

Stride Ahead  
With

# SCIENCE

8



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## 1

Crop Production  
and Management

## Chapter Focus

-  Birth of Agriculture
-  What is a Crop?
-  Methods of Crop Production
-  Animal Husbandry

## Kick-off Activity

## Make a plastic bottle planter

Take a few used plastic bottles (1 ℓ). Wash them thoroughly and wait for them to dry completely. Cut the bottle from the middle as shown in the picture. Punch 2 holes on each side of the cut portion in a way that a thick thread can be inserted into these holes. Insert the thick thread into these holes and tie them securely such that when you hang the bottles they should not veer off to one side.



Line the inside of the bottles with aluminium foil. This will act as an insulator. The foil will not allow too much heat from the sun to dry out the soil completely and at the same time will keep the plant warm enough to grow.

Now, put some soil on the aluminium foil. Then, sow some seeds. Hang the bottles in a place where they can get proper sunlight. Keep watering them from time to time.

You have just reused some plastic bottles that would have taken a few thousand years to decompose.



## BIRTH OF AGRICULTURE

Humans began as hunters and gatherers. They used to hunt for animals and gather food from plants and their various parts. Around 11,500 years ago they gradually realised that they could grow plants that can in turn provide them food. Thus, they became farmers. Humans also realised around 10,000 years ago, that they could domesticate animals such as pigs, sheep and cattle. The branch of science that deals with various methods of food production for the benefit of humans is called agriculture. Today, the population of the world is growing rapidly. It has become even more important for us to build newer and better ways of producing crops that can feed such large numbers of people.

## WHAT IS A CROP?

A crop can be defined as a large number of one kind of plants grown together at one place. Crops give us food and fodder for animals, fuel for transport, etc. are its by-products.

Crops can be categorised on the basis of the seasons that they are grown in. This is known as the **cropping pattern**. In India, there are mainly three types of crop cycles:

### Kharif Crops

The crops grown during the monsoons (June–October) are called *kharif* crops. Seeds of these crops are sown at the beginning of the monsoon season. After maturation, these crops are harvested towards the end of the monsoon season. Some examples of *kharif* crops are maize, millets (jowar and *bajra*), cotton, paddy, soyabean, green gram, black gram and sugarcane, etc.



Rice



Sugarcane



Wheat



Mustard

### Rabi Crops

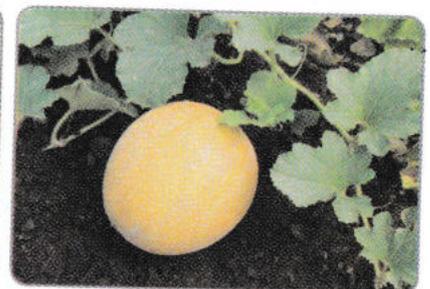
Crops that are grown in the winter season which extends from November to April are called *rabi* crops. These require less water as compared to *kharif* crops. Seeds of these crops are sown in the beginning of the winter season and harvested in April/May. Some examples of *rabi* crops are wheat, pea, linseed, barley and mustard.

### Zaid Crops

These include crops that are grown from March to June between the *rabi* and the *kharif* crops. Watermelon, cucumber and muskmelon are some examples of *zaid* crops.



Cucumber



Muskmelon

## Check Point

Sort out the crops given in the list below as per the three main categories and write in the designated columns in the table.

Paddy                      Jute                      Watermelon                      Mustard                      Wheat  
Cotton                      Soyabean                      Peas                      Linseed                      Muskmelon

Rabi	Kharif	Zaid

## METHODS OF CROP PRODUCTION

The basic activities performed by a farmer in the field to grow a crop are called agricultural practices. With time, these practices have evolved giving rise to modern agriculture that can support an increasing population. Farmers need to take into consideration different factors that would lead to maximum yield from their land. Let us understand the steps that are involved in the process of agriculture of all major crops.

While producing a crop a farmer has to keep in mind the properties of soil, climate, amount of rainfall, temperature, altitude, etc. Depending upon these parameters, farmers decide which crops are to be cultivated and at what time of the year.

The stages involved in producing a crop include:

- |                   |                     |                   |
|-------------------|---------------------|-------------------|
| 1. Crop selection | 2. Land preparation | 3. Seed selection |
| 4. Seed sowing    | 5. Irrigation       | 6. Crop growth    |
| 7. Fertilisation  | 8. Harvesting       | 9. Storage        |

Before we get to know about each stage in detail let us first get to know about the agricultural implements (tools) used in farming during its various stages.

### Do you know?

India is the second largest agricultural producer of the world. In terms of export, India is the 7<sup>th</sup> largest in exporting agricultural produce.

Used for	Name and Function of the Implements	
Preparation of soil		 <p style="text-align: center; color: #f4a460;"><i>Plough</i></p>
	The plough helps in turning the soil.	

Used for	Name and Function of the Implements	
	 <p><i>Hoe</i></p>	<p>A hoe loosens the weeds and turns the soil.</p>  <p><i>Cultivator</i></p> <p>A cultivator prepares the soil for the sowing of seeds.</p>
Sowing	 <p><i>Seed drill</i></p>	<p>A seed drill sows seeds at equal distance from one another and at proper depth.</p>
Irrigation	 <p><i>Moat</i></p>	<p>A moat is a container in which water is drawn from a well using a pulley.</p>  <p><i>Dhekli</i></p> <p>In <i>dhekli</i> a pole with bucket on one side and heavy weight on the other side is used to obtain water from the well.</p>
	 <p><i>Rahat</i></p>	<p>In <i>rahat</i>, an animal, usually a buffalo or an ox, is used to draw water from the well.</p>  <p><i>Chain pump</i></p> <p>In a chain pump several buckets are attached to a long chain positioned on a circular disc.</p>
	 <p><i>Motor pump</i></p>	<p>Here water is drawn up with the help of motors. These motors are called motor pumps</p>
Harvesting	 <p><i>Sickle</i></p>	<p>Sickle is an implement with a curved metallic blade used for reaping grains.</p>  <p><i>Combine harvester</i></p> <p>Combine harvester is used in harvesting a wide variety of crops.</p>

Once the crop is selected on the basis of factors such as season, price of the crop and its demand in the market the farmers begin other stages that follow in its production. Let us look at all the stages now in detail.

## Preparation of soil

This is the first and one of the most important steps. Turning the soil is important because it loosens the soil. Loose soil allows the roots to breathe easily even when the roots go deep into the soil. Earthworms and other microbes present in the soil help loosen the soil and are called the *friends of the farmer*. They also add humus to the soil.

As plants and animals die they are mixed into the soil. These are acted upon by the soil microbes and converted into simple nutrients, which are beneficial to the plants. Since only a few centimetres of the top layer of the soil supports plant growth, turning and loosening of the soil brings the nutrient-rich soil to the top.

The process of loosening and turning of soil is called **ploughing** or **tilling**. This could be done with the help of a plough, a hoe or a cultivator. Sometimes additional water or manure is added to the soil depending on its condition.



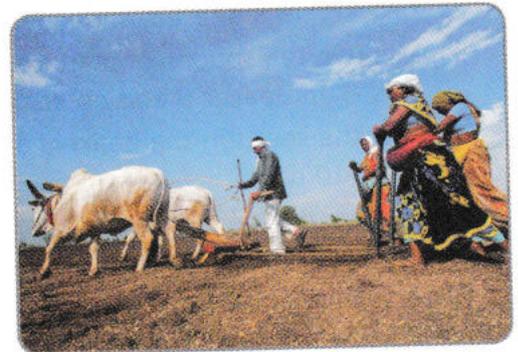
*Ploughing using modern equipments*

## Seed selection and Sowing

After the preparation of the soil, high quality or healthy seeds are selected and dispersed in the field by the process called sowing. Sowing can be done manually (by hand) or by using seed drilling machines.

Some crops are first grown into seedlings in a small area before being transplanted to the main field, e.g. paddy.

It is important to remember that even with an improved variety of a plant the crop would not be good enough if the seeds are bad. A common practise is to soak seeds under water to assess the condition of the seeds. The bad seeds become light and float on the water surface whereas the good seeds sink to the bottom. Thus, it becomes easier to identify bad seeds from the good lot.



*Seed sowing*

## Adding manure and fertilisers

Plants need nutrients to grow. As the plants absorb nutrients they slowly start depleting from the soil. In order to bring the balance back, nutritional supplements such as natural manure and chemical fertilisers are added to the soil.

Manure is the product of decomposition of plants and animal wastes. Fertilisers are chemical compounds consisting of a particular plant nutrients and are produced commercially. Some examples of fertilisers are—urea, ammonium sulphate, super phosphate (monocalcium phosphate), potash, NPK (Nitrogen, Phosphorus, Potassium), etc.

The use of fertilisers has brought about marked growth of yield in maize, wheat, paddy and other crop produces. However, excessive use of fertilisers could hamper the natural content of the soil resulting in degeneration of the quality of the soil. Thus, using manures is a better alternative to help maintain the fertility of the soil.

The table given below distinguishes between manures and chemical fertilisers.

Chemical fertilisers	Organic manure
These are chemical salts	Natural substance obtained by the decomposition of animal waste and plant residues
They are prepared in factories	Could be prepared in the field or in a small set up
They contain absorbable nutrients only	Contain other things along with absorbable nutrients
They are effective and show immediate action	Effective but slow in producing results
They can be easily washed away by water	Can remain in the soil for long periods

## Activity

**Aim:** To understand the role of manures and fertilisers in the growth of plants

**Materials required:** Green *moong* seeds, a petri-dish, three beakers, some soil, a packet of NPK fertiliser, some organic manure, water and a measuring scale

### Procedure:

1. Soak the *moong* seeds overnight in a petri-dish to make them soft.
2. Take soil in 3 beakers and label them as Beaker A, B and C.
3. Mix two tea spoons of manure in Beaker A, two teaspoons of NPK in Beaker B and no additional nutrients in Beaker C.
4. Sow the seeds in the beakers and place them in the sun for 8–10 days.

Make sure the soil does not dry completely during the course of your experiment.

**Observation:** Measure the length of the plants using a scale and note your observation below.

A: \_\_\_\_\_

B: \_\_\_\_\_

C: \_\_\_\_\_

**Discussion:** The length of the plants in both A and B are more than that in C because of the extra nourishment that the manure and the fertiliser have provided. The length of the plant in Beaker A however is still not more than Beaker B as manure takes more time to act than a fertiliser.



To avoid using excessive fertilisers a farmer could also leave the field uncultivated in between two crops—a practise called **fallow**. In addition to this, using manure can improve soil texture and its water retaining capacity. Thus replenishing all the nutrients.

Soil nutrients could also be replenished through **crop rotation**. This means growing different crops alternately. The process of growing different crops in succession on a single piece of land to avoid exhausting the quality of the soil and to control weeds and pests is called **crop rotation**. Earlier, farmers in northern India used to grow legumes as fodder in one season and wheat in the next season.



*Crop rotation*

**Mixed farming** is a practise where two types of crops are grown simultaneously increasing the yield. Here the two crops are chosen in a way to ensure that they fulfill each other's nutritional needs. For example, the *rabi* crops wheat, gram and mustard can be used in mixed farming.

Now-a-days farmers use **biofertilisers**. These are preparations containing living cells of good microorganisms that help crop plants' uptake of nutrients. Biofertilisers increase the nitrogen fixation rate in the soil and help crops grow better.



*Mixed farming*

## Irrigation

Water is the most important element for the growth of plants. However, different crops require different quantities of water at different times during their growth. That is why water through excessive rain or flood leads to the destruction of crops.

Irrigation may be defined as the science of artificial application of water to the land in order to fulfill the water requirements of the crops for the complete nourishment of the crops.

You have already learnt about the different implements of irrigation from the table given on page no. 16. Some of these are a more traditional methods of irrigation, while some others have made their way into more modern methods.

### Traditional methods of irrigation

**Moat, chain-pump, dhekli, and rahat** are some of the **traditional** implements of irrigation, and involve more effort on the farmer's end as these tools use physical force for the purpose of drawing water. In case of modern methods we use machines or pumps to draw water.

### Modern methods of irrigation

Modern methods of irrigation help us to use water cautiously with less effort. Here the farmer saves water and energy with more effective results.

Some of the modern methods of irrigation are described below.

- **Sprinkler System:** This constitutes of a system of pipelines with the main pipeline going along the field and giving rise to a number of smaller and thinner sub-channels.

The smaller pipes are fitted with a rotating nozzle that sprinkle water over the crop when required. The water is allowed to flow through the main pipe under pressure with the help of a pump. Through the rotating nozzle the crop receives water as if it is raining.

**Uses:** Sprinkler irrigation is very useful in sandy soil where the soil is porous and escapes quickly. This system is particularly appropriate where there is limited or irregular water supply for agricultural use. It is suited for crops that are grown closely together such as cereals, pulses, wheat, sugarcane, groundnut, cotton, vegetables, fruits, flowers and spices.

- **Drip irrigation system:** Drip system is more effective in terms of saving water. In this system, the water falls drop by drop near the roots hence the name.

**Uses:** It is the best technique for watering fruit plants, gardens and trees. It can be very useful in places of water scarcity.



*Sprinkler system*



*Drip irrigation system*

## Protection from weeds

All plants need similar resources for growth and sustenance. That is the reason, farmer needs to clear the field of all additional plants to minimize competition and maximise the chances of easy availability of resources for the main crop.

The wild, unwanted plants that grow in the crop field during cultivation and compete with the crop for space, water and other resources are called **weeds**.

Many aggressive grass varieties like the smooth tufted grass and erect grass are weeds of paddy crop.

The process of removal of weeds is called **weeding**. Some weeds interfere even in harvesting and may also be poisonous for animals and human beings.

Major part of agriculture comprises the removal and control of weeds. The best time for the removal of weeds is before they produce flowers and seeds. The different methods adapted to remove weeds are:

- **Tilling** before sowing of crops, thus uprooting and killing of weeds,
- The **manual removal** of weeds by uprooting or cutting them close to the ground, from time to time. This is done with the help of a *khurpi*.
- Using a seed drill to uproot weeds.
- Controlling weeds by using certain chemicals, called **weedicides**. 2,4-d Amine salt, 2,4-D Ethyl ester are some common weedicides used in India.

Chemical weedicides kill the weeds without affecting the crop.

Farmers dilute the weedicide to its desirable concentration and spray in the fields using a sprayer.

**Caution:** Chemical weedicides could affect the health of the farmer adversely. The farmers should cover their mouth and nose properly before spraying. This is why weedicides are sprayed from a distance and away from the body.



*Erect annual grass  
(50-100 cm tall)*



*Smooth, tufted annual grass  
(70-75 cm tall)*



*Weeding*

## Harvesting

After all the hard work comes the sweet harvest. The cutting and gathering of crop after it is fully mature is called **harvesting**.

For a cereal crop maturation usually takes 3 to 4 months. Harvesting in our country is either done manually by a **sickle** or by a **combine harvester**.

In the harvested crop, the grains need to be separated from the additional small plants (corn or other crops). This is done by a two-way process:

1. **Threshing:** The process of separating the grain from husk or straw is called threshing. It can be either done manually (by hand) or by using a machine called treadle thresher.



*Threshing*

2. **Winnowing:** After threshing, we must separate the grains from the chaffs. Winnowing is the process of separating the grains from the chaff using the varied weights of grain and chaff as the method.



*Winnowing*

In India, harvest is celebrated with a lot of enthusiasm. Various festivals like Pongal, Baisakhi, Bihu, Nabanya, Makar Sankranti, Onam, Lohri etc are celebrated in different parts of the country at this time.

### Do you know?

The date for Makar Sankranti, the harvest festival, changes every hundred years due to the revolution of Earth. Now, the Makar Sankranti is celebrated on January 14 but a thousand years ago, it used to be celebrated on December 31.

### Storage and protection of crop

Grains obtained by threshing are dried in the open. Adequate drying of grains is required to prevent the growth of microorganisms that can harm the grains. The various methods of storing grains for a longer time before they can be used are:

- Keeping dried grains in **jute bags, metallic bins or mud bins**.
- Large scale storage of grains in **silos and granaries**.
- The dried grains being stored in gunny bags, and placed in properly ventilated concrete halls, known as **godowns**.



*Silos*

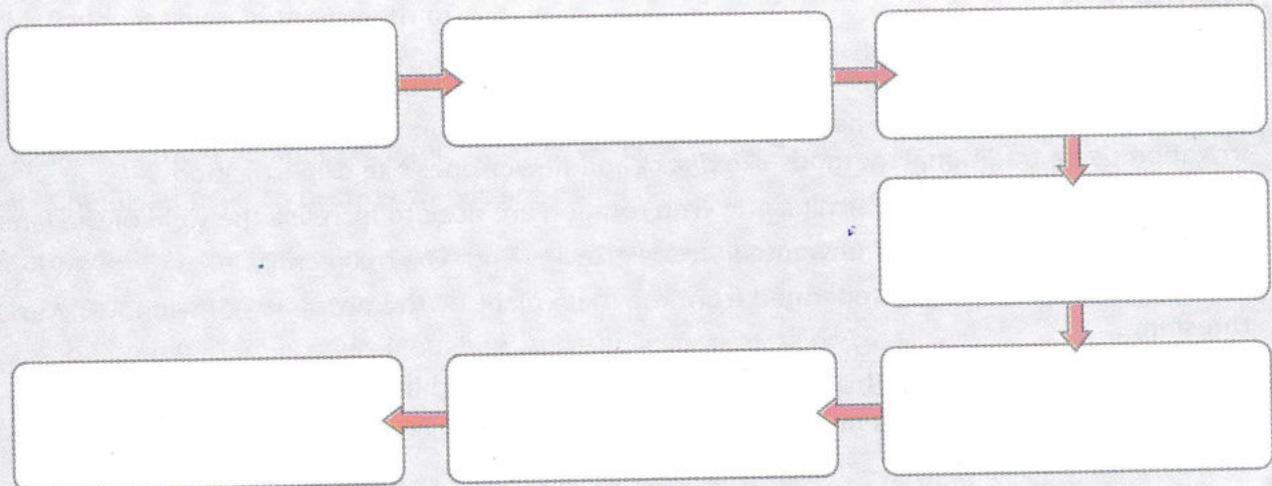


*Mud bins*

In large godowns pesticides are used to keep away animal pests or microbes. Routine inspection is also required to be done to ensure that the grains are protected at all time.

### Check Point ✓

Make a flow chart to explain the main steps involved in agriculture.



## ANIMAL HUSBANDRY

Animal husbandry is the scientific management of livestock for food or other useful harvests. It includes feeding, breeding and disease control of the animals concerned.

Animal husbandry has led to many useful produce. Some of these are:

- Milk produced from cows, goats, buffaloes and other animals which eventually leads to the production of cheese, *ghee*, butter, etc.
- Eggs produced from hen, goose, turkey, duck, etc.
- Meat produced from goats, sheep, poultry, ducks, etc.
- Fish
- Wax
- Honey

### Do you know?

In India, there are 36 pure cattle breeds. Five of these breeds are known for their milking prowess. The rest of the breeds are used as plough animals.

### Key Terms



- **Crops:** Same kind of plants grown in large scale at a particular area under controlled conditions
- **Mixed Farming:** Practise where two types of crops are grown simultaneously increasing their yields
- **Crop Rotation:** Practice of growing different crops alternately
- **Irrigation:** Science of the artificial application of water to the land in order to fulfill the water requirements of the crops for their complete nourishment
- **Drip Irrigation System:** An irrigation system wherein the water falls drop by drop near the roots
- **Sprinkler Irrigation System:** An irrigation system wherein the water is sprinkled on crops using a system of pipelines
- **Weeds:** The wild, unwanted plants that grow in the crop field during cultivation and compete with the crop for space, water and other resources
- **Harvesting:** The process of cutting and gathering of crop after it is fully mature
- **Threshing:** The process of separating the grains from the straw
- **Winnowing:** The process of separating the grains from the chaffs
- **Animal husbandry:** Scientific management of livestock for food or other useful harvests that includes feeding, breeding and disease control of the animals concerned

### Recall



- Agriculture in India entails the cultivation of *Kharif*, *Rabi* and *Zaid* crops.
- Methods of crop production have several steps such as preparation of soil using the plough, irrigation using traditional methods like *dhekli* and newer ones like drip irrigation
- Various methods like mixed farming and crop rotation are used to increase the yield of the land.
- Weedicides are used against unwanted weeds growing with the main crop.
- After harvesting, grains are separated from the main plant by the processes of winnowing and threshing.
- The harvested and separated crop is then stored in large mud bins, silos or godowns.
- Animal husbandry has led to many useful produce such as increase in the production of meat, eggs, fish and honey.

## Assess Zone

### A. Tick (✓) the correct answer.

- Which of the following are important for the growth of plants?  
a. Temperature      b. Humidity      c. Sunlight      d. All of the above
- Which of the following statement is not true for organic manure?  
a. It enhances water holding capacity of soil.      b. It has a balance of all plant nutrients.  
c. It provides humus to soil.      d. It improves texture
- The practise in which farmers leave the field uncultivated in between two crops is  
a. ploughing      b. harvest      c. fallow      d. sowing
- Method that uses motor pump to lift water for irrigation is  
a. drip      b. moat      c. *dhekli*      d. chain pump
- The process of loosening or turning the soil is called  
a. sowing      b. tilling      c. harvest      d. winnowing
- Method by which grains are separated from the chaff is called  
a. sowing      b. tilling      c. harvest      d. winnowing
- Fertilizers and Manures are a way of  
a. making the soil loose      b. replenishing nutrients in the soil  
c. making the soil moist      d. getting rid of weeds
- Which of the following is an implement used for removing weeds?  
a. Plough      b. Seed drill      c. *Khurpi*      d. *Rahat*
- What do we use for making compost?  
a. Microbes      b. Earthworm  
c. Animal and plant waste      d. All of the above
- Which of the following is used for tilling the land by a cultivator?  
a. Tractor      b. Bullock      c. Buffalo      d. Horse

### B. Fill in the blanks.

- Paddy is sown in the month of \_\_\_\_\_.
- \_\_\_\_\_ can be grown between the months of March–June.
- \_\_\_\_\_ is used for sowing of seeds.
- Plants grown in large scale for food are called \_\_\_\_\_.
- Chemicals used to destroy weeds are called \_\_\_\_\_.

### C. State whether the following statements are true or false.

- Kharif* crops grow during winter. \_\_\_\_\_
- Soil preparation involves ploughing and application of weedicides. \_\_\_\_\_
- To avoid spoilage, grains should be washed thoroughly in water. \_\_\_\_\_
- Roots of wheat house *Rhizobium* bacteria. \_\_\_\_\_
- Practises like crop rotation can increase the yield further. \_\_\_\_\_

**D. Match the following.**

- |                         |                                |
|-------------------------|--------------------------------|
| 1. Rabi crop            | a. Weedicide                   |
| 2. Hoe                  | b. Separating grain from straw |
| 3. 2,4-D Amine salt     | c. Absorbable nutrients        |
| 4. Threshing            | d. Loosening of soil           |
| 5. Chemical fertilizers | e. Wheat                       |

**E. Give reasons for the following.**

1. Crop rotation help in replenishing soil nutrients.
2. Manures are better than chemical fertilizers.
3. Earthworm are considered the friend of the farmer.
4. Drip irrigation could be effective in places with water scarcity.
5. Physical removal of weeds is better than weedicides.

**F. Answer the following questions in one word or a single sentence.**

1. Define Agriculture.
2. What do you understand by mixed farming?
3. Name the chemicals that are commonly used to kill weeds?
4. What are the implements used for the traditional irrigation method?
5. Where do farmers store their grains?

**G. Answer the following questions in brief.**

1. What are the factors required for the process of germination?
2. What are biofertilisers? How do they improve crop yield?
3. Give the difference between fertilizers and manures.
4. What is fallow? How does it help in yielding better crops?
5. How are the grains obtained from the crop?
6. Differentiate between mixed farming and crop rotation.
7. What are the various food products that we get from animals?

**H. Answer the following questions in detail.**

1. Classify crops as per the seasons they grow. Explain each with examples.
2. What are the different methods by which nutrients are replenished in the soil? Explain each in brief.
3. What is irrigation? Describe different ways in which irrigation happens in India.

### Out of The Box

1. You are made in charge of a 15 days camp in a remote area of a tropical rainforest.
  - a. Apart from tinned food, what other food rations would you like to stock up for your team?
  - b. Which methods would you employ for safe storage of the food?
2. Which system of irrigation would you suggest for plants grown on either side of a newly constructed road? Give reasons.

## In Real Life

To ensure food security, alternate methods of pest control like the bio-pesticides need to be introduced to farmers in a consorted manner to take Green Revolution a step forward in the coming generation. Moreover, organic farming has emerged as an alternative to ever-changing agriculture practices. The organic crop as produced is safe to consume as it does not have any chemicals or pesticides.

## Subject Enrichment

### Activity Zone

Visit a nearby farm and talk to the farmers there. Ask them about the difficulties they face in agriculture. Get to know how they solve them. Do they use any kind of technology to prevent these challenges? Help them with the information you now know and share it with them.

### Project Zone

Go to a nearby agricultural institute. Find out what new varieties of crop plants have been produced there so far. Try to understand the method that was adopted to produce these new varieties.

OR

Go to a nearby godown or a granary. Find out the various steps a crop goes through while it is being stored. Explore the efficiency of storing grains using these methods and how effective they are.

## Web-links

- Rice harvester: <https://www.youtube.com/watch?v=kqIAAtigSko>
- Irrigation: <https://www.youtube.com/watch?v=amrCMakolKA>
- Harvest festivals: <https://www.youtube.com/watch?v=-5JCBcTPKOk>

## Crosslinks

Refer to your geography book and mark the various cereal producing states in the map of India. Can you identify some areas in a state that do not produce any major crops? Can you guess why? Do not forget to make a legend with your map.

## Teacher's Note

Project-based learning could be used to teach this chapter better. Arrange the trips to a nearby farm and an agricultural research institute and help them understand the different aspects of crop production. You could also arrange a trip to a nearby silo or granary to help students understand how various crops are stored. Inculcate respect for farmers in the student's mind and make them aware of the importance they have in our society.

# 2

## Microorganisms— Friends or Foes

### Chapter Focus

- What are Microbes?
- Beneficial and Harmful Microorganisms
- Nitrogen Fixation
- Food Preservation

### Kick-off Activity

#### Observing life we cannot see

Take a paper plate with some food items such as a piece of cut apple, an orange slice and its peel, a slice of bread, and a small piece of banana. Sprinkle a few drops of water on the plate that has these food items. Take a zip lock bag and place the filled plate inside the bag.

Leave the bag as is for a week. You will observe that the food pieces have moulds on them and the bag is giving a distinct odour of rotten food. This experiment confirms the presence of microbes present in the atmosphere that act on our food and can spoil it, that is, make food not fit for consumption if left in open even for a few days.



#### WHAT ARE MICROBES?

The literal meaning of the word **microorganism** is a very small living thing that can only be seen under a microscope. Thus, they are also known as microscopic organisms or microbes. The study of microbes is referred to as **microbiology**.

Microorganisms are everywhere around us. Be it inside the soil, the ocean floor, high up in the atmosphere, deep inside the rocks and even within the Earth's crust.

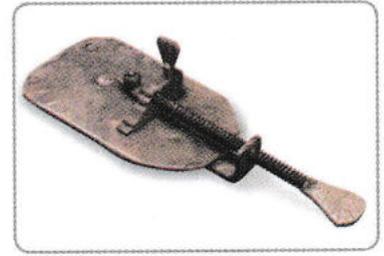
#### History of Microbiology

The Dutch scientist, regarded as the **father of microbiology**, Antonie van Leeuwenhoek was originally a businessman by profession. He ran his own shop of fabrics and wanted to study on how to improve

the quality of threads, which makes up a fabric. In order to observe a thread more carefully, he started to make his own lens and designed a microscope in the process. He accidentally observed microbes for the first time and got his work published in the Royal Society of London.



*Antonie van Leeuwenhoek*



*Leeuwenhoek's microscope*

## Activity



**Aim:** To observe microorganisms that cannot be seen through naked eyes.

**Materials required:** Some soil, water and a microscope.

### Procedure:

1. Collect some soil from your school ground.
2. Mix it in water in a beaker and let the soil settle down.
3. Take a drop of water from the beaker and put it on a slide.
4. Keep the slide under the lens of the microscope and observe it. Take the help of your teacher in placing the slide correctly and tuning (adjusting to get a clear view under the lens) the microscope.



**Observation:** Make a diagram of what you see under the microscope in your notebook. Write the description of what you have just observed in your own words.

## Types of Microorganisms

Microorganism can be classified into four major groups—fungi, bacteria, protozoa and algae.

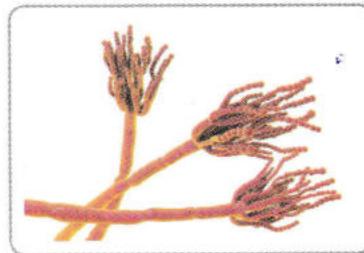
- Fungi:** Fungi (singular fungus), are a varied group including the yeasts, rusts, mildews, moulds, and mushrooms. Not all fungi are microscopic—we see mushrooms cropping in our garden during monsoons proving the fact. Fungi grow best in dark and moist places but are also found in desert and cold regions.

### Do you know?

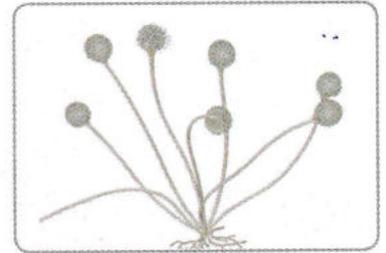
Mushrooms are more similar to animals than they are to plants. They are parasitic like animals instead of being autotrophic like plants.



*Mushrooms*

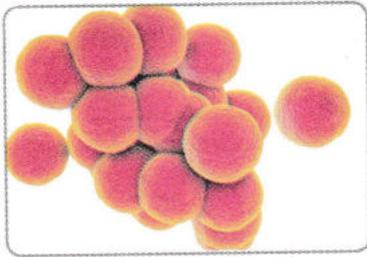


*Penicillium*

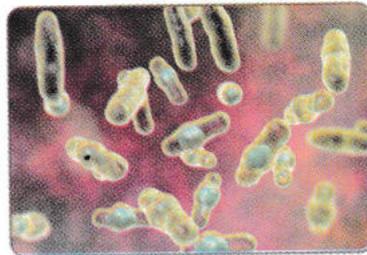


*Rhizopus (bread mould)*

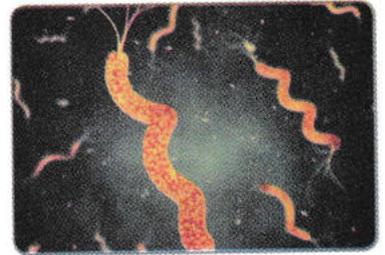
- b. **Bacteria:** Bacteria are the simplest and the most ancient organisms on the Earth. They do not have a proper nucleus and can be both beneficial and harmful to humans. For example, *Lactobacillus* is used in making curd whereas *Clostridium* can cause food poisoning.



*Staphylococcus aureus*

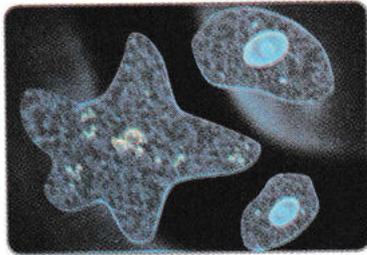


*Clostridium perfringens*

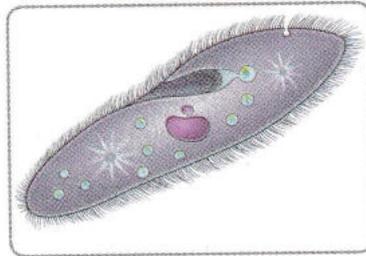


*Spirillum*

- c. **Protozoa:** These are unicellular organisms that behave like animals and belong to a group called protista. Here a single cell performs all major functions. Common examples are *Entamoeba* causing amoebiasis and *Euglena*. *Euglena* contains chlorophyll and can photosynthesise food.



*Amoeba*

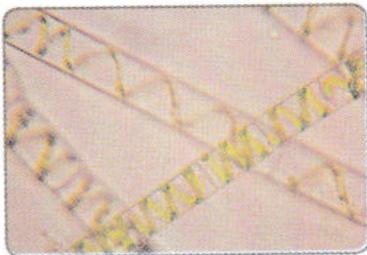


*Paramecium*

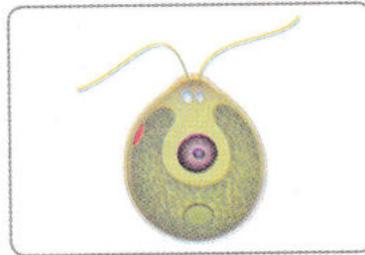


*Trypanosoma brucei*

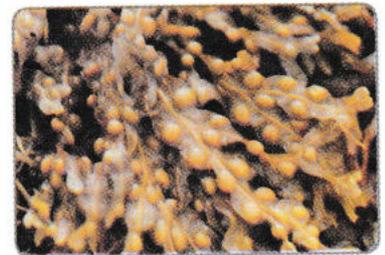
- d. **Algae:** These are unicellular organisms that can photosynthesise food due to the presence of chlorophyll. The cyanobacteria or blue green algae, *Chlamydomonas* and *Spirogyra* or water silk are common examples of algae.



*Spirogyra*



*Chlamydomonas*



*Bladderwrack*

- e. **Virus:** Viruses are also microscopic. In fact they are several times smaller than other microbes. However, viruses are unique. They behave like living organisms only inside a living cell, like a plant or animal cell or a bacteria. Viruses are extremely harmful and cause various diseases like common cold, flu, measles, chicken pox etc. Some examples of viruses are flu virus, cold virus and human immune deficiency virus (HIV), etc.

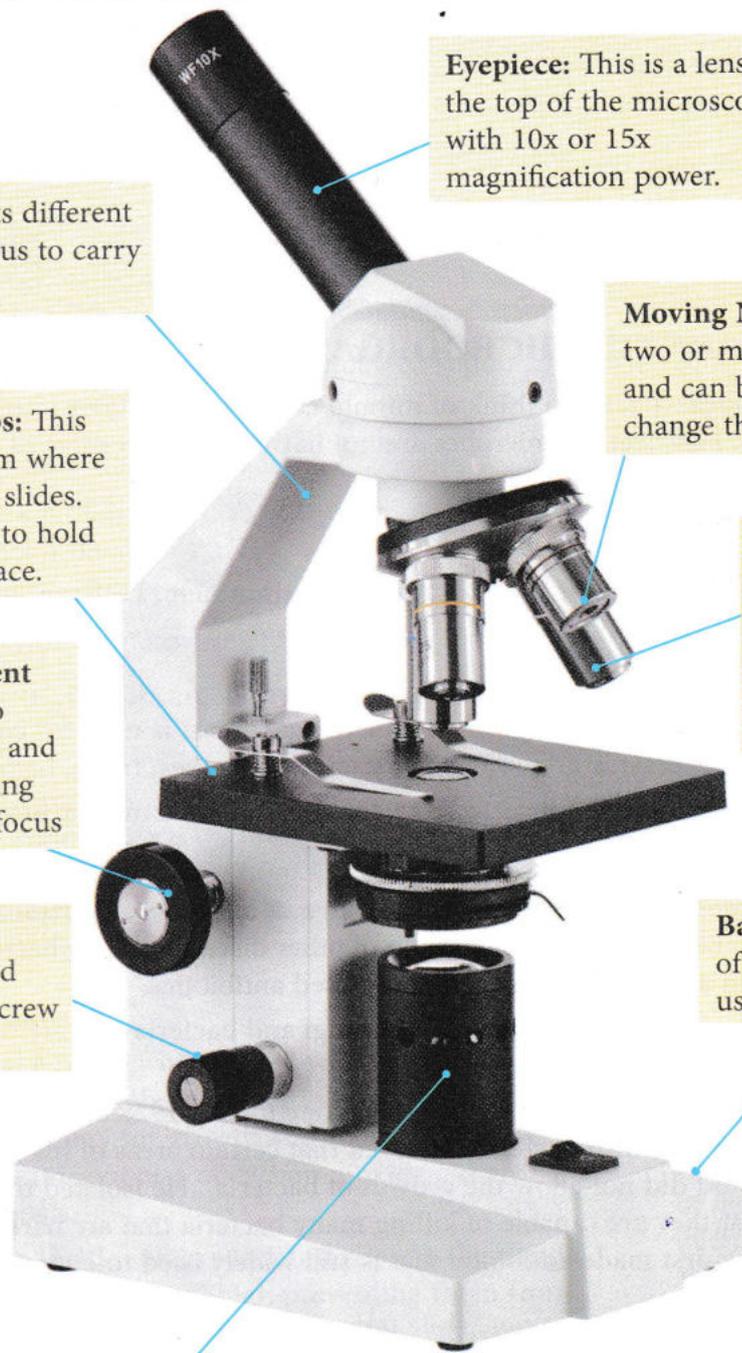


*Flu virus spread*

## Microscope

The current day microscope that you see in the school laboratory is very different from the instrument that Leeuwenhoek had designed. A simple optical microscope can magnify an object up to ten times its actual size denoted by 10x. A compound microscope has two systems of lenses for even greater magnification. We usually mount the specimen on a glass slide, cover it with a coverslip and observe and examine it for closer inspection under a microscope.

Different parts of the microscope and their functions will be clear from the spread given below.



**Arm:** It supports different parts and helps us to carry the microscope.

**Stage with clips:** This is a flat platform where you place your slides. There are clips to hold the slides in place.

**Coarse adjustment Screw:** It helps to move the lens up and down thus bringing the specimen in focus

**Fine adjustment Screw:** To be used after the coarse screw for better clarity

**Eyepiece:** This is a lens at the top of the microscope with 10x or 15x magnification power.

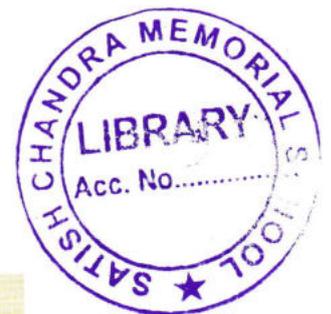
**Moving Nosepiece:** This holds two or more objective lenses and can be rotated to easily change the magnification.

**Objective lenses:** One of the most important parts of a compound microscope, as they are the lenses closest to the specimen.

**Base:** The bottom of the microscope, used for support.

**Illuminator:** Some microscopes come with a light to help one see the specimen better. More commonly microscopes have a mirror that reflects light from an external light source through the bottom of the stage.

*A Compound Microscope*



## Check Point

1. State the function of the following parts of the microscope:

- |              |       |                   |       |
|--------------|-------|-------------------|-------|
| a. Eye Piece | _____ | b. Stage          | _____ |
| c. Base      | _____ | d. Objective Lens | _____ |
| e. Clips     | _____ | f. Arm            | _____ |

2. Give two examples of each of the following:

- |             |       |       |
|-------------|-------|-------|
| a. Algae    | _____ | _____ |
| b. Bacteria | _____ | _____ |
| c. Protozoa | _____ | _____ |
| d. Fungi    | _____ | _____ |
| e. Virus    | _____ | _____ |

## BENEFICIAL AND HARMFUL MICROORGANISMS

Whenever we think of microbes we tend to think of minute creatures that enter into our bodies causing us pain and diseases. However, all microbes are not harmful. In fact most of them are beneficial in more ways than one.

### Beneficial Microbes

Microbes are vital for the survival of living organism in the environment. Different ways by which they help us are described below.

#### Commercial use

We use microbes for the production of alcohol, wine and vinegar. Yeast is used for commercial production of alcohol and wine. Yeast is grown in sugary juices of grapes, fruits, barley, rice, etc. The process by which sugar in juices are converted to alcohol is called **fermentation**.

#### Medicinal use

All of us fall ill some time or the other; the doctor usually give us antibiotics. **Antibiotics** are medicines made from micro-organisms that kill or stop the growth of other disease-causing bacteria. Streptomycin, tetracycline and erythromycin are some of the commonly used antibiotics.

Now-a-days many antibiotics are produced from certain fungi and bacteria and are used to cure diseases even in plants and animals.

The discovery of antibiotics tells a great story and inspiring one too. In 1928 Scottish Scientist Alexander Fleming, while working with bacteria observed that certain areas of his petridish that were contaminated with green mould did not allow the growth of bacteria. He isolated the moulds and cultured them to discover that they are capable of killing many bacteria that are harmful to humans. This mould, Penicillin was the first made antibiotic that is still widely used to cure many ailments.

**Caution:** However we should be very cautious while taking antibiotics. They should be taken only on the recommendation of a practising doctor. Indiscriminate use of antibiotics could cause our body to get used to the bacteria. This condition is referred to as antibiotic resistance and can lead to a state where the diseases are not cured by medicines anymore. You should also finish your antibiotic course once you start it, otherwise the disease does not get fully cured.

## Microbes in our body

Surprising though it might seem, some bacteria live in our body and actually help us all the time. Certain bacteria are a part of our intestine. These help a great deal in the process of digestion and keeping our body disease free. After an antibiotic treatment, these beneficial bacteria also get killed along with the harmful ones. We should take lots of curd or probiotic products after an antibiotic course to replenish the good bacteria of our gut.

## Domestic use of microbes

You must have had *raita* or curd with your food. And who can resist a cool glass of *lassi* or buttermilk in summers especially after a long session of playing. *Lactobacillus* is a bacteria that helps in making curd, yogurt and cheese. These bacteria multiply very quickly in the milk and turns it into curd. The same bacteria help in making cheese and probiotics.

### Activity



**Aim:** To understand the growth of beneficial microorganisms.

**Materials required:** Lukewarm milk, two bowls, spoon and some curd.

**Procedure:**

1. Take lukewarm milk in two bowls.
2. Mix a tea-spoon of curd in one of the bowls with lukewarm milk and stir well. Label it Bowl A.
3. Leave the other bowl as it is. Label it Bowl B.
4. Keep the bowls outside overnight covered in a cloth



**Observation:** Note your observation in the space below:

Bowl A: \_\_\_\_\_

Bowl B: \_\_\_\_\_

**Discussion:** You would notice that the milk in Bowl A has turned into curd. This is because the microbes (*Lactobacillus*) in the spoonful of curd we had put in Bowl A multiplied overnight turning the bowl of milk into curd. Bowl B on the other hand remained unchanged.

## Microbes and bakery

Yeast is used to make bread while mixed with sugar, flour and warm water. The yeast uses the sugar and flour as its food. It breaks the food for energy for growth and reproduction by budding. As it does this bubbles of carbon dioxide gas are produced in the dough.

These bubbles make the dough expand and rise. As the dough is extremely sticky it traps the bubbles, preventing them from escaping. When the dough is baked the heat kills the yeast and we get fluffy, soft bread and cakes. *Saccharomyces* is a strain of fungi that is known as the baker's yeast for this reason.

### Do you know?

Fermentation is actually a process of respiration for yeast and other microbes where they break down simple sugar to produce energy.

## Activity

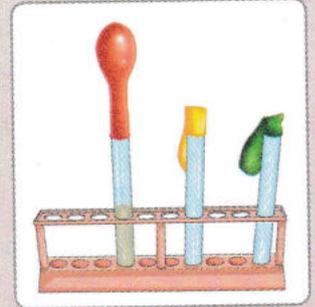


**Aim:** To observe the production of carbon dioxide by the yeast cells in sugar solution.

**Materials required:** Three test tubes, sugar solution, test tube rack, yeast, three balloons, elastic bands and three stirrers.

### Procedure:

1. Take three test tubes and place them on the test tube rack. Make sure the test tubes are completely dry before using them for the experiment.
2. Label the test tubes A, B and C.
3. Add a few drops of sugar solution in Test tube A and B and plain water in Test tube C. Keep the level of liquid in all the test tubes same.
4. Add a good amount of yeast in Test tubes A and C and stir well with different stirrers for each test tube.
5. Attach three balloons over A, B and C and make them air tight using rubber bands.
6. Keep them overnight.



**Observation:** Note your observation in the space below:

A: \_\_\_\_\_

B: \_\_\_\_\_

A: \_\_\_\_\_

**Discussion:** The balloon in Test tube A gets inflated demonstrating that a gas was produced here. If you pass this gas through lime water you will see that it turns milky proving that the gas produced is carbon dioxide. The process that occurred in Test tube A is fermentation.

Test tube B does not produce carbon dioxide because there is no yeast present for the process of fermentation.

Test tube C, though has yeast, does not ferment because there is no sugar solution present in it. If you smell the liquid in test tube A you will see that it gives a strange smell, that of alcohol, again a product of fermentation.

### Other common products

Some special bacteria are used to produce vinegar, coffee and tobacco, while some are even used in making toothpaste.

### Microbes in recycling nutrients

All fungi and some bacteria are saprophytic in nature. They derive nutrients from the dead and decaying matter and thus play a vital role in keeping the nutrient cycle rolling. Fungi and bacteria as decomposers continuously work to release necessary nutrients and other elements into the soil.

### Vaccines and Microbes

Ask your parents and take out your vaccination card from your childhood. Make a note of all the vaccines that you have taken so far. Does it not seem like a long one?

Our body has its own system of fighting against disease causing organisms called the immune system. The body produces specific proteins called antibody in response to any foreign element entering the body.

Vaccine is actually a suspension of weak or killed germs that is administered primarily to prevent disease. Vaccination introduces weak germs in the body to produce these specific antibodies that can defeat the germs while the real infection breaks off.

Several diseases such as polio, smallpox, measles, mumps, rubella, varicella, influenza, rotavirus, and yellow fever are controlled by vaccines..

### Microbes as food

Some species of microbes of algae, bacteria and fungi are high in protein and are used as food supplement. For example, Chlorella and Spirulina.



*Chlorella*



*Spirulina*

### Harmful Microbes

Microorganisms that can cause diseases in animals and plants are called **pathogen**.

True to all microbes, pathogens are present everywhere and they enter our body through the air we breathe, the water we drink or the food we eat. They can also get transmitted by touching an infected person or carried through an animal. Diseases that can spread from an infected person to a healthy person are called communicable diseases. Examples of such diseases include **cholera, common cold, chicken pox** and **tuberculosis**.

When a person suffering from common cold sneezes, fine droplets of moisture carrying thousands of viruses are spread in the air. The virus may enter the body of a healthy person while breathing the same air.

Some diseases, however, spread from one person to another through other organisms. For example, malaria is caused by a single celled organism, Plasmodium, but is carried from an infected to a healthy person through the female Anopheles mosquito. Organisms that can carry communicable disease from one infected individual to another are referred to as **carriers**.

Housefly is one such carrier. The flies sit on the garbage or animal excreta thus carrying the pathogen which stick to their bodies. They then transfer the pathogen when they sit on uncovered food. Similarly, female Aedes mosquito acts as a carrier for the dengue virus.



*Anopheles mosquito*

Thus we could control communicable diseases by controlling their carriers or other means of transfer. The table below will give you information about some common communicable diseases:

#### Communicable Diseases in Humans

Diseases	Causative pathogen	Mode of transfer	Preventive measures
Tuberculosis	Bacteria	Air/Contact	<ul style="list-style-type: none"> <li>The patient should be kept in complete isolation.</li> <li>Personal belongings of the patient should be kept away.</li> <li>Maintain basic hygiene</li> <li>Vaccination to be given at a suitable age.</li> </ul>
Measles	Virus		
Chicken Pox	Virus		
Polio	Virus	Food/Water	<ul style="list-style-type: none"> <li>Personal hygiene and good sanitary habits should be maintained.</li> <li>Food should be properly cooked and drinking water boiled.</li> <li>Vaccination to be given at a suitable age.</li> </ul>
Cholera	Bacteria		
Typhoid	Bacteria		
Hepatitis B	Virus	Water/unhygienic conditions	

Diseases	Causative pathogen	Mode of transfer	Preventive measures
Malaria	Protozoan	Anopheles Mosquito	<ul style="list-style-type: none"> <li>Using mosquito net and repellents to prevent mosquito bites.</li> </ul>
Dengue	Virus	Aedes mosquito	<ul style="list-style-type: none"> <li>Insecticides should be sprayed to kill mosquitos.</li> <li>Mosquito breeding could be prevented by not allowing water to collect in the surroundings. Any open water drains should be covered.</li> <li>Vaccination to be given at a suitable age.</li> </ul>

Some diseases in plants caused by microorganisms are mentioned below.

