looking at the reactivity series. *A metal will only react with a salt solution if it is placed higher in the reactivity series than the metal in the salt.* For example, iron, which is placed higher in the reactivity series than copper, reacts with copper sulphate solution. Copper, however, does not react with iron sulphate as it is less reactive than iron. Some more examples are discussed below.

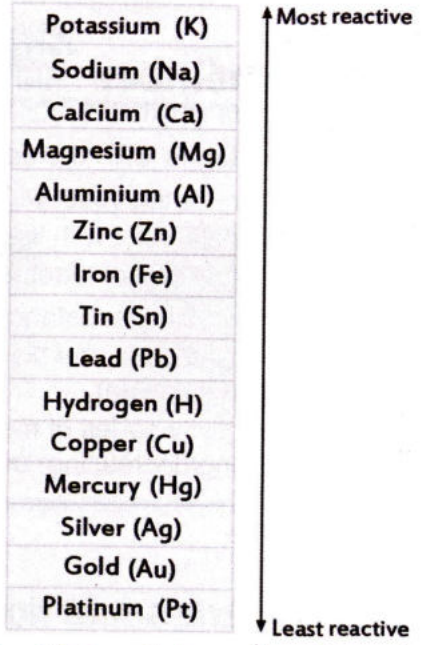



**Fig. 4.7** *Reactivity series of metals*

- Silver does not react with zinc sulphate.

$$\underset{\text{silver}}{Ag} + \underset{\text{zinc sulphate}}{ZnSO_4} \longrightarrow \text{No reaction}$$

- Zinc reacts with copper sulphate to form zinc sulphate and copper.

$$\underset{\text{zinc}}{Zn} + \underset{\text{copper sulphate}}{CuSO_4} \longrightarrow \underset{\text{zinc sulphate}}{ZnSO_4} + \underset{\text{copper}}{Cu}$$

- Silver does not react with copper sulphate.

$$\underset{\text{silver}}{Ag} + \underset{\text{copper sulphate}}{CuSO4} \longrightarrow \text{No reaction}$$

From the above reactions, we can conclude that the order of reactivity of zinc, copper, and silver is: Zn > Cu > Ag (i.e., zinc is the most reactive of the three and silver, the least reactive). You can verify this from Figure 4.7.

## Activity

**Aim:** To prove that iron is more reactive than copper

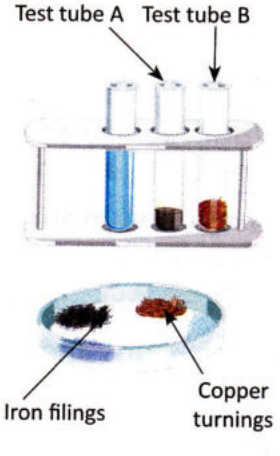
**Materials needed:** Iron filings, copper turnings, copper sulphate solution, iron sulphate solution, test tubes, and a dropper

**Method:**

1. Take some iron filings in a test tube labelled A, and add some copper sulphate solution with the help of a dropper.
2. Take some copper turnings in a test tube labelled B and add some iron sulphate solution with the help of a dropper.

**Observation:** In test tube A, iron filings turn brown due to the deposition of copper and the solution turns pale green due to the formation of iron sulphate solution. No reaction is observed in test tube B.

**Conclusion:** Iron is more reactive than copper as it displaces copper from copper sulphate solution.



## Let's Remember

**Fill in the blanks with the correct words.**

1. Most non-metals react with oxygen to form _____ (metallic/non-metallic) oxides.
2. Most metals react with water to produce _____ (hydrogen/oxygen) gas.
3. Non-metals do not react with _____ (water/bases).
4. The brown-flaky substance present on iron object is _____ (rust/dust).
5. Silver objects become black due to their reaction with atmospheric _____ (oxygen/hydrogen sulphide).
6. The reactivity series of metals is a list of common metals arranged in the _____ (increasing/decreasing) order of reactivity.

## USES OF METALS AND NON-METALS

The uses of some common metals and non-metals are as follows.

### METALS

***Iron*** Iron is one of the most commonly used metals. It is extensively used for making heavy machinery, building materials, automobiles, wrought iron furniture, cast iron rods, (Fig. 4.8) gates, window and door grills, and shipping containers. Iron is also used to make railway tracks, nuts and bolts, nails, pipes, and tools.

**Fig. 4.8** *Cast iron rods*

**Tech Specs**

An alloy is a mixture of two or more metals or a metal and a non-metal. Examples of alloys are stainless steel (a mixture of iron, nickel, and chromium) and bronze (a mixture of copper and tin). Alloys have more desirable properties than their constituents and are more corrosion resistant

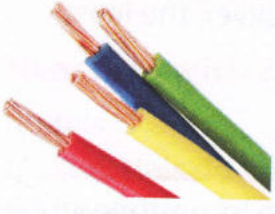


**Fig. 4.9** *Copper wires*

***Steel***, an alloy of iron, is very strong and is used to make building materials, nails, and screws.

***Copper*** Copper is used for making electrical wires (Fig. 4.9) and cables, coils, pipe fittings, and parts of electrical equipment. It is also used for making cooking utensils, in integrated circuits, and electromagnets.

***Aluminium*** Aluminium is used for making parts of machinery, automobiles, and building materials (e.g., aluminium sheets, rods, doors, and window frames). It is also used for making household utensils (Fig. 4.10), packaging tins and cans, and streetlight poles. Thin sheets of aluminium are used as packing foils at homes.

**Fig. 4.10** *Aluminium utensils*

***Zinc*** Zinc is primarily used for coating iron so as to prevent it from rusting. This process is called galvanization. Zinc is also used with other metals such as aluminium and lead for making alloys.

***Mercury*** Mercury is primarily used in thermometers. It may also be used as amalgams (alloys of mercury) for dental fillings.

***Lead*** Lead is used in car batteries (Fig. 4.11), pigments, and paints.

***Gold, silver, and platinum*** These metals are used primarily to make jewellery and also sometimes cutlery (Fig. 4.12).

**Fig. 4.11** *Lead in a car battery*

**Fig. 4.12** *Silver cutlery*

## Non-metals

***Diamond*** Diamond, a form of carbon, is one of the most expensive substances on the Earth. It is widely used for making jewellery (Fig. 4.13a). Due to their hardness, diamonds are also used in cutting and drilling tools.

***Graphite*** Graphite, another form of carbon, is used mostly to make the lead of pencils (Fig. 4.13b). It is also used in the powdered form as a lubricant for machine parts. Rods of graphite are also used in zinc-carbon batteries to make electrodes.

***Hydrogen*** Hydrogen is primarily used for the synthesis of ammonia and methyl alcohol. It is also used in welding torches and in extraction of metals. Hydrogen can also be used as a non-polluting fuel.

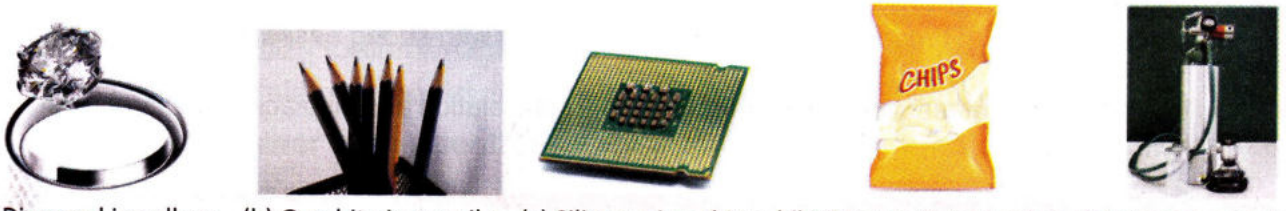
***Sulphur*** Sulphur is used for hardening rubber, manufacturing compounds such as sulphuric acid and sulphates, and in the production of matches, dyes, and gunpowder. It is also used in fungicides and insecticides.

***Silicon*** Silicon is a major component of sand. It is used extensively for making semiconductors and microchips (Fig. 4.13c). It is also used in solar cells and transistors.

***Phosphorus*** Phosphorus is used in making matchsticks and fireworks. Compounds of phosphorus, called phosphates, are an important agricultural fertilizer.

***Nitrogen*** Nitrogen is used for making ammonia and nitrates, which can be used as fertilizers. Nitrogen is also used for packaging food items such as chips (Fig. 4.13d). Liquid nitrogen is used for refrigerating cells for medical research.

***Oxygen*** Oxygen is stored in cylinders (Fig. 4.13e), which are used by mountaineers and deep-sea divers as breathing equipment. It is also used in the manufacture of steel and other chemicals such as nitric acid and hydrogen peroxide. Oxygen is used with acetylene for oxyacetylene torches that are used for welding and cutting metals.




(a) Diamond jewellery (b) Graphite in pencils (c) Silicon microchips (d) Nitrogen in packaging (e) Oxygen cylinders

**Fig. 4.13** *Uses of non-metals*

## Let's Remember

**Fill in the blanks with the correct words.**

1. _____ (Painting/Galvanization) is the process of coating iron with zinc to prevent rusting.
2. _____ (Graphite/ Sulphur) is used in the powdered form as a lubricant for machine parts.
3. _____ (Phosphorus/ Sodium) is used in making matchsticks and fireworks.
4. _____ (Rust/Steel) is an alloy of iron used for making building materials, nails and screws.
5. _____ (Aluminium/Lead) is used in car batteries, pigments and paints.
6. _____ (Hydrogen/Sulphur) can be used as a non-polluting fuel.
7. Liquid _____ (oxygen/nitrogen) is used for refrigerating cells for medical research.

## Key Words

| | |
|---|---|
| **Malleability** | The property by virtue of which metals can be beaten into thin sheets is called malleability. |
| **Ductility** | The property by virtue of which metals can be drawn into thin wires is called ductility. |
| **Sonority** | The property by virtue of which metal objects produce a ringing sound when struck with a hard object is called sonority. |
| **Corrosion** | The process of slow wearing away of a metal due to the attack of atmospheric gases and moisture on its surface is called corrosion. |
| **Salts** | Compounds formed when a metal replaces hydrogen in an acid are called salts. |
| **Reactivity series of metals** | A list of common metals arranged in the decreasing order of reactivity is called the reactivity series of metals. |

## Summary

- Most metals are solid, shiny, malleable, ductile, hard, and good conductors of heat and electricity.
- Most non-metals are solid or gaseous, brittle, soft, and poor conductors of heat and electricity.
- Most metals combine with oxygen to form metallic oxides; non-metals form non-metallic oxides.
- Most metals react with water to produce a metal hydroxide or metal oxide and hydrogen gas. Non-metals do not react with water.
- Metals react with acids to produce salts and hydrogen gas. Non-metals do not react with acids.
- Most metals do not react with bases. Only a few react with strong bases such as sodium hydroxide.
- In a displacement reaction, a metal reacts with a salt solution and displaces the metal present in it.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. Copper is a
   a. white metal
   b. greenish-yellow gas
   c. colourless gas
   d. reddish –brown metal
2. A soft metal that can be cut with a knife is
   a. gold b. silver c. potassium d. iron
3. The property of metals due to which they can be drawn into thin wires is
   a. malleability
   b. ductility
   c. sonority
   d. good conductors of electricity
4. Which of the following is a good conductor of heat?
   a. Diamond b. Silver c. Copper d. All of these
5. The order of reactivity of metals is
   a. Cu > Mg> Zn > Fe
   b. Cu> Fe> Zn> Mg
   c. Mg> Zn> Fe > Cu
   d. Mg> Fe >Zn > Cu
6. A metal that will displace copper from copper sulphate solution is
   a. mercury b. gold c. aluminium d. silver
7. Which of following gases is produced in the reaction of a metal with an acid?
   a. Sulphur dioxide b. Carbon dioxide c. Oxygen d. Hydrogen
8. Which of following is the least reactive metal?
   a. Gold b. Potassium c. Copper d. Silver
9. Which of following metals is used in paints and pigments?
   a. Iron b. Lead c. Mercury d. Copper
10. Which of following non-metals is used for making matchsticks and fireworks?
    a. Sodium b. Silicon c. Phosphorous d. Graphite

**B. Fill in the blanks with the correct words.**

1. The property of metals due to which they produce a ringing sound when struck with a hard object is called _____ (thermal conductivity/sonority).
2. A non-metal that is a good conductor of heat is _____ (diamond/graphite).
3. A metal that burns with white dazzling light is _____ (magnesium/sodium).
4. Metallic oxides turn _____ (red/blue) litmus solution to _____ (red/blue).
5. _____ (Sodium/Magnesium) is kept immersed in kerosene.
6. Non-metallic oxides dissolve in water to form _____ (acids/bases).

### II. Very short answer type questions

**A. Complete the equations.**

1. $4Na + O_2 \rightarrow$ _____
2. $S + O_2 \rightarrow$ _____

3. $CO_2 + H_2O \rightarrow$ _____

4. $2Na + 2H_2O \rightarrow 2NaOH +$ _____

5. $Zn + H_2SO_4 \rightarrow$ _____ $+ H_2$

## III. Short answer type questions

1. Define the following terms: malleability, ductility, and sonority.
2. State and explain how a particular property of metals helps in making the following:
   a. Wind chimes and musical instruments
   b. Electrical wires
   c. Decorative articles and jewellery
   d. Cooking utensils
3. Compare the reactions of metals and non-metals with oxygen.
4. How does the sodium metal react with water? Give two examples of metals that do not react with water.
5. Write one use of each of the following: steel, aluminium, mercury, silicon, sulphur, and diamond.

## IV. Long answer type questions

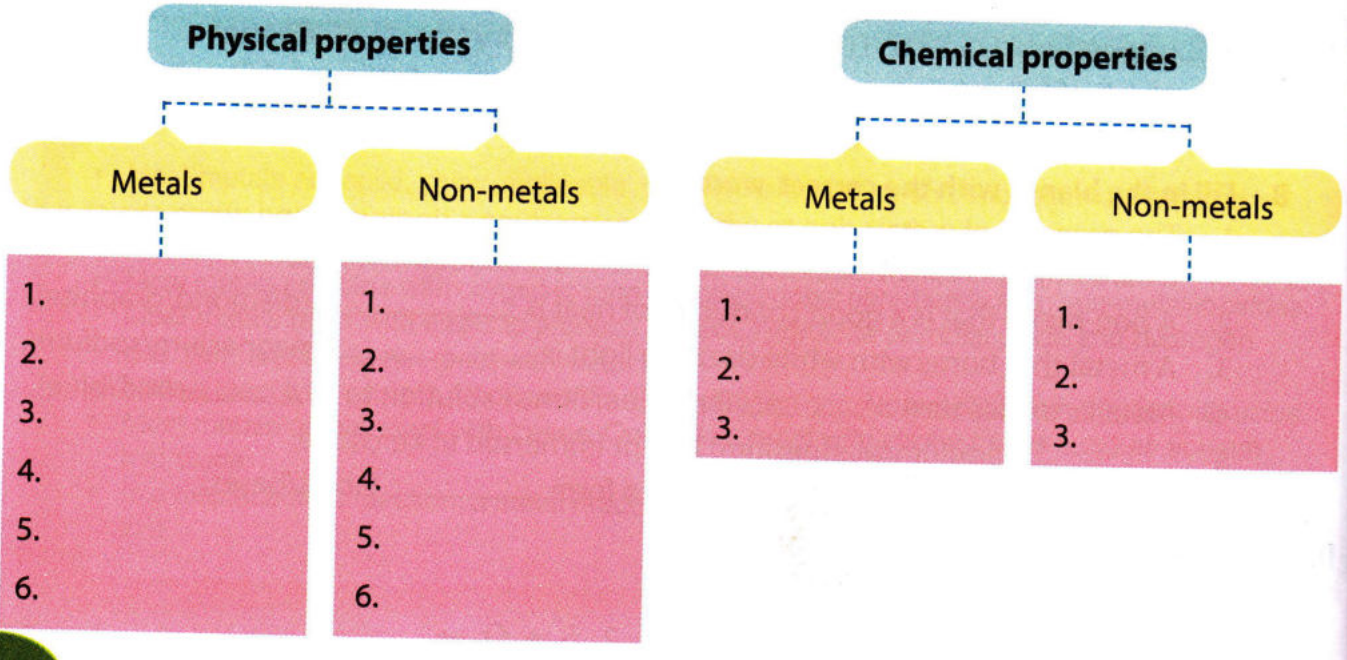
1. How do metals and non-metals react with acids? Write and explain the chemical equation for the reaction of magnesium with sulphuric acid and aluminium with hydrochloric acid.
2. Define corrosion. Explain the corrosion process in iron, copper and silver.
3. What is a displacement reaction? On the basis of the reactivity series of metals, predict whether these metals will react with each of the following salt solutions or not.

   **Metals:** copper, magnesium, zinc, and iron

   **Salt solutions:** copper sulphate, magnesium sulphate, zinc sulphate, and iron sulphate

## LET'S RECALL


Recall and complete the concept map given below.



## LET'S OBSERVE

UNDERSTANDING LO 5

Which phenomenon leads to the following change? Explain the process in the space provided.

_____

_____

_____

_____

## LET'S CONNECT

COMPUTER SCIENCE AND HISTORY

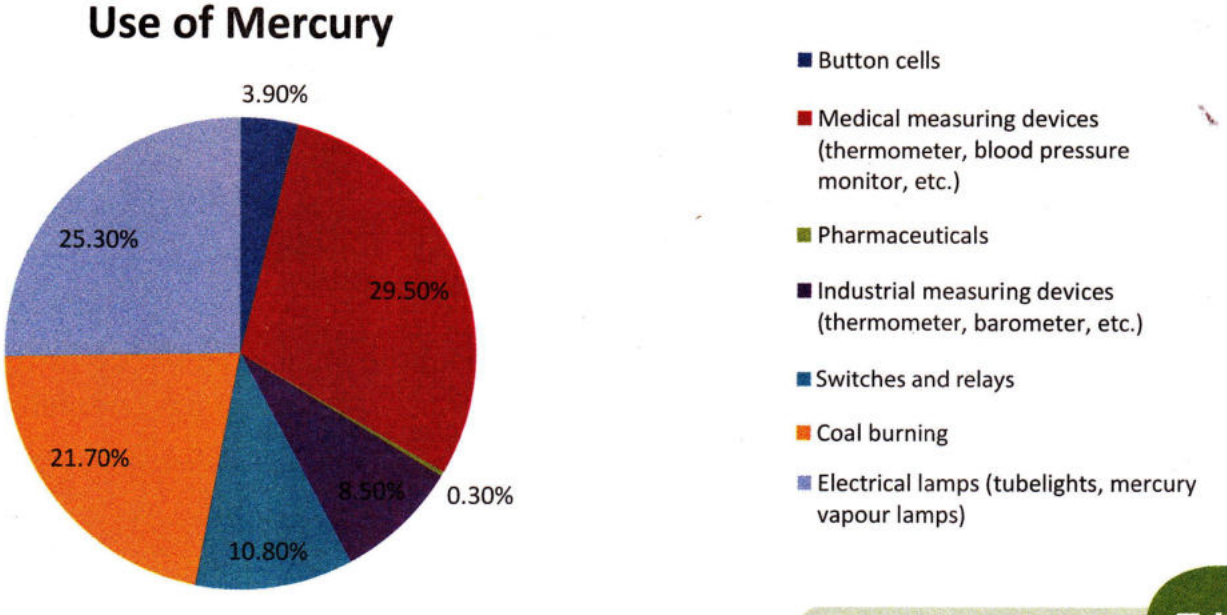
1. Make a PowerPoint Presentation on any one element. Find out about its occurrence in nature, physical and chemical properties and its usage in everyday life.
2. Prepare a project report on the comparison of Bronze Age with Iron Age. Discuss the type of tools and weapons, utensils, ornaments, etc. used in the two ages.

## LET'S ANALYSE AND EVALUATE

LO 4 LO 5

The exposure to mercury metal leads to mercury poisoning, which results in a number of health problems. In children, it may result in acrodynia or pink disease in which the skin becomes pink and peels. Mercury can get into our bodies by breathing contaminated air, drinking contaminated water or eating contaminated food, particularly mercury-contaminated fish. The pie chart given below shows the various sectors where mercury is used. On this basis of the pie chart, answer the following questions.

1. Which sector uses mercury the most? Where is it used the least? ANALYSING
2. How is mercury used in medical measuring devices? EVALUATING
3. What are the possible ways by which mercury can get into our bodies?
4. Can you suggest some methods by which the usage of mercury could be reduced?



## LET'S APPLY

1. A yellow powder 'X' burns in air to form a gas 'Y' with pungent, suffocating odour. The gas 'Y' dissolves in water to form 'Z', which turns blue litmus solution red. Identify 'X', 'Y', and 'Z' and write relevant chemical equations.(*Hint:* Chemical properties) LO 6
2. Which out of the two, zinc container or copper container, can be used to store hydrochloric acid? (*Hint:* Recall reactivity series)
3. Can an iron spoon be used to dissolve solid copper sulphate in water? (*Hint:* Recall reactivity series)

## LET'S CREATE

1. Make a list of at least 10 objects made up of different metals. Record your observations as shown in the table given below. Also, make a report based on your observations. Your report should explain why a particular metal can or cannot be used for making other objects included in the table. LO 11 LO 2

| Object | Metal used |
|---|---|
| Scissors | |

2. Make a wind chime to demonstrate the sonority of metals. LO 10
   You will need coloured strings, a coat hanger, and spoons/thin strips or rods or metals or any other object that you think will produce a pleasant sound. Tie a piece of string to the objects and fix them on the hanger. The heavier items should be towards the middle so that the wind chime is balanced. Now hang your wind chime where they would make a tinkling sound as the wind passes through them.
3. In groups of five, prepare a chart on uses of common metals and non-metals, on any one industry of your choice. LO 2 LO 11

**Web Research**

- To know more about the properties of metals and non-metals, browse through:
  https://www.texasgateway.org/resource/matter-and-energy-metals-nonmetals-and-metalloids
  (accessed and checked on 12/08/2019)
  To know more about elements and the periodic table, browse through:
  https://www.ducksters.com/science/elements.php
  (accessed and checked on 12/08/2019)
- To know more about Beryllium, browse through:
  https://www.gordonengland.co.uk/elements/be.htm
  (accessed and checked on 12/08/2019)

# 5 Combustion and Fossil Fuels

**You will learn about**

- Combustion
- Fuels
- Fossil fuels: Coal, petroleum, and natural gas

What is common in the following illustrations? Burning! Can you identify the substances that are burning in each of them?

1. 

2. 

3. 

4. 

What are the two things that are produced when a substance burns? Burning a substance produces heat and light.

In this chapter, we will discuss the process of burning and various fuels we use in everyday life.

Answer: 1. Wood, 2. Candle wax, 3. Coal, 4. LPG

## COMBUSTION

*The process of burning of a substance in the presence of air or oxygen with the liberation of heat and light is called* ***combustion***. Substances can be classified as combustible or non-combustible, depending on whether or not they can be burnt.

*Substances that burn in air or oxygen to produce heat and light are called* ***combustible substances***. Paper, wood, kerosene, and LPG are examples of combustible substances.

*Substances that do not burn in air or oxygen to produce heat and light are called* ***non-combustible substances***. Water, sand, glass, and cement are examples of non-combustible substances.

### Types of Combustion

Combustion can be of three types: rapid combustion, explosion, and spontaneous combustion.

#### Rapid combustion

In this type of combustion, a large amount of heat and light are released in a very short span of time. Combustion of LPG, which produces heat and light instantly, is an example of rapid combustion.

#### Explosion

This type of combustion is characterized by the sudden release of heat, light, and sound accompanied by the liberation of a large amount of gas. The bursting of firecrackers is an example of an explosion. An explosion can also occur upon the application of pressure.

#### Spontaneous combustion

In this type of combustion, substances catch fire on their own without the application of heat. For example, white phosphorous catches fire on its own at room temperature.

Combustion of hydrocarbons (compounds of hydrogen and carbon, e.g., LPG, petrol, and natural gas) can be of two types: complete combustion and incomplete combustion.

#### Complete combustion

This type of combustion takes place in adequate amount of air or oxygen. It results in the formation of carbon dioxide, water, heat, and light.

#### Incomplete combustion

This type of combustion takes place in inadequate amount of air or oxygen. It results in the formation of carbon monoxide, soot, water, heat, and light.

### Conditions Necessary for Combustion

The following conditions are necessary for combustion to take place.

***Presence of a combustible substance*** Combustion is only possible if the substance is combustible.

***Presence of a supporter of combustion*** The adequate supply of a supporter of combustion (e.g., oxygen) is essential for combustion.

***Attainment of ignition temperature*** A substance starts to burn only after it has attained a certain minimum temperature. *The temperature at which a particular substance burns in the presence of air is called its* ***ignition temperature***. A substance cannot catch fire if its temperature is lower than its ignition temperature.

Substances such as alcohol, petrol, LPG, and nylon fibres catch fire very easily. This is because these substances have low ignition temperatures. Such substances are called *inflammable substances*. Special care needs to be taken while storing or transporting inflammable substances.

### Activity

**Aim:** To prove that combustion of a candle does not take place below its ignition temperature
**Materials needed:** A lit candle (Fig. A) and aluminium foil
**Method:** Cut a hole in a piece of aluminium foil and slide it just below the base of the candle flame and above the melted wax (Fig. B).
**Observation:** The candle gets extinguished (Fig. C).

Fig. A

Fig. B

Fig. C

**Conclusion:** The candle gets extinguished because the aluminium foil conducts away the heat and the temperature goes below the ignition temperature.
***Note:*** Adult supervision required.

## Extinguishing a Fire

A fire can be extinguished using water. Water evaporates, taking away heat from the fire, which in turn cools down the burning material well below its ignition temperature. However, there are certain cases where use of water could be dangerous.

- Water should not be poured over burning petrol, kerosene, or diesel. These substances are lighter than water and do not mix with it. As a result, water forms a layer beneath them and the substance continues burning.
- Water should not be used over electrical fires, as it conducts electricity and can pose danger to people trying to extinguish the fire.

Fire extinguishers make use of carbon dioxide gas as it is not a supporter of combustion. Being heavier than air, carbon dioxide settles down and cuts off the supply of oxygen, which extinguishes the fire. Two common types of fire extinguishers are carbon dioxide fire extinguisher and soda-acid fire extinguisher.

***Carbon dioxide fire extinguisher*** This type of fire extinguisher consists of carbon dioxide filled under high pressure in cylinders.

***Soda-acid fire extinguisher*** This type of fire extinguisher has a concentrated solution of sodium hydrogen carbonate and sulphuric acid in separate compartments. When the fire extinguisher is used, the two substances come into contact with each other, producing carbon dioxide.

## Flame

TD

A ***flame*** *is a region where combustion of fuel takes place.* The colour of the flame depends on the temperature, amount of air available, and the nature of the substance burning. Hydrocarbons burn with a blue or yellow flame. Figure 5.1 shows the change in flame colour of a Bunsen burner with increasing oxygen supply.

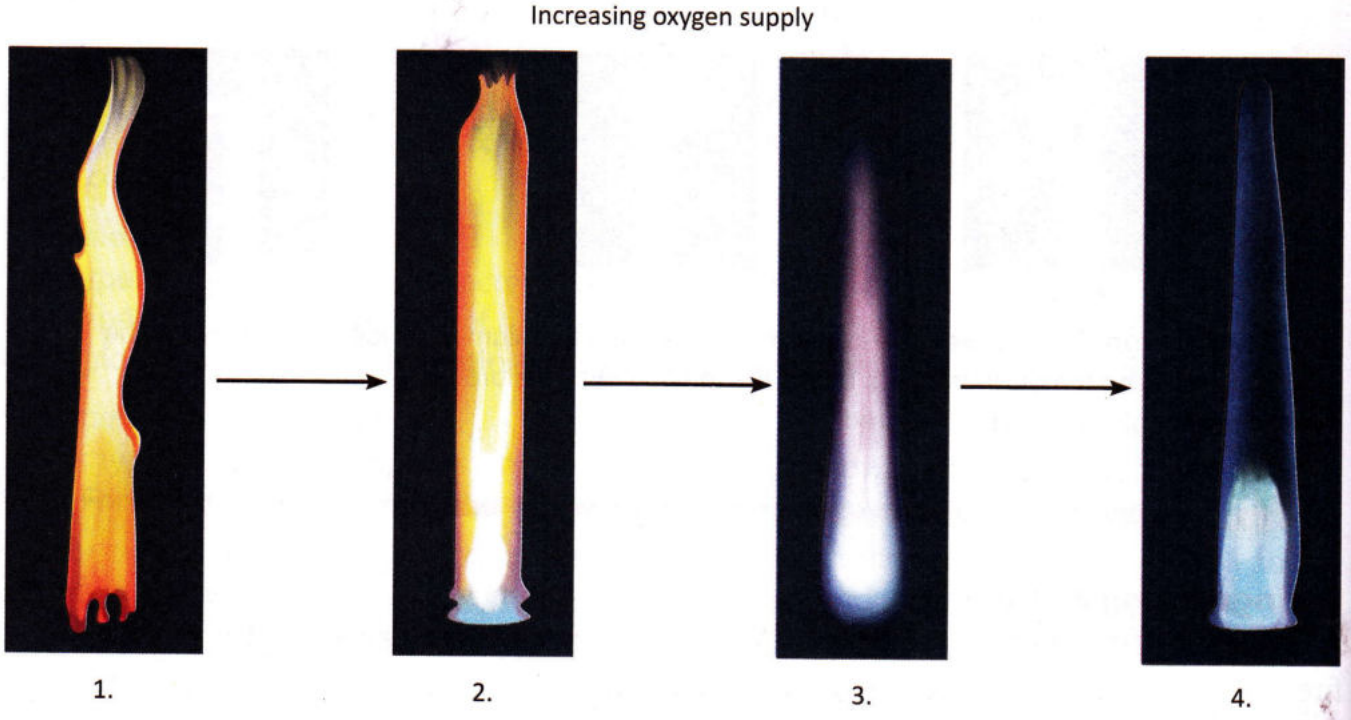



**Fig. 5.1** *Change in the colour of a Bunsen burner flame with increasing oxygen supply*

A yellow flame is also called a *luminous flame*, as it emits a lot of light. A luminous flame is generally observed when there is insufficient oxygen (i.e., incomplete combustion). Its temperature is lower than that of a blue flame and it leaves behind black soot and other residue.

A blue flame is also called a *non-luminous* flame as it emits very little light. A blue flame is generally observed when there is adequate amount of oxygen available (i.e., complete combustion). This type of flame leaves behind no residue.

However, a flame may not show the same colour uniformly. We sometimes observe different colours or *zones* in a flame. Let us understand this using the example of a candle flame.

**Word help**

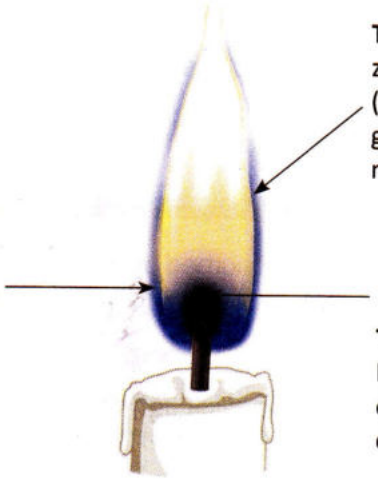
**Emit** Give off
**Residue** A small amount of something that remains at the end of a process

## Zones of a Candle Flame

TD LL

A candle flame can be divided into three zones (Fig. 5.2), depending on the amount of oxygen available.

**The outer zone (blue)** is the hottest part of the flame. In this zone, the wax vapours have enough oxygen to burn completely (producing carbon dioxide and water). This zone emits very little light.



**The middle zone (yellow)** is less hot than the outer zone. Here, incomplete combustion of wax vapours (due to low oxygen) produces carbon particles (which glow, giving the zone its yellow colour) and carbon monoxide. This zone emits the most light.

**The inner zone (black)** is the coolest part of the flame. In this zone, the wax vapours remain unburned as no oxygen is available. This zone is completely dark and emits no light.

**Fig. 5.2** *Zones of a candle flame*

## Combustion of a Wax Candle

If you observe a candle flame closely, you will notice the following.

- The wick burns and it stands in a pool of liquid wax.
- There is a small portion of unburnt wick between the flame and the liquid wax.
- The liquid wax is trapped in a 'cup' of solid wax.
- The liquid or solid wax never catches fire.

We can see that the wick is burning. But it cannot be the only substance that is burning as the candle gets smaller as it burns. So, what is burning in addition to the wick? It is the wax vapours that burn. If a lit match is brought a little above a candle wick immediately after the candle has been blown out, it is noticed that the flame from the match jumps the gap and reignites the wick. This happens because the wax vapours rise from the wick immediately after the candle is blown out and the burning match reignites them.

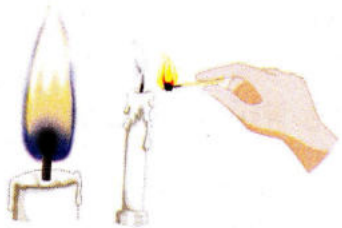
### Activity

**Aim:** To prove that when a candle burns, it is the wax vapours that burn and not the liquid wax

**Materials needed:** A candle and a matchbox

**Method:**

1. Light the candle using a match.
2. Blow out the candle and immediately bring a burning matchstick near the smoke. In case the smoke is not visible, hold the lit match above the wick.



**Observation:** The flame from the match reignites the wick.

**Conclusion:** When a candle is lit, it is the wax vapours that burn, not the liquid wax.

From this, we conclude the following.

- It is only the wax vapours that burn. Neither liquid wax nor solid wax burns.
- When a candle wick is lit, the heat produced from the flame melts the wax.
- The wick soaks or absorbs the molten wax.
- The heat of the flame vaporizes the molten wax in the wick.
- The wax vapours burn in the flame. This process continues till the entire wax is consumed or the candle is extinguished.

## Activity

**Aim:** To prove that when a candle is lit, the liquid wax absorbed by the wick is converted into vapours
**Materials needed:** A candle, a matchbox, and a pair of tongs or tweezers
**Method:**

1. Light the candle using a match.
2. Take a pair of tongs or tweezers and pinch the wick tightly just below the flame for some time.

**Observation:** The flame goes out.
**Conclusion:** By pinching the wick, the absorption of liquid wax by the wick stops, which cuts off the flame's fuel supply and it extinguishes.

## Activity

**Aim:** To prove that carbon dioxide is produced on burning candle wax
**Materials needed:** A candle, a matchbox, a glass jar, aluminium foil, and lime water solution
**Method:**

1. Fix a candle into the glass jar.
2. Light the candle using a matchstick.
3. Cover the beaker with a piece of aluminium foil to cut down the air supply.
4. When the candle goes out, slowly and carefully remove some portion of the aluminium foil and take out the candle from the beaker, trying not to disturb the contents of the beaker. Pour the lime water solution down the side of the beaker and swirl it.

**Observation:** Lime water turns cloudy.
**Conclusion:** Combustion of candle wax produces carbon dioxide gas, which reacts with lime water to produce insoluble calcium carbonate.

## Let's Remember

REMEMBERING UNDERSTANDING

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

1. Wood is a non-combustible substance.
2. The bursting of firecrackers is an example of rapid combustion.

3. Ignition temperature is the temperature below which a particular substance burns in presence of air.
4. Water should not be used for extinguishing electrical fires.
5. The middle zone of the flame is the hottest zone of the flame.

**II. Answer the following questions orally.**

1. What is spontaneous combustion?
2. What are the three necessary conditions for combustion?
3. What are the three zones of candle flame?

## FUELS

Most of the substances used for burning are fuels. Substances that produce heat and light energy on burning are called fuels. Some commonly used fuels are wood, coal, cow dung cakes, kerosene, LPG, petrol, and diesel. We use fuels for cooking, heating, in automobiles, and for the generation of electricity. Based on their physical state, fuels can be classified as solid, liquid, or gaseous (Table 5.1).

**Table 5.1** Types of fuels

| Solid fuels | Liquid fuels | Gaseous fuels |
|---|---|---|
| Fuels that exist in solid state at room temperature are called solid fuels. Wood, charcoal, cow dung cakes, agricultural waste, coke, and coal are examples of solid fuels. | Fuels that exist in liquid state at room temperature are called liquid fuels. Kerosene, petrol, diesel, and fuel oil are some examples of liquid fuels. | Fuels that exist in gaseous state at room temperature are called gaseous fuels. Petroleum gas, natural gas, and biogas are examples of gaseous fuels. |

### Characteristics of Fuels

Not all combustible substances can be used as fuels for all applications. This is because although all fuels produce heat and light on burning, some produce more energy than others. Besides the amount of energy produced, the choice of fuel, whether for domestic or industrial use, also depends upon its cost, efficiency, availability, and the extent of pollution it causes. A very important characteristic of a fuel is its calorific value.

Calorific value of a fuel is defined as the amount of heat produced in kilojoules when one gram of a fuel is completely burned. The unit for representing calorific value is kilojoule (kJ). Calorific value is expressed in kJ/g. In simple terms, the higher the calorific value of a fuel, the more heat it produces when burned. Thus, the higher the calorific value of a fuel, the better fuel it is. Calorific values of some fuels are given in Table 5.2.

When a fuel is burnt by a machine, some of the energy produced is given off as waste heat, which cannot be used for cooking or other purposes. The proportion of energy from a fuel that is converted into useful work by a machine is called the fuel efficiency of a machine. Till date, no fuel-burning device is known to exhibit 100% efficiency.

**Table 5.2** Calorific value of some fuels

| Fuel | Calorific value (kJ/g) | Fuel | Calorific value (kJ/g) |
|---|---|---|---|
| Wood pellets | 17 | Coal | 25–33 |
| Charcoal | 35 | Cow dung cakes | 7 |
| Coke | 33 | Kerosene | 48 |
| Petrol | 47 | Biogas | 35–40 |
| LPG | 50 | Methane | 55 |
| Hydrogen | 150 | Diesel | 45 |

The following are some of the important characteristics of an ideal fuel.

- It should have a high calorific value.
- Its ignition temperature should be low but well above the room temperature. If the ignition temperature is too low, the fuel will catch fire very easily (which could be dangerous) and if it is very high, the fuel has to be heated for a long time before it can catch fire.
- It should have a moderate rate of combustion and should release heat in a controlled manner.
- It should be fairly cheap and easily available. A fuel may have a very high calorific value but if it is expensive and not easily available, it cannot be used on a day-to-day basis.
- It should be safe to handle, store, and transport.
- It should not cause pollution on burning.

Not all fuels can fulfill every one of these characteristics. Hence, fuels need to be compared to each other in order to choose the right fuel. Let us discuss some fuels based on their characteristics.

***Hydrogen as fuel*** Hydrogen is considered the best fuel as it has the highest calorific value. However, as it is highly inflammable, there are difficulties associated with its transport, storage, and handling. It is, therefore, used as a fuel only where it is absolutely necessary (e.g., as rocket fuel).

***Methane and LPG as fuels*** Both methane and LPG have fairly high calorific values. They burn with a smokeless fire and, therefore, do not cause pollution. They are also easily stored and transported via cylinders or pipelines. Hence, they are ideal for use as domestic fuels.

***Petrol and diesel as fuels*** Both petrol and diesel are mainly used in automobiles. Their main disadvantage is their limited availability. Another disadvantage is that their combustion releases harmful gases into the atmosphere.

## FOSSIL FUELS

Fossil fuels are formed from the buried remains of plants and animals over a period of millions of years. Coal, petroleum, and natural gas are examples of fossil fuels. Since fossil fuels are obtained from nature, they are referred to as natural resources. Natural resources can be divided into the following two types.

***Inexhaustible natural resources*** These are resources of which there is a limitless supply. Sunlight and air are examples of inexhaustible resources.

***Exhaustible natural resources*** These are resources whose supply is limited. Their overuse should, therefore, be avoided. Fossil fuels, forests, and wildlife are examples of exhaustible resources.

Let us discuss each of the fossil fuels (coal, petroleum, and natural gas) and their limitations in detail.

## Coal

Coal is generally black or brownish-black in colour. Depending on its carbon content, it can be of three main types.

***Anthracite*** It has a carbon content of around 86% or higher and is regarded as the highest grade of coal. It is mainly used for heating.

***Bituminous coal*** It has a carbon content of around 70–86% and is mainly used for power generation and for manufacturing another fuel called coke.

***Lignite*** It has a carbon content of around 60–70% and is regarded as the lowest grade of coal. It is mainly used for power generation.

### Tech Specs

My Eco Energy, an Indian company, has synthesized a clean and renewable diesel called Indizel. This fuel has been recognized as a drop-in fuel as per Indian National Policy on Biofuel, 2018

Coal was formed from the remains of plants that grew in warm, humid swamps 300 to 400 million years ago (Fig. 5.3). The process of formation of coal is shown below. TD

1. Trees and other plants that grew in swampy areas 300 to 400 million years ago died and their remains got buried in the swampy soil. Over time, these remains were covered with layers of sediments such as mud and sand.
2. In low-oxygen conditions, the buried plant material formed a dark brown material called **peat**.
3. Gradually more and more sediments got deposited over peat. Peat was compressed between layers of sediments and formed **lignite**.
4. Further compression resulted in the formation of bituminous **coal**.
5. Even further compression resulted in the formation of **anthracite**.

**Fig. 5.3** *Formation of coal*

Coal is processed further to obtain useful materials such as coke, coal tar, and coal gas.

***Coke*** It is a hard, dry fuel produced by heating bituminous coal to a very high temperature in the absence of air. Coke has a high carbon content and is used as a fuel and in steel manufacture.

***Coal tar*** It is a thick, black, opaque fluid obtained as a by-product of the process of manufacturing coke. It is used in anti-dandruff shampoos, ointments, soaps, perfumes, etc.

***Coal gas*** It is a gaseous fuel obtained as a by-product of the process of manufacturing coke. Before the development of natural gas supplies, it was used as domestic and lighting fuel.

## Petroleum and Natural Gas

Petroleum or crude oil is a complex mixture of solid, liquid, and gaseous hydrocarbons. Petroleum and natural gas were formed from the remains of tiny marine organisms that died millions of years ago. The process of formation of petroleum and natural gas is shown below (Fig. 5.4).

**Get it Right**

Petroleum was mainly formed by the decay of tiny marine organisms, not large land animals such as dinosaurs.

1. Tiny marine organisms died and settled on the ocean floor.
2. Over time, this layer of dead organisms was covered beneath sediments.
3. Enormous heat and pressure transformed these remains to petroleum and natural gas.
4. Rising through porous rocks such as sandstone, petroleum and natural gas reached a layer of impermeable rock and were trapped below it.

**Fig. 5.4** *Formation of petroleum and natural gas*

## Extraction and Refining of Petroleum Oil

Petroleum and natural gas are extracted by drilling through the impermeable rocks. Petroleum oil is separated into useful substances through a process called *refining of petroleum* (Fig. 5.5). This is done in oil refineries. In this process, petroleum is heated to temperatures above 400 °C and introduced in a fractionating column, which is a tall, cylindrical structure fitted with horizontal trays. As the vapours of petroleum rise inside the *fractionating column*, they cool and condense at different heights, depending on their boiling points, and are collected in different trays. Uncondensed hydrocarbons (petroleum gas) pass out of the column. The refining process is also called *fractional distillation* of petroleum. The main products obtained are shown in Figure 5.5.

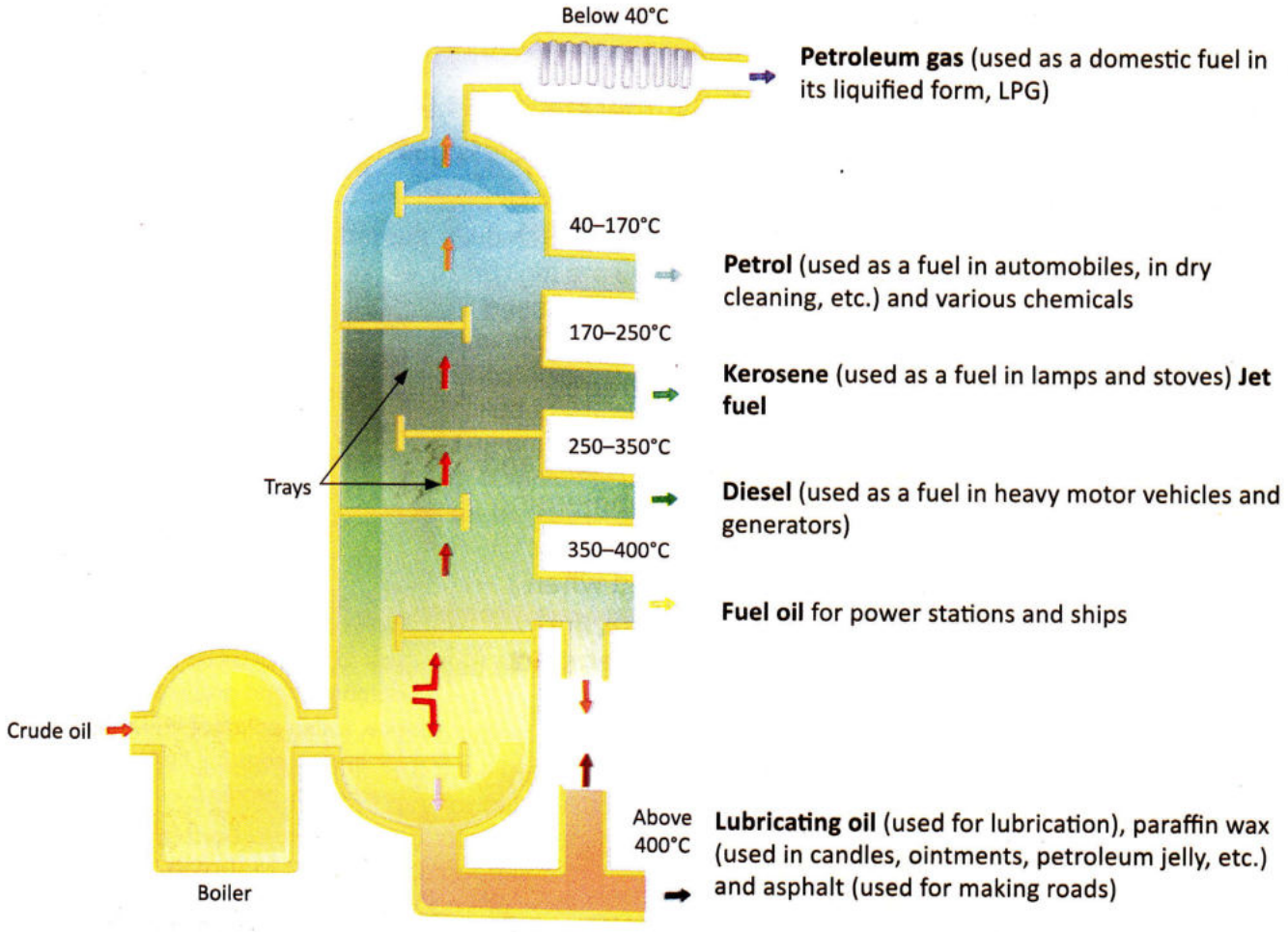



**Fig. 5.5** *The products of petroleum refining*

Natural gas consists mainly of methane. It has the following main uses.

- It is used for the generation of electricity.
- Compressed natural gas (CNG) is used as a fuel in automobiles as it is more environment friendly than petrol or diesel.
- It is used as a domestic fuel and is transported to houses via gas pipelines.
- It is used in the production of ammonia.
- It is used to produce hydrogen.
- It is used in the manufacture of steel, glass, plastics, and other products.

## Limitations of Fossil Fuels

The two main limitations of fossil fuels are their limited availability in nature and the air pollution caused due to their use.

***Limited availability*** Fossil fuels take millions of years to form. If we run out of the existing stock of these fuels, we will not get more until natural processes have regenerated them.

***Air pollution*** Use of fossil fuels adds many undesirable substances, called pollutants, in the atmosphere. These

### Tech Specs

Scientists at Sandia National Laboratories, New Mexico, have succeeded in producing fuels such as petrol and methanol using sunlight and carbon dioxide.

pollutants adversely affect the life of organisms. Pollutants can be in the form of particles or gases.

Some of the main air pollutants and their harmful effects are given below.

- *Carbon monoxide* is a colourless, odourless, and tasteless gas. It is produced by incomplete combustion of fossil fuels. Exposure to carbon monoxide can cause headache and dizziness and can even lead to coma and death.
- *Carbon dioxide* levels in the atmosphere have increased due to the widespread combustion of fossil fuels. This can lead to an increase in the global average temperature. This phenomenon is called global warming. It can cause the melting of polar ice caps and glaciers, resulting in a rise in sea level and submerging of coastal areas.
- The *oxides of sulphur and nitrogen* are released when coal is burned. Use of fossil fuels such as petrol, and diesel also releases nitrogen oxides. These gases react with oxygen and water vapour present in the air to produce dilute solutions of sulphuric acid and nitric acid, which fall on Earth as acid rain and damage plants, aquatic life, soil, and buildings.
- *Soot particles* are introduced in the air due to the incomplete combustion of wood and fossil fuels such as coal and petroleum. These particles can enter our bodies when we breathe and trigger asthma attacks and cause wheezing, coughing, and respiratory irritation.

### Green corner

**Biofuel**

Ethanol mixed with petrol is being used as automobile fuel in our country. The combustion of petrol ethanol blend not only produces less pollution but also saves foreign exchange as ethanol is produced in our country. Food items such as sugarcane, maize, wheat, sweet sorghum, sugar beet, starch rich food such as corn, cassava, damaged food grains like broken rice, rotten potatoes that are unfit for human consumption, etc. are used for its production.

### Let's Discuss

Are fossil fuels a boon or a curse? Discuss.

## Conservation of Fossil Fuels

Keeping in mind the limitations of fossil fuels, the need of the hour is to conserve them to the extent possible.

Conservation of fossil fuels can be done by

- judicious use of the existing resources and
- use of alternate sources of energy such as tidal power, wind energy, solar energy, and nuclear energy to meet our fuel needs.

## Let's Remember

REMEMBERING UNDERSTANDING

**Fill in the blanks with the correct words.**

1. Kerosene, petrol, diesel and fuel oil are examples of _____ (solid/liquid) fuels.
2. _____ (Fuels/Fossils) are substances that produce heat and light energy on burning.
3. _____ (Anthracite/Lignite) is the highest grade of coal.
4. _____ (LPG/Hydrogen) has the highest calorific value.
5. _____ (Kerosene/Fuel Oil) is used as a fuel in power stations and ships.

## Key Words

| | |
|---|---|
| **Combustion** | The process of burning of a substance in the presence of air or oxygen with the liberation of heat and light is called combustion. |
| **Combustible substances** | Substances that burn in air or oxygen to produce heat and light are called combustible substances. |
| **Non-combustible substances** | Substances that do not burn in air or oxygen to produce heat and light are called non-combustible substances. |
| **Ignition temperature** | The temperature at which a particular substance burns in the presence of air is called its ignition temperature. |
| **Fuels** | Substances that produce heat and light energy on burning are called fuels. |
| **Calorific value** | The amount of heat produced in kilojoules when a gram of fuel is completely burned is called the calorific value of the fuel. |

## Summary

- Substances may be classified as combustible or non-combustible, depending on whether they can be burnt.
- Combustion can be of three types: rapid combustion, explosion, and spontaneous combustion.
- Combustion of hydrocarbons can be complete or incomplete.
- The conditions necessary for combustion to take place are presence of a combustible substance, a supporter of combustion, and attainment of ignition temperature.
- The colour of the flame depends on the temperature, the amount of air available, and the nature of the substance burning.
- A candle flame may be divided into three zones: the outer zone (blue), the middle zone (yellow), and the inner zone (black).
- Based on their physical state, fuels can be classified as solid, liquid, or gaseous.
- Coal, petroleum, and natural gas are examples of fossil fuels.
- Depending on carbon content, coal can be of three types: anthracite, bituminous coal, and lignite.
- Petroleum is separated into useful substances using a process called refining of petroleum.
- The two main limitations of fossil fuels are their limited availability in nature and the air pollution caused due to their use.

# Exercises

## LET'S UNDERSTAND

REMEMBERING UNDERSTANDING

QT

### I. Objective type questions

**A. Fill in the blanks with the correct words.**

1. _____ (Inflammable/Non-flammable)substances have low ignition temperature.
2. Non-luminous flame is of _____ (blue/yellow) colour.
3. _____ (Outer/Inner) zone is the coolest part of the flame.

4. _____ (Exhaustible/Inexhaustible) natural resources have limited availability in nature.
5. _____ (Coal/Natural gas) was formed from the remains of plants.
6. _____ (Extraction/Refining) of petroleum is done to separate petroleum into useful products.

**B. Choose the correct option.**

1. The colour of the flame depends upon:
   a. temperature
   b. amount of air available
   c. nature of the substance burning
   d. All of these
2. What burns in a candle flame?
   a. Solid wax b. Liquid wax c. Wax vapours d. Oxygen
3. Which of the following is produced in incomplete combustion of hydrocarbons?
   a. Carbon dioxide
   b. Carbon monoxide
   c. Oxygen
   d. Methane
4. Which of the following is a characteristic of an ideal fuel?
   a. High calorific value
   b. High rate of combustion
   c. Low ignition temperature
   d. Should cause pollution
5. Which of the following is the main constituent of natural gas?
   a. Oxygen b. Petrol c. Methane d. Carbon dioxide
6. Which of the following is an air pollutant?
   a. Carbon monoxide
   b. Oxides of nitrogen and sulphur
   c. Soot particles
   d. All of these
7. In which of the following cases, water should not be used for extinguishing fire?
   a. Burning diesel b. Burning petrol c. Electrical fire d. All of these
8. Which of the following fuels is considered an ideal fuel for domestic use?
   a. Hydrogen b. Petrol c. Cow dung cakes d. Methane
9. Which of the following types of coal is used for manufacturing coke?
   a. Lignite b. Peat c. Bituminous coal d. Anthracite
10. Which of the following products of petroleum is used in candles, ointments and Vaseline?
    a. Fuel oil b. Paraffin wax c. Lubricating oil d. Asphalt

**C. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Oxides of sulphur and nitrogen | a. Methane |
| 2. Domestic fuel | b. White phosphorous |
| 3. Diesel | c. Carbon dioxide |
| 4. Spontaneous combustion | d. Acid rain |
| 5. Fire extinguisher | e. Heavy motor vehicles |

## II. Very short answer type questions

**A. Give one word for the following.**

1. Burning of a substance in the presence of air or oxygen with the liberation of heat and light _____

2. The combustion which takes place in adequate amount of air or oxygen _____
3. A region where combustion of fuel takes place _____
4. Flame that emits a lot of light _____
5. The amount of heat produced in kilojoules when one gram of fuel is completely burned _____
6. The resources which have limitless supply _____

## III. Short answer type questions

1. Why is water not always used for extinguishing fire?
2. State any two characteristics of an ideal fuel.
3. Why are methane and LPG considered ideal for use as domestic fuels?
4. List the different types of coal with their carbon content and one use.
5. What are the various products obtained from refining of petroleum? Write one use for each.

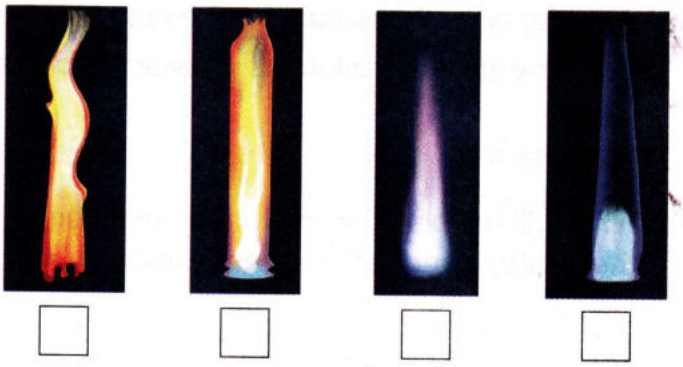
## IV. Long answer type questions

1. Write any one difference between the following.
   a. Combustible and non-combustible substances.
   b. Rapid and spontaneous combustion
   c. Complete combustion and incomplete combustion
   d. Blue and yellow flame
   e. Exhaustible and inexhaustible natural resources
2. Explain the different zones of a candle flame.
3. What are fossil fuels? How were coal and petroleum formed?

## LET'S OBSERVE

UNDERSTANDING

Look at the picture given alongside. LO 4 It shows different colours of the flame with change in oxygen supply. Number them in correct order from 1 to 4 according to increase in oxygen supply.



☐ ☐ ☐ ☐

## LET'S CONNECT

COMPUTER SCIENCE AND HISTORY

1. Make a PowerPoint presentation on any one inexhaustible source of energy such as wind energy, solar energy, and nuclear energy. Discuss the following aspects:
   - Can this source contribute majorly to the energy needs of the world?
   - What are the challenges associated with harnessing this source of energy?

- What are the advantages and disadvantages of this source of energy?
- What kind of climatic/geographical conditions are best suited for harnessing the energy from this source?
- Any other special characteristic.

2. Make a project report on the topic, 'History of fuels.' Trace the history of fuels starting from usage of wood by man about two million years ago to present times.

## LET'S APPLY

1. Why can we not use fire crackers as a fuel?(*Hint:* Type of combustion)
2. Which out of the two is a better method for using animal dung—making cakes and using it as a fuel in the kitchen or using biogas in homes by constructing biogas plants in the villages and why? (*Hint:* Characteristics of ideal fuels) LO 1
3. Which type of coal will have the highest and lowest calorific value and why? (*Hint:* Carbon content)

## LET'S ANALYSE AND EVALUATE

The pictures given below depict the generation of electricity by two methods. Thermal power plant uses coal energy and wind turbine utilizes wind energy for generating electricity. Answer the following questions based on the pictures.

1. Can you identify the polluting and non-polluting sources of energy from the pictures?
2. Categorize the sources of energy as inexhaustible and exhaustible sources of energy? LO 2
3. What type of pollution can be seen in the pictures?
4. Name any two pollutants released. Also discuss the effect of these pollutants on our health.

## LET'S CREATE

1. What will happen if we run out of fossil fuels on one fine day? Discuss the pros and cons of the situation and make a presentation on your thoughts. LO 11 LO 13
2. In groups of five, Prepare a report on alternative sources of energy (e.g., solar energy, nuclear energy, tidal power, and wind energy). You can use books/magazines/Internet to collect information. Evaluate fossil fuels (petroleum, coal, and natural gas) against solar energy on the following parameters: cost, challenges, impact on environment, and pollution. LO 13

**Web Research**

- To know more about making a solar water filter at home, check the following links.

https://www.youtube.com/watch?v=CktV2gWowX8 (accessed and checked on 12/08/2019)
https://playtube.pk/watch?v=fwwjSsMTFuU (accessed and checked on 12/08/2019)

# Worksheet 2

**Skills assessed:**
Problem solving and Qualitative analysis

**Read the passage and answer the questions.**

Identify the elements from the following observations.

In a certain exam, students were provided with six different elements: A, B, C, D, E and F. They observed that A, C, E and F had lustre. A, E and F were good conductors of electricity, and D, E, and F were good conductors of heat. B and F were liquids. E and B were brownish in colour, F was silvery white, and C was violet. A was soft, while D was extremely hard.

1. Name the six elements.

   A _____ D _____

   B _____ E _____

   C _____ F _____

2. Which of the above elements can be used in a thermometer?

   a. E b. F c. A d. B

3. Which of the following can be more suitable for making jewellery?

   a. C b. F c. B d. D

4. Which of the following can be used for making electrical wires and cables?

   a. E b. C c. A d. D

5. Which of the following can be best used as a lubricant for machine parts?

   a. E b. A c. B d. F

6. Which of the following would be the hardest substance?

   a. A b. C c. D d. B

UNIT 3: THE WORLD OF THE LIVING

# 6 Conservation of Plants and Animals

**You will learn about**

- Biodiversity
- Loss of biodiversity
- Conserving biodiversity

Sara has collected some picture cards of animals. Where are these animals likely to be found? Write your answer in the boxes provided.

Match the animals to the places where we can find them.

1. 

2. 

3. 

4. 

a. Ocean

b. Desert

c. Grasslands

d. Arctic Poles

Let us learn about the diversity (i.e., the number and variety) of organisms on Earth and the need to conserve them.

Answers: 1. c. Grasslands, 2. d. Arctic Poles, 3. a. Oceans, 4. b. Desert

## BIODIVERSITY

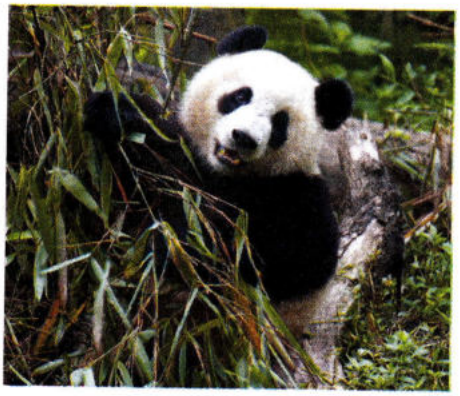
Our planet is inhabited by many different types of living organisms. They live in a variety of places such as forests, grasslands, deserts, rivers, oceans, and the polar regions. *The number and variety of plants, animals, and other organisms that exist is known as* ***biodiversity***. One can use the term biodiversity while talking about the organisms of a particular region, or of the Earth as a whole. Depending on climatic conditions and geographical area, some regions show higher biodiversity than others. Before exploring the various issues related to biodiversity, let us discuss a few terms associated with biodiversity.

***Species*** *They are a group or class of animals or plants having certain common and permanent characteristics that clearly distinguish it from other groups and which can interbreed among themselves.* For example, *Homo sapiens* or human beings form one type of animal species.

***Habitat*** *The natural environment of a plant or animal species, where it lives, multiplies, and thrives naturally is called its* ***habitat***.

***Flora and fauna*** *The numerous species of plants living in their habitat are called the* ***flora*** *of a place. The numerous species of animals living in their habitat are called the* ***fauna*** *of a place.*

***Endemic species*** *Plant and animal species confined to a specific geographical area are called* ***endemic species***. The giant panda [Fig. 6.1(a)], for example, is endemic to the mountains of Sichuan, Gansu, and Shanxi Provinces in China. In India, the Asiatic Lion [Fig. 6.1(b)] is endemic to Gir National Park in Gujarat.



(a) Giant panda

(b) Asiatic lion (male)

**Fig. 6.1** *Endemic species*

***Migratory species*** *Species of animals that travel long distances at certain times of the year in order to escape unfavourable conditions or to find more suitable conditions for feeding and reproducing are called* ***migratory species***. *The phenomenon of movement of animals in large numbers from one place to another to overcome unfavourable conditions is called* ***migration***. For example, migratory birds, such as the Siberian crane travel great distances and come to India in groups during winter in order to escape cold, unfavourable conditions.

## LOSS OF BIODIVERSITY

LL

Several species of plants and animals have become extinct in the last two centuries and there are many that face the threat of extinction. As life on Earth relies on the interactions and interdependencies among different plants and animals, biodiversity is essential for our

own survival. Loss of biodiversity (because of extinction) is, therefore, one of the leading environmental problems today. Some of the major causes for loss of biodiversity are given below.

**Fig. 6.2** *Deforestation*

***Destruction of forests*** *The loss or continual degradation of forest habitat due to natural or human-related causes is called* ***deforestation***. Following are the main reasons for deforestation.

- *Requirement of wood* is one of the main reasons trees are felled for (Fig. 6.2). Wood is used as a fuel, for making furniture, in construction, and for making paper, boats, ships, artworks, and rayon. It is also processed to make plywood (used for making furniture) and hardboard (used in construction, and for making furniture).
- *Overgrazing by cattle* is also a key factor that contributes to deforestation.
- *Rapid urbanization* and increase in human population have led to conversion of forests to agricultural land. Forests have also been cleared for construction of roads, railway tracks, and dams.

**Fig. 6.3** *Desertification*

Destruction of forests has the following adverse effects.

- Roots of trees help in binding the soil particles together. When trees are destroyed, soil is left loose and becomes prone to being eroded (i.e., being carried away) by wind and moving water. Loss of topsoil, which is rich in humus and nutrients, due to erosion reduces the fertility of soil. Over time, the fertile soil gets converted into a desert (Fig. 6.3). This is called *desertification*.
- Forests are the natural habitat of many species of animals and birds. Cutting down trees destroys the homes of these species, which poses a threat to their survival.
- As trees take in carbon dioxide and give out oxygen during photosynthesis, their destruction disturbs the balance of these gases in the atmosphere. Increase in the concentration of carbon dioxide in the atmosphere may lead to an increase in global temperature.
- Trees draw groundwater using their roots and release water vapour into the atmosphere through a process called transpiration. If a large number of trees are destroyed, overall transpiration rate will be greatly reduced. This can make the atmosphere drier and lead to reduced rainfall.
- Trees help to absorb the rainwater that falls on the ground. If they are destroyed, this excess water could cause floods.
- Loss of trees may lead to reduction in the binding capacity of soil particles during rainy season. This may, in turn, lead to landslides in mountainous regions.

***Pollution*** Pollution of air, water, and land adversely affects many plants and animals.

***Climatic changes*** Natural and human activities have led to global climatic changes. Species that are not able to adjust to the changing climate become extinct.

***Growth of invasive species*** When new species are introduced to a new region, they grow

and multiply rapidly, hindering the growth of already existing plants and animals, thus causing their gradual decrease and consequently death. A common example is the growth of water hyacinth on the surface of water bodies.

**Let's Discuss**

Strict laws should be enforced against poaching of animals Discuss.

***Hunting of animals*** Many animals are hunted down illegally for their meat, skin, and other body parts. Illegal hunting (called poaching) is a major threat to wildlife.

Poachers hunt animals for

- body parts used in traditional medicine, e.g., poaching of *Indian rhinoceros* (Fig. 6.4) for horns and the tiger for bones.
- body parts valued as ornaments, e.g., *Asian elephants* (Fig. 6.5) for ivory tusks (Fig. 6.6) and turtles for shells

**Fig. 6.4** *Indian rhinoceros*

**Fig. 6.5** *Asian elephant*

**Fig. 6.6** *Ivory tusks*

- fur and hides, e.g., deer and cattle for leather, alligators and snakes for skin (Fig. 6.7), and wild cats, minks, Tibetan antelope, and bears for fur. Reckless hunting of such animals has resulted in a drastic reduction in their numbers.

***Natural disasters*** Earthquakes, floods, droughts, cyclones, tsunamis, and hurricanes also contribute to the reduction of plant and animal species in many areas.

**Fig. 6.7** *Snake skin*

## Let's Remember

REMEMBERING UNDERSTANDING

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

1. All plant and animal species have become extinct in the last century.
2. Deforestation has helped roots to bind the soil particles together.
3. Poaching is the best way to preserve wildlife.
4. Tibetan antelope is hunted in large numbers for making medicines.
5. Hunting of animals has led to a drastic reduction in their numbers.

## CONSERVING BIODIVERSITY

*The preservation and careful management of plant and animal species in order to prevent their extinction is called* ***conservation***. Several steps have been taken by many national and international organizations towards conservation of biodiversity.

### Organizations Involved in Conservation

Conserving the biodiversity is the duty of every human being. To promote conservation, government and non-government organizations at the local, national, and international levels are constantly organizing awareness programmes and issuing rules and regulations to protect forests and wildlife.

The International Union for Conservation of Nature and Natural Resources (IUCN) works towards assessing the global conservation status of plant and animal species. IUCN maintains a comprehensive list known as *the IUCN Red List of Threatened Species*. Here, species are classified into nine categories, on the basis of criteria such as the rate of decline, population size, and area of geographical distribution. The main aim of the IUCN Red List is to focus the attention of conservationists towards species that are under threat of becoming extinct. IUCN also publishes a catalogue, called the *Red Data Book*, which lists rare species and those in danger of extinction.