### Communicable Diseases in Plants

Diseases	Causative pathogen	Mode of transfer	Preventive measures
Citrus canker	Bacteria	Air	<ul style="list-style-type: none"> <li>Isolating affected plants</li> </ul>
Rust of wheat	Fungi	Wheat seeds	<ul style="list-style-type: none"> <li>Isolating affected seeds</li> </ul>
Bhendi Yellow Vein Mosaic (BYVM)	Virus	Insect	<ul style="list-style-type: none"> <li>Isolating affected plants</li> <li>Spraying of insecticides</li> </ul>
Tomato wilt	Bacteria	Through soil	<ul style="list-style-type: none"> <li>Removal of affected plant</li> </ul>



*Citrus canker*



*Wheat rust*



*Yellow vein*



*Tomato wilt*

### Check Point



Name the causative pathogen of the diseases given below.

- Tuberculosis \_\_\_\_\_
- Citrus canker \_\_\_\_\_
- Cholera \_\_\_\_\_
- Chicken pox \_\_\_\_\_
- Tomato wilt \_\_\_\_\_
- Dengue \_\_\_\_\_

### NITROGEN FIXATION

Nitrogen is one of the most important constituents of all living organisms. It makes an important part of proteins, chlorophyll, nucleic acids and vitamins. Our atmosphere has 78% of nitrogen but atmospheric nitrogen cannot be taken directly by plants and animals.

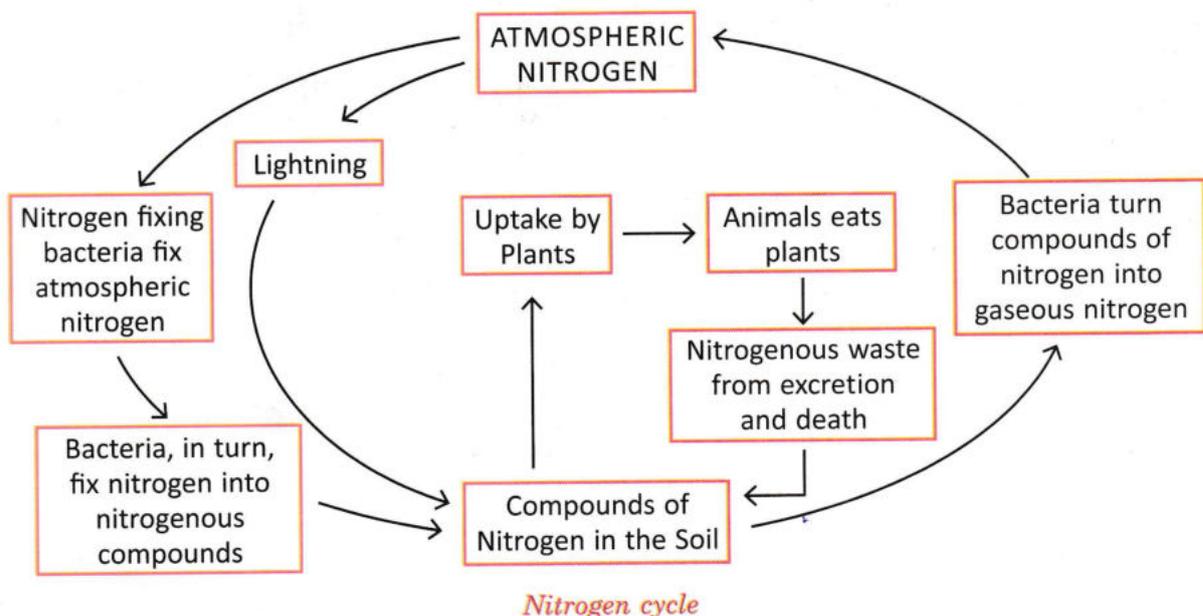
As studied in the previous class, we know that *Rhizobium* are symbiotic bacteria living in the root nodules of leguminous plants such as pea and soyabean that help fix atmospheric nitrogen.

Nitrogen fixation can be defined as the process in which the atmospheric nitrogen is converted into ammonia or other molecules of nitrogen. These nitrogen compounds are then taken up by plants.

The process by which nitrogen is taken in from the atmosphere and is given back to the atmosphere can be defined using the steps given below.

1. Only some nitrogen-fixing bacteria (cyanobacteria) and algae in the soil fix nitrogen from the atmosphere and convert it into compounds of nitrogen. Atmospheric nitrogen can also be converted into nitrogen compounds by exerting tremendous amount of heat, pressure and energy. This is done through some natural process like volcanic action and lightning discharges. Human intervention by combustion and industrial means can also convert atmospheric nitrogen to other molecules of nitrogen.
2. Once nitrogen is converted into compounds that can be used by living organisms, it is absorbed by plants from the soil through their roots.
3. Nitrogen is then used for the synthesis of plant proteins and other compounds.
4. Animals feeding on plants get these proteins and other nitrogen compounds.
5. After death of organisms fixed nitrogen goes back into the soil and is decomposed by the saprophytic microbes.
6. Thus these microbes convert the nitrogenous wastes into nitrogenous compounds to be used by plants again.
7. Certain other bacteria convert some part of the dead to nitrogen gas which is released into the atmosphere.

The total percentage of nitrogen in air is thus maintained with this chain of events which completes the nitrogen cycle.



## FOOD PRESERVATION

We now know that microorganism are both harmful and beneficial. One would appreciate that microbes such as saprophytes help in recycling nutrients. However the same property makes them

spoil our food. These saprophytic microbes though are not pathogenic in nature, they produce substances that could be toxic to our body. Consuming spoiled food thus could lead to **food poisoning**. Common symptoms of food poisoning include nausea, vomiting and diarrhea.

### Do you know?

In Rome soldiers were sometimes paid in **salt**. In fact the word 'salary' is derived from the latin word 'Sal' and 'Salarium' meaning salt.



*Rotten tomatoes*

## Methods of food preservation

We humans have been dealing with the problem of food spoilage since ancient times.

Very early on, we realised that microbes are living organisms and they need food, moisture and air for survival and growth just like we do. Thus anything kept in open for long will be consumed by these microbes. However, it is important that we protect what we eat from these microbes as it can lead to various kinds of diseases in our body.

Some of the methods through which food items can be preserved are described below.

- a. **Preservation by salt:** Salt works as water absorbent and removes excess water from food. In the absence of water, bacteria and other microbes are unable to multiply and hence salt act as a **preservative**. Common salt is used to preserve meat, fish, tamarind, *amla*, etc.
- b. **Preservation by oil:** Edible oils cut off air supply from food preventing microbes from spoiling it. This principle has been used since ages and still exists in the pickle making processes.
- c. **Chemical preservatives:** Sodium benzoate and sodium metabisulphite are common preservatives added to food. These are used in the jams and squashes to check their spoilage.



*Pickle*



*Preservatives mentioned on food labels*

- d. **Preservation by Sugar:** Fruits in squashes, jams and jellies are preserved by sugar. Sugar reduces the moisture content which inhibits the growth of bacteria that spoil food.
- e. **Preservation by Vinegar:** Vinegar prevents spoilage of food by making it acidic in nature. Bacteria cannot live in such an environment. Vegetables, fruits, fish and meat are often preserved by this method.

- f. **Killing Microbes by heat/cold:** Bacteria, even though are somewhat adaptive, are unable to withstand extreme temperatures. Thus refrigerating food helps keep it fresh for longer. Milk is boiled for similar reasons before use, as boiling kills microbes.

- g. **Pasteurisation:** You must have seen 'pasteurised milk' or 'processed milk' written on the milk packets or cartons. **Pasteurisation** is a process by which pathogenic microorganisms in certain foods and beverages are destroyed by heat. The process is named after a French scientist **Louis Pasteur**, who in the 1860s demonstrated that abnormal fermentation of alcohol could be prevented by heating.



*Boiling milk*

The milk is heated to about 70–75°C for 15 to 30 minutes and then suddenly chilled and stored. By doing so, it prevents the growth of microbes. Pasteurized milk can be consumed without boiling as it is free from harmful microbes.



Pasteurised milk



Canning

## Activity



**Aim:** To understand different methods of food preservation.

**Materials required:** Raw mango slices, a knife, salt, oil, sugar, water and 5 petri-dishes.

### Procedure:

1. Cut the mango into five pieces and place them in five separate petri-dishes.
2. Petri dish 1 will have one mango piece covered in salt.
3. Petri dish 2 will have a mango slice covered in sugar.
4. Petri-dish 3 will have a slice of mango covered in oil.
5. Petri-dish 4 will have a plain mango slice. Place it in the refrigerator.
6. Keep the fifth petri-dish with a plain mango slice under the Sun.

**Observation:** Observe all the mango pieces after a few days and note your observation.

**Discussion:** Petri-dish 5 will have fungus growing on the mango slice as it was kept outside the refrigerator and was not treated with any other material. The rest of the slices have been subjected to various treatments that prevent the growth of microbes in them thereby preventing the mango slices from spoiling.

- b. Canning:** In this process the food contents are processed and sealed in an airtight container. Since the cans are airtight, there is no contact with microbes. Canning provides a shelf life ranging from one to five years, although under specific circumstances it can be made to be much longer.

## Key Terms



- **Microorganism:** Organisms that can be observed only under the microscope.
- **Microbiology:** Science involving the study of microbes.
- **Virus:** Infectious agents that replicate inside the body of a living organism.
- **Bacteria:** Unicellular organisms lacking a proper nucleus.
- **Fungi:** Saprophytic organisms that reproduce via spores.
- **Protozoa:** A type of single-celled microscopic organism.
- **Algae:** Non-flowering aquatic organisms containing chlorophyll and thus they produce their own food.
- **Fermentation:** Process by which sugar in juices are converted to alcohol.
- **Antibiotics:** Medicines made from micro-organisms that kill or stop the growth of other disease-causing bacteria.
- **Pathogen:** Microorganisms that cause diseases in animals and plants.
- **Carriers:** Organisms that carry a communicable disease from one infected individual to another individual on organism.
- **Antibodies:** Specific proteins produced by the body to neutralise pathogens.

## Recall



- Microorganisms can be of different types such viruses, bacteria, fungi, protozoa and algae.
- A microscope is a device that can be used to study these minute organisms.
- Microbes are of great use to us. Yeast is used for commercial purposes to make alcohol through the process of fermentation. It can have medicinal uses to make antibiotics, as well as domestic use, when we use Lactobacillus to make curd.
- Microbes can also act as pathogens and infect the organism, either directly or via carriers.
- Immune system is body's own system to fight off diseases.
- Vaccines are weak or dead pathogens that are given for the prevention of diseases.
- Microbial pathogens infect both plants and animals. In plants they cause diseases like citrus canker, yellow vein, tomato wilt, etc. In humans, they cause tuberculosis, chicken pox, polio, etc., entering the body via different mediums or carriers.

## Assess Zone

### A. Tick (✓) the correct answer.

1. Microorganisms that do not show any signs of life outside of a host organism are  
a. viruses                      b. bacterias                      c. algae                      d. fungi
2. Cyanobacteria is an example of  
a. virus                      b. bacteria                      c. algae                      d. fungi
3. \_\_\_\_\_ helps to hold the slide in place in a microscope.  
a. Fine adjustment screw                      b. Course adjustment screw  
c. Stage                      d. Clip
4. \_\_\_\_\_ is the common name for Spirogyra.  
a. Soft silk                      b. Water silk                      c. Green silk                      d. Pond silk
5. Bacteria that causes food poisoning is  
a. entamoeba                      b. euglena                      c. clostridium                      d. amoeba
6. Yeast is used in the production of  
a. sugar                      b. alcohol                      c. hydrochloric acid                      d. oxygen
7. The following is an antibiotic:  
a. Sodium bicarbonate                      b. Streptomycin  
c. Alcohol                      d. Yeast
8. Carrier of malaria-causing protozoan is  
a. female Anopheles mosquito                      b. cockroach  
c. housefly                      d. butterfly
9. The most common carrier of communicable diseases causing diarrhoea is  
a. ant                      b. housefly                      c. dragonfly                      d. spider

10. The bread or idli dough rises because of
- a. heat
  - b. grinding
  - c. growth of yeast cells
  - d. kneading

**B. Fill in the blanks.**

1. Dry cells of \_\_\_\_\_ are used as food supplements.
2. Tuberculosis is transmitted by \_\_\_\_\_.
3. Cholera is caused by a \_\_\_\_\_.
4. In plants, citrus canker is caused by \_\_\_\_\_.
5. Female \_\_\_\_\_ mosquito serves as a carrier for dengue.

**C. State whether the following statements are true or false.**

1. We should cover our food because they can get contaminated by flies. \_\_\_\_\_
2. Leaves are the only parts of the plant that can photosynthesise. \_\_\_\_\_
3. Oxygen is produced during photosynthesis. \_\_\_\_\_
4. Bladderworts are insectivorous in nature. \_\_\_\_\_
5. Leucoplasts help plants look green. \_\_\_\_\_

**D. Match the following.**

- |                            |                        |
|----------------------------|------------------------|
| 1. Rhizobium               | a. Food preservation   |
| 2. Canning                 | b. Water borne disease |
| 3. Aedes mosquito          | c. Antibiotic          |
| 4. Streptomycin/Penicillin | d. Root nodules        |
| 5. Hepatitis B             | e. Dengue              |

**E. Give reasons for the following.**

1. Cakes and pastries are fluffy in nature.
2. Oil acts as a preservative for stored food.
3. Raisins have a longer shelf-life than grapes.
4. All the bowls used to feed a new born baby is boiled in water.
5. Canning is an effective method of preserving food.

**F. Answer the following questions in one word or a single sentence.**

1. Name the process by which yeast makes alcohol.
2. Name one microorganism that can fix atmospheric nitrogen in the soil.
3. Why are Microorganisms called so?
4. Who is regarded as the father of Microbiology?
5. Who was Louis Pasteur?

**G. Answer the following questions in brief.**

1. Why should we always wash our hands before and after eating?
2. What are the major groups of microorganisms?
3. Why is nitrogen important for living organisms?
4. Which microbe causes cholera in humans? What can we do to prevent it?

5. Name one viral disease in human and its preventive measures.
6. Name one plant disease and its causative microbe.

#### H. Answer the following questions in detail.

1. Write 10 lines on the usefulness of microorganisms in our lives.
2. Write a short paragraph on the harms caused by microorganisms.
3. What are antibiotics? What precautions should we follow while taking antibiotics?

### Out of The Box

Look inside your kitchen or refrigerator and try to find at least five food items that are preserved using various preservatives. Make a list of the food items and the preservatives used to preserve them. Find out why a particular preservative is used. Record your findings in your notebook and discuss in class.

### In Real Life

You know now how water accumulating in and around your locality could affect you and the health of your family. Make sure you are not allowing water to collect not just in your house but also outside your home. Educate people on how this can also help prevent diseases like dengue and malaria.



### Subject Enrichment

#### Activity Zone

Take a fresh orange and cover it in a bowl with its lid closed. Place this bowl in a warm place and leave it there for a week. Observe and record what changes have occurred to the orange in a week's time. Can you see the formation of moulds on the orange peel? Carefully pick one sample of the mould with the help of forceps. Place it on a slide and put a drop of glycerine on it. Cover it with a coverslip and observe the sample under the microscope. Record your observations and draw what you can see through the microscope.

Extend this activity by using leftover bread slices and observing the structure of a bread mould under the microscope.

#### Project Zone

##### Making a lens

**Materials required:** Some water, a newspaper sheet and a glass cup

##### Procedure:

1. Take a glass cup and fill it with water.
2. Place a small piece of newspaper on one side of the glass and look at it through water.
3. You will see the text magnified.

You have just made your own home-made magnifying lens. You could take glass cups of different shapes and sizes to see the variation in magnification.

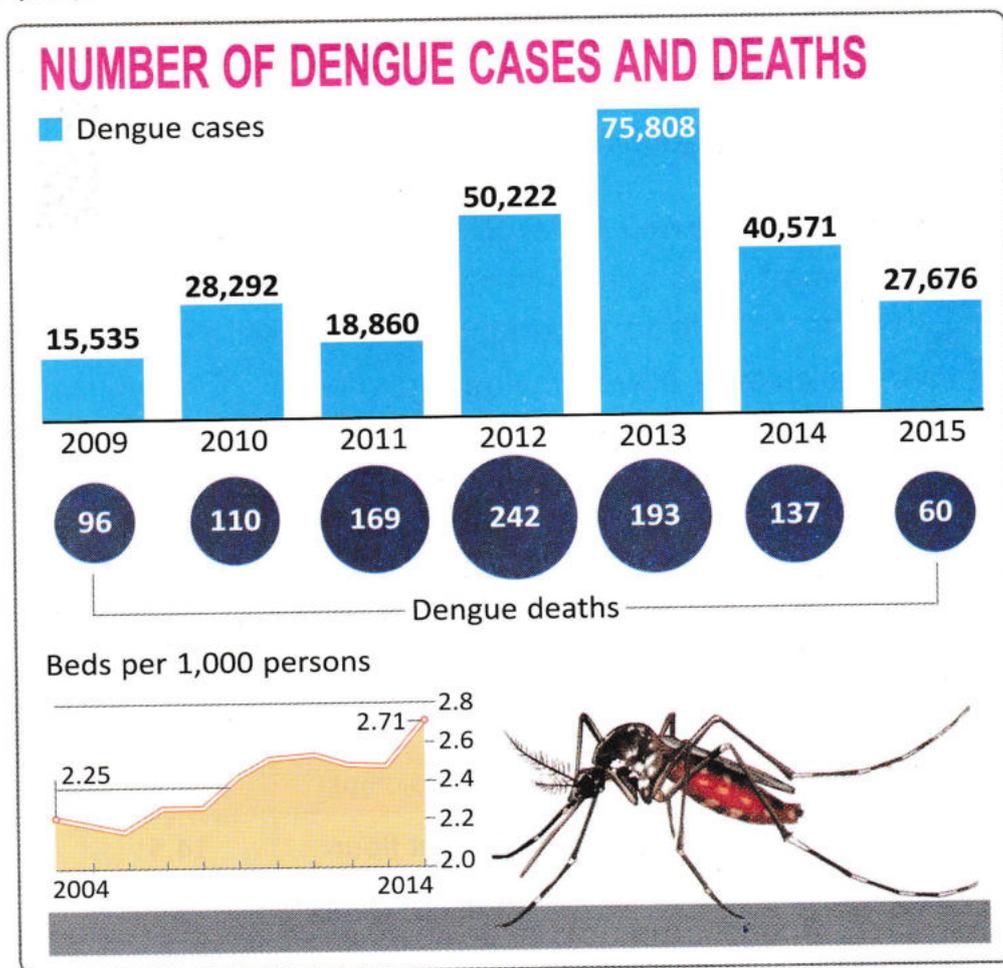
## Web-links

- Soil microbes: <https://www.youtube.com/watch?v=gSY-4AtqQG0>
- Immunity: <https://www.youtube.com/watch?v=IWMJIMzsEMg>
- Story of the discovery of vaccine: <http://science.howstuffworks.com/life/30004-100-greatest-discoveries-the-beginning-of-vaccinations-video.htm>
- Food safety: <https://www.youtube.com/watch?v=1EkehFkhWf4>

## Crosslinks

Look at the graph and answer the following questions:

1. Which year detected the highest number of dengue cases in Delhi?
2. Which is the year for the lowest number of cases?
3. What do you predict from the data in the last 3 years? What could be the reason for such a trend?



### Teacher's Note

Make learners aware of the various ways microorganisms are both useful and harmful to us and other living beings. Introduce the class to using and observing various samples using a microscope.

# Worksheet 1

(Unit 1 – Food)

## Food Preservation — Amount of Water in Food

Look at the table below. It shows a variety of foods with their water content and their water activity.

**Water activity** means the amount of moisture that is available in the food to enable microbes to grow. The lower the value the more difficult it is for microbes to grow and spoil the food.

Draw a bar diagram or chart to show the water content and water activity of each foods in the table.

Using information from your bar graph answer the following questions.

Which two foods are the most difficult for microbes to grow in?

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Which two foods are the easiest for microbes to grow in?

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What do you conclude with this activity?

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**Table: Water in food**

Food	Water content (%)	Water activity
Fresh meat	70	0.985
Dried vegetables	5	0.2
Rice	16	0.8
Breakfast cereal	5	0.2
Bread	40	0.86
Biscuits	5	0.2
Milk	3.5	0.11
Toffee	8	0.6
Nuts	18	0.65
Potato chips	1.5	0.08
Wheat flour	14.5	0.72
Boiled sweets	3	0.3
Oats	10	0.65

# Unit Test Paper 1

(Unit 1 – Food)

## A. Tick (✓) the correct answer.

- Which of the following stages of agriculture comes after fertilisation?  
a. Seed selection    b. Storage of grains    c. Seed sowing    d. Harvesting
- Which of the following parts of a microscope is usually closest to the specimen being studied?  
a. Arm    b. Eyepiece    c. Objective Lens    d. Illuminator
- Which of the following implements is used for sowing seeds?  
a. Chain pump    b. Sickle    c. Seed drill    d. Hoe
- Which of the following methods is not a traditional way of irrigating a field?  
a. Drip    b. *Dhekli*    c. Chain pump    d. *Rahat*
- Which of the following microbes is an example of a protozoa?  
a. Spirillum    b. Amoeba    c. Rhizopus    d. Spirogyra

## B. Are the following statements true or false? Correct the false statements.

- Weedicides are sprayed from a distance and away from the body.
- Grains in large scale are kept in granaries or silos.
- Animal husbandry is the management of wild animals and their upkeep.
- Immune system is body's self defence mechanisms to spread diseases.
- A microscope is a device used to study large organisms.

## C. Give one word or one example for the following.

- Organisms that carry communicable diseases from infected organisms
- Food preservation method for milk
- Practice of growing different crops alternately
- Wild, unwanted plants
- A harvest festival

## D. Answer the following questions.

- What are the main steps involved in crop production?
- What are the two modern methods of irrigation?
- What is canning?
- Name three plant diseases, their pathogens and the mode of transfer.
- What is nitrogen cycle? Explain with a diagram.

## 3

Synthetic Fibres  
and Plastics

## Chapter Focus

- Natural Fibres
- Synthetic Fibres
- Types of Synthetic Fibres
- Plastics and its types
- Plastics and our Environment

## Kick-off Activity

## Look and identify

Look at the picture of the hiking gear given below.



Can you identify the type of fabric used to make each of the object in this hiking gear? Why do think these fabrics have been used instead of simple cotton or jute fibres?

People have been using natural fibres like cotton, silk and wool to make clothes for centuries. But with the advancement in technology and increasing needs, many other fibres have been created using science and technology. These fibres are created using scientific methods using chemicals in the laboratory and hence are called **artificial** or **synthetic fibres**. These are also commonly known as **man-made fibres**.

## NATURAL FIBRES

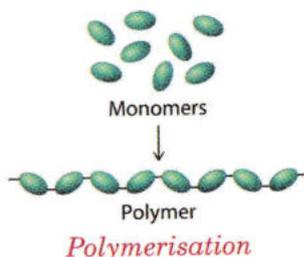
Natural fibres as the name suggests are derived from nature. Some natural fibres are cotton, wool, silk and jute. These fibres have been considered over other synthetic fibres due to many advantages. Some of these advantages are as follows:

- Natural fibres are more comfortable to wear.
- They are more durable and lighter in weight.
- They absorb moisture and do not wrinkle easily.
- They are easy to maintain than any other synthetic fibre.
- They do not catch fire easily.

## SYNTHETIC FIBRES

Fibres that are produced by man by artificial means are synthetic fibres. Some common examples of synthetic fibres are plastics, nylon, rayon, acrylic and polyester. Most of these fibres are produced using petrochemicals like coal, petroleum and natural gas.

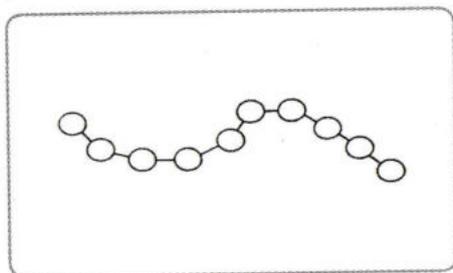
Synthetic fibres are made up of molecules or small units called monomers. These **monomers** are attached to each other by various methods, just like beads in a string, to form long chains of molecules. These long chains formed by a number of monomers are called **polymers**. Polymer is derived from two Greek words—*poly* means many and *mer* means unit. Hence, we can say that polymers are huge units formed by joining a number of smaller units repeatedly, called monomers. This process of joining monomers repeatedly to form polymers is known as **polymerisation**.



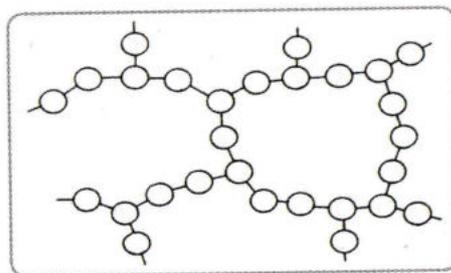
### Do you know?

Polythene is a polymer made by joining small ethene units, hence the name—poly + ethene

The process of monomers on joining linearly to form a polymer is known as linear polymerisation. It appears like beads in a string. However, the process of monomers on joining in a criss-cross manner—is known as cross-linked polymerisation.



a. Linear polymerisation



b. Cross-linked polymerisation

*Types of Polymerisation*

## Types of Synthetic Fibres

### Nylon

Nylon was the first synthetic fibre produced by humans. It was the first non-cellulosic fibre produced by DuPont Company using coal, water, and air.

### Properties of Nylon

- Nylon is strong and elastic.
- It is light and wrinkle-resistant.

- It is water-resistant and is thus durable.
- Since it absorbs less water it dries quickly.

#### Uses of Nylon

- As Nylon is strong it is used to make ropes, fishing nets and packing material.
- It is also used to make swimwear, umbrellas, toothbrush, parachutes, etc., as it is water-resistant.
- Because of its elasticity it is used to make socks and stockings.



*Uses of nylon*

#### Acrylic

Acrylic fibres are made from a polymer known as polyacrylonitrile. The properties of acrylic fibres are similar to the properties of wool. This is why acrylic is also used as a substitute for wool. These are also known as orlon.

#### Properties of Acrylic

- Acrylic fibre is light in weight and very strong.
- It is wrinkle resistant and does not shrink easily.
- It absorbs less water and can be dyed easily.
- It is resistant to chemicals and moths.

#### Uses of Acrylic

- Acrylic is warm, thus it is often used to make sweaters and blankets.
- It is used to make contact lenses and dentures.
- It is used to make water-resistant paints.
- It is used to make bullet-proof glasses and helmets due to its property of being a strong material.



*Acrylic used in bulletproof glass*

#### Polyester

Polyester is made of repeating ester units (poly+ester). The most commonly used polyester is Terylene. Terylene is often blended with other natural fibres to enhance its properties. For example, Terrycot is a blend of Terylene and cotton and Terywool is a blend of Terylene and wool. These fibres that are formed by mixing two or more kinds of fibres are known as blended fibres. Blended fibres have improved and better characteristics and properties than the fibres which they are made of.

#### Properties of Polyester

- Polyester is very strong, wrinkle resistant, light and elastic.
- It can be blended with natural fibres like cotton and wool.
- It absorbs less water so it is easy to wash and dries quickly.

#### Uses of Polyester

- Polyester is used to make clothing items like pants, coats, etc.
- Terrycot is used to make shirts, suits and other dressing material.
- PET (polyethylene terephthalate) is used to make bottles and utensils.



*Uses of polyester*

## Rayon

Rayon is also known as artificial silk as its properties resembles with that of silk. It is however cheaper than silk. It is made artificially as an alternative to silk, from wood pulp. Hence, it is semi-synthetic in nature.

### Properties of Rayon

- It resembles silk in its properties. For example, it is light and lustrous like silk.
- It absorbs moisture and sweat.
- It can be dyed in different colours.

### Uses of Rayon

- It is widely used to make clothes and dresses.
- It is used to make home furnishings like bed sheets, upholstery and blankets.
- It is also used to make surgical products.



*Bed sheet made of rayon*

### Check Point ✓

State True or False for the following statements.

1. Polyester is also known as artificial silk.
2. Polymers are made from joining repeated units of monomers.
3. Rayon is used to make ropes.
4. Acrylic is made from wood pulp.
5. Terrycot is a blended fibre.



## Advantages of Synthetic Fibres

Synthetic fibres are widely used due to their advantages over natural fibres. Some advantages of synthetic fibres are discussed here.

- Synthetic fibres are less expensive and more durable.
- They are strong, elastic and mothproof.
- Most of the synthetic fibres are water resistant.
- They are wrinkle resistant and need low maintenance.

## Disadvantages of Synthetic Fibres

Synthetic fibres have certain disadvantages. Some of the disadvantages of synthetic fibres are given here.

- Synthetic fibres are inflammable and melts on heating. Hence, they are unsafe to wear near fire.
- They do not absorb moisture and thus are unsuitable to be worn in summers.

### Check Point ✓

Synthetic fibres have many advantages over natural fibres. But, people do not wear pure synthetic clothes and instead prefer to wear a mix of natural and synthetic fibres. What do you think is the reason behind this?

## PLASTICS

The word plastic is derived from the Greek word *plastikos* that means capable of being shaped or molded. It means that plastics are the polymers that can be remoulded into different shapes. Plastics can be classified into two types—thermoplastics and thermosetting plastics, based on their capability to be remoulded.

### Types of Plastics

**Thermoplastics** are the plastics that can be remoulded to different shapes. These plastics melt on heating and can be remoulded to different shapes on cooling. Polythene is an example of a thermoplastic. On the other hand, **thermosetting plastics** cannot be remoulded by the process of heating and cooling. These plastics once set into a shape cannot be softened on heating. For example, bakelite.

Thermoplastics	Thermosetting plastics
Thermoplastics can be heated and remoulded on cooling.	Thermosetting plastics once set, cannot be remoulded.
The monomers in thermoplastics are arranged linearly, thus making it soft and flexible.	The monomers in thermosetting plastics are arranged in criss-cross manner, making these plastics strong and hard to break.
Some common examples are PVC (polyvinyl chloride) and polythene.	Some common examples are Bakelite and Melamine.
These are used to make polythene bags and packing material.	These are used to make electrical switches and Melamine utensils.

### Properties of Plastics

- Plastics are poor conductors of heat. It means they have poor thermal conductivity. This is why they are widely used in making handle of cooking vessels.
- Plastics also have poor electrical conductivity which means that they do not conduct electricity. Because of this property they are used to make the outer covering of metal wires.
- Plastics are inflammable and so can catch fire easily.
- Plastics are highly durable. They do not react with water or moisture. This is why they are used in storing pulses, beauty products, buckets, etc. Plastics are not corroded easily.

### Some Common Plastics and Their Uses

Some plastics that are used commonly are given in the table below.

Some common plastics and their uses

Plastic	Type of Plastic	Uses
Polythene	Thermoplastic	Polybags, packing food items, shopping bags
PET (Polyethylene terephthalate)	Thermosetting	Bottles, microwave friendly vessels, bottles of beverages like soft drinks
PVC (Polyvinyl chloride)	Thermoplastic	Outer covering of electrical wires, water bottles, water pipes, window and door frames, credit cards
Bakelite	Thermosetting	Electric switches, plugs
Teflon	Thermosetting	Non-stick coating in cooking utensils
Polystyrene	Thermoplastic	Food containers, trays, packaging material

## PLASTICS AND OUR ENVIRONMENT

Though plastics have found their application in our day-to-day life, they have posed a serious threat to our environment. Plastics are **non-biodegradable** in nature and this is the major reason behind this threat. Plastics take several years to decompose.

Improper disposal of plastics and the material made of plastics has become a major concern these days. Throwing plastic bags, bottles, etc., carelessly results in many problems like, choking of drains and soil pollution. Animals feed on food waste. If eaten by animals it may result in choking and even death. Storing food products in plastic bags may contaminate the food and might result in health problems when consumed.

### Do you know?

Uniforms of firemen have a coating of melamine to make them fire resistant.

### What We Can Do

We can take different appropriate measures to save our environment from the hazards caused by the use of plastics.

- Avoid using plastic bags and carry jute or cloth bags instead.
- Throw plastic waste in dustbins meant for recyclable material instead of throwing them in drains or on land.
- Follow 4Rs principle to minimise plastic waste. The 4Rs stand for reduce, reuse, recycle and recover.
- Try to minimise the use of plastics as much as possible in your daily life. For example, instead of taking a plastic lunch box to school carry a steel lunch box.

### Key Terms



- **Man-made fibres:** The fibres that are created using scientific methods using chemicals in the laboratory are called artificial or synthetic fibres and are also commonly known as man-made fibres.
- **Natural Fibres:** Natural fibres are derived from nature. Some natural fibres are cotton, wool, silk and jute.
- **Monomers:** Synthetic fibres are made up of molecules or small units called monomers.
- **Polymers:** The long chains formed by joining a number of monomers are called polymers.
- **Polymerisation:** This process of joining monomers repeatedly to form polymers is known as polymerisation.
- **Thermoplastics:** Thermoplastics are the plastics that can be remoulded into different shapes.
- **Thermosetting plastics:** Thermosetting plastics cannot be remoulded by the process of heating and cooling.

### Recall



- Synthetic fibres are made by man using chemical methods.
- Monomers are the small units that joins together to form long chain polymers. This process is known as polymerisation.
- Polyester can be combined with cotton and wool to form terrycot and terewool, respectively.
- Thermoplastics and thermosetting plastics are two types of plastics.
- We should follow 4Rs principle to save our environment from plastic wastes and the hazards they cause.

## Assess Zone

### A. Tick (✓) the correct answer.

- This is also known as artificial silk.  
a. Nylon                      b. Rayon                      c. Acrylic                      d. Polyester
- Which of the following is a thermosetting plastic?  
a. Bakelite                      b. Orlon                      c. Polythene                      d. Nylon
- It is also known as Orlon.  
a. Acrylic                      b. PET                      c. Rayon                      d. Plastic
- Which of the following is a synthetic fibre?  
a. Jute                      b. Cotton                      c. Wool                      d. Nylon
- Which of the following is used to make bottles?  
a. Nylon                      b. Bakelite                      c. Acrylic                      d. PET
- Which of these joins to form synthetic fibres?  
a. monomer                      b. polymer                      c. ester                      d. PET
- Which of these is a less expensive fibre?  
a. Nylon                      b. Silk                      c. Cotton                      d. Wool
- Which of these is used to make packaging material?  
a. Polystyrene                      b. PVC                      c. Bakelite                      d. Acrylic
- Which of these is the first synthetic fibre?  
a. Acrylic                      b. Rayon                      c. Nylon                      d. Polyester
- What do the 4Rs stand for?  
a. Recycle, Rename, Reduce, Recover                      b. Reduce, Recycle, Recover, Roll  
c. Reduce, Reuse, Recycle, Recover                      d. Reuse, Recover, Recycle, Raise

### B. Fill in the blanks.

- Rayon is also called \_\_\_\_\_ silk.
- \_\_\_\_\_ is used to make bottles.
- \_\_\_\_\_ plastics cannot be remoulded to different shapes.
- Synthetic fibres are stronger and more durable than \_\_\_\_\_.
- Teflon is a \_\_\_\_\_.

### C. State whether the following statements are true or false.

- Rayon is also known as Orlon. \_\_\_\_\_
- Polyester is made of ethane units. \_\_\_\_\_
- Artificial fibres are wrinkle resistant. \_\_\_\_\_
- Polythene is a thermoplastic. \_\_\_\_\_
- Artificial fibres are cheaper than synthetic fibres \_\_\_\_\_

**D. Answer the following questions in one word or a single sentence.**

1. Which is a synthetic fibre: nylon or Jute?
2. Which simple unit forms polymer?
3. Which type of fibres are manufactured in factories?
4. Which fabric is also known as artificial silk?
5. Name the plastic used to make bottles.
6. Name the monomer that forms polythene.
7. Give two examples of natural fibres?
8. In which two categories can the fibres be classified?

**E. Answer the following questions in brief.**

1. What are synthetic fibres? How are they different from natural fibres?
2. What are the properties and uses of Polyester?
3. Write a short note on:  
a. rayon                      b. nylon                      c. acrylic                      d. polymerisation
4. What are the advantages of plastics?
5. Give two properties and uses of nylon and acrylic.
6. Name the type of plastic that is used in making electrical switches.

**F. Answer the following questions in detail.**

1. Differentiate between thermoplastics and thermosetting plastics?
2. Plastics are both a bane and a boon. Explain with examples.
3. What can be done to save our environment from harmful effects of plastics?
4. What are synthetic fibres? What are the types of synthetic fibres and their properties?
5. What are plastics? What are their types and uses?

## Out of The Box

1. Synthetic fibres are considered better over natural fibres. If you were to choose between the two what would be your choice and why?
2. Why can wearing nylon clothes while bursting crackers can be dangerous?
3. Holding a hot pan with Bakelite handle does not burn our hands. Why?

## In Real Life

Read about the alternatives that can be used in day-to-day life to reduce plastic use. For example, instead of a plastic straw you could use a paper straw that you can make on your own or keep a permanent straw made of steel. You could use edible cutlery that is made of organic material like rice and wheat. It decomposes easily and causes no harm while using. Find other such alternatives that can be used in daily life and make a list. Make sure to keep and use these alternatives every time you move out of your home.

Educate your friends and neighbours or other people around you on these alternatives and their benefits in the long run. Encourage them too to use these alternatives each time.

## Subject Enrichment

### Activity Zone

Make a presentation on various practices adopted by us that is causing harm to our oceans and other water bodies. Give suggestions on how plastic can be reused so as to minimize the harm.

### Project Zone

Synthetic fibres and natural fibres can be differentiated by other methods as well.

Take fibres of different types and perform burn test. Take each type of fibre one by one and burn them using a matchstick. Observe how each fibre burn, what kind of smell each fibre release and the end product they form. Tabulate your observations.

Type of fibre	Kind of smell	How it burns	Residue left after burning

**Precaution:** Be careful while you perform the burn test. Perform this test only under the supervision of an adult.

### Web-links

- Life without plastic, <https://www.youtube.com/watch?v=jeFHnYw0-pA>
- How harmful are plastic bags to the climate?, <https://www.dw.com/en/how-harmful-are-plastic...the.../av-37688879>

### Crosslinks

Collect and study the relevant material on the Internet relating to the historical significance of using both natural and synthetic fibres in our daily life. Find out what factors led to the invention of synthetic fibres and plastics and how they have become such an integral part of our daily life.

### Teacher's Note

Make learners aware of different types of synthetic fibres and their uses in our daily life on the basis of their properties. Encourage them to organise campaigns or perform a street play on the ill effects of plastic and how it affects our planet.

# 4

## Metals and Non-Metals

### Chapter Focus

- Occurrence of Metals and Non-metals
- Physical Properties of Metals and Non-metals
- Chemical Properties of Metals and Non-metals
- Inert Metals
- Corrosion of Metals
- Alloys
- Uses of Metals and Non-metal

### Kick-off Activity

#### Observe and tell

Observe the pictures of the various objects given below. What materials out of the given options would you use to make these objects? Why would you use these materials? Give reasons for each.



Metal  
Glass  
Ceramic



Metal  
Glass  
Ceramic



Metal  
Glass  
Ceramic

Everything that we see around us like books, bottles, mugs, table, chair, paper, doors, windows, glass etc. when broken down to their most basic form, on the basis of their physical and chemical properties can be categorized into either metals or non-metals. This makes it important for us to learn about metals and non-metals.

There are 118 elements known to us, out of which 92 occur naturally while the rest are prepared by us in the laboratory.

All elements can be further classified into:

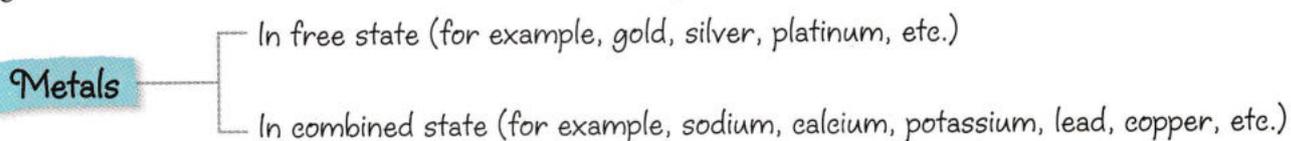
- Metals:** Metals are characterized by their bright lusture (quality of reflecting light from its surface), hardness, ability to resonate sound and being good conductors of heat and electricity. For example, iron, copper, silver, gold and tin.
- Non-Metals:** Non-metals are characterized by properties such as non-lustrous, brittle and being poor conductors of heat and electricity (except Graphite). Non-metals can be gaseous, liquids or solids. For example, sulphur, phosphorus, hydrogen, oxygen, nitrogen and carbon.

3. **Metalloids:** Elements that have properties of both metals and non-metals are called metalloids. For example, silicon, boron, arsenic, antimony and germanium.

## OCCURRENCE OF METALS AND NON-METALS

Metals occur in nature either in free or combined (as minerals) state. A metal is said to occur in native or free state when it is found in nature in its metallic state. For example, gold occurs in nature as metal. However, iron and copper are found in nature in the combined state.

Non-metals exist on the Earth in the combined state as oxides, carbonates and phosphates. However, there are some non-metals that occur in nature in the free state. For example, oxygen occurs in free state in the atmosphere and also present in combined state in water. All the noble gases occur only in free state. Some are also found in seawater in the form of soluble salts as sodium chloride and magnesium chloride. From these salts sodium and magnesium are extracted.



## PHYSICAL PROPERTIES OF METALS AND NON-METALS

The properties that can be observed without making the metal react with any other substance are called physical properties. Let us learn the various physical properties of metals.

### Physical state

Most metals are solid at room temperature (except mercury and gallium). None of the metals exist in gaseous state.

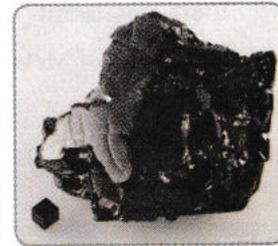
Non-metals occur generally as solids or gases. For example, oxygen exist as gas and carbon exist as solid in the atmosphere.



Gold (A solid)



Mercury (A liquid)



Carbon (A solid)

### Malleability

Metals that can withstand hammering and can be made into thin sheets or foils are called malleable metals. This property of metals due to which they can be hammered and made into thin sheets without breaking is called **malleability**. Gold, silver, aluminium and copper are highly malleable metals making them very useful in various applications.

A sugar cube sized chunk of gold can be hammered or pounded into a thin sheet that can cover a football field.

Aluminum is used to make foils that are used to pack foodstuff, medicine covers or chocolates.

Non-metals, however, cannot withstand hammering and so are known to be brittle in nature. For example, zinc on hammering breaks into pieces and is thus brittle in nature.

This property of non-metals (when they occur in solid state) due to which they break into pieces on hammering is called **brittleness**.

Some non-metals such as oxygen and hydrogen are in the gaseous state and bromine in liquid state do not show the property of brittleness.

## Activity



**Aim:** To check whether a given substance is malleable or brittle.

**Materials required:** An aluminium can, a piece of coal and a hammer

### Procedure:

1. Take an aluminium can and beat it with a hammer. (While beating, you must take care not to hurt your arms or fingers.)
2. Now, take a piece of coal and beat it with a hammer.
3. Observe that on beating an aluminium can it did not break and got spread into a thick sheet. However, the piece of coal broke into smaller pieces and eventually became a powder.

**Conclusion:** Metals that can be hammered without breaking them into pieces such as aluminium are malleable and non-metals that break into smaller pieces or become powder on hammering such as coal are brittle in nature.



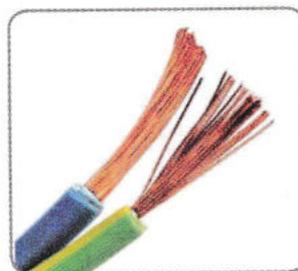
*Coal pieces*



*Aluminum can after hammering*

## Ductility

The property that enables a metal to be drawn or stretched into thin wires is called ductility. Gold and silver are known to be best ductile metals. A 100 gm of silver can be drawn into a thin wire of about 200 m long. Copper, aluminum, iron and magnesium can also be drawn into thin wires. Some of the practical uses of ductility of metals include copper being used inside electric cables as wires and tungsten being used for making the filament of an incandescent bulb.



*Electric cables made of copper wires*



*Tungsten filament inside an incandescent bulb*

## Lustre

The property due to which metals appear shiny is called lustre. Most metals are lustrous in nature. This property makes the metals good reflectors of light. These metals can be polished. For example, gold, silver, platinum and copper.

Non-metals do not have lustre hence they do not appear shiny. They do not reflect light and appear dull. However, a few non-metals such as iodine and graphite show some lustre.



*Gold: A metal with lustre*

## Activity



**Aim:** To identify if the given material is lustrous or not.

**Materials required:** A bar of silver, iron, copper, tin, brass and aluminium, a piece of wood, a piece of glass and a piece of graphite (charcoal).

**Procedure:**

- To identify if a given material is lustrous or not, ask yourself these questions:
  - Is the material shiny or dull in appearance?
  - Does it look more like a mirror or more like mud?
  - Does it reflect light?
  - Can it be polished?
- Record your observations in the following table.

Name of the material	High Lustre	Low Lustre	No Lustre
Silver			
Iron			
Copper			
Tin			
Brass			
Aluminium			
Wood			
Glass			
Graphite (Charcoal)			

**Conclusion:** On recording your observation after examining each material, you will find that wood has no lustre whereas silver has high lustre. Graphite is low on lustre when compared with silver.

## Heat or Thermal Conductivity

Metals are good conductors of heat. Silver and copper are the two best conductors of heat. Lead is the poorest conductor of heat. Bismuth, mercury and iron are also poor conductors.

Since metals like silver, aluminum and copper are good conductors they are used in making all kinds of utensils for cooking.

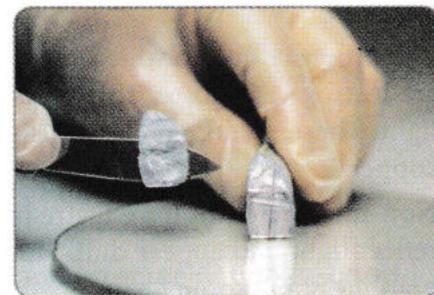
Non-metals are poor conductors of heat. However, diamond a non-metal is a good conductor of heat.

## Hardness

Metals usually being solid in nature are hard. For example, iron is very hard. Because of



*An iron bridge*



*Cutting sodium using a knife*

this property of iron it is used in the construction of bridges, railway lines and machines. However, there are some exceptions to this property. Metals such as sodium and potassium are very soft and can be cut using a knife.

Non-metals on the other hand are soft. They easily break when a large object is put on them. However, diamond, a non-metal, is the hardest naturally occurring substance found on the Earth.

## Tensile strength

The tensile strength of a material is the maximum amount of stress or strain a material can take without breaking. Metals usually have very high tensile strength. For example, iron and aluminum have high tensile strength and so are used in construction of buildings and other big structures. However, zinc has low tensile strength.

Non-metals have very low tensile strength, i.e., they break easily. However, carbon fibres have very high tensile strength.

## Density

Metals are usually heavy and have very high density. Iridium and osmium have the highest densities whereas lithium, sodium and potassium have low densities, i.e. they float on water.

Non-metals have very low densities except diamond.

### Activity

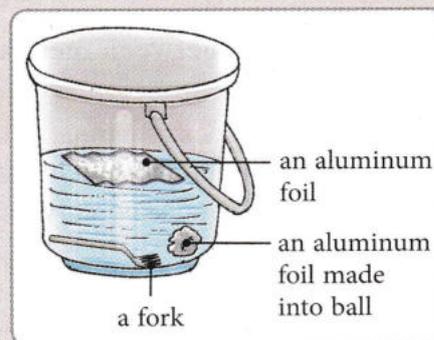


**Aim:** To see if the given object floats or sinks.

**Materials required:** An aluminium foil, a steel fork and a bucket half filled with water

**Procedure:**

1. Take an empty bucket and fill it with water so that it is half filled.
2. Put the steel fork in the bucket and observe whether it floats or sinks. You will see that the steel fork sinks to the bottom of the bucket.
3. Now, put a sheet of aluminium foil on the water. You will see that it floats on the water.
4. Take some more aluminium foil from the roll and make a ball out of it.
5. Now put the aluminium ball in the bucket filled with water. Interestingly, this time the ball of aluminium foil sinks to the bottom of the bucket.



**Conclusion:** Thus, we conclude that some metals have higher density (steel fork) over other metals (aluminium foil). Also, whether an object will float or sink does not depend just on the density but the form in which they are put in the water (the ball of aluminium foil).

## Conductivity of Electricity

Silver, which is also a good conductor of heat, is the best conductor of electricity. Similarly, copper and aluminum are good conductors of electricity and thus are used in electrical wiring for houses and other buildings. Silver being cost heavy is not used in electric wires, whereas copper offers the most cost effective way.

Non-metals are poor or bad conductors of electricity. For example, sulphur and phosphorus. However, graphite is the only non-metal that acts as a good conductor of electricity.

## Sonority

Sonority is the property of metals to produce a deep resonating sound when struck with an object. Thus, metals are sonorous by nature. This property makes metals useful in making bells or musical instruments.

On the other hand, non-metals do not make sounds when struck with an object. Thus, non-metals are non-sonorous by nature.



*A bell*



*A violin*

### Activity



List all the objects around you that produce resonating sound when struck with an object. Notice the different sounds and depth of resonance made by different elements. Record your observations in a notebook.

## Melting and Boiling points

The melting and boiling points of both metals and non-metals vary widely. Metals tend to have a higher melting and boiling point. Metals, which are physically flexible elements that can conduct heat and electricity, tend to be solid at room temperature due to their relatively high melting points. Non-metals, which are physically weak and poor conductors of heat and electricity, can be solid, liquid or gaseous, depending on the element. For example, tungsten (a metal) has a melting point of  $3,370^{\circ}\text{C}$  whereas the melting point of hydrogen (a non-metal) is  $-259.14^{\circ}\text{C}$ .

### Differences between metals and non-metals on the basis of their physical properties

Metals	Non-Metals
1. Metals are generally solid in state. (Exceptions include mercury and gallium)	Non-metals are found in all three states.
2. Metals are lustrous and can be polished.	Non-metals generally are not lustrous and cannot be polished.
3. Metals are heavy	Non-metals are light in weight
4. Metals are hard and non-brittle (Exceptions include sodium, potassium and lead)	Non-metals are usually soft. Solid non-metals are hard but are brittle. Exception includes diamond, a non-metal, which is the hardest substance on the Earth.
5. Metals are good conductors of heat and electricity.	Non-metals are poor conductors of heat and electricity except graphite.
6. Metals are ductile and malleable.	Non-metals are neither ductile nor malleable.
7. Metals have high melting and boiling points.	Non-metals generally have low melting and boiling points.
8. Metals produce deep resonating sound when struck.	Non-metals do not produce resonating sound.

## CHEMICAL PROPERTIES OF METALS AND NON-METALS

All elements react and show certain chemical properties they have depending on their nature and conditions of reactions. Metals and non-metals differ from each other due to these chemical properties each possess.

### Reactions with Oxygen

Metals tend to react with oxygen to form basic oxides. Some metals also form amphoteric oxides, i.e., they show properties of both acids as well as bases. For example, ZnO and  $\text{Al}_2\text{O}_3$ .

#### Activity



**Aim:** To show that metals when react with oxygen form basic oxides.

**Materials required:** A thin magnesium ribbon, a sandpaper, a pair of tongs, a Bunsen burner, water, a boiling tube, red litmus solution and a safety goggle.

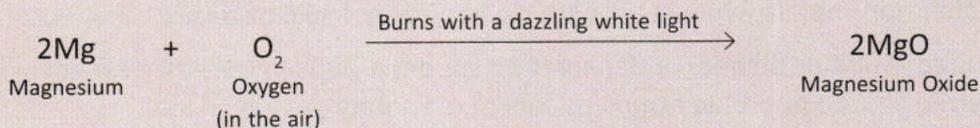
#### Procedure:

1. Take a thin magnesium ribbon and rub it with sandpaper to clean it.
2. Wear your safety goggles.
3. Hold the magnesium ribbon from one end with the help of a tong and bring it near the flame of the Bunsen burner. Keep holding the ribbon till it catches fire. Do not look directly at the burning magnesium. After a while you will get ash which is nothing but magnesium oxide.
4. Put the ash thus obtained (i.e., the magnesium oxide powder) in a boiling tube, add a little water and shake it. Now, add some red litmus solution to the boiling tube and observe the change in colour.

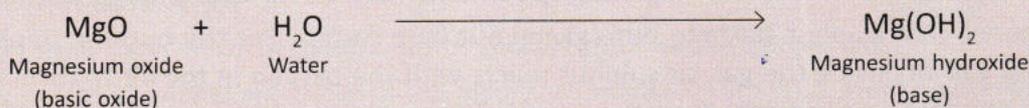


#### Observation and conclusion:

1. We observed that magnesium ribbon burned to produce a dazzling white flame and left behind white ash or powder. This was the result of magnesium reacting with oxygen present in the air to form magnesium oxide.



2. Magnesium oxide on dissolving in water formed magnesium hydroxide solution.

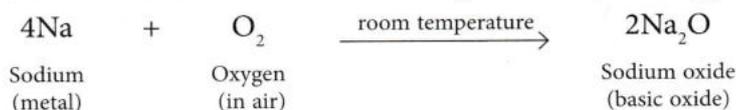


3. Magnesium hydroxide turns red litmus solution to blue, thus proving that it is a base.

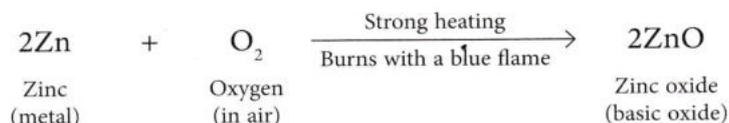
So, we can say that metals when reacted with oxygen form basic metal oxides.

Similarly, other metals such as sodium and zinc react with oxygen to form basic oxides.

Sodium when reacts with oxygen present in air at room temperature forms sodium oxide. Thus, it is stored in kerosene as it catches fire on reacting with air (i.e., oxygen present in air).



Zinc reacts with oxygen only on strong and prolonged heating to form zinc oxide that produces a blue flame.



Gold, a metal, on the other hand is highly unreactive with oxygen. Ornaments and jewellery made of gold remain and look new for a long period because it does not react with oxygen and other gases present in air or with water vapour.

Non-metals on reaction with oxygen form acidic oxides. Some of the non-metals also form neutral oxides.

For example, when carbon burns in air, it reacts with the oxygen present in the air to form carbon dioxide.



Carbon dioxide (acidic oxide) when dissolved in water forms carbonic acid.



On the other hand, nitrogen when reacts with oxygen forms nitrous oxide which is a neutral oxide.



## Activity



**Aim:** To show that non-metals when react with oxygen form acidic oxides.

**Materials required:** Sulphur powder, a deflagrating spoon, a Bunsen burner, a jar covered with lid, water, a petri dish, red and blue litmus papers and a safety goggle.

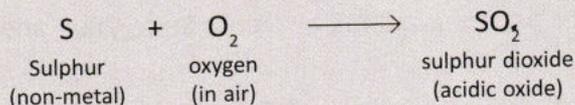
### Procedure:

1. Take some sulphur powder in a deflagrating spoon and heat it over the flame of the burner.
2. You will notice that sulphur starts to burn giving out blue flames. Put the burning sulphur into a glass gas jar. Inside the gas jar sulphur reacts with the oxygen in the air to form sulphur dioxide, a pungent smelling gas. Keep the lid of the glass gas jar closed so as to not let sulphur dioxide escape.
3. After some time, remove the deflagrating spoon from the glass gas jar.
4. Add some water into the jar and quickly close the lid.
5. Shake the jar to dissolve sulphur dioxide in water.

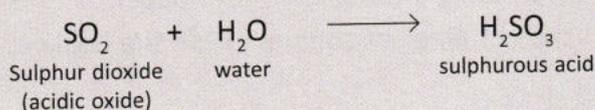
- Now, pour this water into a petri dish.
- Insert both red and blue litmus paper into the petri dish. Observe that red litmus paper remains unchanged. However, blue litmus paper becomes red.

**Observation, Reaction and Conclusion:**

- When sulphur powder reacts with oxygen in the air it burns to form sulphur dioxide, an acidic oxide.

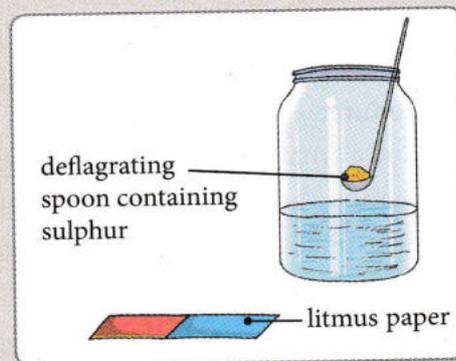


- This sulphur dioxide on dissolving in water forms sulphurous acid solution.



- Sulphurous acid turns a blue litmus paper to red showing that it is acidic in nature.

So, we can say that non-metals when reacted with oxygen form acidic metal oxides.



**Check Point** ✓

Tick (✓) the correct answer.

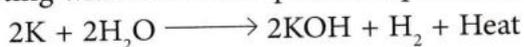
- Metals form which type of oxides?
  - Basic
  - acidic
  - neutral
  - amphoteric
- Sodium at room temperature is stored in:
  - Water
  - Kerosene
  - Cooking oil
  - An empty box
- Hydrogen on reaction with oxygen forms:
  - Acidic oxide
  - basic oxide
  - Neutral oxide
  - metallic oxide
- Sulphurous acid solutions changes:
  - Red litmus paper to blue
  - Blue litmus paper to red
  - No change in colour
  - Turns phenolphthalein to pink colour

**Reaction with water**

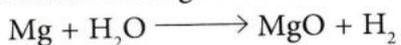
Metals react with water to form hydroxides or metal oxides and hydrogen gas.

Depending on the chemical reactivity of the metals, some react with cold water some with hot water and some with steam.

For example, potassium on reacting with cold water produces potassium hydroxide and hydrogen gas.



Magnesium reacts vigorously with steam or boiling water to form magnesium oxide and hydrogen gas.



Zinc reacts quickly with steam to form zinc oxide and hydrogen gas.



Copper does not react with hot or cold water.

## Activity



**Aim:** To show that metals react with water to form metallic oxide and hydrogen gas.

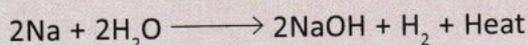
**Materials required:** A piece of Sodium, a filter paper, a 250 mL beaker, a knife, blue and red litmus papers, water and safety goggles.

### Procedure:

1. Cut a small piece of sodium with the help of a knife.
2. Remove kerosene from the sodium piece by pressing it in folds of filter paper.
3. Fill the 250 mL beaker with water and put the cut piece of sodium inside the beaker.

### Observation and conclusion:

1. You will notice that sodium quickly starts floating on the surface of the water releasing a hissing sound.
2. Tiny bubbles of hydrogen gas are also produced in this process.
3. The sodium rapidly melts in the water and forms a silvery white ball.
4. This silvery white ball eventually becomes smaller and catches fire. It burns with a golden yellow flame. The solution becomes hot. This heat melts the sodium metal and releases hydrogen gas, which catches fire.
5. Once the reaction gets over, if the solution is tested with litmus paper the solution turns red litmus paper to blue. This shows that the solution thus formed is basic in nature.



Thus we can conclude that when metal reacts with water, hydrogen gas is formed.

## INERT METALS

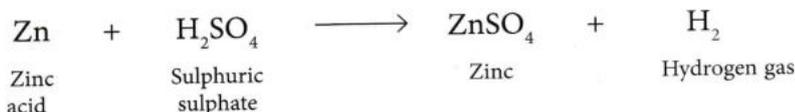
There are some metals that do not react at all with water. These metals are called inert metals. For example, gold, silver and platinum are quite unreactive. This property makes them valuable assets to be used as ornaments, decorative items or as jewellery. Platinum is also used for making electrical gadgets and international standards of weights and measures.

Non-metals do not react with water. Thus, for phosphorus water is used as a storage medium.

## Reaction with acids

Metals on reaction with acids form salts and hydrogen gas.

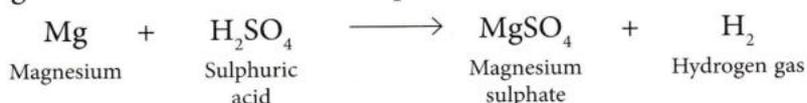
For example, zinc on reaction with sulphuric acid forms zinc sulphate and hydrogen gas.



### Do you know?

Pure gold or 24-carat gold is very soft in nature and is thus not used for making jewellery. It is always mixed with either copper or silver to make ornaments.

Also, magnesium on reaction with sulphuric acid forms magnesium sulphate and hydrogen gas.



Copper reacts only with nitric acid and during this reaction no hydrogen gas is evolved.

### Check Point



Tick (✓) the correct answer.

- What gas is produced emitting a pop sound when an acid is reacted with water?
  - Carbon dioxide
  - Oxygen
  - Hydrogen
  - nitrogen
- How are metals such as gold, silver and platinum that are unreactive called?
  - Acidic
  - basic
  - metalloids
  - inert
- What happens when copper is reacted with hydrochloric acid?
  - No reaction takes place
  - A vigorous reaction takes place with a pop sound
  - A moderate reaction takes place with a pop sound
  - A weak reaction takes place with a pop sound

## CORROSION OF METALS

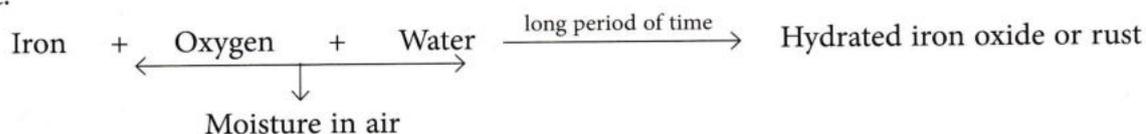
On prolonged exposure to air and moisture, most metals deteriorate or get corroded. This happens due to the reactive nature of metals.

When they react with air for a long time, they form a new substance. This causes deterioration and the metals become useless.

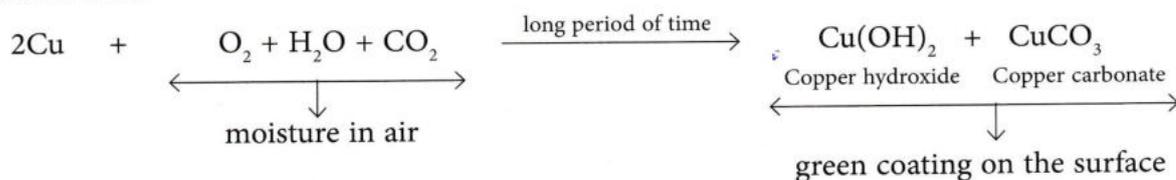
This process of metal reacting with oxygen present in the air causing it to deteriorate is called *corrosion*. Copper, iron and silver are some examples of metals that corrode.



- When iron is left damp in air for a long time, it gets covered with a flaky substance that is reddish brown in colour. This substance is called rust and the process is known as rusting of iron. Iron on combining with oxygen and moisture forms hydrated iron oxide or rust.



- Copper on exposure to damp air for a long time reacts slowly with carbon dioxide and water of air. It loses its shine as a green coating of copper hydroxide and copper carbonate is formed on its surface over time.



- Similarly, silver kept in air, becomes tarnished and turns black over a course of time. This happens due to the formation of thin silver sulphide layer due to the action of hydrogen sulphide present in the air.

## How to prevent corrosion?

Corrosion can be prevented by avoiding metals to come in contact with moist air. To ensure this, following measures can be taken:

1. Paint, grease or oil can be applied on the surface of the metal. This extra layer will keep the metal away from air and moisture.
2. Coating a layer of zinc on iron objects prevents corrosion. This process is called galvanisation. This extra layer of zinc deposited on the surface of the iron object protects it from getting corroded.
3. A layer of another metal is deposited on the surface of the metal object being protected through a process called electroplating.
4. Anodising the aluminum object by applying a uniform layer of aluminum oxide.
5. Mixing some other metals or non-metals with the metal being protected through a process called alloying.

## ALLOYS

An alloy is a combination of metals or metals with non-metals to give greater strength or to prevent corrosion. An alloy is a homogenous mixture (equal proportions) of two or more metals or non-metals.

### Properties and Uses of Alloys

1. Alloys are usually very hard. For example, carbon when added with iron increases the hardness manifolds producing steel. Steel is used widely in construction of ships, bridges, support structure for buildings and vehicles.
2. Alloys are usually resistant to corrosion. For example, an alloy of iron, chromium and nickel is called stainless steel as it is resistant to corrosion. Stainless steel is used in making utensils, cutlery and surgical instruments.
3. Alloys have very high tensile strength. For example, an alloy of iron and chromium forms chrome steel. Chrome steel because of its high tensile strength is used in making various cutting tools and axle.
4. Solder is an alloy of tin and lead having low melting point. This property makes it useful for joining electric wires.



A summary of common alloys, the metals they contain and their uses is given as follows:

Alloy	Metals in alloy	Typical use
Amalgam	Mercury and silver	Dental fillings
Brass	Copper and zinc	Hinges and electrical fittings
Bronze	Copper and tin	Coins, statues and medals
Duralumin	Aluminium, copper, magnesium and manganese	Parts of automobiles and pressure cookers
German silver	Copper, zinc and nickel	Resistance wires and electroplating

## USES OF METALS AND NON-METALS

### Uses of metals

Metals because of their useful properties and characteristics are used widely in various applications.

1. Zinc is used in galvanizing (putting a coat) iron to prevent it from rusting.
2. Iron is used as the main construction material in bridges, ships, buildings etc. The alloy of iron forms stainless steel that is used in making various kinds of utensils.
3. Tin is used for making foils, soldering and coatings to help prevent corrosion.
4. Lead is used in making water pipes, batteries, pigments etc.
5. Mercury is used in thermometers.
6. Copper is used widely in making electrical wires and cables.
7. Some radioactive metals such as uranium and plutonium are used in nuclear power plants to generate energy.

### Uses of non-metals

Non-metals due to their non-reactive nature also find a wide range of applications. Some applications are given below:

1. Oxygen, hydrogen and nitrogen are called building blocks of life and are present and used by all living things.
2. Carbon is used as a fuel and for making electrodes.
3. Iodine is used to prevent thyroid and in making antiseptics.
4. Hydrogen is used for making ammonia gas, which is used to manufacture fertilisers such as urea and ammonium sulphate.
5. Chlorine is used to purify water in the form of bleaching powder.
6. Phosphorus is used for making crackers.
7. Boron is used for making skin ointments.
8. Sulphur is used for making sulphur drugs, match boxes, gun powder, and in vulcanisation hardening of rubber which are then used as tyres.

### Check Point

Tick (✓) the correct answer.

1. Bronze, an alloy constitutes what all metals?
  - a. Copper and zinc
  - b. Copper and tin
  - c. Copper and iron
  - d. Copper and aluminum
2. Which of the following is not a property of a typical alloy?
  - a. Alloys are usually soft
  - b. Alloys are usually gaseous in nature
  - c. Alloys are usually hard and resistant to corrosion
  - d. Alloys usually have low tensile strength
3. What is dipping of an iron object in molten zinc known as?
  - a. Anodising
  - b. Electroplating
  - c. Corrosion
  - d. Galvanising

## Key Terms



- **Physical properties of a substance:** The properties that can be observed without making the metal react with any other substance are called physical properties.
- **Malleable:** Metals that can be hammered without breaking them into pieces such as aluminum are malleable.
- **Non-malleable:** Non-metals that break into smaller pieces or become powder on hammering such as coal are brittle in nature.
- **Chemical properties of a substance:** All elements react and show certain chemical properties they have depending on their nature and conditions of reactions. Metals and non-metals differ from each other due to these chemical properties each possess.
- **Inert Metals:** There are some metals that do not react at all with water. These metals are called inert metals.
- **Corrosion:** The process of metal reacting with oxygen present in the air causing it to deteriorate is called corrosion.
- **Alloy:** An alloy is a homogenous mixture (equal proportions) of two or more metals or non-metals.

## Recall



- There are 118 elements known to us, out of which 92 occur naturally while the rest are prepared by us using labs and other means.
- Metals occur in nature either in free or combined (as minerals) state.
- Non-metals exist on earth in combined state as oxides, carbonates and phosphates.
- The properties that can be observed without making the metal react with any other substance are called physical properties.
- Most metals are solid at room temperature (except Mercury and Gallium). None of the metals exist in gaseous state while non-metals occur generally as solids or gases. For example, Oxygen exist as gas and Carbon exist as solid in the atmosphere.
- Metals that can be hammered without breaking them into pieces such as aluminum are malleable and non-metals like that break into smaller pieces or become powder on hammering such as coal are brittle in nature.
- Wood has no lustre whereas silver has high lustre. Graphite is low on lustre when compared with silver.
- Some metals have higher density (steel fork) over other metals (aluminum foil). Also, whether an object will float or sink does not depend just on the density but the form in which they are put in the water (ball of aluminum foil).
- Metals when reacted with oxygen form basic metal oxides.
- When metal reacts with water, hydrogen gas is formed.
- There are some metals that do not react at all with water. These metals are called inert metals. For example, gold, silver and platinum are quite unreactive.
- The process of metal reacting with oxygen present in the air causing it to deteriorate is called corrosion.
- An alloy is a combination of metals or metals with non-metals to give greater strength or to prevent corrosion. An alloy is a homogenous mixture (constant proportions) of two or more metals or non-metals.

## Assess Zone

### A. Tick (✓) the correct answer.

1. What property of metal allows it to be drawn into wires?  
a. Conductivity      b. Reactivity      c. Malleability      d. Ductility
2. What property of metal allows it to be hammered into thin sheets?  
a. Brittleness      b. Softness      c. Ductility      d. Malleability
3. If a given object breaks easily into smaller pieces it is called?  
a. Brittle      b. Malleable      c. Soft      d. Hard
4. Which of the following is not usually a property of a metal?  
a. Brittleness      b. Conductor      c. Shiny      d. Malleable
5. An element that has high density, is a good conductor of heat and electricity and is solid in nature would be classified as?  
a. Metal      b. Non-metal      c. Metamorphic      d. Alloy
6. The dull green coating on copper vessels is caused by  
a. exposure to air      b. rusting of copper  
c. exposure to water      d. exposure to nitrogen
7. Which of the following is a liquid metal?  
a. Aluminum      b. Mercury      c. Copper      d. Zinc
8. Which of the following non-metal is liquid in nature?  
a. Iodine      b. Chlorine      c. Bromine      d. Sulphur
9. What happens when iron filings are added to hydrochloric acid?  
a. Salt and water is produced      b. Iron oxide is formed  
c. Hydrogen gas is evolved      d. Chlorine gas is evolved
10. Which of these elements can be found in nature in pure state?  
a. Lithium      b. Iron      c. Aluminium      d. Gold

### B. Fill in the blanks.

1. Sulphur dioxide reacts with water forming \_\_\_\_\_.
2. \_\_\_\_\_ is a metal that catches fire on being exposed to air.
3. All materials around us can be classified into \_\_\_\_\_ and \_\_\_\_\_.
4. Non-metals are generally \_\_\_\_\_ in nature.
5. \_\_\_\_\_ does not react with concentrated hydrochloric acid.

### C. Give reasons for the following.

1. Why is sodium stored in kerosene and not in water?
2. What property makes graphite or charcoal suitable to be used inside a pencil?
3. What is a solder? What property of solder makes it suitable for joining electrical wires?
4. Can the solution of copper sulphate be stored in an iron container?
5. Can a wire be drawn out of wood?

**D. Answer the following questions in one word or a single sentence.**

1. The metal foil used for wrapping food is made up of which metal?
2. Which metal is used in thermometers?
3. Which non-metal is essential for breathing?
4. What is the alloy of iron, nickel and chromium known as?
5. Name the gas released when metals react with acids.

**E. Answer the following questions in brief.**

1. Which is a synthetic fibre: nylon or Jute?
2. Which simple unit forms polymer?
3. Which type of fibres are manufactured in factories?
4. Which fabric is also known as artificial silk?
5. Name the plastic used to make bottles.

**F. Answer the following questions in detail.**

1. Distinguish between metals and non-metals on the basis of their physical properties.
2. Write any five uses of metals and non-metals.
3. How are metals different from non-metals in terms of their chemical properties?
4. What are the various methods applied to help prevent corrosion? Discuss and give examples.
5. What are alloys? Give examples and their uses.

## Out of The Box

1. Discuss the various acids that are present in food that we intake daily along with their properties.
2. Discuss the importance and usage of neutralisation of acids. How do farmers neutralise acidic soils? What does our stomach contain that digests food and what do we do in case of indigestion? How can one neutralize bee stings?

## Subject Enrichment

### Activity Zone/Field Trip

1. Show that Metals (such as copper) and graphite are good conductors of electricity and non-metals (such as wood) are poor conductors.
2. Take students to a goldsmith's workshop and show them how they mould the gold into various shapes using heat.

### Project Zone

Study and explore the role of metals that can be found in the architecture of India's forts and monuments. Why do you think the usage of metals was so widespread in the doors and bridges of these forts and monuments?

## In Real Life

Now that you have learnt how harmful rust can be, it is important to understand to how to take care of objects around you to prevent them from rusting. Take good care of your cycles to prevent them from rusting. You could do this by using the following methods:

1. Using a mixture of baking soda and water and applying on the effected region for 15 minutes. Scrub it after 10 minutes.
2. Keeping your cycle in shade and away from water.
3. Cleaning your cycle regularly with a dry cloth.

## Web-links

- Liquid Metal that is Safe to Touch and Play with, <https://www.youtube.com/watch?v=0Hx2DYx4umQ>
- Spotlight on Corrosion, <https://www.youtube.com/watch?v=bKvroCboUVc>

## Crosslinks

Take a map of India and identify the states that are abundant in metals. Colour these states on the map. Why do you think these states are abundant in various metals while others are not? Explain with reasons.

### Teacher's Note

Encourage students to undertake a survey on the use of synthetic material. Teach them to ask all the relevant questions. Let the students discuss their findings in the classroom and learn from each other.

# 5

## Coal and Petroleum

### Chapter Focus

- Types of Fuels and their characteristics
- Renewable and Non-renewable Resources
- Coal, petroleum and their various products
- Natural gas

### Kick-off Activity

#### Identify the sources of energy

Fill the following table by writing the source of energy required to run a particular object or to perform a particular activity as given in the table:

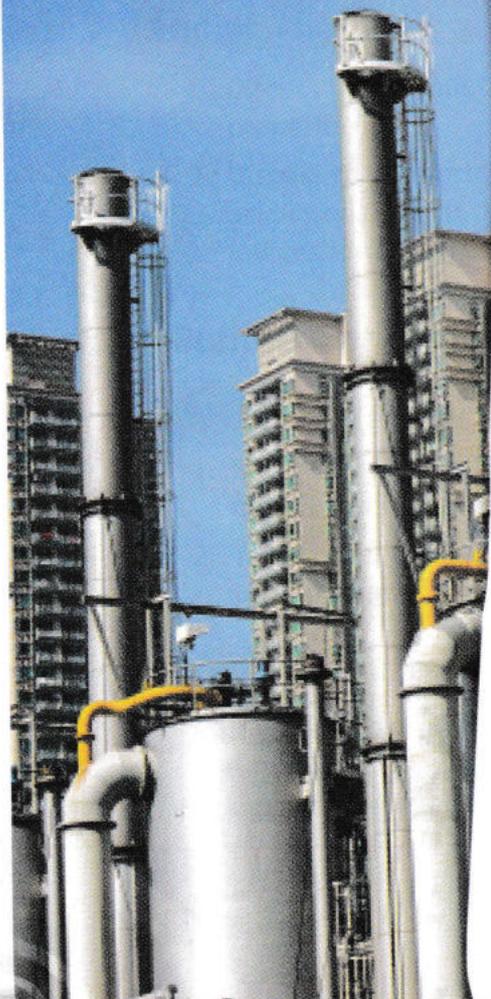
S.No.	Object/Activity	Source of Energy
1.	Human beings	
2.	Cooking	
3.	Running a car	
4.	Running a truck/bus	
5.	Burning a candle	

### TYPES OF FUELS AND THEIR CHARACTERISTICS

We need fuel to run various modes of transport, machinery in factories and cooking and production of electricity. This fuel primarily comes from sources such as coal, petroleum and natural gases. These sources take millions of year to form and hence are limited.

Animals also need various sources of energy to survive and sustain. We, human beings too require energy to carry out various activities. The food we eat provides us energy to carry out these activities. Nature provides various resources to fulfil these requirements. These resources are called **natural resources**. These primarily include water, air, soil, and minerals.

Thus we can define fuel as a material that can be made to react with other materials so as to generate heat and energy required to perform work.



## Characteristics of a good fuel

Before we move forward to understand various resources in details, let us discuss some characteristics of a good fuel.

1. It should have a high calorific value. Calorific value can be defined as the amount of energy produced (in kilojoules) when one kilogram of fuel is burnt. The unit of calorific value is kJ/kg.
2. Its ignition temperature (minimum temperature required for burning) should be easily achievable but should be higher than the room temperature.
3. It should not undergo explosion on burning. Its rate of combustion should be moderate.
4. It should be convenient to store, transport and handle.
5. It should be cheap and easily available.
6. It should not cause pollution on burning. Nowadays, eco-friendly sources of energy are preferred such as wind and solar energy.

### Do you know?

Hydrogen is the fuel with highest calorific value, i.e. 150 kJ/g so it is used in rockets and spacecrafts.

## RENEWABLE AND NON-RENEWABLE RESOURCES

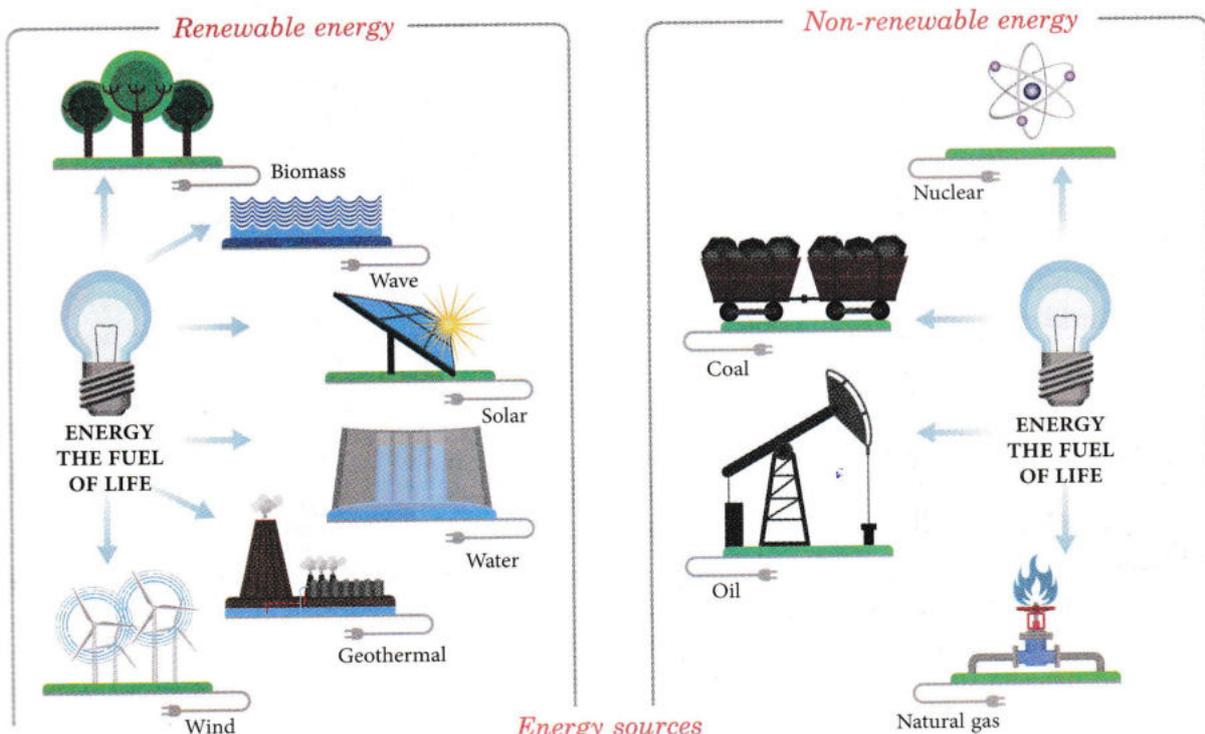
Natural resources can be grouped into two categories depending upon their availability and abundance as renewable and non-renewable.

### Renewable natural resources

These are natural resources like air, water and sunlight which are present in abundance in nature. These can be continuously replenished, recycled and reused.

### Non-renewable natural resources

These are natural resources which are present in limited amount in nature. They cannot be replenished continuously, hence can be exhausted. For example, fossil fuels that are formed from the decomposition of plants and animals which got buried under the Earth due to anaerobic conditions and geological changes that occurred millions of years ago. They are called non-renewable resources because they take millions of years to be formed. Coal, petroleum, etc. are some examples of fossil fuels.



## Check Point ✓

1. What are fuels?
2. Name two renewable sources of energy.
3. Name two non-renewable sources of energy.

## COAL, PETROLEUM AND THEIR VARIOUS PRODUCTS

Let us discuss in detail about the non-renewable natural resources.

### Coal

Coal is black, hard combustible substance. It consists of more than 50% of carbon with a mixture of hydrogen and oxygen and a small amount of nitrogen, sulphur and phosphorus. Coal is used as fuel for cooking food. It is also used in railway engines to produce steam and thermal power station to produce electricity.

### Do you know?

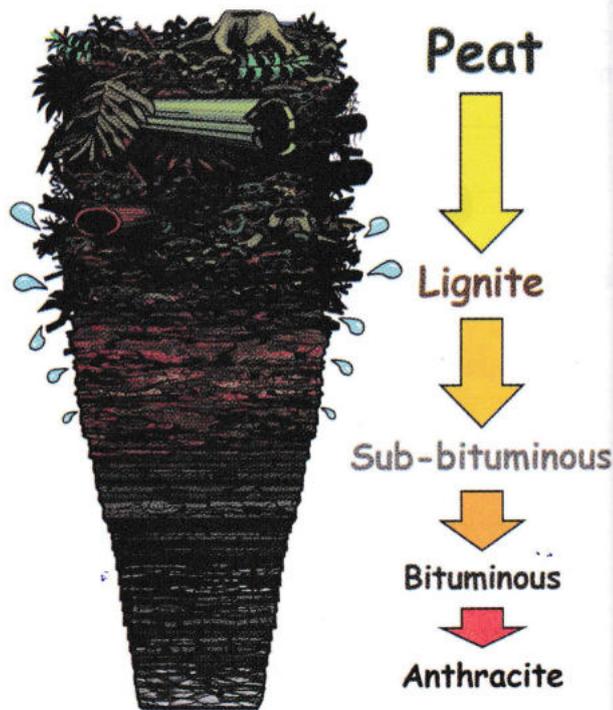
Diamonds are also prepared naturally by this process but the pressure required is much higher.

### Formation of Coal

Coal is formed from the dead remains of dense forests in low lying wetland areas that got buried under the earth about 300 to 400 millions of years ago. It is considered that due to natural calamities such as floods, earthquakes and land slides, the dense forest got buried under the surface of the earth. These dead plants got compressed as gravel and soil got deposited over them. Due to high temperature, high pressure and anaerobic conditions, the dead plants gradually changed into coal. This slow process of conversion of dead vegetation into coal is called carbonisation. It takes millions of years to convert the living matter to fossil fuels.

### Different Stages of Coal Formation

- **First Stage:** When the vegetation gets buried under the soil and remains there for millions of years, a material called **peat** is formed. It is an accumulation of partially dead and decaying animals, leaves, branches or lignite. It contains very little amount of carbon but its moisture content is high.
- **Second Stage:** Peat gets compressed between sediment layers and a brown coal called **lignite** is formed which consists of compressed woody matter with very little moisture. Carbon content in lignite is nearly 70%. It is soft and can be crumbled.
- **Third Stage:** Due to further compression of lignite coal, bituminous coal is formed. It is dense, dark and brittle with almost no moisture and impurities. The carbon content in this type of coal is nearly 80–85%.
- **Final Stage:** When bituminous coal remains under the soil for a long time and is subjected to extreme pressure, anthracite coal is formed. It is hard and has semi-metallic lustre. It is the purest form of coal which contains about 94–98% carbon. Its moisture content is very low and thus it is also known as smokeless coal.



## Products of Coal

Various products that can be obtained from coal are given as follows:

### Coke

The solid residue left behind after dry distillation of coal is called coke. It is greyish black in colour and not as shiny as coal. It is hard, porous and contains 98% carbon.

#### Uses of coke

1. Coke is a smokeless fuel and is used in the extraction of metals like iron.
2. It is also used in the preparation of fuel gases like producer gas and water gas (synthetic or Syn gas). Mixture of coke and nitrogen is called producer gas. Mixture of coke and steam is called water gas.



### Coal tar

It is a dark, black, oily liquid with an unpleasant smell. It is a complex mixture of about 200 organic compounds.

#### Uses of coal tar

1. Coal tar is used to make a number of useful products like insecticides, drugs, dyes, paints, perfumes, naphthalene balls to repel moths and insects, explosives, etc.
2. The residue left after destructive distillation of coal tar is used to surface the roads.



### Coal gas

It is a mixture of methane, carbon monoxide, hydrogen and other gases. It is a flammable gas that is also known as town gas. It has a high calorific value.

#### Uses of coal gas

1. It is used for cooking and lightening purposes.
2. It is an important industrial fuel because it produces a lot of heat on burning.



## Petroleum

Petroleum or crude oil is a naturally occurring dark coloured thick oily liquid which is a complex mixture of various hydrocarbons and other liquid organic compounds such as paraffin wax. Petroleum is lighter than water and is also immiscible in it. It is found deep under the Earth between the layers of impervious rocks. Petroleum is called black gold due to its great economic importance.

### Formation of petroleum

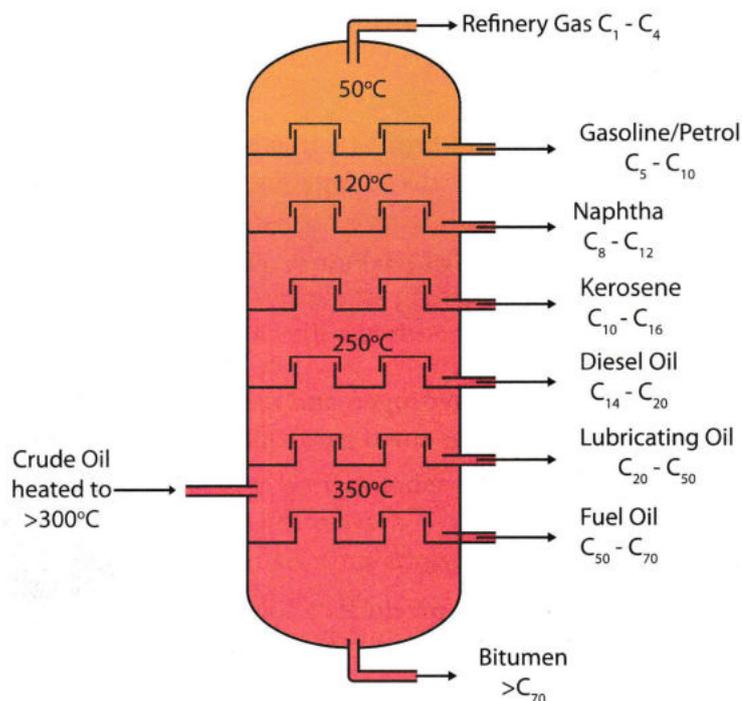
Petroleum is a fossil fuel formed from dead organisms in the sea, such as phytoplankton, zooplankton and algae. A vast quantity of dead remains of marine animals and plants settled at the bottom of the sea and got covered with sediments. Due to intense heat and pressure in the lower regions, more layers settled over the seabed, thus the organic matter liquefied and seeped down until it reached a bed of impervious rocks. This is how the dead organisms transformed into petroleum hydrocarbons. Petroleum is obtained by drilling oil wells into the Earth's crust. In India, oil wells are found in the state of Assam and Gujarat, the offshore of Mumbai and the deltas of Godavari and Kaveri rivers.

## Refining of petroleum

Crude petroleum is a mixture of about 200 hydrocarbons. It contains some useful substances such as petroleum gas, petrol, diesel, paraffin wax and lubricating oil. The process of separation of various constituents of petroleum is called refining of petroleum. It can be done by fractional distillation.

### Fractional distillation of petroleum

- Fractional distillation of crude petroleum is done in a tall fractionating column in a petroleum refinery. Crude oil is heated to above 350 °C.
- The oil vapours rise in the distillation tower and cool down. There are a series of shallow trays in which these vapour get condensed to become liquid.
- The fraction which has higher boiling point condenses near base and one having a low boiling point condenses in the topmost tray.
- The gas which goes out of the column is known as petroleum gas. The various fractions obtained by refining of petroleum and their uses are summarised in the table given below.



*Fractional distillation of petroleum*

S.No.	Petroleum Products	Usage
1.	Petroleum gas in liquid form (LPG)	Fuel for home, industry and vehicles
2.	Petrol	Motor and aviation fuel, solvent for dry cleaning
3.	Kerosene	Fuel for stoves, lamps and for jet aircraft.
4.	Diesel	Fuel for heavy motor vehicles, electric generators
5.	Lubricating oil	Lubrication
6.	Paraffin wax	Ointments, candles, vaseline
7.	Bitumen	Paints and road surfacing

## Check Point

Write different stages of coal formation in the following table along with the percentage of carbon for each stage.

Stages	Name of the Stage	Percentage of Carbon
Stage 1		
Stage 2		
Stage 3		
Stage 4		

## NATURAL GAS

Natural gas is a fossil fuel found deep under the Earth, between two layers of impervious rocks, either above or along with petroleum deposits. It contains mainly methane ( $\text{CH}_4$ ) and small amounts of gases like ethane, propane and butane. It is an efficient and convenient fuel because it does not produce any ash or smoke on burning. It is highly flammable. It is supplied through pipeline. Such pipelines exist in Vadodara and some parts of Delhi. Natural gas is used for manufacturing many chemicals and fertilizers. In India, we have vast reserves of natural gas in Tripura, Rajasthan, Maharashtra and in the Krishna Godavari Delta (KG basin).

### Compressed Natural Gas

Compressed natural gas (CNG) is a natural gas stored under high pressure. It is used as a domestic and industrial fuel and in manufacturing of carbon black. It is an eco-friendly fuel as it does not emit harmful gases like oxides of nitrogen and oxides of sulphur which pollute the environment. Thus, it has been increasingly used as a fuel to run automobiles and buses.

The use of CNG as a fuel has brought down the pollution level in Delhi.



### Coal and petroleum on the verge of extinction

Fossil fuels are non-renewable sources of energy. They take millions of years to be formed. Although over extraction of petroleum may not cause any environmental problem but its excessive use is causing some major environmental problems like global warming, air pollution, etc.

Petroleum is used all over the world primarily for transportation. A large number of useful products are also made by using various fractions obtained from refining of petroleum.

The rate at which we are using petroleum, the day is not too far when all petroleum reserves may become depleted. It will result in energy crisis.

Coal mining is reported to cause some major environmental problems. Methane, a greenhouse gas, is released during coal mining, if gets mixed with ground water causes water pollution.

Coal dust is also harmful for humans. It may cause various respiratory problems.

The major consequence of its overuse is that it will be finished in next 100 years because we have limited resources of coal.

## Conservation of Fossil Fuels

We have already discussed that fossil fuels are available in limited amount in nature. So the following steps should be taken to conserve the fossil fuels:

- We should use renewable sources of energy like wind energy, solar energy, hydro energy to fulfill our energy needs. Renewable sources of energy cause no pollution and are unlimited.
- Energy should be generated from biomass.
- Petrol and diesel can be saved by using fuel-efficient vehicles and machines; by driving vehicles at a moderate speed; by switching off the engines of vehicles at traffic signals; by ensuring correct tyre pressure and by regular maintenance of vehicles.
- Using carpools is a good way to reduce consumption of fuels like petrol and diesel.
- Walking down to nearby places instead of going by a vehicle also helps to save fuel.

### Check Point

1. What is a natural gas?
2. From where is natural gas generally obtained?

### Key Terms

- **Fossil fuels:** The fuels which are formed by the anaerobic decomposition of dead decaying organic matter present deep inside the Earth's crust are called fossil fuels.
- **Carbonisation:** Slow conversion of dead plants and trees to coal
- **Coke:** A solid fuel formed by heating coal in the absence of air
- **Coal tar:** A thick, black liquid formed by heating coal in the absence of air
- **Coal gas:** The gas obtained when coal is heated in the absence of air
- **Fractional distillation:** The process of separation of the components of a mixture on the basis of their boiling points

### Recall

- The formation of fossil fuels started millions of years ago
- There are mainly two sources of energy on the Earth: renewable and non-renewable.
- Renewable sources are natural sources such as air, water, land and sunlight.
- Non-renewable sources are fossil fuels such as coal, natural gas and nuclear fuel.
- Refining of petroleum releases various useful products such as LPG, petrol, kerosene, diesel, lubricating oil, paraffin wax and bitumen.
- Coal and petroleum are now on the verge of depletion and thus it is important to look for and use natural renewable sources like solar and hydrothermal for daily energy needs.

## Assess Zone

### A. Tick (✓) the correct answer.

- Which of the following is not a fossil fuel?  
a. Coal                      b. Petroleum                      c. Natural gas                      d. Solar energy
- The process of separating useful products from petroleum is called  
a. fractional distillation                      b. refining  
c. condensation                      d. crystallisation
- A dark-coloured liquid with an unpleasant smell obtained from coal is  
a. kerosene                      b. coal tar                      c. alcohol                      d. glycerine
- Anaerobic condition means  
a. absence of air                      b. absence of carbon  
c. absence of nitrogen                      d. absence of helium
- Which of the following is called 'black gold'?  
a. Diesel                      b. CNG                      c. Petroleum                      d. Biogas
- Which of the following has the lowest carbon content?  
a. Anthracite                      b. Lignite                      c. Bituminous                      d. Peat
- An example of renewable source of energy is  
a. air                      b. water                      c. wind                      d. all of these
- Petroleum is obtained from  
a. rocks                      b. minerals                      c. ocean bed                      d. forests
- A fuel should  
a. have High calorific value                      b. be cost effective  
c. easy to handle                      d. all of these
- The fossil fuels are  
a. renewable resources                      b. non-renewable resources  
c. both of these                      d. none of these

### B. Fill in the blanks.

- A fuel produces \_\_\_\_\_ on combustion.
- \_\_\_\_\_ is obtained from coal and is used for construction of roads.
- \_\_\_\_\_ is obtained from fractional distillation of petroleum and is used for making shoe polish.
- \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ are obtained from coal.
- Natural resources are which are present in abundance and can be replenished are called \_\_\_\_\_.

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

- Type of pollution caused by burning of fossil fuels \_\_\_\_\_
- Natural gas mainly contains this gas \_\_\_\_\_

3. By this process, different products are obtained from petroleum
4. The amount of energy produced by burning 1g of a fuel
5. I am obtained from petroleum. I am used in winters to repair cracked skin

**D. Give reasons for the following.**

1. Diamond and coal are basically different forms of carbon.
2. Energy is the fuel of life.

**E. Answer the following questions in one word or a single sentence.**

1. What is a fuel?
2. Name the type of coal which contains minimum carbon content.
3. Define carbonisation.
4. Which gas is also known as the town gas?
5. What is the black gold?
6. Name the constituents of petroleum used to make road surfaces.

**F. Answer the following questions in brief.**

1. Why should we use fossil fuels judiciously?
2. Give full form of CNG. Why is it preferred over other fossil fuels?
3. Define the term 'fossil fuel'. Give two examples.
4. How can we conserve fossil fuels?
5. What is calorific value of a fuel?
6. What are conditions required for the formation of fossil fuels?

**G. Answer the following questions in detail.**

1. Differentiate between renewable and non-renewable resources with examples.
2. How are coal and petroleum formed in nature?
3. What are the characteristics of an ideal fuel?
4. Explain the fractional distillation of petroleum.

### Out of The Box

1. What are alternative sources of energy which can be used instead of coal and petroleum?
2. An element which makes the major portion of coal. It is present in diamond as well as graphite (lead of pencil). Though all these objects are made up of same element, why these are entirely different in appearance? Identify the element and answer the question.

### In Real Life

Pooja and Priya cook the same amount of food daily. However, the LPG cylinder finishes faster at Pooja's house? What could be the possible reasons? Suggest some tips for Pooja to reduce the consumption of LPG.

## Subject Enrichment

### Activity Zone

Prepare a record of fuel consumption in your homes for a week. This could be from various activities such as cooking and commuting every day. Record the money spent on these fuels for a week and analyse the consumption. Find out ways you could adopt as a family to save money and fuel consumption.

### Project Zone

1. Prepare a chart showing different stages of coal formation.
2. Write an essay on the topic, 'Making Oil Conservation: A Way of Life'.

### Crosslinks

Mark on the map of India the states where coal and petroleum or mineral oil are obtained in abundance.