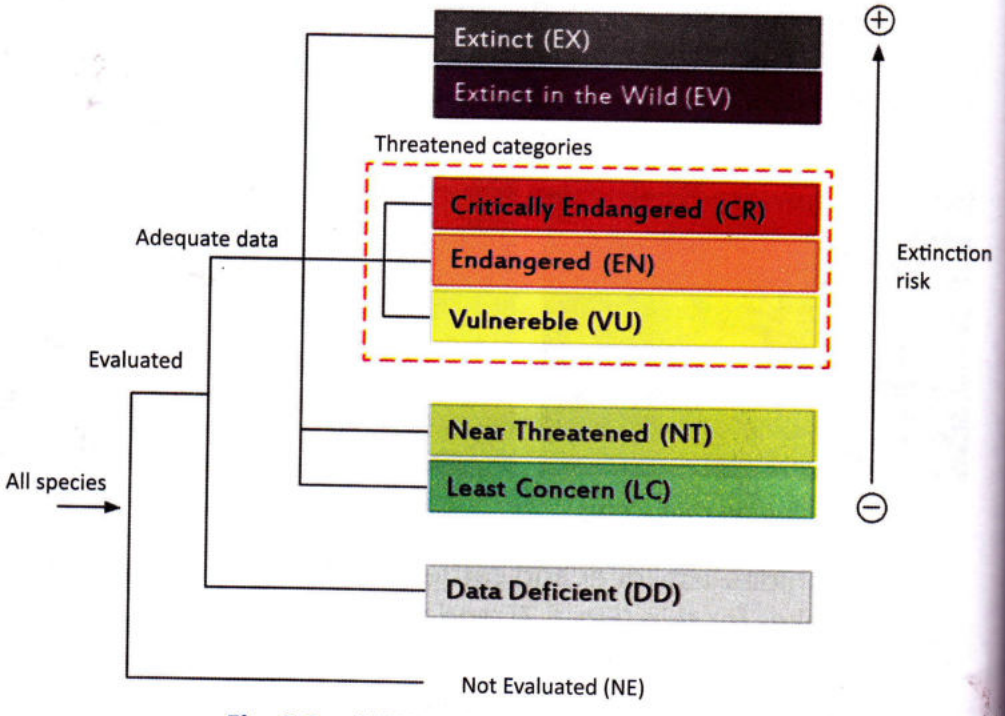



**Fig. 6.8** *IUCN categorization of species*

The nine categories in the IUCN Red List of Threatened Species are given alongside.

***Extinct species*** *Species that no longer exist anywhere on the Earth are called extinct species.* The dodo bird, Tasmanian wolf, and Labrador duck are examples of extinct species.

(a) Gharial (b) Asiatic cheetah

**Fig. 6.9** *Critically endangered species*

***Critically endangered species*** *Species that face an extremely high risk of extinction in the wild are called critically endangered species.* The Indian gharial [Fig. 6.9(a)], Great Indian Bustard, and the Asiatic cheetah [Fig. 6.9(b)] are examples of critically endangered species.

***Endangered species*** *Species that face a very high risk of extinction in the wild are called endangered species.* The Bengal tiger [Fig. 6.10(a)], Giant panda, Snow leopard [Fig. 6.10(b)], and Asian elephant are examples of endangered species.

(a) Bengal tiger

(b) Snow leopard

**Fig. 6.10** *Endangered species*

***Vulnerable species*** *Species that face a high risk of extinction in the wild are called vulnerable species.* The Indian bison [Fig. 6.11(a)], Indian Rhinoceros, and the mandrill [Fig. 6.11(b)] are examples of vulnerable species.

(a) Indian bison

(b) Mandrill

**Fig. 6.11** *Vulnerable species*

In India, some non-government organizations (NGOs) share the job of conserving the environment with the government. While some organizations aim at spreading awareness among people, some work towards implementation of rules and regulations setup by the government in this regard. Still others focus on restoring habitats through fieldwork and surveys. Some of the famous Indian conservation programmes that have gained recognition in the recent past are Project Tiger, the Van Mahotsava programme, and the Chipko movement.

## Protected areas

Several areas rich in biodiversity have also been declared as protected areas in order to maintain and protect the natural habitats of flora and fauna. Wildlife sanctuaries, national parks, forest reserves, zoological parks, and botanical gardens are such protected areas. Human activities in these areas is strictly controlled, and, at times, prohibited.

***Forest reserves*** Forest reserves are large areas of forest cover that are protected from human exploitation. Strict laws have been enacted all over the world to prevent felling of

trees in forest reserves. Thus, forest reserves have been established with an aim at serving the following purposes.

- Prevention of deforestation
- Replenishment of lost forest cover by planting new trees (reforestation)
- Protection of food and shelter meant for wildlife

***Wildlife sanctuaries*** Wildlife sanctuaries are special protected areas where only limited human activity is allowed. In India, there are more than four hundred wildlife sanctuaries. Cutting trees and hunting animals in these areas is strictly prohibited.

### Know your Scientist

Birbal Sahni (14 November 1891 – 10 April 1949) was an Indian biologist who studied fossils of plants in India and around. He developed theories of evolution in plants and also took an interest in the fields of Geology and Archaeology. He founded the Birbal Sahni Institute of Palaeobotany in the year 1946 at Lucknow. He worked on living plants species and studied their evolutionary process forming a link with the geographical distribution of plants across the Indian subcontinent. His ability to apply theory to observations and make hypotheses based on observations also helped his students immensely.

***National parks*** National parks are also protected areas meant for conservation of wildlife. Compared to wildlife sanctuaries, human activities in national parks is severely restricted or not allowed at all. Both national parks and wildlife sanctuaries aim to preserve natural flora and fauna in their natural habitats. Figure 6.12 shows the locations of various wildlife sanctuaries and national parks in India.

***Zoological parks*** A zoological park or zoo refers to any park, building, cage, enclosure, or premise in which animals are kept for public exhibition. Zoos play a major role in providing information about the occurrence of different species of plants and animals and in creating awareness among common people about the need to conserve nature. Some zoos also serve as breeding centres for certain rare or endangered animals

***Botanical gardens*** Botanical gardens are cultivated gardens established to conserve rare and threatened plant species. There are about 1600 botanical gardens world over. Most botanical gardens also serve as seed banks and have reserves of seeds of several species of plants.

### Case Study: Crocodile Conservation Project

The Indian Crocodile conservation project was introduced in Corbett in the year 1976. It is considered to be one of the more successful conservation initiatives in the world and has helped in the recovery of the dwindling numbers. The main aim of this project was to protect three endangered species of crocodiles, namely freshwater crocodile, the saltwater crocodile, and the *Gharial*.

The project ensured that crocodiles were bred on a large scale in captivity. The eggs of various species were collected from their natural habitat and were reared and made to hatch in captive breeding centres so that mortality rate was reduced before the newly hatched babies were released in the wild. To train and build a large group of captive breeders and trainers, the Central Crocodile Breeding and Management Training Institute has been set up in Hyderabad.


**Fig. 6.12** *National parks, tiger reserves, and wildlife and bird sanctuaries in India*

## Let's Remember


**A. Cross the odd one out. Give one reason for your choice.**

1. Plywood, paper, wood, overgrazing
2. Global warming, transpiration, deforestation, increase in carbon dioxide
3. Fur, horn, bones, rhinoceros

**B. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Hyacinth | a. Leather |
| 2. Turtles | b. Fur |
| 3. Elephants | c. Invasive species |
| 4. Cattle | d. Shells |
| 5. Mink | e. Ivory |

## Key Words

| | |
|---|---|
| **Biodiversity** | The number and variety of plants, animals, and other organisms that exist is known as biodiversity. |
| **Species** | They are a group or class of animals or plants having certain common and permanent characteristics that clearly distinguish it from other groups and which can inter-breed among themselves. |
| **Habitat** | The natural environment of a plant or animal species, where it lives, multiplies, and thrives naturally is called its habitat. |
| **Flora** | The numerous species of plants living in their habitat are called the flora of a place. |
| **Fauna** | The numerous species of animals living in their habitat are called the fauna of a place. |
| **Endemic species** | Plant and animal species confined to a specific geographical area are called endemic species. |
| **Migratory species** | Species of animals that travel long distances at certain times of the year in order to escape unfavourable conditions or to find more suitable conditions for feeding and reproducing are called migratory species. |
| **Migration** | The phenomenon of movement of animals in large numbers from one place to another to overcome unfavourable conditions is called migration. |
| **Deforestation** | The loss or continual degradation of forest habitat due to natural or human-related causes is called deforestation. |
| **Conservation** | The preservation and careful management of plant and animal species in order to prevent their extinction is called conservation. |
| **Extinct species** | Species that no longer exist anywhere on the Earth are called extinct species. |
| **Critically endangered species** | Species that face an extremely high risk of extinction in the wild are called critically endangered species. |
| **Endangered species** | Species that face a very high risk of extinction in the wild are called endangered species. |
| **Vulnerable species** | Species that face a high risk of extinction in the wild are called vulnerable species. |

## Summary

- The major causes for the loss of biodiversity are destruction of forests, pollution, climatic changes, growth of invasive species, hunting of animals, and natural disasters.
- The International Union for Conservation of Nature (IUCN) works towards assessing the global conservation status of plant and animal species and maintains a comprehensive list known as the IUCN Red List of Threatened Species.
- IUCN also publishes a catalogue, called the Red Data Book, which lists rare species and those in danger of extinction.
- Some of the famous conservation programmes in India that have gained recognition in the recent past are Project tiger, the Van Mahotsava programme, and the Chipko movement.
- Forest reserves are large areas of forest cover that are protected from human exploitation.
- Wildlife sanctuaries are special protected areas where only limited human activity is allowed.
- National parks are also protected areas meant for conservation of wildlife. Compared to wildlife sanctuaries, human activities in national parks is severely restricted or not allowed at all.
- Zoological parks and botanical gardens have been established to conserve animals and plants, respectively, and to create awareness among people about the need to conserve nature.

# Exercises

## LET'S UNDERSTAND


QT

### I. Objective type questions

**A. Fill in the blanks with the correct words.**

1. In _____ (endemism/migration) an animal moves from one place to another, to overcome unfavorable conditions.
2. _____ (Overgrazing/Destruction) by cattle is a key factor that contributes to deforestation.
3. _____ (Trees/Animals) help to absorb the rainwater that falls on the ground.
4. Species that no longer exist anywhere on the Earth are called _____ (extinct/endangered) species.
5. _____ (Wildlife sanctuaries/Botanical gardens) are special protected areas where only limited human activity is allowed.
6. _____ (Zoos/Botanical gardens) are cultivated gardens established to conserve rare and threatened plant species.

**B. Choose the correct option.**

1. Which of these refers to an endemic species?
   a. Natural environment of a plant  b. Species of animals living in a habitat
   c. Species confined to a specific geographical area
   d. A group of plant and animal species that thrives and multiplies
2. Which of these is a major cause for loss of biodiversity?
   a. Overgrazing by cattle and poaching of animals

b. Rapid urbanization and deforestation
c. Pollution and climate change
d. All of these

3. When new species is introduced in a region and grows and multiplies rapidly, thus causing the gradual decline of already existing plants is known as
   a. endemic species
   b. migratory species
   c. invasive species
   d. threatened species
4. Which of these does the Tasmanian wolf belong to?
   a. Extinct species
   b. Threatened species
   c. Critically endangered species
   d. Vulnerable species
5. Which of these are some Indian conservation programs?
   a. Zoos and Botanical gardens
   b. Chipko movement and Project Tiger
   c. Van Mahotsava and National parks
   d. Wildlife sanctuary and Zoo
6. Which of these refers to species of animals that travel long distances at certain times of the year in order to escape unfavourable conditions ?
   a. Endemic species
   b. Migratory species
   c. Flora and fauna
   d. Threatened species
7. Which of these has contributed to reduction of plant and animal species in many areas?
   a. Natural disasters
   b. Climatic changes
   c. Destruction of forests
   d. All of these
8. Human activities are restricted in which of these areas?
   a. Forest reserves
   b. Wildlife sanctuaries and national parks
   c. Botanical gardens and zoological parks
   d. All of these
9. Which of these is the main reason for poaching of Indian Rhinos?
   a. Fur and hide  b. Shells and skin  c. Bones  d. Horns
10. Which of these serve as breeding centres for certain rare or endangered animals?
    a. National parks
    b. Zoological parks
    c. Forest reserves
    d. None of these

## II. Very short answer type questions

### A. Give two examples for the following.

1. Reasons for deforestation _____ _____
2. Animals poached for fur _____ _____
3. Natural disasters that are reducing plant and animal species in large numbers _____ _____
4. Extinct species _____ _____
5. Critically endangered animal species of India _____ _____

6. Endangered animal species of India _____ _____
7. Animal species that are vulnerable _____ _____
8. Indian conservation programs _____ _____
9. Wildlife sanctuaries in India _____ _____
10. Bird sanctuaries in India _____ _____

**B. Give one word for the following.**

1. The number and variety of organisms that exist _____
2. The natural environment of a plant or animal species where it lives and thrives _____
3. The numerous plant species living in its natural environment _____
4. Plant and animal species confined to a specific geographical area _____
5. Large scale loss of forest habitat _____
6. Illegal hunting of animals _____
7. Species that no longer exist anywhere on the Earth _____
8. Species that are at a high risk of extinction in the wild _____
9. A confined or enclosed area where animals are kept for public exhibition _____
10. The preservation and careful management of plant and animal species to prevent them from extinction _____

## III. Short answer type questions

1. What is a species? Give one example.
2. Why do some places show higher diversity than others?
3. Why do some animals show migration?
4. Why are trees felled for wood?
5. Define poaching. Name any three animals that are commonly poached.
6. With the help of an example, define invasive species.
7. What does IUCN stand for? Name the book it comes out with, that lists threatened species.
8. List the nine categories of species in the IUCN list.

## IV. Long answer type questions

1. Explain biodiversity in detail.
2. Explain the major causes for loss of biodiversity on Earth.
3. Define conservation. Explain the role of NGOs in conservation of biodiversity in India.
4. Explain with examples what we mean by extinct, endangered and vulnerable species.
5. Explain briefly the different kinds of protected areas and how they have helped in conservation of biodiversity.

## LET'S RECALL

REMEMBERING

Recall and complete the concept map given below.

**Causes of loss of biodiversity**

1.
2.
3.
4.
5.

**Ways of conserving biodiversity**

1.
2.

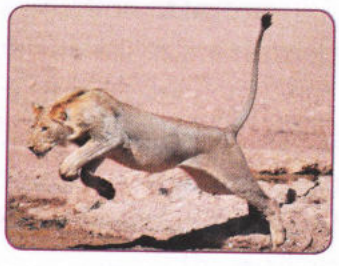
## LET'S OBSERVE

UNDERSTANDING

1. a. Name the animal in the picture _____
   b. What kind of an animal is this? _____
   (Threatened/ Vulnerable/ Extinct/ Endemic)
   c. Can you name any one more animal that falls in this category? _____ LO 2

2. Look at the pictures given below. Which picture shows flora and which one shows fauna? Write in the space provided. Also mention the habitat of each. LO 1

a.



Lioness: _____

Habitat: _____

b.

Water lily: _____

Habitat: _____

## LET'S CONNECT

ENGLISH

Imagine yourself as a forest officer. Write a formal letter to the Environment minister, detailing the issues of poaching and disappearance of food in your forests that have led to declining numbers of rhinos there. Suggest some measures that need to be put in place to save the rhinos from extinction in your letter.

_____

_____

_____

## LET'S APPLY

1. If we recycle paper, we can help in increasing the number of pandas says the Chinese government. Can this be true? How? LO 4
2. Prateek says that he sees Siberian cranes in the Bharatpur bird sanctuary only at a particular time, once every year. Could he be speaking the truth? Where do these birds disappear rest of the year? LO 3

## LET'S ANALYSE AND EVALUATE

LO 15 LO 13

1. Categorize these animals shown below as per the IUCN levels of threatened species.



2. Evaluate why the rhinos are still decreasing, despite measures. Which of the conservation methods could actually be most useful in saving the Indian rhinos?

## LET'S CREATE

1. In groups of five, make a poster on conservation of any one animal. Discuss with each other the animal that you would like to conserve, the drawing that you would make and add an effective slogan to your poster. Celebrate a week on conservation of wildlife and put up your posters in school, after taking required permissions. LO 13 LO 14
2. Choose any one plant species that is getting threatened and is on the verge of extinction. Design and draw a stamp of that plant and display it in class. LO 13
3. In groups of five, choose any one wildlife sanctuary or a forest reserve of the country and make a presentation on the name of the sanctuary, the animal/ plant it protects, the place where it is found and the challenges faced by it. Collect data and highlight how effective or ineffective it has been in protecting the species over the last five years. Give the presentation in your mother tongue. LO 13 LO 15

**Web Research**

- Browse the Internet and find out about Project Tiger and prepare a case study, using the information you gathered. Some suggested websites are:
  http://www.moef.nic.in/division/introduction-18 (accessed and checked on 12/08/2019)
  https://www.kaziranganationalpark.com/project-tiger.htm (accessed and checked on 12/08/2019)
- Find out about the various plant species that are listed in the IUCN Red Data book, under the various categories of: vulnerable, endangered, critically endangered and extinct species of India. Make a list of at least 10 species in each category. Some suggested websites are:
  https://www.iucn.org/theme/species/our-work/plants (accessed and checked on 12/08/2019)
  http://www.nationalredlist.org/red-listed-plants-of-india-2015/ (accessed and checked on 12/08/2019)

# 7 Cell: Structure and Function

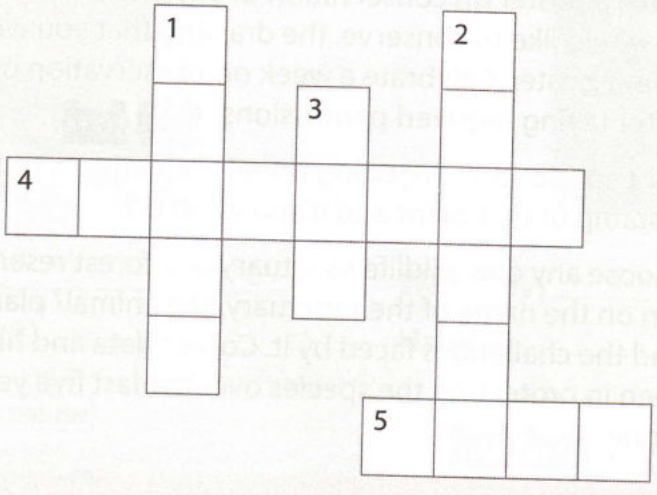
All living things carry out certain basic functions with the help of different sets of organs.

**You will learn about**

- Variation in cells
- Prokaryotic and Eukaryotic cells
- Preparing a slide to view cells
- Structure of a generalized cell
- Plant and animal cells
- Cell division and growth

Solve the following crossword with the help of clues.

1. What is stomach to the digestive system?
2. The xylem in the plant is an example of this.
3. Made up of one cell is _____ cellular.
4. The entire plant body.
5. The building block of a living body.




Cells are called the *structural unit* of an organ. These may be compared to the bricks of a wall. As bricks are assembled to make a wall, similarly, cells are assembled to form an organism.

Let us find out more about cells.

Answers: 1. Organ, 2. Tissue, 3. Uni, 4. Organism, 5. Cell

## VARIATION IN CELLS

*All organisms, whether plants, animals, or microorganisms, are made up of cells. The smallest structural and functional unit of an organism is called a* ***cell***. Cells of organisms show variation in terms of their number, shape, and size. Let us discuss each of these variations in detail.

### Variation in Number

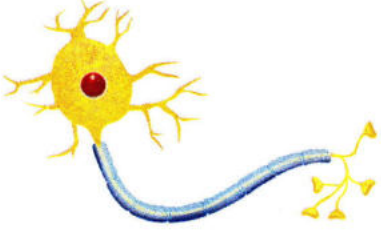
Organisms may be composed of one cell or of many cells. *Organisms whose body consists of a single cell are called* ***unicellular organisms***. Examples of unicellular organisms are *Amoeba, Paramoecium, Euglena*, and bacteria. In a unicellular organism, a single cell performs all vital activities such as feeding, movement, respiration, and reproduction. Thus, this single cell can exist independently.

*Organisms whose body consists of many cells are called* ***multicellular organisms***. In multicellular organisms, similar types of cells are grouped together to perform particular functions. Thus, different cells carry out different functions. Most plants and animals (including human beings) are multicellular organisms.

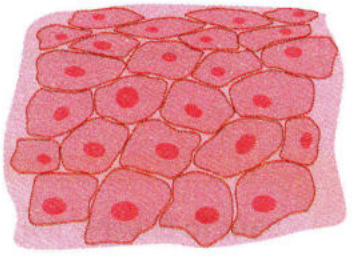
### Variation in Shape

Different cells, carrying out different functions, exist in different shapes. They can be disc-shaped, polygonal, rectangular, branched, or even irregular. The shape of a particular cell depends on the specific function it performs. The examples shown below illustrate this.

**Muscle cells** help in movement through contraction and expansion. Hence, they are thin and long.



**Nerve cells** carry messages between different parts of the body to the brain or spinal cord. Hence, they are elongated in shape.



**Skin cells** cover a large area. Hence, they are flat and broad in shape.

### Variation in Size

Most cells are microscopic and cannot be seen with the naked eye. Cell size may vary from a micrometre (a millionth of a metre) to a few centimetres. The smallest cells are bacteria, which generally range in size from 0.1 to 0.5 micrometre. The largest cell is the egg of an ostrich, which is 170 millimetre in diameter. Nerve cells are believed to be the longest cells, in the human body.

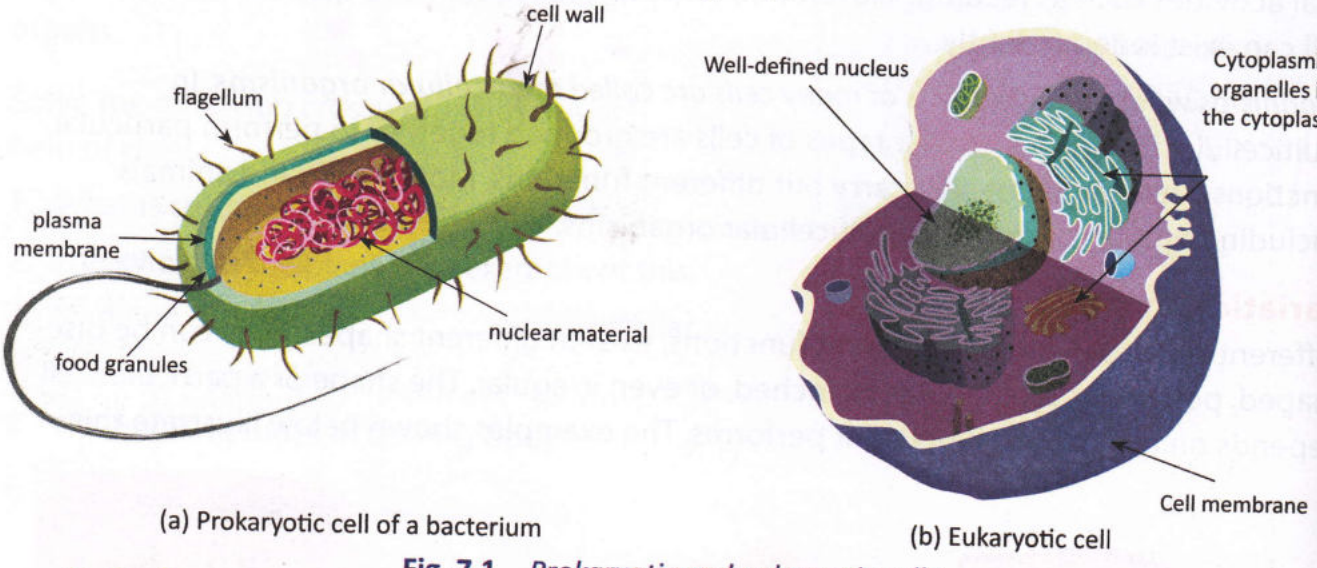
**Get it Right**

Cell size has no relation to the size of an organism. It is not necessary that the cells of, say, an elephant be much larger than those of a mouse.

## PROKARYOTIC AND EUKARYOTIC CELLS

The cells of certain organisms lack a well-defined nucleus. Instead, they contain genetic material floating in the cytoplasm. *Such cells that lack a well-defined nucleus surrounded by a nuclear membrane are called* ***prokaryotic cells*** *(pro,* primitive*; karyon,* nucleus*)* [Fig. 7.1(a)]. Organisms that have such cells are called prokaryotes. Examples of prokaryotes are bacteria and blue-green algae.

On the other hand, *cells that have a well-defined nucleus are called* ***eukaryotic cells*** [Fig. 7.1(b)]. Organisms that have such cells are called ***eukaryotes*** *(eu,* true*; karyon,* nucleus*)*. All organisms apart from bacteria, and blue-green algae, are eukaryotes. Viruses are neither *Eukaryotes* or *Prokaryotes* and fall in a different group.

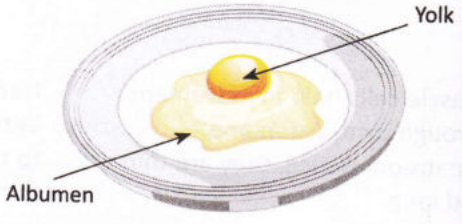



(a) Prokaryotic cell of a bacterium (b) Eukaryotic cell

**Fig. 7.1** *Prokaryotic and eukaryotic cells*

### Activity

**Aim:** To observe the structure of a single cell (hen's egg)
**Materials needed:** A hen's egg, a plate
**Method:** Crack the shell and break open the egg onto a plate.
**Observation:** The egg has a yellow part and a transparent part surrounding it. The transparent part (called albumen) is jelly-like and represents the cell's cytoplasm, while the yellow part (called yolk) is thicker and represents the cell's nucleus. On the internal side of the shell can be seen a thin membrane-like structure, which represents the cell membrane.




### History of the Cell

Robert Hooke (1635–1703), an Englishman, first discovered the cell in 1664 while examining a slice of cork under a microscope. Hooke observed that a slice of cork is made up of tiny honeycomb-like compartments, arranged one on top of the other. He called these compartments 'cells'. It was much later that scientists discovered that living things are made up of cells. Today, biologists study living things based on the cell theory

proposed by two German scientists, Matthias Schleiden and Theodor Schwann. The cell theory states that

- all organisms are made of one or more cells and
- cells arise from pre-existing cells.

You may be amazed to know that irrespective of the number of cells an organism is made up of, cell theory applies to every organism in the world!

## PREPARING A SLIDE TO VIEW CELLS

Most cells are viewed with the help of a compound microscope. To view a specimen under a microscope, it has to be first placed on a glass slide. *Preparing the specimen on a slide is called* ***mounting***. Two types of mounts are generally prepared in the laboratory: dry mount and wet mount.

A *dry mount* is generally used for viewing inanimate objects. As the term suggests, a dry mount does not require water. *Wet mounts* are generally prepared using water or glycerine and are used for viewing living specimens such as organisms and cells. In a wet mount, a small piece of the specimen is placed at the centre of the slide with one or two drops of water. The specimen is then covered with a coverslip and viewed under a microscope. In case of permanent slides (i.e., slides that need to be preserved for later use), materials other than water need to be used as the specimens have to be preserved for a longer duration. The specimen to be viewed under a microscope is often stained (i.e., coloured) with a dye. Staining highlights biological tissues and specific regions in the cells, which makes it easier for us to view the details (Fig. 7.2). Some of the commonly used staining dyes are iodine solution, safranin, methylene blue, and crystal violet.

**Word help**

**Inanimate** Not alive

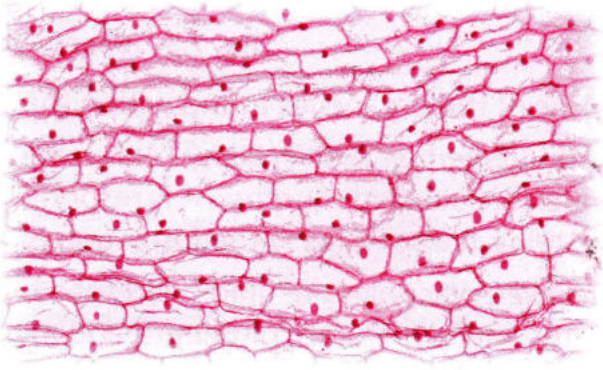


**Fig. 7.2** *Stained cells of onion peel when viewed under a microscope*

## STRUCTURE OF A CELL

LL

Though cells may differ in shape and size, all of them have the same basic structure. A cell contains both living and non-living parts. The main parts of any cell are cell membrane, cytoplasm, and nucleus.

### Cell membrane

A cell membrane is the outermost covering of a cell, which protects the cell and demarcates it from other cells. It is a porous membrane and is selectively permeable. This

means that the cell membrane allows certain substances to pass through, while restricting the absorption of other substances. Plant cells have an additional layer outside the cell membrane, called the *cell wall*. The cell wall is made up of cellulose and is tough and rigid, giving shape to plant cells. Animal cells lack the cell wall.

## Cytoplasm

The cytoplasm is a viscous jelly-like substances present within the cell membrane. It is the site for most of the cell's chemical reactions. Present within the cytoplasm are several, *living membrane-bound bodies that have definite shape and functions*, called cell organelles. Figure 7.3 shows some of the organelles present in an animal cell.

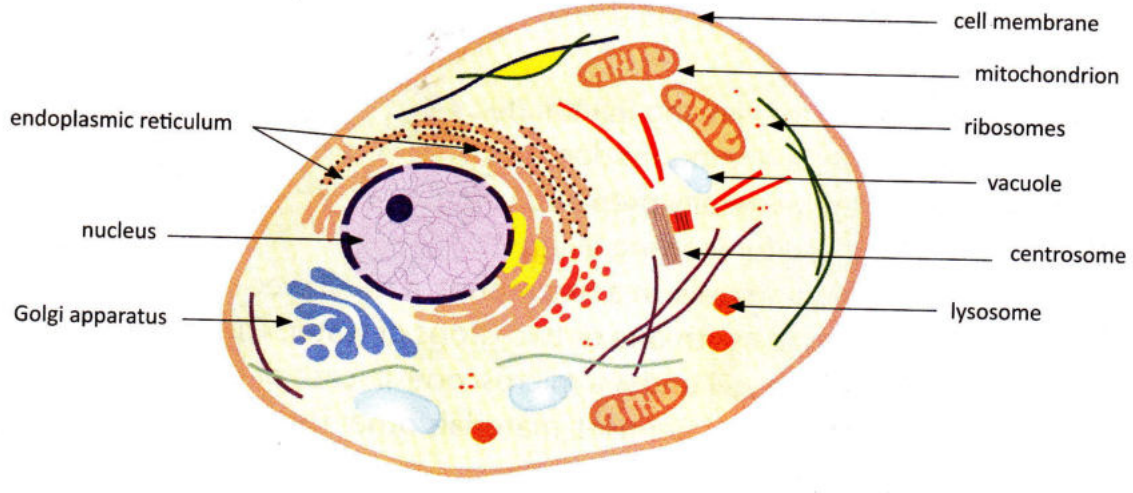



**Fig. 7.3** *Generalized structure of an animal cell*

Some of the organelles found within the cell are discussed below.

***Golgi apparatus (or Golgi body)*** It is made of several membrane-bound, fluid-filled sacs, which are stacked together. It is responsible for the packaging and transporting of fats and proteins. It also helps in the formation of lysosomes.

***Vacuole*** Vacuoles are fluid-filled spaces enclosed by a membrane. Vacuoles store excess water, useful minerals, pigments, and many other substances. Large vacuoles are present in plant cells, where they maintain the shape of the plant cell. Smaller and more numerous vacuoles are present in animal cells.

***Lysosomes*** Lysosomes contain chemical substances called enzymes that are capable of digesting cells and a variety of intra- and extra-cellular materials [intra, internal (inside); extra, external (outside)]. In times of emergency, lysosomes burst and destroy the cell. Hence, they are also called *suicide bags of the cell.*

***Endoplasmic reticulum*** It is an interconnected network of tubules and channels and is involved in the synthesis, storage, and transport of cell products.

***Ribosomes*** Ribosomes are small granular structures found scattered around in the cytoplasm. They are the primary sites for protein synthesis. Ribosomes are sometimes found attached to the surface of endoplasmic reticulum. Such a type of endoplasmic

reticulum (ER) is called *Rough endoplasmic reticulum (RER)*. On the other hand, *Smooth endoplasmic reticulum (SER)* does not have attached ribosomes.

***Mitochondria (singular: mitochondrion)*** These are also double membrane-bound, spherical or rod-shaped bodies. They act as sites of energy production and are, therefore, called the powerhouses of the cell.

***Plastids*** Plastids are double membrane-bound organelles which are present only in plant cells. They are spherical or ovoid in shape and bear certain pigment that have a specific role to play in the functioning of the plant. Depending on the pigment colour, plastids are of three kinds: chloroplasts, chromoplasts, and leucoplasts.

- Chloroplasts contain the green pigment chlorophyll, which helps plants in making food (Fig. 7.4).
- Chromoplasts contain non-green pigments that give colour to flowers and fruits.
- Leucoplasts are colourless and store food in the form of carbohydrates, fats, and proteins.

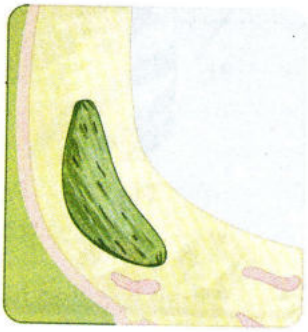


**Fig. 7.4** *Chloroplast*

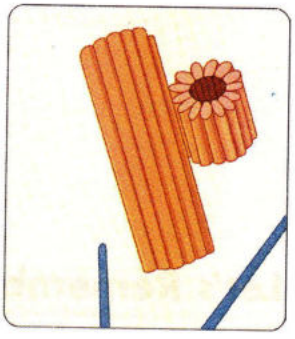


**Fig. 7.5** *Centrosome*

***Centrosomes*** These are present only in animal cells (Fig. 7.5). Centrosomes initiate and regulate cell division.

**Let's Discuss**

Not all plants have green leaves, some have coloured leaves. Discuss.

**Know your Scientist**

Har Gobind Khorana (9 January 1922 – 9 November 2011) was an Indian American scientist who won the Nobel Prize for Medicine in the year 1968. His research with co-researchers with whom he shared his Nobel Prize showed the manner in which genetic code was carried in nucleic acids. He also discovered how nucleotides in nucleic acids also controlled the synthesis of proteins in a cell.

## Nucleus

The nucleus (Fig. 7.6) is considered to be the brain of the cell. It is a spherical body surrounded by a double-membrane called the *nuclear membrane*. This membrane bears many pores, called *nuclear pores*. Within the nuclear membrane lies the semi-solid *nucleoplasm*, which contains several thread-like fibres called *chromatin fibres*. These fibres carry genes, which transfer the characteristics of a cell to the new cells that are formed during cell division. The nucleus also bears one or more rounded granules called *nucleolus*. The nucleolus is an important site for protein synthesis.

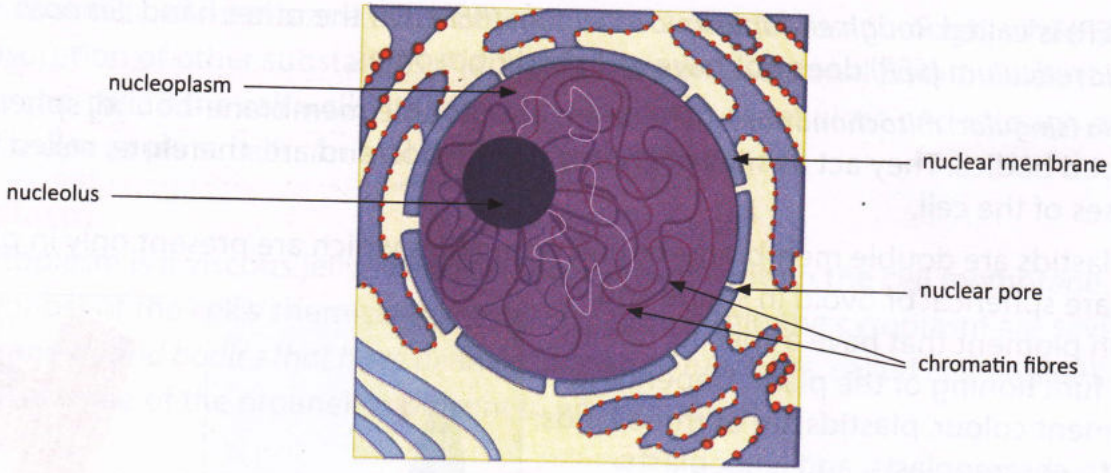


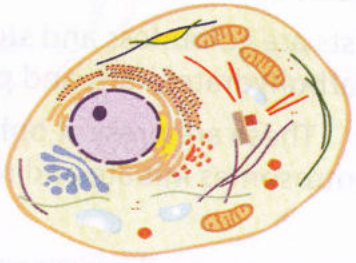

**Fig. 7.6** *Parts of the nucleus*

## Let's Remember

REMEMBERING UNDERSTANDING

**Identify the parts of the cell given below, and then label them on the diagram.**

1. A viscous jelly-like substance within the cell membrane _____
2. Suicide bags of the cell _____
3. Primary sites for protein synthesis _____
4. Powerhouses of the cell _____
5. Brain of the cell _____
6. Fibres that carry genes _____



## PLANT AND ANIMALS CELLS

LL

Although plant and animal cells have the same basic structure, there are certain differences between them.

Figures 7.7 and 7.8 compare a plant cell and an animal cell.

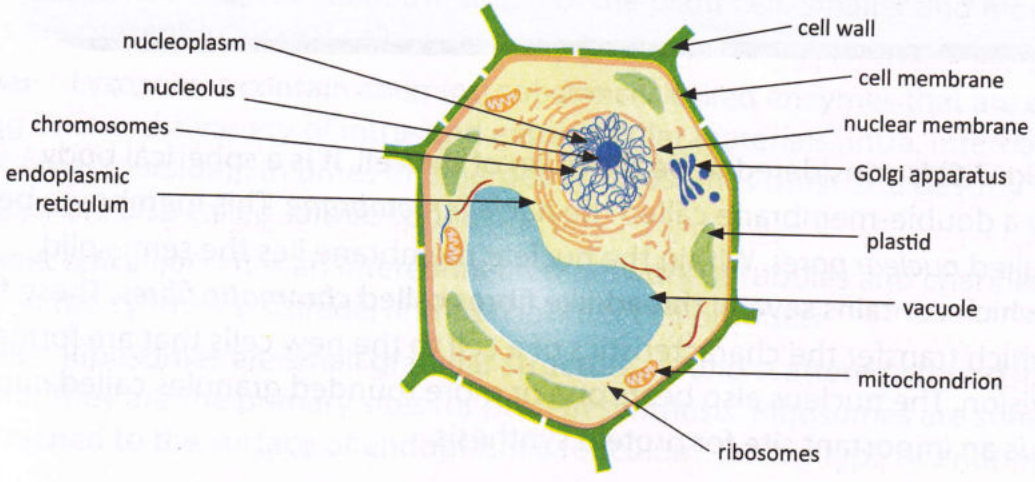



**Fig. 7.7** *Plant cell*

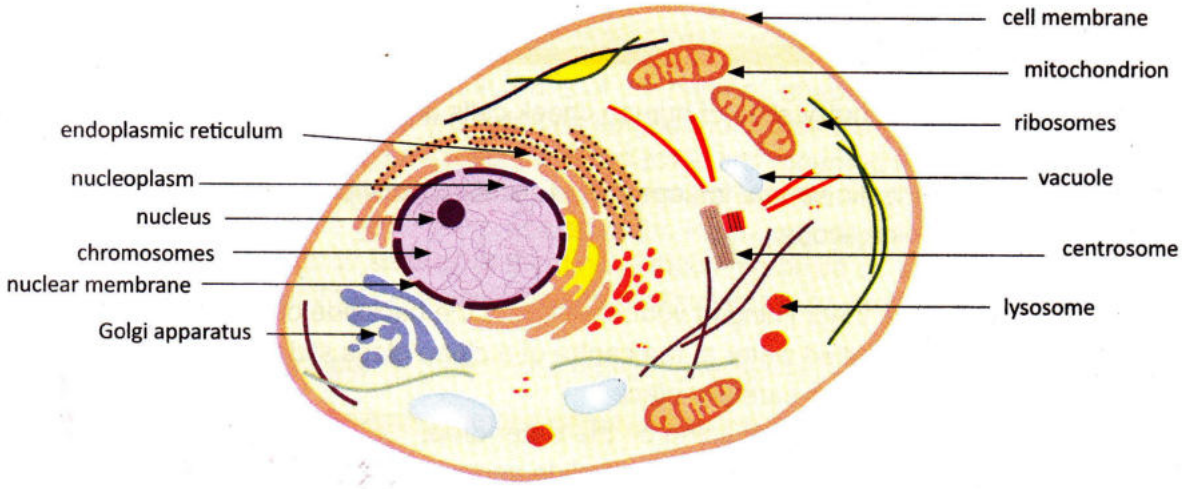



**Fig. 7.8** *Animal cell*

The differences between a plant cell and an animal cell are listed in Table 7.1.

**Table 7.1** Differences between a plant cell and an animal cell

| Plant cell | Animal cell |
|---|---|
| 1. Cell wall is present. | 1. Cell wall is absent. |
| 2. Cytoplasm is not as dense as in an animal cell. | 2. Cytoplasm is dense. |
| 3. A large vacuole is present. | 3. Vacuoles are generally absent. If present, they are small in size. |
| 4. Plastids are usually present. | 4. Plastids are absent. |
| 5. Centrosome is absent. | 5. Centrosome is present. |

## Activity

**Aim:** To prepare a temporary slide of an onion peel and observe the cells under a microscope
**Materials needed:** Onion, blade, forceps, glass slides, coverslip, glycerine, iodine solution, dropper, blotting paper, and microscope
**Method:**

1. Cut out a portion of the onion.
2. Separate the fleshy scales with the help of a pair of forceps and carefully peel out a piece of the onion scale.
3. Place the peeled scale on a glass slide and add a drop of dilute iodine solution to colour the onion peel.
4. Take another glass slide and put a drop of glycerine at its centre. Place the coloured onion peel on the glycerine drop and carefully cover it with a coverslip. Wipe any extra glycerine on the sides of the coverslip using a blotting paper.
5. View the slide under the microscope.

**Observation:** You should be able to see the large vacuoles and thick cell walls peculiar to plant cells.

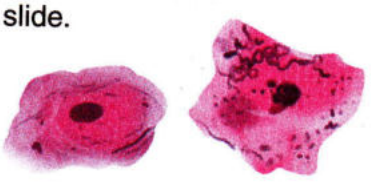
## Activity

**Aim:** To prepare a temporary slide of human cheek cells and observe them under a microscope

**Materials needed:** Plastic spoon, forceps, glass slides, coverslip, distilled water, dropper, blotting paper, and microscope

**Method:**

1. Gently scrape the inner lining of your cheek with the backside of a plastic spoon.
2. Place a drop of distilled water at the centre of a clean glass slide.
3. Using a pair of forceps, carefully place a small piece of the scraped lining on the water drop.
4. Carefully place a coverslip on the glass slide and wipe off extra drops of water on the sides of the coverslip.
5. View the slide under the microscope.



Cheek cells

**Observation:** You should be able to see the cell membrane, cytoplasm, and nucleus of cells from the lining of the cheek.

## CELL DIVISION AND GROWTH

The food that we eat leads to an increase in the size of cells. After reaching a certain size, a cell divides into two by a process known as *cell division*. Increase in the number of cells in the body as a result of cell division is responsible for growth in organisms. Cell division also replaces the dead or damaged cells with new ones and is, thus, responsible for healing wounds.

### Get it Right

Growth occurs because of cell division, not because of an increase in the size of cells. Most cells only grow till a certain point, after which they start dividing.

## Key Words

| | |
|---|---|
| **Cell** | The smallest structural and functional unit of an organism is called a cell. |
| **Unicellular organisms** | Organisms whose body consists of a single cell are called unicellular organisms. |
| **Multicellular organisms** | Organisms whose body consists of many cells are called multicellular organisms. |
| **Prokaryotic cells** | Cells that lack a well-defined nucleus surrounded by a nuclear membrane are called prokaryotic cells. |
| **Eukaryotic cells** | Cells that have a well-defined nucleus are called eukaryotic cells. |
| **Organelles** | Living, membrane-bound bodies that have definite shapes and functions are called organelles. |

## Summary

- Cells of organisms show variation in terms of the number, shape, and size of cells.
- Most cells can be viewed with the help of a compound microscope.
- To view a specimen under a microscope, it has to be first mounted (i.e., placed) on a glass slide and covered with a coverslip. The specimens are often stained with a dye.
- Two types of mounts are generally prepared in the laboratory: dry mount and wet mount.
- Though cells may differ in size, all of them have the same basic structure.
- Although plant and animal cells have the same basic structure, there are certain differences between them.
- Cell division is responsible for growth and healing of wounds in organisms.

# Exercises



## LET'S UNDERSTAND

REMEMBERING UNDERSTANDING

QT

### I. Objective type questions

**A. Fill in the blanks with the correct words.**

1. Cells of organisms are _____ (same and do not differ/different) in shape and size.
2. _____ (Muscle/Skin) cells cover a large area and are thus flat in shape.
3. _____ (Skin/Nerve) cells are the longest cells in the human body.
4. Cells that have a well-defined nucleus are called _____ (eukaryotic/ prokaryotic) cells.
5. A _____ (dry/wet) mount is generally used for viewing inanimate objects.
6. A cell _____ (membrane/wall) is the outermost covering of a cell.
7. _____ (Cell division/Cell organelle) is responsible for growth in organisms.

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

1. All cells of living beings are the same in shape and size.
2. Nerve cells help in movement through contraction and expansion.
3. All organisms are eukaryotic in nature.
4. We cannot prepare a mount of a specimen by using water.
5. All parts of a cell are living in nature.
6. Vacuoles are empty spaces found only inside a plant cell.

**C. Choose the correct option.**

1. In which of these terms do cells show variation?
   a. In number
   b. In shape and size
   c. In a. and b.
   d. In cytoplasm and nucleoplasm
2. Which of these are prokaryotes?
   a. Amoeba and paramoecium
   b. Hydra and human beings
   c. All plants and animals
   d. Bacteria and blue green algae
3. Which of these are organelles found in the nucleus?
   a. Cytoplasm and ribosomes
   b. Chromatin and nucleolus
   c. Nucleoplasm and plastids
   d. Golgi apparatus and mitochondria

4. Which of these are commonly used stains for making a slide?
   a. Glycerine and water
   b. Coverslip and specimen
   c. Iodine solution and safranin
   d. None of these
5. Which of these are plastids found only in plant cells?
   a. Chloroplasts
   b. Chromoplasts
   c. Leucoplasts
   d. All of these
6. Which of these are the longest cells in the human body?
   a. Muscle cells b. Nerve cells c. Skin cells d. Brain cells
7. Which of these are neither Eukaryotes nor Prokaryotes?
   a. Bacteria b. Virus c. Blue green algae d. Fungi
8. Which of these is true about living cells?
   a. They contain both living and non living parts
   b. They contain cytoplasm and nucleus
   c. They have an outer cell membrane
   d. All of these
9. Which of these cell organelles contain enzymes that digest cells and cellular material?
   a. Golgi apparatis b. Lysosomes c. Ribosomes d. Vacuoles
10. Which of these initiate and regulate cell division in animal cells?
    a. Chromosomes b. Centrosomes c. Chloroplasts d. Golgi apparatus

## II. Very short answer type questions

### A. Give one word for the following.

1. The smallest structural and functional unit of an organism _____
2. Organisms whose body consists of many cells _____
3. Cells that lack a well-defined nucleus _____
4. A living membrane bound body that have a definite shape and function _____
5. The process of preparing the specimen on a slide _____
6. Non green pigments in plants that gives colour to flowers and fruits _____
7. They initiate cell division in animals _____

## III. Short answer type questions

1. What is a cell? How do cells differ from each other?
2. What is a prokaryotic cell? Give two examples.
3. What is a eukaryotic cell?
4. What is mounting? Name two kinds of mounts that are generally prepared in the laboratory.
5. Name the three main parts of a cell.
6. What is an organelle? Name any two organelles found inside the nucleus.
7. What does ER, RER, and SER stand for?
8. What are plastids? Name three kinds of plastids.
9. What is a nucleolus?
10. What is cell division? Why do cells need to divide?

## IV. Long answer type questions

1. Explain how cells differ from each other in shape, size, and number.
2. How would you prepare a slide of a human cheek for viewing?
3. With the help of a labelled diagram, explain the role of any five organelles present in the cytoplasm of a generalized cell.

4. With the help of a labelled diagram, explain the structure of a nucleus.
5. Differentiate between plant and animal cells.

## LET'S RECALL

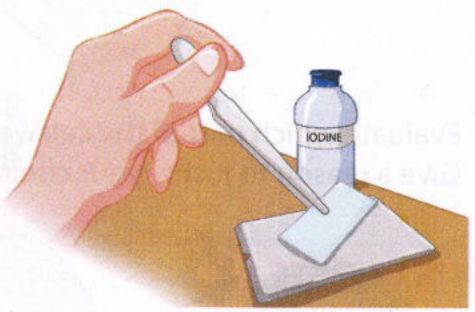
Recall and complete the concept map given below.

**Main parts of a generalized cell**

- Cell membrane
- Nucleus
  1.
  2.
  3.
  4.
- Cytoplasmic organelles
  1. 2. 3. 4.
  5. 6. 7. 8.
  9. 10. 11.

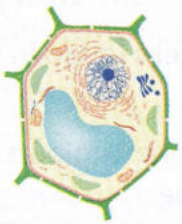
## LET'S OBSERVE

A. Observe the picture and answer the questions.




1. Label, a. Specimen, b. Slide, and c. Stain.
2. The girl is trying to view her cheek cells. What is the process of making the slide called? LO 8
3. Is she making a dry or a wet mount?
   _____
4. What will she use iodine solution for?
   _____

B. Label the diagrams given below.

1. 

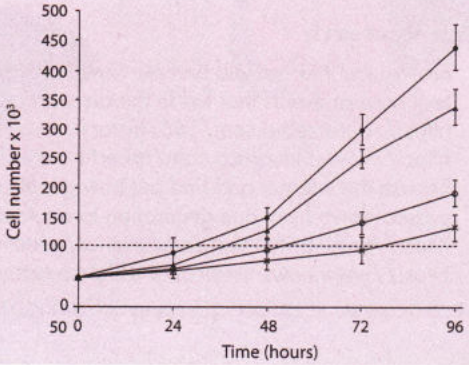
2. 

Which of these represents a plant cell? _____

## LET'S CONNECT MATHS

Study the graph given here that shows the cell multiplication in four petri dishes over a few hours.

How many cells are found in the four petri dishes after 24 hours and 48 hours, if the X-axis represents the value of *x* and the number of cells = $\times 10$ to the power of 3?

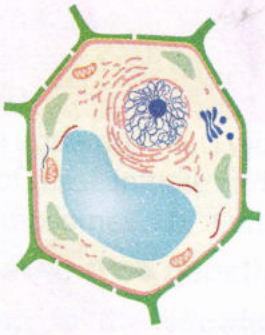


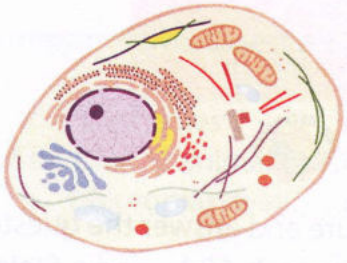
## LET'S APPLY


1. Mohan was making a slide of an onion peel. He is unable to view the details of the cells clearly under a microscope. Which of the solutions shown here should he use? What is the process of adding it called? _____ LO 3
2. Why are nerve cells longer than skin cells?

## LET'S ANALYSE AND EVALUATE

1. Compare the two figures given below and then analyse which of the two would be the cell of a hen's egg. LO 1





2. Evaluate which part of the cell would help to preserve the characteristic features of a species. Give a reason to justify your choice. LO 4

## LET'S CREATE

1. Go to a laboratory and observe permanent slides of human blood, slides of stem to see tissues, and any other 4 different types of cells. Make drawings to show the cells on a chart paper. LO 9
2. Make a chart showing the shape and structure of different types of cells found in the human body. LO 9
3. Make a plasticine model of a generalized cell, using plasticine of different colours. Then talk about the structure and functions of each part in your mother tongue.
4. Put flowers in a vase with water. Leave the arrangement for a few days. Then, make a slide using a drop of water from the vase and view it. Draw all that you can see. LO 8

**Web Research**

- Browse the Internet and find out how cell was discovered by Robert Hooke. Then write a brief account describing the sequence of events that led to the discovery. Some suggested websites are:
  https://bitesizebio.com/166/history-of-cell-biology/ (accessed and checked on 12/08/2019)
  https://www.thoughtco.com/robert-hooke-discovered-cells-1991327 (accessed and checked on 12/08/2019)
- Browse the Internet and find out how genetics play a role in inheritance. Find out how physical characteristics get passed down from one generation to another and write a report.
  https://www.britannica.com/science/genetics (accessed and checked on 12/08/2019)
  https://www.news-medical.net/life-sciences/What-is-Genetics.aspx (accessed and checked on 12/08/2019)

# 8 Age of Adolescence

In our day-to-day life, we experience various emotions. Sometimes, we feel very happy and sometimes we feel sad. Similarly, we experience various emotions such as fear, excitement, anger, worry, embarrassment, and irritation.

**You will learn about**

- Endocrine system
- Adolescence and puberty
- Nutritional requirements and personal hygiene
- Drug abuse and AIDS

Write one emotion, to express how you would feel in each of the following situations:

1. If you see a tiger approaching you
   _____

2. If you see your younger brother playing with your school project
   _____

3. If your mother gets angry at you
   _____

4. If you find your homework is lost
   _____

5. If you forgot your textbook at home
   _____

Answers: 1. Fear, 2. Anger, 3. Upset, 4. Anxious, 5. Worried

## ENDOCRINE SYSTEM

LL

The endocrine system consists of a collection of specialized organs that secrete particular chemical substances, called glands. These glands are located at specific places inside our bodies. The chemical substances released by these glands, called *hormones*, are released directly into the bloodstream and act as chemical messengers.

The major glands that make up the human endocrine system are pituitary, thyroid, adrenals, pancreas, ovaries, and testes.

The pituitary gland, located at the base of the brain, is called the *master gland* of the endocrine system because it releases hormones that control the activities of the other endocrine glands.

The adrenal gland is called the gland of *emergency* because it releases the hormone, epinephrine or adrenaline, which prepares the body to act when we are in a stressful or potentially dangerous situation. Hence it is also known as the *fight-or-flight* hormone. It is because of this hormone that the body experiences emotional states such as anger and excitement. The changes brought about by adrenaline are widespread, very rapid, and last a very short time. Some of the changes brought about by adrenaline are listed below.

- It increases the heart rate.
- It increases the overall blood sugar level.
- It results in an overall increase in the body's energy level.

A diagrammatic representation of the human endocrine system is shown in Figure 8.1.

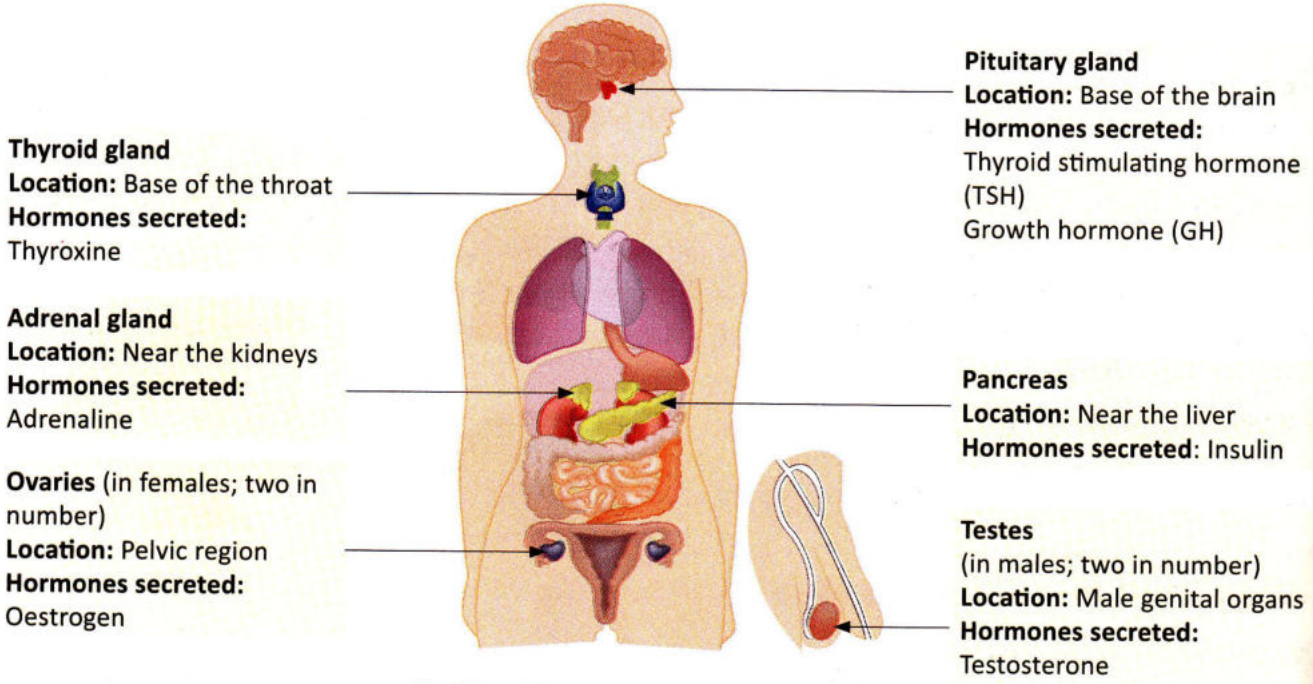



**Fig. 8.1** *Diagrammatic representation of the human endocrine system*

The role of a few key hormones is given in Table 8.1.

**Table 8.1** Hormones and their role in the body

| Hormone | Role in the body |
|---|---|
| Thyroid stimulating hormone (TSH)<br>Growth hormone (GH) | TSH stimulates the growth and functions of the thyroid gland.<br>GH stimulates the growth and development of the body. |
| Thyroxine | It regulates body metabolism and plays an important role in growth and development. Inability of the body to produce this hormone may result in a disease called goitre, which causes swelling of the neck. |
| Adrenaline | It helps in the defence of the body in emergency situations. |
| Insulin | It regulates the blood sugar level. Inability of the body to produce insulin in sufficient quantity may result in a disease called diabetes. |
| Oestrogen | It controls the development of secondary sexual characteristics, such as development of breasts, in females. |
| Testosterone | It controls the development of secondary sexual characteristics, such as facial hair, in males. |

Hormones play an important role in the growth and development of the body, especially during a period known as *adolescence*.

## ADOLESCENCE AND PUBERTY

*The period of transition from childhood to adulthood is called* ***adolescence***. The boys and girls passing through this period are called adolescents. The World Health Organization (WHO) defines adolescence as the period of life between 10 and 19 years of age. Adolescence is characterized by the reproductive organs in both males and females reaching maturity and beginning to function. A female will start to produce egg (or ovum) and the male will start to produce sperms. Other changes also take place such as development of breasts in girls, and facial hair in boys. As these characteristics help in distinguishing boys from girls, they are referred to as secondary sexual characteristics. The stage in which *secondary sexual characteristics* develop is referred to as the stage of maturity or puberty. ***Puberty*** *is the time of growth in which an individual becomes sexually mature and achieves reproductive maturity.* Let us discuss the changes that take place when girls and boys reach puberty.

### Physical Changes

The following physical changes take place in girls and boys during puberty.

***Development of reproductive organs*** In girls, the ovaries enlarge and start producing mature eggs. In boys, the testes and penis develop completely and the testes start producing sperms.

***Enlargement of breasts*** During puberty, breasts increase in size and milk-producing glands called mammary glands develop inside them.

***Increase in height and weight*** Puberty is characterized by a 'growth spurt'—a rapid increase in height and weight in both boys and girls. The rate of growth may vary from person to person. Generally, girls grow faster than boys initially, but both reach their maximum height around 18 years of age.

**Fact File**

Hormones are present in plants too. Plant hormones (also called phytohormones) control or regulate germination, growth, metabolism, and other important activities in plants.

***Change in body shape*** In girls, the hips broaden and the pelvic region widens. In boys, muscles develop and shoulders and chest become broader.

***Body hair*** During puberty, hair develop under armpits, in the pubic region as well as arms and legs in both boys and girls. Boys also develop facial hair (i.e., moustache and beard) and hair on the chest.

***Change in voice*** The voice box or larynx increases in size during puberty, which results in a change in voice. Generally, this increase in size is more prominent in boys and the enlarged voice box can be observed as a lump called *Adam's apple* in the neck region (Fig. 8.2). Due to larger voice boxes, boys generally develop a deep voice while girls tend to have a high-pitched voice. Initially, increase in the size of the larynx may cause a boy's voice to 'crack' or 'break', but the voice becomes normal after some time.

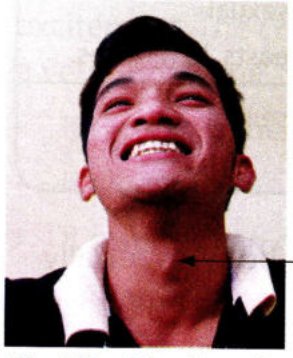


**Fig. 8.2** *Adam's apple*

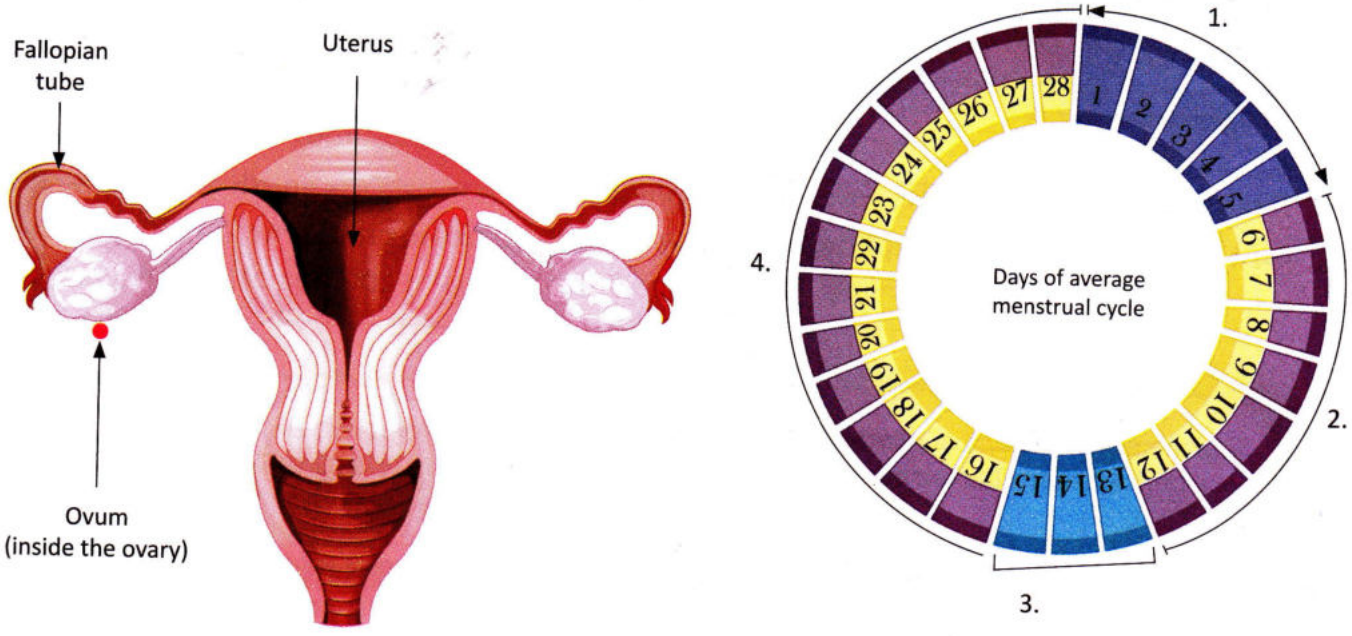
***Increased activity of sweat and oil glands*** During puberty, sweat and oil glands in the body become very active and cause increased sweating. Increased activity of oil glands cause, *acne* or *pimples* in adolescents.

## Menstrual cycle

*The cycle of producing and releasing mature ova along with associated changes in the ovaries and uterus is called the* ***menstrual cycle*** *(menstrual* means 'month' in Latin). The start of the menstrual cycle indicates that the girl has now acquired the ability to have a baby. The following are the sequence of events that occur during a menstrual cycle:

1. The pituitary gland secretes a hormone that stimulates the ovaries to release a mature ovum. The two ovaries take turns to produce an egg or ovum (plural ova), and one ovum is released every 28 days. *The process of release of a mature ovum by an ovary is called* ***ovulation.***
2. The ovaries release two important hormones, oestrogen and progesterone, which changes the lining of the uterus, and prepares itself for possible pregnancy.
3. The ovum then begins its journey down the fallopian tube (Fig 8.3(a)).
4. In case the ovum is not fertilized by a sperm, it dies and starts disintegrating and the hormone levels drop.

5. The lining of the uterus starts breaking down and is shed, accompanied by a loss of blood. This phase, which usually lasts 4-6 days, is called a girl's menstrual period or *menstruation*.
6. The next menstruation takes place after around 28 days if there is no fertilization within this period. Fig. 8.3 (b) shows the various changes occurring during the menstrual cycle. An adolescent girl's first menstruation is called *menarche*, and usually occurs between 10–15 years of age. As a woman grows older, her ability to reproduce and have a baby decreases. Her menstruation eventually stops. This is called *menopause*, and usually happens between 45 and 55 years of age.




(a) Ovum, fallopian tube, and uterus

1. Lining of uterus sheds
2. New egg matures
3. Ovulation (ovum is released from ovary)
4. Ovum travels to the uterus and dies if not fertilized

(b) Changes occurring during the menstrual cycle

**Fig. 8.3** *Ovulation and menstrual cycle*

## Emotional Changes

A person may also experience various emotional changes during puberty. Due to an increase in the hormonal level, mood swings and irritability may occur. One may become conscious of the changes occurring in one's body and feel awkward or embarrassed. During this phase one may also develop attraction towards the opposite sex. Puberty is also the phase during which one has a great capacity to learn and one's way of thinking matures. Adolescents begin to think independently and learn to make their own decisions. They often tend to get confused. All these changes are normal and are a part of growing up.

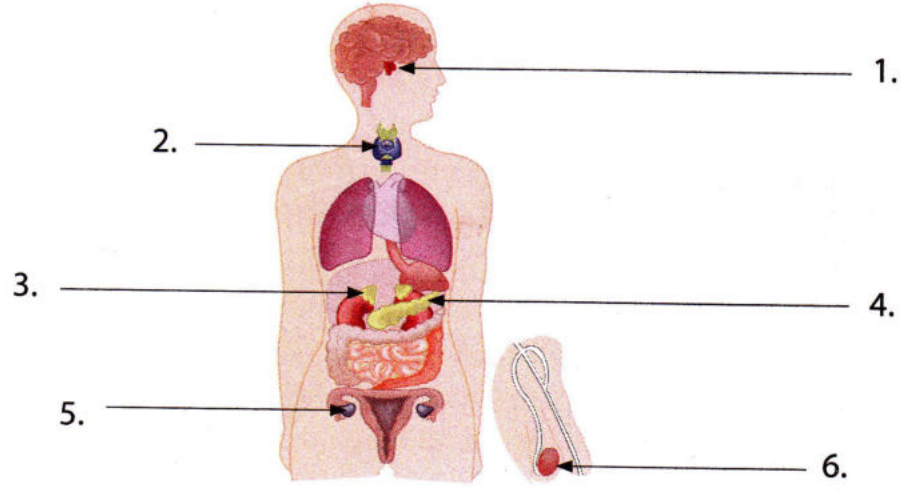
## Role of Hormones During Puberty

The changes experienced during adolescence are brought about by hormones. In girls,

a hormone released by the pituitary gland stimulates the ovaries to produce female sex hormones called *progesterone* and *oestrogen*. Oestrogen is responsible for the production of ova and development of secondary sexual characteristics in girls. In boys, a hormone released by the pituitary gland stimulates the testes to produce the male sex hormone called *testosterone*. Testosterone is responsible for the production of sperm cells and the development of secondary sexual characteristics in boys.

## Let's Remember

**Identify each of the following glands and label them.**




## NUTRITIONAL REQUIREMENTS AND PERSONAL HYGIENE

During adolescence, there is rapid physical and mental growth and, as a result, the nutritional requirements of the body increase tremendously. It is, therefore, important to have a balanced diet at this stage. Consuming too much junk foods should be avoided as these are deficient in important nutrients such as proteins, vitamins, and minerals. Milk, green-leafy vegetables, and fruits are some examples of food items that are good for adolescents. Since girls start menstruating at this stage, they need to consume foods rich in iron, calcium, and zinc.

Personal hygiene is also very important during adolescence. Sweating may become a major problem at this stage. Bacteria multiply rapidly in sweat and cause bad odour. One can manage these odours by bathing daily and wearing clean clothes.

It is also very important to keep the genital areas clean. Girls should be aware of supplies such as sanitary pads and tampons and their use during menstruation.

A large number of adolescents are affected by acne or pimples. One should wash the face with a mild non-oily soap to keep it clean. In some cases, acne may require medical attention.

## ADDICTIVE SUBSTANCES, DRUG ABUSE, AND AIDS

Substance abuse is a common problem among adolescents all over the world. Alcohol, cigarettes, gutkha, and pan masala are substances that are harmful to a person's health, and when consumed regularly, they also become highly addictive.

***Drugs** are chemical substances that produce physical, mental, behavioural, or emotional changes in the user. Use of a drug for purposes other than medicinal use is called* drug abuse.

***Drug abuse*** harms the body seriously. Once a person starts taking drugs, he/she develops physical and/or psychological dependence on them. This dependence, commonly termed as addiction, makes it difficult for people to stop taking drugs. It is, therefore, important to say no to drugs and avoid them at all costs. Cocaine and marijuana are some common examples of drugs.

**Let's Discuss**

There are many physical and emotional changes that boys and girls go through during adolescence. Discuss.

People who use drugs are also at a risk of being infected with HIV, the deadly virus that causes AIDS. This virus can spread by sharing syringes used for injecting some drugs into the body. AIDS also spreads through sexual contact with an infected person.

### Key Words

| | |
|---|---|
| **Adolescence** | The period of transition from childhood to adulthood is called adolescence. |
| **Puberty** | The time of growth in which an individual becomes sexually mature, and achieves reproductive maturity. |
| **Ovulation** | The process of release of an ovum by an ovary is called ovulation. |
| **Menstrual cycle** | The cycle of producing and releasing mature ova is called the menstrual cycle. |
| **Drugs** | Chemical substances that produce physical, mental, behavioural, or emotional changes in the user are called drugs. |
| **Drug abuse** | Use of a drug for purposes other than medicinal use is called drug abuse. |

### Summary

- Hormones play an important role in the growth and development of the body, especially during a period known as adolescence.
- The major glands that make up the endocrine system are pituitary, thyroid, adrenals, pancreas, ovaries, and testes.
- Various physical and emotional changes take place in girls and boys during puberty.
- The hormone oestrogen (produced by ovaries) is responsible for the development of secondary sexual characteristics in girls.
- The hormone testosterone (produced by testes) is responsible for the development of secondary sexual characteristics in boys.
- Nutritional requirements of the body increase tremendously during adolescence. It is, therefore, important to consume a balanced diet at this stage. Personal hygiene is also very important.
- It is important to say no to drugs and avoid them at all costs.

# Exercises



## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Fill in the blanks with the correct words.**

1. Endocrine glands _____ (secrete/excrete) chemical substances called hormones.
2. _____ (Oestrogen/Progesterone) controls the development of secondary sexual characteristics in women.
3. _____ (Adolescence/Adulthood) is characterized by the reproductive organs in both males and females reaching maturity and beginning to function.
4. Milk producing glands are called _____ (adrenal/mammary) glands.
5. The _____ (ovary/oviduct) releases hormones that help to prepare the uterus for a possible pregnancy.
6. Use of a drug other than medicinal use is called _____ ( drug usage/drug abuse).

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

1. All endocrine glands are controlled by the master gland called adrenal gland.
2. Thyroid releases chemical substances that help to regulate sugar.
3. During adolescence, boys and girls only undergo physical changes.
4. Insulin is responsible for developing secondary sexual characters in males.
5. The lining of the uterus starts breaking down and is shed accompanied by blood, if the ovum gets fertilized by a sperm.
6. The nutritional requirement of an adolescent increases due to rapid physical and mental growth.

**C. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Endocrine system | a. 10 to 19 years |
| 2. Hormones | b. Master gland |
| 3. Adrenal | c. 28 days |
| 4. Pituitary | d. Glands |
| 5. Adolescence | e. Emergency |
| 6. Ovulation | f. Chemical messengers |

**D. Choose the correct option.**

1. Which of these changes are caused due to adrenaline?
   a. Increase in heart rate
   b. Increase in overall blood sugar level
   c. Increase in body's energy level
   d. All of these
2. Which of these hormones stimulates growth and development of the body?
   a. TSH  b. GH  c. Insulin  d. Thyroxine
3. Which of these are secondary sexual characteristics in adolescent girls?
   a. Enlargement of breasts
   b. Increase in height and weight
   c. Body hair
   d. All of these
4. How many days is the usual menstrual period in a girl?
   a. 28 days  b. 4 to 6 days  c. 10 to 15 days  d. None of these

5. Which of these refers to the period when a woman loses the ability to have a baby?
   a. Menopause
   b. Menstruation has stopped
   c. 45 to 55 years of age
   d. All of these
6. Which of these is true about hormones?
   a. They are chemical substances secreted by glands
   b. They are released directly into the blood stream
   c. They act as chemical messengers
   d. All of these
7. Which of these hormones regulates the blood sugar levels of the body?
   a. Thyroxine  b. Adrenaline  c. Insulin  d. Growth Hormone
8. Which of these are usual signs of puberty?
   a. A growth spurt
   b. A change in voice
   c. Acne and increased sweating
   d. All of these
9. Which of these glands secretes a hormone which stimulates the ovaries to release a mature ovum?
   a. Pituitary gland  b. Thyroid gland  c. Ovary  d. Adrenal gland
10. Which of these hormones is responsible for development of secondary sexual characteristics in boys?
    a. Testosterone  b. Progesterone  c. Oestrogen  d All of these

## II. Very short answer type questions

### A. Give one word for the following.

1. The chemical substances secreted by the glands _____
2. Specialized organs that secrete particular chemical substances _____
3. The master gland _____
4. The period of transition from childhood to adulthood _____
5. The process of release of a mature ovum by an ovary _____
6. Chemical substances that produce physical, mental, and emotional changes in a user _____
7. The cycle of producing and releasing a mature ova _____
8. An adolescent girl's first menstruation _____

## III. Short answer type questions

1. What are hormones?
2. Name any five glands of the human endocrine system.
3. Why is the adrenal gland known as the emergency gland?
4. Define adolescence.
5. What is menarche? How is it different from menopause?
6. Name the hormones that bring about changes during adolescence in girls.
7. What are drugs? Give two common examples of drugs.
8. Define drug abuse.

## IV. Long answer type questions

1. Explain the main glands of the endocrine system with the hormones and the role each of them plays in the human body.
2. Define puberty. Discuss some physical changes that boys and girls undergo during puberty.
3. With the help of a labelled diagram, explain the menstrual cycle in adolescent girls.
4. Discuss some of the emotional changes that boys and girls go through during adolescence.
5. Write a note on the nutritional requirements and personal hygiene needed by girls during adolescence.

## LET'S RECALL

Recall and complete the concept map given below.

**Endocrine system**

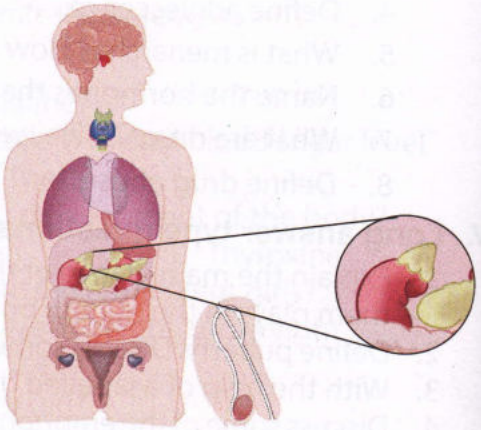
- Pituitary gland
  - Location:
  - Hormones secreted:
- _____
  - Location:
  - Hormones secreted:
- Testes (in males)
  - Location:
  - Hormones secreted:
- _____
  - Location:
  - Hormones secreted:
- _____
  - Location:
  - Hormones secreted:
- Ovaries (in females)
  - Location:
  - Hormones secreted:

**Physical changes during puberty**

- Physical changes observed especially in boys:
  1.
  2.
  3.
  4.
- Physical changes observed especially in girls:
  1.
  2.

## LET'S OBSERVE

1. Name the gland highlighted in the figure given here _____
2. Name the hormone it secretes _____



## LET'S CONNECT ART

Draw and paint a poster projecting the emotional, physical and/or behavioural effects of drug abuse. The poster should aim to spread awareness and motivate people on quitting such addictions.

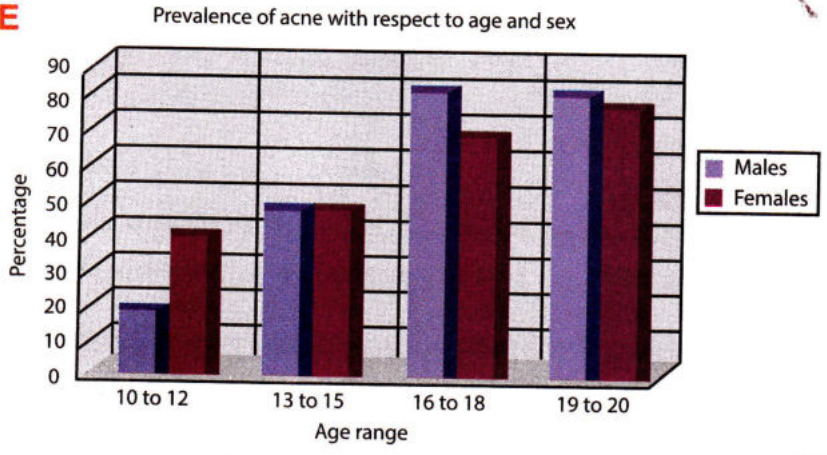
## LET'S APPLY

1. Shriya's grandfather has diabetes, and her mother feels that not eating carbohydrate-rich foods can really help him. Could she be right? Why or why not? LO 11
2. Punita's daughter was given hormonal injections due to which she started growing facial hair. Which hormone could have caused this change? LO 3

   a. Insulin  b. Oestrogen  c. Progesterone  d. Adrenaline

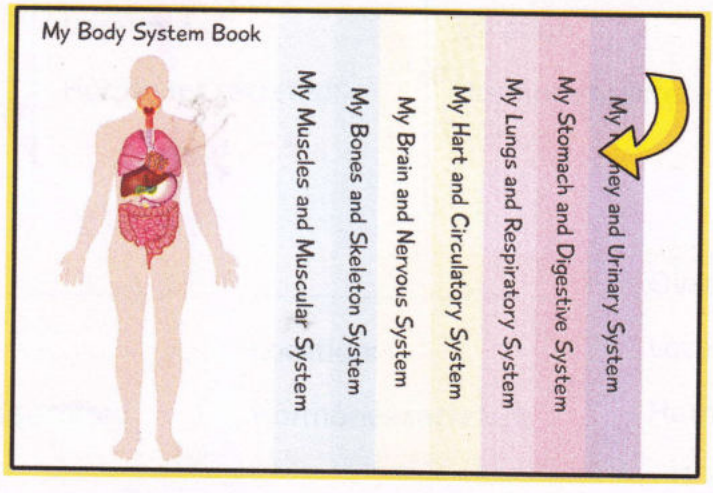
## LET'S ANALYSE AND EVALUATE

1. Interpret the given chart and compare the percentage of teen acne among boys and girls at every age.
2. Do you think acne is a common problem of all teenagers? Justify with a reason. LO 11



## LET'S CREATE

1. Make a flip book like the sample on body systems on the various glands and hormones that form the endocrine system. Each flap should contain information on one gland, the location, the hormone it secretes and the role that hormone plays in the body. LO 14
2. Make a poster to spread awareness about Drug abuse and how it harms our life. Write a catchy slogan too in your mother tongue. LO 15




### Web Research

- Browse the Internet and find out about IVF, its advantages, and disadvantages. Make a presentation on the process. Some suggested websites are:
  https://medlineplus.gov/ency/article/007279.htm (accessed and checked on 12/08/2019)
  http://americanpregnancy.org/infertility/in-vitro-fertilization/ (accessed and checked on 12/08/2019)
- Browse the Internet and find out how insulin is important to regulate sugar. Describe how lack of insulin causes diabetes. Some suggested websites are:
  https://www.diabetesselfmanagement.com/blog/what-does-insulin-do/ (accessed and checked on 12/08/2019)
  https://www.endocrineweb.com/conditions/type-1-diabetes/what-insulin (accessed and checked on 12/08/2019)

# 9 Reproduction

**You will learn about**

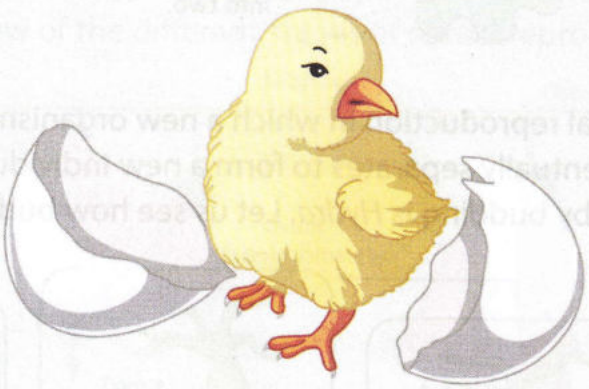
- Types of reproduction
- Reproduction in human beings
- Gender issues and myths
- Problems of adolescent pregnancy

All organisms reproduce. They reproduce in different ways. Some organisms reproduce by laying eggs and some by giving birth to babies.

Observe the two methods of reproduction shown in the pictures given below.

(a)

(b)



1. Which of these needs cells of two parents? _____ (a/b)
2. Which of these is multiplying by just dividing itself? _____ (a/b)
3. Which of these involve laying eggs for multiplying individuals? _____ (a/b)

Some organisms reproduce by other means too. Let us learn about different types of reproduction.

Answers: 1. b 2. a 3. b

## TYPES OF REPRODUCTION

***Reproduction** is the process by which living things produce offspring (i.e., young ones) of their own kind.*

There are two types of reproduction in organisms: *asexual* and *sexual*.

**Fact File**

In asexual reproduction, the offspring are completely identical to the parent.

### Asexual Reproduction

In asexual reproduction, a new individual is formed from the cell(s) of a single parent. It is the simplest form of reproduction, and is most commonly observed in organisms such as *Amoeba*, *Hydra*, yeast, starfish, sponges, and worms.

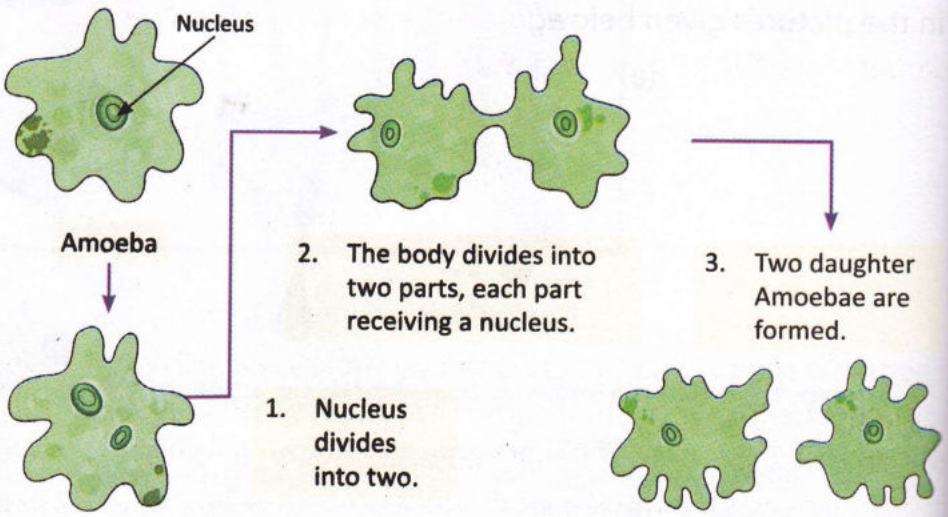
**Let's Discuss**

Asexual reproduction is the simplest form of reproduction. Discuss. Why and how?

Examples of asexual reproduction are *binary fission* and *budding*.

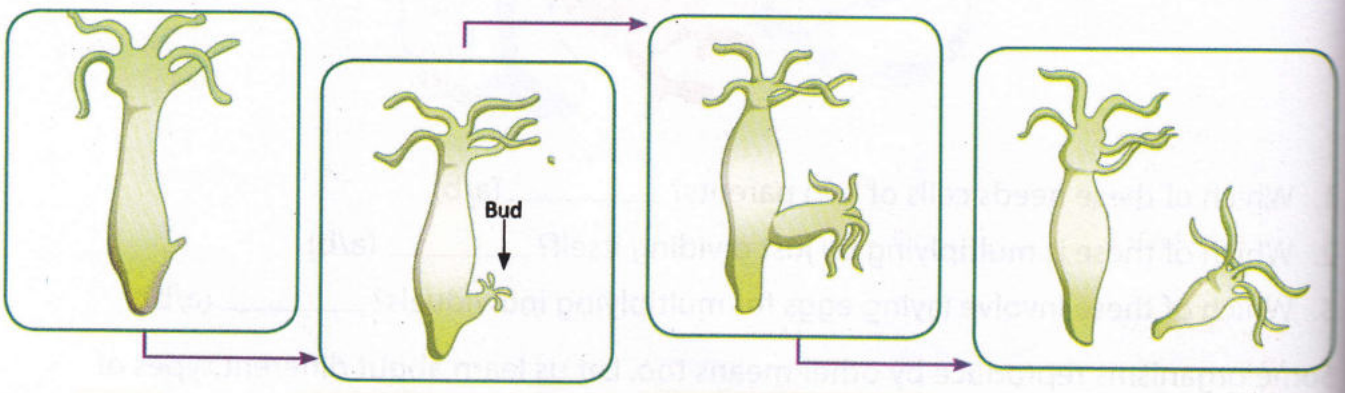
#### Binary Fission

Binary fission is the simplest type of asexual reproduction in which a single cell divides to form two daughter cells. An example of an organism that reproduces by binary fission is *Amoeba*. Let us see how binary fission occurs in *Amoeba*.




#### Budding

Budding is a form of asexual reproduction in which a new organism grows out from a part of the parent body and eventually separates to form a new individual. An example of an organism that reproduces by budding is *Hydra*. Let us see how budding occurs in *Hydra*.



## Sexual Reproduction

In sexual reproduction, two parents are required to produce a new organism. Most plants and animals, including human beings, reproduce sexually.

## REPRODUCTION IN HUMAN BEINGS

AN

Most animals, including human beings, have different reproductive systems in males and females, with different organs performing specific functions. Before we learn about the male and female reproductive organs in detail, let us understand the basic process of reproduction.

Both male and female individuals produce special reproductive cells called *gametes*. The female gamete is usually called an *ovum* (or egg) (Fig. 9.1) and the male gamete is called a *sperm* (Fig. 9.2).

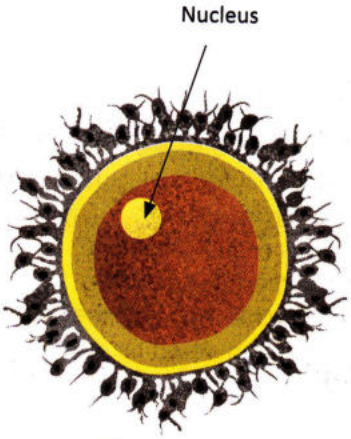



**Fig. 9.1** *Ovum*

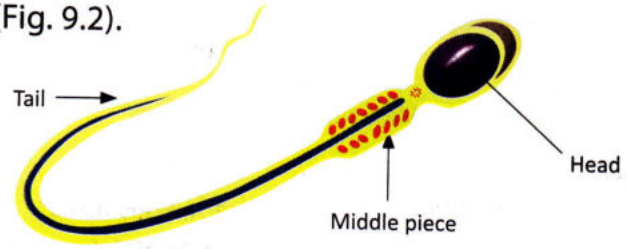
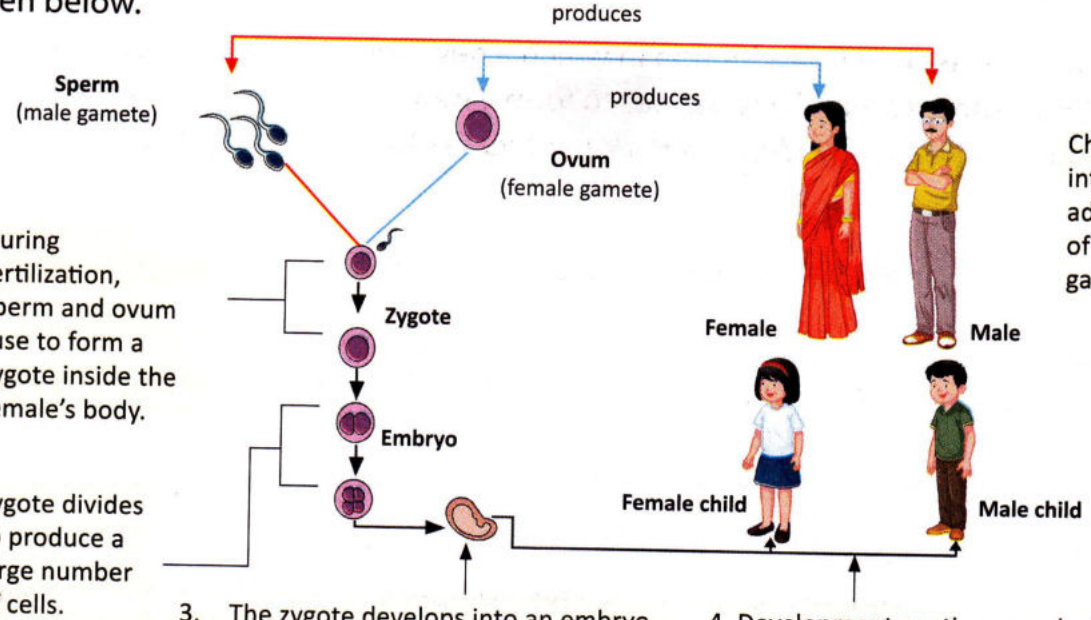



**Fig. 9.2** *Human sperm*

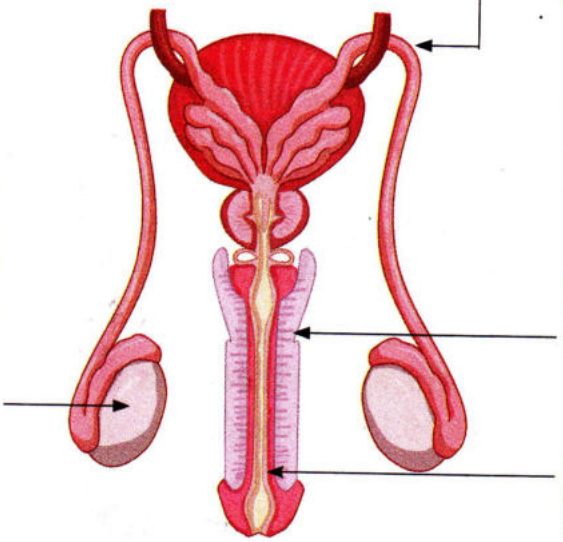
The two gametes join or fuse during a process called *fertilization* to form a zygote. This initiates the formation of a baby. The process by which new individuals are formed by the union of specialised female gamete (ovum) and male gamete (sperm) is called sexual reproduction. An overview of the different stages of sexual reproduction in human beings is given below.



## Male and Female Reproductive Organs

Let us now understand the structure and the functions of male and female reproductive organs (Fig. 9.3).

**Testes** (*singular: testis*) are present as a pair in males and located within bag-like scrotal sacs.
A testis is made up of numerous coiled tubes that produce sperm cells. When a male reaches puberty, the testes are stimulated by the pituitary gland to produce the male sex hormone testosterone.



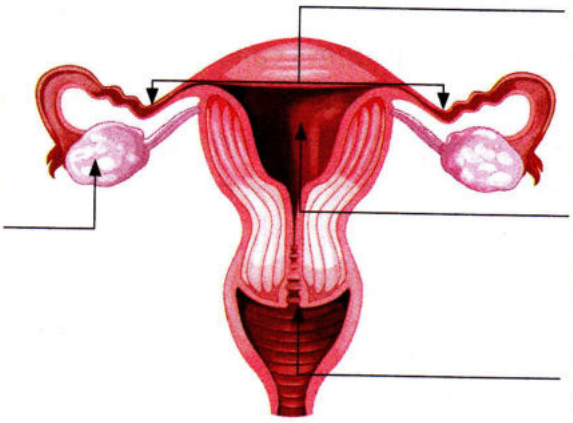
**Sperm duct** (vas deferens) is a narrow tube that helps to transport sperms produced in each testis. Several fluids are secreted inside this tube by different glands, which mix with the sperms to form a fluid called semen.

**Penis** transfers the semen, and with it the sperms, into the female body.

**Urethra** is a tube inside the penis through which semen and urine pass out of the body.

(a) Male reproductive organs

**Ovaries** produce and release eggs (ova). Each ovary has the shape, and a size almost equal to that of an almond. When a girl reaches puberty, the ovaries are stimulated by the pituitary gland to produce the female sex hormone oestrogen.



**Oviduct** (fallopian tube) carries the ovum released by each ovary. Fertilization occurs here and zygote is formed.

**Uterus** is the organ where the zygote matures and grows till it is ready to be born. The embryo (i.e., developing baby) grows and develops inside the uterus, which is also called the womb.

**Vagina** receives the penis during sexual intercourse.

(b) Female reproductive organs

**Fig. 9.3** *Reproductive organs in human beings*

## Fertilization

*The fusion of male and female gametes to produce a zygote is called* ***fertilization.*** The main stages of fertilization in human beings are listed below.

1. Once a month, an ovum is released from the ovary by a process called ovulation.
2. The ovum moves into the oviduct (fallopian tube).
3. During sexual intercourse, the male transfers sperms into the vagina through the penis. The sperms travel through a narrow opening called cervix into the uterus and then the oviduct.

4. A single sperm fuses with the ovum in the oviduct and fertilization takes place. The fertilized ovum continues its journey down the oviduct, into the uterus.
5. The fertilized ovum implants itself into the uterus wall and develops into a human embryo.

This process is summarized in Figure 9.4.

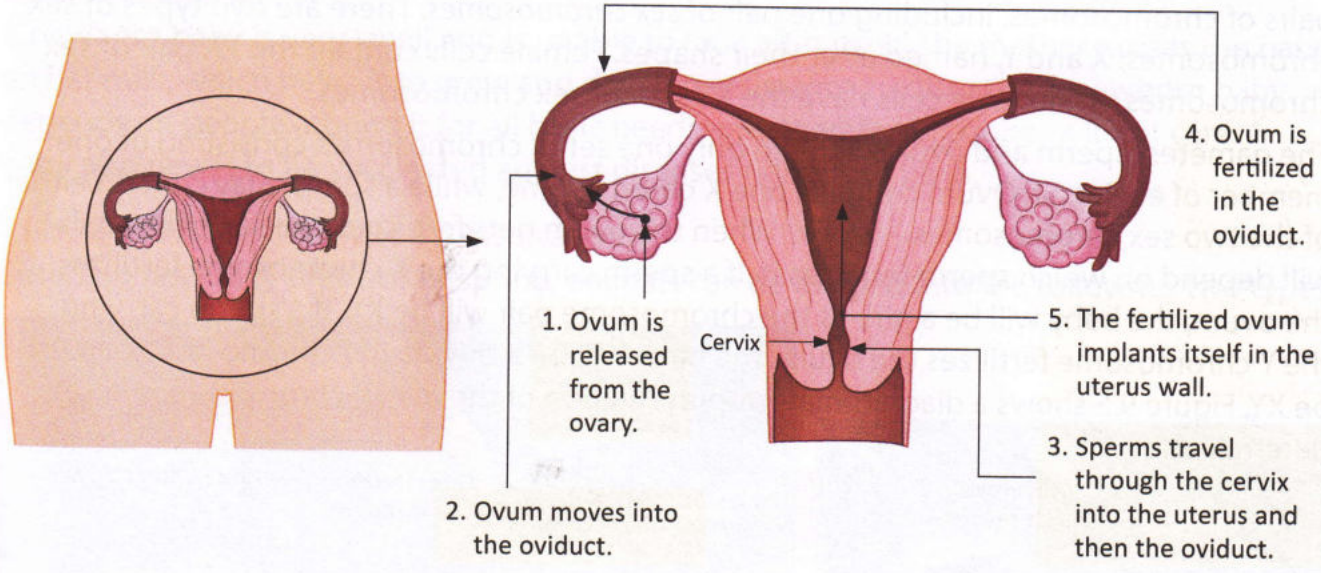



**Fig. 9.4** *Ovulation and fertilization*

There are two types of fertilization: internal and external.

***Internal fertilization*** In this type of fertilization, the fusion of male and female gametes occurs inside the female's body. Mammals such as cow, horse, dog, cat, and human beings are examples of organisms that reproduce by internal fertilization.

***External fertilization*** In this type of fertilization, the fusion of male and female gametes occurs outside the body. Fish, frog, and starfish are examples of organisms that reproduce by external fertilization.

### Tech Specs

In vitro fertilization (IVF) is a technique in which the sperm and ova are combined in a laboratory dish. After fertilization, the embryo is transferred into the woman's uterus. Babies conceived through this technique are called test tube babies.

## Activity

**Aim:** To observe a fertilized egg of a hen
**Materials needed:** Some eggs and a torchlight
**Method:** Place a few eggs in a dark room and, using a torchlight, try to observe which of them show a tiny blood vein (reddish in colour) through the yolk. You may need to examine quite a few to find a fertilized egg.
**Observation:** A fertilized egg will show a tiny blood vein (reddish in colour) through the yolk.
***Note:*** Handle the eggs carefully so as not to disturb the babies developing inside.

## Determination of the Sex of a Baby

TD

Do you know what determines whether the baby developing inside the mother's womb is a boy or a girl? This is determined by chromosomes, the thread-like structures found inside the nucleus. Chromosomes carry information in the form of genes. Each cell contains 23 pairs of chromosomes, including one pair of *sex chromosomes*. There are two types of sex chromosomes, X and Y, named after their shapes. Female cells contain the XX pair of sex chromosomes, while male cells have the XY pair of sex chromosomes.

The gametes (sperm and ovum) contain only one set of chromosomes consisting of one member of each pair. Ovum contains one X chromosome, while a sperm may contain either of the two sex chromosomes—X or Y. When the ovum gets fertilized, the sex of the baby will depend on which sperm fertilizes it. If a sperm carrying the X chromosome fertilizes the ovum, the baby will be a girl, as the chromosome pair will be XX. If a sperm carrying the Y chromosome fertilizes the ovum, the baby will be a boy, as the chromosome pair will be XY. Figure 9.5 shows a diagrammatic representation of the role of chromosomes in sex determination.

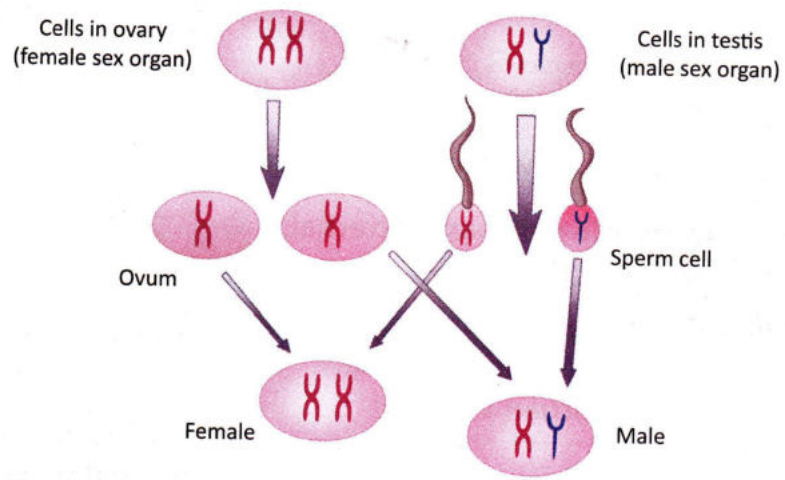



**Fig. 9.5** *Diagrammatic representation of the role of chromosomes in sex determination*

## Baby Inside the Womb

When the egg gets fertilized, the single-celled zygote divides repeatedly to form a ball of cells, as it travels through the Fallopian tube. By the fourth week, this ball of cells implants itself in the uterus, and is hereafter known as the *embryo*. During this period, the embryo receives its nutrition directly from the mother's blood. The embryo grows and develops rapidly within the mother's womb (or uterus), and all of the major systems of the body begin to develop.

Gradually, the different body parts and major internal organs start to develop. This stage of growth of the embryo, where most of the body parts can be identified, is known as the foetus. The baby stays and grows inside the mother's womb (uterus) for about 40 weeks to develop fully (Fig. 9.6).

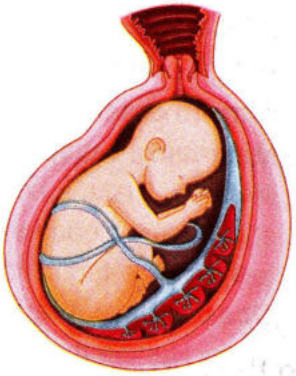


**Fig. 9.6** *Baby inside the womb*

This period is called the *gestation period*. It receives nourishment from the placenta during this period.

When the foetus is fully developed, the walls of the uterus begin to contract, in order to push the baby out of the mother's body. This process is called *parturition*.

## Care After Birth

A newborn baby is very small and is unable to look after itself. The mother nurses the baby on her milk, which helps it to grow and develop resistance to diseases. A newborn baby depends on people around it for all basic needs and, therefore, requires a lot of care. A baby also needs to be vaccinated against diseases right from birth.

## Viviparous and Oviparous Animals

Based on how they produce offspring, animals can be divided into the following two types.

**Fig. 9.7** *An elephant is viviparous.*

**Fig. 9.8** *A hen is oviparous.*

***Viviparous animals*** *Animals that give birth to live offspring (i.e., babies) are called* ***viviparous animals.*** Mammals such as cow, horse, dog, cat, elephant, and human beings are examples of viviparous animals (Fig. 9.7).

***Oviparous animals*** *Animals that lay eggs, which hatch into offspring, are called* ***oviparous animals.*** Birds, snakes, frogs, and butterflies are examples of oviparous animals (Fig. 9.8). Newly hatched birds and young ones of mammals look similar to their parents. However, in some animals the newly hatched individuals do not resemble the parents and undergo a series of changes (called *metamorphosis*) after birth. Let us understand this process using the life cycles of frog and butterfly.

**Fact File**

Duck-billed platypus and spiny anteater are the only mammals that are not viviparous. They lay eggs.

**Tech Specs**

Cloning is a technique through which multiple copies of a single gene, chromosome, or whole organism can be produced. Perhaps the most famous example of cloning is Dolly the sheep, which was cloned at Roslin Institute, Scotland. Cloning has many applications, including generation of tissues and organs for transplant.

## Let's Remember

**I. Match the columns. Give one reason for matching them. One is done for you.**

| *Column A* | *Column B* | Reason |
|---|---|---|
| 1. Dog | a. Male gamete | _____ |
| 2. Amoeba | b. Ovary | _____ |
| 3. Hydra | c. Binary Fission | _____ |
| 4. Ovum | d. Cat | Internal Fertilization |
| 5. Sperm | e. Bud | _____ |

**II. Give two examples for the following.**

1. Organisms that reproduce by internal fertilization _____ _____
2. Organisms that reproduce by external fertilization _____ _____
3. Organisms that reproduce by budding _____ _____

### Metamorphosis in Frog and Butterfly

External fertilization occurs in frogs. A female frog lays millions of eggs (called spawn) into the water, which are fertilized by the sperms discharged by a male frog. There are three main stages in the life cycle of a frog:

Egg ▶ Larva (tadpole) ▶ Adult frog

The egg develops into a larva (called a tadpole), which is very different from an adult frog. The tadpole undergoes a series of changes, during its development, to finally become an adult frog. It loses its tail, develops lungs for breathing, and grows legs (Fig. 9.9).

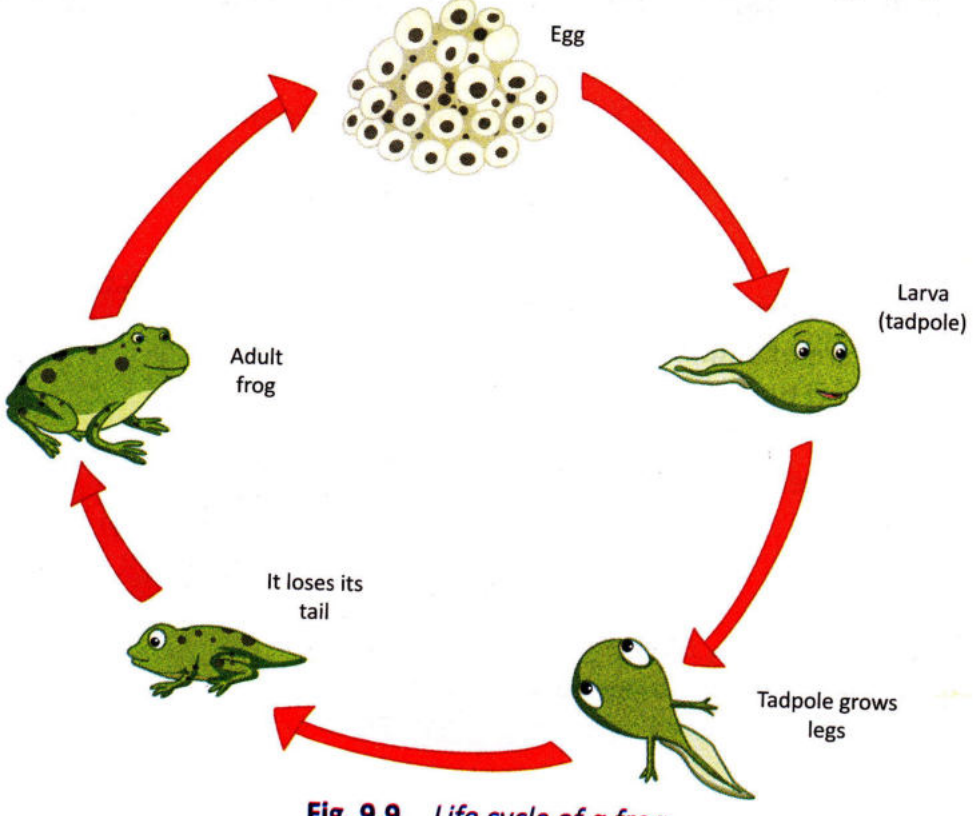



**Fig. 9.9** *Life cycle of a frog*

Similarly, there are four main stages in the life cycle of a butterfly:

Egg ▶ Larva (caterpillar) ▶ Pupa ▶ Adult

The larva of the butterfly transforms into an adult after undergoing a series of drastic changes. *The transformation of a larva into an adult through a series of drastic changes is called* ***metamorphosis***.

## GENDER ISSUES AND MYTHS

In some cultures, even today, there is a strong preference for male children, and the female child is considered to be a financial burden on her parents. Girls are often deprived of access to basic health and education, and are forced into early marriage and motherhood.

Techniques such as ultrasonography are often misused to determine the sex of the unborn child. The foetus can be killed in the womb before birth using a method called abortion. The selective killing of the female foetus is called *female foeticide*. To curb female foeticide, the Indian government has made it illegal to find out the sex of the foetus. Often, the mother is blamed for being unable to bear a male child. However, the fact is that the sex of a child is determined by the father's sperm (as it carries either the X chromosome or the Y chromosome). Many other similar gender myths continue to be prevalent. These can only be dispelled by increasing awareness among people.

## PROBLEMS OF ADOLESCENT PREGNANCY

Each year, about 16 million children are born to girls in the 15–19 year age group worldwide. Since girls are not physically and mentally prepared for motherhood at such an early age, adolescent pregnancy is dangerous to both the mother and the child. Besides posing health problems, early marriage and motherhood also restricts educational opportunities for girls.

## Key Words

| | |
|---|---|
| **Reproduction** | The process by which living things produce offspring of their own kind is called reproduction. |
| **Fertilization** | The fusion of male and female gametes to produce a new organism is called fertilization. |
| **Viviparous animals** | Animals that give birth to live offspring are called viviparous animals. |
| **Oviparous animals** | Animals that lay eggs, which hatch into offspring, are called oviparous animals. |
| **Metamorphosis** | The transformation of a larva into an adult through a series of drastic changes is called metamorphosis. |

## Summary

- There are two types of reproduction in animals: asexual and sexual.
- Examples of asexual reproduction are binary fission and budding.
- The reproductive systems in males and females are different, with different organs performing specific functions.
- There are two types of fertilization: internal and external.
- The sex of a baby is determined by the chromosome carried by the father's sperm.
- Depending on how they produce an offspring, animals can be viviparous or oviparous.
- In animals such as frog and butterfly, the newly hatched young ones undergo a series of changes called metamorphosis.
- Adolescent pregnancy is dangerous to both the mother and the child.

# Exercises

## LET'S UNDERSTAND

REMEMBERING UNDERSTANDING

QT

### I. Objective type questions

**A. Fill in the blanks with the correct words.**

1. In asexual reproduction, a new individual is formed by _____ (single parent/ both parents).
2. In _____ (budding/binary fission), a new organism grows out from a part of the parent body.
3. Male and female individuals produce special reproductive cells called _____ ( Sperms/gametes).
4. The _____ (penis/urethra) transfers the sperms along with semen into the female body.
5. The _____ (ovary/uterus) is where the zygote matures and grows till it is ready to be born.
6. In _____ (internal/external) fertilization, fusion of male and female cells takes place inside the female body.
7. The male cells contain _____ ( XX/XY) chromosomes.

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

1. No animals can multiply asexually. They do so only by laying eggs.
2. Once a female reaches puberty, the ovary secretes hormones that stimulate it to release female cells called sperms.
3. Fertilization in a female body takes place inside the fallopian tubes.
4. The baby grows inside the mother's womb for 40 days and is then pushed out of the mother's body.
5. A newborn baby is very small and is unable to look after itself.
6. The larva of a butterfly looks like an adult and transforms due to drastic changes.

**C. Choose the correct option.**

1. Which of these is a reproductive process shown in Hydra?
   a. Budding
   b. Binary fission
   c. Through eggs
   d. By giving birth to babies

2. Which of these is true about male gametes?
   a. They are produced by ovaries. b. They are produced by testes.
   c. They are called sperms and have a tail.
   d. Both b. and c.
3. Which of these is a narrow tube that helps to transport sperms produced in each testis?
   a. Vas deferens b. Fallopian tube c. Urethra d. Penis
4. In which of these animals does the fusion of male and female gametes takes place outside the female body?
   a. Cow and horse b. Human beings c. Cat and dog d. Fish and frog
5. Which of these shows a male child?
   a. XX b. XY c. YY d. None of these
6. Which of these is true about asexual reproduction?
   a. A new organism is formed from the cells of a single parent
   b. Two parents are required to produce a new organism
   c. Most plants and animals reproduce by this method
   d. All of these
7. Which of these refers to reproductive cells produced by male and female individually?
   a. Gametes b. Zygotes c. Embryo d. None of these
8. In which of these reproductive organs does fertilization occur and a zygote gets formed?
   a. Ovary b. Testes c. Oviduct d. Uterus
9. Which of these refers to the stage of growth of the human embryo when most body parts can be identified?
   a. Zygote b. Gametes c. Foetus d. Parturition
10. Which of these is true about the life cycle of a butterfly but not a frog?
    a. It undergoes metamorphosis b. The egg develops into a larva
    c. The larva turns into a pupa before becoming an adult
    d. The larva does not resemble the adult form

## II. Very short answer type questions

### A Give one word for the following.

1. The process by which living things produce offspring of their own kind _____
2. Special reproductive cells _____
3. The process by which male and female gametes fuse to form a zygote _____
4. Male sex hormone _____
5. The process by which an ovum is released from the ovary _____
6. The period in which the baby stays and grows inside the mother's womb _____
7. The part of the female body that is called the womb _____
8. Animals that give birth to live offspring _____
9. Animals that lay eggs that hatch into offspring _____
10. The transformation of a larva into an adult through a series of drastic changes _____

## III. Short answer type questions

1. What is reproduction? Name two types of reproduction in an organism.
2. What is asexual reproduction? Give two examples of animals that reproduce asexually.

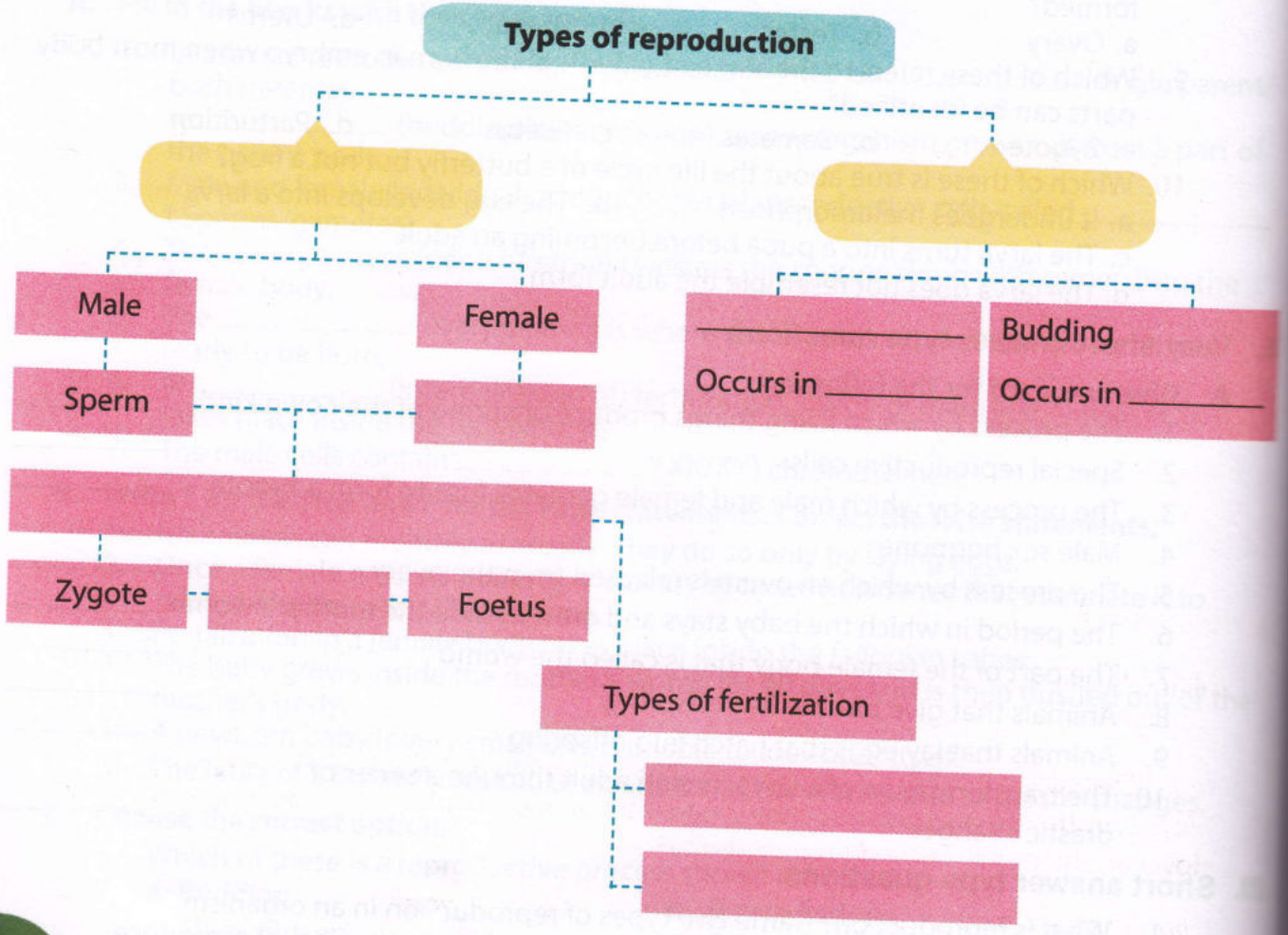
3. What are gametes? Name the male and female gametes.
4. Differentiate between internal and external fertilization.
5. What are chromosomes? Name the two types of sex chromosomes.
6. What is parturition?
7. What are viviparous animals? Give two examples.
8. Define metamorphosis. Name two animals that undergo metamorphosis.
9. Write a short note on gender issues and myths associated with female infanticide.
10. What are some of the problems associated with adolescent pregnancy?

## IV. Long answer type questions

1. With the help of a labelled diagram, explain how an animal reproduces asexually.
2. Explain the structure of human male and female gametes.
3. With the help of a labelled diagram, explain how reproduction takes place in human beings.
4. Describe the stepwise process of fertilization in human beings.
5. With the help of an example, illustrate how a pair of chromosomes determine the sex of a child in human beings.
6. With the help of a labelled diagram, explain the life cycle of a frog.

## LET'S RECALL

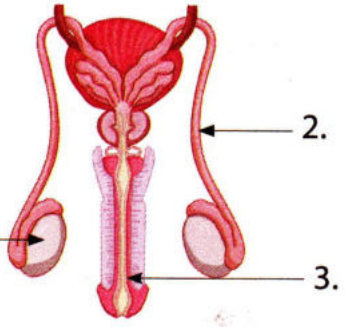

Recall and complete the concept map given below.



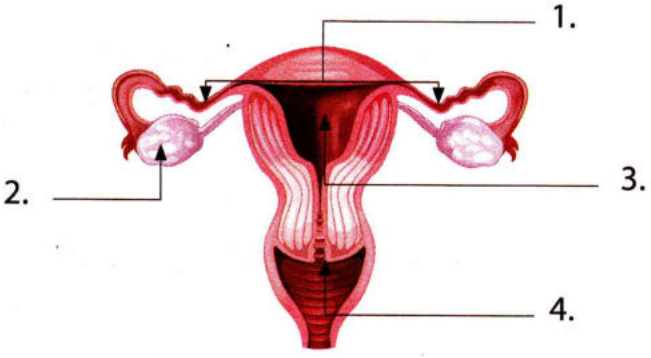
## LET'S OBSERVE

I. Label the parts of male and female reproductive organs given below.

A.




B.




II. A. Number the pictures in order to show the life cycle of frog correctly.

B. Give two differences between the larva and the adult. _____

_____

C. What is this process known as (in which a larva changes into an adult through drastic changes)? _____ LO 5

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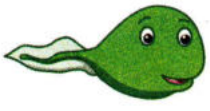

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## LET'S CONNECT ENGLISH

Kiran has had a little baby. Imagine yourself to be her mother. Write a note for Kiran as her mother listing how she can take care of the newborn baby.

_____

_____

_____

_____

## LET'S APPLY

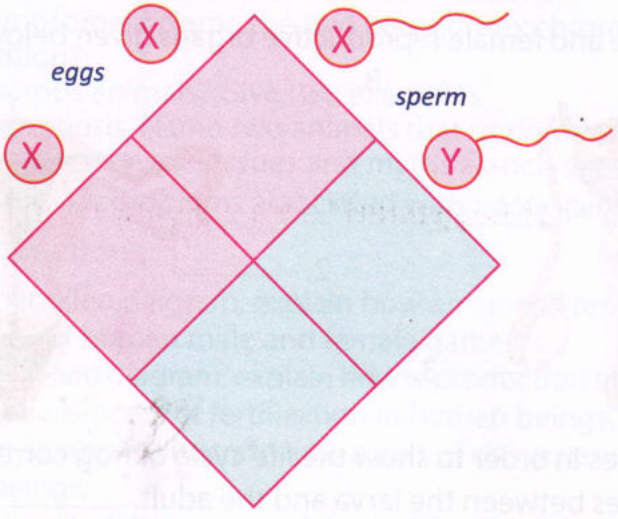
1. Malti's family blames her for the birth of a daughter. Are they right in blaming her? Why or why not? LO 15

   (*Hint*: Chromosomes for sex of the baby depend on the X or the Y chromosome?)

2. Maya's mother says eating nutritious food would help the growing baby inside. Is she right? How can the mother's food help the baby? LO 11

   (*Hint*: The baby and the mother are connected inside the womb)

## LET'S ANALYSE AND EVALUATE




1. In the grid given above, illustrate how X and Y chromosomes can combine to give four sets of chromosomes by filling in the squares. ANALYSING LO 4

2. Evaluate whether the sex of the child will depend on the chromosomes of the egg or the sperm that fertilizes it. Give a reason to justify your answer. EVALUATING

## LET'S CREATE CREATING

1. In groups of five, collect pictures of any twenty animals and then find out the method of reproduction in each and make a chart. LO 11 LO 9

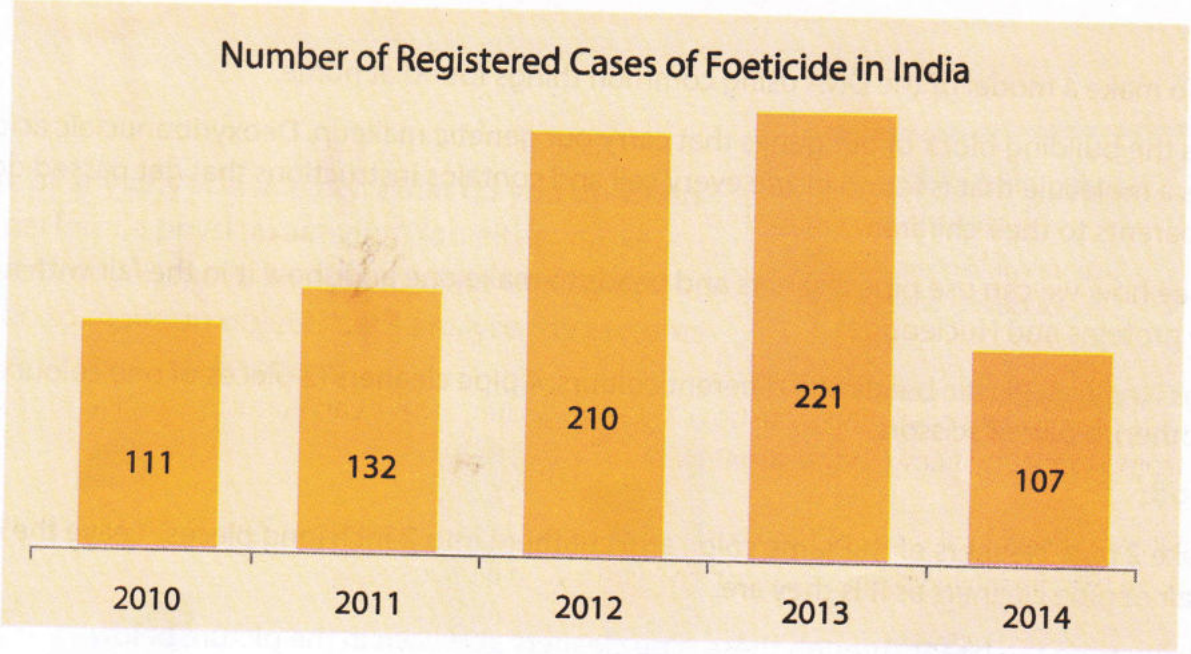
2. In groups of five, find out the myths associated with the female foeticide in India. Collect information on the legal Acts that have been established against female foeticide and data behind their efficacy. Discuss in your class in your mother tongue. LO 15

**Web Research**

- Browse the Internet and find out about cloning. Make a presentation on why cloning is a boon. Some suggested websites are:
  https://www.genome.gov/25020028/cloning-fact-sheet/ (accessed and checked on 12/08/2019)
  https://www.britannica.com/science/cloning (accessed and checked on 12/08/2019)
- Browse the Internet and find out the physical, and emotional problems associated with adolescent pregnancy and the social beliefs that prevail in India regarding pregnancy in adolescence. Make a report. Some suggested websites are:
  https://www.healthline.com/health/adolescent-pregnancy (accessed and checked on 12/08/2019)
  https://www.unfpa.org/adolescent-pregnancy (accessed and checked on 12/08/2019)

# Worksheet 3

**Skills assessed:**
Problem solving , Qualitative analysis and Quantitative analysis




1. In which year were the maximum number of foeticide cases registered? _____
2. Which of these could be the main reason for female foeticide?
   a. A female child is considered a financial burden.
   b. A female child is considered a financial support.
   c. Female child does not have to be educated.
   d. None of these
3. Is the sex of a child determined by the father or the mother? How?

   _____

   _____
4. What is the female reproductive cell known as? _____
5. What is the male reproductive cell known as? _____
6. What do we call the process of fusion of a male and female reproductive cell?

   _____
7. What was the average annual increase in foeticide cases between 2010-2013? _____

Teacher facilitation required*

# SCIENCE FAIR

**Skills learnt:**
Measuring , and Communicating

**AIM:** To make a model of the DNA using common things found at home.

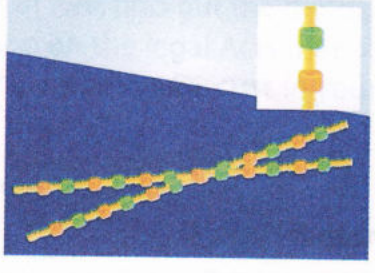
DNA is the building block of our genes that carry our genetic makeup. Deoxyribonucleic acid or DNA is a molecule that is found inside every cell and contains instructions that get passed down from parents to their children.

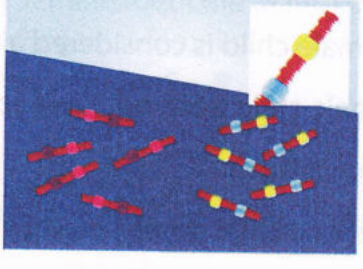
Let's see how we can use pipe cleaners and beads to make one and show it in the fair with names of the proteins and Nucleotides

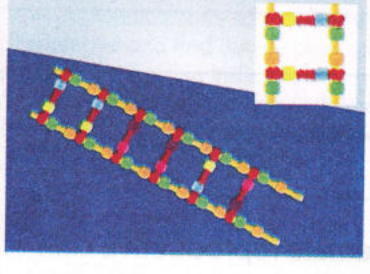
**Things Needed:** Plastic beads of 6 different colours, 4 pipe cleaners (2 pieces of one colour and 2 of another), a pair of scissors

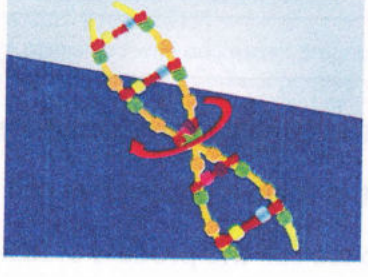
**Method:**

1. Take 2 pipe cleaners of the same color, and cut them into 2-inch long pieces. Leave the other pair of pipe cleaners as it is they are.
2. Now, string the beads through these pipe cleaners as shown in the picture below.
3. Once all the small sections of pipe cleaners with their beads have been attached, twist the ends of the two pipe cleaners. Make sure you twist them in an anti-clockwise direction so that it appears like a true DNA strand.









4. The DNA double helix model gets made! Use the model to explain the structure and functions of the helix.

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

10

UNIT 4: MOVING THINGS, PEOPLE, AND IDEAS

# Force and Friction

Think of any physical activity. What do you do when you perform a physical activity? You either move yourself, or you move an object. What exactly do you do to move an object? Let's analyse the pictures below to see what happens.

**You will learn about**

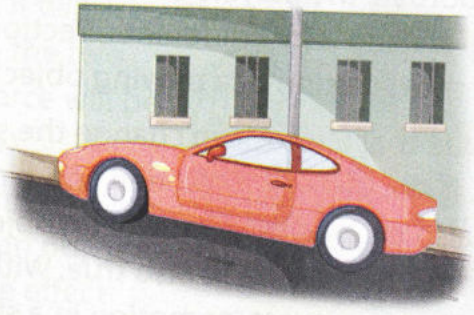
- Force and its effects
- Classification of forces: non-contact and contact forces
- Friction

1. What does the boy do to lift the school bag?

2. What does the girl do to open the door?

3. What does the potter do to change the shape of the clay?

4. What does the driver do to stop the bus?



5. What stops the car from slipping on the sloping road?

In this chapter, we will learn about force and its effects and the types of forces in nature. We will also learn about friction and how it affects us in our day-to-day activities.

Answers 1. The boy pulls up the bag to lift it., 2. The girl pushes the door to open it., 3. The potter presses (pushes) the clay to change its shape, 4. The driver stops the bus by applying the brakes (i.e. by applying a force), 5. The rough surface of the road offers a certain force that keeps the car from sliding.

## AND ITS EFFECTS

LL

A push or a pull acting on an object is called force. The SI unit of force is newton (N). We use force to perform various activities. Force has the following effects on objects.

***Force can make a stationary object move or make a moving object move faster.*** A toy car can be made to move by giving it a little push. Similarly, a stationary football can be made to move by giving it a small push (i.e., by kicking it). If we have an already moving toy car or ball, we can make it move faster by giving it a push in the direction in which it is moving. Thus, a force can make a stationary object move, and it can also make an already moving object move faster (Fig. 10.1).

**Fig. 10.1** *A push (i.e kick) makes a stationary football move.*

***Force can slow down or completely stop a moving object*** A moving toy car can be made to stop by applying the brakes, i.e., by applying a force. A bicycle can be stopped or slowed down by applying the brakes. In football, the force applied by the goalkeeper stops the ball that is hit towards the goal. In order to stop or slow down a moving body, we need to apply a force in a direction opposite to the direction of motion of the moving body.

***Force can change the direction of a moving object*** In cricket, when a batsman hits the ball that is bowled at him, the direction in which the ball is moving changes (Fig. 10.2). In football, the players can change the direction of the moving ball by kicking it in a different direction. In these examples, force changes the direction of a moving object.

We can conclude that a force can change the state of motion of an object, that is, it can change the speed and direction in which an object moves. It can also change the shape of an object, and even break it. We should note that the converse is also true. Without a force, an object will remain in its state of rest, or motion in a straight line.

**Fig. 10.2** *A force can change the direction of motion of a moving object (in this case, the cricket ball)*

***Force can change the shape or size of an object*** While making chapattis, we change the shape of the dough by applying force with our hands. The length of a rubber band increases when it is pulled. You can also break things by applying a force. Materials that break easily when we apply a force are termed brittle. For example, objects made of glass and porcelain break easily when we apply force on them. Fig. 10.3 depicts these situations where force can change the shape or size of an object.

**Fig. 10.3** *Force can change the shape or size of an object*

## Magnitude of Force

The magnitude of a force is the strength of the force acting on an object. It depends upon the number of forces involved in a particular action, and also the direction in which they act.

- When two or more forces act in the same direction, then the magnitude of the resultant force on the object is the sum of the forces (Fig. 10.4).
- When two or more forces act in opposite directions, then the magnitude of the resultant force on the object will be the difference of the forces. It will act in the direction of the larger force. In case the two opposing forces are equal, the resultant force will be zero (Fig. 10.5).
- Also, if the magnitude of force on an object changes, the effect of the force will also change. For example, if we apply a small force to an inflated balloon, it will be deformed. But if we keep increasing the magnitude of

**Fig. 10.5** *When two forces act in opposite directions, then the resultant force will have a magnitude that is the difference between the two forces*

**Fig. 10.4** *When two forces act in the same direction, the resultant force is the sum of the forces*

### Get it Right

A force can have more than one effect at the same time. For example, when we hit a ball with a bat, we change its direction and also its speed at the same time. The shape of the ball could also change slightly at the time the bat hits it.

### Get it Right

A force does not necessarily cause motion. There are times when we push or pull an object with all our might but it does not move. This does not mean that we are not applying a force, but that the force we are applying is not sufficient to move the object.

the force, at a certain force, the balloon will burst (Fig. 10.6).

From the above explanations, we can conclude that to fully understand the effect of a force, we need to know its strength (magnitude) as well as the direction in which it acts

**Fig. 10.6** *A balloon bursts if the magnitude of the force acting on it keeps increasing*

### Activity

**Aim:** To study the effect of force on different objects
**Materials needed:** Play dough, chapatti atta (dough used for making chapatti), metal spring, rubber bands, table, chair, toy car, and ball
**Method:** Apply a force with your hand (by giving a push or pull) on each of these objects and see how it affects them. Classify your observations under different headings such as 'change of shape', 'change in size', 'makes a stationary object move', and so on.
**Observation:** It is observed that force has different effects on different bodies.

## CLASSIFICATION OF FORCES

In the cases discussed above, we observed that force acts on an object only when the force is in contact with the object. Such forces are called *contact* forces. However, some forces can act on objects without physical contact. These are called *non-contact* forces. Let us learn about different kinds of *non-contact* and *contact* forces.

### Non-Contact Forces

LL

*Forces that do not need physical contact with the object on which they are acting are called* ***non-contact forces.*** Gravitational force, electrostatic force, and magnetic force are examples of non-contact forces.

### Activity

**Aim:** To observe how some objects move without being touched
**Materials needed:** A book, small pieces of paper, plastic ruler, metal clips, and a magnet
**Method:**
1. Hold the book a little above the floor and leave it. You will observe that the book will fall on the floor.
2. Rub the plastic ruler on your hair and bring it close to the pieces of paper. You will see that the pieces of paper will jump and stick to the plastic ruler.
3. Bring the magnet close to the metal clips. The paper clips will be pulled towards the magnet.

**Conclusion:** It is possible to move objects without touching them.

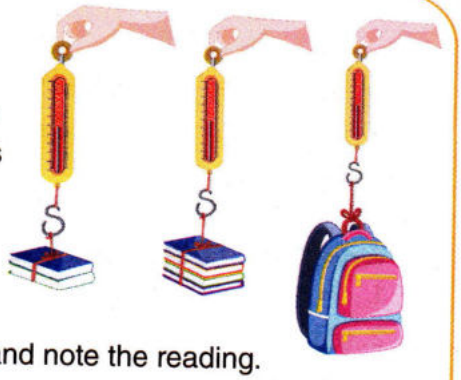
## Gravitational Force

The force with which objects pull each other is called *gravitational force*. This force is very small and we can feel it only if an object is very massive. For example, the Earth exerts a gravitational force on us that is strong enough to keep us bound to it. It is also the gravitational force that causes a ball thrown up to fall back down to the ground. Gravitational force makes the Earth move around the sun and also makes the moon go around the Earth. In fact, our weight is the gravitational force of the Earth acting on us. Different objects exert different magnitudes of gravitational force. For example, the gravitational force of the moon is about one-sixth that of the Earth. This means that the weight of any object on the moon will be one-sixth of its weight on the Earth.

### Activity

**Aim:** To measure the gravitational force acting on a body

**Materials needed:** a spring balance, four heavy books, a fully loaded school bag, and a string that is long enough to be tied around the books, and strong enough to lift the books



**Method:**

1. Tie the books—two, three and four at a time—with the string and hold them up with the spring balance.
2. Note the reading on the spring balance.
3. Next, hold up your school bag with the spring balance and note the reading.

**Conclusion:** The reading on the spring balance is actually the gravitational force between the Earth and the object. This is called the 'weight' of the object.

## Electrostatic Force

*The force between electric charges is called* ***electrostatic force***. If we rub a plastic object such as a pen, comb, or CD with hair and bring it close to tiny bits of paper, the bits of paper get attracted to the plastic object (Fig. 10.7). This is due to electrostatic force. Tiny particles of dust and smoke can also be attracted by electrostatic force. This method is used in electric air purifiers and in factories to purify air in chimneys before letting it escape into the atmosphere.

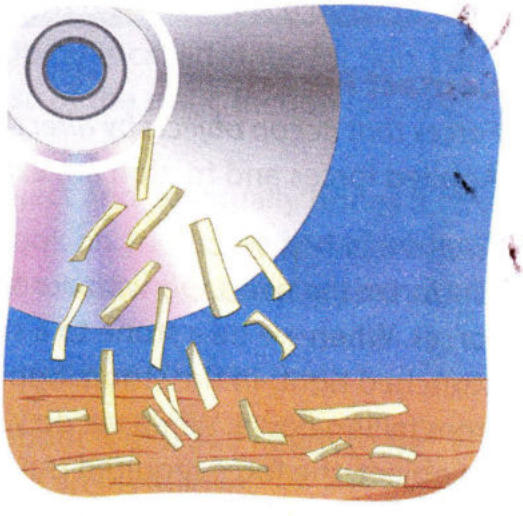


**Fig. 10.7** *A charged CD attracting pieces of paper*

## Magnetic Force

The force exerted by magnets on each other and on metals such as iron, cobalt, and nickel is called

magnetic force. Since magnets attract iron (Fig. 10.8), they are used to separate waste iron objects, or scrap iron from garbage dumps so that they can be recycled.

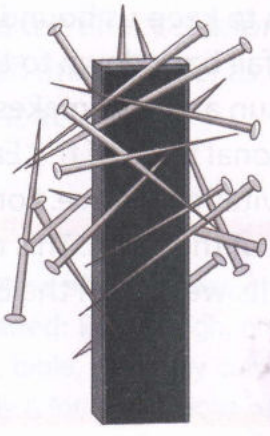


**Fig. 10.8** *A magnet attracting iron pins*

**Fact File**

There are only four known forces in nature. They are: the gravitational force, electromagnetic force (electric and magnetic forces are related, and are together referred to as the electromagnetic force), and strong and weak interaction forces. All other forces are manifestations of these four fundamental forces.

## Let's Remember

REMEMBERING UNDERSTANDING

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

1. A push or a pull acting on a body is called force.
2. The SI unit of force is m/s.
3. A force cannot change the direction of motion of an already moving object.

**II. Answer the following questions orally.**

1. Give three effects that a force can produce.
2. What are contact forces?
3. Is gravitational force a contact or non-contact force?

## Contact Forces

*Forces that act on objects by direct or indirect physical contact are called* ***contact forces.*** Applied forces and friction are examples of contact forces.