### Web-links

- Physical processes influence formation and distribution of renewable, nonrenewable and flow resources: <https://sites.google.com/site/aspringerdc6/physical-processes-influence-formation-and-distribution-of-renewable-nonrenewable-and-flow-resources>
- Non-renewable energy: <http://www.geography.learnontheinternet.co.uk/topics/resources4.html>

### Teacher's Note

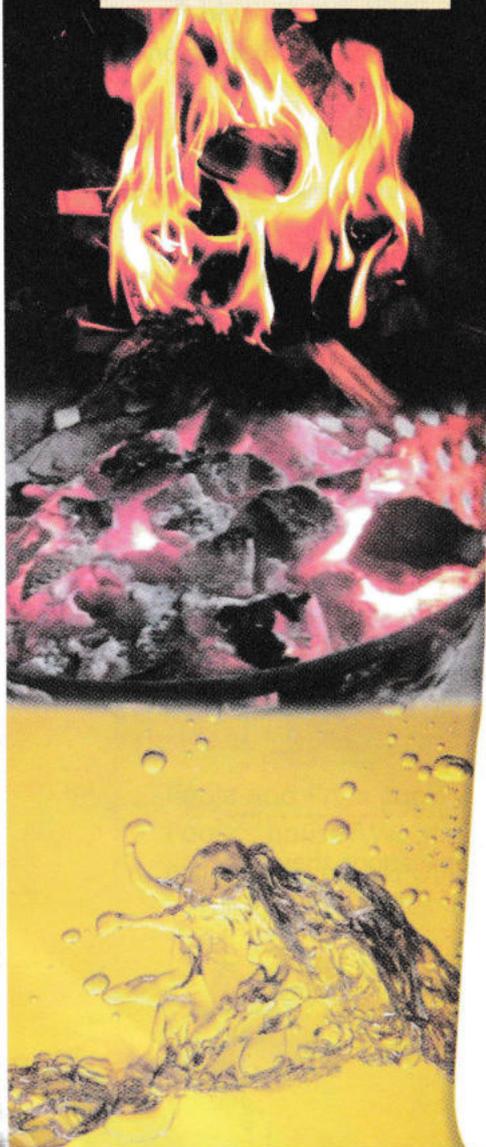
Encourage students to collect information on various fuels and their applications they encounter in everyday life and understand the importance of conserving them.

# 6

## Combustion, Flame and Fuels

### Chapter Focus

- ➔ Combustion
- ➔ Methods to control fire
- ➔ Flame, Fuels and Pollutants formed after Combustion



### Kick-off Activity

#### The Burn Test

Collect some materials like Borosil glass, matchsticks, stones, straw, paper and iron nails. Under the supervision of your teacher try to burn each material for not more than a few seconds one by one and record your observations in the table given below.

S. No.	Name of the Material	Does it burn?	What was produced on burning (heat/light/sound/all three)?
1	Borosil glass		
2	Matchsticks		
3	Stone		
4	Straw		
5	Paper		
6	Iron nails		

### COMBUSTION

Have you observed that to cook food we use a cooking gas? Similarly, while ironing clothes we burn pieces of coal inside the iron. Why do you think we need cooking gas and coal? In order to produce energy we burn certain materials. The process of burning of a substance in the presence of air or oxygen to give off heat and light is called **combustion**. Some materials on burning also release sound. We can classify all materials on the basis of whether they burn or are combustible or do not burn that is are non-combustible.

In combustion, oxygen reacts with the substance getting burnt. The addition of oxygen is also called **oxidation**. We can say that combustion is a chemical change. We cannot get back the original substance after combustion.

A combustible substance that is used to produce heat or energy to do work is called fuel, e.g. coal, petrol, CNG, LPG, etc. Substances like some metals, glass, etc. do not burn in air. They are called non-combustible substances.

## Conditions Required for Combustion

There are three conditions necessary for combustion. Let us study each of them in detail.

### Combustible substance

For combustion the presence of a combustible substance is must such as LPG (liquefied petroleum gas), CNG (compressed natural gas) and petrol.

### Presence of air or oxygen

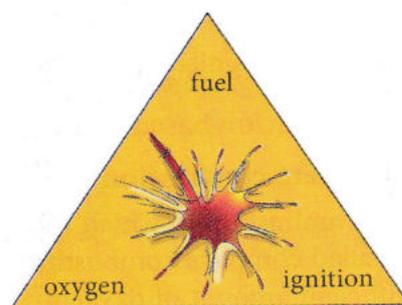
Combustion can take place only in the presence of oxygen. For complete combustion to take place, oxygen should be present in sufficient quantity. In case of insufficient supply of oxygen, the combustion is incomplete and the fuel remains un-burnt. Have you ever noticed that if the holes of a burner are blocked then the bottom of the utensil gets blackened? This is due to insufficient supply of oxygen.

### Ignition temperature

It is the minimum temperature at which a substance starts burning. Different substances have different ignition temperatures. A matchstick catches fire when it is rubbed against a rough surface. A burning matchstick can set a paper on fire but it cannot set a piece of wood on fire. This is because wood and paper have different ignition temperatures. Some substances which have very high ignition temperature do not catch fire easily while some substances like LPG and petrol which have low ignition temperature catch fire easily. These substances are called inflammable substances.

### Do you know?

Elements like sodium and phosphorus start burning on their own when kept exposed to air. So they are stored in kerosene oil.



### Activity

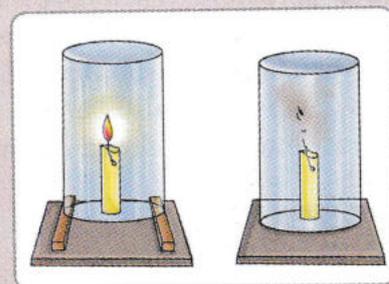


**Aim:** To show that air is necessary for combustion

**Material required:** Two candles, two glass jars or beakers and a matchstick

**Method:** Set the apparatus as shown. Light two identical candles at the same time. Cover both the candles with inverted glass jars or beakers. Under one glass jar leave some space as an inlet for air. Note your observation. Which of the candles burns for a longer duration and why?

**Observation and conclusion:** The candle that has an opening in one of the jars burns for a long time as its gets the required amount of oxygen for combustion to take place. In the absence of air, candle does not remain lit for a long time.



## Types of Combustion

Combustion can be classified on the basis of the rate of combustion.

## Slow combustion

Combustion is basically oxidation. In certain cases, it takes place at a very slow rate, with a continuous release of energy. Only energy released is in the form of heat. For example, respiration is an example of slow combustion. In this the oxidation of food takes place.

## Rapid combustion

The combustion in which a substance burns quickly to produce a lot of heat and light. For example, burning a matchstick, burning of LPG, etc.

## Spontaneous combustion

The combustion in which a substance burns suddenly into flames, without providing any external source of heat.

For example, sodium and phosphorus burns spontaneously when exposed to air. Forest fires are also examples of spontaneous combustion.

## Explosion

The combustion in which the production of a large amount of heat and light is evolved along with a loud sound. It is accompanied by the liberation of a large amount of gas. For example, when fire crackers are ignited, heat, sound and light are produced.

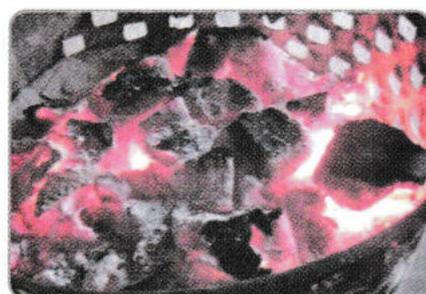
## Classification based on the availability of oxygen

### Complete combustion

The combustion in which the substance gets completely burnt is called complete combustion. It takes place in the presence of sufficient amount of oxygen.

### Incomplete combustion

The combustion that takes place in the presence of insufficient oxygen is called incomplete combustion. It results in the formation of carbon monoxide and soot particles (unburnt carbon particles). When coal is burnt in sufficient supply of oxygen it gives carbon dioxide while in insufficient supply of oxygen it gives carbon monoxide. Carbon monoxide is poisonous and can also be fatal. So it is advised not to burn coal in winters in a closed room.



### Do you know?

Carbon monoxide has 300 times more capacity to mix with blood than oxygen. So when it combines with blood, blood cannot supply oxygen to the brain which leads to death.

### Check Point



1. Name two fuels which undergo rapid combustion.
2. What are non-combustible substances? Give examples.

## METHODS TO CONTROL FIRE

Uncontrolled fire leads to a lot of destruction to human life and property. It is thus essential for us to understand the various ways we can employ to control fire. Let us discuss them in detail.

## Water

Water is the most common fire extinguisher. It cools down many combustible substances. The water vapours surround the combustible substance and cut off the supply of air. Water can be used to put out fires caused by wood or paper. However, it cannot be used to put off fires caused by oil, petrol, kerosene, etc, because these substances are lighter than water and keep floating on water. Thus, the fire keeps burning. Water should also not be used to put off a fire caused by electrical equipment as water is a good conductor of electricity and thus can lead to electrocution (death or serious injury caused by electric shocks or current passing through the body).

## Soda acid fire extinguisher

In this method, the reaction between baking soda and sulphuric acid takes place that leads to the formation of carbon dioxide and water. Both of these act as fire extinguishers. Carbon dioxide can be used to extinguish fire caused by petrol, oil, kerosene, etc. It is heavier than oxygen and covers the combustible substance like a blanket, thus cutting off the contact between the combustible substance and air. It can also be used to extinguish fire caused by electrical equipment because it does not conduct electricity and thus there is no danger of electrocution.



## Carbon dioxide cylinders

In fire extinguishers, carbon dioxide is stored in liquid form under high pressure. When released from the cylinder, it comes out in the vapour form and expands enormously in volume. Thus, carbon dioxide extinguishes fire by simultaneously cutting off the air supply and bringing down the temperature of the combustible substance.

## By using a blanket

When a person's clothes catch fire, a blanket should be wrapped around his body to cut off the air supply, thereby extinguishing the fire.

### Check Point



1. Why can you blow out a candle?
2. Which gas is essential for combustion?

### Activity



(Note: To be performed by the teacher)

**Aim:** To show that vapours are essential to produce a flame.

**Materials required:** A candle, a piece of coal, a china dish and a match box

**Procedure:** Take a candle and burn it. Now take a piece of coal. Keep it in a china dish and burn it. Observe the difference between a burning candle and a piece of coal.

**Observation and Conclusion:** You will observe that a candle burns with a flame while coal burns without flame. The substances which emit vapours while burning produce flame. For example, candle, LPG etc. When you burn the candlewick, the wax around it melts and gets vapourised. The vapourised molten wax moves upward through the wick due to capillary action. The vapours burn in air and produce a flame.

Similarly in case of LPG, in cylinder it is in liquid state but when pressure decreases it changes to gaseous state and rises to produce a flame.

## FLAME, FUELS AND POLLUTANTS FORMED AFTER COMBUSTION

### Flame

Before we begin to understand the various zones of a flame let us perform an activity.

#### Zones of Flame

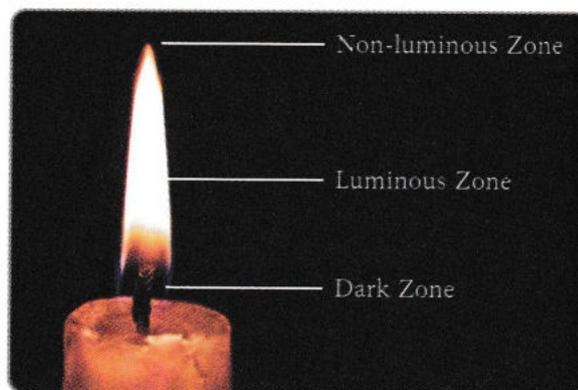
A candle flame is divided into the following three zones.

**The intermediate zone (Dark zone) of no combustion:** It is dark black in colour. It consists of unburned wax as no combustion takes place here due to the lack of oxygen. Thus, it is also known as the zone of no combustion. It is the least hot zone of the flame.

**The middle zone (Luminous zone) of incomplete combustion:** In this region, partial combustion takes place due to insufficient supply of oxygen. As a result, wax starts burning with a yellowish flame. Some unburned carbon particles present in the zone become red hot and impart yellow colour to the flame. This region is moderately hot and is also called the luminous zone or zone of incomplete combustion.

**The outermost zone (Non-luminous zone) of complete combustion:** It is a faintly visible zone which is transparent blue in colour. In this region, complete combustion of wax takes place with a blue coloured flame. Wax burns to produce heat, carbon dioxide and water vapour. It is the hottest region of a candle flame. It is also known as non-luminous zone or zone of complete combustion.

Goldsmiths blow the outermost zone of a flame with a metallic blowpipe to melt gold and silver pieces so as to mould them into desired shapes. Blowing air helps in the rapid combustion of unburned fuel and makes the flame hotter, sufficient to melt gold and silver.



*Zones of a flame*

### Fuels

The substance that burns to produce energy which is used to do some useful work is called fuel. On the basis of their physical state, fuels are grouped into three categories.

#### Solid fuels

The fuels like wood, coal, coke and cow dung cake which exist in solid state at room temperature are called solid fuels.

#### Liquid fuels

The fuels like oil, alcohol, petrol and diesel which exist in liquid state at room temperature are called liquid fuels.

#### Gaseous fuels

The fuels like natural gas, biogas and petroleum gas which exist in gaseous state at room temperature are called gaseous fuels.

#### Calorific value of fuel

Different fuels produce different amounts of energy. The amount of energy produced by the complete combustion of 1 kg of a fuel in air is called its calorific value. Calorific value of a fuel is expressed in kilojoules per g (kJ/g).

Higher the calorific value of a fuel, the better its efficiency. The table given below gives the calorific value of some fuels.

Calorific Values of Some Fuels	
Fuel	Calorific Value (kJ/g)
Cow dung cake	6–8
Wood	17–22
Coal	25–33
Petrol	47
Kerosene	48
Diesel	45
Methane	55
CNG	50
LPG	41
Biogas	35–40
Hydrogen	150

Hydrogen has the highest calorific value and may be considered as the best fuel. But it is highly inflammable and there are difficulties to transport and store it. Thus, its use is mostly limited as a rocket fuel.

Methane and LPG have high calorific values and burn without producing smoke; thus, do not cause pollution. They are used as domestic fuel. LPG can also be used in automobiles as fuel.

Petrol and diesel are used as automobile fuels. They release harmful gases upon burning and their availability is limited in nature.

### Characteristics of a good fuel

- It should be cheap and easily available.
- It should have high calorific value.
- It should not produce harmful gases on burning and should not leave behind any undesirable substances.
- It should be safe to handle and transport.
- It should burn at a moderate temperature.
- It should have a low ignition temperature but it should be considerably higher than the room temperature.
- It should not be explosive in nature.

### Pollutants obtained by burning fuels

- Un-burnt carbon particles (soot) — Fuels such as wood, coal and petroleum release unburned carbon particles into the environment on burning called soot. These fine particles can cause respiratory problems such as asthma and bronchitis.
- Incomplete combustion of carbon — Burning fuels like petrol, kerosene and diesel produce carbon monoxide, which is a poisonous gas. If a person is exposed to carbon monoxide for a long duration, it may prove fatal and he or she may even die.

- Burning of coal and diesel produces gases like sulphur dioxide and petrol engines release nitrogen oxides. These oxides dissolve in rainwater to form sulphuric acid and nitric acid which fall down in the form of acid rain. Acid rain harms statues, buildings, soil, plants, etc.
- Most fuels on combustion release carbon dioxide which is a greenhouse gas. It has the ability to trap heat. Excessive use of such fuels leads to the increase in the level of carbon dioxide in the atmosphere. As a result the average temperature of the Earth increases. This increase in the temperature of the Earth's surface is called global warming. It results in melting of glaciers, which consequently leads to rise in sea level that may cause floods in coastal areas.

### Check Point

#### True or false

1. Carbon dioxide is a greenhouse gas.
2. Acid rain is not harmful for monuments made of marble.
3. Alcohol is a gaseous fuel.
4. Inner part of the flame is its hottest region.
5. A good fuel should have a high calorific value.

### Key Terms

- **Combustion:** A process in which a substance burns in air or oxygen to produce energy.
- **Combustible substance:** A substance that can burn easily.
- **Non-combustible substance:** A substance that cannot catch fire easily.
- **Ignition temperature:** The minimum temperature at which a substance catches fire.
- **Flame:** The light-emitting part of a fuel which rises in air.
- **Fuel:** Any substance that burns to produce heat and light to perform work.
- **Calorific value:** The amount of heat produced by the complete combustion of 1 kg of a fuel.

### Recall

- The oxidation of a substance in air to produce energy is called combustion.
- The presence of air is necessary for combustion.
- Ignition temperature of a substance should be achieved for combustion to occur.
- The energy produced by burning 1 Kg of a fuel is called its calorific value.
- The fire extinguishers extinguish the fire by cutting off the supply of oxygen and by bringing down the temperature.
- Many pollutants such as  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{SO}_2$  etc. are produced during combustion.

## Assess Zone

### A. Tick (✓) the correct answer.

1. Which gas is produced when most of the fuels are burnt?  
 a. Sulphur dioxide      b. Helium      c. Nitrogen      d. Carbon dioxide
2. Which gas is the supporter of combustion?  
 a. Oxygen      b. Hydrogen      c. Nitrogen      d. Carbon dioxide
3. Water cannot be used to put off fire caused by which of the following substances?  
 a. Kerosene      b. Petrol      c. Electrical appliance      d. All of these
4. Which of the following substance does not burn with a flame?  
 a. LPG      b. Wood      c. Coal      d. Candle
5. Which among the following substances undergo spontaneous combustion?  
 a. Firecracker      b. Magnesium ribbon      c. Sodium      d. LPG
6. Which is the hottest zone of a candle flame?  
 a. Innermost zone      b. Middle zone      c. Outermost zone      d. All of these
7. In which part of the candle flame does complete combustion take place?  
 a. Innermost zone      b. Middle zone      c. Outermost zone      d. All of these
8. Which fuel has the highest calorific value?  
 a. Methane      b. LPG      c. Petrol      d. Hydrogen
9. Soot is made up of which of the following?  
 a. Un-burnt carbon particles      b. Carbon dioxide  
 c. Carbon monoxide      d. None of these
10. Which among the following is a constituent of natural gas?  
 a. Methane      b. Ethane      c. Propane      d. Butane

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

1. A greenhouse gas \_\_\_\_\_
2. The minimum temperature at which a substance catches fire \_\_\_\_\_
3. The gas required for combustion \_\_\_\_\_
4. Soda acid fire extinguisher produces this gas \_\_\_\_\_
5. A gaseous fuel \_\_\_\_\_
6. Natural gas mainly contains this gas \_\_\_\_\_
7. This is the amount of energy produced by complete combustion of a fuel \_\_\_\_\_

### C. Match the following.

- |                            |                            |
|----------------------------|----------------------------|
| 1. Hydrogen                | a. Pollutant               |
| 2. Fire crackers           | b. Oxidation               |
| 3. Respiration             | c. Highest calorific value |
| 4. Carbon monoxide         | d. Hottest part of a flame |
| 5. Invisible zone of flame | e. Explosion               |

**D. Give reasons for the following.**

1. Water should not be used to put out a fire caused by oil or petrol.
2. The middle zone of a flame is yellowish in colour.
3. Carbon dioxide is used to put out a fire caused by petrol or kerosene.

**E. Answer the following questions in one word or a single sentence.**

1. What is combustion?
2. Name two combustible substances.
3. Which zone of the candle flame is called the dark zone?
4. How is the calorific value of a fuel expressed?
5. Name two liquid fuels.
6. What type of combustion occurs when a substance catches fire on its own?

**F. Answer the following questions in brief.**

1. How can you say that respiration is also a type of combustion?
2. Why is it necessary to attain the ignition temperature of the fuel?
3. What will you use to put off fire caused by electrical gadgets? Give reasons.
4. List the conditions essential for combustion.
5. Why is combustion considered to be a chemical change?
6. We should not burn coal in a closed room. Why?

**G. Answer the following questions in detail.**

1. Describe the zones of flame with a well-labelled diagram.
2. List the pollutants produced by burning of carbon-containing fuels.
3. Distinguish between complete and incomplete combustion.
4. Explain three methods which are used to extinguish fire.

### Out of The Box

1. Hydrogen has the highest calorific value. It is an eco-friendly fuel but still it is not used as a regular fuel and its use is limited as a rocket fuel. Why?
2. A goldsmith uses a blow pipe to direct the invisible part of flame towards gold ornaments to melt them. Why?

### In Real Life

Students should also be made aware about the use of induction tops for cooking instead of normal conventional ways as an alternative way of cooking food.

## Subject Enrichment

### Activity Zone

1. Rhythm's grandmother burns coal in an *angithi* inside the room during winters to make the room warm and cosy. Rhythm suggests her that she should not burn coal in a closed room. Why should she not burn coal in a closed room?

### Project Zone

1. Compare the calorific values of different fuels and relate it to their usage.
2. Students should be taken to chemistry lab to show them the working of Bunsen burner. The role of holes below the burner and how the flame is controlled should be explained to the students.

### Web-links

- Combustion: <https://www.grc.nasa.gov/www/k-12/airplane/combst1.html>

### Teacher's Note

The importance of combustion in our daily life can be discussed in detail in the class in which students can be asked to take an active part.

- The various zones of a candle flame can be taught by lighting a candle in a dark room and pointing out the different zones to explain each.
- The use of cleaner fuels and fossil fuels judiciously should be stressed in the class. The students could be asked to design posters and banners in this respect to create awareness in school and in their neighbourhood.

## Worksheet 2

(Unit 2 – Materials)

### Examining Materials — The Effect of Heat on the Property of a Metal

We now understand that it is possible to change the characteristics of a material by treating them in various ways. Let us determine the effect of heat on a metal in this activity. Obtain a few paper clips or safety pins. First, determine how many times does it take to bend a clip or pin back and forth to break it. The stress at the point of bending causes the paper clip or the bobby pin to break.



Now, try various types of heat treatment to see the effect they have on the metal.

Try heating the piece of the pin in the flame of a burner until it becomes red. To do this, hold the piece with the help of forceps or tongs. Allow the piece to cool on its own until it is safe to handle. Then try to break it, being careful to bend it back and forth exactly as you did earlier with the normal pin or clip.

Record your results.

Let us now try another method of heating. This time heat the pin to redness and cool it down by putting it in water or heat the pin several times only moderately.

Record your observation each time.

Method applied	Effort taken to break (back and forth of the piece of the pin)	Time taken to break	Observations
Without heating or cooling			
Heating to redness and let the pin cool on its own			
Heating moderately and let the pin cool on its own			
Heating to redness and then cooling in water			
Heating moderately and then cooling in water			

What do you think is the relationship between the method applied of heating and the characteristic of the metal?

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## Unit Test Paper 2

(Unit 2 - Materials in Daily Life)

### A. Tick (✓) the correct answer.

- Which of the following is not a synthetic fibre?  
a. Rayon                      b. Nylon                      c. Polyester                      d. Silk
- Which of the following is an example of a thermosetting plastic?  
a. Bakelite                      b. Polythene                      c. PVC                      d. Polystyrene
- Which of the following materials is not malleable at room temperature?  
a. Gold                      b. Silver                      c. Aluminum                      d. Mercury
- Which of the following substances is the solid residue left behind after dry distillation?  
a. Petroleum                      b. Diesel                      c. Kerosene                      d. Coke
- Which of the following synthetic fibres is used to make bottles?  
a. Polyester                      b. Acrylic                      c. Nylon                      d. Rayon

### B. Are the following statements true or false? Correct the false statements.

- Acrylic is cold and is thus used to make clothes for summer.
- Thermoplastics cannot be remoulded into different shapes.
- Non-metals are poor conductors of electricity except graphite.
- Crude oil is refined by the process of fractional distillation.
- Coal is a renewable natural resource.

### C. Give one word or one example for the following.

- A product used in making insecticides, drugs, dyes, perfume, etc.
- An eco-friendly gas used as a fuel
- Coating done on the uniforms of firemen to make them fire resistant
- The natural process of corrosion of metals
- Synthetic fibres made up of long chains of monomers

### D. Answer the following questions.

- What is the difference between biodegradable and non-biodegradable substances?
- What are alloys? Give three examples of alloys along with their uses.
- What is fractional distillation? What products are obtained through this process?
- What are the different types of combustion? Explain with examples.
- How is a flame divided into zones? Explain with a diagram.

## 7

Conservation of  
Plants and Animals

## Chapter Focus

- Importance of Biodiversity
- Loss of Biodiversity — Causes and Consequences
- Flora and Fauna
- Conservation of Biodiversity
- Wildlife Conservation
- Protected Areas
- Migration

## Kick-off Activity

## Plants and animals you know of

When was the last time you went for a vacation with your family? Was it a forest or a mountain? Or was it a plain or may be a sea shore?

Try to list out 5 different animals and plants that you found in abundance there, but is not very common in your area.

Name of Plants	Name of Animals
1	1
2	2
3	3
4	4
5	5

We already know that there is a vast variety of plants, animals and microorganisms on this Earth. Whether it is a forest or a desert or some aquatic body, there are different types of plants, animals and microorganisms inhabiting it. Biodiversity can be defined as the diverse variety of plants, animals and microorganisms living in a particular area. We can also say that the living population of a particular area is known as the biodiversity of that area. Different regions have different biodiversity. For example, the biodiversity of a grassland is completely different from that of a desert. Thus, there is a vast variety of biodiversity present on the Earth. Approximately, 10 million species of microorganisms, plants and animals are present on our Earth. However, we have been able to identify only one or two million living organisms till now.

## Do you know?

Pando, a colony of quaking aspen trees in Utah, USA is said to be around 80,000 years old making it the oldest living organism on the planet.



In this chapter, we will learn about the importance of biodiversity, why we are losing this biodiversity, what are the consequences of losing the biodiversity, and what steps can be taken to conserve it.

Let us first learn about a few important terms—species, ecosystem and habitat.

**Species:** A group of organisms that have common characteristics and can interbreed among themselves is called species. For example, humans (*Homo sapiens*) are one species and dogs (*Canis familiaris*) constitute a different species.

**Habitat:** A habitat is the natural environment of an organism, where it lives and breeds. For example, desert is the habitat of camels and cactus plants whereas a rainforest is the habitat of wide varieties of evergreen trees.

**Ecosystem:** An ecosystem is the interaction of the living components with the non-living components of a particular area. In other words, the interactions of living things (plants, animals and microorganisms) among themselves as well as with the physical or non-living components, such as air, water and soil, is called an ecosystem. The biotic and abiotic components interact with each other. For example, plants interact with climate, soil and water and make food which is consumed by other non-green plants and animals. Some examples of ecosystems are a forest, a desert, a grassland, a lake, a mountain, etc.

## IMPORTANCE OF BIODIVERSITY

Biodiversity is very important for the survival of life on this Earth. Biodiversity includes all living plants and animals that depend on each other. Be it a microorganism or a rhinoceros, every organism interacts with other living organisms around them. No one can survive alone. Each and every organism plays an important role in nature. Biodiversity, thus, maintains our environment. We depend on our environment and other living organisms for food (plants and other animals), shelter (wood, stones, etc.) and clothes (plant fibre and animal fibre such as wool and silk).

## LOSS OF BIODIVERSITY—CAUSES AND CONSEQUENCES

We are losing much of biodiversity every day. This loss is threatening our own existence. Let us understand the causes and consequences of this loss.

### Deforestation

The cutting down of trees over a vast area is called deforestation. In other words, clearing of forests is known as deforestation.

#### Causes of Deforestation

Some of the main reasons why deforestation happen are as follows:

1. To build homes for the ever-increasing human population
2. To build roads, industries, dams, etc. to support human survival
3. To clear land for agricultural practices
4. To get wood for fuel, furniture and paper
5. To make grazing fields for the cattle
6. To mine minerals and petroleum products



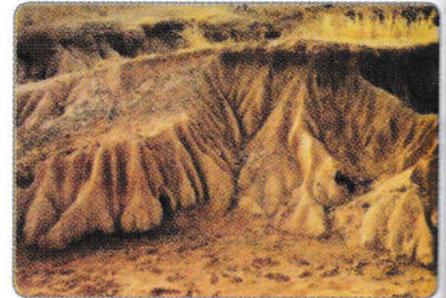
Deforestation

In addition to the human-caused deforestation, some natural causes are also responsible for deforestation, such as

1. Forest fires, severe drought, heavy floods, etc.
2. Over-grazing by cattle and other animals.

### Consequences of Deforestation

1. Deforestation is one of the major causes of soil erosion. Soil erosion is the removal of the top fertile layer of the soil. Roots of trees and plants bind the top fertile layer of the soil together. When there are no trees, this fertile layer gets washed away with water (flood and strong rains) and strong winds. The soil, thus, loses its top layer which is rich in nutrients and humus. This leads to poor growth of vegetation and ultimately results in infertility of the soil with time.

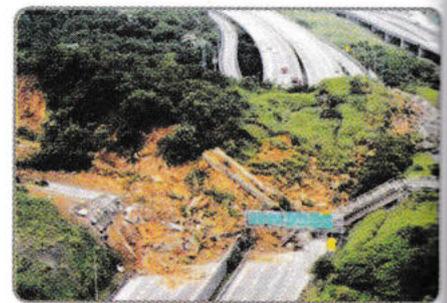


*Soil erosion*



*Giant Panda*

2. Cutting down of forests leads to loss of natural habitats and homes of many species. It has been estimated that an average of 137 species are driven to extinction in rainforests every day due to cutting down of forests. Another example is of giant pandas. The home of these pandas, the bamboo forests, have been reduced to less than half of their original density. Thus, resulting in loss of giant pandas in so many numbers that this species has become endangered now.
3. Trees play a very important role in maintaining the balance of gases in the Earth's atmosphere. As we know, plants take in carbon dioxide and give out oxygen. Cutting down of trees leads to less absorption of carbon dioxide from the atmosphere. The excess of carbon dioxide heats up the atmosphere, resulting in melting of glaciers and ice caps. The phenomena of increase in global temperature due to imbalance in atmospheric gases is known as global warming. Global warming disturbs the water cycle, affects rainfall and results in floods and droughts.
4. We know that trees release water vapour in atmosphere by the process of transpiration. Cutting down of trees on large scale has resulted in the decrease of amount of water vapour in the atmosphere, leading to decrease in overall rainfall.
5. Cutting down of trees makes the soil loose as there are no roots to bind the soil. This leads to natural catastrophe such as landslides.
6. Deforestation leads to **desertification** of land. Desertification is conversion of fertile land into desert, where no or very less vegetation is seen. Without any trees present to hold up the top layer of the soil, water and wind remove the fertile soil, thus, making it unfit to support the growth of any vegetation.
7. Deforestation also leads to decrease in the water-holding capacity of the soil. This increases the frequency of floods.



*Landslide*

### Poaching

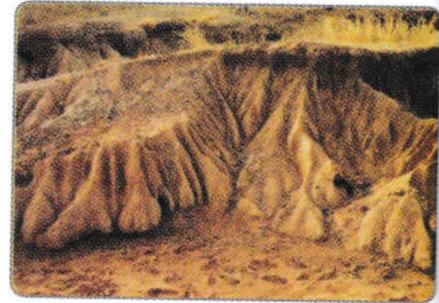
**Poaching** is the illegal hunting done across the world to capture or kill animals for commercial purposes. Animals such as tigers, rhinoceros, elephants, leopards, whales, crocodiles, seals, foxes,

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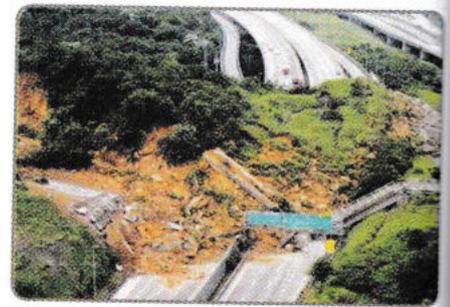


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*Landslide*

### Poaching

**Poaching** is the illegal hunting done across the world to capture or kill animals for commercial purposes. Animals such as tigers, rhinoceros, elephants, leopards, whales, crocodiles, seals, foxes,

rabbits and many others are hunted down for their skins, furs, bones, tusks or horns, claws, meat and other body parts. Poaching has led to extinction of cheetah from Indian jungles. Similarly, a Mauritius bird called the dodo is now extinct due to poaching.

## Pollution



*Fish dying due to pollutants in water bodies*

Biodiversity is adversely affected by pollution of land, air and water. Fish and other aquatic animals are killed by accumulation of pesticides and other harmful chemicals accumulated in water bodies. These chemicals make the natural habitats of these animals inhabitable. Another major cause of loss of aquatic species is oil spillage from drilling rigs or from an oil tanker on land or leakage of petroleum from a vehicle.



*Cheetah*

## Natural Disasters

Natural disasters such as earthquakes, floods, cyclones, tsunamis, hurricanes and droughts also lead to loss of biodiversity in the affected areas.

### Do you know?

In a severe flood in 2012, Kaziranga National Park lost approximately 600 animals, including elephants and rhinoceros.

### Check Point



#### A. Fill in the blanks.

- \_\_\_\_\_ causes soil erosion.
- Glaciers are melting due to \_\_\_\_\_ in Earth's \_\_\_\_\_.
- \_\_\_\_\_ are now extinct from Indian jungles due to poaching.
- In an ecosystem, \_\_\_\_\_ components interact with abiotic components.
- Due to less number of trees, absorption of \_\_\_\_\_ is uneven leading to disturbance in the water cycle.

#### B. Given below are number of factors. Colour the ones that you feel contributes to deforestation:

Building dams

Making furniture

Rejecting toilet paper

Building roads

Population control

Crop production

Plantation drive

Grazing of animals

## Activity



**Aim:** To observe and understand local flora and fauna.

**Procedure:** Walk through your school campus and make a list of the plants that are there. Do the same for animals. Remember, do not just look for big animals, but the smaller ones as well. You could use a magnifying glass for the insects or other creepy-crawly. Also include the birds and animals living on the trees.

**Observation:** Note your observation in the table below and also the place you discovered it, for example, a squirrel could be on top of a tree

Name of Plant/Animal	Place of discovery

**Discussion:** All that you see in this list makes up the flora and fauna of your place. Try to find if these are indigenous to this place or these have been found some place else. You will be surprised to see how much the locals know about the flora and fauna of a place.

## FLORA AND FAUNA

The biodiversity of a place is formed by the flora and fauna of that region. Let us first define understand the terms flora and fauna.

**Flora** — Plants of a particular region, habitat or geographical period.

**Fauna** — Animals of a particular region, habitat or geographical period.

We need to conserve the biodiversity of our earth. Each component is dependent on another for survival. To maintain life on this earth, the biodiversity has to be conserved and protected. Conservation of biodiversity ensures availability of useful resources (flora and fauna) for future generations. Biodiversity conservation is also important to maintain the ecological balance in the nature.

Many organisations, both governmental and non-governmental, are working towards conservation of biodiversity by designing and leading conservation programmes on local, national and international levels. Laws have been framed to protect the existing forests and wildlife. Conservation awareness programs are being run of large scale to make public aware of different ways and methods in which they can help in conservation of biodiversity.

The **World Conservation Union (WCU)**, earlier known as the **International Union for Conservation of Nature and Natural Resources (IUCN)**, studies and assess the conservation of plant and animal species across the world. It maintains a list known as the **IUCN Red List** of endangered/threatened

species. The main aim of this list is to help conservationists identify the endangered species or soon to be extinct species and promote the conservation practices accordingly.

The present flora and fauna have been classified into following categories by the IUCN:

1. Extinct species
2. Extinct in natural habitat
3. Endangered species
4. Endemic species

Let us learn more about these above-mentioned categories.

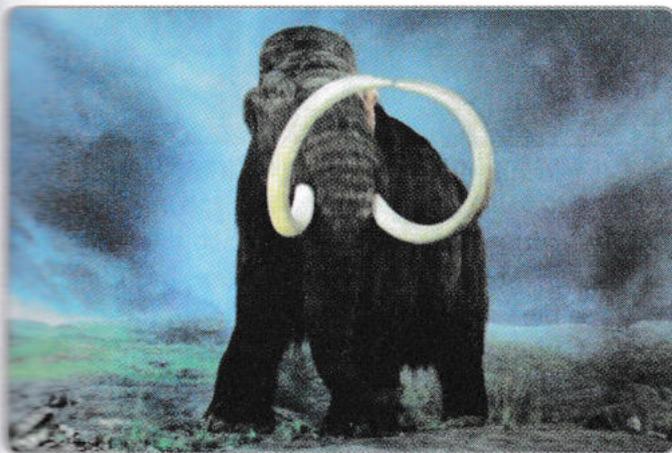
### Extinct Species

Extinct species are those species of plants and animals that once lived on earth and now not even a single individual of the species is alive. One of the most popular examples of extinct species is dinosaurs. Dinosaurs inhabited the earth millions of years ago. It is believed that the temperature of the earth suddenly cooled down and dinosaurs could not adjust to this change in living conditions and thus died. Some other examples of extinct species are dodo bird, mammoth, passenger pigeon, woolly mammoth, Eastern cougar, California grizzly bear, Tasmanian tiger and Tasmanian wolf. Plants such as Nilgiri holly and cry pansy have also become extinct from India. Other examples of extinct plant species are Siphium, Saint Helena olive, Erica pyramidalis and Lepidodendron.

### Do you know?

#### The IUCN Red List of Threatened Species

It is the world's most comprehensive inventory of threatened species. The term threatened species comprises of endangered, vulnerable and critically endangered species.



*Woolly Mammoth*



*Eastern Cougar*

### Extinct in Natural Habitat

Some species are now extinct in their natural habitat but are represented alive only by the living members in captivity such as zoos and wildlife parks. Such species are called extinct in natural habitat species.

Some examples are Wyoming toad, South China tiger, Hawaiian crow, Black soft-shell turtle. Some Indian examples are the Cheetah and the pink-headed duck. Kalimantan mango or kasturi mango is an example of extinct in natural habitat plant species.



*Wyoming Toad*



*Black Soft-Shell Turtle*

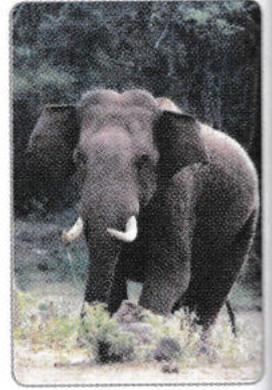
## Endangered Species



*African Penguin*

The species that are at the risk of being extinct if proper conservation steps are not taken towards protecting them are called endangered species. These species have declining number of living individuals or are dying due to loss of their habitat because of drastic change in environmental conditions.

Some examples of such species are Mexican wolf, African penguin, Asian elephant, Bengal tiger, blue whale, common chimpanzee, giant otter, green sea turtle, Indian pangolin, purple-faced langur, snow leopard, wild water buffalo, and red panda.



*Asian Elephant*

Some examples of endangered plant species are guggal, paneer bandh, rohida, indrok, small whorled pogonia, *Lindera melissifolia* and *Helianthus paradoxus*.



*Bengal Tiger*



*Red Panda*



*Giant Otter*



*Indian Pangolin*

### Do you know?

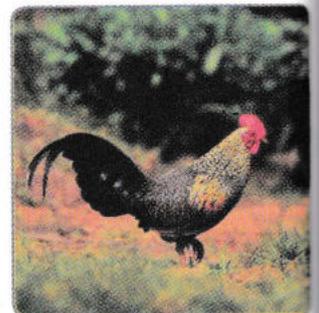
#### Project Tiger

The Government of India launched this tiger conservation programme in 1973. The main aim of this project is to ensure a viable population of the Bengal tigers in their natural habitat. Another aim of this project was to limit factors that lead to reduction of tiger habitats and to manage the habitats such that the damages already done are reduced to minimum and a sustainable ecosystem is created and maintained.

## Endemic Species

The species of plants and animals that are found exclusively in a particular geographical area are called endemic species. Such species are not found naturally in other areas. Let us study some examples of endemic species.

1. Grey Jungle Fowl – This species of fowl is mainly found in Indian peninsula but is also distributed in the regions of Gujrat, Madhya Pradesh and southern Rajasthan.
2. Greater One-horned Rhinoceros – These rhinoceros are found in India and Nepal, in the foothills of Himalayas.



*Grey Jungle Fowl*

- 3 Nilgiri Tahr – This mountain goat is found in the Western Ghats of Tamil Nadu and Kerala.
- 4 Asiatic Lion – These are only found in and around the Gir Forest National Park of Gujrat.
- 5 Sangai Deer – This brown antlered deer is only found in the Keibul Lamjao National Park of Manipur.
- 6 Lion-tailed Macaque – This species is endemic to the Western Ghats of southern India.
- 7 Kashmir Stag – Also known as Hangul, this is the only species of elk found in India. These are endemic to the riverine forests of Dachigam National Park, Kashmir Valley of Jammu and Kashmir and Chamba in Himachal Pradesh.
- 8 Ganga River Dolphin – This species of dolphins is found only in the river Ganga.
- 9 Black Buck – These are found in the slopes of Himalayas.
- 10 Nilgiri Marten – This mammal is only found in the Western Ghats.



*Nilgiri Tahr*



*Asiatic Lion*



*Lion-Tailed Macaque*



*Ganga River Dolphin*

Some other examples of Indian endemic species are Purple Frog (Western Ghats), Pygmy Hog (Assam), Nilgiri Blue Robin (Shola Forest). The Giant Panda is an endemic species of south-west China. Darwin's finches or Galapagos finches are an endemic species of small birds found only on the Galapagos islands. Rajasthan also has some endemic animal species such as Aravalli red Spurfowl, Rajasthan Red-Whiskered Bulbul, Mt. Abu White-throated Babbler and White-naped Tit.

Some examples of **endemic plants** of India are Red Sandal (Southern India), and Khedula, Indrok and Penpa (Rajasthan).



*Red Sandalwood*

### Do you know?

India is listed at number 6 in the list of mega-diverse countries worldwide. More than half of the world's tigers are found in India. In addition, it also has 65% of Asian elephants, 100% of Asian lions and 85% of one-horned rhinoceros.

Another category of animals is called exotic species. These are the species that are growing in a non-native environment. Exotic species do not belong to the place they are living in naturally and are introduced from someplace else. In other words, exotic species are those species that are introduced to a region or an ecosystem, often unintentionally, through human migration or trade. This practice sometimes leads to scarcity of resources for the natural resident species. For example, Mediterranean fruit fly has been introduced in America unintentionally and has become a pest now. Similarly, the water hyacinth is an exotic species in India. It grows rapidly in water bodies and covers up the entire water bodies, thus threatening survival of many native plant species.

## Check Point ✓

Give two examples of each of the following.

1. Extinct species \_\_\_\_\_
2. Extinct in wild species \_\_\_\_\_
3. Endangered species \_\_\_\_\_
4. Exotic species \_\_\_\_\_

## CONSERVATION OF BIODIVERSITY

We now know the importance of biodiversity for our survival as well as the survival of other life forms on Earth. We should always be aware about how some of our activities are effecting the biodiversity. Some of the steps that can be taken to conserve biodiversity are as follows.

1. **Afforestation:** Afforestation is planting of trees on a large scale so as to build forests where there were no trees present earlier. Planting of trees is an important step towards conservation of biodiversity.
2. **Stop Overgrazing:** Overgrazing by cattle should be prevented. Grazing by animals should be controlled to save vegetation in an area.
3. **Prevent Forest fires:** Precautions such as spraying fire extinguishers from helicopters or changing the direction of wind to prevent spreading of forest fire by using high duty air blowers can be taken.

Apart from the above steps that the authorities can take, it is also our responsibility to help conserve the biodiversity. We should adept such living practices that do not disturb the biodiversity. Practices such as over hunting, over logging, over-grazing, etc. should be avoided.

## WILDLIFE CONSERVATION

Forests are natural homes of wildlife. To conserve wildlife, we need to conserve our forests. When we cut down forests, the wildlife automatically gets destroyed, which in turn destroys the biodiversity. To help conserve the wildlife, following steps should be taken.

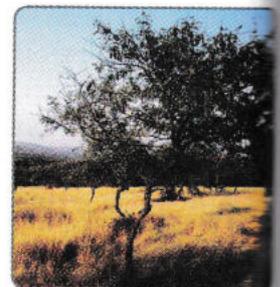
1. **Regulated hunting:** The government should lay down strict regulations for hunting the wildlife. These regulations should be sternly followed. Hunting of endangered species should be completely banned and a penal offense.
2. **Protection of Habitats:** Conservation areas such the wildlife sanctuaries, national parks and biosphere reserves should be developed and protected by the government. The protection of such area will help the wildlife to flourish in their natural habitats, safe from the outside world.

## PROTECTED AREAS

The undisturbed natural habitats of wildlife are called protected areas. Examples of protected areas are national parks, biosphere reserves and wildlife sanctuaries. Such areas are protected both on land and in water. These areas are protected through strict legal laws and guidelines.

### National Parks

A national park is a vast area of land, and sometimes water, protected by government of conservation of wildlife. Within this area, the wildlife lives in its



*Ranthambore National Park*

habitat in a protected environment. Cattle grazing or agricultural practices are not allowed in this area. The national parks are also promoted as tourism destinations so that the public can watch and observe wildlife in their natural habitats.

India has a total of 104 national parks across its different regions. Some of the famous national parks are mentioned in the table given below.

### List of National Parks

S. No.	National Park	Location	Flora and Fauna
1.	Bandipur National Park	Karnataka	Chital, Bengal Tiger, Gray Langurs, Indian Giant Squirrel, Gaur, Leopard, Sambar Deer, Indian Elephants, Honey Buzzard, Red-Headed Vulture
2.	Bhitarkanika National Park	Odisha	Mangroves, Saltwater Crocodile, White Crocodile, Indian Python, Black Ibis, Wild Pigs, Rhesus Monkeys, Olive Ridley Turtle, Chital
3.	Gir Forest National Park	Gujarat	Asiatic lion
4.	Jim Corbett National Park	Uttar Pradesh	Tiger
5.	Kaziranga National Park	Assam	Indian One-Horned Rhinoceros
6.	Rajaji National Park	Uttarakhand	Elephants, Tigers, Leopards and several species of birds, reptiles and mammals
7.	Ranthambore National Park	Rajasthan	Tigers
8.	South Button Island National Park	Andaman and Nicobar Islands	Dugong, Dolphin, Water Monitor Lizard, Blue Whale

### Wildlife Sanctuary

A wildlife sanctuary is a protected area where wildlife can thrive in their natural habitat. Such an area provides a refuge to species in danger of becoming extinct. No human activities are allowed inside the sanctuary that may disturb the wellbeing of the wildlife. Although certain activities such as collection of small forest products and small-scale timber collection are allowed, under strict supervision of legal authorities to ensure that no wildlife is being harmed in these processes.

Wildlife sanctuaries provide home for some endangered species too. In India, animals such as pink-headed duck, black buck, python, gharial, etc. are protected in different wildlife sanctuaries. India has 435 wildlife sanctuaries. Refer to the following table for some famous Indian wildlife sanctuaries.

### Wildlife Sanctuaries of India

S. No.	Wildlife Sanctuary	Location	Flora and Fauna
1.	Gautam Buddha Wildlife Sanctuary	Bihar and Jharkhand	Tigers, Leopards, Wolves, Sloth Bears, Chitals, Chinkaras and many species of birds.
2.	Salim Ali Bird Sanctuary	Goa	Striated Heron, Western Reef Heron, Little Bittern, Black Bittern, Red Knot, Jack Snipe, Pied Avocet, Mudskippers, Fiddler Crabs

S. No.	Wildlife Sanctuary	Location	Flora and Fauna
3.	Barda Wildlife Sanctuary	Gujarat	Blue Bull, Chinkara, Blackbuck and Wolf.
4.	Bharatpur Bird Sanctuary (now known as the Kleoladeo National Park)	Rajasthan	Siberian Crane, Indian Grey Hornbill, Pallas' Fish Eagle, Short-Toed Eagle, Tawny Eagle, Imperial Eagle, Spotted Eagle, Crested Serpent Eagle, Ereater Spotted Eagle
5.	Cauvery Wildlife Sanctuary	Karnataka	Tiger, Elephant, Wild Boar, Leopard, Spotted Deer, Sambar, Four-Horned Antelope, Black-Naped Hare, Malabar Giant Squirrel, Smooth-Coated Otter, Mugger Crocodile, Indian Mud Turtles, Indian Rock Python, Indian Cobra, Russell's Viper
6.	Gandhi Sagar Sanctuary	Madhya Pradesh	Tree species found in the Sanctuary are Khair, Salai, Kardhai, Dhawda, Tendu, Palash etc. Chinkara or Indian Gazelle, Nilgai, Sambar, Indian Leopard, Langur, Indian Wild Dog, Peacock, Otter, Mugger Crocodile

### Biosphere Reserve

A biosphere reserve is an area rich in biodiversity that is protected and conserved and has plant and animal species of special scientific and environmental interests. The human communities that inhabit such areas are also protected. Such areas are developed to conserve biodiversity. Another aim of developing a biosphere reserve is to spread awareness to lead an eco-friendly life in adherence to biodiversity conservation.

India has 18 biosphere reserves, out of which 10 are part of the World Network of Biosphere Reserves, based on the UNSECO Man and the Biosphere (MAB) Programme list. The following table lists the important biosphere reserves present in India.