### Applied Forces

*The forces that we apply with our hands, legs, fingers, etc., are collectively called* ***applied forces.*** When we tie a stone to a string and suspend it, the tension (the state of being stretched tight) in the string, opposes the force of gravity of the Earth and keeps the stone from falling down. When we do work with our hands, such as lifting a weight, or pulling an object, the force required is provided by the tension of our muscles. When we need to apply a force, the brain sends a signal to the muscle (in the form of electrical signals via the nerve cells), which makes the muscle contract. This is how we can apply a force with our hands and legs.

## Activity

**Aim:** To observe forces that need direct or indirect physical contact
**Materials needed:** A biscuit, a sheet of paper, a branch with leaves, rubber bands, play dough (or chapatti dough), string, and a pencil
**Method:**
Break the biscuit, tear the paper, pluck leaves from the branch, pull the rubber bands, and make different shapes from the play dough
**Conclusion:** In each of the above cases, we exerted a force on the object by touching it, that is, by direct physical contact.

### Friction

***Friction** is the force that offers resistance when two surfaces in contact move or try to move with respect to each other.* The force of friction comes into play only when two surfaces are in direct physical contact, and is therefore a contact force.

**Fact File**

The branch of science that deals with the study of friction is called tribology.

#### Factors that Affect Friction

Friction depends on the following.

- ***Mass of the object***—the heavier the object, the greater will be the frictional force.
- ***The nature of the surfaces in contact***—In general, a rough surface will offer a greater frictional force than a smooth surface.

#### Static Friction and Kinetic Friction

In addition to mass and nature of the surfaces in contact, the force of friction between two surfaces also depends on whether the surfaces are moving with respect to each other or not.

The force of friction that holds a stationary object from slipping is called static friction. For example, you can stand without slipping on a slope because of the static friction between your shoes and the surface of the slope.

The force of friction that slows down an already moving object and eventually brings it to a stop is called kinetic friction. For example, if you slide a book on your table and leave it, it will slow down and come to a stop because of kinetic friction. You will learn later that static friction is always larger than kinetic friction.

#### Causes of Friction

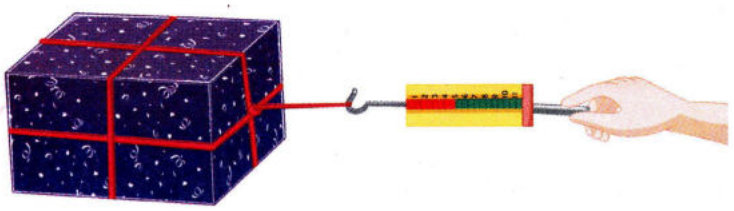
Friction is a very complex phenomenon, and there is a lot about it that still needs to be explained. Two simple explanations for why friction is caused are as follows.

- Any surface, however smooth, has a lot of irregularities when seen under a microscope. These irregularities are like hills and valleys. When two such surfaces slide over each other, there will be a resistance to motion (friction).

- Another theory that explains friction says that when two surfaces come in contact, their atoms and molecules pull each other due to electrostatic forces. They 'stick' to each other at a microscopic level. When we try to slide the surfaces with respect to each other, these offer a resistance to motion.

## Activity

**Aim:** To show that frictional force depends on the nature of the two surfaces in contact
**Materials needed:** A few books, plastic sheet, nylon cloth, gunny cloth, jute cloth, sandpaper, thread, and spring balance
**Method:**



1. Make a stack of books and, with the help of a thread, wrap a plastic sheet around it as shown in figure given here.
2. Attach this stack to a spring balance, as shown in the figure, and pull gently.
3. Note the reading on the spring balance.
4. Do the same for all materials. Note down the readings in each case.

**Observation:** You will notice that different materials offer different amounts of resistance (friction) to sliding. You will see from this activity that the force of friction depends on the nature of the surfaces in contact.
**Conclusion:** The frictional force depends on the nature of the two surfaces in contact. The reading on the spring balance will be higher for rougher surfaces (generally).

## Activity

**Aim:** To study the effect of mass of a body on friction
**Materials needed:** A 100/200 page notebook and two or three thick books (small enough so that they can be placed on the notebook)
**Method:**

1. Place the notebook on the floor, and push the notebook gently on the floor (Fig. A). Make a mental note of the resistance (friction) offered to your pushing the notebook.
2. Place one thick book on the notebook and repeat step 1 (Fig. B).
3. Keep increasing the number of books and repeat step 1 (Fig. C).

Fig. A Fig. B Fig. C

**Observation:** As you increase the number of books on your notebook, the mass increases, and you will see that the frictional force increases. The area of contact and the nature of the surfaces (notebook and floor) remain the same.
**Conclusion:** Frictional force increases as mass increases.

### Sliding Friction and Rolling Friction

Generally, sliding an object such as a cylinder is more difficult than rolling it. *The frictional force offered when sliding an object is called* ***sliding friction*** (Fig 10.9). For example, a box sliding on a surface. *The frictional force offered when rolling an object is called rolling friction.* For example, a ball rolling on a surface.

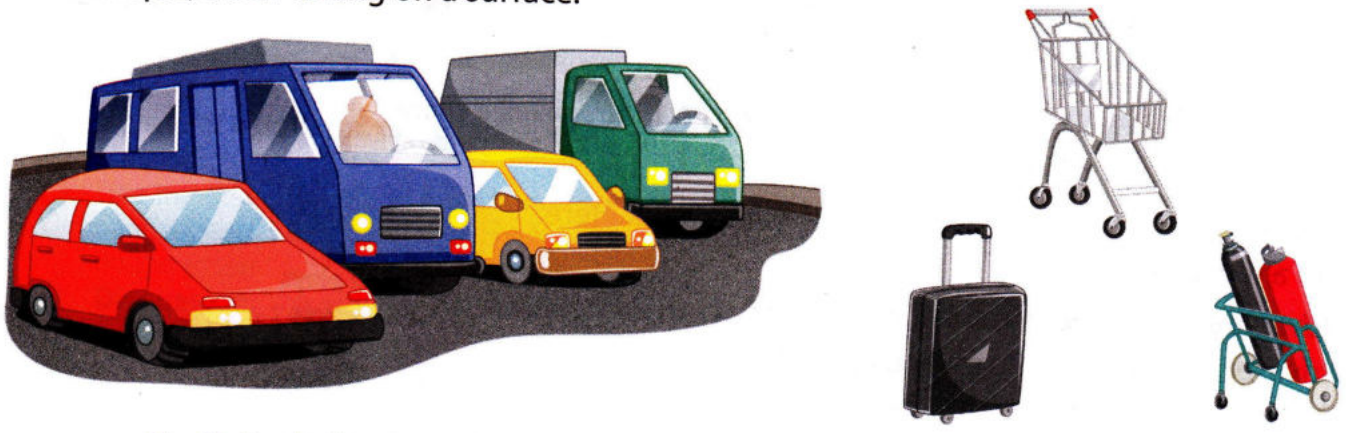


**Fig. 10.9** *'Rolling' is used instead of 'sliding' in many situations to make it easier to move heavy objects*

## Activity

**Aim:** To understand that sliding friction is greater than rolling friction
**Materials needed:** A smooth cylindrical water bottle filled with water, a pencil, and a flat tabletop
**Note:** Close the cap of the water bottle tightly and make sure that the water does not leak even if the bottle is horizontal.
**Method:**

1. Place the water bottle upright on the tabletop. Push it gently at the bottom with a pencil till it slides (Fig. A).
2. Next, place the water bottle horizontally on the tabletop. Push it gently with the pencil (Fig. B). You will find that the water bottle rolls with very little effort.

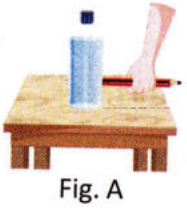


Fig. A

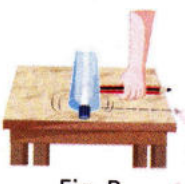


Fig. B

**Observation:** We have observed that a greater force is required to slide the water bottle on the tabletop than to roll it.
**Conclusion:** Sliding friction is greater than rolling friction for the same object and the same set of surfaces in contact.

### Motion of Objects in Fluids

When an object moves in a fluid (i.e. in a liquid or a gas), it experiences a force that tends to slow it down. This resistive force is called *drag*. This resistive force or drag becomes more noticeable when the object moves faster. To reduce drag, automobiles, ships, and aeroplanes are given a special shape, called a streamlined shape. An automobile with a streamlined body experiences lower resistance when travelling through air. Even sea creatures such as fish and shark have streamlined bodies, which makes it easier for them

to move with great speeds in water. Figure. 10.10 depicts some objects with streamlined shape.

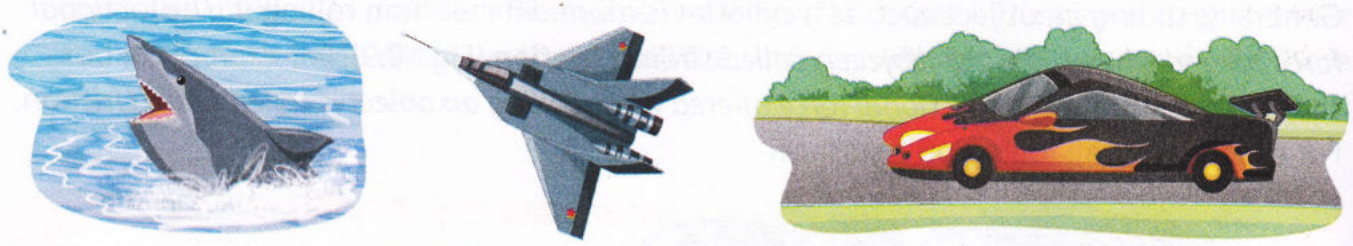


**Fig. 10.10** *Objects with streamlined shape*

## Advantages and Disadvantages of Friction

Friction has both advantages and disadvantages. Here are a few examples.

***Advantages*** It is because of friction that we can walk, drive, open doors, turn taps, and write. Screws and nails do not slip off because of the friction between the wood and the metal surface of the screw. A knot remains in place because of the friction of the rope with which you tie it. Bed sheets remain on the bed because of friction. You can sit on a chair without sliding off because of friction.

***Disadvantages*** Friction causes the moving parts in machinery and automobiles to heat up. This results in wastage of energy and fuel. Friction also causes wear and tear of the moving parts. Depending on our requirements, we may need to reduce or increase the friction between surfaces.

## Methods of Reducing Friction

Wear and tear due to friction depends on two factors: the roughness and nature of the two surfaces in contact, and the amount of time the two surfaces rub against each other. Wear and tear of an object is not desirable as it reduces the life of the object. This is more so in case of moving parts in automobiles and machinery. Therefore, efforts are made to reduce friction between moving parts.

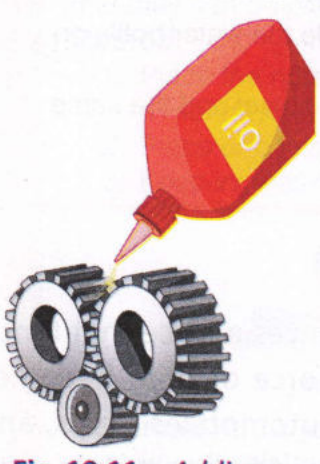



**Fig. 10.11** *Adding a lubricant helps reduce friction between moving parts*

### Fact File

**Friction plays a major role in lighting up a matchstick**

You would have observed how a matchstick lights up when it is rubbed (or struck) along the coating on the side of the matchbox. The head of the matchstick contain some chemicals, and so does the coating on the side of the matchbox. On the coating on the side of the matchbox, the chemical is mixed with sand and powdered glass, which together provides a rough surface. The small amount of heat produced because of the friction between the head of the matchstick and the coated surface on the side of the matchbox is enough to 'light up' the head of the matchstick.

### Word help

**Wear and tear** Damage caused to objects as a result of normal use

### Let's Discuss

Is friction a 'Friend' or 'Foe'? Discuss.

Friction between moving parts is usually reduced by introducing a substance between the moving surfaces. This process is called *lubrication*. The substance introduced is called a *lubricant*. Common lubricants are oil and grease (Fig. 10.11).

## Activity

**Aim:** To show that greater friction causes increased wear and tear
**Materials needed:** A new eraser, a piece of paper from your notebook, a piece of cardboard, and sandpaper
**Method:**
Use the eraser to rub on the different surfaces (paper, cardboard, and sandpaper). Each time, make a note of the amount of wear and tear on the eraser.
**Discussion:** You will see that rougher the surface, the greater is the wear and tear.

Ball bearings are elements used in machinery and appliances to reduce friction of moving (especially rotating) parts. The structure of ball bearings is shown in Figure 10.12. Ball bearings change sliding friction to rolling friction. This is very useful as rolling friction is much smaller than sliding friction. Ball bearings are used in most mechanical structures which have moving parts. Small metal balls made of stainless steel, brass, ceramic, etc., are placed between moving surfaces (the surfaces can be flat or cylindrical) to reduce friction.

**Fig. 10.12** *Ball bearings*

### Methods of Increasing Friction

There are two methods of increasing friction: one is by making the surfaces rough and the other by increasing the mass of the object that is moving. For example, the tyres of vehicles have treads (these are the 'designs' that you can see on the tyre surface), which increase the friction between the tyre and the road (Fig. 10.13). Similarly, the soles of shoes have grooves or spikes in order to increase friction. Gymnasts often apply a coarse material on their hands to get a better grip by increasing friction.

### Fact File

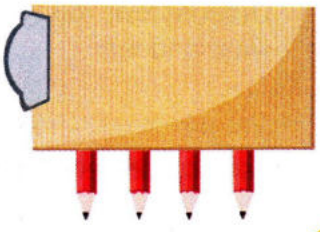
**Treads**
The shape and structure of the 'treads' in tyres are such that, if they are on a wet road, they squeeze out the water between the grooves, and therefore, provide a better grip on the road

**Fig. 10.13** *Tyres have treads*

## Activity

**Aim:** To show the basic principle of ball bearings
**Materials needed:** Two wooden examination pads/planks and 4–6 pencils of equal size and round sides (or 4–6 small marbles of equal size)
**Method:**

1. Place one of the examination pads upside down on a table top. Place it at the edge of the table so that the clip juts out. Ensure that the pad is absolutely flat on the table.
2. Place the second examination pad (with the clip facing upward). Make sure that the two examination pads are touching each other back to back.
3. Slide one pad over the other. Make a mental note of the friction offered.
4. Place the pencils/marbles between the two back surfaces of the pads, and slide one pad over the other. Notice the friction offered.
5. Compare the friction encountered in steps 3 and 4. What do you conclude?



**Observation:** You will notice that if pencils or marbles are placed between the two pad surfaces, the friction offered is much less. This is because the pencils/marbles roll as the pads slide across each other.
**Conclusion:** Rolling friction is less than sliding friction.

## Key Words

| | |
|---|---|
| **Force** | A force is a push or a pull acting on an object. |
| **Non-contact forces** | Forces that do not need physical contact with the object on which they are acting are called non-contact forces. |
| **Contact forces** | Forces that act on objects by direct or indirect physical contact are called contact forces. |
| **Friction** | The resistance to motion experienced when two surfaces in contact move with respect to each other is called friction. |

## Summary

- Force can make a stationary object move or make a moving object move faster.
- Force can slow down or completely stop a moving object.
- Force can change the direction of a moving object.
- Force can change the shape and size of an object.
- Gravitational force, electrostatic force, and magnetic force are examples of non-contact forces.
- Applied forces and friction are examples of contact forces.
- Frictional force depends on two main factors: the nature of the surfaces in contact and the mass of the object.
- Rolling friction is less than sliding friction.
- Depending on our requirements, we may need to reduce or increase the friction between surfaces.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. When two forces in the same direction act on an object, then the resultant magnitude of the forces acting on the object is
   a. the sum of the two forces
   b. equal to the smaller force
   c. the difference between the two forces
   d. equal to the larger force

2. Gravitational force
   a. is a 'non-contact force'.
   b. opposes motion of a body, just like friction.
   c. can act only if a body is charged.
   d. is zero on the Moon.

3. This is an example of a contact force.
   a. Electrostatic force
   b. Magnetic force
   c. Friction
   d. Gravitational force

4. This force is our weight.
   a. Electrostatic force
   b. Magnetic force
   c. Friction
   d. Gravitational force

5. Static friction acts when a body is
   a. moving
   b. stationary
   c. rolling
   d. sliding

6. The SI unit of force is
   a. meters per second
   b. newton
   c. pascal
   d. newton per meter

7. We can expect the force of friction to be greater for an object moving on a surface if the surfaces in contact are
   a. smooth and the object is heavier
   b. rough and the object is heavier
   c. smooth and the object is lighter
   d. rough and the object is lighter

8. This force makes the Earth go around the Sun.
   a. Electrostatic force
   b. Frictional force
   c. Gravitational force
   d. Magnetic force

9. A 'streamlined' shape is given to automobiles in order to
   a. increase friction
   b. reduce drag
   c. reduce gravitational force
   d. get greater electrostatic force

10. Ball bearings are used to
    a. give a streamlined shape
    b. increase grip
    c. increase drag
    d. reduce friction

**B. Write T for the True and F for the False statements. Correct the false statement/s.**

1. Frictional force between two surfaces depends on the nature of the two surfaces.
2. Rolling friction is greater than sliding friction.
3. Ball bearings are used to increase friction.
4. Fluid friction acts between two solid surfaces that are moving.
5. Tyres of vehicles have treads to reduce speed.

## II. Very short answer type questions

**A. Answer the following.**

1. Give an example of one contact force.
2. What is the SI unit of force?
3. What is a spring balance used for?
4. Give an example of one non-contact force.
5. Give two advantages of friction.

**B. Define the following.**

1. Applied forces
2. Static friction
3. Rolling friction
4. Sliding friction
5. Wear and tear

## III. Short answer type questions

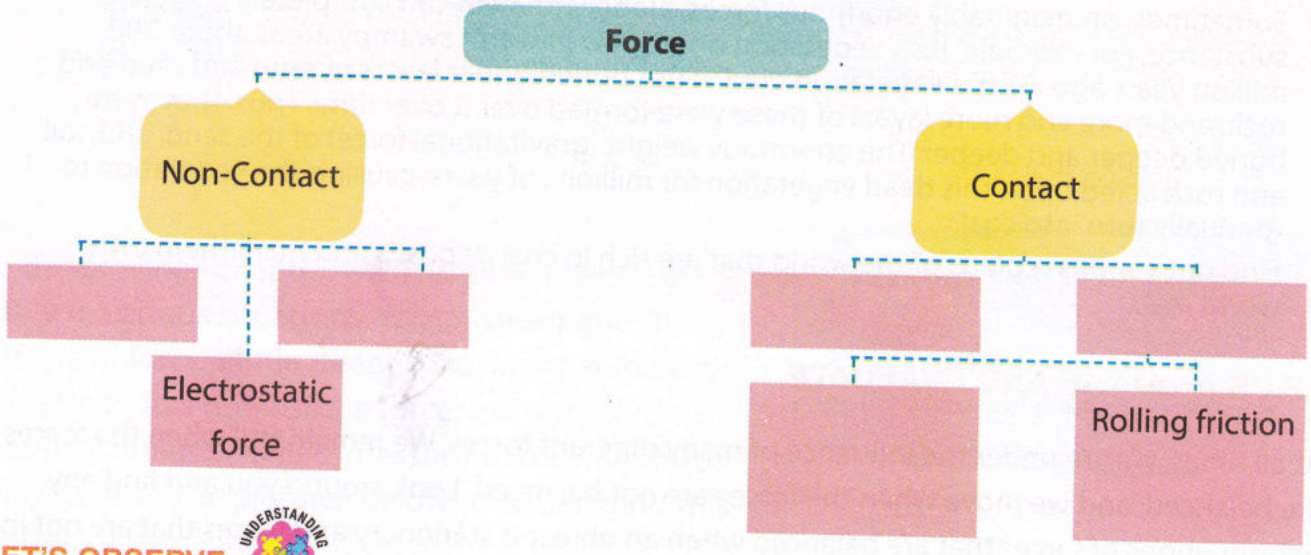
1. What is the dominant force that acts between two electrically charged objects called?
2. Write down two factors on which the magnitude of frictional force between two surfaces depends.
3. How can we change the shape of an object? Give an example.
4. Name one factor on which gravitational force depends.
5. Why is friction a disadvantage?
6. Why are oils and grease used in machinery?

## IV. Long answer type questions

1. Discuss the effects of force.
2. Describe an activity to show that the force of friction between two surfaces depends on the nature of the two surfaces in contact.
3. What is 'streamlined shape'? Explain and give two examples.
4. Describe how friction can be reduced. In what way will it help if friction is reduced?
5. How can we increase friction between two surfaces?

## LET'S RECALL

Recall and complete the concept map given below.




## LET'S OBSERVE

1. Write **R** for the item that helps in reducing friction and **I** for the one that helps in increasing friction. LO 1

☐ Ball bearings

☐ Tyre treads

2. Look at the following pictures and write a few lines on how the structure/shape/design in each case is used to reduce/increase friction/grip, and the need to do so. LO 4

a. _____

b. _____

c. _____

d. _____

e. _____

## LET'S CONNECT GEOGRAPHY

### Formation of Coal

Sometimes, unimaginably enormous forces, along with heat can completely change a substance. For example, lush vegetation once grew in warm swampy areas about 300 million years ago. As the vegetation died, it got buried under layers of sand and mud and rock, and more and more layers of these were formed over it over time. Thus, they were buried deeper and deeper. The enormous weight (gravitational force) of the sand, and soil and rock acted upon this dead vegetation for millions of years, causing the vegetation to gradually turn into coal.

Find out various regions of the world that are rich in coal deposits and mark them on a world map.

## LET'S ANALYSE AND EVALUATE

At all times, we are under the influence of many different forces. We remain still when the forces are balanced, and we move when the forces are not balanced. Look around you and find any two situations of forces that are balanced when an object is stationary and forces that are not in balance when an object is moving. ANALYSING EVALUATING LO 5

For example, when you are sitting on a chair, the gravitational force of the Earth is pulling you down, and the chair on which you are sitting exerts a force that stops you from falling down. Make a list of similar situations and mention the forces at play.

## LET'S CREATE CREATING

1. Make a chart on the various effects of force in our everyday life. LO 11
2. Collect pictures of different types of tyres used for different purposes. Give reasons at least in two cases why a particular type of treading is used. For example, types of treading in bicycle tyres, racing bikes, and those used for cross-country biking. Make a chart based on your findings. LO 14
3. If possible, organize a visit to a nearby factory (a manufacturing unit that uses heavy machinery) to find out the different methods they use to reduce friction in the moving parts of the machinery. Then prepare a report based on your findings. LO 11 LO 5
4. If possible, organize a visit to a local automobile mechanic's shop and see how they service cars and two-wheelers. An important part of the servicing is to grease the moving parts and to check the brake linings. Find out how and why they do this. Then prepare a report based on your findings. LO 11

### Web Research

- To learn more about forces in nature, browse through https://science.howstuffworks.com/environmental/earth/geophysics/fundamental-forces-of-nature.htm (accessed and checked on 12/08/2019)
- To learn more about gravity, browse through https://spaceplace.nasa.gov/what-is-gravity/en/ (accessed and checked on 12/08/2019)
- To learn more about the life of Isaac Newton, browse through https://www.britannica.com/biography/Isaac-Newton (accessed and checked on 12/08/2019)

# 11 Pressure



In the previous chapter, we learnt the effects of force in various situations. When we explore the effects of force a little deeper, we find that in many situations, it is not just the force, but another physical quantity called 'pressure' that comes into play. Look at the pictures below to understand this better.

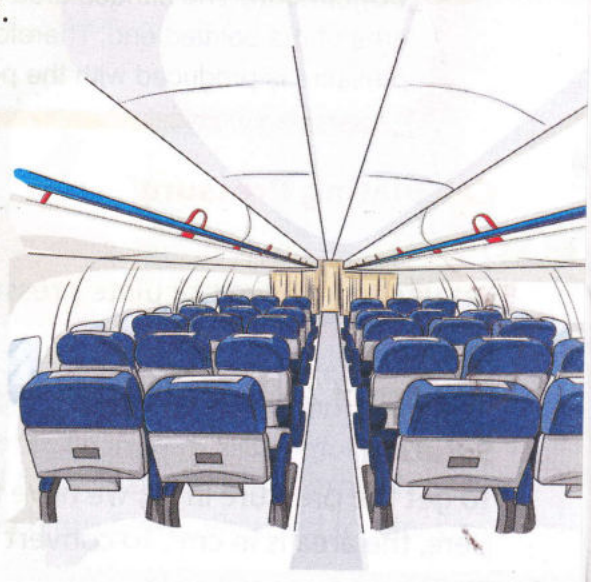
**You will learn about**

- Pressure
- Fluid pressure
- Applications of pressure

1.

2.

3.



1. Which end of the tack pin should be used for pinning up the notice?
2. Why does the balloon burst?
3. Why is it necessary to pressurize the cabins of high-flying airplanes?

Answers: 1. The sharp end., 2. The balloon bursts when too much air is blown into it.
3. Because airplane flies at very high altitudes and the air pressure is very low there.

## PRESSURE

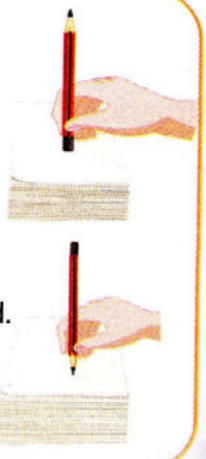
***Pressure** is defined as force per unit area.* The SI unit of pressure is pascal (Pa), which is newton (N) per square metre ($m^2$).

$$\text{Pressure (in Pa)} = \frac{\text{Force (in N)}}{\text{Area (in } m^2\text{)}}$$

Some very important and useful devices such as the syringe, dropper, and drinking straw work on the principle of pressure.

### Activity

**Aim:** To observe the effect of pressure
**Materials needed:** A sheaf (bundle) of paper and a sharpened pencil
**Method:**
Press the papers very hard with the blunt end of the pencil. Now, turn the pencil around and press very hard on the paper with the pointed end of the pencil.
**Observation:** You will find that if you press very hard, you may be able to make an impression on the paper with the blunt end of the pencil. However, with much less effort you could even make a hole in the paper with the pointed end.
**Conclusion:** The surface area of the blunt end is larger than the surface area of the pointed end. Therefore, with a much smaller force, a greater pressure is produced with the pointed end of the pencil.



### Calculating Pressure

TD

Let us see how we calculate pressure.

**Example 1**

If a force of 2 N is applied over an area of 2 $cm^2$, calculate the pressure produced.

**Solution**

To get the pressure in Pa, we have to make sure that the force is in newton and the area in $m^2$. Here, the area is in $cm^2$. To convert this into $m^2$, we have to divide the given area by 10,000.

Thus,

$$\text{Area} = \frac{2}{10{,}000}$$

$$= 0.0002\ m^2$$

Now,

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$= \frac{2\ N}{0.0002\ m^2}$$

$$= 10{,}000\ Pa$$

**Example 2**

Calculate the pressure if a force of 2 N is applied on an area of 2 $mm^2$.

**Solution**

Here, again the area is not in $m^2$. To change it into $m^2$, we divide the area by 1,000,000.

Thus,

$$\text{Area} = \frac{2}{1{,}000{,}000} = 0.000002\ m^2$$

Now,

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{2\ N}{0.000002\ m^2} = 1{,}000{,}000\ Pa$$

In these examples, we took the same force and calculated the pressure over two different areas. The same force acting on a smaller area produces a greater pressure.

## Variation of Pressure

Pressure depends on two main factors: force and surface area.

- Increasing the force on an area increases the pressure produced.
- Similarly, increasing the area over which a particular force acts decreases the pressure produced. The converse is also true—decreasing the area over which a particular force acts increases the pressure produced. For example, the pointed end of a high-heeled shoe exerts a greater pressure than the flat end, as the force is acting over a smaller area at the pointed end.

**Fact File**

A camel has flat, broad feet that reduce the pressure exerted on the sand. As a result, the camel's feet sink very little in the sand, allowing it to move fast.

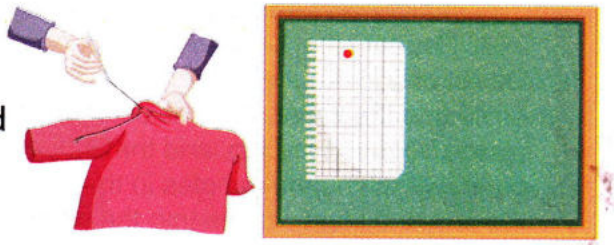


**Fig. 11.1** *The sharp point of a needle makes it possible to pass it through a cloth and the notice board with lesser effort*

This is also the reason why needles are made with sharp points. Since the sharp point of a needle has a very small surface area, lesser effort is needed to pass the needle through cloth while stitching. The same is true for drawing pins, which are generally used to pin- up notices on notice boards (Fig. 11.1).

## FLUID PRESSURE

Liquids and gases are together called *fluids*. Fluids exert pressure on all bodies immersed in them and on the walls of the containers that hold them.

This is why a balloon expands when we blow air into it. The air inside the balloon exerts pressure on the inner wall of the balloon. If we blow in too much air, and the material of the balloon is not capable of expanding further, increasing the pressure inside can cause the wall of the balloon to break at one or more points. This is why a balloon bursts when too much air is blown into it.

When an object is immersed in a liquid, the liquid exerts a net upward force on the object. If you try to push an inflated balloon into a bucket of water, you will find that as you try to push down the balloon, the water seems to be pushing it back upward! In fact, if you stop pushing the balloon, the balloon will be pushed back to the surface. This is because the water in the bucket exerts pressure on the balloon. (Fig. 11.2)

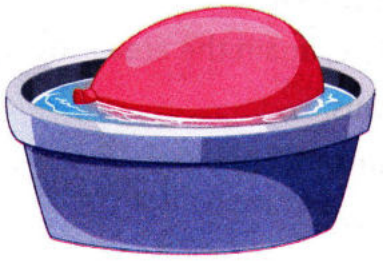


**Fig. 11.2** *Water exerts pressure on the balloon*

This upward force exerted by a liquid determines whether the object will float or sink in the liquid. If the upward force exceeds the weight of the object, the object floats; if the weight of the object exceeds the upward force, the object sinks.

## Activity

**Aim:** To see if we can push an inverted bottle into a bucket full of water

**Materials needed:** A transparent plastic water bottle, a bucket full of water, compass/divider with sharp points

**Method:**

1. Take an empty plastic water bottle, upturn it, and try pushing it in the upturned position into the water in the bucket with the cap open.
2. Make a note of what you observe.
3. Next, with the help of an adult, use the divider/compass to make holes at the base of the plastic water bottle.
4. Repeat step 1 and see what happens.

**Observation:** You will see that you will need to put in a lot of effort to push the inverted plastic bottle into the water. You will also notice that there is some air trapped inside the inverted plastic bottle, at the top, and that it never goes away, no matter how hard you try. On the other hand, when you make holes in the base of the inverted plastic bottle, you will be able to push the inverted plastic bottle into the water quite easily.

**Conclusion:** When we try to push the inverted plastic bottle into the water, air trapped inside the inverted bottle gets compressed, with no escape. This exerts pressure on the water, making it difficult for the water to rise inside the bottle, thus also making it difficult to push the bottle in. However, when we make holes at the base of the plastic bottle and then try to push it in, air escapes through these holes, and we find that we can push in the inverted plastic bottle quite easily.

## Atmospheric Pressure

Did you know that all of us are immersed in a sea of air and are experiencing its pressure all the time? This is called atmospheric pressure. Scientists discovered atmospheric pressure in the seventeenth century. This discovery uncovered an interesting fact—that air actually has weight! The weight of the atmosphere presses down on the Earth's surface and creates a pressure on it.

***Atmospheric pressure*** *is defined as the pressure exerted on an object by the weight of the air above it.* The atmospheric pressure on the Earth's surface at sea level is about one hundred

thousand pascal, i.e., 100 kPa. If such an enormous amount of pressure is acting on us, why do we not feel it? This is because the pressure of the blood in our blood vessels and that of the other fluids present in the body balances out the atmospheric pressure. Atmospheric pressure is measured using an instrument called barometer (Fig. 11.3).


**Fig. 11.3** *Barometer*

**Fact File**

The weight of the atmosphere on the top of your head is 250 kg wt, which is equivalent to the weight of about two baby elephants!

## Variation of Atmospheric Pressure With Altitude

The *altitude* of a place is its height above sea level. The atmospheric pressure at a place depends on its altitude and decreases as we go up. We know that atmospheric pressure at a place is the pressure exerted by the weight of the air column above that place. As we go up, the length of the air column above us decreases. This means its weight decreases, and, therefore, the atmospheric pressure is lower at higher places (than at sea level).

If the pressure of the atmosphere is reduced suddenly, the blood vessels in our body will burst due to the pressure of the blood and other fluids inside.

**Fig. 11.4** *Astronauts wear special suits*

**Fact File**

**Synthetic diamonds**

Diamonds are formed from naturally available carbon in the Earth's interior by the enormous pressure and temperature deep under the earth. Till recently, producing such high pressures was beyond our capability. However, technology has now progressed so much that the required high pressures and temperature can be produced in a lab. Therefore, diamonds can now be produced in the laboratory by applying high pressure and temperature to carbon. These diamonds are the same as natural diamonds and are also called laboratory-made diamonds.

Astronauts who go out in space have to wear special pressurized suits because there is no air and, therefore, no air pressure in space (Fig. 11.4).

### Otto von Guericke's Experiment

We have just learnt that the pressure of the atmosphere is enormous. A very spectacular demonstration of this was done by the German physicist and engineer Otto von Guericke in the 1600s. In this demonstration, he took two semicircular bowls made of copper, fitted them together to form a hollow sphere, and removed the air inside this sphere

using the suction pump he had invented. These two semicircular bowls were held together only by the pressure of the atmosphere. He then got two teams of eight horses each to pull the bowls apart. Guess what? The bowls held tightly together, demonstrating the enormous force of atmospheric pressure.

## Activity

**Aim:** To show the presence of atmospheric pressure
**Materials needed:** A glass tumbler (with a smooth edge at the mouth, and without a rim), a piece of stiff cardboard (a little bigger than the mouth of the tumbler), and water. (It would be convenient to perform this activity over a wash basin or the kitchen sink.)
**Method:**

1. Fill the tumbler with water to the brim. Cover the tumbler with the cardboard piece (Fig. A).
2. Place the palm of your hand over the piece of cardboard, and quickly invert the tumbler (Fig. B).
3. Slowly remove your hand supporting the piece of cardboard (Fig. C).

**Observation:** You will observe that the cardboard piece will not fall.
**Conclusion:** Atmospheric pressure provides enough force to support a full glass of water.

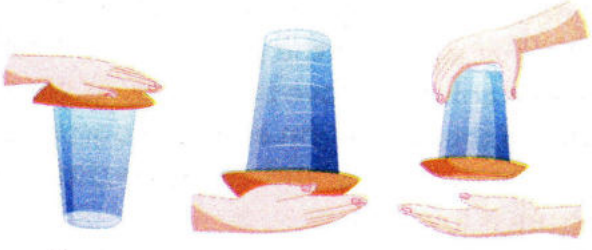


Fig. A Fig. B Fig. C

## Activity

**Aim:** To study atmospheric pressure using rubber suckers
**Materials needed:** Rubber suckers
**Method:**

1. Take a rubber sucker and press it firmly to a smooth surface such as a kitchen tile or a plain glass window.
2. Try to pull it out.

**Observation:** You will see that it is really difficult to pull the rubber sucker off the smooth surface.
**Conclusion:** By pushing the rubber sucker against the smooth surface, you have created a partial vacuum, and the pressure of the air pressing on the outer surface of the sucker holds it in place.
**Extension:** Take a smooth stainless steel or ceramic plate and stick the rubber sucker on it. You can now hold the plate at any angle (horizontal, vertical, upside down, etc.) and try to pull the rubber sucker off the plate. You will find that the rubber sucker remains stuck to the plate regardless of the angle at which you hold the plate. This shows that air exerts pressure in all directions.

## Let's Remember

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

1. For the same force, pressure increases if we increase the area over which it acts.
2. Air does not exert any pressure.

**II. Answer the following questions orally.**

1. If we press a sheaf of paper very hard with our thumb, it may crease a bit, but otherwise we do not see any change. However, if we press it with a sharp pin, we can make a hole in it. Why is this so?
2. Name the instrument used to measure atmospheric pressure.

## Measuring Pressure

The general term used for an instrument used to measure pressure is 'pressure gauge'. A very simple type of pressure gauge is an open-tube manometer (Figure 11.5). It consists of a tube placed in the form of a 'U' with a liquid in it. One arm of the tube is open to air and the other arm is connected to a rubber tube which can be connected to the point where the pressure is to be measured. For example, it could be inserted under a liquid surface at a certain depth (taking care that the liquid does not flow back into the tube), or it could be connected to a gas chamber, whose pressure is to be measured. When there is a difference in pressure at the ends of the two arms of the U-tube, the liquid levels in the two arms will no longer be the same. The liquid in the arm that experiences a higher pressure will be pushed down, and this pushes up the liquid in the other arm. There is a scale provided, on which the pressure (or pressure difference) can be read.

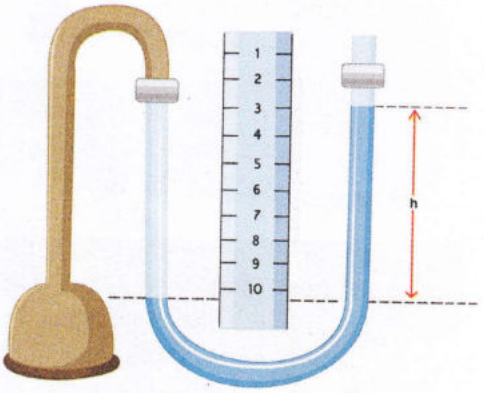



**Fig. 11.5** *Open-tube manometer*

## Variation of Liquid Pressure With Depth

Just like we saw in the case of atmospheric pressure, pressure exerted at a point under a liquid is due to the weight of the liquid above it. Therefore, as we go deeper beneath the surface of a liquid pressure increases.

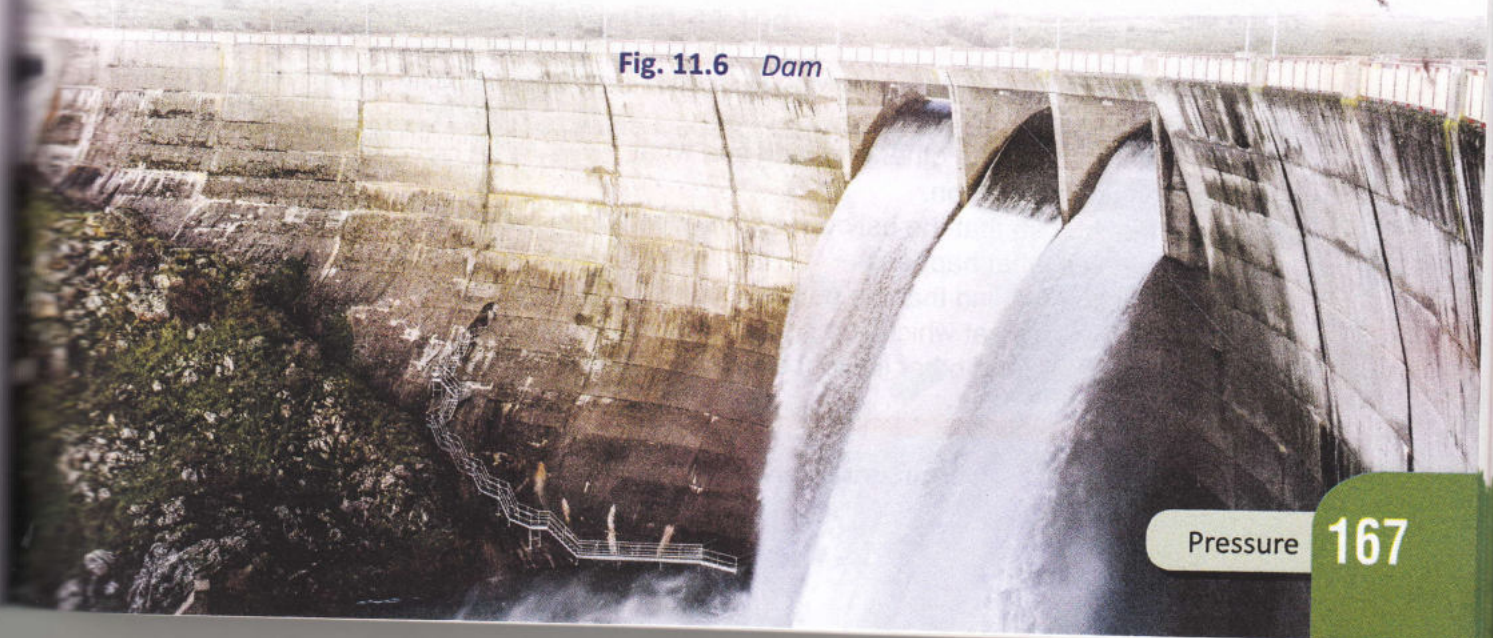


**Fig. 11.6** *Dam*

Deep under the sea the pressure exerted by water is much greater than at the sea level. The pressure experienced by deep-sea divers is so great that they have to wear specially designed suits to protect themselves. They use special suits called diving suits and buoyancy compensators to combat the weight of their diving equipment and the water pressure at great depths. Dams are made stronger and thicker at the bottom than at the top to withstand the high pressures at greater depths (Fig. 11.7).

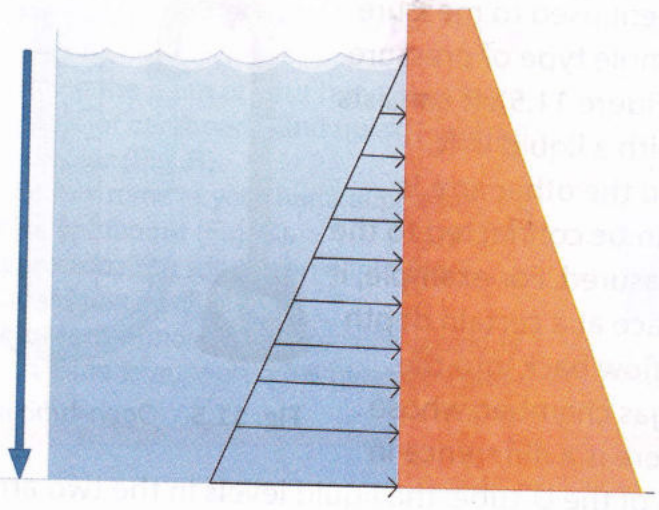


**Fig. 11.7** *Dams are thicker at the base than at the top.*

## Get it Right

While buying packaged food, you must be very careful to make sure that the package is not swollen. A swollen package indicates that something is causing a gas to build up inside the package resulting in increased pressure, which is pushing the walls of the package, making it swell up. Another reason could be that acid contained in food packaged in metal containers, is reacting with the metal to give out hydrogen gas, which is causing the metal container to swell up. The most dangerous reason for the swelling up could be that the food inside has been spoiled and bacteria growing in the spoilt food are giving out gases that swell up the food package. These bacteria and the by-products that they produce are highly toxic, which means that if consumed or even inhaled, they can cause severe food poisoning that could even be fatal.

## Activity

**Aim:** To show that liquids exert pressure in all directions

**Materials needed:** A 30-cm-long rubber pipe (like the one you use for watering plants; make sure it is smooth on the outside) and a balloon with a mouth that fits in very tightly on the rim of the pipe

**Method:**

1. Attach the balloon (without blowing it) to one end of the tube.
2. Fill water through the other end, and see what happens to the balloon.
3. Hold the tube so that the balloon is at various angles, horizontal, vertical, upside down etc., and see what happens.

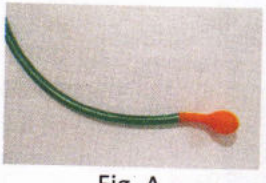


Fig. A

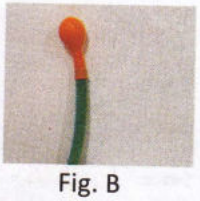


Fig. B

**Observation:** You will find that the balloon bulges out with the pressure of the water, regardless of the angle at which you hold it (Figs. A and B).

**Conclusion:** Water (and other liquids) exerts pressure in all directions.

## Let's Remember

**Fill in the blanks with the correct words.**

1. An open-tube manometer has _____ (one/two) arms.
2. The pressure at a point just below the water surface is _____ (greater/smaller) than the pressure at a deeper point below the surface.
3. Dams are made with thicker walls at the _____ (bottom/top) to withstand higher pressures.
4. A liquid exerts pressure in _____ (one/all) direction/s.

## APPLICATIONS OF PRESSURE

Examples of applications of pressure are given below.

- Skis have a large area to reduce the pressure on the snow. This ensures that the skis do not sink into the snow too far (Fig. 11.8).
- The pressure under the studs on the soles of football shoes is high enough for them to sink into the ground, which gives extra grip (Fig. 11.9).
- The area of the edge of a knife's blade is extremely small (Fig. 11.10a). This creates a pressure high enough for the blade to cut through a material.
- Syringes are used to take blood for blood tests. The pressure of the liquid (blood) forces the liquid to move into the syringe when its plunger is withdrawn (Fig. 11.10b).
- When air is sucked out of a drinking straw, the air pressure inside it decreases and the atmospheric pressure outside forces the liquid to go inside the straw (Fig. 11.10c).
- A vacuum cleaner has a fan inside that creates a low pressure inside the device. Consequently, air and dirt particles are sucked into the device (Fig. 11.10d).
- Heavy bags, such as school bags and laptop bags are given broad straps to increase the area over which the weight of the bag acts, thereby reducing the pressure on the person carrying them (Fig. 11.10e).

### Let's Discuss

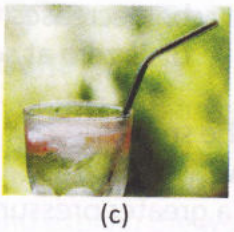
It is more difficult to cut fruits using a blunt knife than a sharp knife. Why?

**Fig. 11.8** *Skis reduce pressure on the snow.*

**Fig. 11.9** *Studs on the soles of football shoes increase the pressure on the ground.*

(a)

(b)



(c)

(d)

(e)

**Fig. 11.10** *Applications of pressure*

## Key Words

| | |
|---|---|
| **Pressure** | Force per unit area is called pressure. |
| **Atmospheric pressure** | The pressure exerted on an object by the weight of the air above it is called atmospheric pressure. |

## Summary

- Increasing the area over which a particular force acts decreases the pressure produced.
- Decreasing the area over which a particular force acts increases the pressure produced.
- Liquids and gases are together called fluids. Fluids exert pressure on all bodies immersed in them and on the walls of the containers that hold them.
- The weight of the atmosphere presses down on the Earth's surface and creates a pressure on it.
- The atmospheric pressure at a place depends on its altitude and decreases as we go up.
- In liquids, pressure increases with depth.
- Some very important and useful devices such as syringes and drinking straws work on the principle of pressure.

# Exercises

## LET'S UNDERSTAND

REMEMBERING UNDERSTANDING

QT

### I. Objective type questions

**A. Choose the correct option.**

1. The pressure exerted depends on
   a. the force and the nature of the surface
   b. the force and the area over which it acts
   c. only on the area and not the force.
   d. only the temperature of the atmosphere
2. Atmospheric pressure acts
   a. upwards b. downwards c. east to west d. in all directions
3. Rubber suckers stick to a smooth surface because of
   a. the temperature of the smooth surface
   b. moisture
   c. atmospheric pressure
   d. small holes in the rubber sucker that allow air to pass through.
4. Atmospheric pressure
   a. increases with altitude b. decreases with altitude
   c. remains the same d. is zero at sea level
5. Skis have a large area so as to
   a. increase the pressure exerted on the snow.
   b. decrease the pressure on the snow.
   c. cut through the snow by exerting a greater pressure.
   d. press the snow so that it melts.

6. The SI unit of pressure is
   a. meters per second  b. newton
   c. pascal  d. newton per meter
7. If we increase the area over which a force acts, the pressure produced
   a. remains unaffected  b. decreases
   c. increases  d. changes direction
8. If we increase the force acting over a certain given area, the pressure produced
   a. remains unaffected  b. decreases
   c. increases  d. both a and b
9. Liquids and gases together are called
   a. fluids  b. solids  c. gases  d. crystals
10. In order to cut through a material easily. The edge of a knife should have
    a. a large area  b. a rough surface  c. ball bearings  d. a very small area

**B. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Wide base | a. Manometer |
| 2. U-shaped tube | b. Dam |
| 3. Barometer | c. Pressure |
| 4. Force per unit area | d. Atmospheric pressure |

## II. Very short answer type questions

**A. Give reasons for the following.**

1. Needles have a sharp point.
2. A balloon bursts when too much air is blown into it.
3. We have to put an effort to push down an open and inverted glass bottle into a bucket full of water.
4. Atmospheric pressure reduces as we go up in altitude.

**B. Give one word for the following.**

1. The SI unit of pressure
2. Pressure exerted by an object by the weight of the air above it
3. Height above sea level
4. General name for an instrument used to measure pressure

## III. Short answer type questions

1. What is 'pressure' in physics?
2. Do fluids exert pressure? In what direction?
3. What is the approximate value of atmospheric pressure on the surface of the Earth at sea level?
4. Name the instrument used to measure atmospheric pressure.
5. How does atmospheric pressure vary with altitude?
6. How does the pressure in a liquid vary with depth?

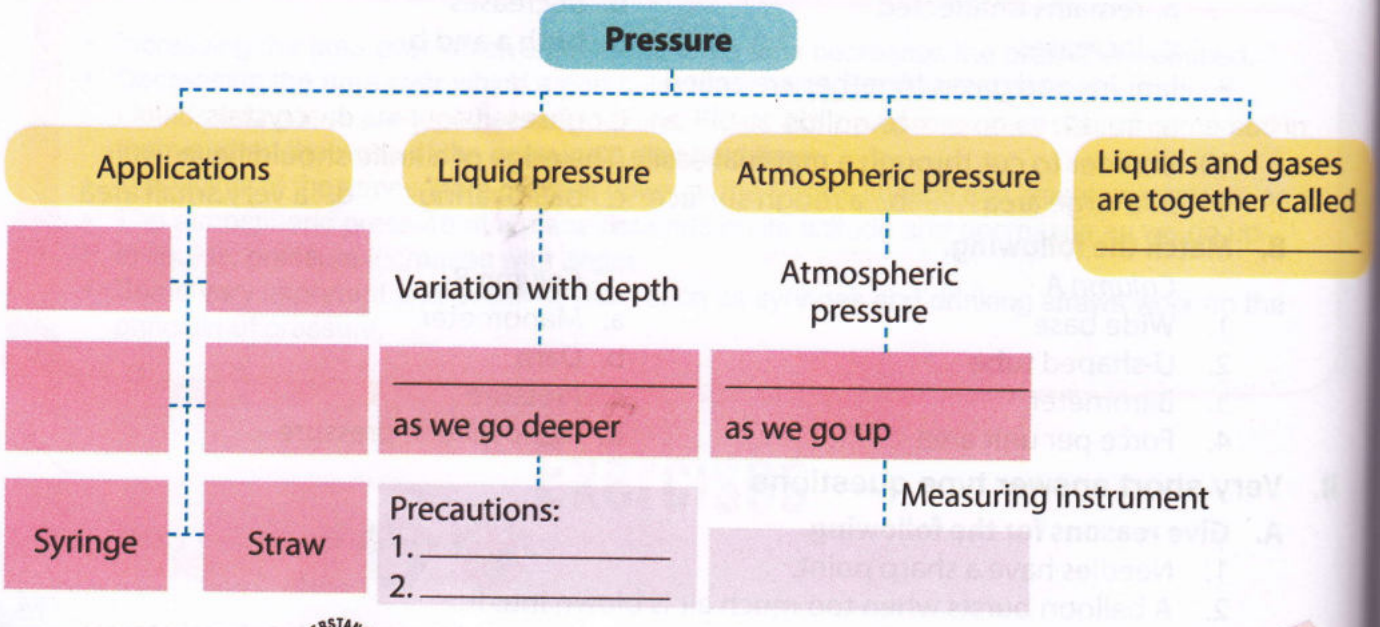
## IV. Long answer type questions

1. Describe an activity to show that the pressure produced increases when the surface area is decreased, for the same force applied.
2. Briefly outline an activity to demonstrate the presence of atmospheric pressure.
3. Draw a simple diagram and explain the working of an open-tube manometer.

4. Why are dams thicker at the base than at the top?
5. Describe two everyday applications where the area over which a force applied is reduced in order to increase the pressure produced.

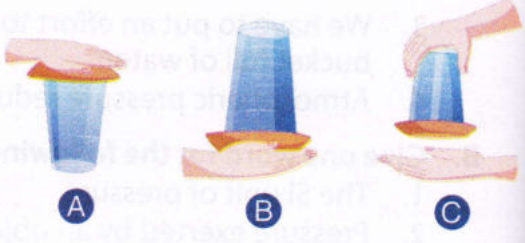
## LET'S RECALL

Recall and complete the concept map given below.




## LET'S OBSERVE

1. Name the phenomenon that is being demonstrated in this experiment. How is it that the water in the glass does not spill in Figure C. LO 5

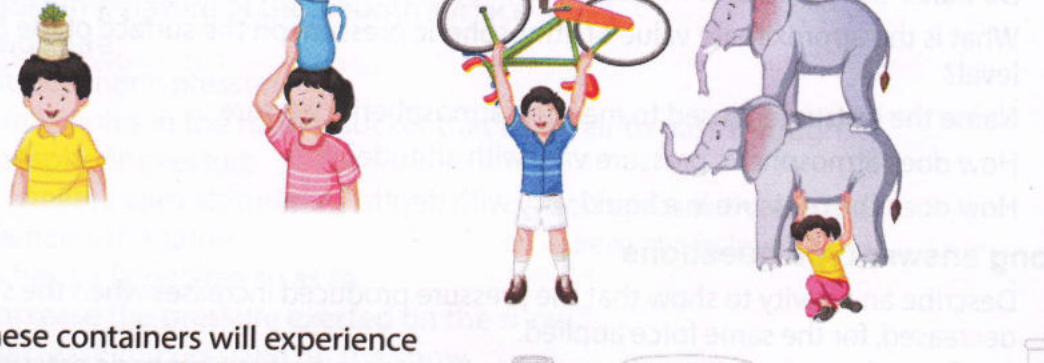



_____

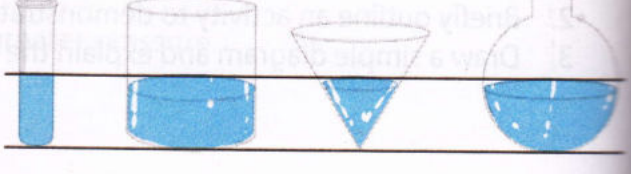
_____

_____

2. Which of the pictures below best captures the amount of atmospheric pressure that we experience on the surface of the Earth?



3. Which of these containers will experience the highest pressure at the bottom? LO 4



## LET'S CONNECT ENGLISH

Pressure cookers are specially designed vessels for cooking under high pressure. Cooking under high pressure reduces the time required for cooking by a substantial amount and this helps in reducing the amount of fuel used. In a paragraph of about 250 words, explain the advantages of using pressure cookers for cooking.

## LET'S APPLY

1. You are standing in a queue. The person immediately in front of you steps back and accidentally stomps on your foot with the heel of one shoe. Would you be more hurt if this person were (a) a woman wearing normal flat-soled shoes or (b) a woman wearing high-heeled shoes? Explain your answer assuming that both woman weigh the same. (Hint: How does pressure vary with area?) LO 11
2. Would you be able to suck juice with a drinking straw on the moon? Give a reason for your answer. (Hint: Recall the discussion on applications of pressure.) LO 4

## LET'S ANALYSE AND EVALUATE

1. There are many different types of vehicles on the road, from bicycles to huge trucks carrying heavy loads. If you look at the tyres of these vehicles, you will find that they come in many different sizes. Analyse why some vehicles use broad tyres whereas some others use narrow ones. Is there a connection between the function of a vehicle and the width of its tyres?
2. A force of 50 N acts on an area of 25 $cm^2$. Calculate the pressure produced.
3. You are given a square of side 5 mm, calculate the force which should be applied on this area that will produce a pressure of 1000000 pascal.
4. Calculate the area over which a force of 500 N should act to produce a pressure of 25 pascal.

## LET'S CREATE

LO 11

1. Make a chart on the applications of pressure. LO 11
2. Find out the names of different pressure gauges used to measure liquid pressure, atmospheric pressure, and blood pressure. Make a chart based on your findings. Include pictures, if possible. LO 11

**Web Research**

- To learn more about atmospheric pressure, browse through https://www.youtube.com/watch?v=xJHJsA7bYGc (accessed and checked on 12/08/2019)
- To learn more about hydraulic press and how it is used in factories, browse through https://www.youtube.com/watch?v=4ijTXo9Psik (accessed and checked on 12/08/2019)
- To learn more about Blaise Pascal, browse through https://www.youtube.com/watch?v=TOZIE6vNIVY (accessed and checked on 12/08/2019)

# 12 Sound

**You will learn about**

- How sound is produced
- How sound travels
- Characteristics of sound
- Types of sound
- Musical instruments and noise

When you hear the word 'sound', what comes to your mind?

A variety of things such as music, the school bell, traffic noise, your teacher's voice, and so on are some of the things one commonly thinks of. All these come under the category of 'sound'.

We hear sounds around us all the time. We use 'sound' in many different ways. Let's look at the pictures below and analyse some of the common ways in which we 'use' sound. Write down what sound is being used for in each case.

1.

2.

3.

4.

Sound is an integral part of our lives. In this chapter, we will learn a little bit about how sound is produced, how it travels and how we can hear it. We will also learn a little about pleasant and unpleasant sounds.

Answers: 1. To communicate with each other, 2. For enjoyment and relaxation, 3. For entertainment and information, 4. To be reminded of something (in this case, to wake up!)

## HOW SOUND IS PRODUCED

AN

*Objects that produce sound are called* ***sources of sound.*** The study of sound; how it is produced, propagated, and received is of great importance to us. The primary means by which we communicate with each other is through speaking. This is done through a combination of sounds. Even when we speak to each other on the phone, or listen to the radio or television, it is the 'sound' someone or something is making that is communicating to us. Let us find out how we, and other objects produce sound.

Have you ever placed your palm on the speaker of a music system when it was playing or touched your throat while speaking? What did you feel? You will feel a vibration. *A* ***vibration*** *can be defined as a rapid back and forth movement of a body about a central position.* A sound is produced because of a vibration. Thus, sound is a vibration that is capable of being heard. The organ in human beings that is involved in the production of sound is the larynx (commonly called the voice box) (Fig. 12.1). The larynx is located at the top end of the windpipe. When we want to speak, air rushes out of the lungs, through the windpipe and to the larynx. At the top of the larynx are two membranes, called 'vocal folds' (commonly called vocal cords), which begin to vibrate because of the air rushing in from below. This gives out a basic 'sound', like wind passing through a pipe which has a membrane with a narrow opening at the other end. There are muscles in the larynx that lengthen and shorten the vocal folds and also alter their tension to produce different pitches. The space between the vocal folds is called the 'glottis'. So, different sounds can be made by varying the opening and closing of the glottis and also the vibration of the vocal folds. This is not all. After the basic sound comes out of the vocal folds, we use our mouth, tongue, teeth, lips, and nasal cavity to 'articulate' the sound that makes speech.

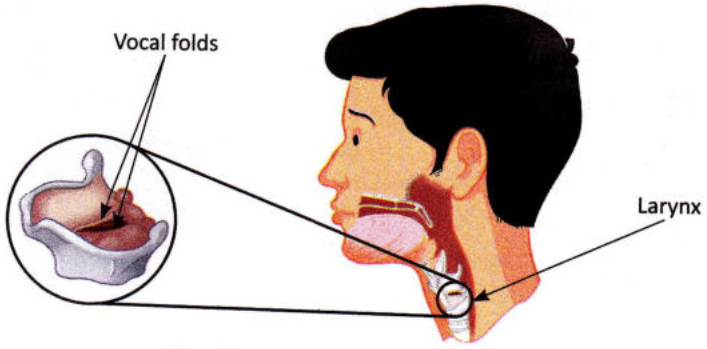



**Fig. 12.1** *Human larynx*

**Word help**

**Articulate** To pronounce clearly

**Fact File**

**Each of us has a unique voice!**
The quality of a person's voice depends on the pitch at which he or she speaks and the range of pitch (or the range of frequencies) of a person primarily depends on the length of the vocal folds (vocal cords). In general, men have longer vocal folds than women, and children have the smallest vocal folds. That is why the voice of a man has a lower pitch than a woman, and a woman's voice is lower in pitch than that of a child. Therefore, when we hear someone speaking, we can straightaway make out if it is a man, woman or child.

## Activity

**Aim:** To demonstrate that sound is produced by vibration
**Materials needed:** A music player/television
**Method:**

1. Hold your throat with your fingertips. Now speak or sing for about 5–10 seconds. What do you feel?
2. Turn on the music player/television. Place your palm on its speaker. What do you feel?

**Observation:** In the first case, you will feel the vibrations in your throat. In the second case, you will feel the vibrations in the speaker.
**Conclusion:** This confirms that sound is produced by vibration.

## HOW SOUND TRAVELS

AN

Have you ever thrown pebbles in a pool of water? The impact of pebbles in water creates ripples of waves that spread in the pool. Vibrations cause waves in the air in the same way. We hear the sound when these waves reach our ears. To understand how this happens, let us take the example of a drum.

**Fact File**

**Acoustics**
The branch of physics that deals with the study of sound is called acoustics.

When a drum is struck, the membrane on the drum moves backwards and forwards, i.e., it vibrates. This causes the air molecules surrounding the drum to vibrate. If we imagine the air molecules to be like small balls, a sound wave travelling through air alternatively pushes these balls close together and then pulls them away from each other. The areas where they lie together are called *compressions*, and the areas where they lie away from one another are called *rarefactions*. A diagrammatic representation of the propagation of sound waves produced when a drummer beats the drum is shown in Figure 12.2. As the sound wave propagates, the molecules themselves do not move from one point to another, they only vibrate about a mean position. It is the effect that propagates and reaches our ears.

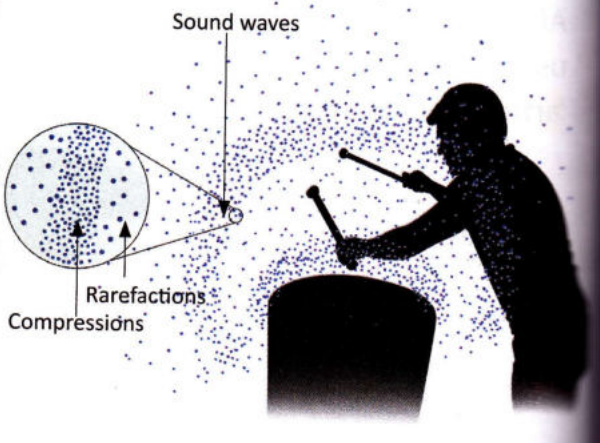



**Fig. 12.2** *Propagation of sound waves*

### Sound Needs a Medium to Travel

Sound waves require a material such as a solid, liquid, or gas to travel through. They cannot travel through vacuum. This is because sound travels by producing a vibration in the molecules of the medium surrounding it and there are virtually no molecules in vacuum.

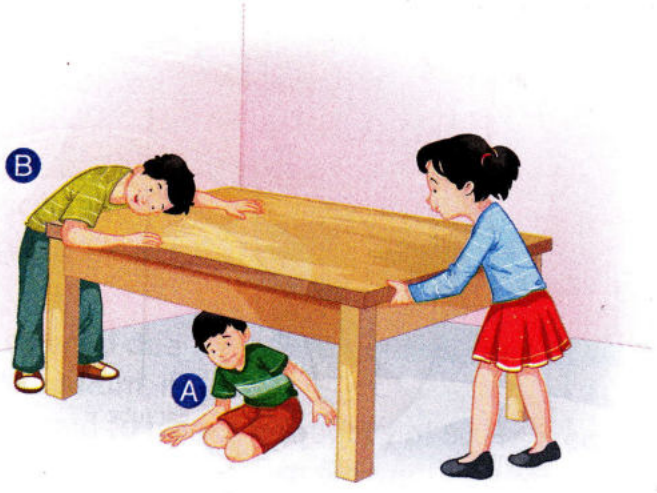
## Activity

**Aim:** To show that sound can travel through solids
**Materials needed:** A long table (dining table/long school bench)
**Method:**

1. Make a friend (A) sit under the table and the other (B) to put his ear to the table top.
2. Now scratch the underside of the table very gently.
3. Find out which one of your friends heard you scratching the table.

**Observation:** You will find that the friend who put his ear to the table top (B) would have heard the sound and the other friend (A) would not have heard it.

**Conclusion:** The sound you made travelled through the table (solid), but was not strong enough to travel through air. If it had travelled through air, friend A would also have heard it. This shows that the sound heard by friend B travelled through solid (table top).




## How Our Ears Catch Sound

AN

We have just learnt how sound vibrations from a source propagate through the air and reach our ears. Let us now discuss how our ears actually 'hear' these sound vibrations. The ear can be broadly classified into three parts: the outer ear, the middle ear, and the inner ear.

***Outer ear*** The part of the outer ear that is visible to us is called pinna. The pinna collects sound waves and directs them to the ear tube. At the end of the ear tube is the ear drum (also called tympanum). The ear drum vibrates when sound waves strike it and transmits the sound to the middle ear.

***Middle ear*** The middle ear is a cavity with three important ear bones. These three bones are placed in such a way that they move when the ear drum vibrates and, therefore, transmit the vibration to the inner ear.

***Inner ear*** The inner ear is connected to the middle ear through a small opening. The inner ear is filled with a fluid. When this fluid vibrates, it excites tiny hair in the inner ear. These hair transform the vibrations into electrical impulses, which are then transferred to the brain via the auditory nerve. This is how we 'hear' a sound.

Figure 12.3 shows the internal structure of the human ear.

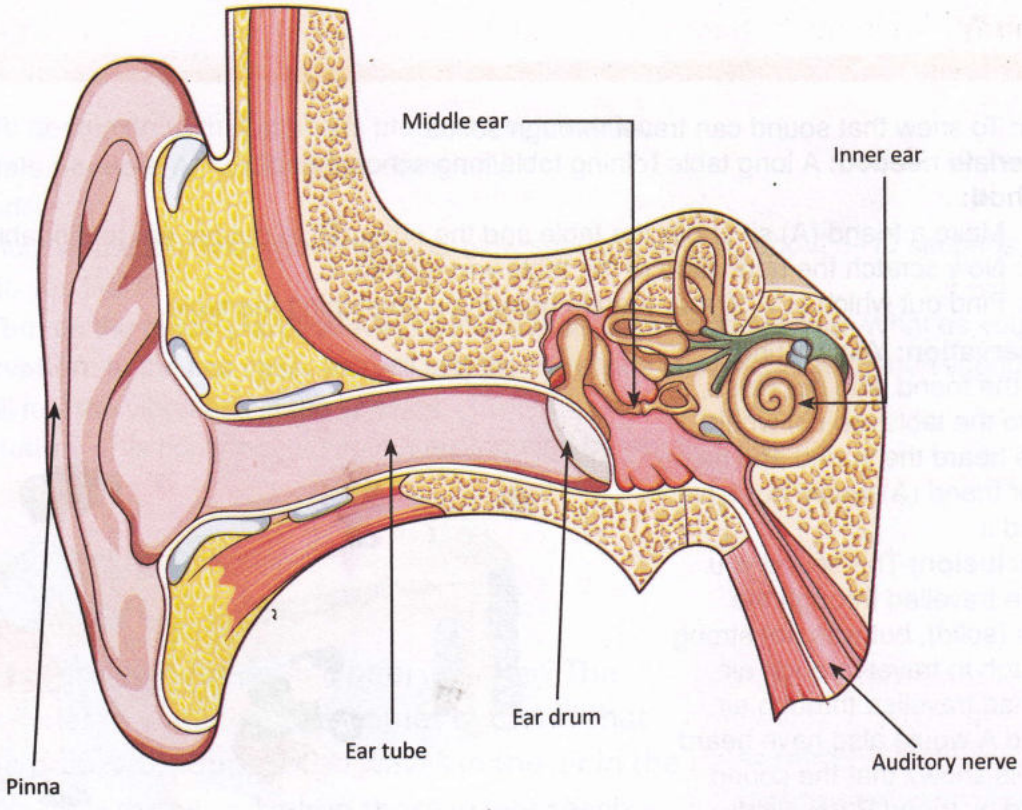



**Fig. 12.3** *Internal structure of human ear*

## CHARACTERISTICS OF SOUND

TD

We have learnt so far that sound travels in the form of a wave. We know that all sounds are not the same. Some sounds are loud, and some are shrill. So, how do the corresponding waves of different types of sound look? There are some features (called characteristics) of a wave that we should first understand so that we can analyse the sounds that they produce. The main ***characteristics*** of a wave are amplitude, time period and frequency (which is actually connected to the time period).