#### Biosphere reserves in India

S. No.	Name	State
1.	Nilgiri Biosphere Reserve	Tamil Nadu, Kerala, Karnataka
2.	Gulf of Mannar Biosphere Reserve	Tamil Nadu
3.	Sundarbans Biosphere Reserve	West Bengal
4.	Nanda Devi Biosphere Reserve	Uttarakhand
5.	Nokrek Biosphere Reserve	Meghalaya
6.	Pachmarhi Biosphere Reserve	Madhya Pradesh
7.	Simlipal Biosphere Reserve	Odisha
8.	Great Nicobar Biosphere Reserve	Great Nicobar
9.	Achanakmar-Amarkantak Biosphere Reserve	Chhattisgarh and Madhya Pradesh
10.	Agasthyamalai Biosphere Reserve	Kerala and Tamil Nadu

## Botanical Gardens

A botanical garden is a garden dedicated to conservation of plants species. The main aims of such a garden are collection of seeds, cultivation of plants, and display of plants with their botanical names. This is done to spread awareness about common and rare plants species. Botanical gardens work to revive endangered and extinct species of plants and trees. Another important aim of developing botanical gardens is to further the research in the related fields. Thus, it can also be said that in principle, the role of botanical gardens is to maintain documented collections of living plants for the purposes of scientific research, conservation, display, and education.

### Botanical Gardens of India

S. No.	Name	Location	Fauna
1.	Indian Botanical Garden Recently changed to Acharya Jagdish Chandra Bose Botanical Garden	Sibpur, Howrah, West Bengal	Bougainvillea, Vitis, Jasminum, Nymphaea, the giant water lilies The 'Great Banyan Tree' which is said to be about 500 years old with its present circumference of its canopy is more than its branches. The tree is now growing without its unidentifiable main trunk.
2.	National Botanic Garden	Lucknow	Mango orchard with "dasehri", "safeda" and other famous varieties of mangoes, beautiful collections of roses, lotus and several varieties of Nymphaea
3.	Lloyd Botanic Garden	Darjeeling	Over 12,000 specimens of beautiful orchids Tulip trees and a collection of exotic oaks. Living fossil of Metasiquosia is present here.
4.	Lalbagh Garden or Mysore State Botanical Garden	Bangalore	Plants from Australia, Africa and South and North America. It has introduced and grown edible, medicinal, industrial, ornamental and other economic plants from most of the parts of the world.

## Biodiversity Hot Spots

A biodiversity hotspot is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction. In simpler words, a biodiversity hot spot is an area rich in endemic flora and fauna but that has been endangered by human activities. Such areas are rich in threatened, endangered and endemic species.

There are 36 biodiversity hotspots across the world. India has three of them. They are

1. Eastern Himalayan region
2. Western Ghats
3. Sundarbans and Nicobar Islands

These hotspots are being destroyed due deforestation. We should take necessary steps to protect and conserve these.

## Zoological Park or Protected Area

In a zoological park or a zoo, animals are housed in cages and are displayed for public viewing. The purpose of such parks is to spread awareness and at the same time protect and care for animals. The zoological parks are also breeding centres of animals that are endangered or extinct in the wild. A zoological park has following objectives to fulfill:

1. To provide a breeding centre for extinct in the wild species
2. To provide information about the local wildlife of a region
3. To spread awareness about wild animals and environment conservation
4. To create love and care for wildlife

### Do you know?

#### Red Data Book

The Red Data Book is a public document that has the recordings of endangered and rare species of all plants, animals and microorganisms of a state or a region. It provides data which helps in research. It also helps in monitoring species in danger and creating and constructing conservation programmes accordingly.

## MIGRATION

The seasonal movement of animals from one place to another to avoid harsh weather conditions is called migration. Animals return to their native place when weather conditions change or become favourable again. Many species of birds, mammals and insects are known to migrate from one place to another. Some famous examples are discussed in the following text. Let us first discuss the reasons that lead animals to migrate.

### Reasons for Migration

Animals migrate from one place to another

- To escape unfavourable and harsh climatic conditions
- To find food, shelter and habitable climatic conditions for survival
- To find suitable reproduction ground or place. For example, some fish (like salmon) migrate from salt water to fresh water to lay eggs, while some other fish (like eels) migrate to salt water from fresh water bodies to lay eggs.

### Migrating Birds

Birds migrate between their breeding and winter grounds. Birds fly long distances to avoid harsh weather conditions and then return to their native places to breed.

Arctic Tern is a bird that flies longest distances during migration. It flies from its native place in the Arctic region, the North pole, to the Antarctic region, the South pole, every year. It breeds in the Arctic region during the summer season there and then migrates to the Antarctic region when it is summer time there. Thus, it enjoys two summer seasons every year. It also sees maximum amount of daylight than any other living organism on the planet.

Another example of migratory birds is the famous Siberian crane. These birds migrate from Siberia to India every year during winters and then return to Siberia during summers. Siberia being a cold region



*Arctic Tern*

gets extremely cold during winter season. Thus, the region becomes inhabitable for these birds. They, then fly towards warmer places and reach India and spend their winters here in the Bharatpur bird sanctuary in Rajasthan. After spending a few months here in India, these birds fly back to their homes when conditions become more favourable with return of summer season in their native place.

Some other examples of migratory birds that come to India are Amur Falcons (Siberia to North East India), Greater Flamingo (Gujarat), Demoiselle Cranes (Rajasthan), Bluethroat (Rajasthan) and Great White Pelican (Assam, Uttar Pradesh, Rajasthan and Gujarat).



*Siberian crane*

### Check Point



State whether the following statements are True or False.

1. A forest is a protected area. \_\_\_\_\_
2. There are 15 biosphere reserves in India. \_\_\_\_\_
3. Malvi is a Rajasthani breed of cow. \_\_\_\_\_
4. Arctic tern travel from Antarctica to Arctic region to breed. \_\_\_\_\_
5. Siberian cranes are native Indian birds. \_\_\_\_\_

### Key Terms



- **Deforestation:** The process of permanent destruction of forest for acquisition of land for human advancement.
- **Biodiversity:** Term that describes the variability among living beings on earth.
- **Biosphere:** The geographical region that supports biodiversity.
- **Species:** Group of organisms with some common characteristics that are separated from other such groups by reproductive isolation.
- **Endemic species:** Certain species found only in certain geographical locations, which could be small island or a particular continent.
- **Extinct species:** Animals and plants that have disappeared completely from the face of the earth due to the death of the last individual.
- **Vulnerable species:** Species existing in very low numbers.
- **Endangered species:** Species with high risks of extinction are termed endangered species.
- **Conservation:** The concerted efforts in order to protect species in their habitat and ecosystem.

### Recall



- The diverse variety of plants, animals and microorganisms living in a particular area is known as the biodiversity of that area. Different regions have different biodiversity.
- The interactions of living things among themselves as well as with the physical or non-living components form an ecosystem. The biotic and abiotic components interact with each other.

- The cutting down of trees over a vast area is called deforestation. It is done to build homes, roads, industries, for agricultural practices, for fuel, furniture and paper.
- Deforestation is one of the major causes of soil erosion, loss of natural habitats and homes, global warming, desertification of land and increase in the frequency of floods.
- Poaching is the illegal hunting done across the world to capture or kill animals for commercial purposes. Poaching has led to extinction of cheetah from Indian jungles.
- The International Union for Conservation of Nature and Natural Resources (IUCN), studies and assess the conservation of plant and animal species across the world. It maintains a list known as the IUCN Red List of endangered/threatened species.
- The species that are at the risk of being extinct if proper conservation steps are not taken towards protecting them are called endangered species. These species have declining number of living individuals or are dying due to loss of their habitat because of drastic change in environmental conditions.
- Conservation of Biodiversity should be done through afforestation, by stopping overgrazing and preventing forest fires.
- Wildlife should be conserved by regulated hunting and protection of habitats through national parks, biosphere reserves, wildlife sanctuaries, zoological parks, and botanical gardens.
- Migration is the seasonal movement of animals from one place to another to avoid harsh weather conditions. Birds such as Arctic tern and Siberian crane migrate to far off places every year.

## Assess Zone

### A. Tick (✓) the correct answer.

- Biodiversity includes
  - animals
  - plants
  - microorganisms
  - all of these
- Which of the following is a natural cause of deforestation?
  - Logging
  - Forest fire
  - Mining
  - Building homes
- Which of the following is responsible for extinction of cheetah from Indian jungles?
  - Deforestation
  - Global warming
  - Poaching
  - Soil erosion
- Plants of a particular region are called
  - fauna
  - flora
  - flora and fauna
  - biodiversity
- Species that once were alive but are not present on the Earth are called
  - extinct
  - endemic
  - endangered
  - exotic
- Wyoming toad is an example of what type of species?
  - Extinct
  - Endemic
  - Endangered
  - Exotic
- Guggal plant is an example of what type of species?
  - Extinct
  - Endemic
  - Endangered
  - Exotic
- Bhitarkanika National Park is in which state?
  - Rajasthan
  - Karnataka
  - Uttar Pradesh
  - Odisha

9. Siberian Cranes migrate to which of the following countries to avoid cold harsh conditions every year?
- a. India                      b. Russia                      c. Australia                      d. New Zealand
10. Salmon fish lay their eggs in which type of water?
- a. Saltwater                      b. Fresh water                      c. Both a and b                      d. Neither a nor b

**B. Fill in the blanks.**

1. Removal of the top fertile layer of the soil is called \_\_\_\_\_.
2. There is an increase in the frequency of floods because of \_\_\_\_\_.
3. \_\_\_\_\_ from drilling rigs leads to death of marine life.
4. We need to \_\_\_\_\_ the biodiversity of our earth.
5. IUCN maintains a list known as the \_\_\_\_\_ of endangered/threatened species.

**C. Match the following.**

- |                      |                                      |
|----------------------|--------------------------------------|
| 1. Deforestation     | a. Endangered species                |
| 2. Poaching          | b. Illegal hunting of wild animals   |
| 3. Nilgiri holly     | c. Endemic species                   |
| 4. Hawaiian crow     | d. Gulf of Mannar                    |
| 5. Blue whale        | e. Large scale cutting down of trees |
| 6. Sangai deer       | f. Extinct plant                     |
| 7. Water hyacinth    | g. Exotic plant                      |
| 8. Biosphere reserve | h. Extinct in natural habitat        |

**D. Give reasons for the following.**

1. Forests are the lungs of our planet.
2. All endangered species are vulnerable but all vulnerable species might not be endangered.
3. Deforestation leads to the destruction of biodiversity.
4. Population growth leads to deforestation.
5. Deforestation could lead to global warming.

**E. State whether the following statements are true or false.**

1. Deforestation could lead to soil erosion. \_\_\_\_\_
2. Black buck is endemic to Russia. \_\_\_\_\_
3. Reforestation requires the planting of new and exotic trees. \_\_\_\_\_
4. Extinct species are the ones whose even the last individual is dead. \_\_\_\_\_
5. The numerous plants that grow naturally in a place constitute its fauna. \_\_\_\_\_

**F. Answer the following questions in one word or a single sentence.**

1. What do you understand by deforestation?
2. Name two animals endemic to the Indian subcontinent.
3. Which book features the names of all endangered and extinct animals and plants?
4. What do you understand by reforestation?
5. What is the full form of IUCN?

### G. Answer the following questions in brief.

1. What are the different causes of deforestation?
2. What is Red Data Book?
3. Elucidate one successful conservation project in India.
4. Which law in India protects wild life? When was it coined?
5. What do you understand by endangered species?
6. How does IUCN help in conservation of ecosystem?

### H. Answer the following questions in detail.

1. Explain the consequences of deforestation in detail.
2. What is a protected area? Elaborate on its different types.
3. What do you understand by endemic species? Explain with the help of examples. Why are they important?

## Out of The Box

1. Most of the national parks were initially wildlife sanctuaries, which are then upgraded to national parks. Why do think this change was done?
2. What is the difference between resident birds and migratory birds? What conditions may lead to decline in the number of migratory birds visiting our country?

## In Real Life

You must have seen many plants in an around your school, park or house. Adopt one of them and take care of its wellbeing. If you could inspire your friends to do the same, you would start a great movement in your locality.

## Subject Enrichment

### Activity Zone

1. Prepare a report on the latest recordings of IUCN Red list. Find out if any new species have made it to any of the four categories. How many Indian species are there? Present your report in the class.
2. Visit a nearby protected area—a national park or a zoological garden. Differentiate the wildlife you see there into following categories: Endemic species, Endangered species and Extinct in natural habitat species.

### Project Zone

“Greater One-horned or Indian Rhinoceros once roamed from Pakistan to the Indo-Burmese border, and in parts of Nepal, Bangladesh and Bhutan. But by the beginning of the 20th century, hunting and habitat loss had reduced the species to fewer than 200 individuals in northern India and Nepal. Thanks to strict protection implemented by the Indian and Nepalese authorities, the population has rebounded.

Make a poster to support a similar cause for any other endangered animal you know of and make people aware of it. You could use an A4 or an A3 size paper and let loose your creativity.

## Web-links

- Conservation in India: <https://www.youtube.com/watch?v=-kEfHSgdRdU>
- Talk by Conservation scientist: <https://www.youtube.com/watch?v=tReyj3wpRQk>
- Save the tiger project: <https://www.youtube.com/watch?v=nhSipS4d5og>
- Endangered species: <https://www.youtube.com/watch?v=FsX71DHVO8k>

## Crosslinks

Mark the location of the national parks mentioned in the chapter on the map of India.

### Teacher's Note

The need to conserve and preserve biodiversity could be stressed for maintaining balance in nature and for the existence of human beings.

- Students could be motivated through activities and campaigns to become 'environmental activists' rather than mere 'arm-chair environmentalists'.
- The students could be asked to display photographs of endangered species of plants and animals on a chart. Information related to their habitat and reasons on why they are endangered could be furnished alongside the photographs.

# 8

## Cell: A Fundamental Unit of Life

### Chapter Focus

- Organisation of living beings
- Structure of a cell and its parts
- Components of cells in different organisms

### Kick-off Activity

#### The role play

Make a group of five and do the following:

- 1 student to hold up a picture frame (representing the frame or skeleton of a person).
- 1 student to hold a calculator above the frame (representing the brain of a person).
- 1 student to hold a bicycle pump mid-frame (representing the heart of a person).
- 1 student to hold a recorder near the top of the frame (representing the vocal cords of a person).
- 1 student to hold a glove at the side of the frame (representing someone's hand).

Ask "What is represented here?"

(A body—skeleton, brain, heart, vocal cords, hand.)

As these things represent different parts of the body the next logical question would be what makes them different? All parts of our body are made up of cells having different jobs. We have muscle cells, skin cells, bone cells, etc. Some of the cells are round, some are block shaped, while others are very long, depending on their type, for example, muscle and nerve cells. Similarly, human skin is made up of different cells working together to protect your muscles, heart and so on from damage.

Just like your school or your classroom, your body is also an active buzzing entity. Think of all that your body is

### Do you know?

An amazing 100 trillion cells are developed in a human body by the time the average person reaches adulthood.



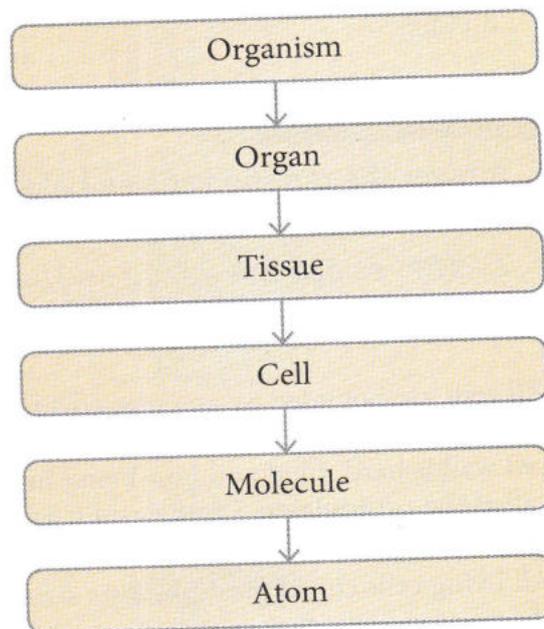
At the moment, you are sitting and reading this book while your lungs are breathing, your digestive system is digesting the food inside your stomach and respiration in every cell of the body is breaking the nutrients to provide you with the energy to carry on with all the functions successfully while your brain is constantly sending signals to and fro your body.

## ORGANISATION OF LIVING BEINGS

If you think of the human body or the body of any living organism for that matter, you will realise that it works like a well-oiled machine, with all its organs working in perfect harmony with each other. How do some of the common machines, such as a washing machine work? Each machine consists of many parts, and each part does a specific job, yet all the parts work together to perform an overall function. The human body, similarly, is organized at different levels. It starts with the cell and ends with the formation of the whole organism.

Thus the following steps could be conceived in the making of the body of an organism.

- The structural and functional unit of all living organism is called a **cell**. Cells are formed of many smaller units—the molecules and atoms. However, these are not living entity.
- Cells with similar functions group together to form tissues.
- Many tissues group together to form an organ performing a similar function.
- A group of organs that work together to perform one or more functions then constitutes an organ system.
- All the organs in the body together work in tandem to form the organism.



### Do you know?

The largest cell to date is the egg of an ostrich. On average they are 6 inches long and 5 inches wide.

## The Cell Theory

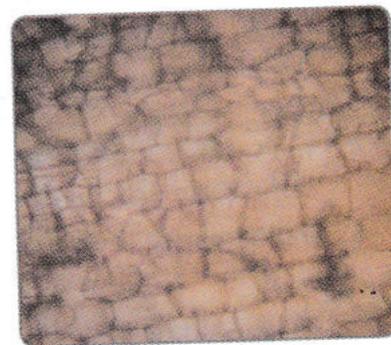
At the same time that the invention of the telescope made the space accessible to human observation, the microscope opened up smaller worlds, showing what living organisms were composed of. The cell was first observed and named by Robert Hooke in 1665.

Hooke observed the cross-section of a cork and noted that it looked strangely similar to cellula (small rooms which monks inhabited) and thus deriving the name. However, what Hooke saw were the dead cell walls of plant cells.

The first man to observe a living cell under a microscope was Anton van Leeuwenhoek in 1674.

### Formulation of the Cell Theory

In 1838, Theodor Schwann and Matthias Schleiden were enjoying after-dinner coffee and talking about their studies on cells. They were struck with the similarity of the characteristics of the cells in plants, studied by Schleiden and animal cells by Schwann.



Cork cells under the microscope

Later their observations were summarised in the Cell theory. The theory states:

- All living things are made up of one or more cells.
- A cell is the smallest basic unit of structure and organization in organisms.
- All cells arise from pre-existing cells through cell division.



*M.J. Schleiden*



*Theodor Schwann*

### Check Point



Answer the questions given below:

1. What is Cell theory? What are the postulates of the cell theory?
2. Who coined the cell theory?
3. Which scientist observed cells for the time?

All cells are bounded by an outer covering called the **cell membrane**. The cell membrane is the living part of the cell. In plants there is an extra covering over the cell-membrane called the **cell wall**. The cell wall is hard, rigid and non-living in nature. The living part of a cell, including the cell membrane is called the **protoplasm**. Protoplasm is again divided into **cytoplasm** (the jelly like medium that fills the cell) and the **cell organelles**.

All living cells constitutes this basic structure. Organelles are structures inside the cells that have specific functions that contribute towards the overall functioning of the cell.

## STRUCTURE OF A CELL AND ITS PARTS

Before begin to study each structure in detail, let us perform an activity.

### Activity



**Aim:** To observe the structure of a single cell (hen's egg).

**Materials required:** A hen's egg, a beaker, vinegar, blue dye, a plate, a needle and a torch.

**Procedure:**

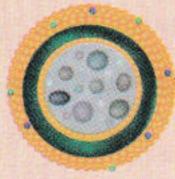
1. Take the egg in a beaker and soak it completely with vinegar.
2. Add blue dye to the vinegar
3. Keep it overnight.
4. You might need to drain out the solution and soak it once more till the time the egg shell gets completely dissolved.
5. Gently pierce the soft outer covering with a needle and let out the contents of the egg on a plate
6. Shine a torch light and observe the contents.

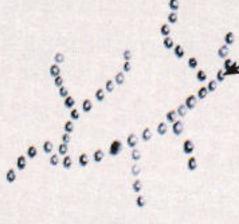
**Observation:** Make a diagram of what you see in your notebook.

**Discussion:** What you hold after the egg shell is dissolved completely, is a cell. However, egg is a special kind of cell which carries enormous amount of food in the form of egg yolk.

The white of an egg is the protein portion. The yellow part or the egg yolk of the egg represents cell's nucleus.

Different structures found in a typical cell and their functions are explained in the table below.

Name of the structure	Description of the structure	Function	
Cell membrane or plasma membrane	A double layer membrane.	It marks the boundary of the cell and allows only certain things to enter or exit the cells. It is thus said to be semi-permeable in nature.	 <p>Cell Membrane</p>
Cell wall	An additional layer outside the cell membrane.	The cell wall is present only in plant cells and is an additional layer outside the cell membrane. It is made up of cellulose. It is rigid and tough and gives the plant cells its shape.	 <p>Cell wall</p>
Golgi apparatus or Golgi body	It is made of sac-like vesicles and long tube-like structures	Movement and packaging of materials within the cell	 <p>Golgi apparatus</p>
Mitochondria	A double membrane bound structure. The inner lining forms finger-like folds.	It is the site of respiration inside a cell. It produces energy through breaking down fats and carbohydrates. This is why mitochondria are called the power-house of the cell.	 <p>Mitochondria</p>
Vacuole	It is a fluid-filled sac.	It stores excess water, or food.	 <p>Vacuole</p>
Lysosome	It is a single walled sac filled with special proteins called enzymes.	It helps in digesting materials inside the cell or other bodies entering the cell. Bursting of lysosomes could digest the entire cell. Hence they are also called <b>suicide bags</b> .	 <p>Lysosome</p>

Name of the structure	Description of the structure	Function	
Ribosome	These are small granular structures present in the cytoplasm or are found attached to the endoplasmic reticulum.	These help in the synthesis of various proteins and enzymes.	 Ribosome
Endoplasmic reticulum	It is a network of tube-like structures with or without ribosomes attached to them.	It helps in synthesising, packaging and storing of cellular materials.	 Endoplasmic reticulum

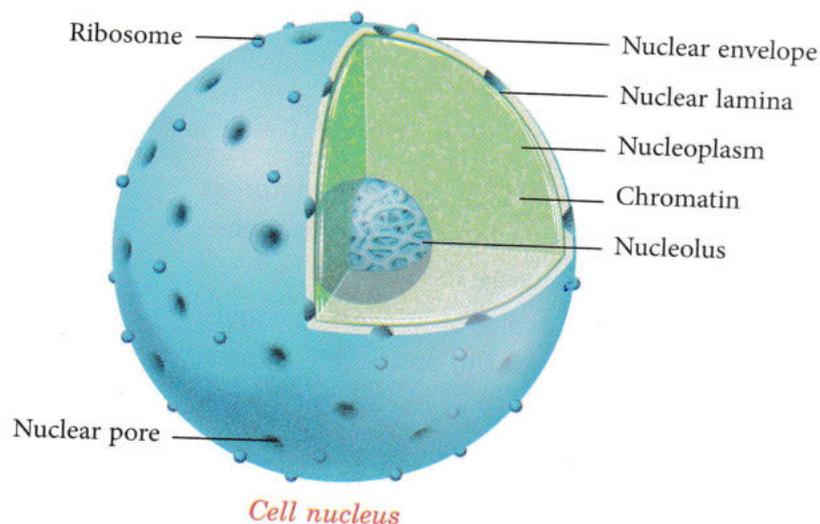
## Nucleus—The Brain of the Cell

In the cytoplasm of almost all cells there is a prominent structure present called the **nucleus**. Nucleus is often referred to as the brain of the cell, because it determines the basic nature of the cell. The nucleus is bounded by a double membrane called the **nuclear membrane or nuclear envelope** lined by an inner layer called **nuclear lamina**. A jelly-like **nucleoplasm** fills the nucleus. In the nucleus lies a tuft of twined structure called the **nuclear reticulum or chromatin**. Inside the nucleoplasm is a dense structure called the **nucleolus** which help in the synthesis of ribosomes.

During cell division, the nuclear reticulum or chromatin opens up to form distinct thread-like structures called the **chromosomes**. **Genes** that determine all the characteristics of organisms reside in the chromosomes.

### Do you know?

Plasma membrane is formed of protein and fat molecules and is actually a fluid.



## Activity



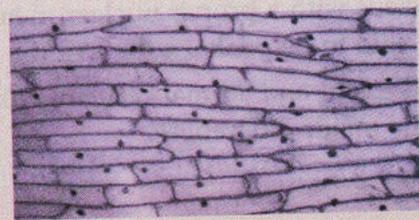
**Aim:** To observe a plant cell.

**Materials required:** An onion bulb, slides, cover slips, 2 watch glasses, a needle, a brush, a compound microscope, a blotting paper, a methylene blue solution, glycerine and some water.

### Procedure:

1. Take an onion and slice it into half. Using forceps pull out a thin membranous peel from the inner surface of one of the leaves of the onion.
2. Take a small portion of this peel in a watch glass containing water.
3. Mix 1 or 2 drops of methylene blue in the watch glass and leave the peel for about 3 minutes.
4. Take a clean slide. Put a drop of glycerine in the middle of the slide. Now, using a brush transfer the stained peel on to the slide on the glycerine drop.
5. Carefully place a cover slip over it by slowly lowering it with the help of a pointed needle. While doing so, make sure no air bubbles enter between the slide and the cover slip.
6. Remove excess glycerine from the edges of the cover slip with the help of a blotting paper. The blotting paper will soak the excess glycerine and water from around the slide.
7. Observe the slide under the microscope, first in low power and then in high power.

**Observation:** You will observe small compartment-like structures called cells. You would also notice a small dot in each of these compartments. This dot is the nucleus of the cell. All cells have distinct but similar shape. The shape to each cell is given by an outer membrane, making them look like compartments. Make a diagram of what you observe under the microscope in your laboratory notebook and label it.



**Discussion:** The small compartments that you see are actually the cells. However, the cells that Robert Hooke observed are very different from the cells you see here. These are living cells with materials inside while he saw cells that were dead and empty as the sample was taken from a slice of a cork.

## Check Point



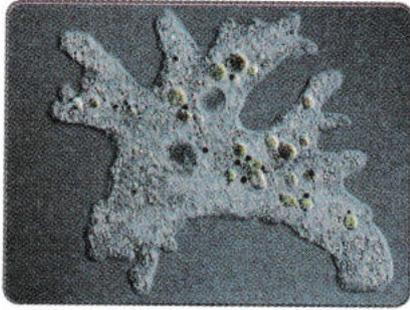
Match the following cell organelles with their corresponding functions:

Name of the Organelles	Corresponding functions
Plasma membrane	Brain of the cell
Nucleus	Powerhouse of the cell
Mitochondria	Controls what enters and leaves the cell.
Golgi body	Synthesis, package and storing material
Endoplasmic reticulum	Destroy worn-out cell parts
Ribosome	Transport within the cell
Lysosomes	Synthesise proteins

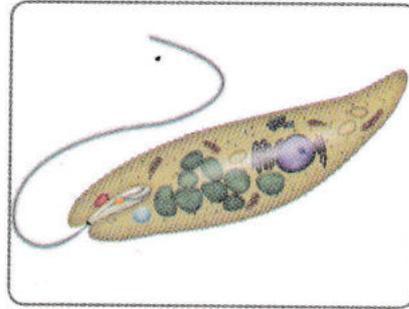
## COMPONENTS OF CELLS IN DIFFERENT ORGANISMS

Cells are of varied shapes, sizes and numbers. All cells do not have the same organelles. You have observed two very different kinds of cells, hen's egg and the cells from the onion peel.

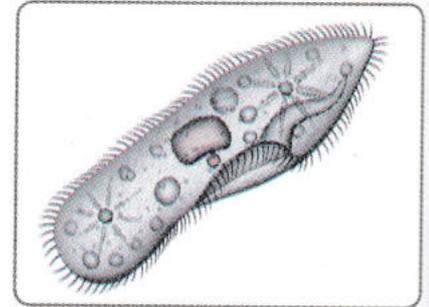
There are many organism on the Earth that have one cell in their body, these organisms make up for the group called **Protista**. *Amoeba*, *Euglena*, *Paramecium* are examples of organisms that come under this group.



*Amoeba*



*Euglena*



*Paramecium*

The bacteria are also unicellular in nature. However most of the bacteria do not have a well-organised nucleus with a proper nuclear membrane. Such organisms are regarded as the most primitive one and are said to be **prokaryotic**. All the other cells that have a proper nucleus are **eukaryotic**.

Both plant and animal cells are eukaryotic in nature. However, cells in plants and animals demonstrate some major differences.

Plant cell	Animal cell
<p>Labels for Plant cell:</p> <ul style="list-style-type: none"> <li>vacuole</li> <li>chloroplast</li> <li>cytoplasm</li> <li>mitochondrion</li> <li>cell membrane</li> <li>nuclear envelope</li> <li>nucleolus</li> <li>nucleus</li> <li>endoplasmic reticulum</li> <li>golgi apparatus</li> <li>cell wall</li> </ul>	<p>Labels for Animal cell:</p> <ul style="list-style-type: none"> <li>ribosomes</li> <li>cytoplasm</li> <li>cell membrane</li> <li>lysosome</li> <li>microtubules</li> <li>nucleus</li> <li>nucleolus</li> <li>endoplasmic reticulum</li> <li>golgi body</li> <li>centrosomes</li> <li>mitochondrion</li> <li>cell wall</li> </ul>
<p>An additional hard rigid covering present outside the plasma membrane called the <b>cell wall</b> is present in plant cells. It gives rigidity to the cell. This is the dead part of the cell and is made of cellulose.</p>	<p>Cell wall is absent in animal cells.</p>
<p>Mature plant cells show a huge central vacuole.</p>	<p>Central vacuoles are absent in animal cells.</p>

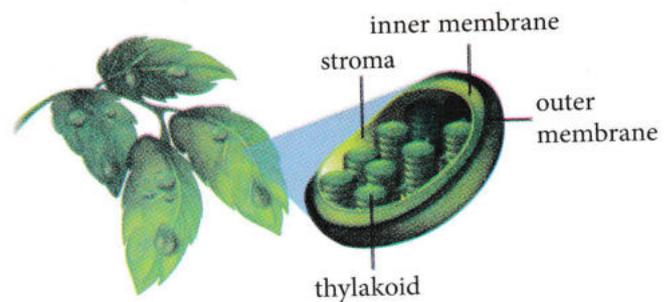
Plant cell	Animal cell
Plant cells have a special organelle—the <b>plastids</b> . (Labelled as chloroplast in the above picture.) Plastids give colour to plants. It is inside the plastid that chlorophyll is present that play a vital role in the process of photosynthesis.	Plastids are absent in animal cells.
Centrosome is absent in plant cells.	Centrosome is present in animal cells.

## Plastids in Plants

Plastids are very important organelles as they serve as the means of classification of cells into plants and animals. That is, all cells that contain plastids are classified as plant cells.

There are three types of plastids present in plants, namely,

- **Chloroplast:** Green pigment is present in chloroplasts. They help the green plants to produce food from inorganic raw materials. These are often referred to as the **food factory** of the cell.
- **Chromoplast:** These contain pigments with colours other than green. The flowers and fruits get their colour due to chromoplasts.
- **Leucoplast:** These plastids do not contain any pigment. They help in the storage of food in the plant body.



*Chloroplasts in a plant leaf*

## Cells in Humans

Humans are considered the most complex of organism alive with highest degree of organisation. The tissues in the human body make up an elaborate organ system that work harmoniously at all times. The cells of the human body gets modified into various shapes, sizes and forms to suit different needs. Some striking variations of cells in the human body are:

1. **RBC or Red Blood Cells/Corpuscles:** The red blood corpuscles are unique as they do not have a nucleus. This helps in accommodating more haemoglobin, which helps in transporting maximum oxygen to the tissues of the body.
2. **Nerve cells:** The cells of the nervous tissue called neuron have numerous long projections. These projections help the neuron receive and transport signals throughout the body.
3. **Sperm:** Sperms, the male reproductive cell, have a long tail-like structure attached to them that help them to move very fast.
4. **Ovum:** The egg cells or ova, the female reproductive cell, on the other hand are big (visible to the naked eye) and static (not capable of active movement).
5. **WBC or White Blood Cells/Corpuscles:** White blood corpuscles behave like an Amoeba. They are capable of changing their shape and thus ingest a pathogen (an organism that causes disease) to fight infection.
6. **Muscles cells:** These are elongated cells with many nuclei. They are specialised cells that can contract and expand thus helping in movement.



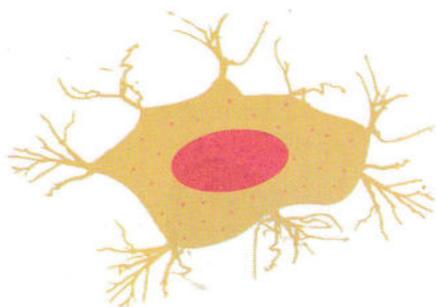
Red blood cells



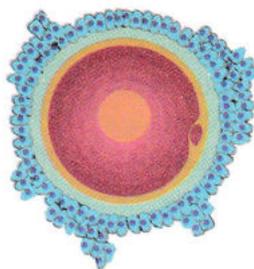
Nerve cell



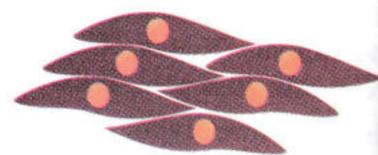
Sperm cell



Bone cell



Ovum



Muscle cells

## Key Terms



- **Cell Membrane:** Outer covering bounding all cells
- **Cell Wall:** Extra covering over the cell-membrane in plants
- **Protoplasm:** All living parts of the cell
- **Nucleus:** Prominent structure within the cell, often called the brain of the cell consisting of an outer nuclear membrane and an inner nucleoplasm
- **Chromosomes:** Distinct thread-like structures containing genes present in the nucleus
- **Prokaryotic:** Cell that lacks a membrane-bound nucleus, mitochondria, or any other membrane-bound organelle
- **Eukaryotic:** Cells that have a nucleus and other organelles enclosed within membranes
- **Plastid:** Special organelles in plant cells that give it its colour

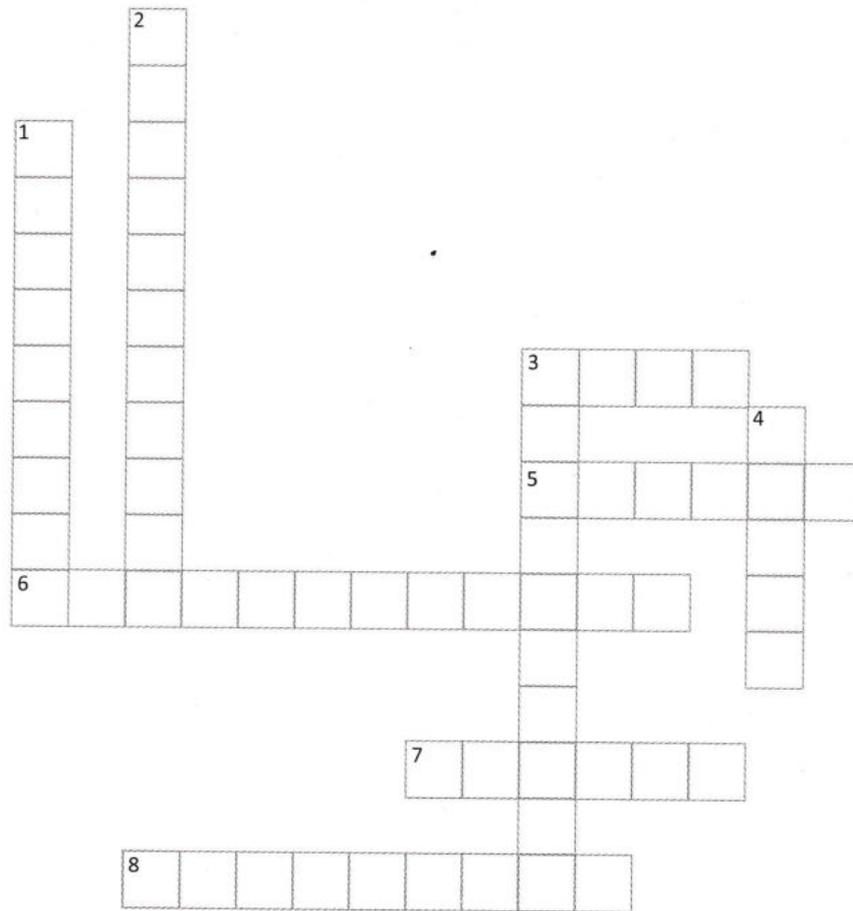
## Recall



- The first cell was observed by Robert Hooke in 1665. The Cell theory was given by Schleiden and Schwann in 1831.
- Cells consist of the cell membrane (an additional cell wall in plant cells) and the protoplasm. The protoplasm is again divided into cytoplasm (the jelly like medium that fills the cell) and the cell organelles.
- Cells can be either eukaryotic or prokaryotic.
- The nucleus is the brain of the cell. It consists of several parts such as the outer membrane (absent in prokaryotes), nucleoplasm, chromatin and nucleolus.



**D. Solve the crossword given below.**



**Across**

3. Structural and functional units of life.
5. Nerve cell
6. Power house of the cell
7. Unicellular living being
8. Suicide bags

**Down**

1. Jelly like fluid that fills the cell
2. Organelles with colour other than green
3. Present only in animal cell
4. Packaging unit of a cell

**E. Give reasons for the following.**

1. Mitochondria is called the power house of the cell.
2. Cell membrane is semipermeable in nature.
3. Nucleus is the brain of the cell.
4. Lysosomes are referred to as the suicide bags.
5. Neurons in human body come with long projections.

**F. Answer the following questions in one word or a single sentence.**

1. Who postulated the Cell Theory?
2. Give one example of a unicellular organism.

3. What are genes?
4. Which organelle is called the food factory?
5. Name an organism which does not have a proper nucleus.
6. Which cell in the human body lacks a nucleus?
7. Name a human cell that has more than one nucleus.

**G. Answer the following questions in brief.**

1. What are the postulates of the Cell theory?
2. Make a flow chart to explain the body organization of living beings.
3. How was cell discovered?
4. What do you understand by the term chromosomes?
5. What is cytoplasm? Where is it found?
6. What is the function of the plasma membrane?
7. What role does the endoplasmic reticulum play in the cell?
8. What are lysosomes?

**H. Answer the following questions in detail.**

1. What are the features that make a cell from a plant body different from that of an animal? Explain with the help of diagrams.
2. Write a brief account of the nucleus also termed as the brain of the cell.
3. What is a plastid? What are its types? Explain its function in the organism where it is found.

## Out of The Box

1. Plants are rigid and strong and stand tall against rain and thunder. How do you think the basic structure of the plant cells help in making this possible? Which part of the plant cell in particular makes this possible?
2. All the organelles in the cells work in complete harmony to make the organisms sustain life. Where do you find such harmony in your daily life? Have you been in a situation where the harmony has been disturbed? Suggest some methods to ensure that synchronisation is maintained at all times.

## In Real Life

We are a collection of trillions of cells. However, everyday we loose millions of cells that need to be replenished. When we are young, the number of cells born are more than the number of cells lost and hence we grow. The process reverses during aging.

It is thus important to eat healthy food to ensure that all the cells of the body keep replacing thus delaying the process of aging and degeneration.

## Subject Enrichment

### Activity Zone/Field Trip

Take a look at your medical report. Observe how the count of different cells in the body help in understanding whether the condition of the body is normal or not. Find out the factors that can make the cell count go above or below normal. You will be surprised to see how important it is for the organs and cells to be in complete sync with each other.

### Project Zone

Get together with some of your friends to make a 3D model of the cell. You could use an empty candy box or empty bottle to make the plasma membrane. Use little card board boxes or old toys to make the rest of the organelles. Display your models in the class and explain which organelles are present in your model.

### Web-links

- Organisms: <https://www.ck12.org/biology/human-body/lesson/Organization-of-the-Human-Body-BIO/>
- Discovery of cells: <https://www.youtube.com/watch?v=4OpBylwH9DU>
- Cell types: <https://www.youtube.com/watch?v=4OpBylwH9DU>

### Crosslinks

Find out the sizes of various animal and plant cells and compare them on the basis of their measurement. Write these measurements in expanded and standard form. Can you now appreciate the importance of exponents and powers?

### Teacher's Note

Children take time to relate to the topic and usually see cells as abstract entities. It is important to constantly relate the study of cells to real-life experiences.

# 9

## Reproduction in Animals

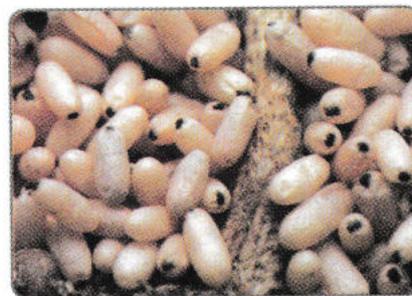
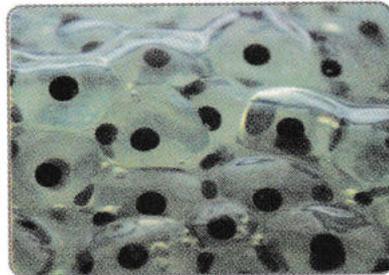
### Chapter Focus

- The Human Reproductive System
- Gamete Formation
- Fertilisation
- Development of a Zygote
- Determination of the Sex of a Baby
- Modes of Reproduction and Development in other Animals

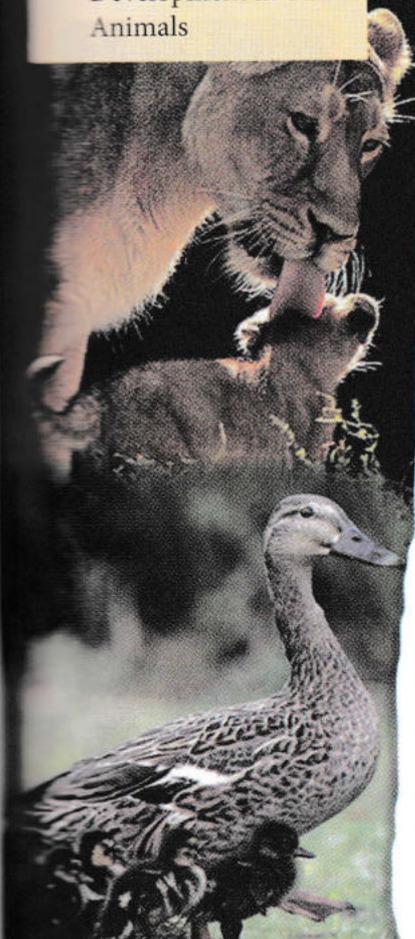
### Kick-off Activity

#### Whose egg is it?

Observe the pictures of different eggs given below and identify the animals that lay them.



We have already learnt about reproduction in plants in Grade 7. Let us now learn about reproduction in animals, including humans. We know that in order for a living being to propagate they need to reproduce. The process of reproduction enables life to continue from one generation to the next.



## THE HUMAN REPRODUCTIVE SYSTEM

Reproduction in humans is strictly sexual, i.e., it involves two parents of the opposite sex, the **male** and the **female**. The organs of the reproductive system in the male and the female are very different from one another.

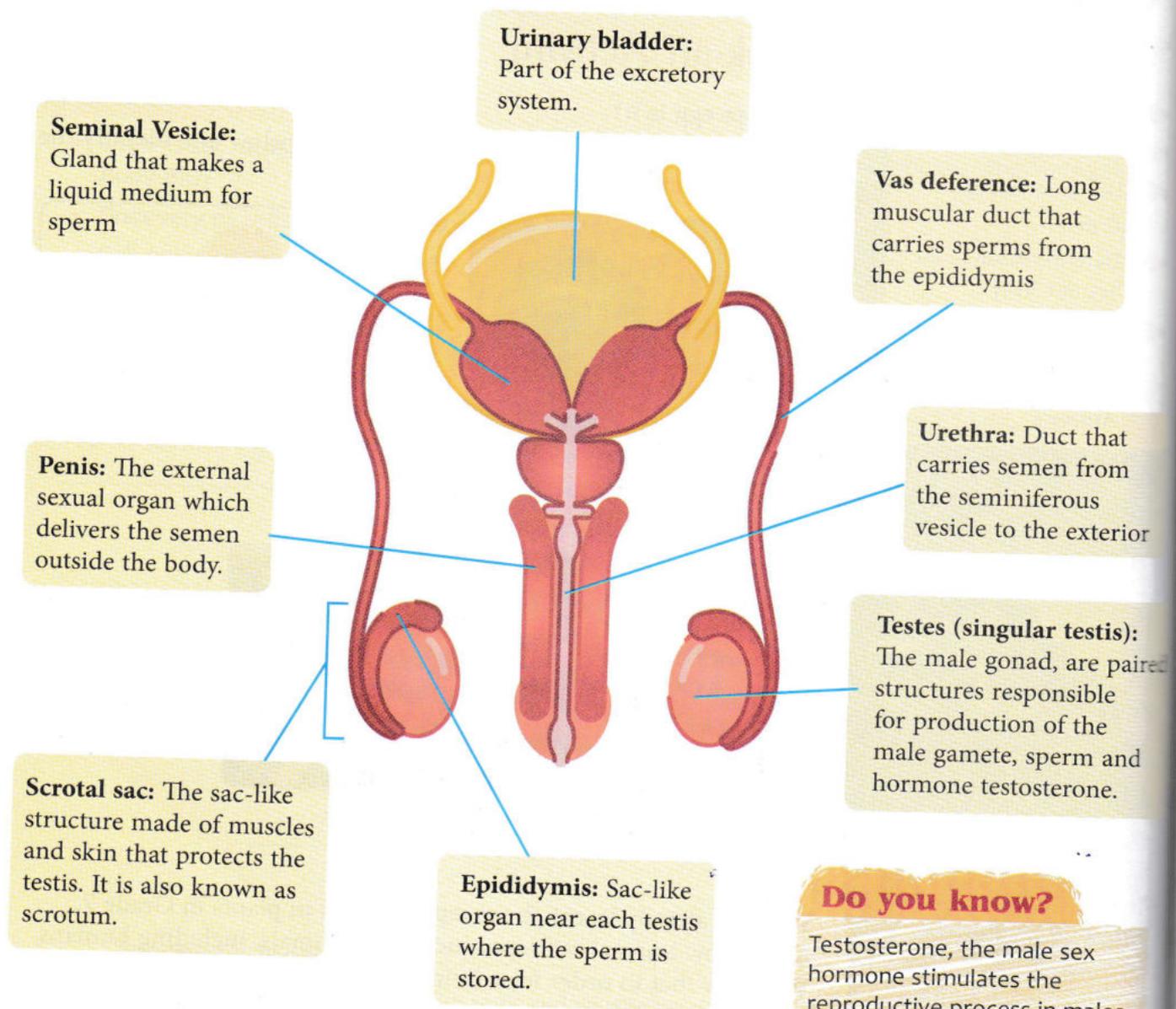
You must remember from Grade 7 that the special reproductive units of reproduction are the cells called **gamete**. The primary reproductive organ producing gametes in humans are referred to as the **gonads**.

### Do you know?

The reproductive system in humans is unique because it produces both the largest as well as the smallest cells of the human body.

### The Male Reproductive System

In males, the reproductive system consists of **testis**, the male gonad, producing male gametes called **sperms**. Different organs associated with the male reproductive system are explained in the diagram below:



### Do you know?

Testosterone, the male sex hormone stimulates the reproductive process in males.

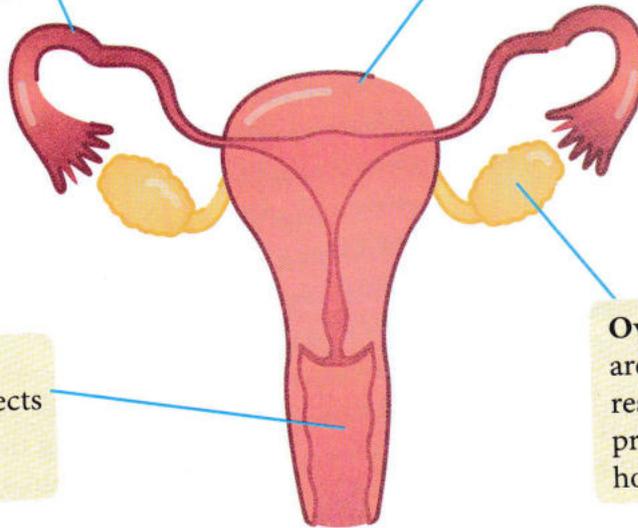
*Male reproductive system*

## The Female Reproductive System

In females, the reproductive system consists of a pair of **ovaries**, the female gonad. The ovary produces female gametes called **ovum**. Different organs associated with the female reproductive system are explained in the diagram below.