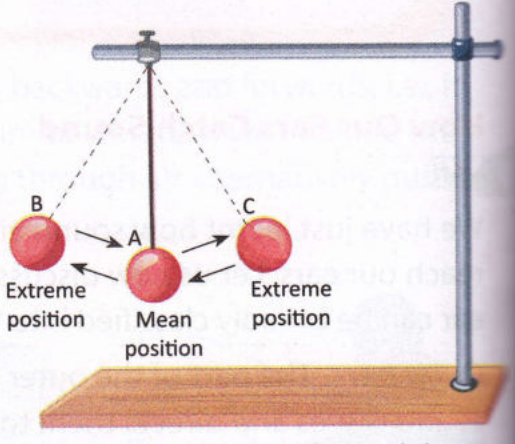



**Fig. 12.4** *A simple pendulum*

We will use the example of oscillations of a simple pendulum to explain the terms amplitude, time period, and frequency. Although a simple pendulum does not produce sound waves that we can hear, this example will help us observe oscillations and understand the terms involved. A simple pendulum (Fig. 12.4) consists of a small ball (called the bob) attached to a string, which is fixed at one end.

***Amplitude*** If we pull the bob sideways and leave it, it will oscillate back and forth for some time and then come to a stop. The position where it comes to a stop is called the mean position (position A in Fig. 12.4). *The maximum displacement of the bob from the mean position during oscillation is called the* ***amplitude*** *of the oscillation*. In Figure 12.4, the maximum displacement occurs when the bob is at positions B and C.

***Time period*** When the bob moves from one position and comes back to the same position (moving in the same direction), it is said to complete one oscillation. For example, in Figure 12.4, if the bob starts from A, goes to C, then to B, and then back to A, we say one oscillation is complete (look at the arrows in Fig. 12.4). *The time taken to complete one oscillation is called the* ***time period*** *of the oscillation*. It is measured in seconds.

***Frequency*** *The number of oscillations per second is called the* ***frequency*** *of oscillation*. For example, if the bob of the pendulum in Figure 12.4 moves five times through point B in a second, its frequency is 5 per second. The SI unit of frequency 'per second' is called hertz (Hz) in honour of the German physicist, Heinrich R. Hertz. When we say that a vibrating body has a time period t, we mean that it completes one oscillation in t seconds. Thus, in 1 second it will complete 1/t oscillations, which is its frequency.

**Tech Specs**

Sound waves of frequencies above 20,000 Hz are called ultrasonic waves. While we cannot hear ultrasonic waves, we apply them in technologies such as Sonar. Sonar stands for Sound Navigation and Ranging. It is used in navigation of ships, to map sea beds, and in submarines.

***Frequency and pitch*** Sound waves are produced due to the to and fro oscillation of particles in a medium. If an object oscillates 80 times per second, it is said to have a frequency of 80 Hz. Frequency is considered an important characteristic of a sound wave because different frequencies sound different to us. Shrillness is explained using a term called *pitch*. Higher the frequency of the vibrating body, the higher will be its pitch. A high-pitched sound appears shrill, and a low-pitched sound appears deep or gruff to our ears.

You might have noticed the difference between the shrill voice of a child and the deep voice of a man. The shrillness of the sound produced is determined by the frequency of the vibrating body (Fig. 12.5).

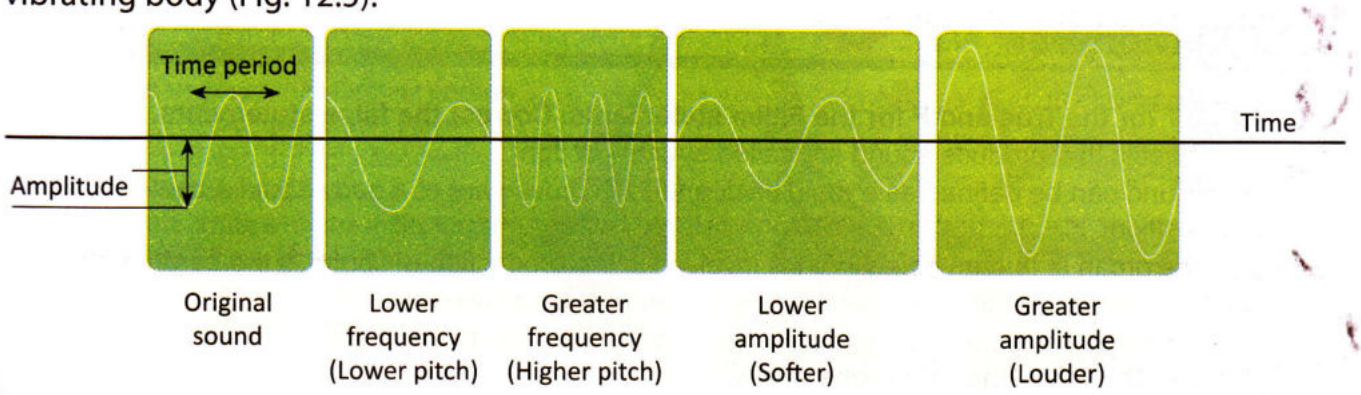



**Fig. 12.5** *Pictorial representations of sound waves*

***Amplitude and loudness*** The amplitude of the vibrating body producing the sound determines the loudness of the sound. If the amplitude is higher, the sound produced is louder (Fig. 12.5). The loudness of a sound depends on the square of the amplitude. If we double the amplitude of a sound wave, its loudness increases fourfold. The loudness of a sound is measured in the unit ***decibel (dB)***. Table 12.1 shows the approximate 'loudness' of some common sounds in decibel.

**Table 12.1** Typical values of 'loudness' of common sounds in decibel (dB)

| Sound | Decibel (dB) (approximate values) |
|---|---|
| Whisper | About 30 |
| Normal conversation | 50–60 |
| Loud music | 100–120 |
| Aeroplane | 120–140 |

**Note:** Hearing sounds above 80 dB over a long period of time can damage the ears and a sudden sound of 120 dB and above can cause an immediate and severe damage to the ear and even result in a partial loss of hearing.

## Speed of Sound

Sound waves travel at different speeds in different substances. Table 12.2 gives the speed of sound in various substances. The speed of sound depends on various factors such as temperature, nature, and physical state of the substance, etc. For example, the speed of sound in air is about 330 m/s at 0°C and 346 m/s at room temperature. Also, notice from Table 12.2 that sound waves travel fastest in solids and slowest in gases.

**Table 12.2** Speed of sound (approx.) in different substances

| Substance | Speed (m/s) |
|---|---|
| Air | 346 |
| Water | 1498 |
| Mercury | 1452 |
| Glass | 5000 |
| Aluminium | 5000 |
| Iron | 5000 |
| Diamond | 12,000 |

## Let's Remember


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

1. Objects that produce sound are called sources of light.
2. Sound can be defined as a rapid back and forth movement of a body about a central position.
3. The organ in human beings that is involved in the production of sound is the eardrum.
4. Vocal folds are thin membranes stretched across the middle ear.
5. Auditory nerves transfer electrical impulses from the ear to the brain.

**II. Answer the following questions orally.**

1. Can an oscillating pendulum produce sound waves?
2. Is the speed of sound greater in water or in air?

## TYPES OF SOUND

Sound can be of different types—soft, loud, pleasant, unpleasant, musical, audible (can be heard), inaudible (cannot be heard), etc. Some sounds may fall into more than one category. For instance, the sound produced when an aeroplane takes off is both loud and

unpleasant. The sound produced by a marble cutter, on the other hand, may not be as loud, but some people might find it irritating and unpleasant.

## Audible and Inaudible Sounds

Although it is true that all bodies that vibrate in air (or any other medium) produce sound waves, we cannot hear all of them. Sometimes a group of neighbourhood dogs start barking on their own, while the residents living in the area are left wondering what provoked the dogs to bark. One possible reason could be that the dogs might have heard some unfamiliar high-pitched sound, which the residents did not hear. Our ears are sensitive only to a certain range of frequencies, 20 Hz to 20,000 Hz. We cannot hear sound waves of frequency below 20 Hz and above 20,000 Hz. Dogs have the ability to hear very high-pitched sounds, which we cannot. Sound waves of frequencies below 20 Hz are called *infrasonic waves*, and those of frequencies above 20,000 Hz are called *ultrasonic waves*. Human beings cannot hear these sound waves. We also cannot hear sound waves if they are too feeble.

**Fact File**

Many animals make sounds that we do not hear because the frequencies they produce are either too low or too high. 'For example, elephants communicate with each other in very low frequencies, most of which we cannot hear.

## MUSICAL INSTRUMENTS

We find certain sounds pleasant and associate them with music. In a musical sound, there are a number of frequencies present in a definite ratio or relation to each other. Broadly, musical instruments are classified into the following three categories.

In **stringed instruments** such as guitar, sitar, veena, piano, and violin sound is produced by a vibrating string (Fig. 12.6). The shrillness or pitch of the sound is altered by changing the length of the vibrating portion of the string. For example, a sitar player plucks the string with the right hand while the pitch of the sound produced is changed by pressing the string with the index finger of the left hand. These instruments-also have an air chamber, which helps increase the loudness of the sound produced.

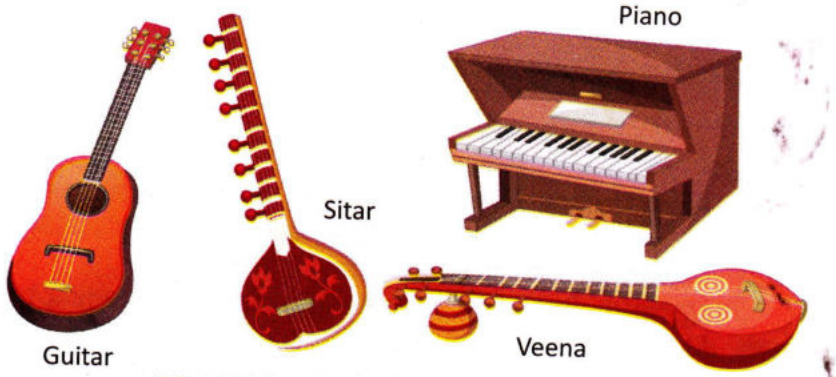



**Fig. 12.6** *Stringed instruments*

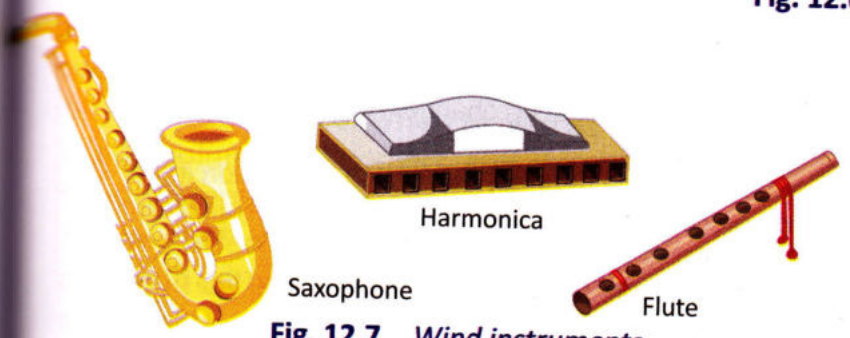
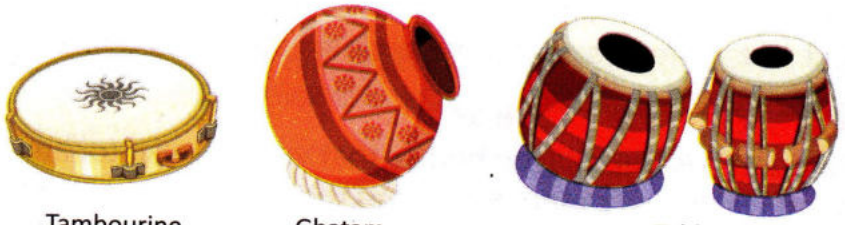



**Fig. 12.7** *Wind instruments*

In **wind instruments** such as saxophone, harmonica, flute, and trumpet, sound is produced by the vibrating air column inside the instrument (Fig. 12.7). The pitch of the sound is altered by changing the length of the vibrating air column.

In **percussion instruments** such as tambourine, ghatam, tabla, drums, and dholak, sound is produced by a vibrating skin or membrane (Fig. 12.8). The pitch of the sound is altered (to a certain extent) by increasing or decreasing the tension in the membrane.



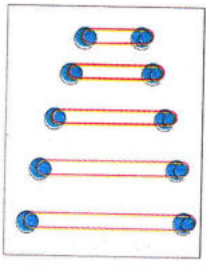
Tambourine Ghatam Tabla

**Fig. 12.8** *Percussion instruments*

## Activity

**Aim:** To understand the principle of a stringed instrument
**Materials needed:** An old soft cover book (which you don't mind damaging), ten drawing pins, five identical (slightly thick) rubber bands, and a ruler
**Method:**

1. On the soft book cover, pierce drawing pins in pairs. Pierce the first pair of drawing pins 4 cm apart, the second pair 6 cm apart, the third pair 8 cm apart, and so on. Make five such pairs.
2. Stretch a rubber band from one drawing pin to the other in each pair.
3. Pluck the rubber band and hear the sound it makes.



**Observation:** You will find that even though we use identical rubber bands, the pitch of the sound produced when we pluck each rubber band is different. Depends on the tension of the rubber band, and its length. When a string is stretched between two points and plucked, the sound it produces depends on many factors like the tension of the string, the distance between the two points, the material and thickness of the string.
**Conclusion:** Many different sounds can be produced with strings!

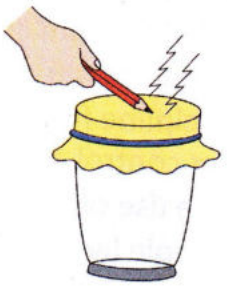
## Activity

**Aim:** To understand the principle of a wind instrument
**Materials needed:** An empty half-litre mineral water bottle/glass bottle with a small opening and water
**Method:** Blow over the top of the mouth of the empty bottle. Make a note of the tone of sound produced. Fill in a little bit of water in the bottle blow again, and make a note of the tone. Everytime keep adding a little more water than the previous time and note the tone of sound produced each time. Repeat this four more times.

**Observation:** You will see that when we blow over the mouth of the empty bottle, a sound is produced. When water is filled, the note of the sound produced changes, and depends on the level of water in the bottle.
**Discussion:** A sound is produced because when you blow air, you set up a vibration in the air that is in the bottle. The tone of the sound produced depends on the length of the air column inside the bottle.
**Conclusion:** Musical instruments called wind instruments are designed, based on this principle.

## Activity

**Aim:** To understand the principle of a percussion instrument
**Materials needed:** An empty vessel/tumbler, thin paper, scissors, and thick rubber bands (big enough to be stretched over the mouth of the vessel)
**Method:** Take a vessel and cut the paper to the size of the mouth of the vessel leaving a margin of three inches all around. Hold the paper tightly over the mouth of the vessel with a rubber band. Strike the paper with a pencil.

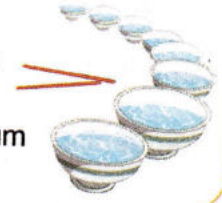


**Observation and Conclusion:** Percussion instruments are made in a similar manner. You will appreciate that using this arrangement, it is not easy to get a variety of tones like with other musical instruments. Percussion instruments are used mainly to keep beats in a musical composition.

## Activity

**Aim:** To make a 'jal tarang' (a musical instrument)
**Materials needed:** Eight identical bowls or tumblers, two drum sticks or pencils, and water
**Method:**

1. Keep all the bowls in a row. Fill all of them with varying levels of water.
2. Strike the bowls one after the other with the drum sticks. What do you find?



**Observation and Conclusion:** On striking the bowls one after the other, you get sounds of different pitches. The pitch is highest in the bowl with the maximum amount of water, and lowest in the bowl with the least amount of water.

## NOISE

*Unpleasant, discomfort-causing sound from any source is called* ***noise****. Sustained presence of harmful, unwanted, or annoying noise in the environment is called* ***noise pollution*** (Fig. 12.9).

**Fig. 12.9** *Noise Pollution*

***Sources of noise pollution*** Any object that produces a noise is a potential source of noise pollution. Examples are automobiles, blaring loudspeakers, television and radio (when played at a loud volume), air coolers, and air conditioners.

***Harmful effects of noise pollution*** Noise has a jarring effect on us. The effect of noise pollution on people should not be underestimated. Here are some of the harmful effects of noise pollution:

- irritation and loss of concentration;
- sleep disturbance and stress (which can lead to high blood pressure);
- ear damage and loss of hearing (which may result from exposure to a sudden loud noise or from continuous exposure to noise over a period of time).

***Measures to reduce noise pollution*** Minimizing noise pollution requires a certain degree of discipline from all of us. Some of the measures one should adopt to keep noise pollution under control are given below.

- The use of loudspeakers should be avoided.
- People living in flats (and houses close to each other) should not talk too loudly or play the television/music too loudly so as not to disturb their neighbours.
- While driving, people should avoid playing loud music and using the horn unnecessarily.
- Trees and shrubs, planted along roads and big buildings can absorb sounds and reduce noise pollution.
- Industries that use heavy machinery and produce a lot of noise should be located far from residential areas.

**Let's Discuss**

'With cities becoming crowded, noise pollution is becoming a constant nuisance'. Discuss.

## Key Words

| | |
|---|---|
| **Vibration** | A vibration is a rapid back and forth movement of a body about a central position. |
| **Amplitude** | The maximum displacement from the mean position during an oscillation is called the amplitude of the oscillation. |
| **Frequency** | The number of oscillations per second is called the frequency of oscillation. |
| **Noise** | Unpleasant, discomfort-causing sound from any source is called noise. |
| **Noise pollution** | Sustained presence of harmful, unwanted, or annoying noise in the environment is called noise pollution. |

## Summary

- A sound is produced because of a vibration.
- In human beings, sound is produced by an organ in the neck called the larynx or voice box.
- Vibrations from a source of sound propagate through the air and reach our ears.
- Sound waves need a material like a solid, liquid, or gas to travel through.
- The ear can be classified into three parts: the outer ear, the middle ear, and the inner ear.
- The higher the frequency of a vibrating body, the higher will be its pitch.
- The amplitude of the vibrating body producing the sound determines the loudness of the sound—the higher the amplitude, the louder is the sound produced.
- Sound can be of different types—soft, loud, unpleasant, musical, audible (can be heard), inaudible (cannot be heard), etc.
- Depending on how they produce sound, musical instruments can be divided into three categories: stringed instruments, wind instruments, and percussion instruments.
- Automobiles, blaring loudspeakers, television and radio, and air coolers are examples of sources of noise pollution.

- Noise pollution is undesirable and can cause harmful effects such as irritation, loss of concentration, loss of hearing, etc.
- Avoiding the use of loudspeakers, not playing music at a loud volume, and avoiding the use of the horn unnecessarily while driving are some of the ways of reducing noise pollution.

# Exercises

## LET'S UNDERSTAND


QT

### I. Objective type questions

**A. Choose the correct option.**

1. Sound cannot travel in
   a. solids b. liquids c. gases d. vacuum
2. In humans, the vocal folds (vocal cords) are present in the
   a. neck b. ear c. mouth d. nose
3. Which of these can produce a sound that we can hear easily?
   a. A simple pendulum b. Ripples in a pond
   c. A drum d. Air
4. Sound travels fastest in
   a. air b. water c. glass d. diamond
5. A sitar is
   a. a wind instrument b. a stringed instrument
   c. a percussion instrument d. used for producing beats
6. Which of these is a unit of time period?
   a. Hertz b. Second c. Newton d. Pascal
7. Sound of which of these frequencies would be audible for us?
   a. 15 Hz b. 2000 Hz c. 50,000 Hz d. 5 Hz
8. For the same pitch, a louder sound would have a
   a. greater amplitude b. greater frequency
   c. lower amplitude d. lower frequency
9. Which of these is a percussion instrument?
   a. Violin b. Tabla c. Veena d. Flute
10. Which of these is a wind instrument?
    a. Guitar b. Harmonica c. Dholak d. Piano

**B. Fill in the blanks with the correct words.**

1. A sound is produced because of _____ (vibrations/molecules).
2. _____ (Music/Sound) is our basic means of communication.
3. Sound needs a _____ (source/medium) to travel in.
4. The unit of frequency is _____ (hertz/seconds).
5. Time period is measured in _____ (hertz/seconds).

### II. Very short answer type questions

**A. Write down the basic function of the following.**

1. Vocal folds (commonly called vocal cords)

2. Auditory nerve
3. The string in a stringed instrument
4. Air column in a wind instrument
5. Skin or membrane in a percussion instrument

## III. Short answer type questions

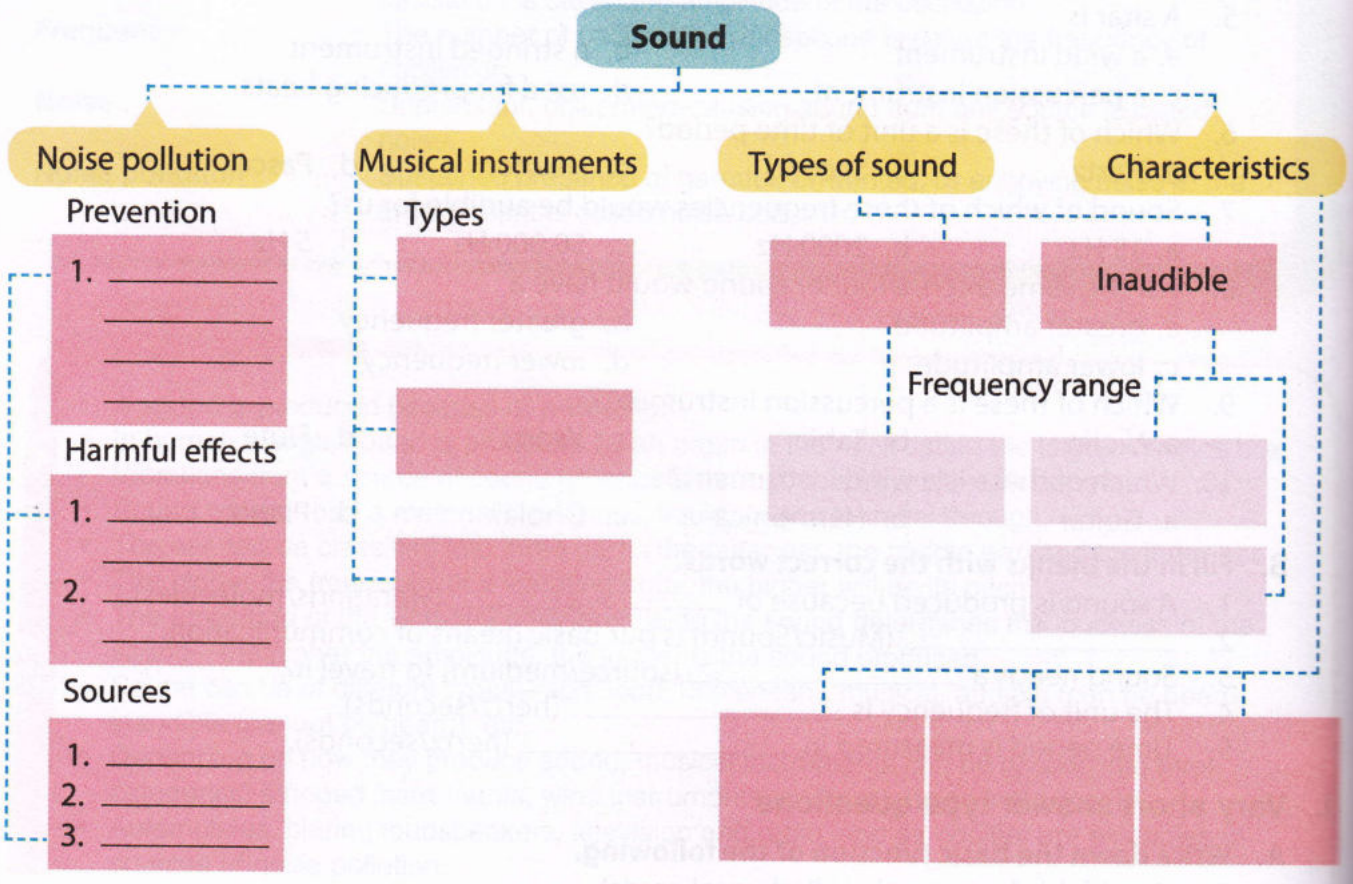
1. How can we make different sounds with our vocal folds?
2. Why it is that sound cannot travel in vacuum?
3. What is 'amplitude' of a vibration?
4. What is the unit in which time period is measured?
5. Name two wind instruments.
6. What is noise pollution?

## IV. Long answer type questions

1. Give a brief description of how a sound wave propagates from the vibrating membrane of a drum to our ears.
2. Explain briefly how we can 'hear' with our ears.
3. What are 'loudness' and 'pitch' of a sound? What physical characteristics are they related to?
4. What are infrasonic and ultrasonic waves? Give their approximate frequency ranges.
5. What are the common sources of noise pollution? What are their harmful effects?
6. How can we reduce noise pollution?

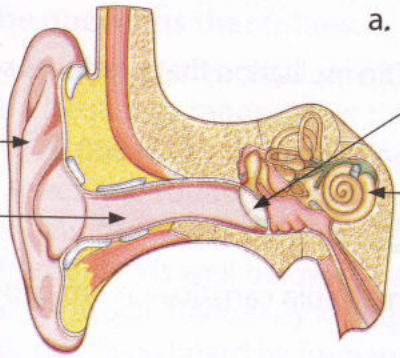
## LET'S RECALL

Recall and complete the concept map given below.



## LET'S OBSERVE

1. Label the parts of the human ear.




2. Classify the following musical instruments in the categories of 'stringed instruments', 'wind instruments', and 'percussion instruments'. (Not all the instruments are mentioned in the chapter, you will have to do some research for some of the instruments shown here).

## LET'S CONNECT

GEOGRAPHY/MUSIC AND ARTS

There is diversity in the clothing, food, language, culture, etc., in different parts of the world. Even music, and art as well as the instruments people play are different in different parts of the world. Choose any one region/ country of the world and identify a unique musical instrument used there. Make a recording of the music played with that instrument. Is it a stringed, wind or percussion instrument?

## LET'S APPLY

1. Name one factor that would change when sound travels in a solid (such as glass) instead of air. (*Hint:* Recall how sound travels; does it differ according to the nature of the substance through which it travels?) LO 3
2. Many musical instruments have an air chamber. Why? (*Hint:* What is the advantage of an air chamber in musical instruments?) LO 1
3. Percussion instruments are not able to produce a wide range of frequencies. Why? (*Hint:* Think how sound is produced in such kind of instruments.)

## LET'S ANALYSE AND EVALUATE

1. Maulana says that by increasing the frequency of an oscillation that produces sound, he can make it sound more deep. Could he be right? Give one reason to justify your answer. 


2. Will increasing the frequency of an oscillation that produces sound make the sound louder? Why or why not? 


## LET'S CREATE  LO 10 LO 14


Make a toy telephone using two small cola cans/ice-cream cups, a long string, and a pair of sharp scissors. The steps are as follows:

(a) Make a very small hole on the bottom of one can/cup. Pull one end of the string through the hole and tie a knot so that it does not slip back through the hole.
(b) Repeat step (a) with same string but another can/cup.
(c) Now ask a friend to take one end of the string with the can/cup and you hold the other end.
(d) Move as far from each other as possible so that the string is held tight. Do not let the string slacken. Hold the can/cup to your ear, and ask your friend to talk very softly into his can. See if you can hear him.

1. How can we find out if the sound (in this case, what your friend says at one end of the string) has actually travelled through the string, and not through the air?
2. Why is it important to keep the string stretched?
3. Select a few different types of material and shape of the cup. For example, cut out a 'cup' from a plastic water bottle, use a tin-can from a soda can, try plastic, thermocole and cardboard disposable cups for 'different materials'. Also try a flat, disposable plates of different materials. See how these different items affect the performance of your toy phone. Which of these was the best?
4. How long can you make the string, and still 'hear' your friend at the other end?
5. After you have found the correct material and shape for the cups, decorate your 'toy phone' to make it look attractive. It should look attractive and also perform well.

**Web Research**

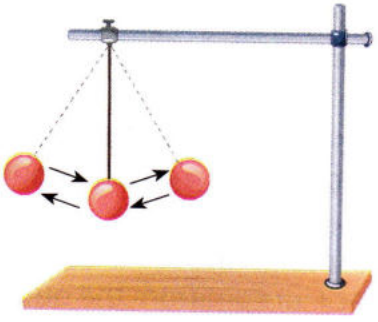
- To learn more about musical instruments and the sounds they produce, browse through https://www.youtube.com/watch?v=-nzckolSaE4 (accessed and checked on 12/08/2019)

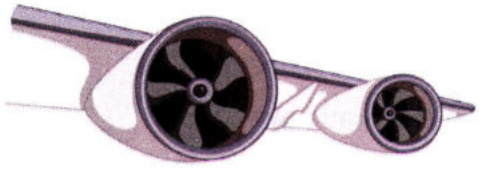
# Worksheet 4

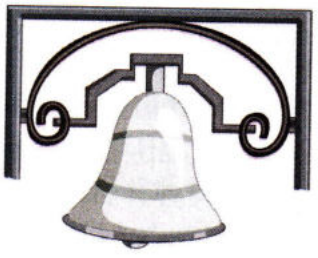
**Skills assessed:**
Problem solving, Qualitative analysis & Quantitative analysis

**Read the passage and answer the questions that follow.**

All vibrations can produce waves. However, our ears are sensitive only to a very small portion of these vibrations that fall in a certain frequency range called the 'audible frequency range'. The audible frequency range is 20 Hz to 20,000 Hz for human beings. Sound waves of frequencies below 20 Hz are called infrasonic waves and sound waves of frequency above 20,000 Hz are called ultrasonic waves. We cannot hear the waves produced by an oscillating pendulum because the frequency of waves it produces is well below the audible range. Animals like dogs, cats and rats can hear well into the ultrasonic frequency range. Rats communicate with each other at very high frequencies so as not to be heard by humans and other predators. However, cats can hear them very well! Elephants and blue whales communicate with each other at very low frequencies in the infrasonic range. Bats use sound waves for 'echolocation'. That is, they use sound waves to navigate, avoid obstacles, and also to catch small insects.







1. Which of the vibrations above will not produce sounds that we can hear?
   a. Thumping on a table
   b. Aeroplane engines
   c. School bell
   d. Oscillation of a pendulum
2. Which of the animals listed below can hear in the ultrasonic frequency range?
   a. Rats
   b. Cats
   c. Dogs
   d. All of these
3. Elephants and blue whales communicate using infrasonic frequencies, what frequency range would that be?
   a. Below 20,000Hz
   b. Above 20 Hz
   c. Below 20 Hz
   d. Between 20 Hz and 20.000 Hz
4. If a vibrating object takes one-hundredth of a second to complete one vibration, can it be heard by a human being?


Teacher facilitation required*

# Activity

**Skills learnt:**
Collaborating, Creating, Communicating, and Critical thinking

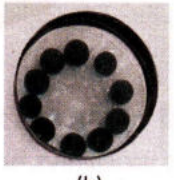
**Aim:** To make ball bearings in groups of five or six.

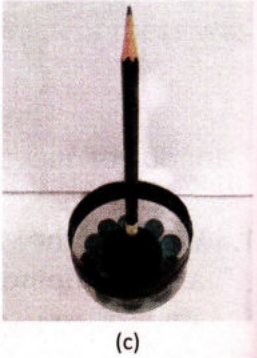
**Materials required:** One plastic bottle (made of soft plastic that can be cut), of diameter about 7 cm, one plastic bottle cap (about 3 cm diameter), 10-12 glass marbles/hard plastic beads (about 2 cm diameter), adhesive tape (coloured insulation tape), a pencil, a sharp knife, scissors, screw driver, a hammer or hard object that can be hit on the screwdriver, a pencil, and adult help.

**Method:**

1. In your groups, cover the bottom circumference of the plastic bottle uniformly with the insulation tape, about 2 cm above the base.
2. Use the knife and scissors to cut the plastic bottle along the edge of the insulation tape that is away from the base. The cut portion now looks like a cup with an insulation tape at the circumference of the edge.
3. Use the screwdriver and hammer to make a hole at the centre of the plastic bottle cap. The hole should be big enough for the pencil to go through.
4. Use the insulation tape to stick the pencil firmly in the hole. Make sure the pencil juts out from the outer portion of the cap and extends only up to the rim of the cap on the inner side (Fig. a).
5. Place the cut portion of the plastic bottle (like a cup) on a table and place the marbles on the inside along the circumference, so that a round space is left in the middle (Fig. b).
6. Place the plastic cap–pencil setup in the round hole. You may have to push gently so that it fits in well (Fig. c).
7. Turn the outer 'cup' while holding the bottle cap stationary with the pencil. Make sure that it turns smoothly.
8. Your ball bearing is ready.


(a)


(b)


(c)

**Answer the following questions based on the above activity**

1. Make step-by-step drawings of how the ball bearings were made.
2. What is the concept used in the use of ball bearings? Discuss.
3. Would it work equally well if we replaced the marbles with balls made of play dough or chapatti atta? Discuss.
4. Is there anything we can apply to make the marbles move more smoothly?
5. If the plastic bottle had a diameter of 9 cm, and the inner plastic bottle cap had a diameter of 5 cm, what diameter of the glass marbles/plastic beads should we use?

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

13

Unit 5: How Things Work

# Chemical Effects of Current

All of us are familiar with electricity. We also know that while electricity is very useful, it can also be very dangerous at times. Look at the pictures below and answer the questions that follow.

**You will learn about**

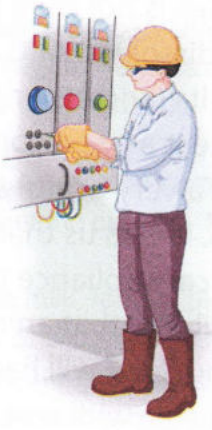
- Electrical conductivity
- Electrolysis

1.

a. Why does the boy in this picture get an electric shock? What should he do to avoid getting a shock?

b. Is there any material that you can identify in the picture that makes him more liable to getting an electric shock?

2.



a. Has the electrician in the picture taken sufficient precaution to protect himself from getting an electric shock?

b. What are the items of his attire that are being used to safeguard himself?

c. What kind of materials are these made of?

We have learnt that some substances, such as metals, allow an electric current to pass through them easily. Such materials are called conductors. However, in the pictures given above, we see that water makes the boy more susceptible to getting an electric shock. Does this mean an electric current can flow through a liquid like water?

In this chapter we will learn that some liquids do allow an electric current to flow through them and we will learn how this happens. We will also learn about the chemical reaction that takes place when an electric current passes through a liquid, and how this process is used in many different applications.

Answers: For picture 1: a. The boy gets an electric shock because his hands are wet and also because he is not wearing proper footwear when touching the electric switch., b. Water present on the floor makes the boy more liable to get an electric shock. For Picture 2: a. Yes, b. Proper footwear and gloves, c. Insulating material such as rubber

## ELECTRICAL CONDUCTIVITY

*The measure of the ability of a substance to allow the flow of electric current is called* ***electrical conductivity***. Substances that are good conductors have high electrical conductivity as compared to substances that are poor conductors (i.e., insulators). Metals such as copper and aluminium have high electrical conductivity, while plastic, rubber, and wood will have low electrical conductivity. Some liquids, but not all, are good conductors. Let us discuss the electrical conductivity of some common liquids.

### Electrical Conductivity of Water

Pure water is a bad conductor of electric current. Therefore, technically, electric current will not pass through a sample of completely pure water under normal circumstances. However, the water that we get in our homes is not pure and contains impurities in the form of dissolved salts. Even small amounts of dissolved salts (and other impurity) present in water will make it a good conductor of electric current. This is a very useful and important piece of information. It tells us that if we come in contact with an electrical appliance through impure water, there is a possibility that an electric current will flow. So, what do you think will happen if you touch an electrical appliance with wet hands? You run the risk of an electric current flowing through you! In other words, you run the risk of getting an electric shock. Even a simple act of operating an electric switch with wet hands can sometimes result in a severe electric shock. We should always make sure that we dry our hands thoroughly before handling electrical appliances.

**Get it Right**

- It is very dangerous to use electrical appliances such as hairdryers and shaving machines in the bathroom. Bathrooms are likely to have wet floors and counters, and handling electrical appliances when you are standing in water or if your hands are wet, could lead to an electric shock.
- You have to be extra careful when you walk on a wet road with puddles of water. As you know, impure water is a good conductor of electricity. So, if by chance a live electrical wire comes in contact with a wet surface or a puddle of water, anyone coming in contact with the water can get a very massive shock (even though the person is not directly in contact with the wire).

### Electrical Conductivity of Other Liquids

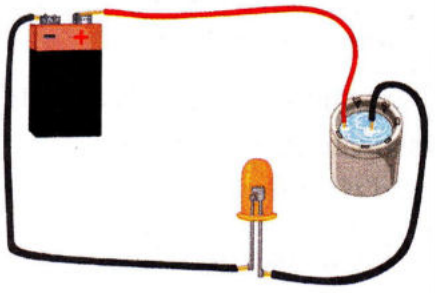
Most acids and bases dissolved in water are good conductors of electricity. When salts such as sodium chloride (common salt) and potassium iodide are heated, the molten salts thus obtained are good conductors. However, most substances that exist as liquids at room temperature, such as alcohol and oils are bad conductors.

**Let's Discuss**

Discuss why water is not used for extinguishing fires caused due to electrical faults.

## Activity

**Aim:** To study the electrical conductivity of common liquids and solutions.



**Materials needed:** Lemon juice, vinegar, distilled water (you will get this in a petrol pump), tap water, table salt dissolved in water, coconut oil, ghee, milk, two-three small plastic water bottle caps, insulated copper wire, 9V cell, a light emitting diode (LED) and adult supervision. While buying the LED, ask for an LED that will light up with a 9V cell.

**Caution:** Please do not use inflammable liquids such as kerosene, petrol, diesel, etc.

**Method:**

1. Arrange the setup as shown in the figure. While connecting the LED, make sure you connect the long lead (or the red wire of the LED) to the positive terminal of the battery.
2. Take a small amount of the liquid (one at a time) in a plastic bottle cap, and dip the two free ends of the copper wire into the liquid as shown in the figure. Take care that the free ends of the copper wire do not touch each other. See if the LED lights up.
3. Repeat the procedure with different liquids.
4. If the LED lights up, it means the liquid being tested allows an electric current to pass through it, which means the liquid is a good conductor of electric current. Make a table as shown and record your observations.

**Observation:** You will find that the LED glows for liquids such as milk, lemon juice, tap water, salt water, and vinegar. It does not glow for distilled water, ghee, and coconut oil.

**Conclusion:** Milk, lemon juice, tap water, salt water, and vinegar are good conductors of electric current. Distilled water, ghee, and coconut oil are bad conductors of electric current.

| Liquid | Does it allow electric current to pass through? (Yes/No) |
|---|---|
| Distilled water | |
| Coconut oil | |
| Ghee | |
| Milk | |
| Lemon juice | |
| Salt water | |
| Vinegar | |

Some fruits and vegetables such as banana and potato also allow an electric current to pass through them (Fig. 13.1). Try it out for yourself! ***Caution:*** *Please DO NOT eat the fruit or vegetable after passing an electric current through them.*

When substances such as salts, acids, and bases are dissolved in water, the resultant solutions are fairly good conductors. Let us find out why this happens.

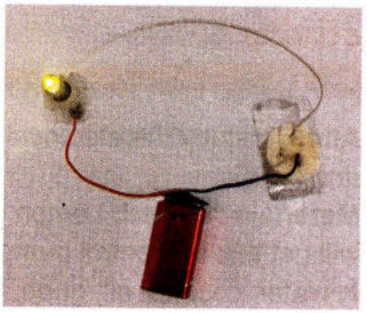


**Fig. 13.1** *Some fruits and vegetables allow an electric current to pass through them*

## Effect of Impurities on Electrical Conductivity of Water

AN

When impurities (such as salts) dissolve in water, they form ions. *Ions are atoms or groups of atoms with a positive or a negative charge.* These ions make it possible for an electric current to pass through the solution.

**Get it Right**

Unlike the dry cell you are familiar with, an electrolytic cell does not use chemical reactions to generate electric current. In fact, it does the opposite. An electrolytic cell uses electric current to produce a chemical reaction.

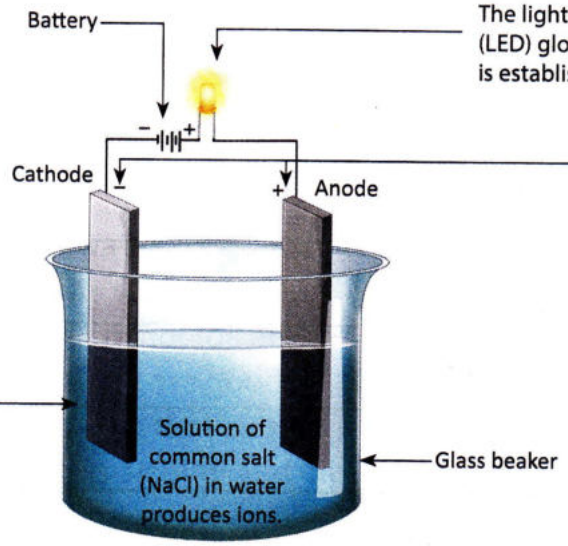
Suppose we dissolve a small quantity of common salt (sodium chloride, NaCl) in pure water. When salt dissolves in water, it forms ions of sodium and chlorine.

$$\underset{\text{Sodium chloride}}{NaCl} \longrightarrow \underset{\text{Sodium ion}}{Na^+} + \underset{\text{Chloride ion}}{Cl^-}$$

If we take this salt solution in a beaker and set it up as shown in Figure 13. 2, an electric current will flow in the circuit. Such an arrangement is called an *electrolytic cell*. Pure water does not form enough ions to conduct electricity. That is why pure water is a poor conductor of electricity.

**Electrolyte**

A liquid that conducts electricity because of the presence of ions is called an electrolyte. Examples of electrolytes are salt solutions and dilute solutions of acids.




**Electrodes: Cathode and Anode**

The rods are made of conducting material and are called electrodes. The electrode connected to the negative terminal of the battery is called the 'cathode' and the one connected to the positive terminal of the battery is called the 'anode'.

**Fig. 13.2** *An electrolytic cell*

A process called *electrolysis* occurs in an electrolytic cell when an electric current is passed through the electrolyte. Let us learn more about electrolysis.

## ELECTROLYSIS

*The production of a chemical reaction by passing an electric current through an electrolyte is called* ***electrolysis***.

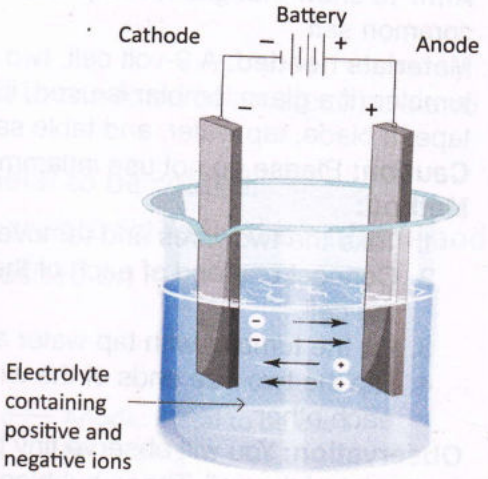



**Fig. 13.3** *Movement of ions in an electrolytic cell*

We know that an electrolyte contains ions, which are charged. The positively charged ions are called *cations*, because they are attracted to the cathode, and the negatively charged ones are called *anions*, because they are attracted to the anode. We know that unlike charges attract each other and like charges repel each other. Cations, being positively charged, get attracted to the negatively charged cathode and move towards it. Anions, being negatively charged, get attracted to the positively charged anode and move towards it. This explains how ions move in an electrolytic cell, and thus 'conduct' an electric current (Fig. 13.3).

A chemical reaction takes place at the anode and the cathode. This can be observed as the formation of bubbles (due to production of gases), or deposition of metal on the electrodes, or as a change in the colour of the electrolyte (Fig. 13.4). The reaction varies depending on the metals used for the electrodes and the electrolyte chosen. Electrolysis of a solution of sodium chloride (NaCl) produces hydrogen gas ($H_2$), chlorine gas ($Cl_2$), and sodium hydroxide (NaOH).

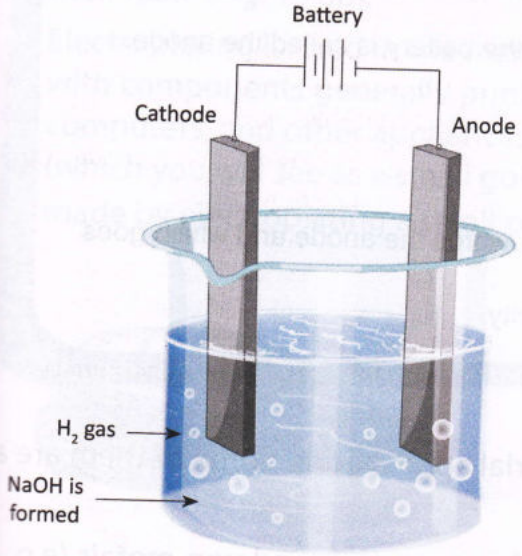



**Fig. 13.4** Electrolysis of sodium chloride (NaCl) solution

**Fact File**

You already know that metals are good conductors of electricity. They are also good conductors of electricity in the liquid state. However, when metals conduct electricity, even in the liquid state, the charge carriers are electrons, and not ions. Therefore, unlike electrolysis, when we pass an electric current through a metal there is no chemical effect.

## Activity

**Aim:** To show that gases are produced when electric current is passed through a solution of common salt

**Materials needed:** A 9-volt cell, two electrical wires (about 10 cm each), a beaker/glass tumbler (if a glass tumbler is used, it should be discarded after the experiment), insulation tape, a blade, tap water, and table salt

**Caution:** Please do not use inflammable liquids such as kerosene, petrol, diesel, etc.

**Method:**

1. Take the two wires and remove the jacket from each end using a blade.
2. Connect one end of each of the two wires to the positive and negative terminals of the cell.
3. Fill the tumbler with tap water and dissolve common salt in it.
4. Dip the two free ends of the wires into the water, making sure that they do not touch each other

**Observation:** You will observe tiny bubbles at the wire connected to the negative terminal (cathode) of the cell. These bubbles are formed due to the formation of hydrogen gas. Chlorine gas is produced at the wire connected to the positive terminal (anode), but the reaction is much slower and cannot be observed easily. To test that the bubbles are indeed formed on passing electric current through the solution, remove the anode wire from the salt solution. You will observe that no bubbles are now formed at the cathode. Dip the wire back into the solution, and the bubbling will start again.

**Conclusion:** Gases are produced when electric current is passed through a solution of common salt.

**Note:** Adult supervision required.

## Let's Remember


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

1. Wood is a good conductor of electricity.
2. The electrode connected to the negative terminal of the battery is called the anode.
3. Oils generally conduct electricity very well.

**II. Answer the following questions orally.**

1. State one difference between ions and atoms.
2. Name two ions formed in sodium chloride solution.
3. Which of the ions in sodium chloride solution goes towards the anode and which goes towards the cathode?
4. Name two liquids that are bad conductors of electricity.

## Uses of Electrolysis

The process of electrolysis has many important industrial applications. Some of them are as follows.

- Electrolysis is used in industry for the production of many metals and non-metals (e.g., aluminium, magnesium, chlorine, and fluorine).

- Electrolysis is commonly employed for coating one metal with another. *The method of coating one metal with another using an electric current is called* ***electroplating***. The general set-up used for electroplating an object is shown in Figure 13.5. The method involved in electroplating is as follows.
  - The object to be coated is made the cathode.
  - The metal to be deposited on the object is taken in the form of an electrode and made the anode.
  - The electrolyte contains dissolved salts of the metal to be coated.
  - Ions of the metal (which are positively charged) are attracted by the cathode and therefore move towards the object and get deposited on it.

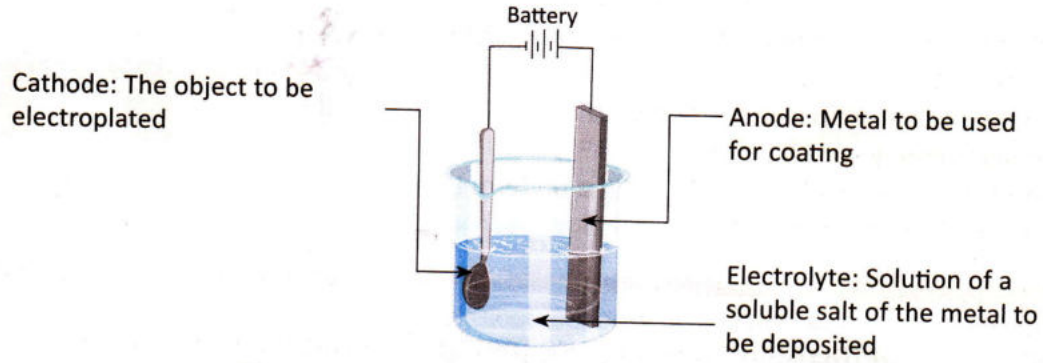
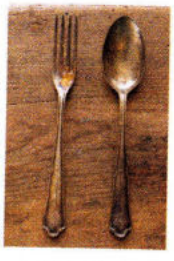



**Fig. 13.5** *General set-up used for electroplating*

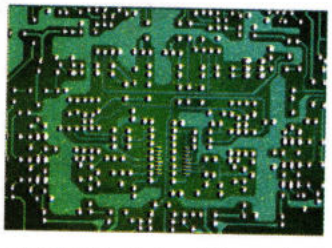
Electroplating is done for many purposes (Fig. 13.6). Here are a few examples.

- Metals that corrode easily are protected by coating them with a metal that does not corrode easily. Nickel and chromium are widely used in the automobile industry for coating (Fig. 13.6a).
- Electroplating is used for decoration. For example, cutlery, statues, and jewellery made of cheaper metals are coated with expensive metals such as gold and silver to enhance their look (Fig. 13.6b).
- Electroplating is used in the manufacture of printed circuit boards (small circuits with components generally printed on a plastic board), which are used in televisions, computers, and other appliances (Fig. 13.6c). ATM cards and SIM cards have a 'chip' (which you will see as a small golden or metallic rectangle on the card). The 'chip' is made by electroplating a small portion of the card with a metal like gold and silver.

(a) Automobiles



(b) Cutlery



(c) Printed circuit boards

**Fig. 13.6** *Uses of electroplating*

## Activity

**Aim:** To observe the electroplating of copper on stainless steel

**Materials needed:** 20 g copper sulphate dissolved in 100 ml of water, copper strip or copper rod, two wires, battery (3–5 volt), beaker, and an object to be electroplated (stainless steel spoon or a coin)

**Method:**

1. Take copper sulphate solution in a beaker (Fig. A).
2. Connect a copper strip (acts as the anode) to the positive terminal of the battery using a connecting wire.
3. Similarly, connect the object to be electroplated (acts as the cathode) to the negative terminal of the battery using a connecting wire.
4. Dip the copper strip and the object to be electroplated in the copper sulphate solution.
5. Electroplate for 20–25 minutes or till a uniform brown coating of copper metal is formed on the object.

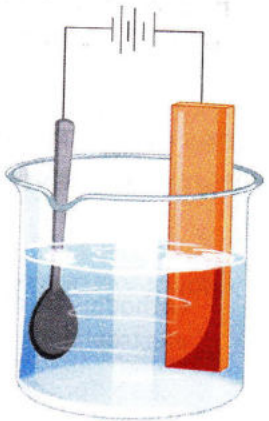
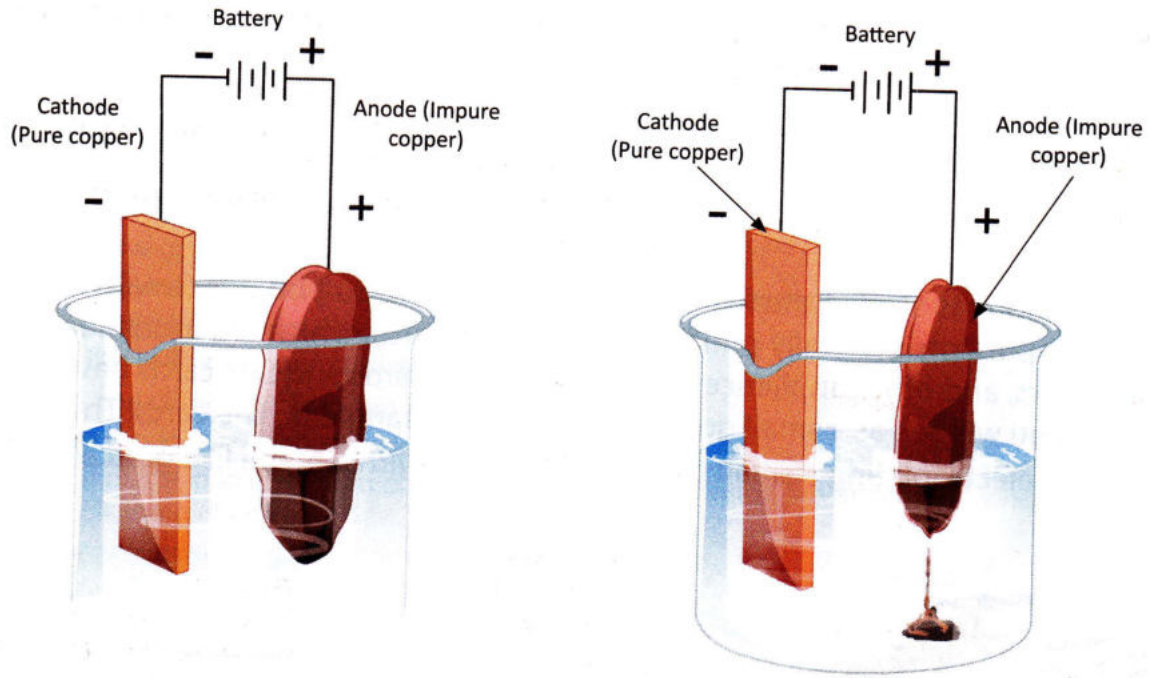


Fig. A

- Electrolysis is used in the refining of impure metals. This method, called electrorefining, can be used to purify metals such as copper, gold, and silver. A simplified explanation of how purification of copper is carried out is shown below in Figure 13.7.




An impure copper rod is taken as the anode and a very thin wire or strip of pure copper is taken as the cathode. The electrolyte is copper sulphate solution.

On passing an electric current, the impure copper dissolves into the solution, and pure copper metal gets deposited at the cathode. The impurities that collect below the anode are collectively called *anode mud*.

**Fig. 13.7** *Purification of copper by electrolysis*

## Activity

**Aim:** To observe the deposition of copper using copper electrodes and copper sulphate solution
**Materials needed:** A battery, electrical wires, a thick copper strip, a thin copper wire (with jacket removed), copper sulphate solution, and a glass tumbler. The glass tumbler should be discarded after the experiment.
**Method:**
Set up the experiment as shown in Figure A. Wait for some time and see what happens to the cathode.
**Observation:** You will observe that the pure copper cathode gets a coating of copper.

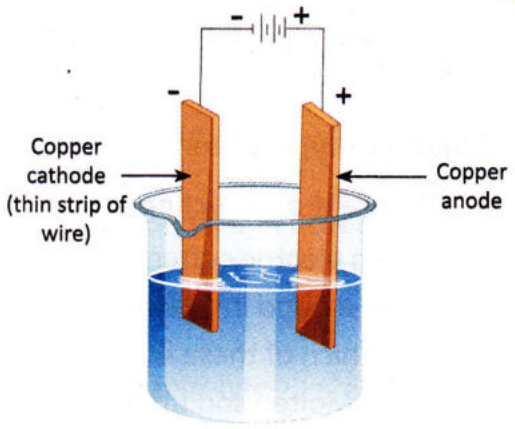


Fig. A

## Key Words

| | |
|---|---|
| **Electrical conductivity** | A measure of the ability of a substance to allow the flow of electric current is called electrical conductivity. |
| **Ions** | Atoms or groups of atoms with a positive or a negative charge are called ions. |
| **Electrolyte** | A liquid that conducts electricity due to the presence of ions is called an electrolyte. |
| **Cathode** | The electrode connected to the negative terminal of the battery is called cathode. |
| **Anode** | The electrode connected to the positive terminal is called anode. |
| **Electrolysis** | The production of a chemical reaction by passing an electric current through an electrolyte is called electrolysis. |
| **Electroplating** | The method of coating one metal with another using an electric current is called electroplating. |

## Summary

- Pure water is a poor conductor of electricity, but most acids and bases dissolved in water are good conductors.
- When impurities such as salts dissolve in water, they form ions, which make it possible for an electric current to pass through the solution.
- An electrolytic cell uses electric current to produce a chemical reaction.
- Passing an electric current through an electrolyte causes a chemical reaction, which can be observed as the formation of bubbles (due to the production of gases) or deposition of metal on the electrodes or as a change in the colour of the electrolyte.
- Electrolysis is commonly employed for coating one metal with another. This process is called electroplating.
- Electrolysis is used in the refining of impure metals. This process is called electrorefining.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. An electric current can flow through
   a. a good insulator b. any liquid c. any solid d. a good conductor
2. Which of these liquids is a bad conductor of electric current?
   a. Molten sodium chloride b. Pure water
   c. Sodium chloride solution d. An acid dissolved in water
3. An anode in an electrolytic cell will attract
   a. anions b. cations c. neutral atoms d. water molecules
4. In an electrolytic cell, the cathode is connected to the
   a. positive terminal of the cell b. anode
   c. earth wire d. negative terminal of the cell
5. During electrolysis,
   a. a chemical reaction take place at the anode and the cathode.
   b. anions and cations move towards the anode and cathode, respectively.
   c. an electric current passes through the electrolyte.
   d. all of the above
6. In an electrolyte, cations are
   a. electrodes b. negatively charged ions
   c. positively charged ions d. neutral atoms
7. Ions can have
   a. only positive electric charges b. only negative electric charges
   c. no electric charges d. either positive or negative electric charges
8. A solution of common salt (sodium chloride) dissolved in water will have
   a. sodium and copper ions b. sodium and chloride ions
   c. sodium and water ions d. chloride and water ions
9. In an electrolytic cell, the anode is the
   a. positive ion b. positive electrode
   c. negative ion d. negative electrode
10. An electrolyte is a/an
    a. electrode b. liquid that conducts electricity
    c. cell that produces electricity d. positively charged ion

**B. Fill in the blanks with the correct words.**

1. Impure water containing dissolved salts is a _____ (good/bad) conductor of electric current.
2. When common salt (sodium chloride) is dissolved in water, sodium and chloride _____ (molecules/ions) are formed.
3. A/An _____ (electric current /chemical reaction) is produced in an electrolytic cell.
4. Anions have _____ (positive/negative) charge.
5. Anode mud is produced during _____ (any electrolysis/electrorefining).

## II. Very short answer type questions

**A. Define the following.**

1. Ions 2. Anode 3. Cathode 4. Electrolyte 5. Electrolysis

## III. Short answer type questions

1. What charged particles make it possible for an electric current to flow through a solution of a salt in water?
2. Name one physical observation by which we can conclude that a chemical reaction takes place during electrorefining.
3. Does the presence of salt in water increase or decrease its conductivity?
4. List two applications of electroplating.
5. What is electrorefining?

## IV. Long answer type questions

1. Explain why we are more likely to get an electric shock if we operate an electrical appliance with wet hands than with dry hands.
2. With the help of a neat and labelled diagram explain in simple terms how electrolysis takes place. Take the example of sodium chloride solution.
3. What is electroplating? How is it done? What is the purpose of electroplating? Draw a simple labelled diagram to show the electroplating of a stainless-steel spoon with copper.
4. With the help of a diagram, explain the process of electrorefining.

## LET'S RECALL


Recall and complete the concept map given below.

**Electrical conductivity of liquids**

**Water**

1. Pure water is a _____ conductor.
2. Tap water and pond water are _____ conductors.
3. Salts dissolved in water are _____ conductors.

**Acids, bases, alcohol, and oils**

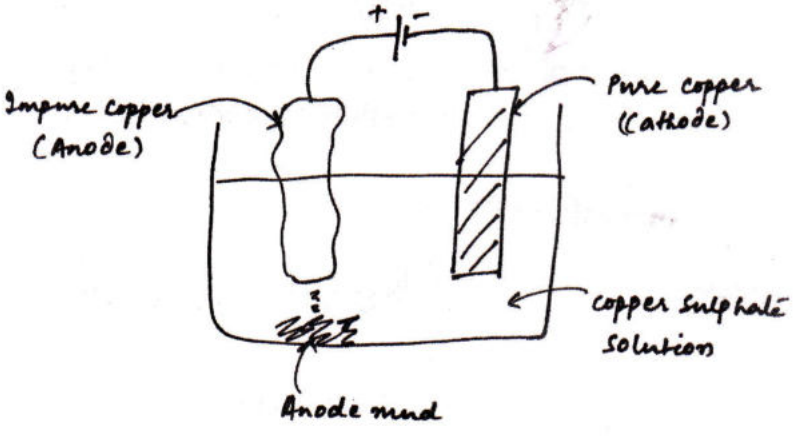
1. Acids and bases are _____ conductors. _____ For example, _____ and _____
2. Alcohol and oil are _____ conductors.

**Uses of electrolysis**

- **Electroplating**
- 
- 

## LET'S OBSERVE

Mary has drawn a diagram to illustrate a certain process that uses the principle of electrolysis. Her drawing is shown below. Identify and write the name of the process she is trying to illustrate.




LO 5

This picture represents:

electroplating ☐ electrorefining ☐

_____

_____

_____

_____

## LET'S APPLY

1. Carbon electrodes are commonly used in electrolytic cells. Can you explain why? (*Hint:* Can you name a non-metal that is a good conductor of electricity?)
2. Electroplating is hazardous to the environment. Give reasons. LO 13 (*Hint:* What happens to the used electrolyte after electroplating?)

## LET'S ANALYSE AND EVALUATE

1. Electrolysis is a very useful process. However, the by-products of the process can have a negative impact. Analyse why it is important to discard the contents and container used for experiments in electrolysis.'
2. Karan has thrown his computer chip and old SIM card in the kitchen dustbin. Do you think this was a wise thing to do? Evaluate the various ways in which these products can be disposed off safely.

## LET'S CONNECT ENGLISH

Sodium, potassium, calcium, chloride, and magnesium are some ions present as electrolytes in our body. We get electrolytes through the food we eat. Some of the functions of electrolytes are muscle contraction, nerve signaling, digestion, and maintenance of blood pressure. It is crucial to maintain a balance of electrolytes in our body at all times. Rohan is sick, and has symptoms of diarrhoea or vomiting. Write a brief account of about 200 words on the severe health issues the electrolyte imbalance can lead to.

## LET'S CREATE CREATING LO 9 LO 10

Make a lemon battery. For this, you will need four lemons, two alligator clips, ten zinc strips, ten copper strips, a LED (2 mA and 2.3 volt), measuring tape, and varying lengths of copper wire.

**Method**:

(a) Take one lemon and make two parallel slits, 2 cm apart, in it.

(b) Insert a copper strip in one slit and a zinc strip in the other. Ensure that the metals do not touch each other.

(c) Make a small nail hole in each of the metal strips. Now, take two pieces of copper wire and connect one each to the copper and zinc strips (by looping the wires through the holes).

(d) Repeat the procedure with the other lemons and join the pieces as shown in the following picture. Connect the free ends of the wires on either ends of the arrangement to an LED as shown in the picture. The current generated by your lemon battery will make the LED glow. Draw a labelled diagram to show the circuit.

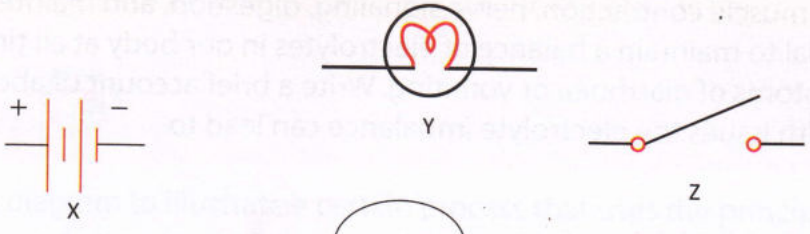
*Note*: Adult supervision required.

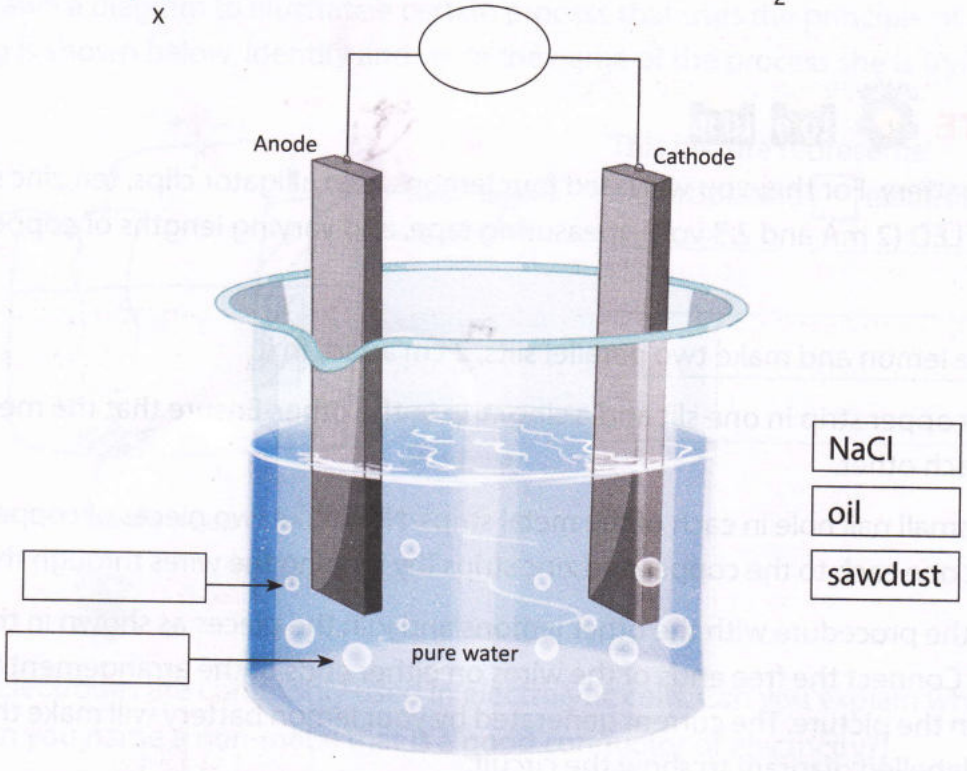
**Web Research**

- To learn how to perform electroplating of Copper, browse through https://www.youtube.com/watch?v=FnJ0V7B7nKo (accessed and checked on 12/08/2019)
- To learn more about Sir Humphry Davy, browse through https://www.famousscientists.org/humphry-davy/ (accessed and checked on 12/08/2019)

# Worksheet 5

**Skills assessed:**
Problem solving and Qualitative analysis




**Read the passage and answer the following questions.**

Anand and his friends are demonstrating the process of electrolysis in the class. They have dipped the electrodes in the electrolytic cell in a beaker of pure water. There are still a few more things that they have to do to be able to start the process of electrolysis.

1. Look at the figure and choose the correct device (X, Y, or Z) that should go into the empty circle.
2. What substance should they put inside the beaker, NaCl, sawdust, or oil?
3. Assuming that they have arranged the set-up correctly, what should they show the class as a proof that electrolysis is indeed taking place?
4. Label the diagram.

14

UNIT 6: NATURAL PHENOMENA

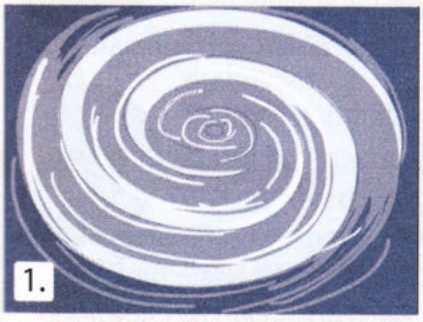
# Some Natural Phenomena

**You will learn about**

- Lightning
- Electric charges
- Earthquakes

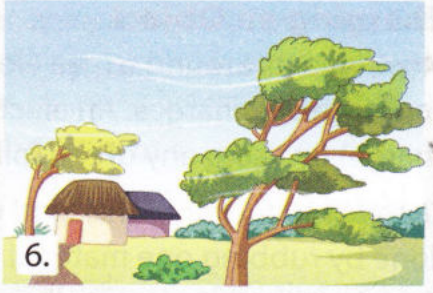
Whether we are aware of it or not, we live in close harmony with nature. We experience natural phenomena all the time. Wind, breeze, rain, sunrise, sunset, waves, and tides are all natural phenomena. These phenomena are relatively mild to us, although they are very crucial to our existence.