**Fallopian tube/  
Oviduct:** Connects the uterus to the ovaries and carries the ovaries.

**Uterus:** The uterus is shaped like an upside-down pear, with a thick lining and muscular wall. It is the site of the growth of the baby in case of a pregnant woman and provides nutrition to the baby.



### Do you know?

Both ovaries cannot produce the ovum at the same time.

**Vagina:** A tube-like structure that connects the uterus to the exterior.

**Ovary:** Female gonad, are paired structures responsible for the production of ovum and hormone oestrogen.

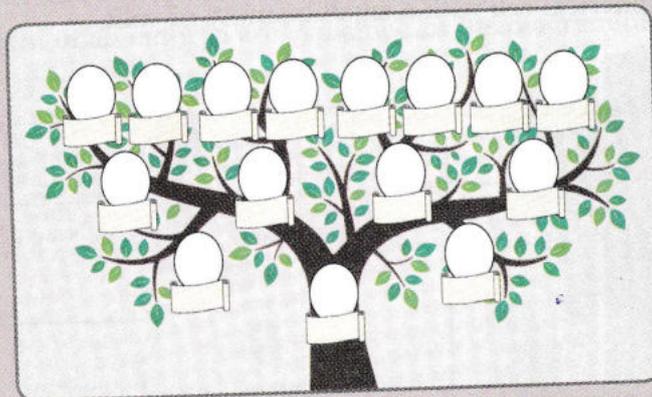
*Female reproductive system*

## Activity

**Aim:** To comprehend the effects of reproduction over generations.

**Procedure:** Talk to your grandparents or any other elderly members of your family. Get an account of your grandparent's siblings and their parents as well.

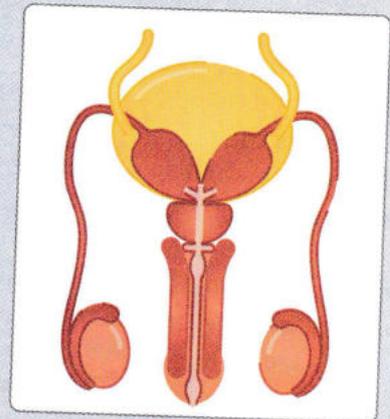
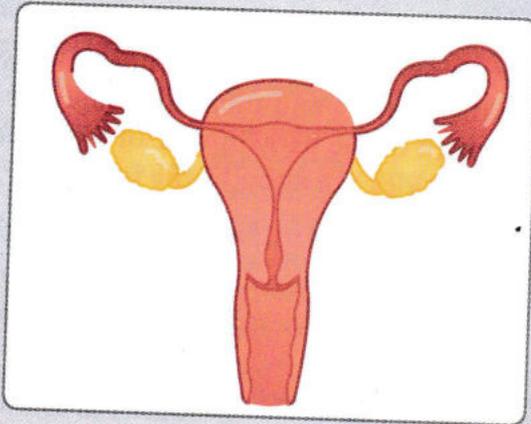
**Observation:** Prepare a family tree like the one shown below in your notebook based on your findings.



**Discussion:** See how your family has changed over the years. On the basis of your observation deduce if your family has grown over the years or reduced in size. You will find that families are dynamic entities that change constantly.

## Check Point

Label the diagrams given below.



## GAMETE FORMATION

After reaching puberty both males and females start producing gametes. **Gametes** are reproductive units in males and females each with half of the genetic materials of a cell.

All cells in the human body have 46 chromosomes in the nucleus. These cells are called **diploid cells**. Chromosomes contain genes, that are blue-print responsible for determining the characteristics of an individual. Thus, the chromosomes of all living beings are unique even within a species.

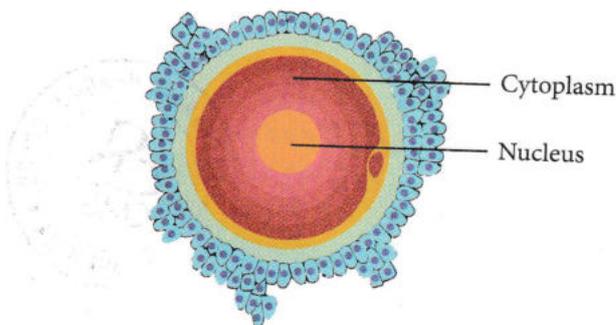
During sexual reproduction the offspring receives chromosomes from both the father and the mother. The formation of gamete cells involves an exclusive method where each gonad produces cells with only half the number of chromosomes.

Inside the testis, male gametes called **sperms** are produced while the ovary produces the female gamete **ovum**. Both sperms and ovum are single cells with only **23 chromosomes**. Such cells with half the number of chromosomes are called **haploid cells**.

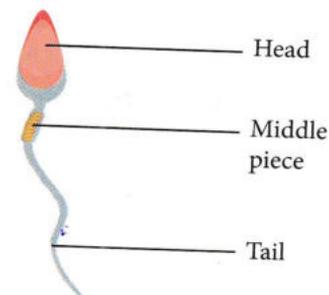
Sperms and ovum are unique also because they look completely different from each other, each having their unique features. A sperm is much smaller than the ovum and has a head, middle piece and a long tail. The ovum, on the other hand, is a stout, spherical cell with a small quantity of yolk.

### Do you know?

The size of the human ovum is 0.1 mm in diameter.



*Structure of an ovum*



*Structure of a sperm*

In fact, the sperm is the smallest and the ovum is the largest cells of the human body. The largest cells on the Earth are the eggs of ostrich.

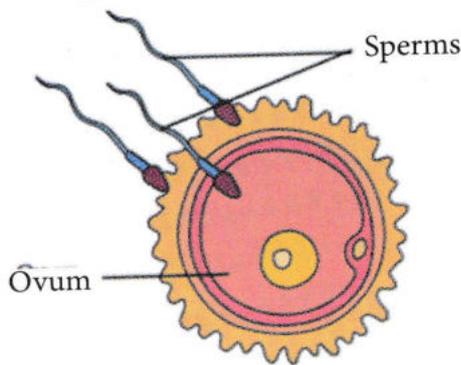
## FERTILISATION

In humans, a single matured egg is released into the oviduct by one of the ovaries every month. This process is called **ovulation**. If intercourse happens at a suitable time, the sperms are released into the female reproductive system by the penis. One of the sperms swims and reaches the ovum in the oviduct.

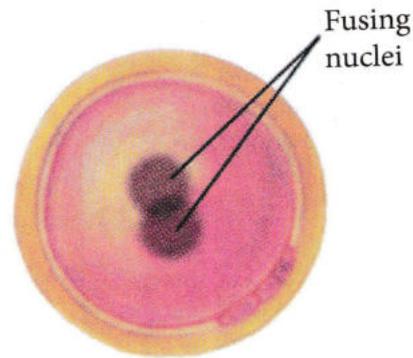
The haploid nucleus of the sperm fuses with the haploid nucleus of the ovum. Thus, a cell with 46 chromosomes is formed again. This fertilised egg is called a **zygote**.

### Do you know?

The lifespan of an ova is 12–24 hours after it is released from the ovary, while a sperm can live up to 36 hours.



*Fertilisation*



*Zygote*

Thus, we can define fertilisation as a process by which sperm and ovum fuse together to form a zygote.

## DEVELOPMENT OF A ZYGOTE

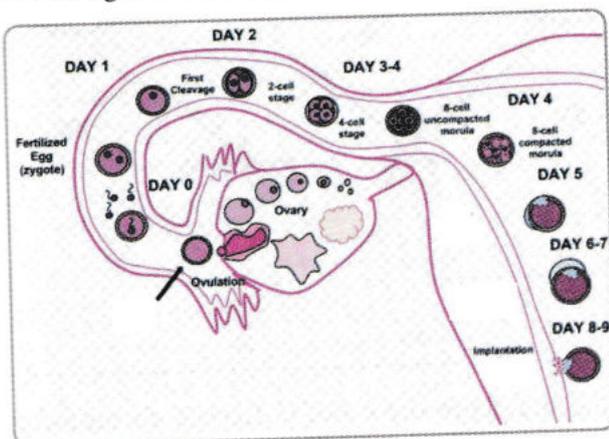
The zygote is the first cell of the body of an organism. The zygote divides repeatedly to form a ball of cells. After a while the cells of this ball form different groups that give rise to different tissues and eventually organs of the body. In the meantime the structure moves down to the uterus and gets embedded into the uterine wall. This is called an embryo now and continues with the process of development in the uterus.

### Do you know?

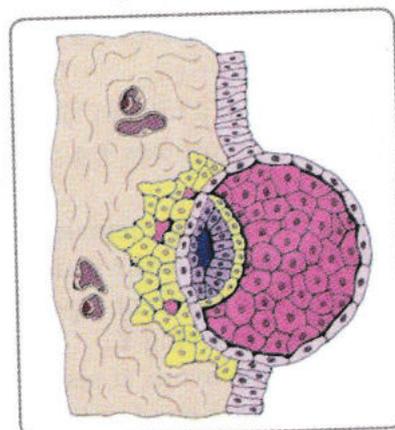
A female uterus is normally about 3 inches long and 2 inches wide, which can expand up to 20 times during pregnancy.

The nutrition and oxygen supply for the growing embryo comes from the mother's body. That is the reason pregnant women require a lot of care and attention. This care ensures that the **embryo** develops well into a healthy baby.

Different stages of development of an embryo are explained in the diagram below:



*Fertilisation and implantation of zygote*

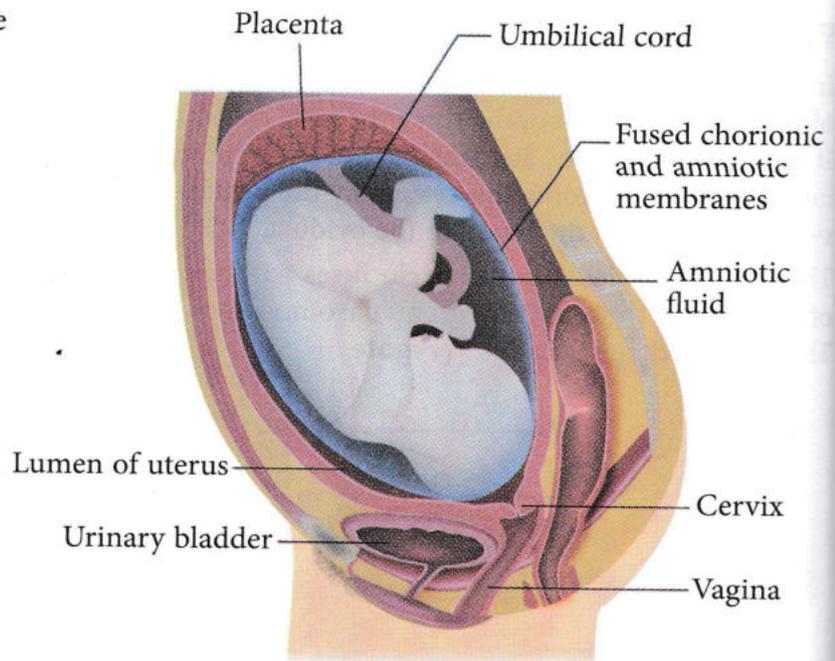


*Embryo embedded in the uterine wall*

After around 8 weeks of fertilisation the baby starts showing body parts such as hands, legs, head, eyes, ears, etc. The embryo is now called the foetus. On full maturity, the baby comes out of the mother's womb by a process called **parturition**.

### Do you know?

The gestation period in human beings is around 260–270 days (around nine months).



*Full term baby in the womb, ready for parturition*

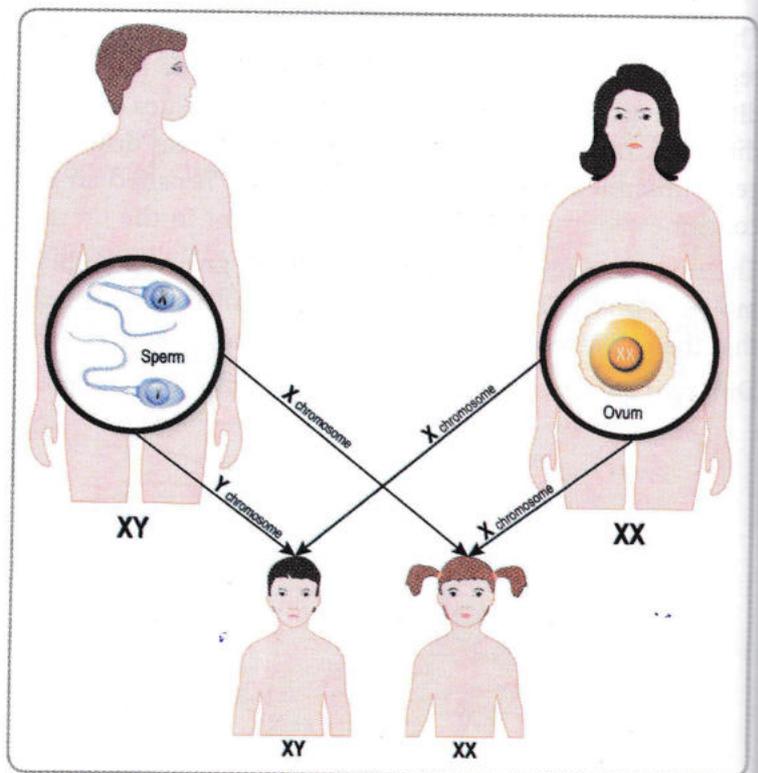
## DETERMINATION OF THE SEX OF A BABY

Chromosomes of all organism that we know of occur in matching sets inside the nucleus. Thus, all human cells normally have 23 pairs of chromosomes. Scientists have also found that mango has 20 pairs, dog 39 pairs and fruit-fly has 4 pairs of chromosomes. That is the reason all cells in the body of an organism are considered **diploid**.

In humans, one of the 23 pairs of chromosomes are called the **sex chromosomes** and the rest 22 pairs are called **autosomes**. In females, both the sex chromosomes are identical to each other and are called X chromosomes. In males, the pair of sex chromosomes are not identical and are referred to as X and Y chromosomes. Thus, we can conclude that:

- All cells in the body of a human male has a pair of 22 chromosomes + a pair of XY chromosome
- All cells in the body of a human female has a pair of 22 chromosomes + a pair of XX chromosome

During the gamete formation, a female forms one type of ovum, while the male is capable of forming two different types of sperms. If the sperm carrying Y chromosome fertilises the ovum, it results in a baby boy. On the other hand, if the sperm fertilising the ovum turns out to have X chromosome, a baby girl is born.



## Activity



**Aim:** To observe effects of chromosome transfer.

**Procedure:** Talk to the people around you and choose at least 5 sibling pairs. You could choose adults as well. Look for certain characteristics in each pair and compare them with their parents.

**Observation:** Note your observations in the table below. You could put a tick if a character is present in a particular individual.

Character observed	Father	Mother	Sibling 1	Sibling 2
Colour of the eye				
Hair (curly or straight)				
Skin (fair/dark)				
Can roll tongue				
Shape of the earlobe				

**Discussion:** You will see that most of the characters in the children come from either one of the parents.

However, some of the characters present in the children might not be there in any of the parents. In that case you might need to dig deeper and see if the child inherited these characters from their grandparents!

## Check Point



Mentioned below are a list of events that occur during the course of reproduction. Arrange them in proper order.

parturition, implantation of embryo, ovulation, maturation of zygote, zygote formation, fertilisation, embryo formation, maturation of foetus, foetus formation, intercourse.

1	
2	
3	
4	
5	
6	
7	
8	

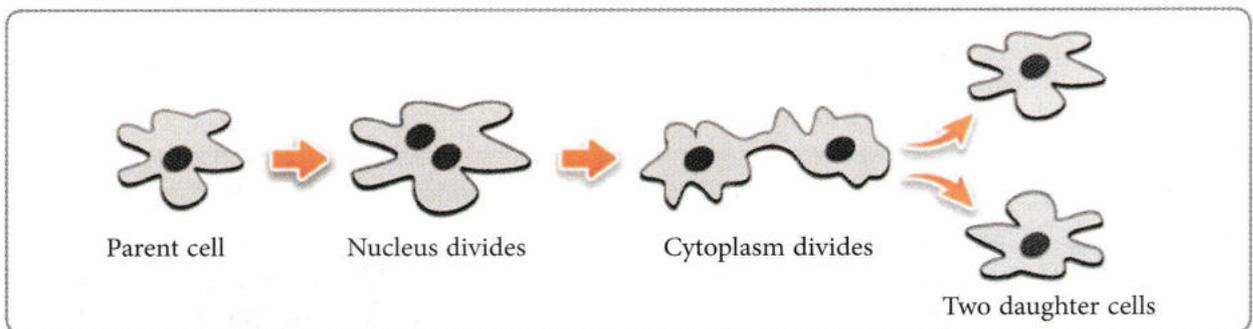
## MODES OF REPRODUCTION AND DEVELOPMENT IN OTHER ANIMALS

You have learnt that reproduction could be of two major types—**sexual and asexual reproduction**. Process of creating one's own kind involving two individuals of different sexes is referred to as sexual reproduction while that involving a single individual is called asexual reproduction.

Just like in plants, animals too exhibit both sexual and asexual modes of reproduction. However, sexual reproduction is more common in the animal kingdom, with asexual mode possible in only some of the lower forms of animals like *Hydra* and *Planaria*.

### Asexual Reproduction in Amoeba

You already know that *Amoeba* is a single-celled organism. In *Amoeba* reproduction could begin with a constriction in the nucleus which finally divides it into two nuclei. This is followed by the division of the cytoplasm where two new cells are produced from the old cell. This process is called binary fission, which literally means division into half. Here two cells are produced from one cell, hence we consider this a type of asexual reproduction.



*Asexual reproduction in Amoeba*

### Asexual Reproduction in Hydra

*Hydra* is a small freshwater animal. A mature *Hydra* often develops one or more bulges in its body, called **buds**. These bulges keep developing into new individuals and finally get separated from the body of the parent. In this type of reproduction a single parent is involved and is thus regarded as asexual reproduction. Since new individuals develop from the buds in *hydra*, this type of asexual reproduction is called **budding**.

In different animals fertilisation could be two kinds depending on the site of occurrence.

### Types of Fertilisation

1. **Internal Fertilisation:** When fertilisation takes place inside the body of an organism, it is called internal fertilisation. Internal fertilisation occurs in many animals including humans, cows, dogs and hens, etc.

Here sperms are ejected inside usually the female reproductive tract after which the fertilisation takes place.

2. **External Fertilisation:** In this type of fertilisation, the fusion of a male and a female gamete takes place outside the body of the animal in a common medium. It is very common in aquatic animals such as fish, starfish, etc.



*Budding in Hydra*

### Do you know?

According to Greek mythology, *Hydra* is a giant water snake with many heads that lived in a swamp near Lerna in the land of Argos.

During spring or rainy season amphibians like frogs and toads move to ponds and river. When the male and female come together in water, the female lays the eggs, in the water. The male then deposits sperm over them. Each sperm swims randomly in water with the help of its long tail. As the sperms come in contact with the eggs, external fertilisation takes place. This is the reason why frogs lay a number of eggs in the water to increase the chances of fertilisation.

### Oviparous and Viviparous Animals

**Oviparous animals:** Animals such as hen, frog, fish and reptiles that lay eggs are called oviparous animals. While fertilisation of the egg can occur internally or externally, oviparous animals always hatch their young ones outside of their body. Many oviparous animals like frogs, birds, fish and reptiles often make nests to protect their eggs.

**Viviparous animals:** The animals which give birth to live young ones that develop inside the body of the parent are called viviparous animals. For example, humans, dogs, cows, elephants, tigers, etc.

### Do you know?

Animals producing young ones by means of eggs which are hatched within the body of the parent are known as ovoviviparous animals. For example, Basking shark.

### Use of Technology in Reproduction

In today's world Science and technology has spread its wings in all aspects of life. Scientists are using technology to produce better variety of crops of various types of plants.

Similarly, in animals cloning is being used to produce an exact copy of a cell, any other living part, or a complete organism. Ian Wilmut was the first person to have cloned a sheep Dolly who was born on July 5, 1996. Many such attempts have been made ever since to clone mammals, but either these attempts went unsuccessful or these animals die immediately after birth.



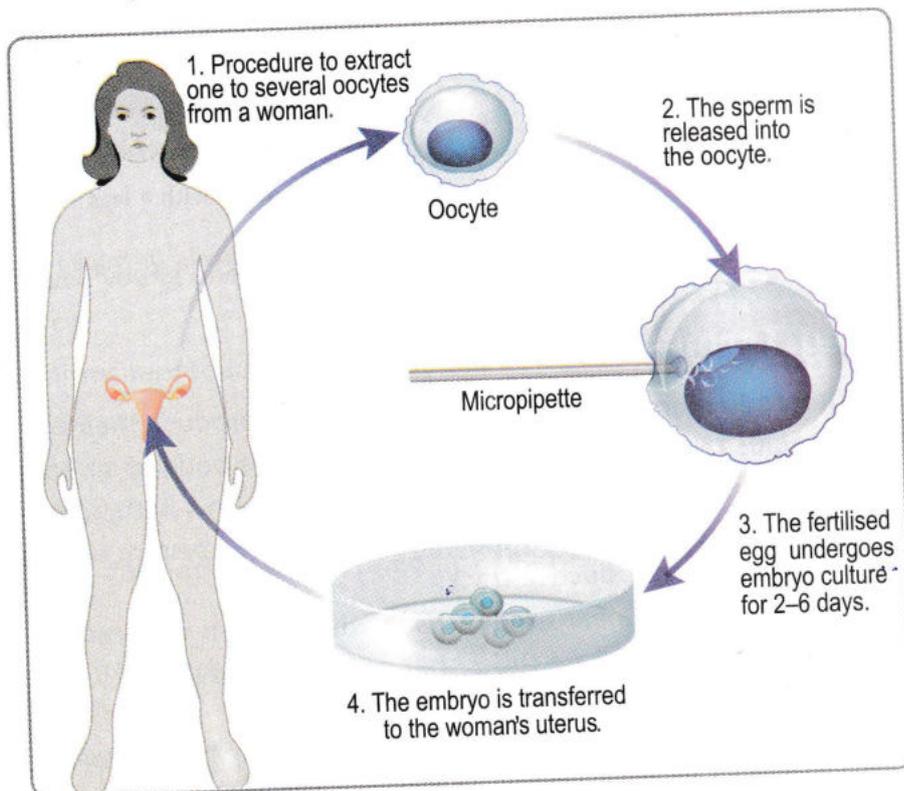
Ian Wilmut with Dolly

In-Vitro Fertilisation is the use of technology in reproduction, commonly referred to as IVF.

In IVF, fertilisation is performed by extracting eggs from a female and retrieving a sperm sample from a male. The egg and sperm are then manually combined in a laboratory dish. The one or more embryos thus formed are then transferred to the uterus of a healthy female, who carries the child through parturition.

### Young ones and Adults

In humans newly born babies look like the adults. In some animals, however, the young ones may look very different from the adults. Insects and young ones of frogs look very different from the adult ones.



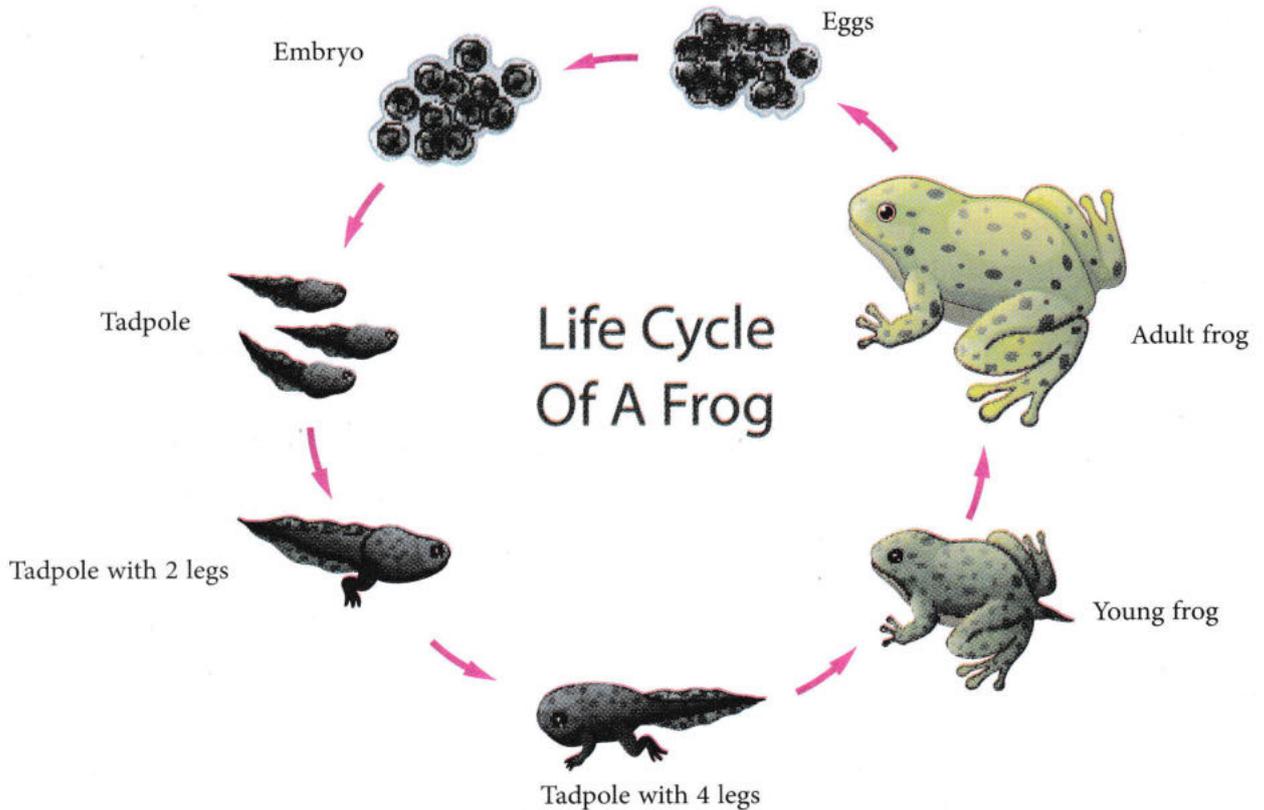
In-vitro fertilisation

Such a process of development is known as **metamorphosis**.

Similar stages of development are found in the life cycle of a butterfly. The main stages of metamorphosis in a butterfly include:

Egg → Larva or Caterpillar → Pupa → Adult

This type of development involving the larval stage in development of embryo into an adult is called indirect development, whereas one that directly develops the embryo into an adult is called direct development. While we say development is direct in humans, lizards, hens and dogs, it is indirect in frogs, toads and insects.



*Metamorphosis in frogs*

### Key Terms



- **Reproduction:** Process by which organisms produce their own kind.
- **Gonad:** The primary sex organ present in the body of an organism that produces gametes.
- **Gametes:** Reproductive units in sexual organisms with haploid nuclei.
- **Penis:** External organ of the male reproductive system through which semen is ejaculated in the female reproductive track.
- **Epididymis:** Sac near each testis in which sperm is stored.
- **Fallopian tube:** Paired tubes that connect the ovaries to the uterus and transmits the egg to the uterus.
- **Uterus:** Hollow muscular organ in which the fertilised zygote is embedded for development.
- **Haploid:** Cells with half the number of chromosomes.

- **Diploid:** All cells with complete, two sets of chromosomes in the nucleus.
- **Sex chromosomes:** Pair of chromosomes that determine the sex of an organism as well as its sexual characteristics.
- **Fertilisation:** The process of fusion of the nuclei of male and female gametes.
- **Oviparous animals:** The egg-laying animals where the egg hatch after leaving the body of the female.
- **Viviparous animals:** Animals that give birth to live young ones.
- **Metamorphosis:** A biological process in which an animal after birth physically develops into an adult organisms undergoing various stages.

## Recall

- Reproduction could be of two main types—Sexual reproduction, involving two individuals and asexual reproduction, involving only one organism.
- Testis and ovary are the male and female gonads producing sperms and ovum, respectively.
- The male and female gamete cells fuse together to form a single diploid cell called zygote. The zygote is the first cell of the body of an individual.
- Binary fission and budding are types of asexual reproduction in animals.
- Fertilisation is said to be internal if it happens inside the body of an organism and external if it happens outside in external environment or medium.
- The mode of development of young ones involving the larval stage is termed as indirect development, while that without a larva is direct development.

## Assess Zone

### A. Tick (✓) the correct answer.

- Which of the following produce young ones through direct development?
  - Fish
  - Frog
  - Snake
  - Human
- Which of the following organisms reproduce through budding?
  - Hydra
  - Frog
  - Bird
  - Amoeba
- In humans, the mode of reproduction is always which of the following?
  - Binary fission
  - Indirect
  - Sexual
  - Asexual
- Which of the following animals does not go through metamorphosis?
  - Elephant
  - Frog
  - Butterfly
  - Mosquito
- Which one of the following is not a part of the female reproductive system?
  - Vagina
  - Epididymis
  - Uterus
  - Fallopian tube
- Which one of the following is not a part of the male reproductive system?
  - Ovary
  - Seminal vesicle
  - Urethra
  - Urinary bladder

7. Where does fertilisation occurs in humans?
  - a. Fallopian tube
  - b. Ovary
  - c. Uterus
  - d. Vagina
8. The mature zygote gets attached to which of the following parts of the female reproductive system?
  - a. Fallopian tube
  - b. Ovary
  - c. Uterus
  - d. Vagina
9. The process of binary fission can be found in which of the following organisms?
  - a. Amoeba
  - b. Hydra
  - c. Frog
  - d. Dog
10. Which of the following is the method in which an egg and a sperm are fused together manually in a laboratory?
  - a. In-vitro fertilisation
  - b. In-vivo fertilisation
  - c. Cloning
  - d. None of these

**B. Fill in the blanks.**

1. Reproduction in humans is of \_\_\_\_\_ type as they give birth to babies.
2. The process of release of a mature ovum is called \_\_\_\_\_.
3. Zygote is the \_\_\_\_\_ cell of the body of an organism.
4. Testis are held inside a muscular sac called the \_\_\_\_\_.
5. \_\_\_\_\_ is the process of giving birth after the full development of the foetus.

**C. State whether the following statements are true or false.**

1. Humans are only capable of sexual reproduction. \_\_\_\_\_
2. Development in birds is indirect. \_\_\_\_\_
3. Ovum is a diploid cell. \_\_\_\_\_
4. There can be two types of sperms. \_\_\_\_\_
5. After 2 weeks of fertilisation the developing organism is called a zygote. \_\_\_\_\_

**D. Answer the following questions in a single sentence.**

1. Define reproduction.
2. What are the different gametes produced during sexual reproduction in humans?
3. Where do you find haploid cells in the body of an organism?
4. What is parturition?

**E. Answer the following questions in brief.**

1. Define gamete. Where are they formed?
2. State the difference between direct and indirect development.
3. What is fertilisation? What are its types?
4. What are the different parts of a sperm?
5. What do you understand by the term metamorphosis? Explain with examples.
6. Explain the process of asexual reproduction in *Hydra*.
7. State two differences between embryo and foetus.

**E. Answer the following questions in detail.**

1. Explain the phenomenon of fertilisation in human.
2. Describe the process by which baby develops into an adult.
3. What is IVF? Describe the different steps involved in IVF. How is it different from cloning?
4. What is metamorphosis? Explain the life cycle of a frog with the help of a diagram.

**G. Find the given words from the word maze below.**

ASEXUAL	CHROMOSOME	EPIDIDYMUS	FALLOPIAN
FERTILISATION	FOETUS	METAMORPHOSIS	OVIPAROUS
TESTIS	UTERUS	VIVIPAROUS	

S	I	F	L	Q	P	L	A	N	S	I	O	F	Z	Z
Z	I	C	A	A	Z	S	R	U	D	R	V	Z	E	I
T	O	S	M	L	E	N	M	B	Z	E	I	U	M	Q
G	U	Y	O	X	L	Y	E	Z	Z	R	P	Q	O	B
P	L	P	U	H	D	O	O	Z	S	V	A	C	S	Z
F	B	A	F	I	P	S	P	K	T	D	R	G	O	W
X	L	G	D	I	P	R	I	I	H	R	O	O	M	R
Y	K	I	R	N	W	J	O	T	A	T	U	Q	O	S
B	P	S	U	R	E	T	U	M	S	N	S	T	R	U
E	C	J	O	L	U	I	V	A	A	E	W	V	H	T
N	U	I	J	F	A	C	W	O	R	T	T	G	C	E
N	O	I	T	A	S	I	L	I	T	R	E	F	Q	O
V	I	V	I	P	A	R	O	U	S	W	A	M	N	F
A	N	A	C	Y	Y	I	R	A	U	C	Q	N	H	S
Q	D	X	X	I	K	D	B	K	W	W	T	W	D	O

**H. Give reasons for the following.**

1. Chromosome of a cat is different from that of a dog
2. Gametes have only half the number of chromosomes.
3. Frogs and toads lay large numbers of eggs.
4. Sperms are very small in size with a long tail.
5. Birds eggs have lesser chances of survival than human eggs.

## Out of The Box

1. The male gonad, testis is present inside a sac made of skin and muscles. Do you think such a sac is necessary? Explain your answer with reason.
2. Scientist, Titas discovered a new species. After close observation she found that the female produces a gamete, which is fertilized by the male externally. The female then lays eggs and gives them a protective covering. Both male and female of the species then place these eggs in a burrow for their protection.

Help Titas decide on the following and give reasons for each conclusion.

Type of fertilisation:

Type of species:

Type of development:

## In Real Life

You know now that the baby grows inside the mother's womb and derives its nutrition from the mother. Even though India has come a long way in 70 years of independence still only 16% of women in rural India receive proper care during pregnancy. Try to educate people around you to increase awareness and make them understand the importance of providing proper nutrition to the embryo growing inside a pregnant women.

## Subject Enrichment

### Activity Zone

Sometimes a mother produces two babies at the same time. We know that they are called twins. Do you know that twins can be of two different kinds? Find out more about the types of twins. Can a mother produce more than two babies at the same time? What are they called? Explore some cases where a mother has given birth to more than two babies. How do parents ensure proper care of children in such cases?

### Project Zone

Make a story board describing different stages in the development of human zygote till parturition.

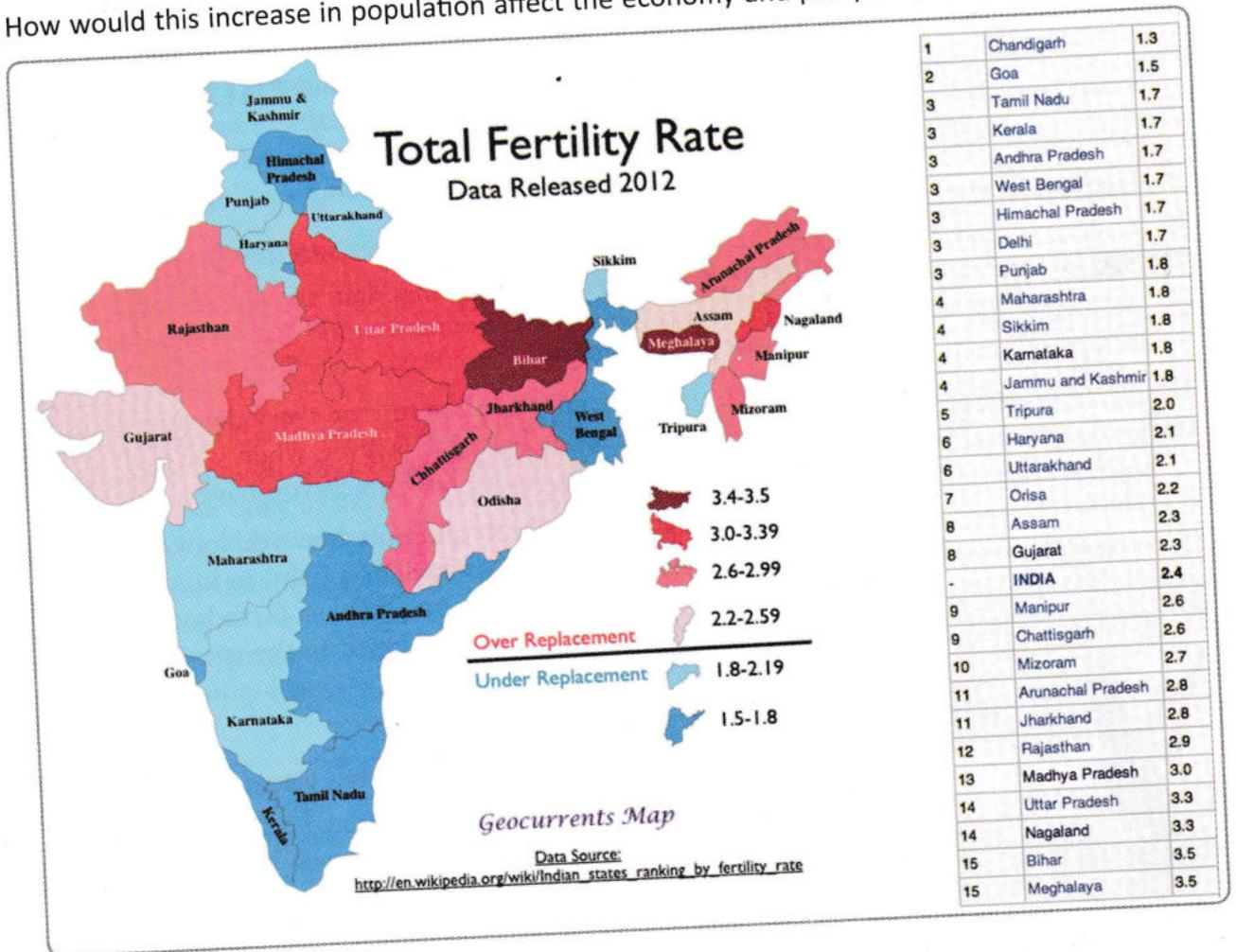
## Web-links

- Ovulation: <https://www.youtube.com/watch?v=nLmg4wSHdxQ>
- Binary fission: <https://www.youtube.com/watch?v=ReX0r2vm2U8>
- Budding in *Hydra*: <https://www.youtube.com/watch?v=d5-hPkcQDrU>
- Development of baby: <https://www.youtube.com/watch?v=WH9ZJu4wRUE>

## Crosslinks

The map given below shows the fertility rate in India of different states. Study the map and answer the questions below:

1. Which states in India show higher fertility rates? Where is the fertility rate low?
2. Do you think the population in our country will increase or decrease in the next 5 years?
3. How would this increase in population affect the economy and prosperity of our country?



### Teacher's Note

Students are both shy and curious about this topic. Teachers need to be sensitive towards their feelings but encourage them to ask as many questions to clear all confusion around this subject.

# 10

## Reaching the Age of Adolescence

### Chapter Focus

- Adolescence and Puberty
- The Role of the Endocrine System
- The Menstrual Cycle
- Personal Hygiene and Overall Health in Adolescents
- Drug Abuse and AIDS

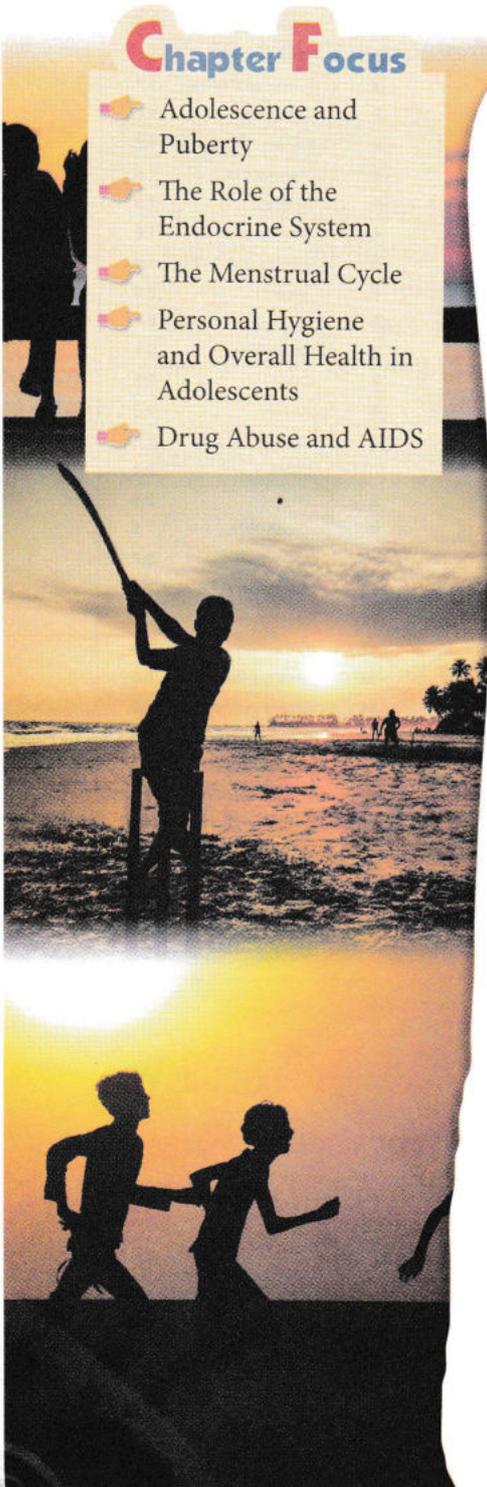
### Kick-off Activity

#### Your own timeline

You must see yourself in the mirror every day and do not notice any difference whatsoever. However, when you look at your picture album you realise how much you have changed since birth.

Take out your old album and note how you looked at different stages of life. Compare yourself as a baby, in kindergarten and from what you looked like on your last birthday. List down 7–10 changes that you can see in yourself in the space below:

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	



## ADOLESCENCE AND PUBERTY

**Adolescence** is the period of life when one attains reproductive maturity. The period begins around 11 years of age and continues till 18 or 19 years. However, this varies from individual to individual. Since these years are counted in 'teens' (as in thirteen and fourteen), the adolescence period is also referred to as the **teenage**.

The changes in the body mark the onset of **puberty** which ends when an adolescent reaches reproductive maturity. While adolescence marks the transition of physical, emotional and psychological development to attain adulthood, puberty is referred to as the physical changes that a child undergoes to attain reproductive maturity. Puberty can be completed in months or can range between 2-5 years depending on one's physiology.

### Do you know?

After infancy, the human brain shows a dramatic growth spurt. This growth muddles ideas in a teen mind.

### Changes during Adolescence

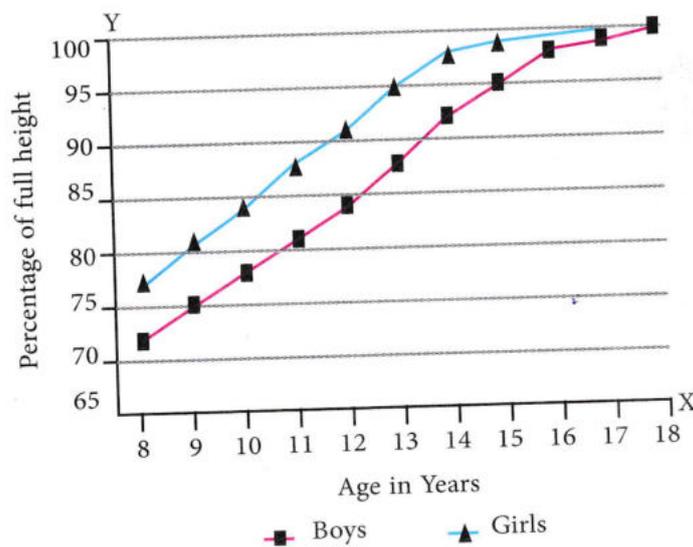
Though sexual maturation is the highlight of adolescence, many allied physical and emotional changes are noticed during this period. Some common changes noticed in an adolescent are given below.

#### Brain

Adolescence is a time of significant growth and development inside the teenage brain. A significant change in pruning of unused connections and strengthening the actively used ones in the brain takes place at this stage. Thus skills or habits practised repeatedly at this time can lead to more efficient learning. Teenagers should thus practise inculcating values of teamwork, respect and moral conviction. This is an appropriate time to develop self-control and skills in planning, problem-solving and decision-making. Due to the rapid development of the brain and increase in activities of the glands, adolescents tend to experiment and demonstrate risk-taking behaviour. It is thus important that they stay away from unhealthy habits of smoking, drinking or other such vices especially during this stage of life.

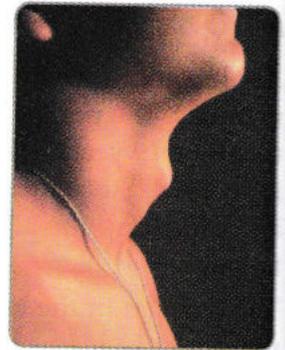
#### Bones, organs and body systems

Many organs develop even further during this time. For example, the performance of the lungs improves, limbs grow and bones increase in density and volume. Thus, it is essential to maintain a healthy and balanced diet to support normal growth of organs.



## Height and Weight

Between the age of 13–18 years maximum increase in height and weight of the body takes place. Increase in height starts much faster in girls than in boys, with boys catching up in the later years of puberty. Thus, a typical teenager requires high-protein diet with plenty of **calcium** and **iron** for normal bone growth and blood circulation.



## Clumsiness

Due to sudden growth during puberty the centre of gravity changes in an adolescent's body and their brain might take a while to adjust. This might make them clumsy at times.

## Physical strength

Muscles increase in strength and size during this period and hand-eye coordination along with motor skills like ball-catching and throwing gets better.

## Voice change

Just like the rest of the body, the larynx and the voice box grows. In boys, this gives rise to an **Adam's apple** and breaking of voice. Like the rest of the changes this soon becomes normal with the boy's voice becoming deeper with adulthood.

## Sleeping pattern

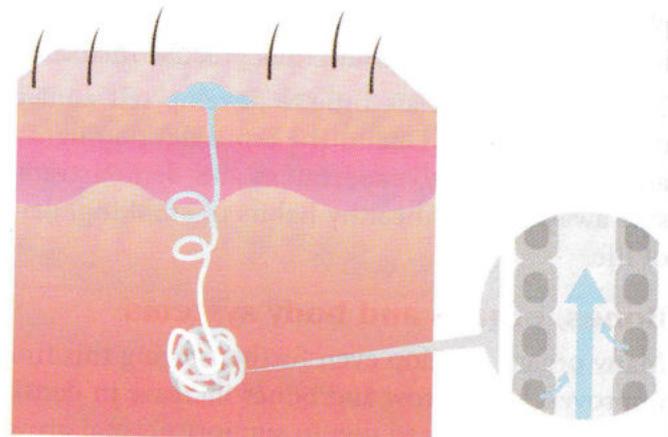
The sleep pattern changes during this period. Children going through puberty need more sleep than they did just before puberty started.

## Sweat

A new type of sweat gland in the armpit and genital area develops during puberty. Bacteria feed on the sweat this gland produces, which leads to body odour. Basic hygiene thus becomes extremely important.

### Do you know?

Adolescent brain is ruled by the limbic system, which is the site for emotions. Hence, teenagers tend to make decisions based more on emotions rather than reasoning.



*A sweat gland*



*Section of skin showing sweat glands*

## Skin and hair

Glands in the skin, on the face, shoulders and back start to become more active during puberty, producing more oil. This might cause pimples and acne.

## Teeth

Most children get their second molars at around 13 years and wisdom teeth later. These teeth can appear in singles, pairs, as a full set of four wisdom teeth or not at all.

## Change in body shape

The body, in boys, becomes broader with shoulders and chest widening. In girls, hips, breasts and thighs develop and increase in size. Mammary or milk glands develop inside the breasts.

## Development of primary sexual characters

The primary sex organs develop and mature for reproduction. The ovaries in girls and testis in boys become fully mature and start producing ova and sperms, respectively.

## Development of secondary sexual characters

Secondary sexual characters are physical characters that appear in members of a particular sex at puberty, but are not concerned with their sex organs. These are characters that help us to distinguish between males and females. In both, boys and girls, hair grows under the arms and in the region above the thighs or the pubic region. However some secondary characters are specific to separate sexes.

- ❑ **Female Secondary sexual characters:** In girls, breasts begin to develop at puberty.
- ❑ **Male Secondary sexual characters:** Boys begin to grow facial hair, that is, moustaches and beard. They also develop hair on the chest.