We hardly notice them as we go about our daily chores as they are common occurrences. There are some other very striking and dramatic natural phenomena that do make us pause and notice them. Here are a few pictures, can you identify the phenomenon depicted?








In this chapter we will learn, about two natural phenomena in a little bit of detail - lightning and earthquake. Both lightning and earthquakes can cause tremendous damage to life and property and so, in this chapter, we will also learn about what precautions we can take to try to protect ourselves from them.

Answers: 1. Storm/cyclone 2. Earthquake 3. Tsunami 4. Lightning 5. Sunrise 6. Breeze

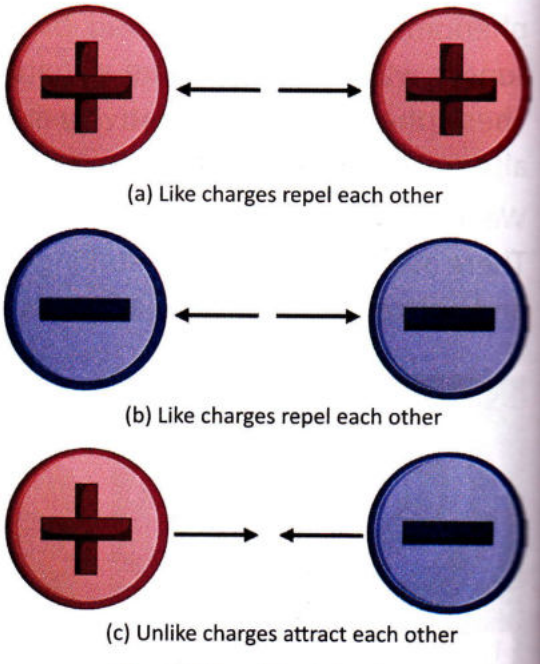
## LIGHTNING

Lightning is caused by electric charge. Therefore, to learn about lightning, we have to first learn a few basics about electric charge and how they behave.

## ELECTRIC CHARGES

All matter is made up of atoms. Every atom is made up of positively charged particles, negatively charged particles, and neutral particles. *The positively charged particles in an atom are called* ***protons****. The negatively charged particles are called* ***electrons****.* Usually, the atom as a whole consists of an equal number of positive and negative charges, and the atom is electrically neutral. If, however, the charges are not balanced, the atom will have an electric charge (positive charge if protons are more in number than electrons, and negative charge if electrons are more in number than protons).

If two objects having the same type of charge (i.e., positive–positive or negative–negative) are brought close together, they repel each other (i.e., push each other away) [Figs. 14.1(a) and (b)]. If, however, the two objects are oppositely charged (positive–negative or negative–positive), they attract each other (i.e., pull towards each other) [Fig. 14.1(c)]. Therefore, we can say like charges repel each other and unlike charges attract each other.



(a) Like charges repel each other

(b) Like charges repel each other

(c) Unlike charges attract each other

**Fig. 14.1** *Electric charges*

### Charging an Object

Most objects around us are electrically neutral because they have equal number of positive and negative charges. An electrically neutral object can be charged (i.e., given an electric charge) by using any of the following methods.

***Charging by friction*** This kind of charging is done by rubbing one material with another. The most common examples are rubbing glass with silk, and ebonite (a kind of hard rubber) with wool. When a glass rod is rubbed with a piece of silk, negative charges are transferred from glass to silk. The glass rod is, therefore, left with a positive charge and the piece of silk acquires a negative charge (Fig. 14.2).

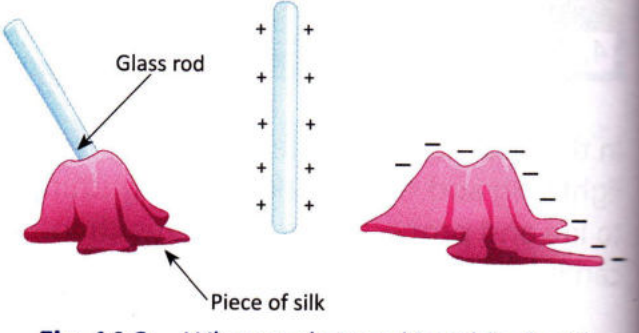



**Fig. 14.2** *When a glass rod is rubbed with a piece of silk, both objects get charged.*

Similarly, if an ebonite rod is rubbed with wool, negative charges are transferred from the piece of wool to the ebonite rod. The ebonite rod becomes negatively charged and the piece of wool becomes positively charged (Fig. 14.3).

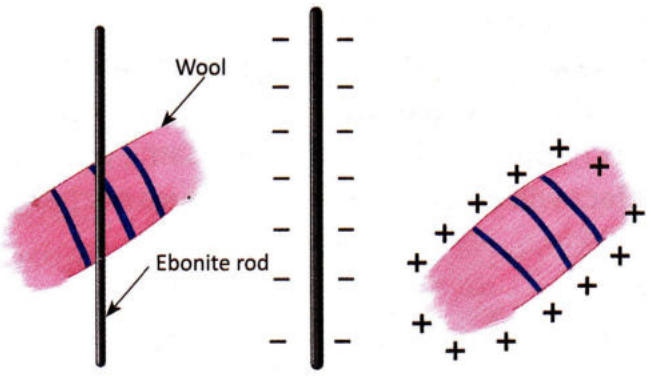



**Fig. 14.3** *When an ebonite rod is rubbed with a piece of wool, both objects get charged.*

## Activity

**Aim:** To use the 'method of charging by friction' to charge some objects. To also find out which objects can be charged by this method and which cannot

**Materials needed:** A non-dust eraser, plastic pencil sharpener, plastic pen cap, plastic comb, small bits of paper, a metal clip, a small hand towel or napkin, and tabletop

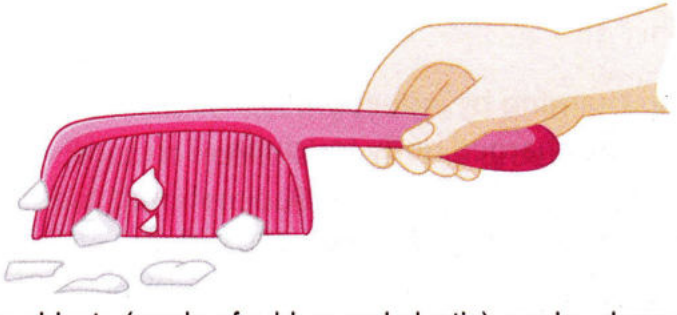
**Method:**

1. Cut out the bits of paper into small squares having 2–4 millimetre sides.
2. Take the eraser, plastic sharpener, plastic comb, and plastic pen cap one by one, and hold each of them, close to the bits of paper and see what happens.
3. Next, spread out the hand towel or napkin on the tabletop and rub the eraser on it vigorously.
4. Thereafter, bring the eraser close to the bits of paper. See what happens now.

Repeat this process with the plastic pencil sharpener, plastic pen cap, plastic comb, and metal clip. What do you observe?

**Note:** The composition of the materials (hand-towel or napkin) is not standard and may vary from place to place. So please try a few materials till you can charge these objects (plastic sharpener, plastic comb, plastic pen-cap, etc.).

**Observation:** You will observe that before rubbing, the eraser, sharpener, comb, pen cap, and metal clip had no effect on the bits of paper. However, after rubbing, the plastic eraser, plastic sharpener, plastic comb, and pen-cap attract the bits of paper. However, the metal clip does not attract the pieces of paper even after rubbing.



**Conclusion:** Some objects (made of rubber and plastic) can be charged by the method of friction, but some (made of metal) cannot be charged by this method.

***Charging by conduction*** An object can also be charged by making it touch a charged body. For example, if we take a charged glass rod and touch a metal object with it, the metal object will also become charged. This is called charging by conduction. The nature of the charge acquired will be the same as that of the charging body. In this case, the metal object will also get the same nature of charge (positive) as the glass rod (Fig. 14.4).

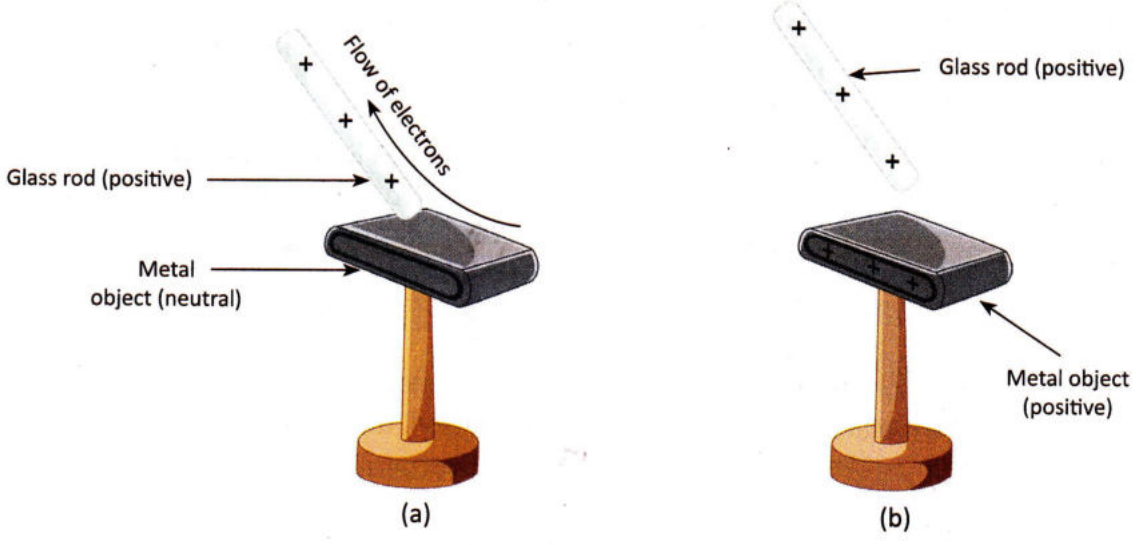



**Fig. 14.4** *Charging a metal object by conduction*

## Activity

**Aim:** To observe how charges behave when they are brought close to each other
**Materials needed:** Two plastic straws, eraser, plastic sharpener, glass bottle/tumbler, piece of silk, wool
**Method:** Charge one plastic straw and keep it in the glass bottle/tumbler. Charge the second plastic straw, eraser, and plastic sharpener, one after the other, and bring them close to the plastic straw in the glass bottle. What do you observe?
**Observation:** You will see that when we bring charged objects close to one another, they are either attracted towards each other or are repelled from each other.

***Charging by induction*** In charging by induction, charging is done without the charged body touching the object that has to be charged. For example, a charged glass rod is brought close to a metal object, but does not touch it (Fig. 14.5).

**Fig. 14.5** *Charging a metal object by induction*

## Transfer of Charge

TD

Electric charge can be transferred from a charged object to another through a metal conductor. A device that works on this principle is the *electroscope*, which is used to detect and measure electric charge. It consists of two very thin metal strips (called leaves, because they are very thin) connected to a metal knob by a metal rod (Fig. 14.6).

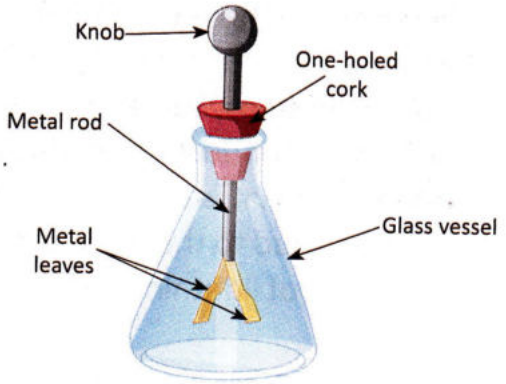



**Fig. 14.6** *An electroscope*

Here is how it works.

1. A charged object is made to touch the knob of the electroscope.
2. The charge is transferred to the thin metal strips through the metal rod.
3. The metal strips repel each other (because they have similar charges) and separate from each other. The electroscope can, therefore, be used to check if a body carries a charge.

When a charged object comes in contact with a body which is not charged, electric charges jump from the charged body to the uncharged body till the charges on the two bodies are equalized. This process is referred to as *discharging*. When a body comes in contact with the Earth, either directly or indirectly, then the charges are discharged to the Earth. This is called *earthing*. Earthing is both important and useful to us. You would have heard the word 'earthing' being used many times in your house. This is because most electrical appliances and the mains of the house are 'earthed' (i.e., connected to the Earth) for our safety, so that we do not get an electric shock.

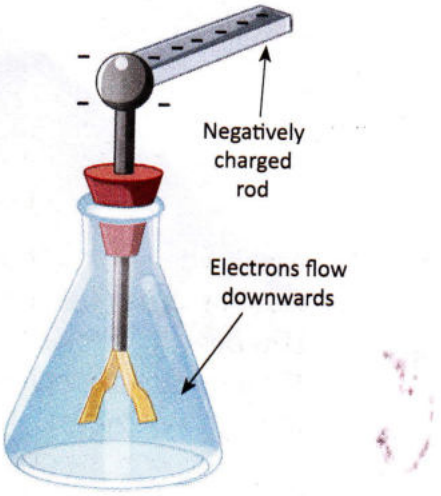



**Fig. 14.7** *Detection of electric charge*

## MECHANISM OF LIGHTNING

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Lightning occurs because of a massive electric charge flowing from cloud to cloud, from one part of the cloud to another, or from a cloud to the ground. Scientists are not very sure exactly how this happens, but thunderclouds carry electric charges, and these charges separate within the cloud. The lower portion of a cloud generally carries negative charges and the upper portions carry positive charges. These charges keep building up. Normally, charges do not flow easily through air. Air is an insulator, but when a huge amount of charge builds up, the insulating property of air breaks down. Nearby air molecules are

ripped apart. These torn molecules carry a charge and this air containing charged particles becomes a conductor of electric current. This process (of ripping apart the air molecules) happens in steps. Successive layers of air are made conductive in a zigzag or step-like path. The path of conductive air (due to charged particles) which extends from the thundercloud is made by what is called a *step leader*. The step leader forms the 'conductive path' in the air, from the cloud to the ground, or to a neighbouring cloud. The step leader is not as bright as the flash of lightning. Figure 14.8 shows how accumulation of charges leads to lightning.

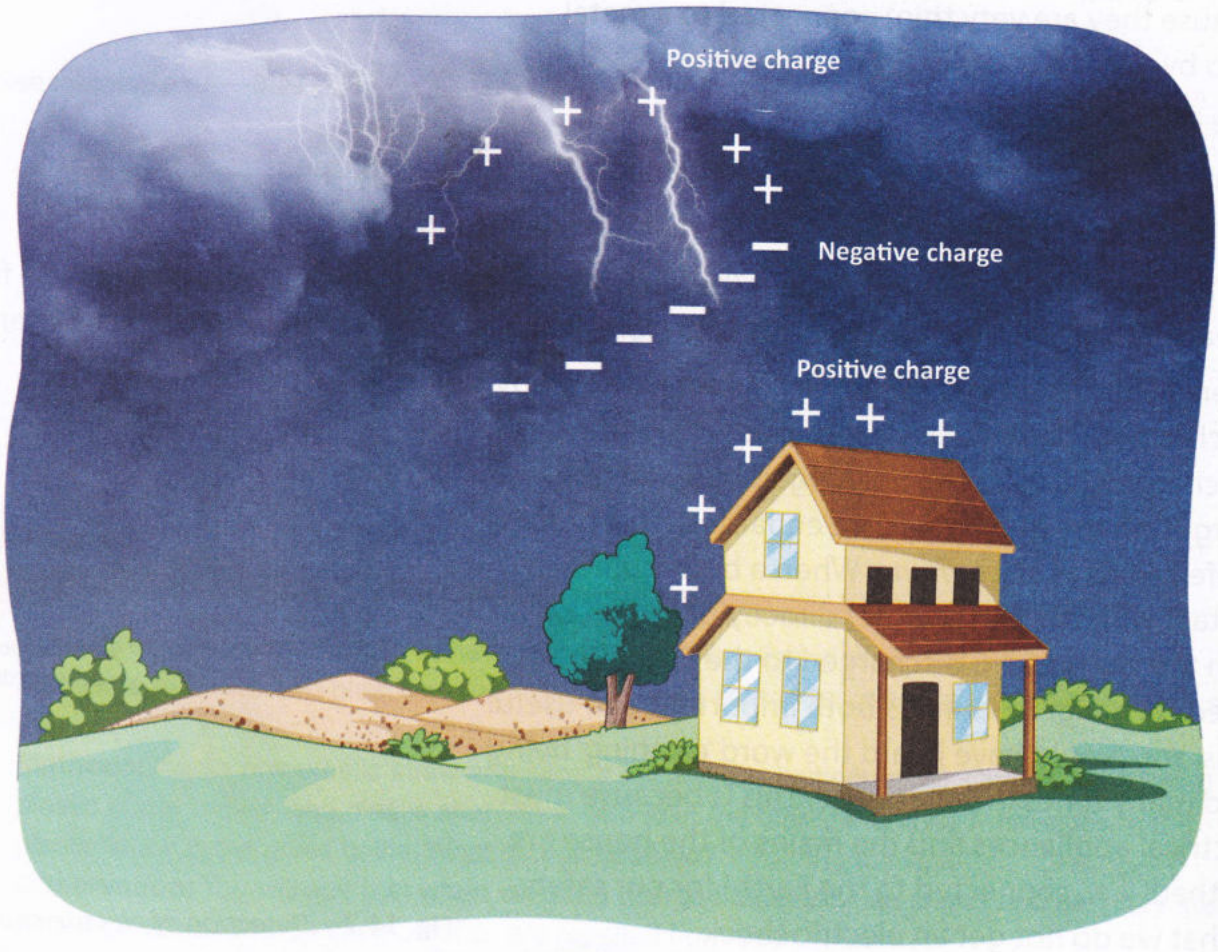



**Fig. 14.8** *How lightning occurs*

A very large amount of electric current is generated during a lightning strike. The air in the path of lightning heats up enormously. Its temperature reaches about 30,000 °C for a moment, even hotter than the surface of the sun! This causes the flash of lightning that we see. The enormous amount of heat produced makes the air expand very suddenly. This causes a wave of vibrations (called a shock wave), which is the cause of the thunder that we hear. Thus, we see that lightning

**Fact File**

During a thunderstorm, lightning and thunder occur together. However, we see a flash of lightning first and hear the sound of thunder afterwards. This is because light travels faster than sound.

is accompanied by large amounts of electric current and very high temperatures, both of which are very dangerous. We must, therefore, learn to protect ourselves during a thunderstorm.

## Lightning Conductors

Lightning conductors are used to protect buildings from the damaging effects of lightning. Lightning strikes buildings or other objects because the materials in them provide an easier path to the ground than air. Lightning is more likely to strike projecting objects such as trees, poles, wires, or buildings than larger, flatter surfaces projecting to the same height or lower. Lone buildings are also primary targets. The basic idea behind lightning protection is to provide a direct, easy path for the lightning bolt to enter the ground without passing through a building or any other object. A lightning conductor (Fig. 14.9) runs from the top to the bottom, along the outer wall of the structure (building, etc.) to be protected. The lower end of the lightning conductor is connected to a metal plate, which is buried deep under the ground. If lightning strikes, the lightning conductor provides an easy path for the charge to pass through to the ground, thus protecting the building.


**Fig. 14.9** *A lightning conductor*

## Safety Measures Against Lightning Strikes

Lightning usually strikes tall buildings and trees. Here are some safety measures you can take if you are caught in a thunderstorm.

- Do not take shelter under a tree. Not only are you in danger of being struck by lightning, but if the tree gets struck by lightning, it could catch fire and cause great harm to you.

### Fact File

**National Disaster Response Force (NDRF)**

The Government of India has constituted a National Disaster Response Force which consists of specialized and trained people who can quickly respond to natural and man-made disasters, and help people in evacuation and rescue operations. Since its inception in 2006, the personnel of the NDRF have saved many lives in various parts of the country.

- Try to take shelter indoors.
- You can even take shelter inside a car or a bigger vehicle such as a truck.
- Do not run across a large open field or high ground.
- If you cannot find a safe place, squat down in a low-lying place.
- Do not touch electrical appliances and metal plumbing lines, taps, etc. during a thunderstorm. Such contact could create an easy path for a lightning strike through you because these objects are good conductors of electricity.
- Do not hold up an umbrella during a thunderstorm. The metal pointed end of the umbrella could attract a lightning strike, especially if it is at a higher level compared to other objects in your immediate surroundings.

### WHAT IS AN ELECTRIC SPARK?

An electric spark is an electric discharge (i.e., flow of electric charges) through vacuum, air, or any other gas. You would have seen these sparks at electric switches. Switch off all the lights at night and then observe the switch closely when you switch off the fan. You will most likely see a small flash of light. This is an electric spark. This is due to the charges jumping across the small gap formed when the switch is being turned off. Lightning is one example of a huge electric spark in the atmosphere. The flash of light that we see is due to the air molecules being heated up to very high temperatures.

## Let's Remember


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

1. A glass rod can be charged by rubbing it with a piece of silk.
2. A positively charged object is attracted to other positively charged objects.
3. An ebonite rod gets a positive charge when rubbed with a piece of wool.
4. An object can be charged by touching it with a charged object.
5. During a lightning strike, the air in the path of the lightning freezes.

**II. Answer the following questions orally**

1. What is an electroscope?
2. Why do we see a streak of light in a lightning?
3. What causes thunder?

## EARTHQUAKES

LL

An earthquake is a destructive natural phenomenon. To understand what an earthquake is, we need to understand the internal structure of the Earth. The Earth is not a uniform solid

sphere. It is made of distinct regions. A simplified version of the structure of the Earth is shown in Fig. 14.10.

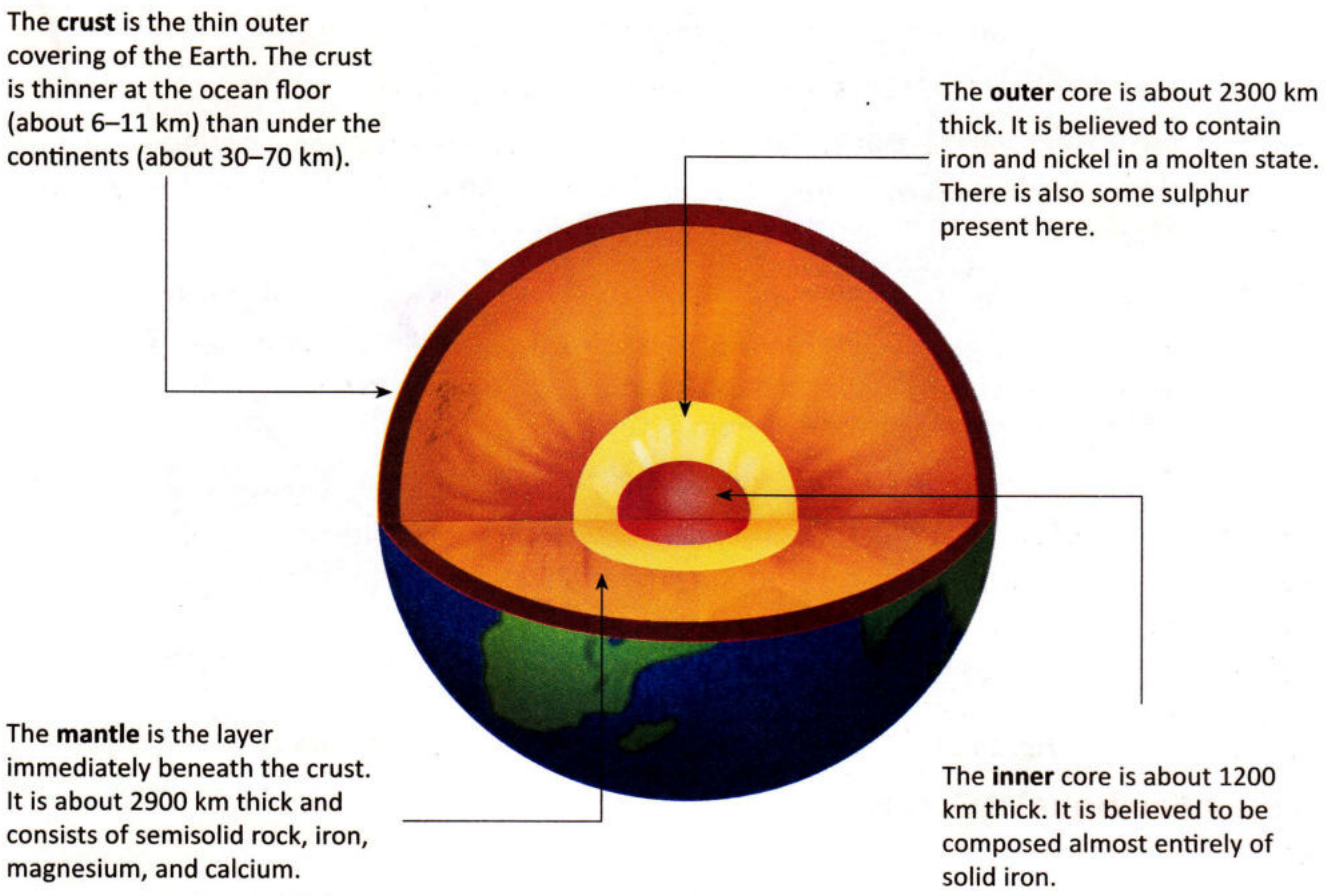



**Fig. 14.10** *Diagrammatic representation of the internal structure of the Earth*

*The Earth's crust and upper layer of the mantle are together called the* ***lithosphere***. An ***earthquake*** is a sudden violent shaking or movement of the ground caused by a disturbance or a fracture in the lithosphere. Earthquakes may range from mild tremors that can barely be felt to massive ones resulting in widespread destruction. *The branch of science concerned with earthquakes and related phenomena is called* ***seismology***. Let us now discuss how the structure of the lithosphere is responsible for earthquakes.

## Plate Tectonics

The Earth's lithosphere is not one continuous piece, but is broken into many pieces called *plates*. The Earth is divided into seven large plates and several smaller plates. Due to the slow movements inside the Earth (called *convection currents*), these plates move with respect to one another by about a few inches every year. This movement of plates results in earthquakes, volcanic eruptions, and mountain formation.

*The theory that the surface of the Earth is made of plates that move with respect to one another is called* ***plate***

**Fact File**

The Himalayas are believed to have been formed by the collision of two continental plates, the Eurasian plate and the Indian plate.

***tectonics***.

Figure 14.11 shows the seven large plates that cover much of the Earth's surface.

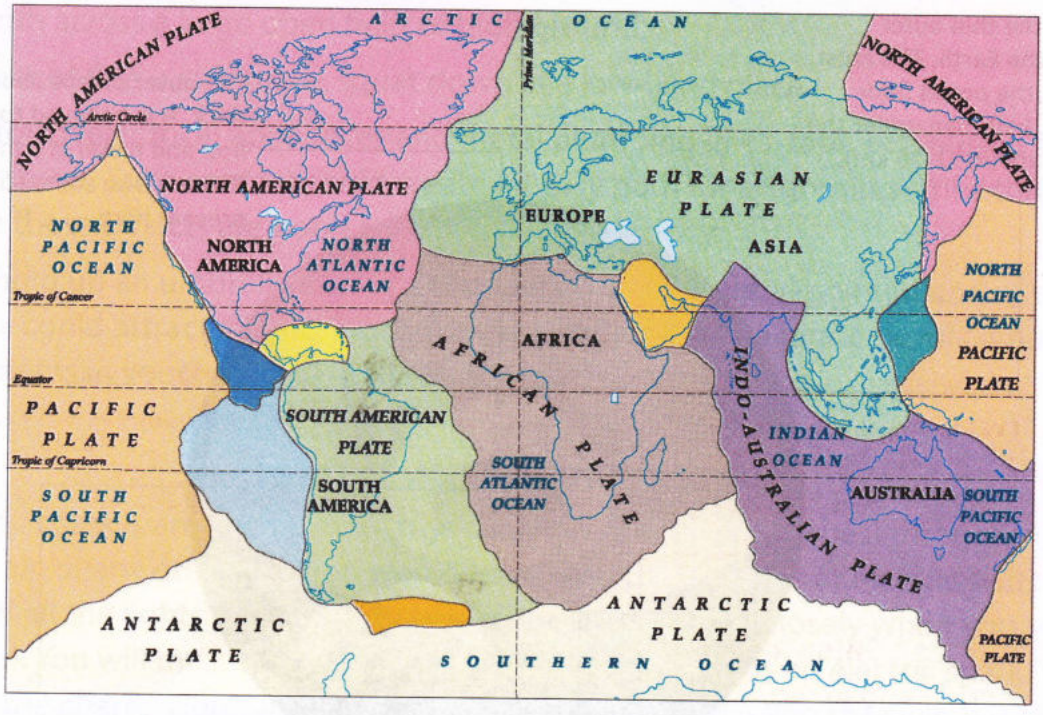


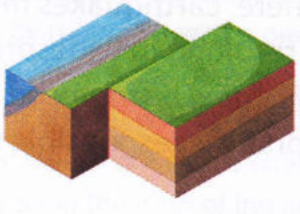

**Fig. 14.11** *The Earth can be divided into seven major plates.*

## How an Earthquake Occurs

AN

Earthquakes generally occur at plate boundaries (also called *seismic zones or fault zones*). Figure 14.12 shows a simplified description of how an earthquake happens.

1. The plates rub against each other as they move. Sometimes, the jagged edges of two plates get locked into each other and prevent them from moving. As a result, pressure builds up against these rough edges.



2. Vibrations caused by an earthquake travel in the form of waves within the Earth or along the surface of the Earth. These waves are called *seismic* waves.

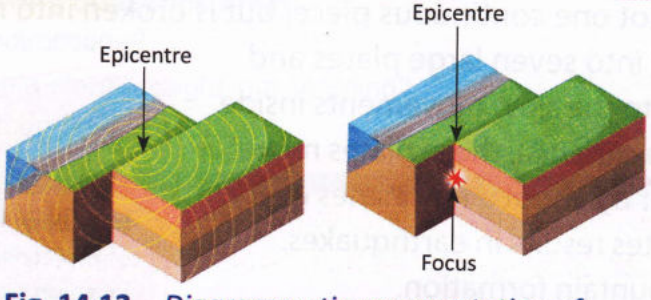



**Fig. 14.12** *Diagrammatic representation of how an earthquake occurs*

3. As the pressure build-up continues, the edges give way. The resulting sudden movement of the plates causes an earthquake. The point where the edges give way is called the focus. *The point vertically above the **focus** on the surface of the Earth is called the **epicentre**.*

### Fact File

**Superdeep Boreholes**

The Kola borehole (in the Kola Peninsula in Russia) is a man-made deep hole in the Earth that is more than 12 km deep. This is the deepest hole that has been drilled so far. Even though it is just about one-third the thickness of the Earth's crust, drilling a hole this deep is a tremendous technological achievement.

## Activity

**Aim:** To get an idea of how an earthquake happens
**Materials needed:** A sheet of thermocole, toy buildings, cardboard, toy cars, and a table
**Method:**

1. Break the sheet of thermocole into several big pieces, and put them together on a large table like a jigsaw puzzle, to make it look like one piece.
2. Use the cardboard to make small bridges, houses, etc. Place these objects on the thermocole.
3. Let them span across many of the broken pieces. Get two or three friends to gather around the table with you.
4. Each of you should then push or pull the thermocole very gently and continuously, while slowly increasing the force with which you push/pull. What do you observe?

**Observation:** You will see that as you keep applying a force, the thermocole gives way at a point and the bridges, cars, buildings, etc., fall.
**Conclusion:** This should give you an idea of how an earthquake happens.

## Measurement of Seismic Waves

*The instrument used to measure seismic waves is called a* ***seismograph***. A typical seismological output, called a seismogram, looks like a series of waves as shown in Figure 14.13. Scientists who study the behaviour of earthquakes are called seismologists.

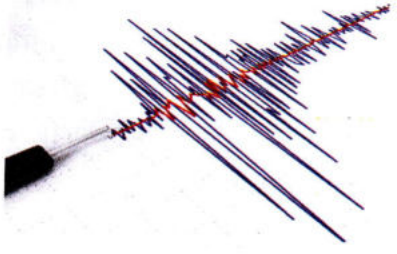
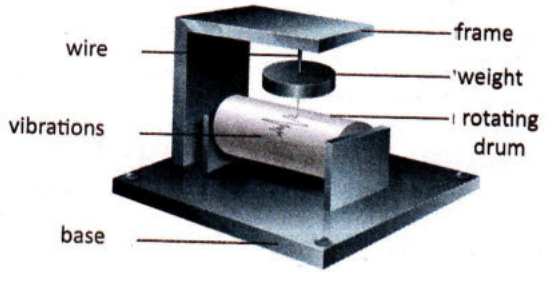


**Fig. 14.13** *A seismogram*

### HOW DOES A SEISMOGRAPH WORK?

A seismograph basically consists of a mass (such as a heavy ball/disc) suspended with a string. This ball/disc has a little pen attached to it, and the tip of the pen touches a sheet of paper (such as a graph sheet) placed on a fixed base. When the Earth shakes, the fixed base also shakes (since it is fixed to the ground), and the suspended ball/disc moves with respect to the fixed base. The pen tip records this movement on the sheet of paper. The output of the seismograph looks similar to the one shown in the Figure 14.13.

**Seismograph**




## Magnitude of an Earthquake

The magnitude of an earthquake can be determined from data recorded by a seismograph. The most common scale used to measure the magnitude of an earthquake is the *Richter scale*. An earthquake of magnitude 2.0–4.0 on the Richter scale is not too damaging. One of magnitude 4–8 is considered a moderate to severe earthquake. An earthquake of

magnitude greater than 8–9 would be very severe. The location of the earthquake (i.e., if it is in a highly populated area or in a remote area) also determines the amount of damage it can cause to human beings and property. Earthquakes are generally followed by low-intensity quakes called *aftershocks*.

On 26 January 2001, there was a major earthquake of magnitude 7.6–8.1 in Gujarat. It resulted in the loss of more than 20,000 lives and severe loss of property. The earthquake that struck the Indo-Pakistan border on the morning of 8 October 2005 had a magnitude of 7.6. It is estimated that more than 50,000 people lost their lives due to this earthquake.

**Fact File**

Some earthquake-prone areas in India are Kashmir, Rajasthan, Rann of Kutch, and places in Gujarat and the Indo-Gangetic plains.

## Earthquake Hazards

In many instances, earthquakes of high magnitude result in widespread damage to human life and property due to various agents of destruction. These agents of destruction are called earthquake hazards. *An **earthquake hazard** may be defined as any event or process associated with an earthquake that may adversely affect people or property*. Earthquake hazards include the following.

**Word help**

**Hazard** A possible source of danger
**Liquefaction (in Geology)** Soil begins to behave like a liquid, and cannot support any weight. In fact, it begins to flow like a liquid.
**Landslide** Slipping of a large portion of rock, earth, or soil down a slope

- Ground failure due to liquefaction (i.e., water-saturated sand or soil temporarily losing strength and acting as a fluid)
- Damage to buildings, roads, dams, bridges, etc.
- Deformation of the ground surface
- Fires resulting from the breaking of electrical power or gas lines
- Occurrence of tsunamis (due to large earthquakes under oceans)
- Occurrence of landslides (in hilly areas)

## Protection Against Earthquakes

It is not in our power to prevent an earthquake. We can, however, take precautions to minimize the damage caused by it.

**Let's Discuss**

Discuss the devastation that can be caused due an to earthquake. How can we protect ourselves when an earthquake occurs?

- Since most damage to human life is caused by the collapse of buildings, we should work towards making them earthquake resistant. The first factor to be considered is the type of soil on which a building is being constructed. Landfills and reclaimed areas are more dangerous as they may not have enough strength to support

a building during an earthquake. Quality of the materials used for construction and the structure and design of the building are also important.

- Buildings in earthquake-prone areas should use lightweight materials so as to reduce the loss of life in case these structures collapse in the event of an earthquake.
- Ceiling fans, air conditioners, and air coolers, should be secured firmly. These objects can cause a lot of harm in case they fall down during an earthquake.

Earthquakes happen very suddenly and last only about 10–30 seconds. Some very intense earthquakes can last a few minutes. So you see, there is very little time for one to act to save oneself. However, here are a few things that you can do to protect yourself, if possible:

- Do not use lift (elevator) during and after an earthquake until it is declared safe.
- If you are indoors, take cover under a heavy table or cot. Keep away from heavy objects that might fall.
- If you are indoors in a public place, you should try to take cover under a sturdy object. Running to the exit may cause a stampede, which could be very dangerous.
- If you are outdoors, move away from buildings, electric poles, and trees which could fall down.
- If you are in a vehicle, stay inside. Vehicles should keep away from bridges, overpasses, and tunnels and avoid stopping under trees, light posts, power lines, or sign boards.

### Get it Right

While building a structure, (e.g., a house) it is very important to take into account various factors such as making sure that the location of our building is safe, that is, the ground is safe to build on. We should not build on landfills and unstable grounds. In mountainous areas, we should also be careful not to build in places that are prone to landslides. Soil testing is an important step before construction begins, as it can determine the depth to which the building's foundation must go and the type of foundation. Next, we should follow the building norms given by the authorities. Both while selecting the site and building your house, the help of experts such as architects and structural engineers should be taken so that you live in a safe building.

As you have learnt, natural phenomena such as lightning, earthquakes, and floods can cause a lot of damage to life and property. While we cannot stop natural phenomena from occurring, we can take certain precautions to protect ourselves. One very important factor towards this is how we build our houses.

## Let's Remember

**Fill in the blanks with the correct words.**

1. A _____ (lightning/earthquake) is the sudden movement or fracture in the Earth's lithosphere.
2. The Earth's plates are _____ (still/moving) with respect to each other.
3. Earthquakes usually occur at _____ (beaches/seismic zones).
4. The magnitude of an earthquake is measured on a _____ (meter/Richter) scale.
5. A seismograph is a/an _____ (graph/instrument) used to measure an earthquake.

## Key Words

| | |
|---|---|
| **Earthquake** | An earthquake is a sudden violent shaking or movement of the ground caused by a disturbance or a fracture in the lithosphere. |
| **Seismology** | The branch of science concerned with earthquakes and related phenomena is called seismology. |
| **Plate tectonics** | The theory that the surface of the Earth is made of plates that move with respect to one another is called plate tectonics. |
| **Earthquake hazard** | Any event or process associated with an earthquake that may adversely affect people or property is called an earthquake hazard. |

## Summary

- If the positive and negative charges are not balanced, the object will have a net electric charge.
- Like charges repel each other, and unlike charges attract each other.
- An object can be charged by friction, conduction, or induction.
- Electric charge can be transferred from one charged object to another object through a metal conductor.
- An electroscope is used to detect and measure an electric charge.
- Lightning is accompanied by large amounts of electric current and very high temperatures, both of which are very dangerous.
- Lightning conductors are used to protect buildings from the damaging effects of lightning.
- Lightning occurs because of a massive electric charge flowing from cloud to cloud, from one part of the cloud to another, or from a cloud to the ground.
- The Earth can be divided into four layers: crust, mantle, outer core, and inner core.
- The Earth's lithosphere is broken into many pieces called plates. The movement of plates results in earthquakes.
- The magnitude of an earthquake can be determined from the data recorded by a seismograph and is measured using a scale known as the Richter scale.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. When a glass rod is rubbed with a piece of silk, the piece of silk gets
   a. positive charge
   b. charge depending on the way it was rubbed
   c. no charge
   d. negative charge
2. An electroscope can be used for
   a. creating lightning
   b. charging an object
   c. detecting an electric charge
   d. protection against lightning
3. Lightning is accompanied with
   a. large amounts of electric current and very high temperature
   b. earthquakes
   c. volcanic eruptions
   d. All of these
4. The lithosphere consists of
   a. Earth's mantle and core
   b. Earth's crust and inner mantle
   c. Earth's core and crust
   d. Earth's crust and upper mantle
5. Plate tectonics is a theory about
   a. charges
   b. lightning
   c. structure of the surface of the Earth
   d. structure of the inner core of the Earth
6. A sudden movement or a fracture in the Earth's crust is called
   a. earthquake  b. lightning  c. thunder  d. cyclonic storm
7. Seismology is the branch of science concerned with
   a. floods  b. earthquakes  c. lightning storms  d. tides
8. A lightning conductor provides an easy path for the charges (from the lightning strike) to
   a. the building
   b. the electrical fittings of the building
   c. the water pipes of the building
   d. deep underground
9. The epicentre of an earthquake is
   a. a point vertically above the focus on the surface of the Earth
   b. a point at the Earth's core
   c. a point below the focus in the mantle of the Earth
   d. the graph of the earthquake

10. Lightning happens because of
    a. earthquakes
    b. transfer of massive electric charges
    c. electric poles
    d. volcanoes

**B. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Natural phenomenon | a. Electric discharge |
| 2. Lightning | b. Richter scale |
| 3. Focus | c. Lightning |
| 4. Earthquake | d. Sunrise |
| 5. Thunder | e. Earthquake |

## II. Very short answer type questions

1. What is charging by friction?
2. What is earthing?
3. What is the outer covering of Earth called?
4. Why is it unsafe to hold an umbrella during a thunderstorm?
5. What is seismology?

## III. Short answer type questions

1. Why is earthing important to us?
2. Under normal circumstances, is air a conductor or insulator of electric current?
3. Name the broad regions into which the internal structure of the Earth can be classified.
4. What is plate tectonics?
5. What are seismic waves?

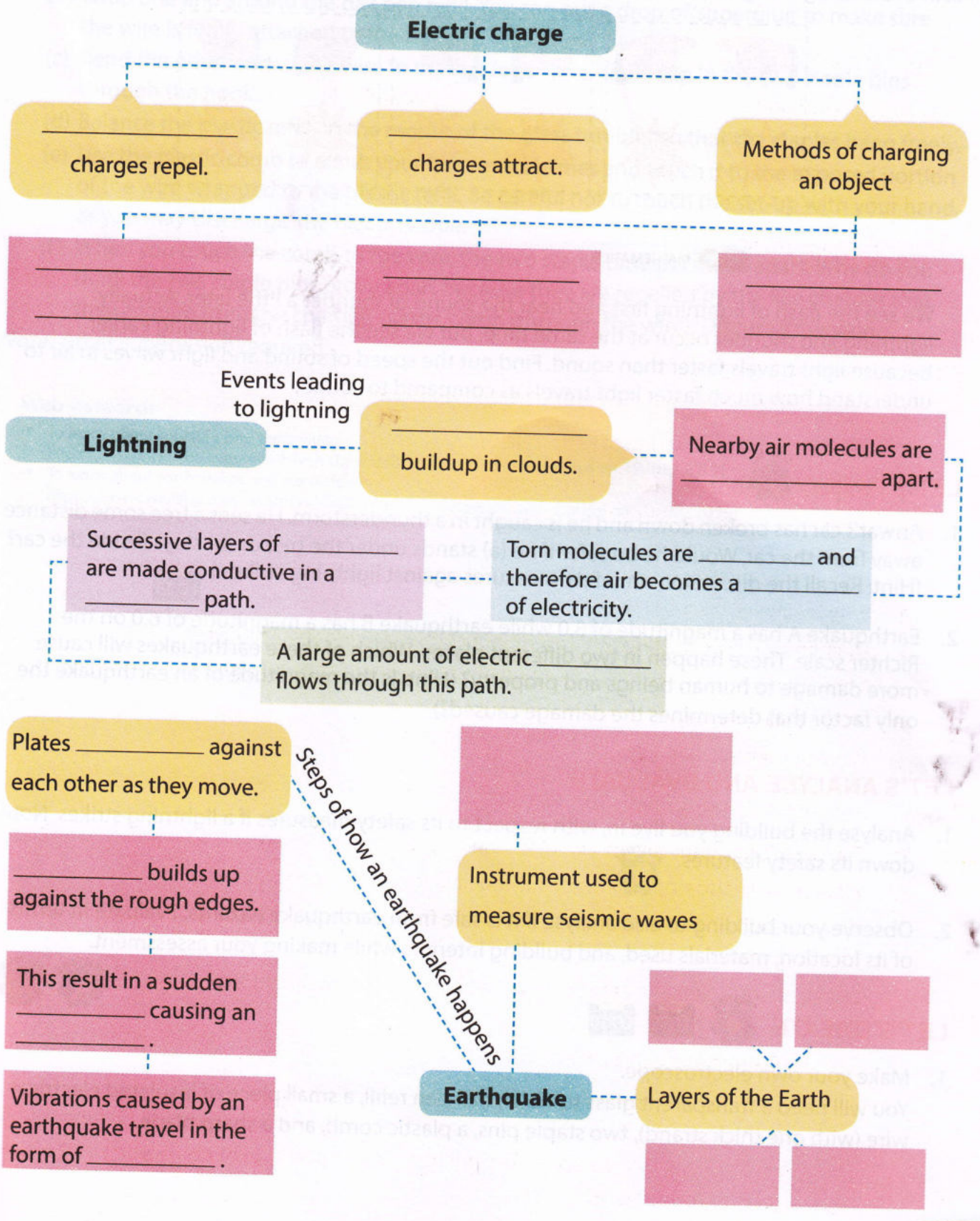
## IV. Long answer type questions

1. Explain with examples, how an object can be charged by friction.
2. What is an electroscope? Draw a neat labelled diagram and explain how it works.
3. With the help of a simple diagram, explain how a lightning conductor can protect a building from a lightning strike.
4. List three steps than we can take to protect ourselves from being struck by lightning during a thunderstorm.
5. Draw a diagram and explain the internal structure of the Earth.
6. Give a simple diagrammatic representation of how an earthquake occurs.
7. In what way can we design buildings to minimize the loss of life and property in the event of an earthquake. Give two examples. Also, mention the importance of the location of the building in reference to earthquake safety.

## LET'S RECALL

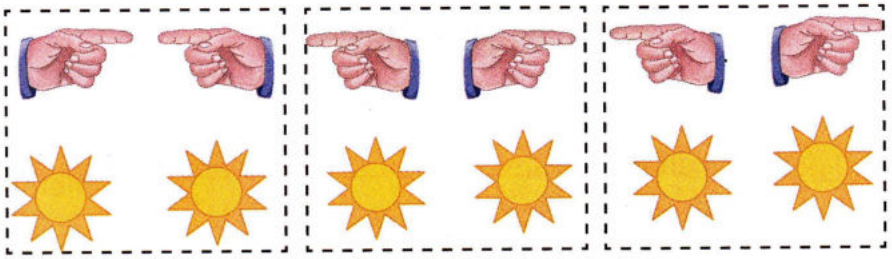
REMEMBERING

Recall and complete the concept map given below.



## LET'S OBSERVE

Fill in the missing charges (positive or negative) in each case.



## LET'S CONNECT MATHEMATICS

We see the flash of lightning first and hear the sound of thunder a little later. Actually, lightning and thunder occur at the same time, but we see the flash of lightning earlier because light travels faster than sound. Find out the speed of sound and light waves in air to understand how much faster light travels as compared to sound.

## LET'S APPLY

1. Anwar's car has broken down and he is caught in a thunderstorm. He sees a tree some distance away from the car. Would he be safer if he (a) stands under the tree or (b) stays inside the car? (Hint: Recall the discussion on safety measures against lightning strikes.) LO 13
2. Earthquake A has a magnitude of 8.0 while earthquake B has a magnitude of 6.0 on the Richter scale. These happen in two different places. Which of these earthquakes will cause more damage to human beings and property? (Hint: Is the magnitude of an earthquake the only factor that determines the damage caused?)

## LET'S ANALYSE AND EVALUATE

1. Analyse the building you live in, with respect to its safety measures if a lightning strikes. Note down its safety features.
2. Observe your building to also analyse if it is safe from earthquake hazards. Evaluate in terms of its location, materials used, and building interiors while making your assessment.

## LET'S CREATE LO 5 LO 10

1. Make your own electroscope.
   You will need a transparent glass tumbler, ball pen refill, a small piece of insulated electrical wire (with one thick strand), two staple pins, a plastic comb, and a sharp blade.

**Method:**

(a) Remove the insulation from the two ends of the wire.

(b) Wrap one end around the ball pen refill. You can put a drop of 'superglue' to make sure the wire is firmly attached to the ball pen refill.

(c) Bend the other end of the wire to make it look like a hook. Slip in the two staple pins through the hook.

(d) Balance the plastic refill on the mouth of the glass tumbler so that the staples hang freely.

(e) Use the plastic comb to comb your hair several times and touch it to the exposed portion of the wire wrapped to the plastic refill. Be careful not to touch the set-up with your hand, as you may 'discharge' the electroscope.

(f) When you touch the comb to the wire, the two staple pins will move apart. Why do you think the two staple pins move apart because they are repelled by the like charges that they acquire from the charged plastic comb (through the wire). Discuss its working.

***Note:*** Adult supervision required.

**Web Research**

- To learn about lightning and see a video
  https://www.youtube.com/watch?v=h-0gNl5f4BU (accessed and checked on 12/08/2019)
- To learn about earthquakes and see a video
  https://www.youtube.com/watch?v=VSgB1IWr6O4 (accessed and checked on 12/08/2019)

# 15 Light

Light is an integral part of our lives, and yet we take it for granted quite a bit. All the time, during day or night, we depend on natural or artificial lighting.

Look at the pictures below and answer the questions that follow.

**You will learn about**

- What makes things visible
- Reflection
- Dispersion
- Human eye

1. 

2. 

3. 

4. 

1. Of the objects shown in picture 1, pick out the objects that make it possible for us to `see' things around us.
2. In picture 2, the girl can see her image in the plate on the left, but not in the plate on the right. Why do you think this is so?
3. In which hand is the boy wearing the wrist watch in the two pictures?
4. Why are the two people wearing spectacles? What do you think will happen if they exchange their spectacles?

Light does not just exist. It is produced by a source, from where it travels outwards and bounces off or gets absorbed by objects in its path. We see light only when it reaches our eyes. In most cases, some of the light falling on an object is always reflected by it. That is how we can see it. Sometimes, we can see our image in the reflected light and at other times, we cannot. We can see things around us only when there is a source of light. When all sources of light are switched off, it gets pitch dark and we can see nothing.

The images produced by reflection have many interesting characteristics, we will study some of them in this chapter. We will also learn how we see with our eyes, how some eye defects can be corrected, and how we can take care of our eyes.

1. The lamp, the Sun, Our eyes, 2. In the first picture, the plate is new and in the second picture, the plate is old, 3. The boy is wearing the wrist watch on his left hand, but in the image, it looks as though the wrist watch is on his right hand, 4. They are wearing spectacles to correct a defect in their eye-sight. They will not be able to see clearly if they exchange their spectacles.

## WHAT MAKES THINGS VISIBLE?

We know that all objects that we see can be classified into two types: *luminous* and *non-luminous*.

Luminous objects are those that emit light on their own. These are also called sources of light (e.g., the sun, the stars, and a light bulb). Non-luminous objects are those that do not emit light on their own (e.g., a table, a chair, and a tree) and are seen in the presence of a source of light. These objects cannot be seen if there is no light source.

Non-luminous objects are seen when light from luminous objects falls on them. Light coming from a light source bounces off a non-luminous object and enters our eyes. When rays of light enter our eyes, they fall on a light-sensitive layer at the back of the eye called the retina. They are then transmitted to the brain through the optic nerves, and the brain interprets the image formed on the retina. This is how we 'see' objects around us. If the object is a source of light, then we can see it from the light it emits. If the object is not a source of light, then we see it from the light it reflects (from a source of light). We also see the moon and the planets because they reflect light rays of the sun.

## REFLECTION

AN

When a ray of light hits a mirror, or any surface, it bounces off the surface. This phenomenon is called *reflection of light*. While light is reflected from any surface, reflection from a mirror or any other highly polished surface (such as metal or polished granite) produces an image that we can see. When you look at a mirror, you see the reflection of other things around you along with your own image. Let us perform an activity to learn more about this phenomenon.

### Activity

**Aim:** To study the nature of reflection from a mirror

**Materials needed:** A4 size paper, a pair of scissors, adhesive tape, and a wall mirror (bathroom mirror, dressing mirror, etc.)

**Method:**

1. Fold the A4 size paper in the middle, lengthwise.
2. Cut out a thin slit on the fold, leaving out 1 inch on the top and bottom of the paper.
3. Open out the paper and stick it on a mirror.
4. Look at yourself in the mirror through the slit in the paper. Make a note of the various objects that you can see behind you.
5. Now move to your right and look at the mirror through the slit. Try out various positions. Try to see along the surface of the mirror. Make a note of the images that you see at the various positions of your eye.

**Observation:** You will notice that you will be able to see yourself only if you are directly in front of the slit. If you move to the right, you will be able to see the image of things to your left. If you move further to the right, you will be able to see things further to your left.

Let us put down our observations from the activity in a scientific manner by drawing a diagram. First draw a line perpendicular (i.e., a line that makes an angle of 90°) to the mirror at the point where the slit is located (Fig. 15.1). This line, SN, is called the *normal*.

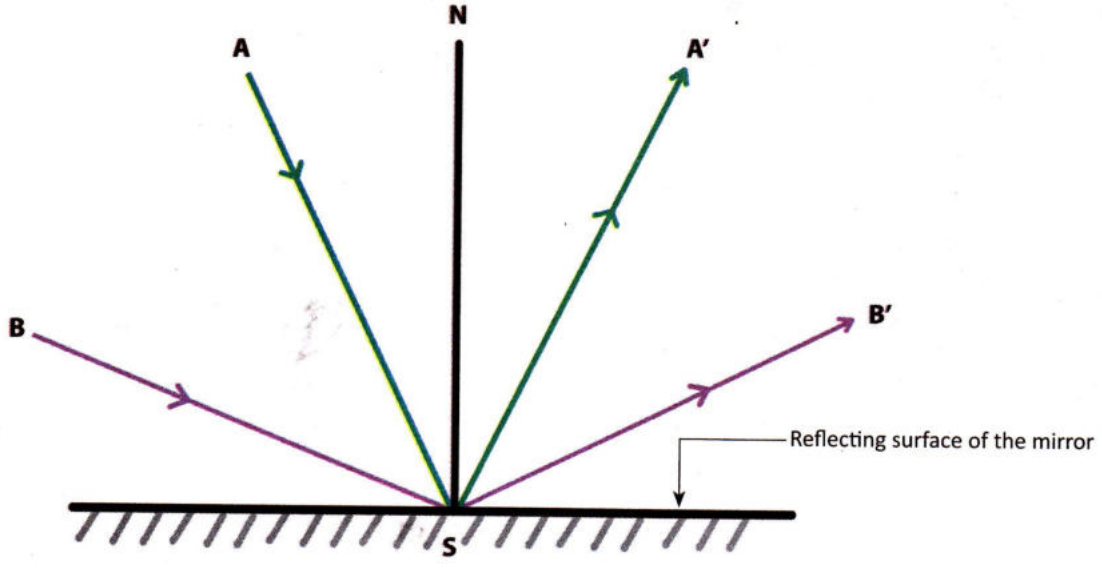



**Fig. 15.1** *Reflection from a plane mirror*

The rays of light that come from the object and hit the mirror are called *incident rays*. In Figure 15.1, AS and BS are incident rays. The rays of light that get reflected from (i.e., bounce off) the mirror are called *reflected rays*. In Figure 15.1, SA' and SB' are reflected rays.

The point at which the incident ray hits the mirror is called the *point of incidence*. In Figure 15.1, S is the point of incidence. A normal drawn to the mirror at the point of incidence is called a normal at the point of incidence. The angle between the incident ray and the normal is called the *angle of incidence*. In Figure 15.1, angle ASN is the angle of incidence of the incident ray AS. The angle between the reflected ray and the normal is called the *angle of reflection*. In Figure 15.1, the angle of reflection of the reflected ray SA' is NSA'.

## Laws of Reflection

In Figure 15.1, the image of an object at A could be seen at A' and the image of an object at B could be seen at B'. What conclusions can you draw from this observation? Look closely at the angle of incidence and the corresponding angles of reflection. You will see that in each case, the angle of incidence equals the angle of reflection. Also, the incident ray, the reflected ray, and the normal at the point of incidence lie on the same plane. These two statements are known as the laws of reflection and are summarized below.

***First law*** The incident ray, the reflected ray, and the normal at the point of incidence lie on the same plane.

***Second law*** The angle of incidence is equal to the angle of reflection.

## Activity

**Aim:** To verify the laws of reflection

**Materials needed:** A drawing board, paper, drawing pins, a plane mirror, common pins, protractor, scale, and pencil

**Method:**

1. Fix a paper on the drawing board with the help of drawing pins.
2. Draw a horizontal line MN on the paper. At the mid-point, mark a point O.
3. Place the protractor at O. Draw a line OX at 90° to MN. OX is the normal.
4. Place the protractor again at O and mark an angle 30° to the normal. Draw a line IO. This is the incident ray.
5. On the incident ray, place two pins P and Q few centimetres from each other.
6. Place the mirror along the line MN as as shown in Figure 15.2.
7. Look into the mirror and fix two more pins R and S on the other side of the normal to represent the images of P and Q respectively. Make sure P, Q, R and S appear to be on the same straight line.
8. Remove the pins R and S. Join the pin prick marks (starting from R) and extend the line to meet the point O. This line is RO representing the reflected ray.
9. Now measure the angle ROX. This gives the angle of reflection.
10. Repeat the experiment for various angles of reflection such as 35°, 40°, 45°, and 50° and record your observations in the table.

**Observation:** You will notice each time, the angle of incidence is equal to the angle of reflection.

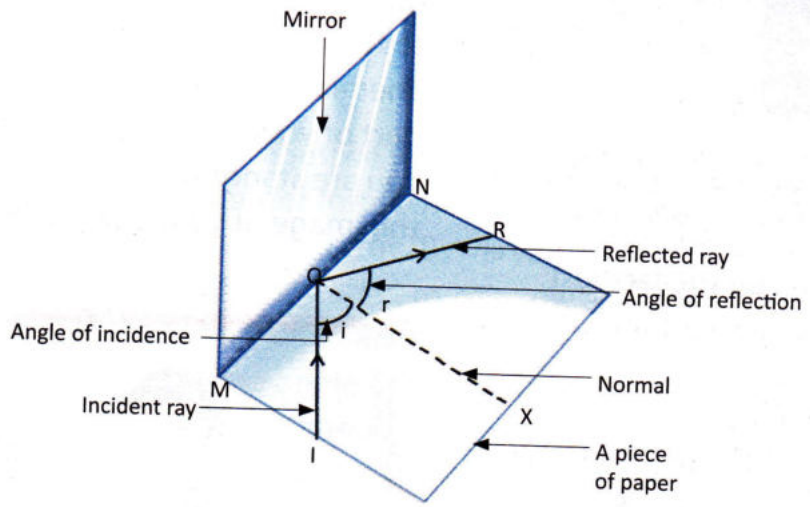



**Fig. 15.2** *Laws of reflection*

## Image Formed by a Plane Mirror

The two laws of reflection remain the same regardless of the shape of the mirror used. However, the characteristics of the image formed, that is, the size of the image, whether it is upright or inverted as compared to the object, etc., vary depending on the type of mirror. In this chapter, we will restrict ourselves to studying the characteristics of an image

formed by a plane (i.e., flat) mirror. These characteristics are given below.

***Size*** Look at yourself in a dressing mirror. Move back and forth. Look at the images of the various objects around you. Do you feel that the images are increased or decreased in size as compared to the size of the object? You will find that the image size and the object size are the same.

***Upright or inverted*** When you see yourself in the mirror every morning, do you see yourself standing upright, or inverted with your feet pointing to the ceiling? You see yourself upright. In other words, a plane mirror forms an upright (also called erect) image.

***The distance of the image (from the mirror) as compared to that of the object*** Stand in front of the mirror and then move back and forth. Observe the image closely. What do you see? You will see that when you move either closer to or away from the mirror, your image also seems to move closer to or farther away, respectively. This is because, in a plane mirror, the distance of the image (from the mirror) equals the distance of the object from the mirror.

**Fig. 15.3** *When you stand on a mirror, the image formed is upside-down*

What happens when you stand on a mirror?

You will see yourself standing upside-down (Fig 15.3)! This is because in a plane mirror, the distance of the image from the mirror is equal to the distance of the object from the mirror. Therefore, the image of your foot (which is the part of your body closest to the mirror, when you are standing on it) will be the closest and the image of your head (which is the farthest from the mirror) will be the farthest. This gives the impression of the image being 'upside down'

***Lateral inversion (left-right reversal)*** Write your name on a sheet of paper and hold it in front of a mirror. What do you see? You will see that your name has been completely reversed. Some letters also look peculiar. This happens because the reflected image undergoes left-right inversion, also called *lateral inversion* (Fig. 15.4).


**Fig. 15.4** *Lateral inversion*

## Regular and Diffused Reflection

Why is it that all the surfaces around us do not act like mirrors? Light bounces off all kinds of surfaces, but we can see images of objects only from highly polished surfaces, such as mirrors. This is because a polished surface reflects a parallel beam of light in one direction [Fig. 15.5(a)], whereas a rough surface reflects a parallel beam of light in many different directions [Fig. 15.5(b)].

Reflection from a polished surface is called *regular reflection* and reflection from a rough surface is called *diffused reflection*. Examples of surfaces that produce a regular reflection are mirrors, shiny smooth metal surfaces, and highly polished granite. Even still water acts like a regular surface. Examples of surfaces that produce a diffused reflection are rough walls, leaves, natural rock, wood, and our skin.

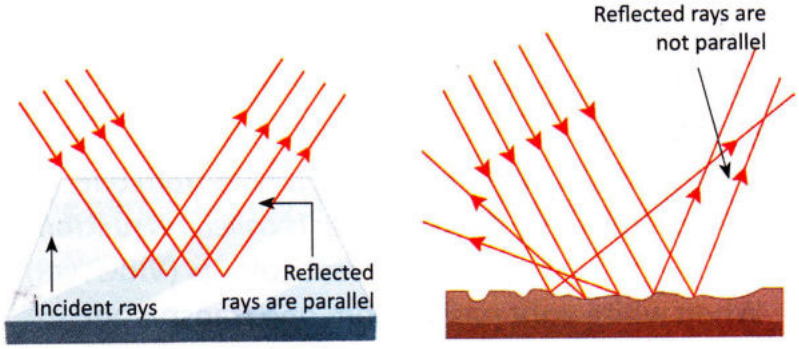



**Fig. 15.5** *Types of reflection*

When a stainless steel plate is new, we can see a clear image in its reflection. But when the plate becomes old, we cannot see a good reflection. This is because use, scrubbing, and washing makes the surface of the plate rough, and hence we only get a diffused reflection from its surface.

## Multiple Reflections

Have you wondered what kind of images we would get if we had two mirrors? You might be thinking that when one plane mirror forms one image, then two plane mirrors together will form two images. However, this is not true. By varying the angle between the two mirrors, we can get any number of images. Let us see how a combination of plane mirrors works. For example, if we keep two plane mirrors at an angle of 90° to each other, we will get three images. As we decrease the angle between the mirrors, the number of images will increase. When the two mirrors are parallel to each other (angle 0°), we get an infinite number of images. You might have observed this in many places. Some elevators (lifts) have mirrored walls. If you try to look at yourself in one mirror, which has a parallel mirror on the opposite wall, you will see that there are an infinite number of images! Have you ever tried to look at the back of your head in a mirror? If you have, you will know that you need a minimum of two mirrors to be able to see the back of your own head. This is again a case of multiple reflections of

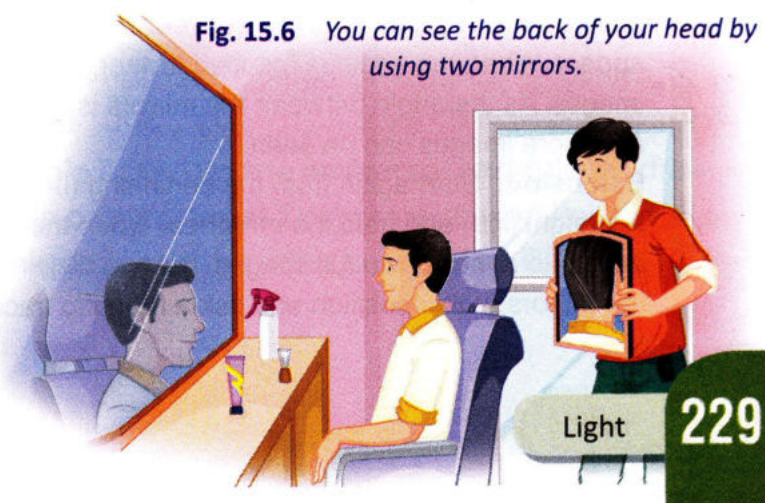


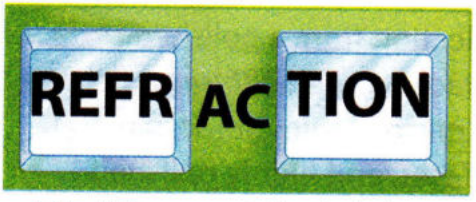
**Fig. 15.6** *You can see the back of your head by using two mirrors.*

light (Fig. 15.6). Although we need a minimum of two mirrors, we also can arrange a set of more than two mirrors in such a way that we can see the back of our own heads. Try it!

### AN WHAT IS REFRACTION?

You have studied how light rays are reflected by mirrors. Instead of a mirror, if we had a transparent substance, such as a thick piece of glass, what do you think would happen? The light rays will pass right through. When a ray of light passes from one transparent medium to another, it generally changes its direction. *The change in the direction of the path of a light ray when it passes from one transparent medium to another is called* ***refraction***. White light consists of different colours (VIBGYOR). When white light passes from one transparent medium to another at an angle, the different colours of light get deflected by different angles. This is the reason why white light gets 'split' into its different colours when it passes through a prism.

Examples of refraction:




Printed letters appear to be raised when a glass block is placed over them.

A pencil dipped in water appears to be bent.

## Activity

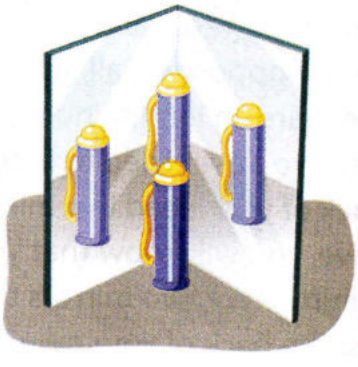
**Aim:** To observe the images formed with two plane mirrors when they are placed at different angles to each other

**Materials needed:** Two plane mirrors and a small object (such as a pen cap)

**Method:**

1. Keep the two mirrors side by side so that they are in a straight line.
2. Place the small object (pen cap) in front of the mirrors. How many images do you see?
3. Now reduce the angle between the two mirrors slowly. Observe the images.

**Observation:** When you keep the two mirrors side by side, you will see only one image as the two mirrors together act as one. As soon as you reduce the angle between the mirrors, two images appear. When the angle is reduced further, you will get three images. As the angle between the mirrors is reduced further, more and more images can be seen.



**Extension:** Start again from the beginning (i.e., the two mirrors in a straight line) and hold the mirror still when the second image just begins to appear (two full images, not two disjointed images). Hold the mirrors at this position and ask a friend to trace the outline of

the base of the mirrors. Remove the mirrors and measure the angle with a protractor. Repeat this for three, four, and five images. Make a table in the format shown below.

| Number of images | Angle |
|---|---|
| | |
| | |

The number of images (N) formed with two plane mirrors kept at an angle a to each other is given by the formula N = (360/a) –1. Check to see if this formula holds true.

## How to Draw Ray Diagrams for Reflection

1. First, draw a thick line indicating the mirror. Lightly shade one side of the line—this is the back of the mirror.

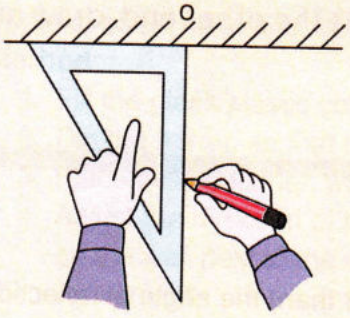



Fig. A

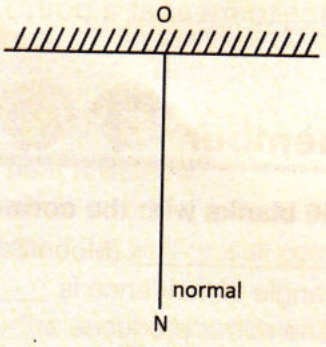



Fig. B

2. Mark a point O on the mirror (near the middle) and use a set square to draw a line perpendicular to the mirror at that point [Fig. A]. This is the normal to the mirror at the point O. Label this line as NO [Fig. B].
3. Now draw an imaginary point object A at any point in front of the mirror. Use a ruler to join A and O with a straight line. Draw an arrow on the line AO such that it points in the direction of the mirror. This is the incident ray [Fig. C].