### Check Point



Look at the list of changes during puberty mentioned below. Colour the ones pertaining to boys in yellow, those to girls in green and the common changes in red:

Hair in armpit

Growing facial hair

Sense of reasoning

Adam's apple

Growth of Pubic hair

Enlarging breasts

Increase in height

Pimples and acne

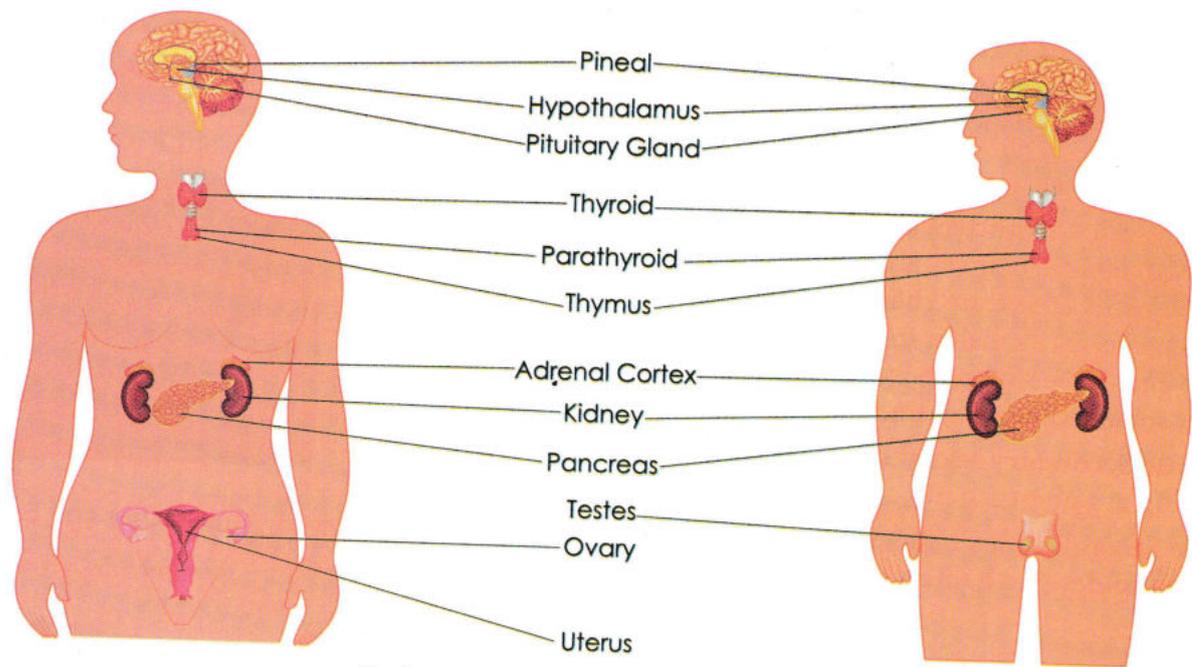
Excessive sweating

## THE ROLE OF THE ENDOCRINE SYSTEM

The changes which occur at adolescence are controlled by chemical substances present inside the body called hormones. **Hormones** are organic substances secreted by plants and animals that regulate physiological activities and are carried through the blood stream.

The onset of puberty is brought about by endocrine glands. **Endocrine glands** are the ones that do not have a duct and release their hormones directly into the blood stream.

There are many endocrine glands in our body. The image below shows all the endocrine glands present in a male and a female body.



*Endocrine System in male and females*

Hormones secreted by endocrine glands or the endocrine system triggers changes in the body that marks the onset of puberty. Once puberty is reached ovaries in girls begin to produce the female hormone or *oestrogen* which makes the breasts develop. Milk secreting glands or mammary glands develop inside the breasts. In boys, testis secretes *testosterone* which initiates the growth of facial hair.

**Do you know?**  
Though considered as the master gland, pituitary gland is very small, just the size of a pea.

The production of most of the hormones is under the control of hormones secreted from the pituitary gland. This is why the pituitary gland is also known as the **master gland**.

Adrenaline, secreted by the adrenal gland triggers the body's fight-or-flight response. This causes air passages to dilate to provide muscles with more oxygen. It also contracts blood vessels to re-direct blood towards major muscles, heart and lungs. The body's ability to feel pain also decreases as a result of adrenaline. **Adrenaline** causes a noticeable increase in the strength and performance, in stressful times. This is the reason adrenal gland is referred to as **the emergency hormone**.

The table below will give you an overview of the hormones secreted from all major glands:

Name of Gland	Hormone secreted	Function of the hormone
Pituitary	TSH (Thyroid Stimulating Hormone)	Stimulates secretion of the thyroid gland
	ACTH (Adrenocorticotropic Hormone)	Stimulates the secretion of the adrenal gland
	FSH (Follicle Stimulating Hormone)	Stimulates the production of ovaries in females and sperms in males.
	GH (Growth Hormone)	Stimulates the growth of the body

Name of Gland	Hormone secreted	Function of the hormone
Thyroid	Thyroxine	Regulates the utilisation of proteins, fats and carbohydrates in our body. The deficiency of this hormone causes a disease called goitre.
Pancreas	Insulin Glucagon	Reduces the blood glucose level Increases the blood glucose level
Adrenal	Adrenalin (emergency hormone)	Helps the body adjust to stress.
Ovary	Oestrogen	Development of secondary sex characters in female. Ovulation
Testis	Testosterone	Development of secondary sex characters in male. Sperm formation

It is important to remember here that hormones are produced by many other animals and plants as well. The thyroid gland secretes thyroxine that is essential for the growth and development of all vertebrates and not just humans. A study conducted recently has revealed the role of thyroxin in amphibian metamorphosis—the process by which a tadpole turns into a frog.

In plants, different hormones regulate the process of **growth, germination**, flower and fruit development, etc.

### Check Point

1. Name one hormone that is secreted from the gland given below:

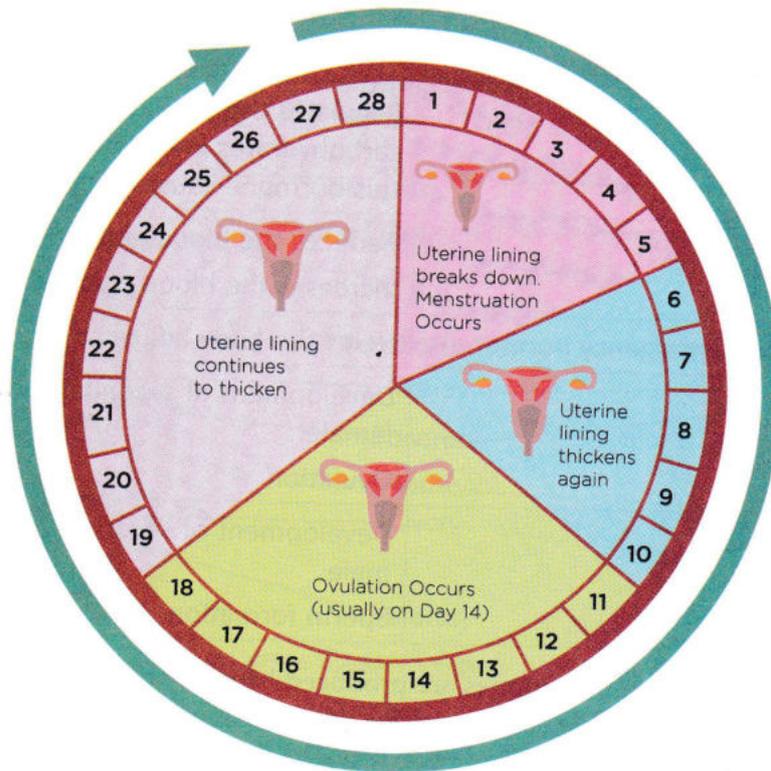
- a. Thyroid : \_\_\_\_\_
- b. Pituitary : \_\_\_\_\_
- c. Ovary : \_\_\_\_\_
- d. Testis : \_\_\_\_\_
- e. Adrenal : \_\_\_\_\_

2. Give one each function of the following hormones:

- a. Thyroxine : \_\_\_\_\_
- b. ACTH : \_\_\_\_\_
- c. GH : \_\_\_\_\_
- d. Adrenaline : \_\_\_\_\_
- e. Oestrogen : \_\_\_\_\_

## THE MENSTRUAL CYCLE

The adolescent period can seem like a whirlwind of rapidly changing emotions. Due to hormonal changes, adolescents attain their sexual maturity and body moves into the reproductive phase. During the reproductive phase the body is capable of producing mature gametes for reproduction.



*Menstrual cycle*

The capacity for maturation and production of gametes lasts much longer in males than in females. In girls it starts with the onset of puberty and generally lasts till the age of 45 to 50 years. Ovaries mature one at a time, with one ovum maturing and being released by one of the ovaries once in about 28 to 30 days. During this period, the wall of the uterus becomes thick. This is nature's way of preparing the uterus to receive the mature egg in case of fertilisation. The fertilised egg attaches to the uterine wall for maturity—a condition referred to as pregnancy.

In case fertilisation fails to occur, the released egg, and the thickened lining of the uterus along with its blood vessels are shed off. This causes bleeding in vagina called **menstruation**. Menstruation persists for 3–5 days. This ensures that the outer lining of the uterus is clean and renewed for receiving the ovum for the next cycle. The first menstrual flow begins at puberty and is termed **menarche**. All the stages in the menstrual cycle are controlled by hormones.

This cycle is repeated every 28-30 days till it stops at 45 to 50 years of age. The stopping of menstruation is termed **menopause**.

The cycle includes the maturation of the egg, its release, thickening of uterine wall and its breakdown if pregnancy does not occur.

## **PERSONAL HYGIENE AND OVERALL HEALTH IN ADOLESCENTS**

As we have read in previous sections of this chapter, during adolescence rapid mental and physical growth takes place. Thus it is vital that one takes care of their health both physically and mentally at this stage. Let us study in detail the measures you can take to ensure this:

1. **Balanced Diet:** The intake of a balanced diet, i.e., a diet containing the right amounts of carbohydrates, proteins, fats, vitamins and minerals is of utmost importance. It is also important to stay away from fast food as much as possible as it can lead to obesity. Fast food should in no case be substituted for a meal at any time of the day.

2. **Personal hygiene:** Your body as it can now produce excessive amounts of sweat and oil can cause body odour and pimples and acne. In order to avoid their occurrence it is important to take bath every day and cleaning all parts of the body.
3. **Exercise:** Taking up a sport, walking, jogging, running, doing aerobics and indulging in outdoor games is good for an adolescent body. Try to make it a habit and include one or more of these activities in your daily routine.

## DRUG ABUSE AND AIDS

When consumed regularly certain substances such as alcohol, cigarettes, *guthka*, and *pan masala* can become a habit as they are highly addictive. These substances are harmful to a person's health and thus should be avoided.

Drug abuse is known as the patterned (or regular) use of drugs in which the user consumes the drugs (or chemical substances) that cause harmful effects to the person's body and the people around them. Once it becomes a routine it becomes very difficult to stop. This condition is known as addiction. It is thus important to not indulge in these activities and avoid these habits at all costs. Some common examples of drugs include cocaine, marijuana, cannabis, ecstasy, heroin and LSD.

The people who become prone to substance or drug abuse often are seen at a risk of being infected with HIV (human immunodeficiency virus), the virus that causes AIDS (acquired immunodeficiency Syndrome). AIDS severely affects the immune system making the infected person vulnerable to infections and other diseases. It spreads by taking used syringes or through sexual contact with an infected person.

It is thus important that whenever you feel confused or clueless about a thing that you talk to a trusted person in your family or school. You can also refer to books or certain websites on the Internet.

### Key Terms



- **Adolescence:** The period of life when one attains reproductive maturity.
- **Puberty:** The period during which adolescents reach sexual maturity and are capable of reproduction.
- **Adam's apple:** A projection at the front of the neck, prominent among adolescent or teenage boys.
- **Primary sexual characteristics:** Certain characteristics that help differentiate between the two primary sexes—male and female.
- **Secondary sexual characteristics:** Certain visible changes that mark adult maturation such as changes in height and body shape.
- **Hormones:** Organic substances secreted by plants and animals that regulate physiological activities and are carried through the blood stream.
- **Endocrine glands:** Glands that do not have a duct and release their hormones directly into the blood stream.
- **Menstruation:** Process in a woman of discharging blood and other material from the lining of the uterus at intervals of one month.
- **Menarche:** The first occurrence of a menstrual cycle.
- **Menopause:** The period in a woman's life when menstruation stops.
- **AIDS:** Acquired immunodeficiency syndrome or AIDS is a diseases that severely affects the immune system.

## Recall

- Adolescence, or the time when one attains reproductive maturity can also be referred to as the teenage years.
- Puberty marks the onset of adolescence. Changes include changes to the brain, body systems, height, weight, increased clumsiness, physical strength, change in sleep patterns and the voice.
- An important part of reaching sexual maturity is the development of primary and secondary sexual characteristics in both males and females.
- This is stimulated by the secretion of hormones from endocrine glands, controlled by the pituitary or master gland.
- In girls menstruation starts with the onset of puberty and generally lasts till the age of 45 to 50 years after which they experience menopause.
- Drug abuse is known as the patterned (or regular) use of drugs in which the user consumes the drugs (or chemical substances) that cause harmful effects to the person's body and the people around them.

## Assess Zone

### A. Tick (✓) the correct answer.

1. What are primary sexual characteristics?
  - a. Certain changes that take place to develop the primary sex organs in either sexes
  - b. Change in height
  - c. Change in weight
  - d. Development of hair at various parts of the body
2. Which of the following hormone stimulates the adrenal gland?
  - a. TSH
  - b. ACTH
  - c. GH
  - d. ADH
3. Which of the following hormone helps in stimulating the thyroid hormone?
  - a. TSH
  - b. ACTH
  - c. GH
  - d. ADH
4. Which one of the following is not secreted by the master gland?
  - a. TSH
  - b. Adrenaline
  - c. Growth Hormone
  - d. Thyroid stimulating Hormone
5. Which of the following hormone is regarded as the emergency hormone?
  - a. TSH
  - b. Adrenaline
  - c. Growth Hormone
  - d. Thyroid stimulating Hormone
6. What is the size of the master gland?
  - a. The size of the heart
  - b. The size of a pea
  - c. The size of the kidney
  - d. The size of the liver

7. What is menarche?  
 a. The stopping of the menstrual cycle      b. The first occurrence of the menstrual cycle  
 c. The last occurrence of the menstrual cycle      d. The lack of menstrual cycle in a female
8. Which of the following substances are harmful to the body?  
 a. LSD      b. Heroin      c. Marijuana      d. All of these
9. Which of the following is the male sex hormone?  
 a. Testosterone      b. Oestrogen      c. Thyroxine      d. Adrenaline
10. Which of the following is the female sex hormone?  
 a. TSH      b. FSH      c. Thyroxine      d. Oestrogen

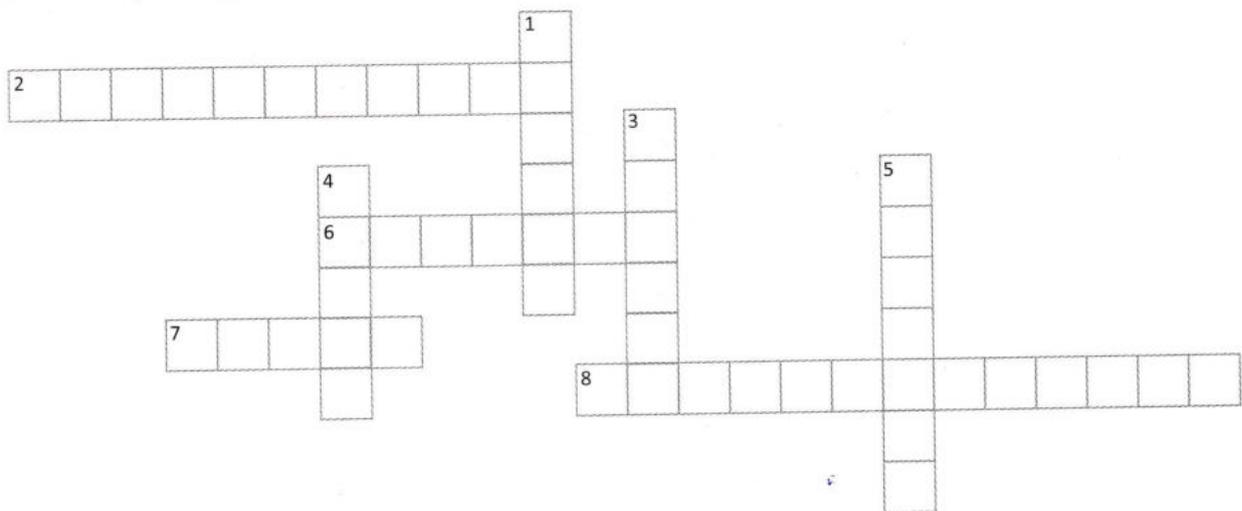
**B. Fill in the blanks.**

- Boys develop \_\_\_\_\_ during puberty as a secondary sexual character.
- In human \_\_\_\_\_ is called the emergency hormone.
- \_\_\_\_\_ help in regulating blood sugar in humans.
- In girls onset of puberty begins \_\_\_\_\_ than boys.
- Adam's apple results due to growth of \_\_\_\_\_ in adolescence.

**C. State whether the following statements are true or false.**

- The voice box in boys grows incessantly to form the Adam's apple. \_\_\_\_\_
- In males two different types of gametes are produced. \_\_\_\_\_
- Menopause is the stopping of the menstrual cycle in females. \_\_\_\_\_
- The adrenal gland is present at the base of the brain. \_\_\_\_\_
- Chromosomes are found in the cytoplasm of the cell. \_\_\_\_\_

**D. Solve the puzzle given below:**



**Across**

- period of life when one attains sexual maturity
- trimming of unused connections in brain
- primary sex organ in female
- tadpole changing to frog

**Down**

- a single male gonad
- first cell of the human body
- male gamete
- physical changes in adolescence

**E. Give reasons for the following.**

1. Adolescents develop pimples and acne.
2. Pituitary is called the master gland of the body.
3. Adrenaline is the emergency hormone.
4. It is important to maintain hygiene and exercise daily.
5. Adolescents need calcium rich diet.

**F. Answer the following questions in one word or a single sentence.**

1. Define adolescence.
2. What are the different gametes produced in humans?
3. Name the gland which helps in controlling blood sugar level in humans.
4. When do changes begin in humans in adolescence?
5. Which endocrine gland produces the growth hormone?

**G. Answer the following questions in brief.**

1. Distinguish between adolescence and puberty.
2. What is the difference between primary and secondary sexual characters?
3. What do you understand by Adam's apple?
4. How does the growth rate differ in boys and girls? Explain with a graph.
5. What is menopause?
6. Name a hormone produced by pancreas? What is its function?

**H. Answer the following questions in detail.**

1. What are secondary sexual characters? Name two such characters that are common to both sexes. Name two characters that are specific to boys and girls.
2. Which gland is referred to as the master gland in human body? Give examples to justify its name.
3. Explain menstrual cycle with the help of a diagram.

## Out of The Box

Ratan's grandmother has been diagnosed with a problem in her blood sugar level. She has given up on sugar intake to deal with it.

Do you think this will be sufficient in curing her disorder? Justify your answer with reason.

## In Real Life

Every community follows its own traditions to celebrate the birth of a child. Piplantri village certainly has a unique ritual. They celebrate the birth of every girl child by planting 111 trees. These trees act like trust fund for the child and helps in making the child independent in attaining adulthood. This practise not only helps the girls but also have been successful in maintaining and enriching the natural greenery of the place.



## Subject Enrichment

### Activity Zone

Prepare a chart of all the activities you should do in a day. Apart from giving ample time to studies, do include activities that involve outdoor games or sports such as badminton, tennis, cricket and volleyball. Make sure you supplement this with a proper balanced diet and avoid eating junk food. If possible, talk to a nutritionist and visit a local health centre.

### Project Zone

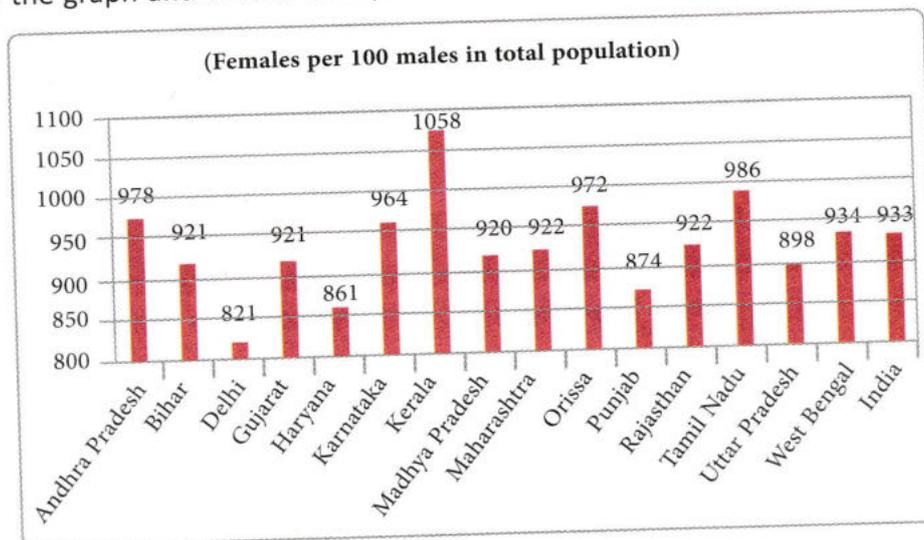
1. Prepare a model of the endocrine system and show the locations of the various glands.
2. Prepare a chart on the ill effects of substance or drug abuse. Display them in your classroom.

### Web-links

- The Endocrine System: [https://www.youtube.com/watch?v=wh6e\\_5bCfnw](https://www.youtube.com/watch?v=wh6e_5bCfnw)
- HIV and Drug Abuse: <https://www.youtube.com/watch?v=EYF8suY5w9k>

### Crosslinks

The graph below shows the number of females born per 100 male child in different states of India. Study the graph and answer the questions below:



1. Which three states in India are most likely to have a gender bias?
2. Which three states are most likely to be safe for a girl child?
3. Which other social depraved practises are likely to be prominent in states like Delhi and Haryana?

### Teacher's Note

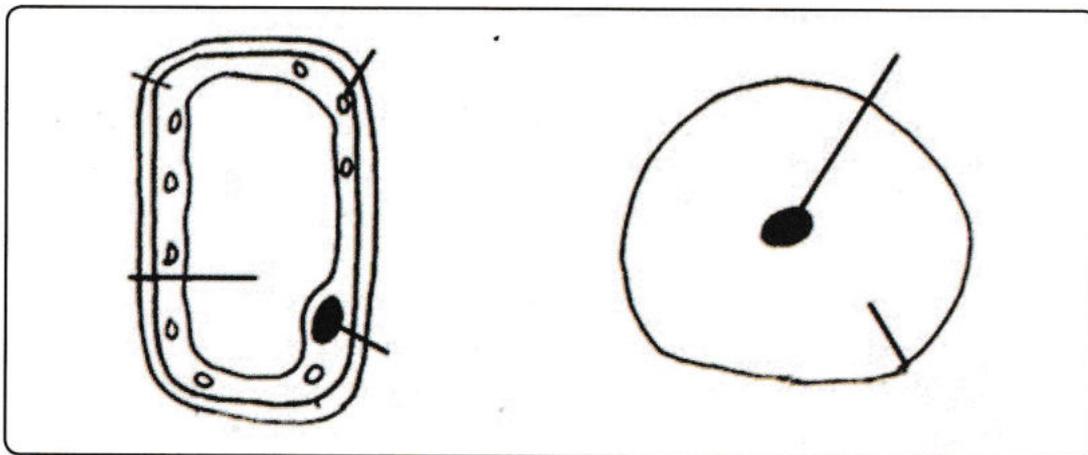
Since the students relate themselves to this chapter it helps to take this up at the beginning of year. This could also be taught in along with the lesson on sex education.

# Worksheet 3

(Unit 3 – The World of the Living)

## Fundamental Units of Life — Cells

1. First identify which one is the plant and which is the animal cell among the two given below.



2. Now add the labels given in the help box below

nucleus	cytoplasm	chloroplast
cell wall	cell membrane	vacuole

3. Match the part with its job.

Part
Nucleus
Cytoplasm
Membrane
Cell wall
Vacuole
Chloroplast

Job
Helps to provide support and contains cell sap
Absorbs light energy for photosynthesis
Carries genetic information
Provides support
Many chemical reactions occur here
Controls the movement of substances in and out of the cell

# Unit Test Paper 3

(Unit 3 – The World of the Living)

## A. Tick (✓) the correct answer.

- Which of the following is a natural cause of deforestation?  
a. Mining                      b. Obtaining wood for paper  
c. Clearing of land      d. Forest fire
- Which of the following is not an example of a plastid?  
a. Chloroplast              b. Chromoplast      c. Central vacuole      d. Leucoplast
- An ovary produces which of the following?  
a. Ovum                      b. Vagina              c. Sperms              d. Oviduct
- Which of the following is defined as a period when one attains reproductive maturity?  
a. Fertilisation              b. Adolescence      c. Puberty              d. Menstruation
- Which of the following is defined as the variety of life on the Earth?  
a. Fauna                      b. Biodiversity      c. Flora                      d. Ecosystem

## B. Are the following statements true or false? Correct the false statements.

- Plant cells contain a cell wall.
- Centrosomes are present in plant cells.
- An ovum is visible to the naked eye.
- Sweat glands develop during puberty.
- Animals that lay eggs are called viviparous animals.

## C. Give one word or one example for the following.

- Organic substances secreted by plants and animals that regulate physiological activities and are carried through the blood stream
- The primary sex organ present in the body of an organism that produces gametes
- Distinct thread-like structures containing genes present in the nucleus
- Group of organisms with some common characteristics that are separated from other such groups by reproductive isolation
- Species with high risks of extinction

## D. Answer the following questions.

- What is migration? What are the various reasons for migration?
- What are plastids? Name different plastids in plants along with their functions.
- What are the various modes of reproduction in animals? Explain with examples.
- How is a zygote developed in the body of an organism?
- What is the role of the endocrine system in humans? Explain for both males and females.

## 11

## Force and Friction

## Chapter Focus

-  Force – A Push or a Pull
-  Effects of Forces
-  Types of Forces
-  Friction
-  Advantages and Disadvantages of Friction
-  Fluid Friction

## Kick-off Activity

## Observe and identify

Look at the images below and identify if these show push, pull or both push and pull types of forces.

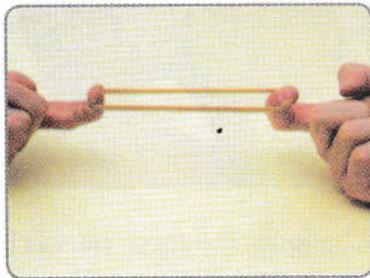
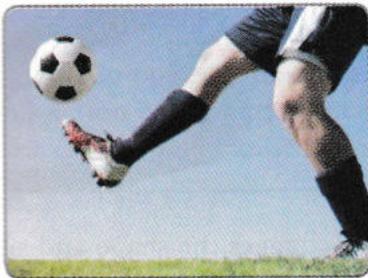


## FORCE—A PUSH OR A PULL

When you look around in your surroundings, you will see a number of things which work with your push and pull. This push and pull action applied on an object is called **force**.



Force is applied in every action we do. Whether we open or shut a door, we lift a book or a heavy object, a football player kicks a ball, a batsman hits a ball, we stretch an elastic rubber band, twist and squeeze wet clothes, etc. All these actions involve forces in the form of push, pull, stretching, compressing and lifting.



Thus, we see that to move an object or to stop the motion of an object, it has to be either pushed or pulled. Hence we can redefine force as a push or a pull.

The direction of application of force is determined by the direction of push or pull.

## EFFECTS OF FORCES

Force causes all types of motion.

What do you observe in the following pictures?

A man pushes the lawn mower to move it from rest. Similarly when a golfer hits the ball at rest, it starts moving. Thus, we see that a lawn mower, a golf ball or any object at rest begins to move only when a force is applied on it.



Therefore, we can conclude that a force applied on an object at rest sets it into motion. In simple words, a force can move a stationary object.

Similarly, when a cyclist applies more force and pedals hard, the speed of the bicycle increases. Also, if someone pushes the bicycle from behind, the speed of the bicycle again increases. On the other hand, if your friend pulls you from the back while cycling, then due to the force applied by him/her in the opposite direction of motion, your bicycle will slow down.

Thus, we conclude that the force applied on a moving object can change its speed. It increases the speed of the object when applied in the direction of motion while it decreases the speed of the object when applied opposite to its direction of motion.

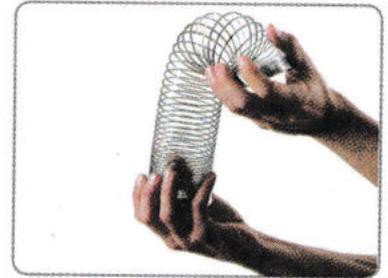
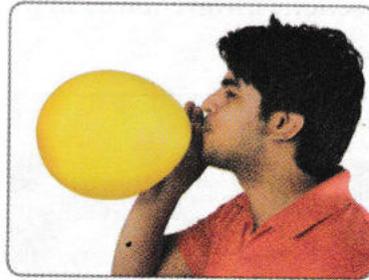
A football player kicks the football and changes its direction. Similarly, a batsman hits the moving ball with his bat and changes its direction.

The force from moving wind changes the direction of the kite flying up in the sky.

Thus, from all these examples we conclude that a force applied on a moving body changes its direction of motion.



Look at the images below. You can see a baker applying some force with his hands and kneading the dough into different shapes.



Similarly, when you blow the air into a balloon, the force caused by the air changes the shape and size of the balloon. Also, when you compress or stretch a spring by applying force on it, the shape and size of the spring change. Thus, we conclude that force can change the shape and size of an object.

To summarise, we conclude that force can

- move a stationary body,
- stop a moving body,
- speed up or slow down a moving body,
- change the direction of motion and
- change the shape and size of a body.

### Magnitude of Force

Consider a scenario where one person pushes a car stuck in snow. It is possible that the car may not move at all. Now, consider two people push it this time. The car might now move a bit. However, when three people move the car it might now move with ease.

Thus, we see that if more people apply the force, the action becomes easier. By increasing the number of people pushing the car, we are actually increasing the strength of the force applied.

This strength of the applied force is known as its magnitude. The magnitude is expressed with a numerical value followed by a unit. The S.I. unit of force is Newton. We define 1 Newton or 1 N as the force which when applied to a mass of 1 kg moves it with a speed of 1 m/s.

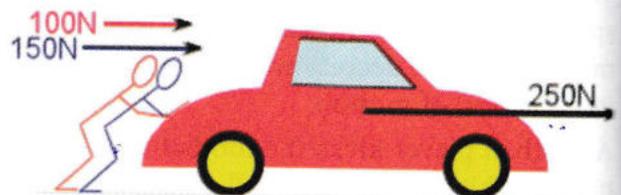
As we have just studied, force not only has magnitude but it also has a direction. When two or more forces act on an object, the strength of the total force acting depends on the directions of the forces. Based on this there are three possible cases. Let us discuss them one by one.

#### When two applied forces act in the same direction

In this image you can see, that the two people are applying force on the car along the same direction. In such a situation, the two forces add together to give a greater net force. Hence the car will move faster. In other words, the total force acting on the car in this case is the sum of the two applied forces.

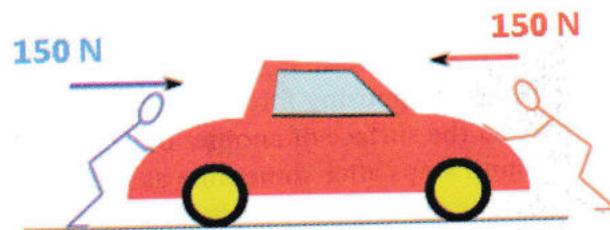
Therefore,  $F = F_1 + F_2$

Hence, we can say that when two forces act on an object along the same direction, the total magnitude and the net effect of the force increases.



### When two different forces act in opposite directions

Now, in this case the two boys are applying forces which are different in magnitudes and opposite in directions. This situation is similar to a tug of war where the winning team is the one which applies a greater force. Since the two forces applied on the car are acting in opposite directions, the car will move in the direction of the larger force. The total force acting on the car will be obtained from the difference of the two forces.

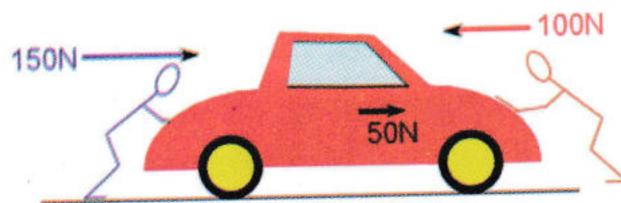


$$\text{Thus, } F = F_1 - F_2$$

Hence we can say that when two different forces act on an object along the opposite directions, the total magnitude and the net effect of the force decreases.

### When two equal forces act in opposite directions

In this image we see that two forces acting on the car are equal in magnitudes and opposite in directions. As a result the net force acting on the car becomes zero. Since the two forces are equal and opposite, the car cannot move in any direction. Therefore, when equal and opposite forces are applied on an object, the net force is zero and the object remains stationary.



$$F = F_1 - F_2 = F - F = 0$$

Thus from all the cases discussed above, the direction of force along with the magnitudes contribute to the outcome of the various forces acting on an object. To summarise,

- If two forces act along the same direction on a stationary object, they move the object and speed it up.
- If two forces act on an object along opposite directions, then the object moves in the direction of the greater force.
- If two equal forces act on an object in opposite directions, then the object does not move at all as the net force becomes zero.

## TYPES OF FORCES

A force can be categorized into two types:

1. Contact forces and
2. Non-contact forces

### Contact Forces

As the name suggests, the contact forces are those which can be exerted by one object on the other only when there is an actual physical contact between the two objects. Contact forces cannot act from a distance. The two main examples of contact forces are:

#### Muscular force

The force that is exerted by muscles is called muscular force. Both push and pull involve the action of muscles in our body. Most of our daily life activities involve the action of muscles. Lifting objects, pulling and pushing, stretching and compressing, physical workouts, pulling your luggage, washing clothes, etc. are all examples of activities that involve muscular forces. Not just humans but animals also use their muscular force such as horses, donkeys and camels apply their muscular force to pull the carts.

As we can see that muscular force can be applied only when there is an actual physical contact between the two objects, therefore muscular force is a contact force.

### Friction

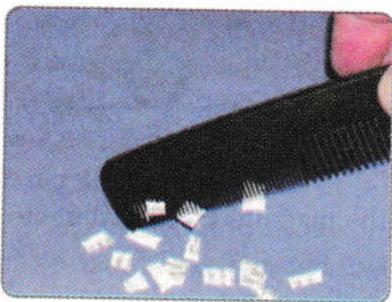
Friction is an opposing force that comes into play when one object is moved on the surface of another object. For example, a ball rolling on the ground stops after some time as the force of friction between the ball and the ground opposes its motion thereby stopping the ball.

The force of friction always comes into action when physical contact is developed between the two surfaces. Thus, friction is also an example of a contact force.



### Non-contact forces

The forces that come into play without the actual physical contact between two objects are known as non-contact forces. It means that non-contact forces between two objects act from a distance without touching each other. Electrostatic, magnetic and gravitational forces are the main examples of non-contact forces.



### Electrostatic force

When two charged bodies interact with each other, they experience a force called electrostatic force. Try rubbing a comb or a scale on your hair and then attracting a few small bits of paper with that comb or scale. Do you know how is it possible for a comb to attract those bits of paper without touching them?

It happens because the comb or a scale when rubbed on dry hair, becomes electrically charged. Charged objects can attract other charged and neutral bodies when kept near them. Another example here is that of a balloon. When an inflated balloon is rubbed against our synthetic clothes or oily hair it becomes charged and sticks to the wall.

Similarly, if two similarly charged bodies are just brought near each other, they repel each other. Thus, electrostatic force between two objects does not need an actual physical contact between two objects. It can act from a distance. Hence electrostatic force is a

non-contact force, i.e., two charged objects can attract or repel each other from a distance.

### Do you know?

Paint spray guns use electrostatic force as the principle of their working. The spray gun is given a positive charge, which causes every paint particle to become positively charged. Since like charges repel so all the paint particles repel each other and spread out. The object to be painted is negatively charged and so attracts the paint particles.

### Magnetic force

Force acting between two magnets or a magnet and a magnetic substance is known as magnetic force.

When a magnet is brought near paper clips or iron nails, they get attracted to the magnet and stick to it. This happens because paper clips and nails are made from iron which is a magnetic substance. On the other hand, if you bring a magnet near a wooden stick or a plastic tumbler or a woolen piece of cloth, there will not be any interaction between the two.



Thus, magnetic force acts only between magnets and magnetic substances. Also the magnetic force acts from a distance without the actual contact between the two objects. Thus, magnetic force is a non-contact force. Similarly, when two magnets with the same poles are brought near each other, they repel. Hence attraction or repulsion between two magnetic substances and magnets is a non-contact force.

## Activity



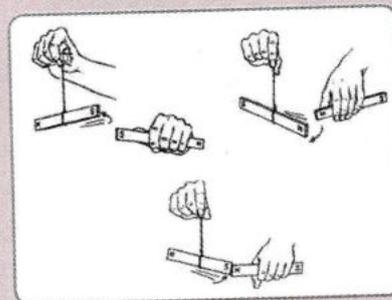
**Aim:** To show that magnetic force of attraction and repulsion is a non-contact force.

**Materials required:** Two bar magnets and a thread.

**Procedure:** Hold both the bar magnets with the North poles facing each other. What did you observe? Repeat the same this time holding the bar magnets with the South poles facing each other. What did you observe? Now, hold the two bar magnets with opposite poles facing each other. What did you observe?

**Observations:** When the magnets are held with the same poles facing each other, they repel and when the magnets are held with the opposite poles they attract each other.

**Conclusion:** It shows that magnets attract and repel without coming in contact with each other. Hence, magnetic force is a non-contact force.



## Gravitational force

A force of attraction exerted by the Earth on all objects due to which everything thrown up falls back to the Earth is known as the gravitational force or gravity.

An object thrown up falls down though there is no actual physical contact between the object and the Earth.

Thus, we can say that gravitational force or gravity is also a non-contact force as it does not require any physical contact between two objects to come into play. Falling of leaves, downward flow of rivers, all are possible because of this non-contact force of attraction, that is, gravity between the objects and the Earth.



## Check Point



Fill in the blanks.

1. Push or pull is known as \_\_\_\_\_.
2. The S.I. unit of force is \_\_\_\_\_.
3. Lifting a heavy load requires \_\_\_\_\_ force.
4. Friction is a \_\_\_\_\_ force.
5. \_\_\_\_\_ force between two charged bodies is a non-contact force.
6. For the force to act \_\_\_\_\_ between two bodies is essential.
7. Force has \_\_\_\_\_ and \_\_\_\_\_.
8. An apple falling from a tree falls down because of \_\_\_\_\_.

## FRICTION

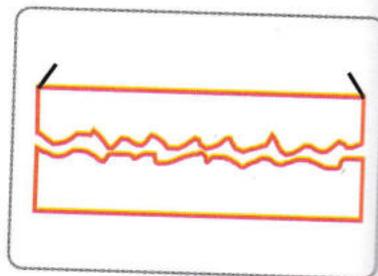
The opposing force that acts when one body moves on the surface of another is called force of friction or simply friction. Friction always opposes the relative motion between two surfaces; therefore friction is a kind of resistance to motion. When we rub our hands against each other, the force of friction comes into play and opposes the relative motion of the hands. This produces heat and our hands become warm.

Walking, writing, running and stopping of vehicles etc. are possible only because of friction. Now, let us find out what causes friction.

### Cause of friction

Friction occurs because no surface is perfectly smooth. Surfaces that might look smooth to the unaided eye will look rough when viewed under a microscope. Thus, all solid surfaces are rough to some extent.

When one surface is brought in contact with the other surface, these grooves get interlocked. Therefore, when one surface will move over the other these interlocking between the irregularities of the surfaces oppose the motion. In simple words, friction between two surfaces is due to the roughness of the surfaces in contact. Thus, friction is higher for rough surfaces and less for smooth surfaces.



### Activity



**Aim:** To demonstrate that friction depends on the nature of surfaces in contact.

**Material required:** A wooden block, a spring balance, a table top, a piece of rough board and a luster tile.

**Procedure:** Attach one side of the wooden block to the hook of the spring balance and place on the wooden table top. Now pull the spring balance towards right. Apply the force just enough that block begins to slide. Observe the reading of the spring balance. This gives the magnitude of the force of friction between the block and the table top. Now, repeat the same steps on the rough wooden board and then on the luster tile. What do you observe?

**Observation:** You will find that the force of friction was less on the luster tile while force of friction was more on the rough wooden board.

**Conclusion:** The friction depends on the nature of two surfaces in contact. It is more for rough surfaces and less for smooth surfaces.

### Static friction, sliding friction and rolling friction

Depending on the state of motion of an object, friction can be categorized into three types:

- (i) Static friction
- (ii) Sliding friction
- (iii) Rolling friction

#### Static friction

We can see that it is more difficult to move an object from rest than to move it when it is already in motion. It is due to the fact that when the object is at rest all the irregularities between the surfaces

in contact are interlocked and hence a greater force is required to break this interlocking. The force required to overcome friction at the instant an object is on the verge of moving from rest is called the force of static friction. Static friction is generally very high.

### Sliding friction

The friction that acts between two surfaces when one is sliding on the surface of another is called sliding friction or kinetic friction.

When an object has started moving or sliding on a surface, then there is not enough time for the interlocking between the two surfaces in contact. Due to lesser interlocking for an object in motion, the resistance offered to its motion is less and hence the sliding or kinetic friction is less than the static friction.



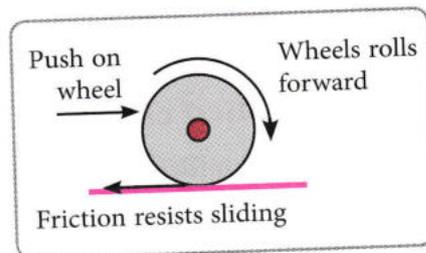
*A penguin sliding on ice*

### Rolling friction

The force of friction that comes into play when an object rolls over the surface of another object is called rolling friction.

Do you ever wonder why most forms of transportation use wheels such as bicycles, cars, four-wheelers, scooters and even bullock carts?

It is because of the simple fact that rolling friction is much less as compared to static and sliding friction. This fact is used as the basis of transporting heavy objects on wheels.



### Activity

**Aim:** To show that rolling friction is less than sliding friction.

**Material required:** A suitcase without rollers, a suitcase with rollers and some 2-3 heavy books.

**Procedure:** Place 2-3 heavy books in the suitcase without rollers. Now slide the suitcase from one room to another room.

Now keep the same books in the other suitcase with rollers. Roll it from one room to another room.

**Observations:** What did you observe in both the cases? We could clearly see that it is difficult to slide the suitcase without rollers. The suitcase with rollers moved quite easily.

**Conclusion:** Thus we conclude that rolling friction is much less than sliding friction.



That is why the invention of wheel was a revolutionary one as it changed the history of transport. Before the invention of wheel, animals were used as a means of transport but today the entire transport on the land is based on wheels or on rolling friction.

## ADVANTAGES AND DISADVANTAGES OF FRICTION

Friction is said to be a necessary evil. It means that it has a great importance in our lives due to its usefulness but at the same time it has some harmful effects too.

First, let us discuss some of the advantages of friction.

## Friction makes walking possible

It is because of friction between our feet and the ground that we are able to walk without slipping. When we walk we push the ground backwards with one foot and the opposing force from the ground pushes the other foot forward. In case there was no friction, instead of getting a push forward we would slip.

However, when water falls on a marble floor, the layer of water comes between our feet and the floor which prevents the interlocking of the foot and the floor. Thus, the friction reduces to a great extent. Therefore, when we accidentally step on the wet floor, we slip and fall down.

## Friction makes the vehicles move

It is the friction between the wheels of a vehicle and the road that makes the movement of vehicles possible. In the absence of friction, the wheels of a vehicle would just spin without any forward movement. Therefore, the friction makes all the vehicles on the road to move without skidding. The reduced friction on wet roads causes the vehicles to skid sometimes. That is why it is said that during rains one should drive the vehicles slowly.

## Brakes applied can stop a vehicle only due to friction

All the brakes in the vehicles work due to friction. When we press the brake pedal, the brake pads press against the rotating wheel. This causes friction between the brake pads and the rotating discs on the wheels. Therefore, the vehicle slows down and stops. Had there been no friction any vehicle which once started moving would never stop.

## Friction makes writing possible

Pencil has lead made of carbon. When we write, carbon particles rub from the lead and stick to the paper due to friction. Since on an oily paper friction is less, it is difficult to write on it. Similarly while writing with a chalk on the blackboard, the friction offered by the rough surface of the black board causes particles of the chalk to stick to the board and makes the writing possible.



## Disadvantages of friction

The disadvantages of friction are:

1. **Friction causes loss of energy in the form of heat.** Whenever any machine works, it leads to a loss of energy in the form of heat. It is because of friction that we cannot have a 100 percent efficient machine.
2. **Friction causes wear and tear.** The soles of our shoes, the parts of a machinery and the tyres of vehicles get worn out after some time. It happens because the rubbing of our shoes and the wheels with the ground leads to the loss of tiny particles due to friction. Therefore, the shoes or tyres wear out with time due to friction. For the same reasons, the machine parts get damaged as they rub against each other and produce heat due to friction.



3. **Friction between the wheels and the road leads to wastage of fuel.** As an engine not only works to move the vehicle but also applies constant effort in overcoming friction the speed of a vehicle varies from a smooth clear road to a rough crowded road. This causes the vehicle to not attain a constant speed and thereby leads to fuel wastage.

### Methods of increasing friction

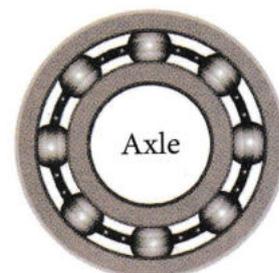
Since friction is necessary for performing various activities, therefore it has to be increased sometimes based on the requirements. Following are a few methods to increase friction:

1. Athletes wear shoes with spikes which get embedded in the ground giving more friction between the shoes and the ground. This enables the athletes to run faster without slipping.
2. Treads or grooves on tyres offer more friction between the tyre and the road which provides a better grip.
3. Kabaddi players rub some dry soil on their hands to increase friction and hence make a better grip. Similarly javelin throwers also rub coarse powder on their hands to enable themselves to hold the javelin tightly.

### Methods of decreasing friction

Since friction causes a lot of wear and tear and also leads to loss of energy, therefore we need some methods of reducing friction.

1. **Polishing the surfaces:** As we know that friction is higher for a rough surface than a smooth surface, therefore polishing the surfaces can reduce friction largely.
2. **Lubrication:** Lubricants form a layer between the surfaces in contact thereby reducing the interlocking and hence the friction between the surfaces.
3. **Spraying some powder:** Talcum powder reduces friction. Therefore, before playing carrom board we sprinkle some talcum to make the surface of the board a smooth one by reducing the friction.
4. **Using ball bearings:** We know that rolling friction is less than the sliding friction, therefore providing ball bearings in the wheels help the wheel to roll smoothly over the axle. Hence most of the machines use ball bearings to decrease friction.



## FLUID FRICTION

Just like solids, fluids also offer resistance to motion. This resistance to motion offered by fluids is known as fluid friction.

While swimming, the swimmer has to exert a lot of force to swim through the pool. It is because when we push the water to swim through it, the water pushes us back thereby resisting our motion. Even if you just push your hand through water, you can feel the fluid friction. In fact all objects floating in water such as fish, boats, ships and submarines, experience the fluid friction.

Similarly objects flying in the air like aeroplanes, birds, parachutes etc. experience the air resistance. Even the cars, buses and cyclists experience the air resistance or fluid friction. Since the fluid friction opposes the motion objects through water and air, therefore they slow down.

The magnitude of the fluid friction exerted by a fluid depends on the following four factors.



1. **The speed of the moving object.** Higher the speed of the object moving through the fluid greater is the fluid friction or drag.
2. **Shape of the object.** The fluid friction is decreased by making the objects of streamline shape.  
That is why aeroplanes, boats and ships are made streamlined so as to experience lesser friction.
3. **Size of the object.** Fluid friction is more for larger objects as compared to smaller ones.
4. **Thickness of the fluid.** Fluid friction is more for a thicker fluid than a thin one. Out of water and air, water is thicker than air and hence the friction offered by water is more than air.



### Activity

**Aim:** To show that friction depends on the nature (viscosity) of the fluid.

**Material required:** Three ceramic plates, some water, honey and vegetable oil and 3 cups.

**Procedure:** Place the three ceramic plates in a row. Now pour water in the first plate, oil in the second plate and honey in the third plate from three different cups. What do you observe?