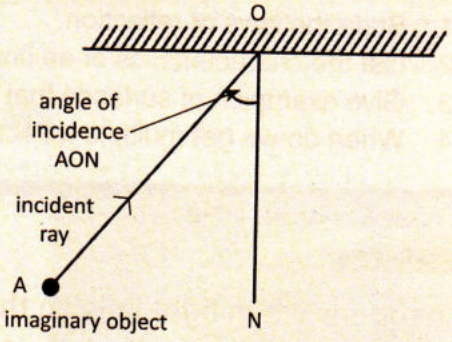



Fig. C

4. Use a protractor and measure the angle AON. Use the protractor and ruler to draw an equal angle NOB on the other side of the normal. Draw an arrow on line OB such that it points away from the mirror. This is the reflected ray [Fig. D].

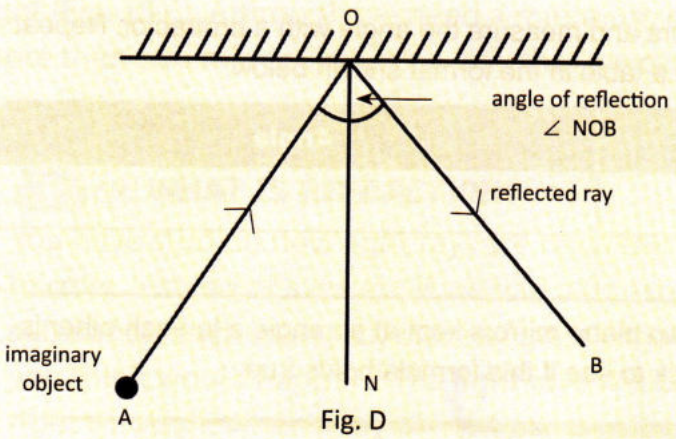


Fig. D

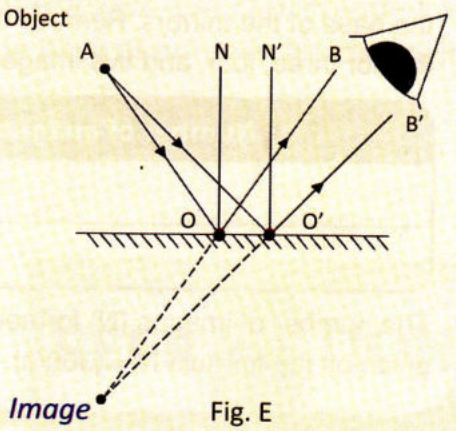


Fig. E

5. Figure E shows how an image is formed in a plane mirror. Take imaginary object A on the left (in front of the mirror). Draw two points O and O′ about ½ centimetre apart on the mirror surface. Draw two normal ON and O′N′ (lines perpendicular to the mirror surface) at O and O′. Draw lines AO and AO′. Draw lines OB and O′B′ such that ∠ NOB = ∠ AON and ∠ N′O′B′ = ∠ AO′N′. Extend BO and B′O′ backwards (behind the mirror with dotted lines to meet at a point). Call this point `IMAGE'. At the other end, draw an eye.

## Let's Remember

**I. Fill in the blanks with the correct words.**

1. The _____ (Moon/Sun) is a luminous object.
2. The angle of incidence is _____ (equal to/greater than) the angle of reflection.
3. A plane mirror produces a _____ (real/virtual) image.
4. A rough surface produces _____ (regular/diffused) reflection.
5. When we place two plane mirrors side by side, the number of images produced depends on the _____ (distance/angle) between them.

**II. Answer the following questions orally.**

1. State the laws of reflection.
2. List the characteristics of an image formed by a plane mirror.
3. Give examples of surfaces that will give diffused reflection.
4. When do we get multiple reflections?

## DISPERSION

What happens when light falls on the surface of a compact disc (CD) or a prism? We see that when light falls on a CD or a prism, it splits up into its many colours. *The process of splitting up of white light into many colours is called* ***dispersion*** (Fig. 15.7). *The band of colours produced when white light is split up is called a* ***spectrum***. A spectrum is formed when white light passes through a prism. A rainbow is an example of a spectrum. Water droplets in the sky split up the sun's rays and form a spectrum, which is called a rainbow. The seven colours of the spectrum are Violet, Indigo, Blue, Green, Yellow, Orange, and Red (VIBGYOR).

## Let's Discuss

Discuss some common examples in your surroundings where dispersion of light can be observed.

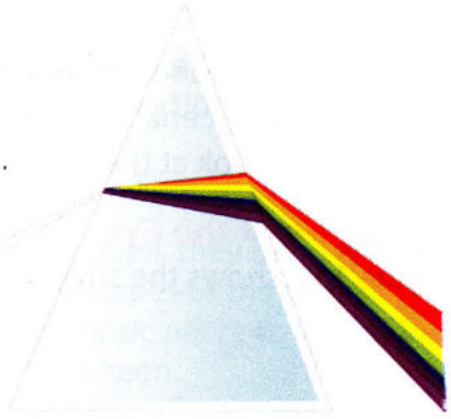


**Fig. 15.7** *Dispersion*

## Activity

**Aim:** To observe the spectrum

**Materials needed:** A plain (transparent, without designs) glass/plastic container/tumbler, a plane mirror with the edges filed (long enough for it to rest on the edge of the container at an angle of about 45°), and water

**Method:**

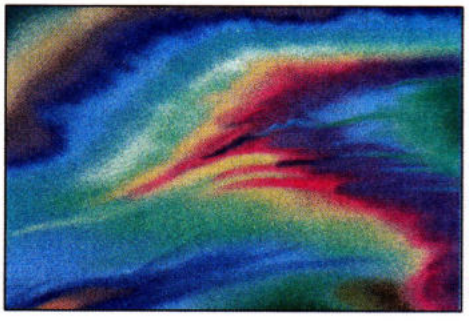
1. Fill the glass/plastic container with water (about three-fourths).
2. Dip the mirror, so that it rests at an angle (of about 45°) on the wall of the container.
3. Place this container, with the mirror facing the sun, near a window.
4. Adjust the direction of the mirror by moving the container so that it reflects the sunlight on the wall next to the window. Use a plain white sheet if the wall or wall colour is not convenient.

**Observation:** You will see a lovely spectrum (like an inverted rainbow) on the wall. Shift the container until you get a sharp spectrum.

**Note:** This activity is best done early in the morning or late in the evening, when the sun's rays are coming in at a large angle.

### COLOUR ON OIL FILMS

Have you observed thin oil films on water, generally present in puddles on the roadside? If you observe these oil films closely, you will see that they are coloured. This happens because both the top and bottom layers of the oil film reflect the incident white light. In some cases (i.e., for some colours) the waves of light reflected from the top and bottom surfaces of the oil film add up, in other cases they cancel each other. As a result, we see colours on a thin oil film.



## HUMAN EYE

Have you ever wondered how our eyes are able to see the beautiful world around us? What does it have that enables us to distinguish colours and see things from far away? Let us take a closer look at the structure of the eye.

### Structure of the Eye

Figure 15.8 shows the structure of the human eye.

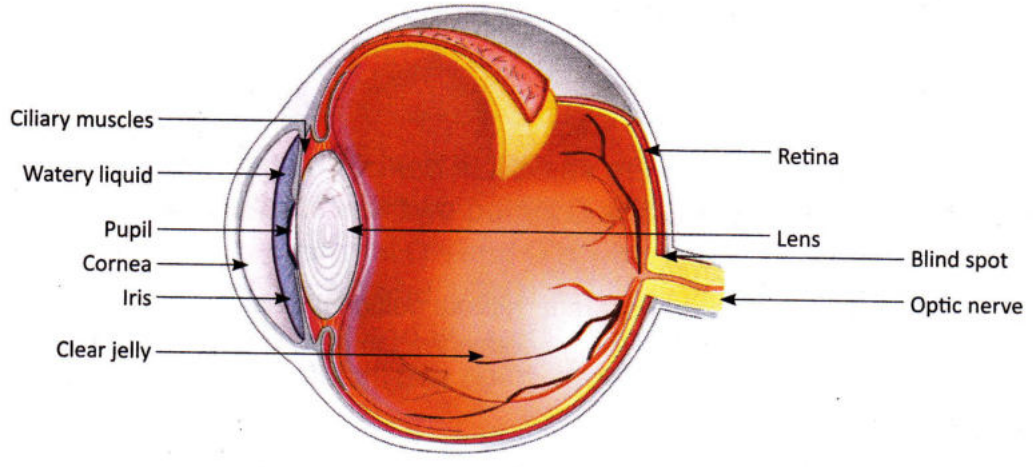



**Fig. 15.8** *Structure of a human eye*

On an average, the human eye is very small, about 2.5 cm in length. The eyelids act as the shutters of the eye and protect them from injury. Internally, the eye is made up of the following parts.

> **Fact File**
>
> The amount of pigmentation in the iris gives colour to the eyes. When the pigmentation is highest, the iris is brown in colour while the least pigmentation results in blue eyes.

***Pupil*** The inner aperture that we can see in the centre of the eye is known as the pupil. The pupil is like a hole through which light enters the eye.

***Iris*** It is the coloured part of the eye and is involved mainly in controlling the size of the pupil. The iris increases and decreases the size of the pupil to regulate the amount of light that enters through the pupil.

***Sclera*** The white part of the eye that we can see is known as the sclera. It is filled with a clear watery fluid.

***Cornea*** It is a thin transparent tissue that covers the front of the eye.

***Retina*** Just behind the eyeball is a lining called the retina. The retina is sensitive to light and has receptors called *rods* and *cones*. These rods and cones respond to light and generate impulses that can be read by the brain. The brain then sends back messages that tell us what we have seen.

***Ciliary muscles*** These control the focal length of the eye lens.

***Lens*** It is a transparent tissue between the pupil and the retina. The lens helps in focussing the light that passes through the pupil into the eye. This helps in focussing the image on the retina by bending the light rays.

***Optic nerve*** It connects the eye to the brain and carries impulses to and from the brain.

***Blind spot*** There is a portion on the retina where the nerve fibres enter the optic nerve. This portion does not have any rods and cones, and images falling on this portion of the retina cannot be 'seen'. This spot is called the blind spot.

## How we see

When light rays reach the lens of the eye after passing through the pupil, they bend and an inverted image is focussed on the retina (Fig. 15.9). The rods and cones of the retina convert the image into an electrical impulse, which is taken by the optic nerve to the brain. The brain interprets the impulse and we comprehend what we have seen.

## Persistence of Vision

The image produced in the human eye is retained for a very short period of time after the object (producing the image) is removed. This phenomenon is called *persistence of vision*. You have learnt about Newton's disc in Class 7. The disc appears white when it is rotated because the images of the different colours overlap in our eyes and the brain perceives it as white.

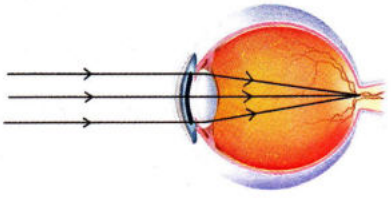


**Fig. 15.9** *Light rays entering the eye*

## Eye Defects and Correction

Here are some common defects of the eye.

***Cataract*** *is a condition of the eye when the eye lens becomes cloudy or opaque, especially as one gets older.* Cataract can be corrected. Many people with even an advanced condition of cataract get back clear vision with surgery and treatment.

For good vision, it is very important that a clear and sharp image is formed on the retina. Sometimes, due to a defect in the eye, the image is formed either in front of the retina or behind it. In either case, the eye will see it as a blurred image.

*If the image is formed in front of the retina, it results in an eye defect called* ***myopia*** *or* ***short sightedness***. A person suffering from myopia cannot see far-off objects very clearly. Wearing spectacles with concave lenses will correct the defect.

*If the image is formed behind the retina, it results in an eye defect called* ***hypermetropia*** *or* ***long sightedness***. A person suffering from hypermetropia cannot see nearby objects very clearly. Hypermetropia can be corrected by wearing spectacles with convex lenses.

## Technology for Coping with Visual Impairment

Till now, very limited resources had been available for people with sight problems, the most popular one being the traditional Braille. The *Braille system*, which enables them to read and write, uses patterns of raised dots to represent letters and numerals. With the advancement of technology, there is a marked improvement in the kind of material available for people with sight problems.

**Fact File**

Some people find it difficult to distinguish between certain colours and shades. This common eye disease is called colour blindness.

- Devices such as portable Braille typewriter, talking calculator, talking clock, audio dictionary, dictaphone, drawings that are raised, and audio measuring devices are very useful to visually impaired people.

- Computers equipped with software specially suited for visually impaired people are available today. These make accessing information available on the Internet much easier for them. Reading software such as Jaws and Kurzweil 3000 are also very useful.
- Special keyboards based on the Braille system, with characters embossed on them, are available. Special scanners and printers are also available today, which have made accessing information very easy for them.

## Know Your Scientist

Nicholas Saunderson (1682–1739) was a scientist and mathematician. He lost his sight when he was about one year old, but he did not let his blindness come in his way of achieving success. He learnt Greek, Latin, and Mathematics at a young age, and later became a teacher of Mathematics, Astronomy, and Optics at Cambridge. He could not see, but his sense of touch and hearing were very good, and he could do lengthy and complicated mathematical calculations in his head. You can imagine how difficult that can be!

## Fact File

**Louis Braille**

Louis Braille was born in 1809 in France. He was an educator and an inventor. Louis Braille injured his eyes and became blind at a very young age due to an unfortunate accident. He developed the **'Braille' system of writing consisting of raised dots** that can be read by the blind by running their fingers on the dots. Braille developed this system in 1824, when he was just 15 years old! Several devices are now available for Braille writing, including electronic embossing machines similar to electronic typewriters and computer driven Braille printers.

**Surdas**

Surdas was an Indian saint and composer who lived in the 15th and 16th centuries. He was born blind, and was not treated very well by his family and his neighbours. He left home at the age of six and went on to become one of the greatest poets and composers of India. Some of his famous works are Sur Sagar, Sur-Saravali, and the Sahitya-Lahiri. Tansen, the famous singer in Emperor Akbar's court is said to have sung some of Surdas' songs, which charmed Akbar. Surdas' songs are sung even today.

## Nutrition and Eye Health

Eye health has a very strong relationship with the food we eat. Eating a diet deficient in vitamin A over a period of time may result in a condition called night blindness. By consuming foods rich in vitamin A, such as carrots, broccoli, tomatoes, liver, egg yolk, and butter, this condition can be reversed. Our body needs oxygen for respiration. However, oxygen produces free radicals inside our body that can have a damaging effect on the retina of the eye. Many vitamins and minerals help in neutralizing these free radicals, and are, therefore, called *antioxidants*. Eating foods especially rich in vitamins A, C, and E can maintain a rich supply of antioxidants. Recent studies have indicated that antioxidants called 'carotenoids' present in coloured fruits and vegetables are very useful in maintaining eye health. Fresh fruits and vegetables can also help in preventing age-related degeneration of the macula (a part of the eye), thereby delaying age-related blindness.

It is very important to take very good care of your eyes. Here are a few suggestions:

- Get your eyes tested periodically.
- Do wear glasses if your doctor has prescribed them for you.
- Do not play with sharp objects. They can injure your eyes.
- Do not throw small hard pieces such as chalk pieces and pencils at each other.
- Do not play games such as cricket and basket ball with your glasses on.

## Let's Remember

REMEMBERING UNDERSTANDING

**I. Fill in the blanks with the correct words.**

1. The band of light that is produced when white light is split is called _____ (dispersion/spectrum).
2. The _____ (pupil/retina) is like a hole through which light enters the eye.
3. The _____ (iris/eye-lens) is the coloured part of the eye.
4. The eye defect 'short-sightedness' is also called _____ (cataract/myopia).
5. A person having the eye defect 'hypermetropia' cannot see _____ (nearby/far-off) objects very clearly.

**II. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Prism | a. optic nerve |
| 2. Blind spot | b. dispersion |
| 3. Cornea | c. cloudy/opaque eye-lens |
| 4. Eye-lens | d. front of the eye |
| 5. Cataract | e. focuses light |

## Key Words

| | |
|---|---|
| **Incident rays** | The rays of light that come from an object and hit the mirror are called incident rays. |
| **Reflected rays** | The rays of light that get reflected from the mirror are called reflected rays. |
| **Point of incidence** | The point at which the incident ray hits the mirror is called the point of incidence. |
| **Angle of incidence** | The angle between the incident ray and the normal is called the angle of incidence. |
| **Angle of reflection** | The angle between the reflected ray and the normal is called the angle of reflection. |
| **Regular reflection** | Reflection from a polished surface is called regular reflection. |
| **Diffused reflection** | Reflection from a rough surface is called diffused reflection. |
| **Dispersion** | The process of splitting up of white light into many colours is called dispersion. |

## Summary

- When a ray of light hits a mirror, or any polished surface, it bounces off the surface. This phenomenon is called reflection of light.
- The first law of reflection states that the incident ray, the reflected ray, and the normal at the point of incidence lie in the same plane.
- The second law of reflection states that the angle of incidence is equal to the angle of reflection.
- A plane mirror forms an upright (erect) image of the same size as the object.
- The image formed by a plane mirror undergoes left-right reversal (called lateral inversion) as compared to the object.
- We can see objects when the light from the object falls on the retina of our eyes.
- By placing two plane mirrors at an angle to each other, we can get many images of an object.
- The main parts of the human eye are pupil, iris, sclera, cornea, retina, lens, and optic nerve.
- Cataract, myopia, and hypermetropia are common eye problems.
- Proper nutrition is essential for maintaining eye health.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. The angle made by the normal with the reflecting surface is
   a. 0° b. 90° c. 180° d. 9°
2. The angle of incidence is the angle made by the incident ray with the
   a. reflected ray b. reflecting surface
   c. normal at the point of incidence d. incident ray
3. If the angle of incidence is 30°, then the angle of reflection will be
   a. 0° b. 45° c. 30° d. 90°
4. Which of these would produce a diffused reflection?
   a. A mirror b. A sheet of glass
   c. A new stainless- steel plate d. A rough wall
5. The minimum number of mirrors needed to see the back of your own head is
   a. one b. two c. three d. four
6. In a plane mirror, the image size is
   a. bigger than the size of the object b. smaller than the size of the object
   c. the same as the size of the object d. either bigger or smaller than the size of the object
7. The splitting up of white light into its many colours is called
   a. dispersion b. reflection c. spectrum d. refraction
8. The light-sensitive lining behind the eyeball is called
   a. sclera b. pupil c. retina d. lens
9. Light enters into the eye through the
   a. pupil b. ciliary muscles c. lens d. iris
10. The left-right reversal of an image formed by a plane mirror is called
    a. convergence b. lateral inversion c. inverted image d. diminished image

**B. Circle the odd one out.**

1. Moon, Stars, Earth, Trees
2. Spectrum, dispersion, colours, incident ray
3. Leaf, rough wall, mirror, skin
4. Cornea, long sightedness, short-sightedness, cataract

## II. Very short answer type questions

**A. Give one word/phrase for the following.**

1. Bodies that give out light of their own
2. The human eye retains an image produced for a short period of time.
3. An eye defect caused by cloudy or opaque eye-lens.
4. A system which involves a pattern of raised dots used by the visually impaired to read.

**B. Define the following.**

1. Diffused reflection
2. Multiple reflection
3. Lateral inversion
4. Dispersion

## III. Short answer type questions

1. Why can we not see an image in an old and worn-out stainless-steel plate?
2. What is a spectrum?
3. On which part of the eye does the image (from the eye-lens) form?
4. What kind of lens is used to correct myopia?
5. The deficiency of which vitamin can cause night blindness?

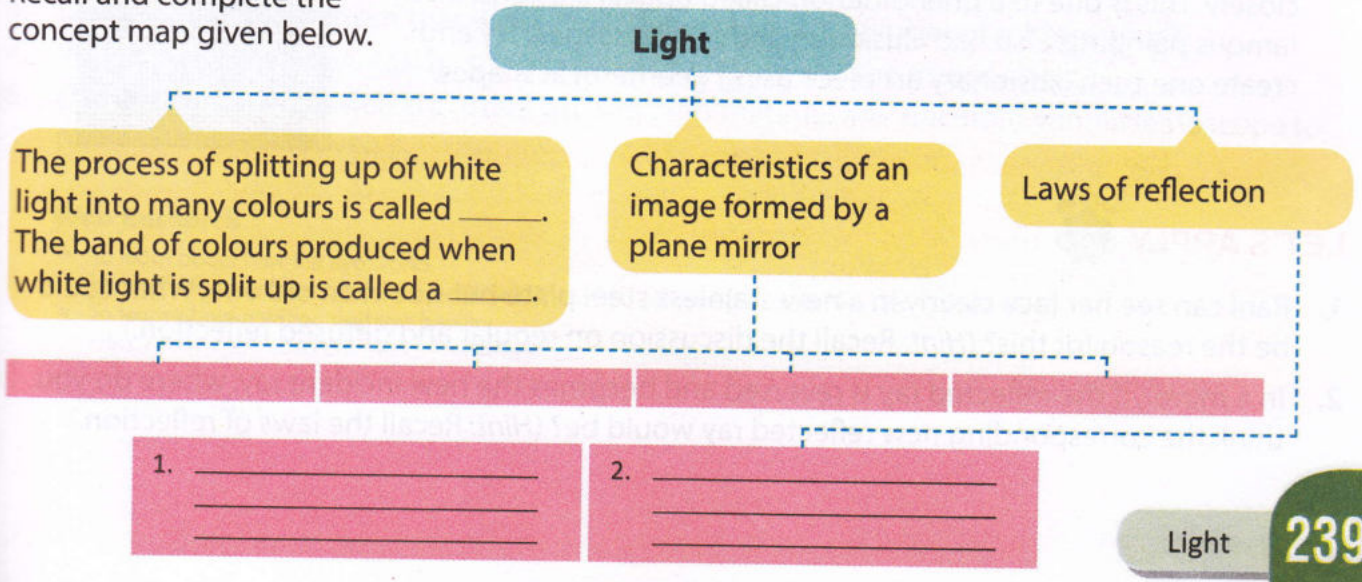
## IV. Long answer type questions

1. Give a brief explanation of how we 'see' things around us.
2. State the laws of reflection.
3. What are the characteristics of an image formed by a plane mirror?
4. With the help of simple diagrams, show how light is reflected from a rough surface and a smooth surface.
5. What is dispersion? Explain with the help of a simple diagram of a prism.
6. Write a short note on the following:
   a. Defects of the eye
   b. Alternative technology available to visually challenged people.
   c. Nutrition and eye health

## LET'S RECALL

REMEMBERING

Recall and complete the concept map given below.



Number of image formed with two mirrors when the angle between them is

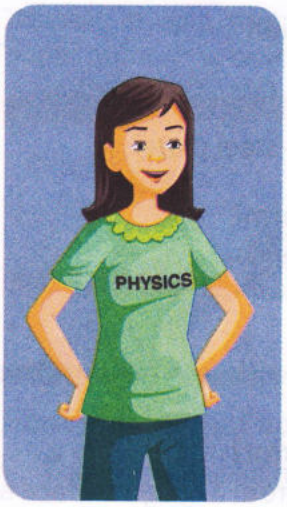
90°

0° (Parallel)

## LET'S OBSERVE

UNDERSTANDING LO 11

Sonia is standing in front of a plane mirror. What do you think is wrong in the second picture given below?




(a) Sonia


(b) Sonia standing in front of a plane mirror

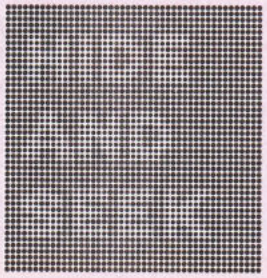
_____ _____ _____

_____ _____ _____

## LET'S CONNECT

ART

If you look at the picture, you will find a secret message hidden in the black dots. However they disappear when you look at them closely. This is due to a phenomenon called optical illusions. Many famous paintings also had illusionary hidden messages. Try and create one such illusionary art piece using geometrical shapes.



## LET'S APPLY

APPLYING

1. Rani can see her face clearly in a new stainless steel plate but not in an old one. What could be the reason for this? (*Hint:* Recall the discussion on regular and diffused reflection.)
2. In a mirror, if the reflected ray is reversed and becomes the new incident ray, where do you think the corresponding new reflected ray would be? (*Hint:* Recall the laws of reflection.)

## LET'S ANALYSE AND EVALUATE

1. Observe any five public areas in your surroundings (buildings, malls, public transport and out- door spaces) and analyse them to see if they are geared up to meet the special needs of the visually challenged. ANALYSING
2. Shibu is a fussy eater and he likes to eat only sweets and fried foods. He dislikes eating fruits and vegetables. In your evaluation, is this diet good for him? What should he eat to keep himself (especially his eyes) healthy? EVALUATING LO 7

## LET'S CREATE CREATING LO 10 LO 14

1. Make your own kaleidoscope.
   You will need a cylindrical cardboard tube (like the inside cardboard of a tissue paper roll), three rectangular pieces of mirror, which will fit into this tube in the form of an equilateral triangle (you could take the design to a hardware shop and ask for the mirrors to be cut. Please make sure the edges of the mirrors are filed so that you do not injure yourself), small coloured pieces of glass (from colourful glass bangles), half a sheet each of white paper and cellophane paper, adhesive tape, and a sheet of colourful gift-wrapping paper.
   **Method:**
   a. Fix the three mirrors in the form of an equilateral triangle.
   b. Cover one end of the tube with white paper. Fix it firmly with adhesive tape so that the mirrors will not fall down if the tube is held vertical.
   c. Put in the coloured glass pieces and cover the other end of the tube with cellophane paper.
   d. Cover the curved portion of the tube with gift-wrapping paper. Your kaleidoscope is ready.

   Look through the kaleidoscope to see beautiful patterns. It will help if you hold it against the light. The beautiful patterns that we see in a kaleidoscope are due to multiple reflections.
   ***Note:*** Adult supervision required.

**Questions:**

1. What is the principle used in making a kaleidoscope?
2. How many mirrors do you think we can use in the design?
3. Do you think the pattern that we see will depend on the number of mirrors used?
4. Which other materials can be used instead of glass to get the mirror effect?
5. Use colour paper, glitter, and other art and craft material and decorate your kaleidoscope to make it look attractive.

**Web Research**

- To learn about how the eye works
  https://www.youtube.com/watch?v=YcedXDN6a88 (accessed and checked on 12/08/2019)
- To learn about nutrition and eye health
  https://www.youtube.com/watch?v=ifArpERZpdI (accessed and checked on 12/08/2019)

# 16 Stars and the Solar System

The night sky is full of interesting objects. These objects are usually the moon, stars, and planets.

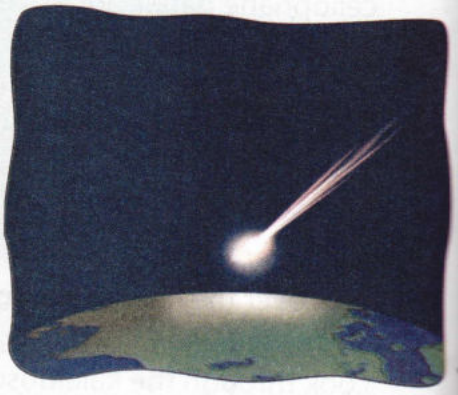
Here are pictures of a few objects that you will see in the night sky. Do you know what they are? Write down in the space provided.

**You will learn about**

- The night sky
- Stars
- Constellations
- Solar system
- Satellites

1. _____

2. _____



3. _____

4. _____

5. _____

Answers: 1. Moon, 2. Stars, 3. A meteor, 4. galaxy, 5. Orion

## THE NIGHT SKY

If you pause to observe the night sky, you will see absolutely amazing, wonderful, and beautiful things. People have been gazing at the night sky for thousands of years. Remember that the sky in earlier times must have been clearer with much less pollution and fewer lights than in an average city of today, and they must have been able to see many more stars far more clearly. After centuries of study by many generations of scientists, we have accumulated a little bit of knowledge about our universe. We say 'little bit of knowledge', because the universe is so vast, and its mysteries are so deep, that what we know is an insignificant fraction of what is out there. *The branch of science that deals with the study of the universe is called* ***astronomy***. It is a fascinating and exciting subject to study, and we will learn a few basics in this chapter.

### Activity

**Aim:** To view the wonderful and mysterious objects in the night sky
**Materials needed:** A mat, a place where you can get a clear view of the sky such as a terrace or a courtyard, and the help of a responsible adult
**Method:** Choose a time and place where you can get a clear view of the night sky, away from glaring lights. Open the mat at a clean spot and lie on your back, facing the sky. Look at the night sky. It will take at least 20 minutes for your eyes to get adjusted to the darkness, and to be able to see objects in the night sky clearly. Enjoy the beauty of the sky! Make a note of all that you see.
**Observation:** You will see bright specks—some single, and some in clusters. Make a note of the patterns made by them. Also, note their positions in the sky; are they to the east or west, north, or south? Note down all your observations, go away, and come back after an hour or two and see and note where the specks are positioned now.

The brightest, and also the biggest natural object that we see in the night sky is the Moon. Other objects that we see are much, much smaller, merely specks. Sometimes, we may see a slowly moving dot of light, which would most likely be a high-flying plane. Sometimes, you may even see an artificial satellite. If the night is dark enough and the air is clear, you may see a fast- moving streak of light. This would be a meteor. You will see several specks of light in the night sky. Look at them steadily for some time. You will see that some seem to flicker or twinkle. These are stars. The specks that do not twinkle are planets.

## STARS

Stars are luminous bodies, which means they give out light of their own. We see them as points of light in the night sky. Our sun is a star too. Many of the stars that we see are much bigger than the sun. Since they are very far away from us, the light reaching us from them

is very faint. This faint light appears to twinkle due to atmospheric disturbances.

**Fact File**

The Milky Way galaxy, to which our sun belongs, has a diameter of about 100,000 light years.

The distances of objects in the universe are so large that we need a very large unit of distance to represent them. One such unit is the light year. The stars that we see with the naked eye are thousands of light years away from us. *A **light year** is the distance travelled by light in one year.* It is an enormously large distance. Light year is commonly used as a unit in astronomy as the distances involved are extremely large.

One light year = (speed of light) × (number of seconds in a year)

= $(3 \times 10^8$ m/s) × (365 x 24 × 60 × 60 s)

= $9.46 \times 10^{15}$ m, or $9.46 \times 10^{12}$ km

The star that is closest to us (other than the sun) is Proxima Centauri, which is about 4.22 light years away. This means that the light from this star takes 4.22 years to reach us! If you look up at the night sky in a place far away from the pollution and lights of the city, you will see a broad band of light. This band is formed by millions of faint stars that belong to the Milky Way galaxy, named so because it looks like a trail of milk spilt across the sky. Our solar system belongs to the Milky Way galaxy.

*Stars, planets, moons, and various other bodies in space are collectively called **celestial bodies**.*

**Fact File**

**Why do we see stars only in the night?** Stars are very far away and the light coming from them is very faint. Therefore, even though there are stars in the sky during daytime, the bright glare from the Sun prevents us from seeing them.

The stars, like the sun, appear to move from east to west. This is due to the Earth's rotation. However, there is one star that appears almost stationary to us. This is the Pole star (also called 'Dhruv tara' or Polaris), named so because it is in the direction of the North Pole.

All the stars appear to rotate about a point very close to the Pole star, which appears to be almost stationary. The angle of the Pole star above the horizon gives us our latitude on Earth.

## CONSTELLATIONS

AN

**Get it Right**

The stars of a particular constellation are not necessarily close to one another. They appear to be close from our point of view, i.e., from the Earth.

Certain groups of stars often seem to form a recognizable pattern in the night sky. These are called *constellations*. These were named by ancient people after animals and mythological characters. There are as many as 88 constellations. You can easily identify some constellations even with the naked eye. Some well-known constellations are Ursa Major, Ursa Minor, Cassiopeia, and Orion.

***Ursa Major*** It is also called the Great Bear. One part of the Ursa Major consisting of seven stars is fairly easy to spot in the night sky. This group of stars is called the *Big Dipper* or 'Vrihat Saptarshi' [Fig. 16.1(a)]. If we join these seven stars with imaginary lines, the figure obtained looks like a big ladle. If an imaginary line joins the two stars at the edge of the ladle, it will point to the Pole star (Polaris) [see Fig. 16.1(a)].

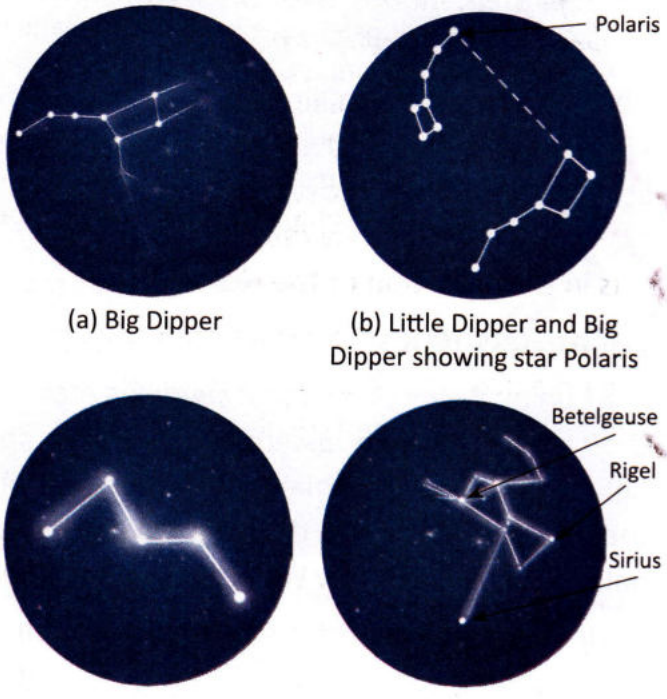
***Ursa Minor*** It is also called the Lesser Bear. One part of this constellation comprising a group of seven stars is called the *Little Dipper* or 'Laghu Saptarshi' [see Fig. 16.1(b)]. The famous star Polaris (North star) is in this constellation. This constellation is faint and difficult to spot.

Sometimes, within a constellation a small number of stars may form a recognizable pattern, like a separate entity. This is called an *asterism*. Common examples of asterism are the Big Dipper in the constellation Ursa Major and Little Dipper in the constellation Ursa Minor [Fig. 16.1(b)].

***Cassiopeia*** This constellation is visible from the Northern Hemisphere. A few bright stars of the constellation make it look like an 'M' or a 'W' [Fig. 16.1(c)]. The interesting thing about Cassiopeia is that the constellation contains several star clusters, one of which contains hundreds of stars. It also contains two planetary nebulae (clouds of gas).

***Orion*** This is one of the most prominent and easily identifiable constellations in the night sky [Fig. 16.1(d)]. As you can see in the figure, if we join the stars of the constellation with imaginary lines, the resulting figure looks like a hunter with a bow. Prominent stars of this constellation are Betelgeuse and Rigel. Betelgeuse, also called Alpha Ori, is one of the 20 brightest stars in the sky and one of the biggest stars known to us. Rigel, which is the brightest star in the Orion constellation, is one of the ten brightest star in the sky.

The brightest star in the night sky, *Sirius*, is very easy to locate with the help of the constellation Orion. To locate Sirius, look at the three stars at the 'waist' of the hunter (i.e., Orion constellation) and move your eyes to the left, along the line of the three stars. You will see a very bright star. This is Sirius [Fig. 16.1(d)].




(a) Big Dipper

(b) Little Dipper and Big Dipper showing star Polaris

(c) Cassiopeia

(d) Orion with some prominent stars such as Betelgeuse, Rigel, and Sirius

**Fig. 16.1** *Diagrammatic representation of some well-known constellations*

## Galaxies

Many millions of stars cluster together due to their mutual gravitational pull, to form galaxies. Galaxies are very, very big. An average medium-sized galaxy would be hundreds of thousands of light years across. Our Milky Way galaxy is more than a hundred thousand light years in diameter. This means light would take more than a hundred thousand years to travel from one edge of the galaxy to the opposite edge! As mentioned, galaxies also contain a very large number of stars. Scientists' estimate that our Sun is one of the 200 billion (that is 200 followed by 9 zeros) stars of the Milky Way galaxy! We should remember that these figures are estimates, because nobody can count that many stars or measure such large distances with any accuracy.

## Let's Remember

REMEMBERING UNDERSTANDING

**I Answer the following questions orally.**

1. Name the brightest object in the night sky.
2. Which galaxy do we belong to?
3. Name two constellations.
4. Which has more stars, a constellation or a galaxy?
5. In which constellation is the star Polaris (North Star)?

**II. Circle the odd one out.**

1. Proxima Centauri, Sun, Earth, Polaris
2. Milky Way, Orion, Cassiopeia, Ursa Major
3. Rigel, Betelgeuse, Virat Saptarishi,
4. Big Dipper, Laghu Saptarishi, Little Dipper, Ursa Major

## SOLAR SYSTEM

The sun and everything that revolves around it form the solar system. The planets and their moons, comets, asteroids, and other space objects orbit the sun. All these objects are held together in the solar system because of the sun's gravitational pull. It is believed that the sun, the Earth, and the other planets of the solar system were formed at the edge of a galaxy called the Milky Way galaxy about 5000 million years ago.

In view of many recent discoveries, and our changing understanding of planetary systems, scientists have felt it necessary to create a new definition for planets and other bodies in the solar system. The objects of the solar system (except satellites) are placed in three distinct categories: planets, dwarf planets, and small solar-system bodies.

**Fact File**

Betelgeuse, a star in the constellation Orion, is 425 light years away and 60,000 times brighter than the sun.

According to the new definition, there are eight planets in the solar system (Fig. 16.2). In the order of their increasing distance from the sun, they are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Pluto and Ceres are placed under the category of dwarf planets. More dwarf planets may be included under this category in the future. Asteroids, comets, and other small bodies are placed under the category of small solar-system bodies.

**Fact File**

Pluto used to be classified as the ninth planet of the Solar System till the year 2006. It was then removed from the list of planets and classified as a dwarf planet.

## Sun

The sun is a medium-sized star. It is a huge ball of gases, mainly composed of hydrogen. There is a massive nuclear reaction taking place in the sun, converting the hydrogen gas into helium gas. This reaction gives out huge amounts of light, heat, and other forms of energy. The diameter of the sun is about 1.4 million kilometres. It is so big that it could hold more than a million planets of the size of the Earth! There are much bigger stars than the sun in the universe. One of the biggest stars that we know of is Betelgeuse.

## Planets

In early times, people studied the night sky by observing the objects with the naked eye and then through telescopes. In the night sky, planets appear as bright specks of light, much like stars. They do not twinkle. While the stars show no visible change in their position in the sky, the planets seem to move or 'wander' with respect to the stars. Hence, they were named planets, which means 'wanderers' in Greek.

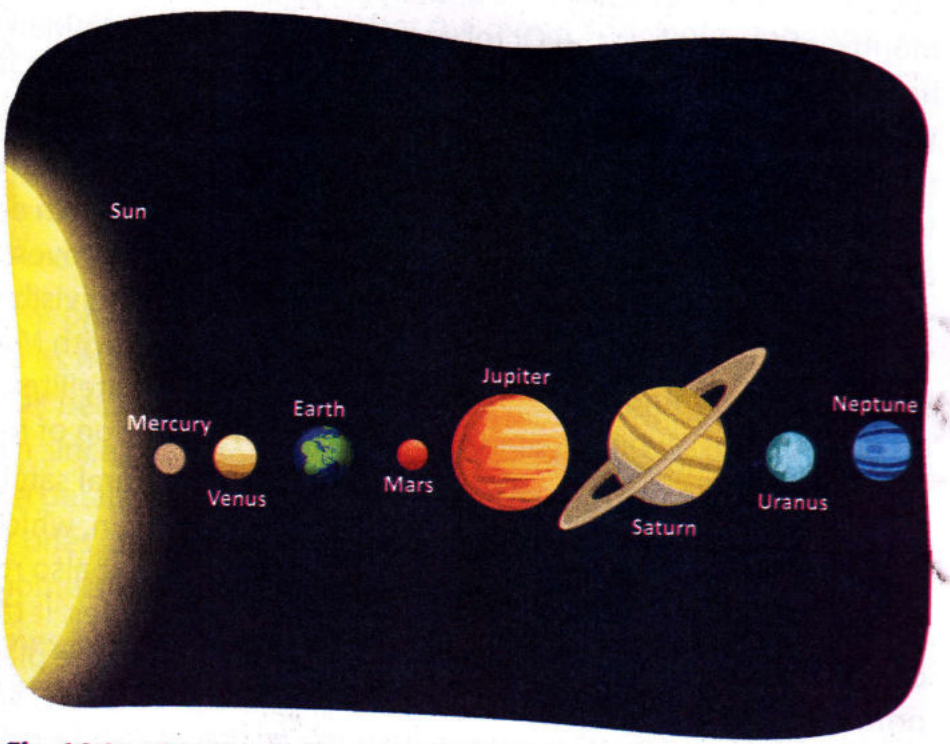



**Fig. 16.2** *Diagrammatic representation of solar system (not to scale)*

Unlike stars, planets do not emit light of their own. They appear bright like stars in the night sky because they reflect light from the sun (like the moon does). They are also closer to us than the stars and, therefore, the light coming to us from the planets is brighter and they appear larger (i.e., they are generally bigger blobs of light). Hence, planets do not appear to twinkle.

Mercury, Venus, Mars, Jupiter, and Saturn are quite bright and can be seen with the naked

eye. The other planets, namely Uranus and Neptune, are very faint and can be seen only with a telescope. Uranus can sometimes be seen with the naked eye. Mercury, Venus, Earth, and Mars are called the *inner planets* because they are much closer to the sun as compared to Jupiter, Saturn, Uranus, and Neptune, which are called the *outer planets*. A few differences between the inner planets and the outer planets are given in Table 16.1.

**Table 16.1** Differences between inner planets and outer planets

| Inner planets | Outer planets |
|---|---|
| 1. They are closer to the sun as compared to the outer planets. | 1. They are much farther away from the sun as compared to the inner planets. |
| 2. They are smaller in size. | 2. They are very large in size. |
| 3. They are very dense, mostly made of rock. | 3. They are very light and are made up mostly of gases. |

Let us now learn about each of these planets.

***Mercury*** This planet is not always visible to us as it is very close to the sun and is generally hidden in the sun's glare. However, it can be seen as a bright spot of light during sunrise and sunset at a particular time of the year. Mercury can be seen just before sunrise in the months of September and October and just after sunset in March and April. Mercury has no satellites. It is the smallest planet in our solar system.

***Venus*** This planet is the brightest object in the night sky after the moon. Since it is close to the sun, like Mercury, Venus too can be seen just before sunrise and just after sunset. Venus rotates very slowly on its axis. In fact, it takes 243 Earth days to rotate once on its axis, while it orbits the sun in 225 Earth days! When Venus overtakes the Earth around the sun, it switches from being visible before sunrise to being visible after sunset or vice versa. Venus is, thus, commonly referred to (sometimes along with Mercury) as both the **morning star** and the **evening star**. Venus, like Mercury, has no satellites. It rotates from east to west (as does Uranus), which is opposite to the Earth's direction of rotation (west to east).

***Earth*** This is the planet that we live on. It has one natural satellite, the moon. The Earth takes 365.256 days to complete one orbit around the sun, which is one Earth year. We know that the Earth revolves around the sun, and that it also rotates about an axis, an imaginary line passing through the North and South poles. It takes 24 hours to complete one rotation. The axis of rotation of the Earth is tilted to the plane of its orbit. This is primarily responsible for the changes in season on the Earth. A thin layer of gases called the atmosphere en[illegible]lops the Earth. Ninety nine per cent of the Earth's atmosphere is made [illegible]ygen, and the remaining 1% contains other gases such as argon, [illegible]ater vapour.

boo[illegible]ear
(except [illegible]winkle.
planets, dw[illegible]e naked

**[illegible]he playground, so that you have enough space to move around.**
[illegible]e of furniture to be the sun.

2. Children who act out the planets should be selected carefully. The shortest ones in the class should be selected for Pluto and Ceres (the dwarf planets) and Mercury; and the tallest children for the giant planets such as Jupiter, Saturn, Uranus, and Neptune.
3. The 'planets' Mercury, Venus, Earth, and Mars should be very close to the 'sun'. Leave a considerable distance and then start the rest of the planets (starting with Jupiter). 'Pluto' should be really very far from the 'sun'.
4. Next, make the orbit of Pluto very highly elliptical (oval) and that of Neptune almost circular, so that for a short period of their orbit around the Sun, Neptune is closer to the sun than Pluto.
5. You can put in more and more information about the planets and the solar system in this fashion. For example, Uranus spins on its side.

***Mars*** This planet is visible to the naked eye. It looks like a bright orange-red star. Mars has two satellites—Phobos and Deimos. Both are dark, dusty, and irregular in shape. The Martian soil contains large amounts of iron oxide, which gives the planet a reddish look. Space probes have photographed deep channels on the surface of Mars, which suggest that water once flowed there in the distant past. The radius of Mars is a little more than half that of Earth. Its mass is about ten times lesser than the mass of Earth.

***Jupiter*** It is the largest planet in the solar system. After the moon and Venus, Jupiter is the brightest object in the night sky.

Jupiter can be easily seen with the naked eye. It looks like a bright star. With a good telescope, we can see its tinted cloud bands and the famous Great Red Spot, which is a great hurricane on Jupiter, twice the diameter of the Earth. Jupiter has many moons, four of which are Io, Europa, Ganymede, and Callisto.

***Saturn*** It is the second-largest planet in the solar system after Jupiter. The radius of Saturn is close to that of Jupiter, and its mass is about one-third the mass of Jupiter. Saturn is often called the 'Ringed Planet' because it is surrounded by distinctive rings of dust and rocks. Saturn has been known since prehistoric times. However, early astronomers could not see Saturn's rings in much detail. Saturn has 25 satellites that measure at least 10 km in diameter and several smaller ones. Saturn's biggest satellite, Titan, is even bigger than the planet Mercury. Some astronomers think that it may be able to support life.

***Uranus*** Uranus can sometimes be seen with the naked eye, but not very easily. Like Saturn and Jupiter, Uranus too has rings. Uranus is about $2.9 \times 10^9$ km away from the sun. It has five known satellites. The atmosphere of Uranus consists mainly of hydrogen, helium, and methane. Unlike any other planet in the solar system, Uranus spins on its side. Astronomers think that this is the result of a collision with a planet-sized object millions of years ago.

***Neptune*** Neptune cannot be seen with the naked eye. It looks like a star through a pair of binoculars and like a small bluish circle through a powerful telescope. Neptune has two known satellites.

***Pluto (a dwarf planet)*** Pluto is so far away that it is very difficult to see it from the Earth. Pluto has an oval-shaped orbit, which takes it 249 years to go once around the sun. For about 20 years of its orbit, it is closer to the sun than the planet Neptune.

## SMALL SOLAR-SYSTEM BODIES

These include asteroids, comets, and other small bodies.

***Asteroids*** These are large pieces of rocks or metals (Fig. 16.3). Most asteroids are found orbiting the sun between Mars and Jupiter. This region is called the Asteroid Belt. Astronomers have so far recorded the orbits of over 4000 asteroids. There are thousands more! Some scientists believe that asteroids were formed when our solar system was formed 5000 million years ago, while others believe that these are the remains of a planet that was broken up by a massive collision.

**Fig. 16.3** *An asteroid*

***Comets*** These are small chunks of ice and dust that revolve around the sun (Fig. 16.4). They have oval orbits and spend most of their time far away from the sun. Comets are characterized by a small solid part (called the *head*) surrounded by a cloud of glowing gases (called the *coma*) (Fig. 16.5). As the comet approaches the sun, the coma stretches out into a long tail of over 1 million kilometres. Comets can be seen from the Earth when they come close to the sun. Since comets have very large orbits, they take a very long time to return, from a few decades to a few thousand years (Fig. 16.6), One of the best-known comets is the Halley's Comet. It is named after Edmund Halley, who calculated its orbit. Halley's Comet comes close to the sun once every 76 years.

**Fig. 16.4** *A comet*

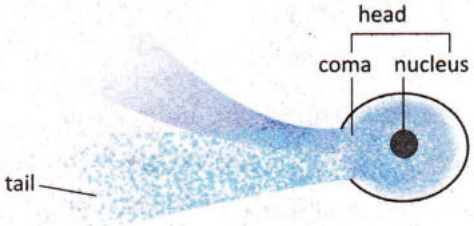



**Fig. 16.5** *Structure of a comet*

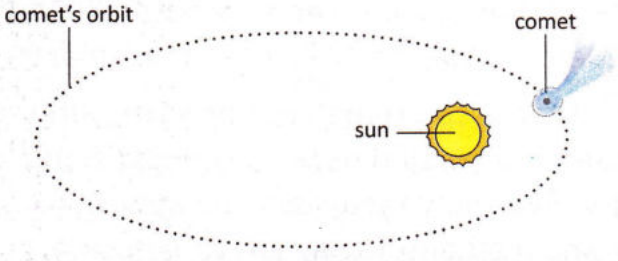



**Fig. 16.6** *Orbit of a comet around the sun*

***Meteoroids, meteors, and meteorites*** Meteoroids are smaller than comets. They are mainly chunks of rock. They may be fragments of comets or shattered asteroids. When the Earth's orbit crosses the path of a meteoroid, it falls through the Earth's atmosphere. As it falls through the Earth's atmosphere, it burns up as a result of the enormous heat generated. This makes a streak of light, which is called a *meteor* or a shooting star. On a clear night, we can

see many meteors in an hour. Most of the meteoroids fully burn up before they reach the lower atmosphere. However, sometimes, a meteoroid does not fully burn up and it hits the Earth's surface as a solid piece. This is called a *meteorite*. A meteorite can cause a crater on the Earth's surface (Fig. 16.7).

**Fig. 16.7** *Meteorite crater in Arizona, USA.*

## SATELLITES

*A relatively small celestial body that revolves around a planet is called a satellite.* Satellites may be natural or artificial. The moon is a natural satellite of the Earth, while man-made objects sent into space for various scientific explorations are the artificial satellites of Earth.

### Moon

The moon is about one-fourth the size of the Earth. The surface of the moon has many craters, which were made by meteorites hitting it. There are many dark patches on the moon's surface. From Earth these look like seas.

As you learnt in the chapter 15 (Light), the moon is not a luminous object. That is, it does not emit any light of its own. It only reflects the sunlight falling on it (Fig. 16.8). When we look at the moon, we don't always see a full round moon. Its shape seems to change from one night to the next. This is because the lit portion of the moon that we see from the Earth differs as it goes around the Earth. *The different 'shapes' of the moon are called the* ***phases of the moon***. The different phases of the moon have been given names.

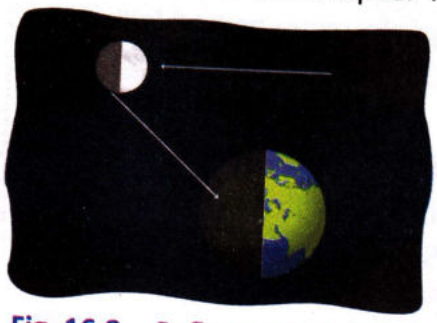


**Fig. 16.8** *Reflected light from the moon reaches the Earth*

**Fact File**

India launched its first moon mission on 22 October 2008. The unmanned spacecraft Chandrayaan–1 was launched from Andhra Pradesh. Its mission was to explore the surface of the moon. The second moon mission, Chandrayaan-2 was launched recently from Sriharikota on 22 July 2019.

### Lunar Calendar

Many cultures follow the Lunar Calendar, which is based on the phases (and hence the position) of the moon. A Lunar Month is the time between two new moons (or two full moons), which is approximately 29.5 days. Ancient Indians followed a calendar based on the movements of the moon as well as the sun. This is followed to this day, which is why the dates of many Indian festivals vary from year to year compared to the Gregorian calendar, which is the commonly used calendar internationally.

Let us begin with the *new moon*.

At new moon, the moon is between the Earth and the sun, and we do not see any light from the moon. After a few days, a small portion of the moon becomes visible to us. This

is called the *crescent moon*. Then, the lit side of the moon becomes bigger every night and when half the moon can be seen (like a semicircle), it is called *first quarter*. The lit portion of the moon keeps increasing even further till it becomes a full moon. At *full moon*, the full lit portion of the moon is visible to us, and the moon looks like a complete circle. After the full moon, the lit portion of the moon (as seen by us) reduces steadily till we reach new moon, and the cycle begins all over again (Fig. 16.9).

**Fig. 16.9** *Phases of the moon*

## Activity

**Aim:** To draw the shape of the lit portion of the Moon and study how it varies from day to day
**Materials needed:** A sketch book, a sharp pencil, an eraser
**Method:**
Look at the moon every night and draw its lit portion as you see it. Make sure to put the date for each day's drawing. See how the shape changes. Study the shape and write down the dates for 'crescent moon', 'first quarter', full moon' etc. Do this for about 29 consecutive days.
**Observation:** The shape of the lit portion of the moon changes through the days.

## Artificial Satellites and Other Man-made Bodies in the Solar System

Man has sent many satellites into space. These are called artificial satellites (Fig. 16.10). The first artificial satellite Sputnik-1 was sent by the former USSR on October 4, 1957. India sent the first satellite *Aryabhata*, into space on March 19, 1975. Satellites are used for many purposes, including conducting scientific experiments; studying stars, galaxies, and other celestial objects; weather forecasting GPS (Global Positioning System); telecommunication and television broadcasting; navigation of ships and aeroplanes; mapping natural resources such as minerals and forests; and for defence purposes.

**Let's Discuss**

Why do we see phases of the moon and not the sun?

### Satellites of India

India's space program interestingly started in a church in a small fishing village in Kerala. The church donated space to ISRO (Indian Space Research Organization) and it was in this church that the first rocket systems were assembled way back in 1962.

Today, India has 76 satellites, starting from Aryabhatta in April 1975 to GSAT-16 in December 2014. Aryabhatta was built by in India by ISRO but was launched by a

Russian rocket. In 1980, ISRO launched a satellite called Rohini with the help of a rocket built indigenously. Today we offer satellite launching facilities on commercial terms.

Our Earth is unique! It is the only place we know where life exists. The composition of its atmosphere and soil, its size, distance from the sun, and the presence of large amounts of water in liquid form on its surface make it different from any other planet of our solar system.

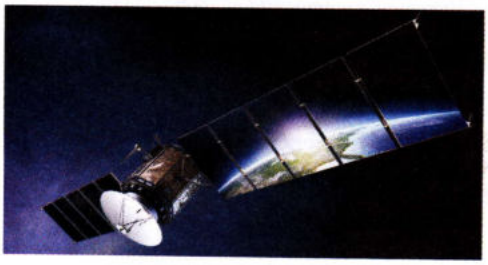


**Fig. 16.10** *Artificial satellite*

Another class of man-made bodies in the solar system are probes. These are used for the exploration of objects of the solar system, such as planets, comets and asteroids.

### Fact File

On 5th June 2017, the Indian Space Research Organisation (ISRO) launched India's heaviest rocket, Geosynchronous Satellite Launch Vehicle- Mark III (GSLV-Mk III) along with a communications satellite. The rocket weighed 640 tonnes and the communications satellite GSAT-19 weighed 3136 kg.

## Key Words

| | |
|---|---|
| **Light year** | The distance travelled by light in one year is called a light year. |
| **Celestial bodies** | Stars, planets, moons, and various other bodies in space are collectively called celestial bodies. |
| **Satellite** | A relatively small body that revolves around a bigger body like a planet is called a satellite. |

## Summary

- Stars are luminous bodies that are regularly seen as points of light in the night sky.
- Certain groups of stars seem to form a recognizable pattern in the sky. These are called constellations.
- Some well-known constellations are Ursa Major, Ursa Minor, Cassiopeia, and Orion.
- Sometimes, within a constellation, a small number of stars may form a recognizable pattern, like a separate entity (e.g., the Big Dipper). This is called an asterism.
- The objects in the solar system (except satellites) are placed into three categories: planets, dwarf planets, and small solar-system bodies.
- Mercury, Venus, Earth, and Mars are called inner planets because they are much closer to the sun as compared to Jupiter, Saturn, Uranus, and Neptune, which are called outer planets.
- Small solar-system bodies include asteroids, comets, and other small bodies.
- The moon is the Earth's only natural satellite.
- Phases of the moon are new moon, crescent moon, first quarter (half moon), and full moon.
- Satellites sent into space by man are called artificial satellites.

# Exercises

## LET'S UNDERSTAND

QT

### I Objective type questions

**A Choose the correct option.**

1. Which of these is not a star?
   a. Dhruv b. Orion c. Sirius d. Rigel
2. Which of these stars is closest to the Earth?
   a. Alpha Centauri b. Alpha Ori c. The Sun d. The Moon
3. Which of these is a dwarf planet?
   a. Pluto b. Mercury c. Venus d. Titan
4. Which of these is a natural satellite?
   a. Aryabhata b. The Moon c. Mercury d. Pluto
5. A comet falls under which of these categories?
   a. A planet b. A satellite
   c. A small solar system body d. An asteroid
6. Light year is a measure of
   a. very large timescales b. very large distances
   c. very small timescales d. very small distances
7. From the Earth, all stars appear to rotate about a point very close to the
   a. moon b. pole star
   c. Orion constellation d. Sun
8. 'Crescent' and 'first quarter' are
   a. phases of the moon b. satellites of Mars
   c. stars of the Milky way d. constellations in the night sky
9. 'Coma', 'head' and 'tail' are parts of a
   a. asteroid b. comet c. star d. planet
10. Weather forecasting, television broadcasting and mapping of natural resources are some functions that can be performed by a/an
    a. natural satellite b. artificial satellite c. planet d. meteor

**B. Fill in the blanks with the correct words.**

1. The Sun is a _____ (planet/star).
2. There are about _____(88/1000) constellations.
3. _____ (Ursa Minor/Little Dipper) is a constellation.
4. _____ (Titan/Uranus) is a planet.
5. _____ (Mercury/Jupiter) is an inner planet.

### II. Very short answer type questions

**A. Give one example for the following.**

1. A galaxy _____
2. A solar system body that is not the Sun or a planet _____

3. A comet
4. A natural satellite
5. An artificial satellite
6. A planet without a natural satellite
7. A star bigger than the Sun
8. A constellation
9. A very light planet made up mostly of gases
10. An asterism



## III Short answer type questions

1. What is a constellation?
2. Name a star in the Orion constellation.
3. Name the Earth's natural satellite.
4. Where is the Asteroid Belt?
5. Which celestial body has a head and a long tail?

## IV Long answer type questions

1. Describe the objects that one could see in the night sky.
2. Draw a rough diagram and give a short description of any one constellation.
3. Name the planets of the Solar System. List them in the order of their distance from the Sun. Also, name the smallest and biggest planet of our Solar System.
4. Distinguish between meteoroids, meteors, and meteorites.
5. What are 'Phases of the Moon'? Draw a rough diagram of any two phases and name them.
6. List five uses of artificial satellites.

## LET'S RECALL

REMEMBERING

Recall and complete the concept map given below.

**Stars and the solar system**

_____ :
Groups of stars forming a pattern in the sky.
Examples:
1.
2.
3.

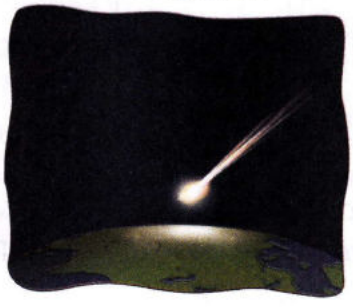
Objects of the solar system:
1. _____
2. Planets
   Examples : _____
   _____
3. Small solar-system bodies
   (a) _____, (b) _____,
   (c) _____
   _____
4. Artificial satellites
   Examples : _____
   _____

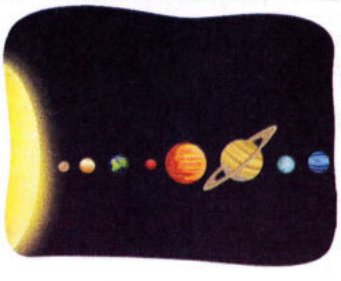
## LET'S OBSERVE

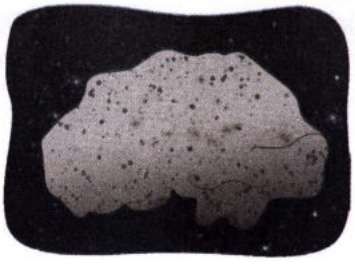
UNDERSTANDING LO 9

1. Name the constellation shown below. Draw the constellation Orion. Label the stars Betelgeuse and Rigel in your diagram.

2. Use these words to fill in the blanks in each of the pictures given below. Asteroid, solar system, comet, stars, galaxy and shooting star.







## LET'S CONNECT

BIOLOGY

There are many factors responsible for the existence of life on Earth, like the presence of water, oxygen in the atmosphere, the right temperature, etc. The presence of a magnetic field around the Earth (the Earth's magnetic field) is also a very important factor for life on Earth. The Sun gives out fast-moving charged particles, called 'solar wind'. Lifeforms cannot survive being exposed to solar wind. The Earth's magnetic field traps these fast-moving particles and acts as a protective shield for all the living creatures below, on the surface of the Earth.

Find out which planets of the Solar System have a magnetic field and which do not.

## LET'S APPLY

APPLYING

1. Captain Zenon's spacecraft is passing though the region between Jupiter and Saturn. Suddenly, the entire spacecraft shakes. 'What was that?,' asks one of the crew members. 'We are passing through the Asteroid Belt. One of the asteroids must have hit us!,' says Captain Zenon. What is wrong in this story? (*Hint*: Recall the discussion on asteroids.) LO 4

2. A meteor makes a streak of light, when it falls to the Earth. Do you think it would look the same when falling on the moon? (*Hint*: Why does meteor burn when it falls through the Earth's atmosphere?) LO 5

## LET'S ANALYSE AND EVALUATE

1. Analyse the importance of artificial satellites for a country like ours. Give two reasons how we can justify the expense of launching and maintaining artificial satellites. ANALYSING
2. Find out the diameters of the planets of the solar system and arrange them in ascending order of size. EVALUATING LO 12

## LET'S CREATE CREATING LO 12

During the design and execution of the many space programs over the past several decades, scientist and engineers have come up with a variety of solutions, such as super-lightweight materials, materials that can withstand very high temperatures and radiation in outer space, recycling water for astronauts spending long periods of time in space, and developing easy to carry compact food items so that they get a balanced diet. Many scientific experiments have also been carried out in space. Many of these advancements in technology have been made available to us. Spend some time in your library and on the internet to list at least ten such applications and find out how these are helping us. Make a presentation of your findings in the form of a chart (with pictures and drawings) or an eye-catching power point presentation.

1. How have satellites helped mankind?
2. Why was the launch of a simple satellite like Sputnik I an considered enormous step for mankind?
3. Why do artificial satellites usually have "rocket thrusters"?
4. Why do scientists need habitable artificial satellites?
5. Analyse the importance of each part of an artificial satellite.

**Web Research**

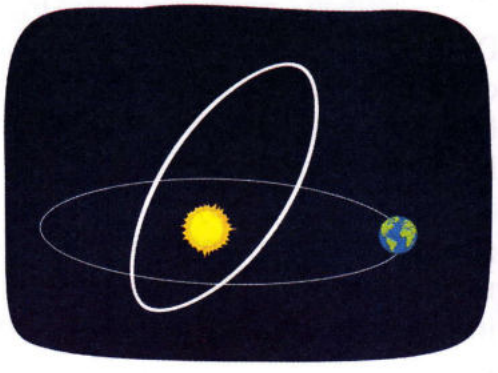
- To learn more about comets, browse through https://solarsystem.nasa.gov/asteroids-comets-and-meteors/comets/in-depth/ (accessed and checked on 12/08/2019)
- To know more about Bhaskaracharya, browse through https://www.booksfact.com/science/ancient-science/bhaskaracharya-greatest-mathematician-introduced-concept-infinity.html (accessed and checked on 12/08/2019)
- To understand how the phases of the moon occur, browse through https://www.youtube.com/watch?v=wz01pTvuMa0 (accessed and checked on 12/08/2019)

# Worksheet 6

**Skills assessed:**
Problem solving and Qualitative analysis

**Read the passage and answer the questions that follow.**

Comets are also objects of the solar system, and they orbit the sun. However, they are very different from planets of the solar system. Comets are actually small chunks of ice, frozen gases and dust and they revolve around the sun in highly elliptical orbits, as shown in the figure. Unlike planets, the orbit of a comet takes it very close to the sun for some duration and then very far away.



When a comet comes close to the sun, the proximity of the sun provides enough heat to vaporise the ice and frozen gases. Solar winds (a 'wind' of particles that are constantly flowing out of the sun) push these gases, causing the comet to develop a 'tail'. This tail can be very, very long (hundreds of thousands of kilometres) and as it reflects the sun's rays (just like the moon and other planets) it can be seen as a glowing tail. Thus, as the comet comes close to the Sun, it can be seen from the Earth. Interestingly, if you observe the picture of any comet closely, you will see that it actually has two tails. One tail consists of gases and the other consists of ions (charged particles).

Comets are relatively rare in the night sky. Some comets take a few decades to go once around the sun, and some can take as long as hundreds of thousands of years! Comets Hale-Bopp and Hayakutake are two spectacular comets that have made their appearance in the last twenty-five years in the Northern Hemisphere of the Earth.

**Choose the correct option.**

1. How are comets different from planets?
   a. Comets do not belong to the solar system whereas planets do.
   b. Comets give out light of their own, but planets only reflect the light from the sun.
   c. Comets have very highly elliptical orbits.
2. When does a comet develop a tail?
   a. A comet always has a tail
   b. When it comes close to the sun, because of the heat of the sun and solar wind.
   c. A comet develops a tail when it goes back far away from the sun
   d. When it comes into the Earth's atmosphere because of the wind in the higher altitudes of our atmosphere.
3. Why does the comet's tail glow?
   a. Because of burning gases
   b. Because of nuclear reactions in its tail
   c. Because it reflects the light from the sun
   d. Because it collides with other stars

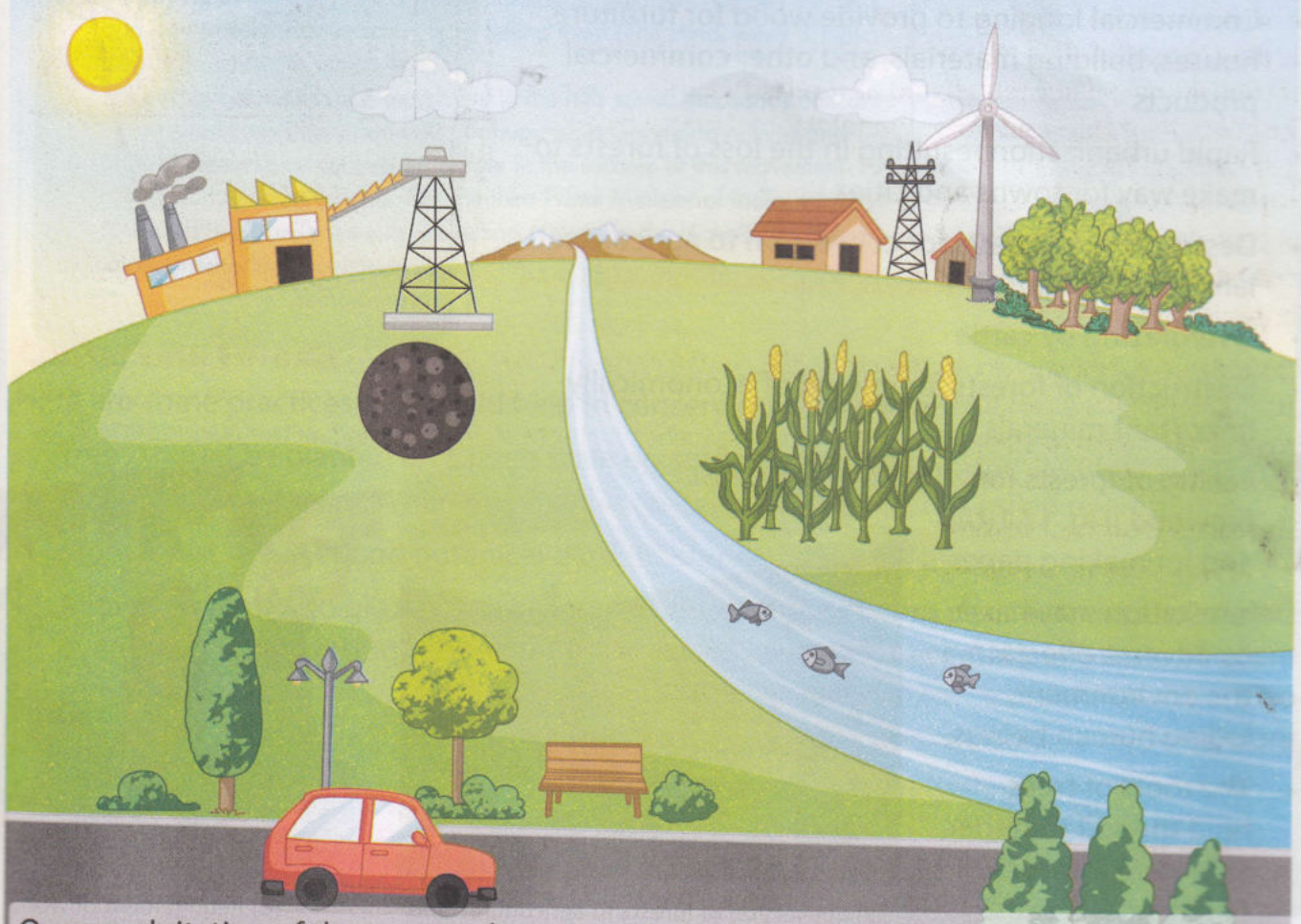
# 17 Human Intervention in Natural Phenomena

Our Earth is rich in natural resources. Many of these natural resources are essential to our survival.

Identify the natural resources from the following illustration and write one use for each one of them.

**You will learn about**

- Forests
- Fossil fuels



Over-exploitation of these natural resources by human beings has many adverse effects on us and our environment.

Let us learn about the harmful effects associated with the over-exploitation of forests (mainly by deforestation) and fossil fuels (mainly by over-extraction).

Answers: Sun, Wind, River, Coal buried underground, Petroleum, Forests

## FORESTS

Forests are a valuable natural resource. The following are some of the ways in which forests are beneficial to human beings and the environment.

- Forests provide habitat to a large number of plants, animals, birds, and insects.
- Trees release oxygen, which is needed for survival. They also absorb carbon dioxide released by animals. Thus, they help to maintain a balance of these gases.
- We obtain useful products such as timber, gum, paper, and medicines from forests.
- The roots of trees help to hold the soil in place, preventing soil erosion and landslides.
- Dead plants and trees decompose to form humus, which helps in maintaining soil fertility.

***Deforestation*** *refers to the continual degradation of forests due to natural or human-related causes*. The main causes of deforestation are as follows.

- Commercial logging to provide wood for furniture, houses, building materials, and other commercial products
- Rapid urbanization resulting in the loss of forests to make way for towns and cities
- Destruction of forests for conversion to agricultural land [Fig. 17.1 (a)].
- Overgrazing by cattle
- Destruction of forests for mining of economically important minerals
- Felling of forests for firewood [Fig. 17.1(b)] and for making paper

**Green corner**

June 5 is celebrated as World Environment Day. Many schools in India celebrate this day by getting children to plant saplings and by organizing environment related programmes.

Deforestation may have many adverse effects on the environment, including human beings.

- The roots of trees hold the soil together. Therefore, the loss of forests will cause soil erosion. Gradual erosion can cause the soil to lose its fertility, leading to desertification.
- Since forests provide homes to many living organisms, their loss will result in destruction of the natural habitat of many plants, animals, and birds.

(a) Conversion of forests to agricultural land (b) Requirement of wood

**Fig. 17.1** *Main causes of deforestation*

- The felling of trees will result in the imbalance of carbon dioxide and oxygen in the atmosphere, since plants take in the carbon dioxide released by animals, thus maintaining the balance. An increase in the amount of carbon dioxide in the atmosphere will cause global warming.
- Plants also play a major role in maintaining the moisture content of the atmosphere. Deforestation will therefore result in the atmosphere getting drier, hence leading to reduced rainfall.
- The roots of trees also absorb rainwater and hence check the flow of water during heavy rains. Lack of forest cover will therefore lead to soil erosion, floods, and landslides.

### Case Study: The Chipko Movement

The Chipko movement, launched in the early 1970s, aimed at preventing the cutting of trees in the Garhwal Himalayas. Villagers hugged the trees and prevented the contractors from felling them (The Hindi word 'Chipko' means 'to embrace' or 'to hug').
The success of the Chipko movement in the hills saved thousands of trees from being felled. Sunderlal Bahuguna, a Gandhian activist and philosopher, played an important role in the success of this movement. He appealed to Mrs Indira Gandhi, the then Prime Minister of India, which resulted in a 15-year ban on the felling of trees in the Himalayan forests.

## Conserving Forests

Here are some practices that could help in conserving our forests.

- Trees should be planted on a large scale on available land. *Large-scale planting of saplings is called* ***afforestation***. When this is done on deforested lands, it is called *reforestation*.
- More forest reserves and botanical gardens should be established.
- Allowing animals to graze on the same patch of land for a long period of time is called overgrazing. Minimizing overgrazing will go a long way in preventing farmlands from turning barren.
- Measures should be taken to prevent and control forest fires.
- Awareness programmes could be conducted by school children and various organizations to promote the need to use our forest resources judiciously. Print and television advertisements are also an effective medium.
- Since paper is obtained from wood pulp, the recycling of paper will also help conserve trees to some extent.

### Let's Discuss

Rita says that we can help in the conservation of forests by reducing the paper we use. Is she right? Discuss.

## Let's Remember

**I. Fill in the blanks with the correct words.**

1. Dead plants and animals decompose to form _____ (humus/forest).
2. _____ (Cloth/Paper) is obtained from wood pulp.
3. _____ (Afforestation/Reforestation) is the large-scale planting of saplings on deforested land.
4. Loss of forest can cause soil _____ (conservation/erosion).
5. _____ (Plants/Animals) play a major role in maintaining the moisture content of the atmosphere.

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

1. A decrease in amount of carbon dioxide in atmosphere will cause global warming.
2. Trees release carbon dioxide and absorb oxygen during photosynthesis.
3. Towns and cities provide habitat to a large number of plants, animals, birds, and insects.

## FOSSIL FUELS

As you have learnt in Chapter 5, fossil fuels are formed from the buried remains of plants and animals over a period of millions of years. Coal, petroleum, and natural gas are some examples of fossil fuels. *Fossil fuels are* ***non-renewable energy sources****, i.e., they are present in a limited quantity and cannot renew or replenish themselves over a short period of time.*

### Over-extraction of Fossil Fuels

Fossil fuels play a major role in generating energy for the world today. Their varied uses have led to their over-extraction. The major consequences of over-extraction of fossil fuels are given below.

***Exhaustion of existing reserves*** The over-extraction of fossil fuels is slowly depleting the Earth of these resources. An energy crisis in the immediate future is a distinct possibility if the present rate of consumption of fossil fuels is not brought under control.

***Air pollution*** When coal and petroleum products are burnt as fuel, they give off carbon dioxide, a greenhouse gas that leads to global warming. They also give off pollutants such as carbon monoxide, nitrogen oxides, sulphur oxides, particulate matter such as mineral ash or fly ash, and unburnt hydrocarbons that pollute the air. Some of these gases combine with water vapour in the air and form droplets that fall to the Earth as weak forms of sulphuric and nitric acid, called *acid rain*.

***Threat to organisms*** Coal contains poisonous metals such as arsenic and mercury, which are dangerous if released into the environment. Mercury that is released into the air settles in water over time. It then enters the bodies of fish and shellfish and can be harmful to animals and people who eat them.

## Conserving Fossil Fuels

We cannot completely stop the use of fossil fuels but we can cut down our dependence on them. In order to conserve fossil fuels, we can instead use renewable energy sources. **Renewable energy sources** *are energy sources that are present in unlimited quantities and can renew or replenish themselves over a short period of time.* These energy sources, such as solar energy, wind energy, nuclear energy, and biomass energy, will not only help conserve fossil fuels, but will also help prevent pollution, and thus safeguard the environment.

Some renewable sources of energy are discussed below.

**Wind energy** Energy of the wind has been used since ancient times to move ships, pump water, and grind corn. These days, huge wind turbines are used to move turbines, which drive generators and produce electricity.

**Hydroelectric energy** Energy derived from flowing water in water bodies such as rivers is used by dams to drive generators to produce electricity.

**Nuclear energy** This is released by splitting or merging together nuclei of atoms. In nuclear power plants, this energy is utilized to produce heat energy, which is used to make steam for driving generators.

**Solar energy** This is utilized with the help of solar panels and solar cells. Solar panels convert solar energy into heat and light energy, while solar cells convert it to electrical energy.

**Biomass energy** Biomass refers to organic matter, such as plant and animal waste. Dung cakes are a form of biomass that is used as a source of energy in rural parts of India. Biomass is also used to produce energy, in the form of biogas, which is then supplied via pipelines to houses for use as cooking fuel.

## Let's Remember

**Fill in the blanks with the correct words.**

1. Coal, petroleum, and natural gas are examples of _____ (fossil/nuclear) fuels.
2. Fossil fuels are _____ (renewable/non-renewable) energy sources.
3. Fossil fuels are used for generating _____ (forests/energy).
4. Coal contains _____ (arsenic/gold) metal.
5. Plant and animal waste is referred to as _____ (biogas/biomass).

## Key Words

**Deforestation** The continual degradation of forests due to natural or human-related causes is called deforestation.

**Afforestation** Large-scale planting of saplings is called afforestation.

## Summary

- Forests are a valuable natural resource.
- The main reasons for deforestation are requirement of wood, rapid urbanization resulting in conversion of forests to agricultural land, and overgrazing by cattle.
- The major consequences of over-extraction of fossil fuels are exhaustion of existing reserves, air pollution, and threat to organisms.
- Shifting to renewable sources of energy such as wind energy, hydroelectric energy, nuclear energy, and solar energy will help us conserve fossil fuels as well as safeguard the environment.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. Forests provide us with
   a. habitat for living organisms
   b. paper
   c. oxygen
   d. All of these
2. Which of the following is a cause for deforestation?
   a. Rapid Urbanization
   b. Landslides
   c. Soil erosion
   d. Reduced rainfalls
3. Which of the following practice can conserve our forests?
   a. Forest fires
   b. Reforestation
   c. Overgrazing by cattle
   d. Felling of trees
4. Which of the following is the consequence of over-extraction of fossil fuels?
   a. Floods
   b. Soil erosion
   c. Deforestation
   d. Air pollution

5. Which of the following is a renewable source of energy?
   a. Energy from fossil fuels  b. Solar energy
   c. Biomass energy  d. Both b and c
6. Which of the following is an effect of deforestation on environment?
   a. Reduced rainfall  b. Global warming
   c. Soil erosion  d. All of these
7. Which of the following will not result in imbalance of carbon dioxide and oxygen in the atmosphere?
   a. Planting trees  b. Deforestation
   c. Burning of fossil fuels  d. Increase in population
8. Which of the following can be used to produce a cooking fuel widely used in rural India?
   a. Flowing water  b. Energy of the wind
   c. Light energy  d. Biomass
9. Energy derived from flowing water in water bodies is called
   a. water energy  b. hydroelectric energy
   c. aquatic energy  d. non-renewable energy
10. Energy that is being used since ancient times to move ships, pump water, and grind corn is
   a. solar energy  b. nuclear energy  c. wind energy  d. biomass energy

**B. Fill in the blanks with the correct words.**

1. Solar_____ (panels/cells) convert solar energy into heat and light energy.
2. _____ (Biomass/Biogas) is supplied via pipelines to houses for use as cooking gas.
3. Acid rain contains_____ and _____ (sulphuric/hydrochloric/nitric) acids.
4. _____ (Renewable/Non-renewable) energy sources can replenish themselves over a short period of time.
5. _____ (Desertification/Deforestation) is a result of gradual erosion of soil that leads to loss of soil fertility.

## II. Very short answer type questions

**A. Give one word for the following.**

1. The continual degradation of forests due to natural or human-related causes _____
2. Large-scale planting of saplings _____
3. A greenhouse gas _____
4. Energy derived from flowing water _____
5. Energy released by the splitting or merging together nuclei of atoms _____

## III. Short answer type questions

1. Define the following terms: Deforestation, Afforestation, and Reforestation.
2. List any four benefits of forests.
3. State any two causes and effects of deforestation.
4. How are the roots of trees important?
5. Name four air pollutants released due to burning of petroleum and coal.

## IV. Long answer type questions

1. State any five practices that can help in conserving forests.
2. Explain the major consequences of over-extraction of fossil fuels.
3. Describe any four renewable energy sources.

## LET'S RECALL

Recall and complete the concept map given below.

**Deforestation**

**Causes:**
1.
2.
3.

Adverse effects:
1.
2.
3.
4.

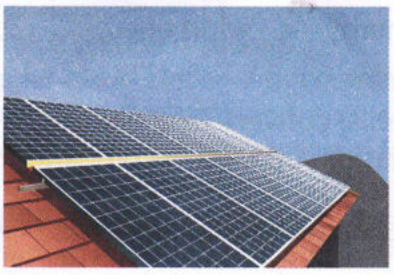
**Over-extraction of fossil fuels leads to:**
1.
2.
3.

**Some renewable sources of energy:**
1.
2.
3.
4.

## LET'S OBSERVE

LO 2

1. Name the sources of energy depicted in the pictures given below. Out of them, circle those that are renewable.

a. _____ b. _____ c. _____ d. _____

2. What is the term used for the continual degradation of forests?_____
3. Write two ways in which this will impact the soil of this place.
   a. _____ b. _____

## LET'S CONNECT

COMPUTER SCIENCE

1. Make a project report on the topic, 'Renewable sources of energy.' Include relevant information on the advantages, disadvantages, and limitations.
2. Make a PowerPoint presentation on any one endangered/extinct species due to deforestation. Include the following details:
   - The picture of the species
   - Present status-extinct or endangered
   - Natural habitat
   - Causes for deforestation

## LET'S APPLY

1. Our health is in the hands of our forest. How? (*Hint:* benefits from forests) LO 13
2. Why forests do not get flooded even after heavy rains? (*Hint:* roots of trees) LO 4

## LET'S ANALYSE AND EVALUATE

1. The table presents the percentage of forest cover in India. Answer the following questions based on the data given in the table.
   a. Calculate the difference in areas covered by moderately and very dense forests. ANALYSING LO 13
   b. How much percentage is the non-forest area? How do you think the non-forest is being utilized by us? ANALYSING
   c. The average forest cover on earth is around 31%. How much is the forest cover present in India? What according to you are the reasons for the difference? ANALYSING EVALUATING

**Forest cover of India**

| Class | Area (sq km) | Percent of Geographical Area |
|---|---|---|
| **Forest Cover** | | |
| Very dense forest | 85,904 | 2.61 |
| Moderately dense forest | 315,374 | 9.59 |
| Open forest | 300,395 | 9.14 |
| **Total Forest Cover*** | 701,673, | 21.34 |
| Scrub | 41,362 | 1.26 |
| Non-forest | 2,544,228 | 77.40 |
| Total Gegraphic Area | 3,287,263 | 100.00 |

## LET'S CREATE CREATING LO 10 LO 14

**Terrarium**

A terrarium is generally a closed glass container containing soil and plants. The heat and light can enter through transparent walls, which result in the process of photosynthesis during the daytime. A mini water cycle is created inside the closed system as moisture from both soil and plants evaporates at elevated temperatures and condenses on the walls of the terrarium.

**Materials required:** a wide- mouthed transparent container with a lid, rocks/pebbles, activated charcoal, soil, water, and small plants of your choice.

**Method:**

1. Place an inch-thick layer of pebbles or rocks at the bottom of the container. This is to create a drainage system for the plant roots.
2. Put a thin layer of activated charcoal on the pebbles. This is to ensure that the water remains fresh, and prevent mould and bacteria from building up.
3. Add a layer of soil.
4. Place plants in the terrarium, starting with the largest plant first.
5. Water lightly and close the lid.
6. Keep it indoors in diffused sunlight.

**Web Research**

- To know more about conserving our natural resources, browse through https://www.ck12.org/earth-science/natural-resource-conservation/lesson/Natural-Resource-Conservation-MS-ES/?referrer=concept_details (accessed and checked on 24/08/2019)
- To know more about preserving and replenishing the natural resources, browse through https://www.veolia.com/en/resourcing-world/introduction (accessed and checked on 24/08/2019)

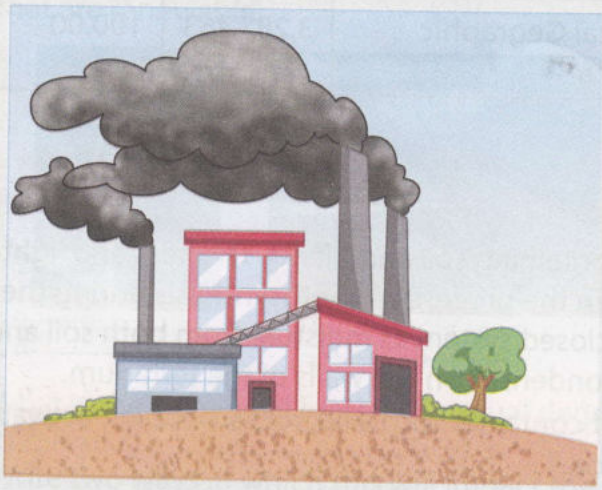
# 18 Pollution of Air and Water

**You will learn about**

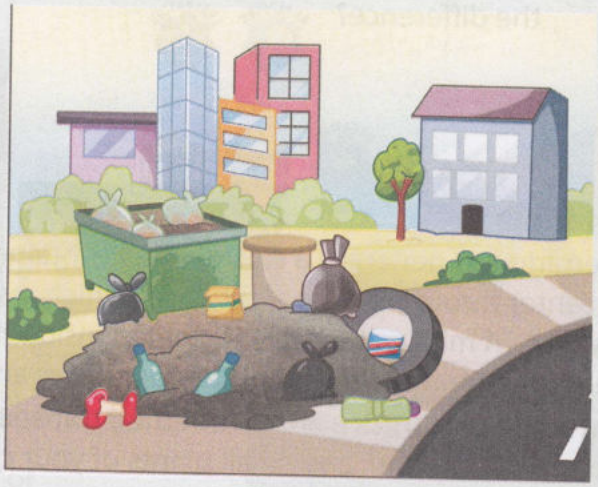
- Air pollution
- Water pollution

Pollution is the addition of substances to the environment in quantities that are harmful to living beings. It can be of different types.

Look at the pictures below. Identify and write the type of pollution shown in each picture.



1. _____



2. _____

3. _____

4. _____

In this chapter, we will discuss air pollution and water pollution in detail.

Answers: 1. Air pollution, 2. Land pollution, 3. Water pollution, 4. Noise pollution

## AIR POLLUTION

LL

The air around us is a mixture of many gases and dust particles. The percentages of the major gases present in air are

- Nitrogen (78.08%)
- Oxygen (20.95%)
- Carbon dioxide (0.03%)
- Other gases (0.97%)

Natural processes and, to a larger extent, human activities, are responsible for the release of various chemicals into the air. *The presence of chemicals in the air in quantities harmful to human health and the environment is known as* ***air pollution***. Common air pollutants and their main sources are discussed below.

**Particulate matter** consists of tiny particles suspended in air. Volcanic eruptions, dust storms, burning of fossil fuels in thermal plants, and forest fires are some of the natural sources of particulate matter. It is also present in the exhaust fumes of automobiles and power plants as soot, fly ash, and lead particles.

**Chlorofluorocarbons (CFCs)** or freons are commonly used as coolants in refrigerators and air conditioners and as propellants in aerosol spray cans. CFCs are also used in home insulation, plastic foam, and throwaway metallic cans.

**Burning of fossil** fuels such as coal and petroleum in thermal power plants and automobiles releases oxides of sulphur and nitrogen into the air.

**Burning of carbon-rich fuels such** as firewood, coal, and petroleum releases carbon dioxide and carbon monoxide into the atmosphere.

## Effects of Air Pollution

Air pollution has far-reaching and long-lasting effects on global climate, plants, and animals. Let us discuss some of them.

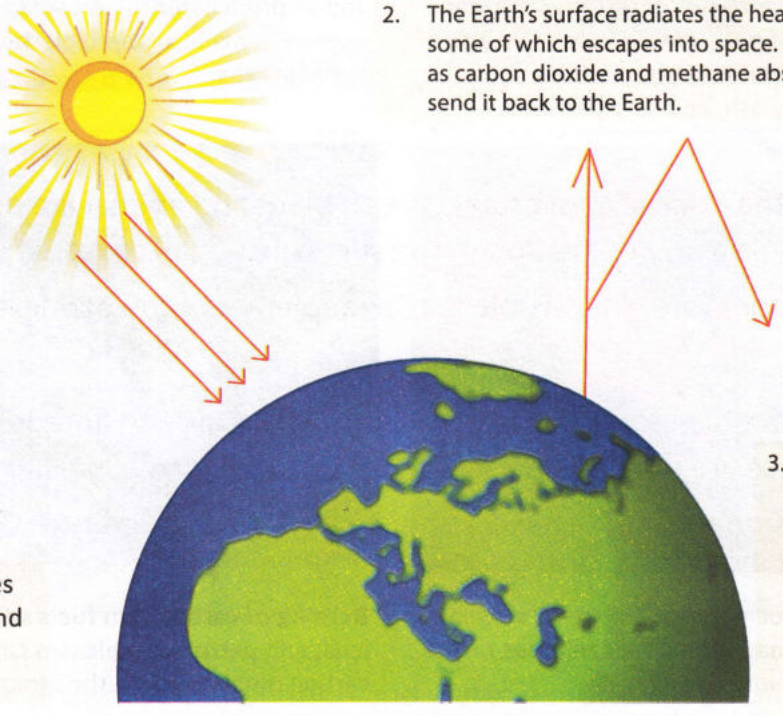
### Global Warming

We know that an increase in the concentration of carbon dioxide in the atmosphere is one of the major causes of air pollution. Scientists believe that an increase in the amount of carbon dioxide and certain other gases is responsible for a phenomenon called global warming. ***Global warming*** *refers to the unnatural increase in the Earth's surface temperature.* To understand how this happens, let us first familiarize ourselves with the concept of the greenhouse effect.

*The phenomenon whereby the Earth's atmosphere traps solar radiation because of the presence of gases such as carbon dioxide, water vapour, and methane is called the* ***greenhouse effect***. Without the natural greenhouse effect, the Earth's surface would have been too cold to sustain life. It is the increase in the amount of greenhouse gases beyond natural limits that is a cause for worry. Figure 18.1 explains how the greenhouse effect is responsible for global warming.

**Fact File**

Botanists and many commercial plant growers use glasshouses or greenhouses for growing plants in cold climatic conditions. The temperature inside a greenhouse is higher than the temperature outside because the solar energy absorbed by the interiors of the greenhouse is re-emitted into the greenhouse, thus keeping it warm. This warmth is what helps plants grow.



1. Sunlight penetrates the atmosphere and warms the Earth's surface.

2. The Earth's surface radiates the heat into the atmosphere, some of which escapes into space. Greenhouse gases such as carbon dioxide and methane absorb some of the heat and send it back to the Earth.

3. When the concentration of greenhouse gases increases in the atmosphere, more heat is trapped near the Earth's surface. This results in a rise in the Earth's surface temperature.

**Fig. 18.1** *Diagrammatic representation of greenhouse effect and global warming*

The causes and possible effects of global warming are summarized in Table 18.1.

**Table 18.1** Causes and possible effects of global warming

| Causes | Possible effects |
|---|---|
| • Deforestation | • Increase in the Earth's surface temperature |
| • Burning of fossil fuels | • Melting of polar ice caps |
| • Release of methane due to the breakdown of organic matter | • Rise in global sea level resulting in flooding of low-lying coastal regions |

## Acid Rain

We know that the Taj Mahal was built using white marble. If you visit this monument today, you will find patches of black dirt on it. Scientists believe that one of the major causes of damage to this monument is a phenomenon called acid rain. Let us understand what acid rain is.

When air pollutants such as oxides of sulphur and nitrogen react with oxygen and water vapour of the atmosphere, they eventually form dilute solutions of sulphuric acid and nitric acid, respectively. These acids mix with rainwater and come down in the form of acid rain.

Acid-forming gases and acid rain have been known to result in

- destruction of vegetation due to acidification of soil;
- accelerated leaching of rocks and soils;
- decay of limestone, marble, and other building materials; and
- damage to the human respiratory system.

**Word help**

**Depletion** Reducing something by a large amount

### Depletion of the Ozone Layer

The ozone layer in the atmosphere protects both plant and animal life on Earth by absorbing harmful ultraviolet radiation of the sun, which may cause skin cancer.

CFCs (also called freons) are responsible for the depletion of the ozone layer.

### Effects on Plants

Air pollution can have lasting and harmful effects on the growth and development of plants. Some of these are discussed below.

- Photochemical smog is said to have an adverse effect on plant growth because it forms a layer on leaves and, along with dust, blocks sunlight from being absorbed by the leaf surface. This layer blocks the absorption of carbon dioxide by the leaves and also affects the functioning of stomata, thereby reducing the rate of photosynthesis.
- Acid rain damages plants and can also cause premature leaf fall.

### Effects on Animals

The toxic air pollutants released into the atmosphere can cause and aggravate respiratory and cardiovascular diseases in human beings. Asthmatic patients, children, and elderly people are especially vulnerable to the harmful effects of air pollution. Some of the health effects of air pollution are given below.

- Carbon monoxide easily combines with the haemoglobin in our blood and hampers the transport of oxygen within the body, which can lead to headache, drowsiness, dizziness, and nausea.
- Exposure to high levels of suspended particulate matter, sulphur dioxide, oxides of nitrogen, and other air pollutants irritates the eyes, nose, throat, and lungs. Years of exposure to these air pollutants can lead to respiratory diseases such as lung cancer, asthma, and bronchitis.

## Prevention of Air Pollution

Following are some of the steps that could be taken to prevent air pollution.

- Use of unleaded petrol should be encouraged.
- Vehicles should be fitted with catalytic converters. The catalytic converter converts harmful carbon monoxide and nitrogen oxides from vehicular exhaust to harmless carbon dioxide, nitrogen dioxide, and water, before releasing the exhaust into the air.
- Less-polluting fuels such as CNG (compressed natural gas) should be used in vehicles.
- Regular pollution-checks should be made mandatory for all vehicles.
- Coal should be made free of sulphur before being burnt in power plants. Only low-sulphur coal should be used for burning.
- Less-polluting energy resources such as hydroelectric energy and nuclear energy should be encouraged.
- The use of public transport in cities should be encouraged.

### Case Study: Bhopal Gas Tragedy

On December 3, 1984, a poisonous gas called methyl isocyanate accidentally leaked from a pesticide plant in Bhopal, India, immediately killing thousands of people and injuring more than 300,000 others. The smoke that engulfed the city was so poisonous that the aftermath of the accident has seen generations suffer from multiple ailments. Further, tons of toxic material dumped at the old plant is believed to have seeped into the groundwater, thereby contaminating the water with poisonous substances. Some of the adverse effects of this gas tragedy included:

- Diseases of the eyes such as cataract, conjunctivitis, poor vision, and complete blindness in many cases
- Reduction in memory skills and motor skills
- Skeletal and muscular problems
- High body temperature and low immunity
- Lung diseases such as bronchitis, breathlessness, and cough

## Let's Remember

**I. Fill in the blanks with the correct words.**

1. _____ (Ozone/Oxygen) layer in the atmosphere protects us by absorbing harmful ultraviolet radiations of the sun.
2. Burning of fossil fuel releases _____ (carbonates/oxides) of sulphur and nitrogen in air.
3. _____ (Deforestation/Afforestation) is one of the causes of global warming.
4. The catalytic convertor converts_____ (carbon monoxide /oxygen) to carbon dioxide.
5. _____ (Coal/CNG) is a less polluting fuel.

**II. Match the following.**

| *Column A* | *Column B* |
|---|---|
| 1. Chlorofluorocarbons | a. 78.08% |
| 2. Melting of polar ice caps | b. Greenhouse gas |
| 3. Particulate matter | c. Air conditioners |
| 4. Methane | d. Global warming |
| 5. Nitrogen | e. Lead particles |

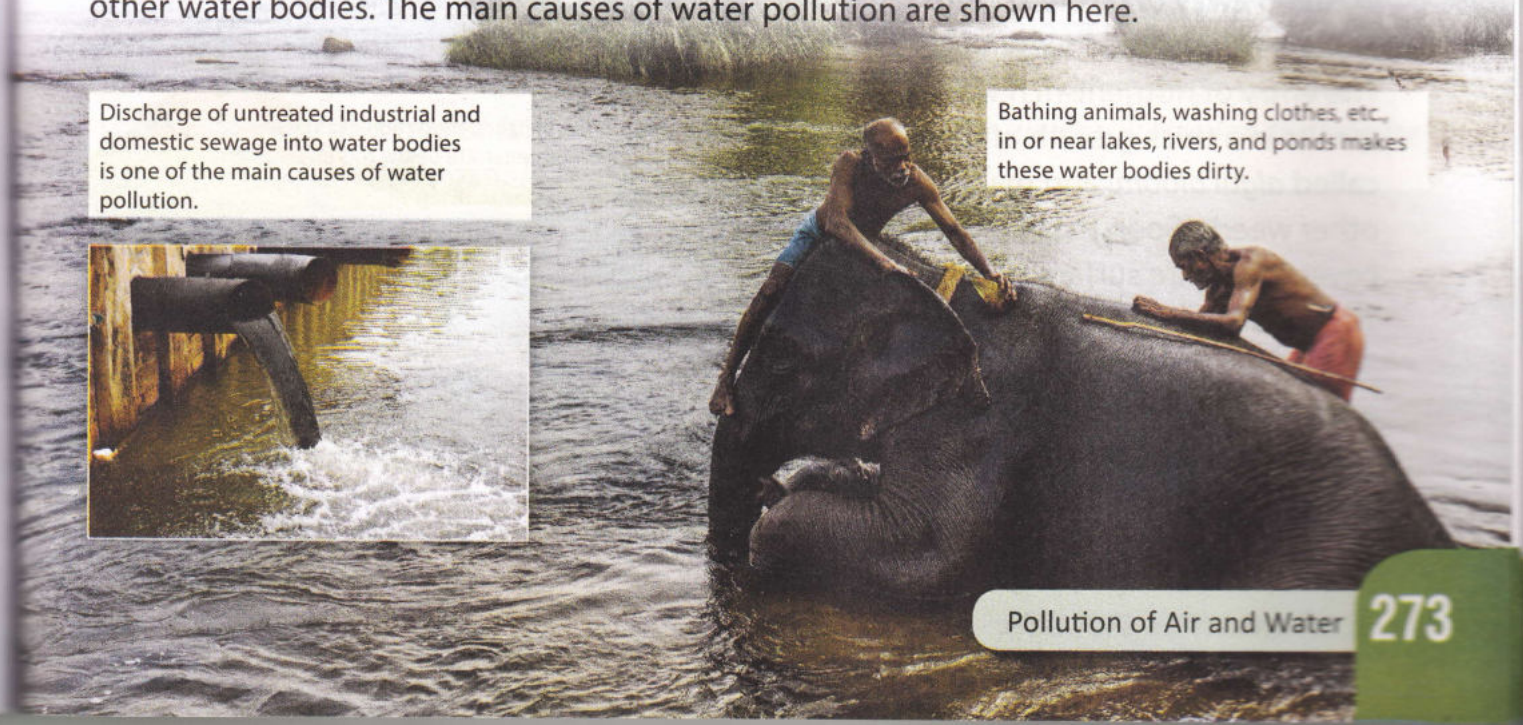
## WATER POLLUTION

LL

Water is one of the most abundant compounds on Earth. About 75% of the Earth's surface is covered with water. The three main types of water sources are

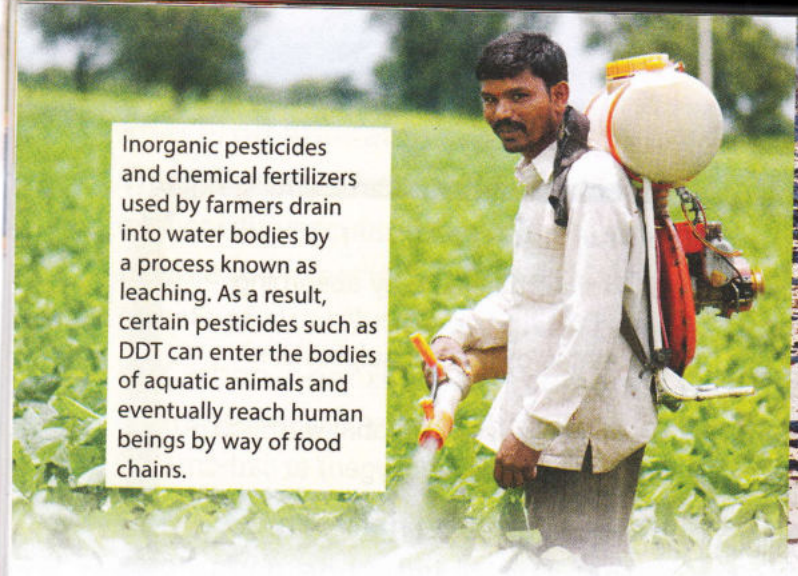
- Surface water (obtained from springs, streams, waterfalls, rivers, and lakes)
- Groundwater (obtained with the help of wells)
- Salty water (obtained from seas and oceans)

All living beings need water to carry out their life processes. Thus, water can be called a supporter of life. Unfortunately, we have been constantly polluting our rivers, seas, and other water bodies. The main causes of water pollution are shown here.

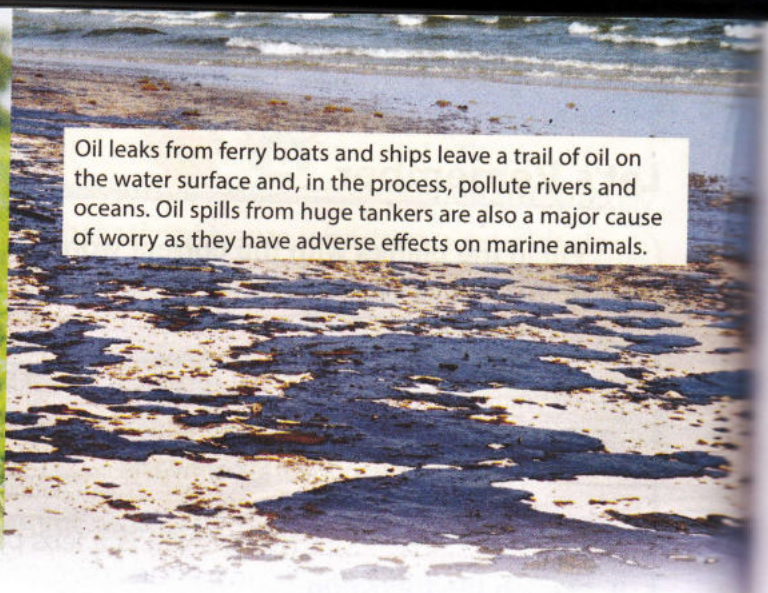


Discharge of untreated industrial and domestic sewage into water bodies is one of the main causes of water pollution.

Bathing animals, washing clothes, etc., in or near lakes, rivers, and ponds makes these water bodies dirty.



Inorganic pesticides and chemical fertilizers used by farmers drain into water bodies by a process known as leaching. As a result, certain pesticides such as DDT can enter the bodies of aquatic animals and eventually reach human beings by way of food chains.



Oil leaks from ferry boats and ships leave a trail of oil on the water surface and, in the process, pollute rivers and oceans. Oil spills from huge tankers are also a major cause of worry as they have adverse effects on marine animals.

## Effects of Water Pollution

Harmful effects of water pollution on living beings are as follows

- Industrial wastes discharged into water bodies contain a lot of toxic substances that make water unfit for drinking and bathing.
- Untreated domestic sewage, when released into water bodies, becomes a breeding ground for a number of organisms that cause water-borne diseases.
- Oil spills from ferry boats, ships, and tankers are very harmful to aquatic animals, and lead to the destruction of marine life. Moreover, the clean-up process also causes a lot of damage to the marine habitat.
- Pollution of water also leads to a reduction in the number of aquatic plants and animals due to destruction of their habitat and nesting places.
- The waste water released by factories and industries and the fertilizer-rich runoffs from agricultural fields is rich in organic matter. The process of washing away of fertilizers into water bodies is called *leaching*. The entry of nutrient-rich water results in a thick growth of algae, called *algal bloom*, and many other weeds. Soon these plants cover the entire surface of water. This is called *eutrophication* (Fig. 18.2). The algae use up so much oxygen that the aquatic animals and other plants die due to lack of it.

***Eutrophication*** *may be defined as the process of nutrient enrichment of water bodies and the subsequent overgrowth of plants on the surface of water.*

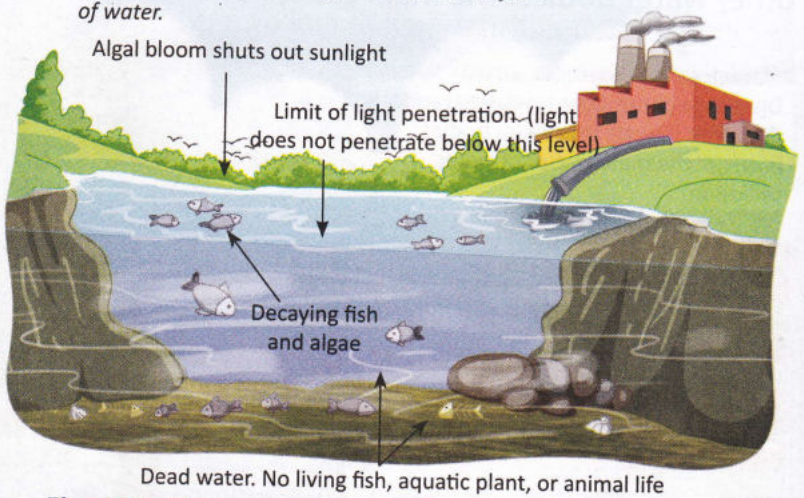



**Fig. 18.2** *Diagrammatic representation of eutrophication*

- Ignition of arms and weapons releases large amounts of mercury. When water contaminated with mercury is used for drinking by animals and human beings, it causes numbness of limbs, lips, and tongue. It can also lead to blurred vision and mental disorders.

## Prevention of Water Pollution

Following are some of the steps that could be taken to prevent water pollution.

- Bathing and washing clothes near water bodies such as lakes, ponds, and rivers should be avoided.
- Domestic and industrial sewage wastes should be treated to remove toxic substances before being released into water bodies.
- Pollution-control rules enforced by the government should be followed strictly.
- Use of eco-friendly fertilizers and herbicides should be encouraged.

### Case Study: Ganga Action Plan

Ganga Action Plan (GAP) was launched by the government of India in 1986 to clean the river Ganga. Since river Ganga flows through many temple towns and industrial cities, human activities such as bathing and washing clothes, discharge of domestic and industrial waste, and religious offerings are the main source of pollution of this river. The GAP aimed at interception and diversion of waste water reaching the Ganga and the installation of sewage treatment plants for its treatment. Other pollution control activities included under the GAP were solid waste management, installation of crematoria, river front development, and provisions of low-cost sanitation facilities. The plan also laid emphasis on public awareness and involvement to keep the Ganga clean. This programme has helped to reduce pollution to some extent but a lot more was required to recuperate the river Ganga again.

The government of India launched 'Namami Gange Mission' in 2014 to clean river Ganga. The government allotted huge funds and announced various plans and schemes for this programme.

## Potable Water

Suppose you feel thirsty while walking on the road. Would you drink water from a muddy puddle on the ground? Of course, not! Water used for drinking and cooking purposes should be pure and free of harmful germs and chemicals. *The water suitable for drinking by human beings is called* ***potable water***.

To be considered fit for human consumption, a sample of water should

- be transparent, colourless, and odourless;
- contain sufficient amount of dissolved oxygen and salts; and
- be free from harmful chemicals and microorganisms.

## Purification of Water

Water supplied in our homes generally comes from rivers and is contaminated with

suspended impurities such as sand, silt, and clay; soluble impurities such as salts; and also microorganisms. Water, therefore, has to be cleaned at large purification plants before it reaches our homes. The three main processes through which water undergoes purification are sedimentation, filtration, and chlorination. Figure 18.3 outlines the various processes employed in purification of water.

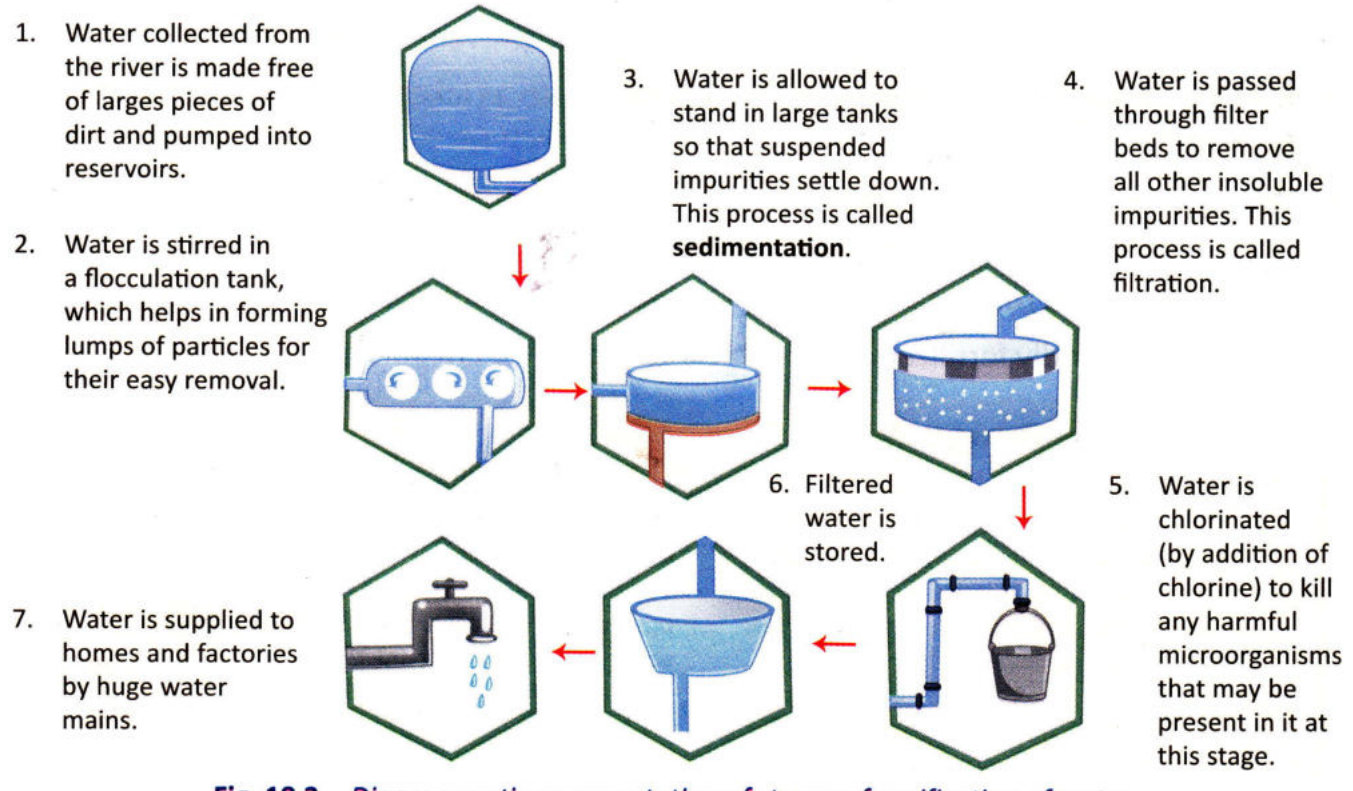


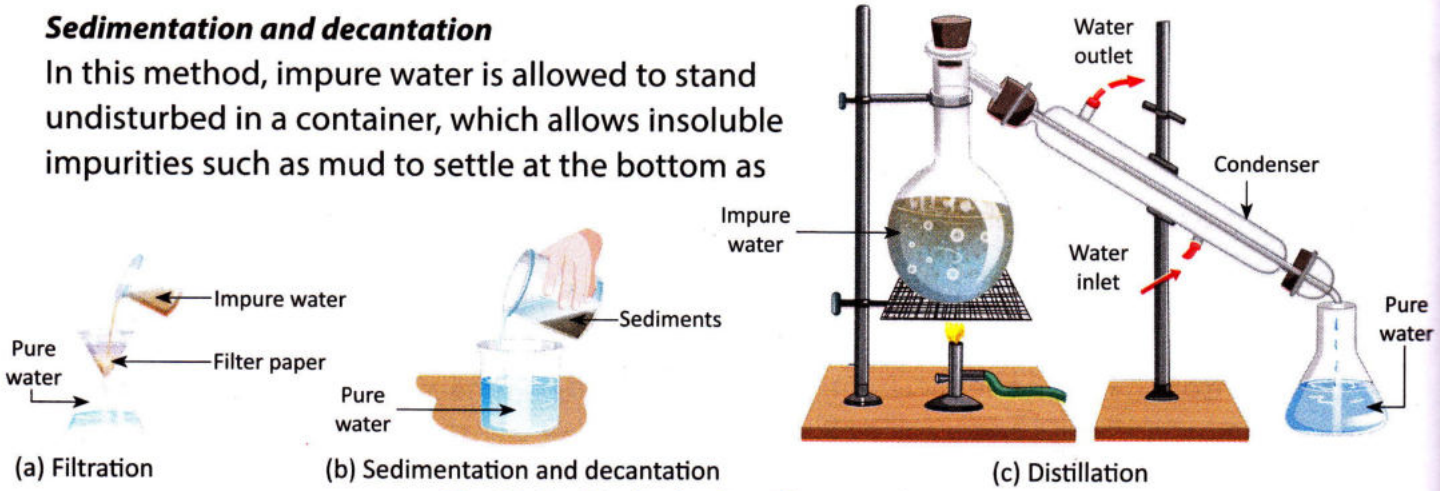

**Fig. 18.3** *Diagrammatic representation of stages of purification of water*

Impure water can be purified by various methods such as filtration, distillation, and sedimentation.

***Filtration*** In this method, insoluble impurities are removed by passing impure water through a filter or a filter paper [Fig. 18.4(a)].

***Sedimentation and decantation***

In this method, impure water is allowed to stand undisturbed in a container, which allows insoluble impurities such as mud to settle at the bottom as




(a) Filtration (b) Sedimentation and decantation (c) Distillation

**Fig. 18.4** *Methods of purification of water*

sediments. This process is called *sedimentation*. Clean water can thereafter be transferred into a clean container by the process of *decantation* [Fig. 18.4(b)].

***Distillation*** In this method, impure water is first heated to its boiling point to convert water into steam. The impurities are left behind in the container. The steam is then passed through a condenser, where it cools and changes back into liquid water [Fig. 18.4(c)].

## Purification of Water at Home

The water supplied to our homes may not be entirely free from undesirable impurities. Also, in villages and small towns, water is taken directly from wells, hand pumps, and rivers. Thus, purification of water at home becomes necessary. This can be done by both physical (e.g., boiling) and chemical (e.g., chemical tablets and electric water filters) means. Let us discuss some of these.

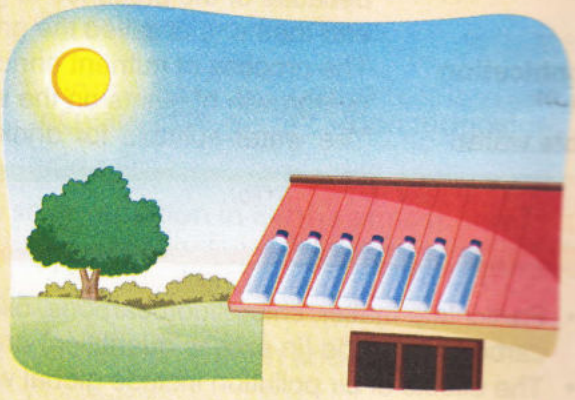
***Boiling*** Boiling water is one of the easiest ways of purifying water. It is, however, very important that water is boiled at 100°C for at least 10–15 minutes to kill harmful microorganisms.

***Addition of chemical tablets*** Chemicals such as chlorine tablets or potassium permanganate can be added to water from wells and water tanks to kill harmful microorganisms and germs.

***Use of electric water filters*** Electric water filters have a micro-porous filter, carbon, and a source of ultraviolet radiation. The micro-porous filter strains physical impurities present in the water, such as dust, rust, dirt, and mud. Carbon absorbs organic impurities and removes unwanted taste and odour. Ultraviolet radiation kills microorganisms.

### Case Study: Purification of Water Using Sunlight

Did you know, sunlight can be used to purify water?



Sunlight is already being used in many developing countries as a medium to disinfect water. This method is popularly known as solar water disinfection (SODIS). Exposure to sunlight has been shown to deactivate many disease-causing microorganisms. This is an effective method of treating water where fuels or solar cookers are unavailable or are very expensive. Inspite of its various advantages, this method has some limitations as well. The duration for which water is exposed to sunlight, strength of sunlight, bottle material, etc. determine its effectiveness.

The basic steps involved in the purification of water using sunlight are:

1. Wash the bottle well.
2. Fill it up with water and close the lid.
3. Place the bottle on a corrugated iron sheet or on the roof top.

## Let's Remember

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

1. Groundwater is one of the sources of water.
2. Discharge of untreated domestic sewage into water bodies causes air pollution.
3. Water used for drinking purposes should be full of harmful germs and chemicals.
4. Potable water should be opaque, colourless, and odourless.
5. Water supplied in our homes undergoes purification by sedimentation, filtration, and oxygenation.
6. Ultraviolet radiation kills microorganisms.

**II. Fill in the blanks with the correct words.**

1. The water suitable for drinking by human beings is called _____ (filtered/potable) water.
2. Chemical fertilizers drain into water bodies by a process known as_____ (leaching/ eutrophication).
3. The entry of nutrient- rich water that results in a thick growth of algae, called_____ (leaching/algal bloom).
4. Ignition of arms and weapons releases large amounts of _____ (mercury/sodium).
5. _____ (Boiling/Freezing) is one of the easiest ways of purifying water.
6. _____ (Carbon/Chlorine) tablets are added to water from wells to kill harmful microorganisms.

## Key Words

| | |
|---|---|
| **Air pollution** | The presence of chemicals in the air in quantities harmful to human health and the environment is called air pollution. |
| **Greenhouse effect** | The phenomenon whereby the Earth's atmosphere traps solar radiation because of the presence of gases such as carbon dioxide, water vapour, and methane is called the greenhouse effect. |
| **Eutrophication** | The process of nutrient enrichment of water bodies and the subsequent overgrowth of plants on the surface of water is called eutrophication. |
| **Potable water** | The water suitable for drinking by human beings is called potable water. |

## Summary

- Particulate matter, chlorofluorocarbons, oxides of sulphur and nitrogen, carbon dioxide, and carbon monoxide (in excess quantities) are some of the common air pollutants.
- The effects of air pollution include global warming, acid rain, depletion of the ozone layer, and adverse effects on plants and animals.
- Discharge of untreated industrial and domestic sewage; bathing animals, washing clothes, etc., in or near water bodies; leaching of pesticides and fertilizers; and oil spills from ferry boats, ships, and tankers are the main sources of water pollution.
- Water can be purified by filtration, sedimentation and decantation, and distillation.
- At home, water can be purified by physical (e.g., boiling) and chemical (e.g., chemical tablets and electric water filters) means.

# Exercises

## LET'S UNDERSTAND

QT

### I. Objective type questions

**A. Choose the correct option.**

1. Which of the following is responsible for depletion of ozone layer?
   a. Carbon dioxide b. Freons c. Oxides of Nitrogen d. Oxygen
2. Which of the following gas combines with the haemoglobin in our blood?
   a. Carbon dioxide b. Methane c. Oxides of Nitrogen d. Carbon monoxide
3. Which of the following practices can prevent air pollution?
   a. Use of unleaded petrol b. Use of CNG as fuel
   c. Using hydroelectric energy d. All of these
4. Which one of the following is an effect of water pollution?
   a. Increase in water-borne diseases b. Bathing animals in water bodies
   c. Reduction in number of aquatic plants and animals
   d. Both a and c
5. Which of the following can prevent water pollution?
   a. Use of eco-friendly fertilizers b. Washing clothes in water bodies
   c. Discharge of untreated industrial waste in water bodies
   d. Oil spills
6. Which of the following is a characteristic of potable water?
   a. Translucent b. Contains sufficient amount of dissolved oxygen
   c. Contains harmful chemicals d. Contains microorganisms
7. Melting of polar ice caps is due to
   a. photochemical smog b. increase in levels of carbon monoxide
   c. global warming d. acid rain
8. Which of the following gases can trap solar radiation in Earth's atmosphere?
   a. Nitrogen b. Methane c. Oxygen d. Carbon monoxide
9. Which of the following is not an air pollutant?
   a. Carbon monoxide b. Oxides of nitrogen and sulphur
   c. CFCs d. Oxygen
10. Which of the following methods of purification of water involves change of state of water?
    a. Distillation b. Filtration
    c. Sedimentation and decantation d. Addition of chlorine tablets

**B. Fill in the blanks with the correct words.**

1. _____ (Carbon dioxide/Oxygen) occupy 20.95% of the total volume of the air.

2. The Earth's surface would have been too cold to sustain life in the absence of _____ (natural/artificial) greenhouse effect.
3. _____ (Acid rain/Greenhouse effect) is the major cause of damage to the Taj Mahal.
4. Oxides of nitrogen and _____ (hydrogen/ sulphur) react with oxygen and water vapour of the atmosphere to form acid rain.
5. _____ (Boiling/Freezing) water for at least 10–15 minutes can kill harmful microorganisms.
6. Impure water can be purified by the process of _____ (drying/distillation).

## II. Very short answer type questions

**A. Give one word for the following.**

1. The presence of chemicals in the air in quantities harmful to human health and the environment_____
2. Entrapment of solar radiation by Earth's atmosphere _____
3. Unnatural increase in the Earth's surface temperature _____
4. Air pollutants responsible for the depletion of the ozone layer _____
5. Washing away of fertilizers into the water bodies _____
6. Overgrowth of plants on the surface of water bodies due to nutrient enrichment _____

## III. Short answer type questions

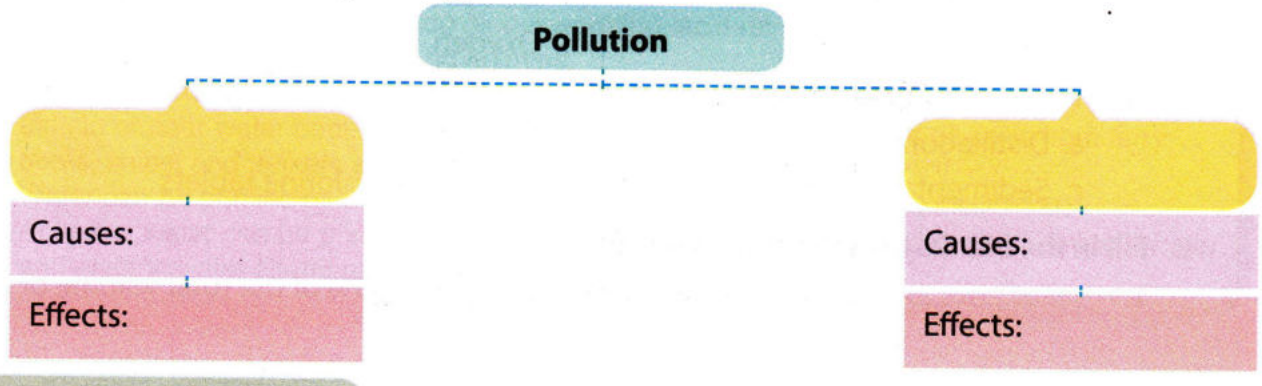
1. How is greenhouse effect responsible for global warming?
2. How is acid rain formed? Write any two effects of it.
3. Write any two effects of air pollution on plants and animals.
4. List any two effects and prevention methods of water pollution.
5. Discuss how inorganic pesticides and chemical fertilizers are responsible for water pollution.

## IV. Long answer type questions

1. Discuss the common air pollutants with their main sources.
2. Explain the process of distillation with the help of a diagram.
3. Describe the various methods used for purification of water at home.

## LET'S RECALL


Recall and complete the concept map given below.



**Methods for purification of water**

1. Filtration
2. _____
3. _____

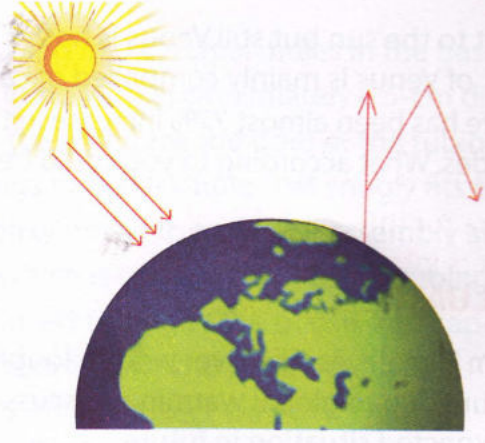
**Methods for purification of water at home**

1. Boiling
2. _____
3. _____

## LET'S OBSERVE

UNDERSTANDING

1. Label the picture given below. Name the phenomenon it represents. LO 5



2. The pictures have been taken at the same location in Beijing, China. Picture A has been taken on any normal day and Picture B was clicked after two days of continuous rain in the city. Answer the following questions based on the pictures.
   a. What is difference between two pictures?
   b. What according to you is the reason for unclear skies? LO 4
   c. Suggest some remedial measures to curb the pollution as can be seen in Picture A. LO 13
   d. What could be the effects of this pollution on our health? LO 11

A

B

## LET'S CONNECT

GEOGRAPHY

1. Choose any one Indian river that has got polluted due to human activities. Collect information on:
   - Which part of the country it flows through? Mark it on the map.
   - What are the various reasons for the pollution of the river?

- What are the consequences of this pollution?
- Discuss the various steps and measures initiated by the government, NGOs and people to clean the river. Carry out an assessment of the success of the measures. Prepare a case study using the information you collected.

2. Collect pictures of an oil spill happened in any part of the world and paste them in a file. Discuss the geographical location of the spill, amount of petroleum spilled, surface area of the spill on the water body, and effect on the flora and fauna.

## LET'S APPLY


1. Mercury is the closest planet to the sun but still Venus is hotter than Mercury. Why? (*Hint:* The thick atmosphere of Venus is mainly composed of carbon dioxide.)
2. According to a research, there has been almost 77% increase in the number of cases of skin cancer in the last three decades. What according to you could be the reason behind it? (*Hint:* CFCs) LO 11

## LET'S ANALYSE AND EVALUATE

1. River Ganges originates from Himalayas. The river would double its flow at 2°C increase in average earth's temperature due to global warming. Discuss the possible effects and consequences due to this expected situation in future. LO 4
2. Increase in human population is one of the causes of global warming. Discuss.


## LET'S CREATE


1. Make a colourful poster on 'Save our Earth from Pollution'. LO 13
2. Prepare flowcharts to show the the various methods used for purification of water. LO 9
3. If possible, organize a visit to a local water body. Collect information on (a) the level of pollution, (b) sources of pollution, (c) how it has affected the people living in nearby areas, and (d) the steps taken (if any) to keep pollution under control. Prepare a case study report based on your findings. LO 11 LO 14

**Web Research**

- To know more about causes and impacts of pollution on the ecosystem, browse through https://www.worldwildlife.org/threats/pollution (accessed and checked on 24/08/2019)
- To know more about the various types of pollutions, browse through https://www.worldatlas.com/articles/how-many-types-of-pollution-are-there.html (accessed and checked on 24/08/2019)
  http://www.all-recycling-facts.com/main-types-of-pollution.html (accessed and checked on 24/08/2019)

Teacher facilitation required*

# Activity

**Skills learnt:**
Collaborating, Communicating, Critical thinking, and Creating

**Aim: To make an air purifier**

Water can be used to purify air as it dissolves gaseous pollutants such as oxides of sulphur and nitrogen. In groups of five, discuss and construct.

**Method:**

1. Take one 2-litre PET bottle and make 6 small holes in the base of the bottle.
2. Take 40-cm long silicon tubing with approximately 0.5-cm diameter bore.
3. Remove the cap of the bottle and trace the bore of the tubing on the cap.
4. Cut the cap on the markings to make a hole that snugly fits the silicon tubing. Apply glue (use either glue gun or epoxy putty) to make the assembly air tight.
5. Plug the upper opening (which is closer to cap) of the tubing with cotton.
6. Fill the bottle with water, insert tubing in the bottle, and cap it tightly as shown in the figure.
7. Remove the cotton plug from tubing and hang the bottle.
8. Keep a bucket under the bottle to collect water.
9. Air bubbles can be seen inside the bottle near the other opening of the tubing. This air passes through the water, which dissolves the pollutants (acidic gases, particles, etc.) and gets collected at the top of the bottle.
10. The air that gets collected is free from a large number of pollutants.
11. More than one bottle or a bottle with larger volume can be used to purify air. The bottle has to be refilled after it gets completely empty. The same water can be used to purify air again and again.

**Discuss:**

(i) List the various measurements that you need.
(ii) Name the instruments that you would use for measuring each of them.
(iii) Was it easy to make holes in the bottle? What did you use to do so?
(iv) Did the model turn out good enough to work?
(v) What changes could you have made, to make it work more efficiently?

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

# Semester 1 Test Paper

**Time : 3 hours**
**Maximum Marks: 80**

**(Chapters 1 to 9)**

## I. Fill in the blanks with the correct words. (1x7 marks)

1. Dhekli and rahat are examples of methods of _____ (harvesting/irrigation).
2. We can see microorganisms with the help of a _____ ( microscopic hand lens/ compound microscope)
3. _____ (Acrylic/Wool) is a synthetic fibre.
4. A yellow flame is also called a _____ (luminous/non-luminous) flame.
5. _____ (Chloroplasts/Chromoplasts) contain the green pigment chlorophyll.
6. _____ (Adrenaline/Thyroxine) is known as the fight or flight hormone.
7. _____ (Thermoplastics/Thermosetting plastics) cannot be remoulded after heating.

## II. Write T for the True and F for the False statements. Correct the false statements. (2x8 marks)

1. Drip irrigation leads to wastage of water.
2. Decrease in amount of carbon dioxide is responsible for global warming.
3. Metals are poor conductors of heat.
4. Most synthetic fibres cannot handle heavy loads.
5. Endangered and vulnerable species are together known as extinct species.
6. Endoplasmic reticulum act as sites of protein synthesis in a cell.
7. The hormone testosterone is produced by ovaries and is responsible for the development of secondary sexual characteristics in boys.
8. Animals cannot reproduce asexually.

## III. Choose the correct option. (1x7 marks)

1. Which of these is a chemical fertilizer?
   a. Compost b. Bark of neem c. NPK d. Bone meal
2. Which of these are examples of algae?
   a. Yeast and mould b. Chlorella and diatoms
   c. HIV and Tobacco Mosaic d. Cocci and bacilli
3. Kerosene, diesel, petrol, and fuel oil are examples of
   a. solid fuels b. liquid fuels c. gaseous fuels d. none of these
4. Spandex fibres are also known as
   a. lycra b. nylon c. polyester d. rayon
5. Which of these animals is poached mostly for ivory?
   a. Tigers b. Elephants c. Snakes d. Rhinoceros
6. Which of these is a fluid filled space enclosed in a membrane, found in a larger size in a plant cell than an animal cell?
   a. Centrosome b. Vacuole c. Plastids d. Cell wall
7. Which of these determines the male child?
   a. XX b. XY c. YY d. XYX

## IV. Give one word for each of the following. (1x8 marks)

1. The process that involves the separation of the grain from chaff _____
2. The process of conversion of a sugar into an acid or an alcohol by the action of microorganisms _____
3. The first true synthetic fibre. _____
4. A region where combustion of fuel takes place. _____
5. A fuel used in heavy motor vehicles and generators.
6. The numerous species of plants living in their natural surroundings _____
7. The brain of a cell _____
8. The process in which two gametes join or fuse to start the process of formation of a baby _____

## V. Give two examples for each of the following. (2x5 marks)

1. Agricultural implements _____ _____
2. Medicinal uses of microorganisms _____ _____
3. Synthetic fibres _____ _____
4. Unicellular organisms _____ _____
5. Endocrine glands _____ _____

## VI. Short answer type questions. (2x5 marks)

1. What are crops? Name two types of crops according to their growing seasons.
2. Write the main conditions required for the growth of microorganisms.
3. What are the properties and uses of nylon?
4. What do you understand by sonority? Give two examples.
5. Why do silver objects turn black on exposure to air?

## VII. Long answer type questions.

1. Explain the various methods of irrigation involved in agriculture. **(5 marks)**
2. What is calorific value of a fuel? Which fuels are considered as ideal for use as domestic fuels and why? **(5 marks)**
3. With the help of labelled diagrams, differentiate between an animal and a plant cell. **(5 marks)**
4. With the help of a labelled example, explain how chromosomes determine whether the foetus will be a boy or a girl. **(7 marks)**

# Semester 2 Test Paper

**(Chapters 10 to 18)**

**Time: 3 hours**
**Maximum Marks: 80**

## I. Fill in the blanks with the correct words. (1x7 marks)

1. Forces that do not need physical contact with an object on which they are acting are called _____ (contact/non-contact) forces.
2. Force per unit area is called _____(pascal/pressure).
3. The number of oscillations per second of an oscillating body is called its _____ (time period/frequency).
4. In an electrolytic cell, the electrode connected to the negative terminal of the battery/cell is called the _____ (cathode/anode).
5. A sudden movement or a fracture in the Earth's lithosphere is called _____ (earthquake/seismology)
6. 0.03% of the air is made up of _____ (oxygen/carbon dioxide).
7. The planet of our solar system that is closest to the sun _____ (Mars/Mercury)

## II. Write T for the True and F for the False statements. Correct the false statements. (2x8 marks)

1. A force can change the shape or size of an object.
2. Dams are made thinner at the bottom than at the top so as to withstand higher pressure of water at greater depths.
1. Acid rain consists of dilute solution of acetic acid and lactic acid.
2. Large-scale planting of saplings on deforested lands is called afforestation
5. When a glass rod is rubbed with silk, the glass rod gets negatively charged.
6. The angle of reflection is always greater than the angle of incidence.
7. Ursa Major and Orion are examples of stars.

## III. Choose the correct option. (1x7 marks)

1. Which of these is a contact force?
   a. Gravitational force
   b. Magnetic force
   c. Frictional force
   d. Electrostatic force
2. When air is sucked out of a drinking straw, the air pressure inside it
   a. increases, and the atmospheric pressure forces the liquid to go inside the straw
   b. decreases, and the atmospheric pressure forces the liquid to go inside the straw
   c. increases, and the weight of the liquid makes it go up the straw
   d. decreases, and the weight of the liquids forces it to drain out of the straw
3. The flute is a
   a. wind instrument
   b. percussion instrument
   c. stringed instrument
   d. water instrument
4. In an electrolytic cell,
   a. a chemical reaction takes place only if pure water is taken as the electrolyte.
   b. positive ions move towards the anode and negative ions move towards the cathode.

c. positive ions move towards the cathode and the negative ions move towards the cathode.
d. both a and b

5. Lightning happens because of a
   a. chemical reaction in the cloud
   b. huge electric discharge
   c. collision of clouds
   d. rain
6. A plane mirror forms an
   a. upright real image
   b. inverted virtual image
   c. upright virtual image
   d. inverted real image
7. The percentage of oxygen in air is
   a. 20.95%  b. 2.097%  c. 0.03%  d. 78.8%

## IV. Give one (or two) word(s) for the following. (1x8 marks)

1. The SI unit of force.
2. The rapid back and forth movement of a body about a central position.
3. Violin, sitar and guitar belong to this class of musical instruments.
4. Atoms or groups of atoms with a positive or negative charge.
5. A common scale used to measure the magnitude of an earthquake.
6. The process of splitting up of white light into many colours.
7. A relatively small celestial body that revolves around a planet.

## V. Give two examples for the following. (2x5 marks)

1. Percussion instruments
2. Liquids that allow electric current to pass through.
3. Defects of the eye
4. Magnetic material
5. Inner planets of our solar system.

## VI Short answer type questions. (2x5 marks)

1. What are the disadvantages of friction?
2. Why does a balloon burst when too much air is blown into it?
3. How does ozone layer protect life on Earth?
4. What is electroplating?
5. What is potable water? State the characteristics of potable water

## VII. Long answer type questions.

1. With the help of a labelled diagram, explain the working of an electrolytic cell. (7 marks)
2. i. Draw a neat diagram of a light ray being reflected by a plane mirror. Label the following in your diagram:
   a. incident ray
   b. reflected ray
   c. Normal at the point of incidence
   d. angle of incidence
   e. angle of reflection (3 marks)
   ii. State the laws of reflection. (2 marks)
3. Define the nitrogen cycle. Draw a well-labelled diagram to explain it. (5 marks)
4. Write two main causes and effects of global warming. (5 marks)