**Observations:** Water spreads fastest along the diameter of the plate. The oil spreads slowly and the honey spreads still slowly along the diameter of the plate.

**Conclusion:** The fluid friction depends on the viscosity (thickness) of the fluid. Water is least viscous so suffers less resistance while honey is most viscous and suffers maximum resistance when poured on the plate.

### Methods of reducing fluid friction

As we just discussed the shape of an object can play a vital role in reducing fluid friction. We can find evidence to support this in nature. The streamlined shape of birds makes it easier for them to fly in the air. All types of fish, dolphins and whales have streamlined bodies to reduce the fluid friction they face in water.

### Do you know?

When a skydiver dives, his speed is slowed down by opening a parachute. Resistance offered by the air against the parachute reduces the speed of the diver.

### Check Point



**State true and false:**

1. Force of friction always supports the motion.
2. Friction prevents us from slipping.
3. Fine powder on the carom board is sprinkled to increase friction.
4. Speedboats are streamlined to reduce the air drag.
5. Rolling friction is highest among the three types of friction.
6. Static friction is more than kinetic friction but less than rolling friction.
7. Lubrication with oil increases the friction among the parts of machinery.
8. Friction produces heat.

## Key Terms



- **Force:** It is a pull or a push which changes the state of motion, direction of motion and shape of an object.
- **Contact force:** The force that comes into play only on contact between two objects.
- **Non-contact force:** The Force that comes into play even from a distance, that is without physical contact.
- **Magnetic force:** The force between two magnets or metals and a magnet.
- **Electrostatic force:** The force between two charged bodies or a charged body and an uncharged body.
- **Gravity:** The force of attraction exerted by the earth on objects present on the earth towards its centre.
- **Muscular force:** The force applied by the muscles.
- **Friction:** The opposing forces that act when one object moves on the surface of another.
- **Static friction:** The force of friction to overcome a stationary object into motion.
- **Sliding friction:** Friction that acts when an object slides on a surface.
- **Rolling friction:** Friction that acts when an object rolls on a surface.
- **Fluid friction:** The force of friction due to air or water.

## Recall



- Force is an external agent in the form of a push or a pull. The direction of application of force is determined by the direction of push and pull.
- Forces can always act and bring an effect only if the two objects interact with each other.
- Strength of a force determines if the force applied is small or large and the strength of the applied force is known as its magnitude.
- When two forces act on an object along the same direction, the total magnitude and the net effect of the force increases.
- When two different forces act on an object along the opposite directions, the total magnitude and the net effect of the force decreases.
- When two equal forces act on an object along the opposite directions, the total magnitude and the net effect of the force becomes zero.
- Muscular force and friction are contact forces while electrostatic force, magnetic and gravitational force are non-contact forces.
- Force can (i) move a stationary body, (ii) stop a moving body, (iii) speed up or slow down a moving body, (iv) change the direction of motion and (v) change the shape and size of a body.
- Friction depends on the weight of the moving object and the nature of two surfaces in contact.
- The resistance to motion offered by air or water is known as fluid friction.
- Fluid friction can be reduced by streamlining the objects.

## Assess Zone

### A. Tick (✓) the correct answer.

- Which of the following is the force applied in drawing water from a well using a rope and pulley?  
a. gravitational      b. friction      c. muscular      d. magnetic
- Which of the following are the characteristics of a force?  
a. magnitude      b. direction      c. both a and b      d. none of these
- Which of the following are the effects of applying force on a body?  
a. change of state of motion      b. change of direction  
c. change of dimensions      d. all of these
- Which of the following is a non-contact force?  
a. electrostatic force      b. lifting      c. friction      d. tension
- The force of friction depends on which of the following factors?  
a. nature of surfaces in contact      b. weight of the object  
c. both a and b      d. none of these
- Which of the following forces of friction is maximum in terms of magnitude?  
a. sliding friction      b. static friction  
c. rolling friction      d. all have same magnitude
- Friction produces which of the following?  
a. heat      b. light      c. charge      d. all of these
- Which of the following quantities can be measured using a spring balance?  
a. weight of an object      b. mass of an object  
c. volume of an object      d. density of an object
- Which of the following reduces the fluid resistance acting on an object?  
a. broadening from the front      b. broadening from the back  
c. streamlining      d. none of these
- Fluid friction depends on which of the following factors?  
a. nature of the fluid      b. speed of the object  
c. shape of the object      d. all of these

### B. Fill in the blanks.

- Muscular force is a \_\_\_\_\_ force.
- Newton is the S.I. unit of \_\_\_\_\_.
- Every object in this universe attracts every other object with a force of \_\_\_\_\_.
- Static friction is \_\_\_\_\_ than sliding friction and \_\_\_\_\_ friction is the least.
- Aeroplanes and speed boats are streamlined to \_\_\_\_\_ friction.

**C. State whether the following statements are true or false.**

1. Soles of shoes are grooved to increase friction.
2. Friction is an evil as it has all disadvantages with no advantage at all.
3. Gravitational force and magnetic forces are attractive as well as repulsive in nature.
4. A force acting on an object can change its direction but cannot change its dimensions.
5. Gravitational force holds the planets around the sun in their orbits.

**D. Match the following.**

- |   |                        |
|---|------------------------|
| 1. Moving a wheel barrow                | a. Drag                |
| 2. Mango falling down                   | b. Magnetic force      |
| 3. Balloon sticking to a wall           | c. Muscular force      |
| 4. Bottle opener stuck to a fridge door | d. Gravity             |
| 5. Bird flying in the sky               | e. Electrostatic force |

**E. Give reasons for the following.**

1. Shape of a balloon changes when you blow air in it.
2. Friction is a contact force and gravitation is a non-contact force.
3. Tyres of a car are treaded.
4. It is easier to roll a luggage bag than to slide it.
5. Sportsmen wear shoes with spikes.

**F. Answer the following questions in one word or a single sentence.**

1. Define force. State its S.I. unit.
2. Define gravity.
3. Give two examples where you push an object. Name the force used.
4. Name the force responsible for walking and writing on a paper.
5. Give two examples of contact forces and two of non-contact forces.
6. Define static friction. Name the friction that acts between the wheels of a car and the road.
7. Why are aeroplanes and ships streamlined?
8. Why the tyres of a vehicle get worn out after some time?

**G. Answer the following questions in brief.**

1. All the pins stick to the top in a pin holder or a magnet. Name the force responsible and the type of force.
2. Justify the statement 'force is always due to an interaction.'
3. With the help of an example state the various effects that can be made with the application of force.
4. Differentiate between sliding and rolling friction.
5. State two methods of reducing friction.
6. Explain the lighting of a matchstick. What makes it possible?
7. State two factors affecting the fluid friction. Give an example for each.

#### H. Answer the following questions in detail.

1. Justify the statement "friction is a necessary evil" with the help of essential examples.
2. Define electrostatic force. How is it a non-contact force? Give two examples where electrostatic forces act.
3. What are the disadvantages of fluid friction? How can we reduce fluid friction?
4. Explain all the factors affecting friction between two surfaces.
5. How can we increase friction and why do we need to increase friction, explain with the help of a diagram.

### Out of The Box

1. When we accidentally step on a wet floor, we slip. Explain why.
2. When a golfer hits the ball with the club, why does it start moving? Why when no one touches the ball it still stops on its own after a while?
3. In an electric bell, we hear the sound when the hammer strikes the gong. What force acts between the hammer and the gong?

### In Real Life

Friction causes a lot of wastage of energy and hence the fuel. How can we make our machines more efficient and minimize loss of energy to conserve fuel?

### Subject Enrichment

#### Activity Zone/Field Trip

Compare the strengths of two different magnets and find out which of the two magnets is stronger. Does keeping space between the magnets affect the pull between the two?

Or

Take the students to a car garage and show them how they increase the friction in some parts like wheels of the car and how they decrease friction in other parts.

#### Project Zone

Using green and white balloons, plastic straws and string, make balloon rockets. Release them and investigate which balloon rocket goes higher depending on the colour and shape of balloon and amount of air filled. Identify the different forces involved in the upward movement of balloon rockets such as; air drag, friction, gravity etc. Classify them as contact and non- contact forces.

### Web-links

- Forces: <https://www.youtube.com/watch?v=GGINhB74iik>
- Friction: <https://www.youtube.com/watch?v=VUfqjSeeZng>

## Crosslinks

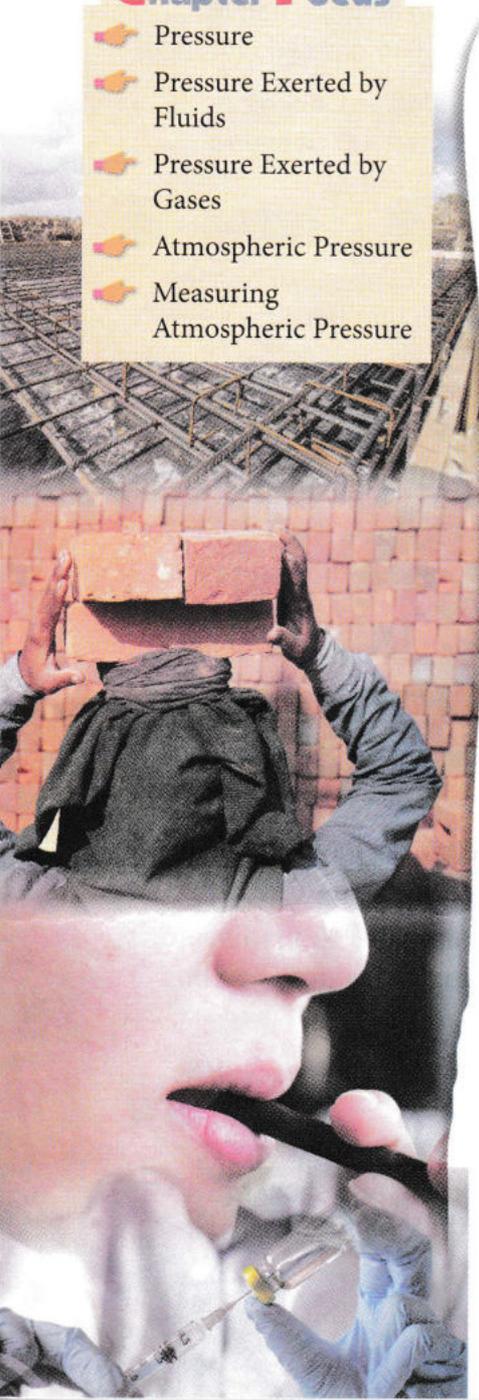
1. How does the gravity of moon affect the environmental conditions on the earth?
2. Write two applications of friction in sports

### Teacher's Note

Teacher can demonstrate the effect of increasing weight on static friction. Also show to students how lubricating helps reduce friction.

## Chapter Focus

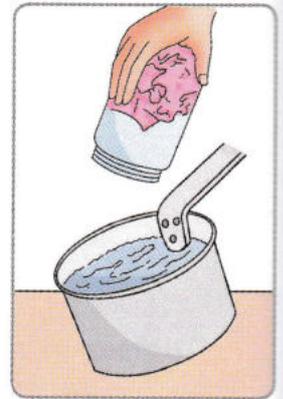
-  Pressure
-  Pressure Exerted by Fluids
-  Pressure Exerted by Gases
-  Atmospheric Pressure
-  Measuring Atmospheric Pressure



## Kick-off Activity

### Does air take up space?

Make a crushed ball of a small paper towel and stuff it into an empty glass in a way that the paper towel does not fall out when you invert the glass. Now, fill a broad container with water. The depth of the water should be equal to or greater than the height of the glass. Place the glass upside down into the water carefully without tilting it to the side. When you lift the glass from the water and remove the paper towel you will observe that the paper towel is still dry.



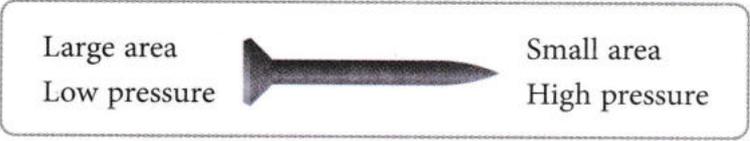
Find out the reason for your observation.

## PRESSURE

You might have noticed that we always hammer on the head of a nail and the pointed side embeds inside the wall. But what will happen if we do the reverse? The nail will never go inside the wall. Why does this happen?

The pointed side of the nail embeds easily into the wall due to the physical quantity called **pressure**. Pressure is not simply force rather pressure can be defined as the force spread out over an area. Mathematically, pressure is expressed as

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}; \quad P = \frac{F}{A}$$



It means a small force exerted on a very small area can create a very large pressure while even a large force when acts on a large area exerts a less pressure.

This explains why when we apply a small force on the pointed side of the nail it comes out as a large pressure on the nail and it gets embedded into the wall. Hence, the pressure depends on:

- the force applied
- the area over which force is spread out

The S.I. unit of pressure is Pascal (Pa). It is defined as

$$1 \text{ Pa} = \frac{1 \text{ N}}{1 \text{ m}^2}$$

When a force of 1N acts on an area of 1 m<sup>2</sup>, the pressure exerted is 1 Pascal. For larger pressures kilopascal is used.

$$1 \text{ kPa} = 1000 \text{ Pa}$$

Let us solve a problem based on pressure and area.

**Example:** Find the pressure exerted by a can of an aerated drink exerting a force of 3.5 N with area of the base as  $5 \times 10^{-3} \text{ m}^2$ .

**Solution:** Force = 3.5 N

$$\text{Area} = 5 \times 10^{-3} \text{ m}^2$$

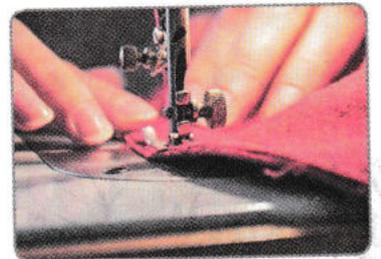
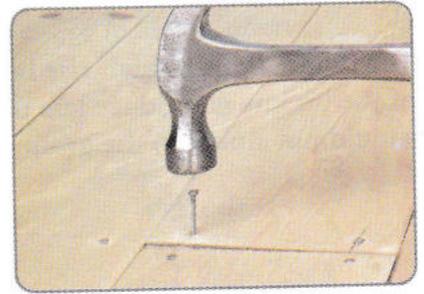
Therefore, using the formula

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}, \text{ we get}$$

$$P = \frac{3.5}{5 \times 10^{-3}} \\ = 700 \text{ Pa}$$

### Applications of pressure in daily life

We know that the tip of a sewing needle is sharp. Since pressure is inversely proportional to the area of contact, so a sharp needle puts large pressure on a very small area of cloth and makes the stitching easy and fast.



The tyres of bigger vehicles such as buses and trucks have broad and double wheels. This reduces the pressure on the tyres and they do not burst. We know that, the wider the area of contact, the less is the pressure and so they can transport greater weight.

The straps of school bags are made thick and wide so as to distribute the heavy weight of large number of books. More the width the lesser the amount of weight you will feel. For the same reason the workers carrying heavy loads keep a round cloth on their head as it spreads the load over a wider area. This reduces the pressure on the head.

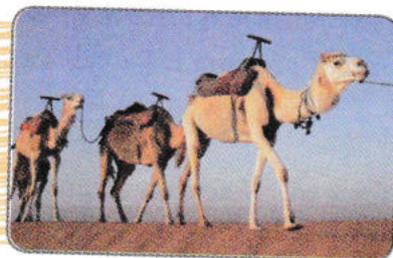


The foundations of high rise buildings are made wider, so that the weight of the buildings produce less pressure on the ground and the buildings should not sink into the ground.



### Do you know?

Camel is known as the ship of the desert. It is difficult for us to walk on sand, but a camel though much heavier can easily run on sand. This is because a camel has broad feet so the weight of the camel spreads over a larger area. Thus, the pressure exerted by its body on the sand is much less as compared to the pressure exerted by us.



### Check Point



Fill in the blanks.

1. Pressure is the force acting on a \_\_\_\_\_.
2. The S.I. unit of pressure is \_\_\_\_\_.
3. A pointed heel exerts \_\_\_\_\_ pressure on the ground than the flat shoes.
4. A camel can run in sand due to its \_\_\_\_\_ feet.
5. The foundations of high-rise buildings are made \_\_\_\_\_ to produce \_\_\_\_\_ pressure due to the weight of the buildings.
6. The pressure is \_\_\_\_\_ proportional to the area of the base.

## PRESSURE EXERTED BY LIQUIDS

If you fill a bottle with water and make holes at the same height from the base of the bottle, then you will observe that water starts leaking out from all the holes in equal amounts. This happens because the water exerts pressure on the walls of the container.

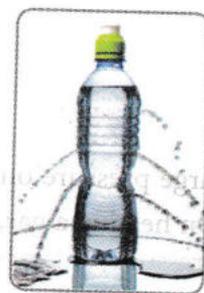
In fact all liquids not only take the shape of the container but also exert pressure on the walls of the container holding them. That is why the moment the liquid gets an outlet, it forces itself out due to the pressure it exerts on the walls. This is often observed if a water pipe gets damaged or has some holes in it. The water bursts out with equal pressure from all the holes resembling a water fountain.

Since the water comes out with equal pressure from all the holes, it means that water exerts equal pressure in all directions at the same height.

The liquid contained in a vessel has some weight. This weight exerts a force on the base of the vessel and hence gives rise to pressure. The liquid pressure is determined using the same formula:

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Here, force is equal to the weight of the liquid and the area is equal to the base area of the vessel.



Now let us check if the water comes out with equal pressure when the holes are made at different heights. Let us do an activity to find out.

## Activity

**Aim:** To demonstrate that the pressure exerted by a liquid at a point depends on the depth below the liquid.

**Materials required:** A bottle and some water

**Procedure:** Poke three holes in a long bottle at different levels from the base of the bottle. Now, fill the bottle with water. What do you observe?

**Observations:** Water rushes out from all the holes but water falls farthest from the lowest hole while water falls nearest to the bottle from the top hole.

**Conclusion:** The pressure exerted by water is highest at the bottom and lowest at the top in the bottle.



Thus, from the above activity we observe that as we go lower in a container, the pressure exerted by the liquid increases. Hence, we conclude that pressure exerted by a liquid increases with depth the container. That is, the pressure exerted at the base will be the highest and the pressure exerted at the surface of a container will be the least.

Moreover, a liquid would exert pressure everywhere on the container, on the walls of the container, the base of the container and upwards. Thus, we conclude that a liquid exerts pressure in all directions.

In brief the two important characteristics of liquid pressure are:

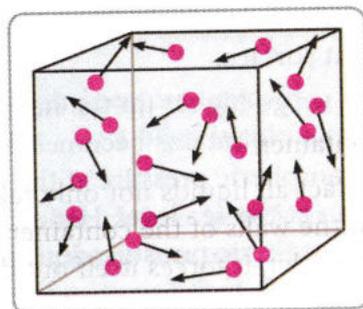
- Liquids exert pressure equally in all directions at a given height
- The liquid pressure increases with depth

## PRESSURE EXERTED BY GASES

Why does a balloon inflate on filling air into it? Let us find out the answer.

The molecules of a gas continuously collide with each other and with the walls of the container. When a molecule collides with the wall of the container it exerts force on the wall. Thus, all the molecules colliding with the walls sum up to produce a large force which in turn exerts a large pressure on the walls of the container.

On heating a gas, its particles move even more rapidly and create a greater pressure. This pressure can become so big that the container might even burst.



We know that air is a mixture of gases. Therefore, when the air is filled in a stretchable container like a balloon, the air molecules make a number of collisions with the walls of the balloon. These collisions create too much air pressure in the walls of the balloon from inside that the balloon expands and hence inflates.

Another observation from our daily life is that the air pressure in the tyres of a vehicle has to be accurately maintained. If the pressure is less, then the friction between the tyres and road increases while if the pressure is more than required, then the tyre can burst.

Thus we conclude that gases exert pressure which is due to the collisions of the molecules amongst themselves and with the walls of the container.

## ATMOSPHERIC PRESSURE

The layer of air that envelops the surface of the Earth is called the atmosphere which extends up to 300 km above the surface of the Earth. This atmosphere has a weight due to which it exerts pressure on us, known as the atmospheric pressure. In fact, the air in our atmosphere is constantly pushing on us and everything else.

### Do you know?

Why there is a warning sign on a deodorant spray to tell you not to leave them in the sunshine? It is because if they get too hot due to the heat of the sun, they might explode.

### Activity

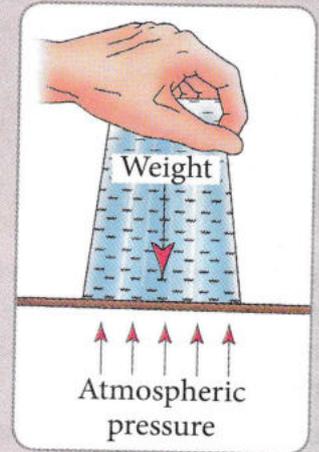
**Aim:** To demonstrate the existence of atmospheric pressure

**Material required:** A glass tumbler, some water, and a square cardboard piece

**Procedure:** Fill up the glass tumbler with water up to the brim and then place a square piece of cardboard on top of it. Now, turn the glass along with the cardboard piece upside down and slowly remove your hand. What do you observe?

**Observation:** The piece of cardboard does not fall and water stays inside the glass.

**Conclusion:** The cardboard does not fall due to the atmospheric pressure acting on it in the upward direction.



The atmospheric pressure allows us to do many things from breathing to sipping through a straw.

### Magnitude of Atmospheric Pressure

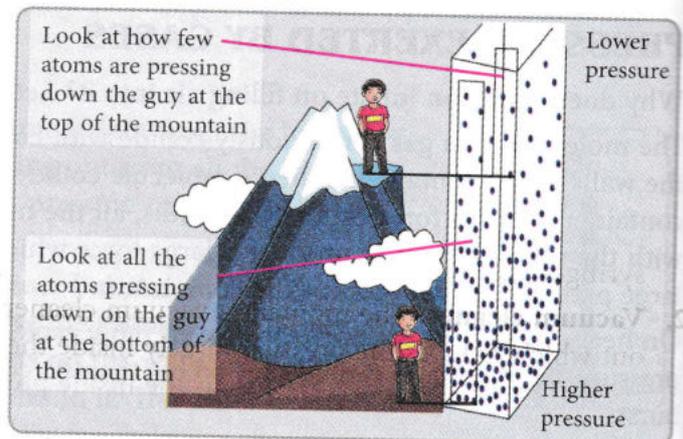
By now we know that pressure is force per unit area. Thus, the atmospheric pressure can be expressed as force per unit area exerted against a surface by the weight of the atmosphere above that surface.

As we go higher up the height of the air column at the mountains becomes lesser. That is, the atmospheric pressure at the mountains is lower than at the sea level. Hence, we can say that the atmospheric pressure decreases as we go up at higher altitudes.

Have you ever wondered why our nose starts bleeding as we go higher up in the mountains?

We know that blood flows through our blood vessels throughout our body. Like other liquids, blood also exerts pressure inside our body known as the blood pressure. The blood pressure is slightly higher than the atmospheric pressure. Thus, the large atmospheric pressure is counterbalanced by our blood pressure which saves us from getting crushed by the atmospheric pressure.

However, as we go to higher altitudes, the atmospheric pressure decreases and the blood pressure becomes much higher than the pressure outside. This higher pressure inside the body causes some blood vessels to burst and hence nose bleeding may start at higher altitudes.



## Activity



**Aim:** To demonstrate the high magnitude of atmospheric pressure

**Material required:** A can with a tight lid, bunsen burner and a pair of tongs.

**Procedure:** Pour some water in the can say about one fourth the volume of the can. Then heat the can on the flame while holding it with the help of tongs. When the water starts boiling, tighten the lid and allow the can to cool. What do you observe after some time?

**Observation:** On cooling, the can collapses.

**Conclusion:** On heating the water turns into steam which on cooling turns back into water. However, because of the tight lid the air pressure reduces inside in the can and thus the high atmospheric pressure outside crushes or collapses the can.

## Measuring Atmospheric Pressure

Pressure at the surface of earth is measured with an instrument called **barometer**.

The most commonly used barometer is the mercury barometer. A mercury barometer consists of a glass tube filled with liquid mercury that is closed at one end. The tube stands inverted on the open end which is submerged in a reservoir of mercury exposed to the air.

When the atmospheric pressure increases, it forces the liquid mercury in the reservoir. Therefore the level of the mercury rises in the glass tube. On the other hand, when the air pressure decreases, the mercury from the glass tube drains out. Thus, the level of mercury in the glass tube determines the exact atmospheric pressure. This is why atmospheric pressure is measured in terms of the height of the mercury column as "millimeters of mercury" or mmHg instead of pascals. The accurate air pressure at the sea level is 760 mmHg.

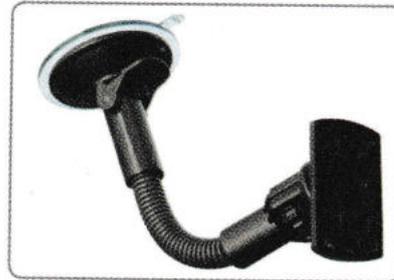


## Applications of Atmospheric Pressure

- Working of a syringe:** When the piston of a syringe is pulled outward, the air pressure inside it reduces. Thus, the larger air pressure outside forces the liquid in a container to get filled inside a syringe.
- Vacuum cleaner:** The moment a vacuum cleaner is turned on the air inside the cleaner is sucked out which reduces the pressure largely inside the vacuum cleaner. The atmospheric pressure which is much higher in magnitude than the inside pressure of the cleaner forces the air and dust particles into the vacuum cleaner and thus help in cleaning.



- Drinking from a straw:** When we suck through a straw, the pressure inside the straw is reduced. The higher pressure outside forces the liquid from the glass into the straw and hence into our mouth.
- Rubber suckers:** When the sucker hits the wall or a glass surface, the air inside it is forced out thereby reducing the pressure inside. The higher atmospheric pressure outside holds the sucker firmly in its place.



### Do you know?

Barometers help us to forecast weather as they are used to predict changes in air pressure which are the basis of changes in weather. A decrease in atmospheric pressure indicates the arrival of stormy weather while a steady high pressure indicates clear weather.

### Check Point



State whether true or false.

- Fluids exert equal pressure in all directions at the same level.
- Pressure in fluids decreases with depth.
- The atmospheric pressure is least at the sea level.
- Camels can walk or run easily on the sand.
- The nose of mountaineers start bleeding at high altitudes due to high atmospheric pressure.
- Atmospheric pressure is generally measured as mm of a mercury column.
- An oil kept in a container will exert pressure only downwards.
- Barometer is used to measure atmospheric pressure.

### Key Terms



- **Pressure:** Force acting per unit area
- **Atmospheric pressure:** The pressure exerted by the gaseous envelope around us called atmosphere.
- **Blood pressure:** The pressure exerted by the blood vessels inside our body.
- **Pascal:** When one Newton force acts on an area of one meter square, the pressure is one pascal.
- **Barometer:** The instrument used to measure atmospheric pressure

## Recall



- Pressure is inversely proportional to area.
- A liquid exerts equal pressure in all directions at the same height.
- The liquid pressure increases with depth below a liquid surface.
- The atmospheric pressure above the sea level is maximum and it equals 101.3 kPa.
- The weather forecasting is based on pressure variations.

## Assess Zone

### A. Tick (✓) the correct answer.

1. How much is the atmospheric pressure at the sea level?
  - a. 1,013 kPa
  - b. 101.3 kPa
  - c. 10.13 kPa
  - d. 1.01 kPa
2. A boy weighing 70 N stands on grass wearing shoes of area  $20\text{cm}^2$  with a girl weighing 55 N and wearing heels of area  $0.2\text{cm}^2$ . Who will exert greater pressure?
  - a. The girl will exert more pressure
  - b. The boy will exert more pressure
  - c. Both will exert equal pressure
  - d. Difficult to predict
3. What is pressure inversely proportional to?
  - a. Volume of the object
  - b. Weight of the object
  - c. Area of the base of the object
  - d. Nature of object
4. Which of the following is not a unit of pressure?
  - a. Pascal
  - b. mm of mercury column
  - c.  $\text{N/m}^2$
  - d. none of these
5. How does the pressure changes due to a liquid?
  - a. Increases with depth
  - b. Decreases with depth
  - c. Remains same at all levels
  - d. First increases then decreases
6. How does the pressure exerted by a liquid vary at a point?
  - a. Greater pressure sideways at all point at same level
  - b. Equal pressure in all directions at same level
  - c. Greater pressure upwards at all points at same level
  - d. Greater pressure downward at all points at same level
7. Why do mountaineers need oxygen cylinder at higher altitudes?
  - a. Moderate atmospheric pressure
  - b. High atmospheric pressure
  - c. Low atmospheric pressure
  - d. Zero atmospheric pressure
8. When is the atmospheric pressure maximum?
  - a. Top of mountains
  - b. base of mountains
  - c. sea level
  - d. same at all places

9. Which of the following does not exert any pressure on the container?  
 a. Hydrogen gas      b. Oxygen gas      c. Water      d. None of these
10. What instrument is used to measure atmospheric pressure?  
 a. Thermometer      b. Barometer      c. Nanometer      d. Spectrometer

**B. Fill in the blanks.**

1.  $N/m^2$  is the unit of \_\_\_\_\_.
2. Pressure exerted is more for a \_\_\_\_\_ object than a \_\_\_\_\_ object.
3. Fluids exert \_\_\_\_\_ in all directions equally.
4. Atmospheric pressure is due to the \_\_\_\_\_ of the air column above us.
5. Sucking through a straw is possible due to \_\_\_\_\_.

**C. State whether the following statements are true or false.**

1. Pressure exerted by an object depends on the weight of the object alone. \_\_\_\_\_
2. Liquids exert pressure downwards and gases exert pressure upwards. \_\_\_\_\_
3. Pressure at the bottom of a vessel is more than at the top surface. \_\_\_\_\_
4. The atmospheric pressure on us is counterbalanced by the blood pressure from inside us. \_\_\_\_\_
5. Pressure is produced when a force acts on per unit area. \_\_\_\_\_

**D. Match the following.**

- |                     |                              |
|---------------------|------------------------------|
| 1. Syringe          | a. High atmospheric pressure |
| 2. Barometer        | b. Sea level                 |
| 3. Maximum pressure | c. Top of mountains          |
| 4. Oxygen cylinder  | d. Atmospheric pressure      |
| 5. Crushing can     | e. Weather forecasting       |

**E. Give reasons for the following.**

1. A balloon inflates on filling air in it.
2. Water flows out slowly from a tap at the second floor than a tap at the ground floor.
3. Nose bleeding occurs at high altitudes.
4. Walls of a dam are made thicker near the bottom than at the top.
5. It is difficult to cut a piece of cloth using a pair of scissors with blunt blades.

**F. Answer the following questions in one word or a single sentence.**

1. Define pressure.
2. Relate the unit Pascal to Newton.
3. Why do gases exert pressure on the walls of the container?
4. What is the magnitude of atmospheric pressure at the sea level?
5. Name a few applications of atmospheric pressure in our daily life.
6. How does the pressure exerted by a liquid vary with depth below the liquid surface?

7. Give an example to show the existence of atmospheric pressure.
8. Name the instrument used to measure atmospheric pressure. Give one of its application in real world.

**G. Answer the following questions in brief.**

1. Why do school bags have wide straps?
2. State the factors on which pressure exerted by an object depends.
3. State two important characteristics of the pressure exerted by liquids.
4. What makes a rubber sucker stick to a wall?
5. Why is tip of a sewing needle made sharp?
6. Compare the pressures exerted by a force of 150N on the areas of  $5\text{m}^2$  and  $10\text{m}^2$ .
7. Calculate the pressure exerted on the piston of area  $154\text{m}^2$  when a car weighing 2400N is placed on it.

**H. Answer the following questions in detail.**

1. Write the relation between pressure, force and area. Define pascal. Explain why the foundations of high rise buildings are made wider.
2. Define atmospheric pressure and state its cause. Describe an activity to show the large magnitude of atmospheric pressure.
3. How do liquids exert pressure? Explain the dependence of pressure on depth in a liquid with an activity.
4. How do we measure atmospheric pressure? Explain the working of a barometer?
5. A force of 50N exerts a pressure of 500Pa at a certain area. How can you increase the pressure to 5000Pa by applying the same force?

### Out of The Box

1. Why are the wheels of buses and trucks made heavier and broader than the wheels of car or scooters?
2. A thick board of wood weighing 50 kg is placed over a bed of 1000 pointed nails. The area of each nail is  $2\text{mm}^2$ . Calculate the pressure exerted by the wooden board on the bed of nails.
3. If recommended tyre pressure for your car is 30 to 35 Psi, what can happen if the pressure goes below 30 Psi or if it goes above 35 Psi?

### In Real Life

Ananya was traveling by an aeroplane for the first time. When she used the toilet inside the plane and flushed it she was surprised to see no water came out rather she heard a loud sucking sound. From where did she hear that sound and how does an airplane toilet flush works without or very little water?



## Subject Enrichment

### Activity Zone

1. Hang two balloons a few inches apart and then blow between them. You will note that the two balloons move together. Why do you think this happened? Give reasons.
2. Plan a visit to a nearby dam and observe how the structure of a dam withstands high pressure of falling water on it.

### Project Zone

Prepare a chart on different kinds of pressure gauges you can explore and study about. For examples, the pressure gauges used to measure liquid pressure, atmospheric pressure and blood pressure. Make your chart as colourful as possible and display it in your classroom.

### Web-links

- The History of Barometer: <https://www.youtube.com/watch?v=EkDhlzA-lwl>
- Atmospheric pressure: <https://www.youtube.com/watch?v=QeAp3CuGjk8>

### Crosslinks

The concept of inverse relationship of pressure with area is used in car garages for washing and repairing. Find out the working of hydraulic lift used in car stations based on pressure.

### Teacher's Note

Take the students to Physics lab and demonstrate the pressure variation in liquids with depth. Also show the students how pressure is related to area of contact.

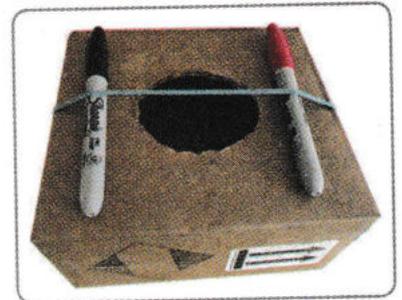
## Chapter Focus

- Sound
- How Sound is Produced
- How Sound Travels
- Speed of Sound
- The Sound We Hear
- Sound Waves
- Characteristics of Sound
- Musical Sound
- Noise
- Audible and Inaudible Sounds

## Kick-off Activity

### Make your own rubber band guitar

Take a cardboard box or a tissue paper box, a rubber band big enough to stretch around the box and two pens or pencils. Using a pair of scissors make a hole right in the middle of the box. Wrap the box around with a rubber band such that it is in the middle of the box and just above the hole. Insert two pens or pencils at the either corners of the rubber band. The pens should be placed in such a way that the portion of the rubber band just above the hole should not be touching the cardboard box.



Pluck the rubber band with your fingers just like you would pluck the strings of a guitar. Did you hear anything? Try adding one more rubber band. Is there a difference between the two sounds when the other rubber band is plucked? Why do think this happened?

## SOUND

We hear a variety of sounds every day from the time we get up to the time we go back to bed. Chirping of birds, rustling of leaves, rattling of doors, ringing of phones, ticking of a clock, honking of vehicles and kids playing are some of the sounds we hear every day. Have you ever wondered how sound is produced? Why different objects have different sounds?

Sound is produced by the vibration of a body. Sound is a type of energy. When continuous vibration occurs in any medium—solid, liquid or gas, it produces sound. Vibration is thus defined as the



continuous back and forth movement of an object which in turn produces sound that causes sensation in our ears, known as hearing.

## HOW SOUND IS PRODUCED

The source of sound is the vibrating object. When a body vibrates it produces sound and when the vibration of a body stops the sound stops by itself. Hence, it can be concluded that sound is produced by vibrations caused by a body or vibrations caused in a body. To understand this let us first understand the organ that produces sound in our bodies.

### Do you know?

In laboratories, to experiment on sound a special instrument is used. This instrument is called a tuning fork. It is a U-shaped single piece of metal with handle and two arms. The handle is called stem and the arms are called a prongs. When we hit a prong, the tuning fork starts vibrating that produces the sound in return.

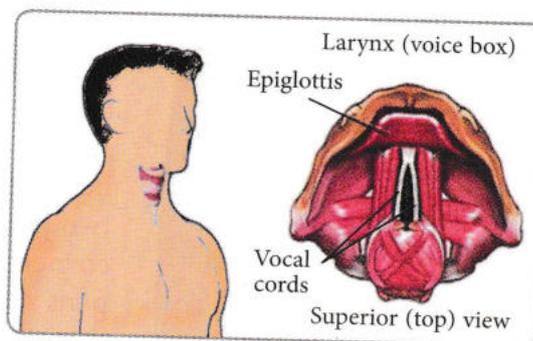


## Production of Sound in Human Body

Have you ever wondered how different people have different sounds? Or, how we are able to make a lot variety of sounds?

We produce sounds with the help of special part in our body called larynx. Larynx is a small box-like structure made up of tissues present inside our throat. It is also called voice box. The voice box has two vocal cords. Vocal cords are present inside the larynx in a very unique arrangement such that there is a narrow gap between the two cords.

The muscles attached to the vocal cord can make the cord tight or loose. When we speak, air from the lungs makes its way through the opening. This passage of air creates vibration in the cords thus producing sound. If the vocal cords are tightly attached to the larynx they produce high pitch sounds whereas the loosely arranged vocal cords produce sounds that have a lower pitch. In females, vocal cords are small and are arranged tightly in the voice box. This arrangement produces shrill voice while males have comparatively large vocal cords and so they have a gruff voice.



### Activity



**Aim:** To make a model vocal cord.

**Materials required:** Two rubber bands of equal length

**Procedure:**

- Take two rubber bands and put them one above another.
- Stretch them with your fingers.
- Blow air between the gap produced between the stretched rubber band.
- Is sound produced?

**Conclusion:** The sound is produced by the vibrations caused by the stretched rubber bands. This arrangement is similar to the vocal cords arranged in the larynx.

## HOW SOUND TRAVELS

Have you ever wondered how the sound produced by the vibrating objects reaches our ear?

Air is full of tiny molecules. These tiny molecules are everywhere in the open space. When an object vibrates it causes vibration in the air molecules that are in contact with the vibrating object. The vibrating air molecules transfer the energy from one molecule to another. Thus, the neighbouring air molecules also start vibrating. This procedure continues till this creates a sensation in our ears. The sensation in our ear enable us to hear the sound.

You must have observed the ripple produced in the pond when a stone is thrown in it. As the ripple dies out after travelling a certain distance in the water similarly, the vibration in the air molecules also dies out after travelling some distance. This is the reason why loud music travels for a long distance before it dies in the air. So, from here we can say that air is required to hear the sound produced. Can we hear any sound if there is no air in the atmosphere? The answer to this question is air requires medium to travel. Any substance or matter through which sound travels is called medium. Air serves as the medium for us to hear the sounds produced. Like air, any liquid or solid are also medium for sound to travel. Sound travels from the source of the sound producer to the listener by the help of a medium. This make us hear sound when we are under water or while we sit in some other room. Closer the particles in the medium, faster the sound can travel. So, speed of sound is the most in the solids and least in the gases.

### Activity



**Aim:** To observe sound travels faster through solids than liquids or gases.

**Materials required:** A table, a small tub and some water

**Procedure:**

- Place your ear on one end of the table and ask a friend to tap on the other end of the table.
- Hear the sound of the tap.
- Lift your head and ask you friend to tap the table with same energy.
- Is the sound heard by you same in both the cases?
- Take a small tub and fill it with water.
- Ask you friend to gently splash the water in the tub. Before that take your ears close to the water tub and hear the sound of splash.
- Now, lift your head and ask your friend to repeat the same.
- Is the sound heard by you same in both the cases?

**Conclusion:** The sound heard by keeping one ear on the table was the loudest than the sound of splash heard in the water and the sound heard in the air was the least in volume.

### Do you know?

Above the Earth's atmosphere there is no air or other medium. So, there is no medium for sound to travel. The outer dark space is thus the most silent place.

## Activity



**Aim:** To observe that sound travels in a medium.

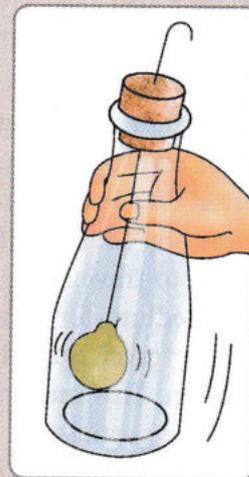
**Materials required:** A small bell, a wire, a bottle with a cork, shreds of paper and a matchstick

### Procedure:

- Take a wire through the cork of the bottle and attach the small bell to the wire.
- Take the bottle and put some paper shreds inside it. Light a match and apply it to the paper shreds. Quickly cover the bottle with the cork that has the bell attached to it. The burning paper will use up the air and create a partial vacuum.
- Let the bottle cool and shake it.
- Reseal the bottle again letting some air get in the bottle this time.

**Observation:** You will observe that after you have removed most of the air, you are not able to hear the bell inside the bottle. Though you can see the bell moving. However, when you let in the air, you can hear the bell.

**Conclusion:** If sound is to travel from a vibrating object to your ear, there must be some substance or medium to carry it. Sound cannot travel in vacuum. As we have seen in the previous activity air is normally the medium that carries the sound however it is not the most effective medium.



## Check Point



State True or False.

1. Sound is a form of \_\_\_\_\_.
2. Sound requires a \_\_\_\_\_ to travel.
3. The organ that produces sound in our body is called \_\_\_\_\_.
4. Air is the \_\_\_\_\_ effective medium of travel for sound.

## SPEED OF SOUND

From the above activity we have noticed that the speed of sound is different in different states of matter. Closer the particles in the object, faster is the speed of sound. So, speed of sound is most in the solid, comparatively less in the liquids and least in the gases. The speed of sound varies with materials. Such as,

Through steel—5180 m/s

Through water—1498 m/s

Through air—340 m/s

The speed of sound also varies with temperature. The speed of sound at room temperature is 346 m/s and at freezing temperature or  $0^{\circ}\text{C}$  it is 331 m/s. That is at higher temperatures the speed of sound is higher as the molecules have more energy and can thus vibrate faster.

### Do you know?

Anything that travels faster than the speed of sound is called **supersonic speed**.

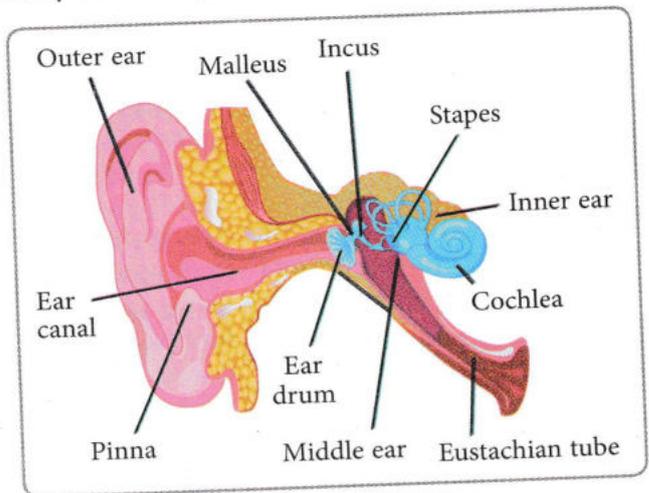
## THE SOUND WE HEAR

As we now know, we hear sound when the vibrating air particles travel from the source of sound and reach our ears. Human ear is divided into three main parts—outer, middle and inner ear. Each part plays a significant role in the hearing of sound. Let us study the each part in detail.

1. **Outer ear:** The outer ear consists of a flap-like cartilaginous structure present on both side of the ear called pinna, ear canal and ends at ear drum. It is the part of the ear that receives the vibrations and transmits the vibrations to the ear canal. The vibration passes from the ear canal to the stretched membrane of the ear, i.e., ear drum. From this position, the sound travels to the middle ear.

2. **Middle ear:** The middle ear has three tiny bones, malleus, incus and stapes. These three bones are placed in a way to make contact between the ear drum and the inner ear. Hence, with the help of these bones the vibration is passed on to the inner ear.

3. **Inner ear:** The inner ear has a coiled tube called cochlea. This tube is filled with liquid and has tiny hair. The fluid and the hair receives the vibration from the middle ear and send a signal to the brain through a special nerve called auditory nerve. The message transmitted by the auditory nerves enable us to hear sound.



*Internal structure of ear*

### Activity

**Aim:** To construct a model ear drum and observe how it works.

**Materials required:** A paper cup, a balloon, some rice grains and a rubber band

**Procedure:**

- Take an empty paper cup.
- Close its mouth by stretching the balloon over the open end of the cup.
- Fix the balloon on the empty paper cup using a rubber band.
- Place some rice on the stretched balloon.
- Gently tap the bottom of the cup.
- Observe the rice grains on the stretched balloon.

**Conclusion:** The rice grain move. This happened as the sound generated at the bottom of the cup travelled to the mouth of the cup. Here, the stretched balloon represents the ear drum and movement of rice grains represents the movement of sound inside our ears.

## SOUND WAVES

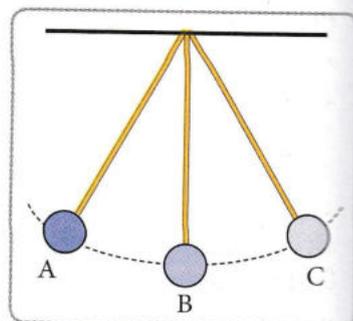
The striking of a body with some force creates vibrations. These vibrations create vibrations in the air particles that are closer to the body. This energy gets transferred from the vibrating body to the surrounding air particles and further. We cannot see this movement with our eyes. This type of movement is known as sound waves.

Sound travels in the form of waves. Sound waves travel from one place to another to reach our ears. The sound waves show some basic features. All the sound waves have frequency, amplitude and takes some time period to travel. Each of these features determines the pitch, loudness and quality of the sound. All these characteristics can easily understood by the motion of a simple pendulum.

## Simple Pendulum

A simple pendulum is made up of a bob, usually a small metal ball; a long thread to tie the bob and a rigid surface to swing the bob. The bob is hung to the rigid surface in order to give it free surface to move back and forth.

If you give a gentle push to the bob, it performs a slow to-and-fro motion. One complete to-and-fro motion is called an oscillation. The movement of a pendulum from point B to A to B to C to B is considered one oscillation. Let us study in detail some other keywords associated with a simple pendulum.



1. **Frequency:** The number of oscillations a pendulum completes in one second is called **frequency**. The S.I. unit of frequency is Hertz (Hz). If a pendulum takes 10 complete oscillations in a second, its frequency is 10 Hz.
2. **Amplitude:** In the above figure, position B is the mean position and point A and C are the extreme positions of the pendulum. The pendulum moves from its mean position to the extreme positions. The maximum displacement by which the bob moves either sides of its mean position is called **amplitude** of the oscillation. In the above figure, displacement BA and BC is its amplitude. The S.I. unit of amplitude is meter (m).
3. **Time Period:** The time taken for one complete oscillation is called the **time period**. Time period and frequency are related to each other. Higher the frequency, less the time it takes to complete one oscillation. The S.I. unit of time period is second (s).

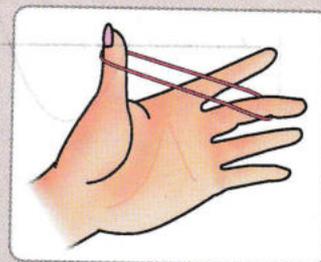
## Activity

**Aim:** To investigate the frequency of sound.

**Materials required:** A few rubber bands

**Procedure:**

- Take a rubber band and wear it around two fingers as shown.
- Strike it slowly. It will produce some sound.
- Observe the vibrations.
- Stretch the rubber band wider across your fingers.
- Strike it again. It will again produce some sound.
- Observe the vibrations.



**Conclusion:** In both the cases rubber band vibrates and produces a sound. In first case the vibration was slower as compared to the second case. The sound produced in the first case was also slower than that of the second case. Here, the vibration represents the frequency. More the frequency, higher the sound.

## Activity



**Aim:** To investigate the amplitude of a sound.

**Materials required:** A few rubber bands

**Procedure:**

- Wrap the rubber band across your two fingers as in the previous activity.
- Stretch the rubber band softly.
- Observe the sound produced.
- Stretch the rubber band hard and wider.
- Observe the sound produced.

**Conclusion:** When we stretch the rubber band softly the sound produced was less. This is because soft stretch has created less amplitude than that of hard stretched rubber band.

## CHARACTERISTICS OF SOUND

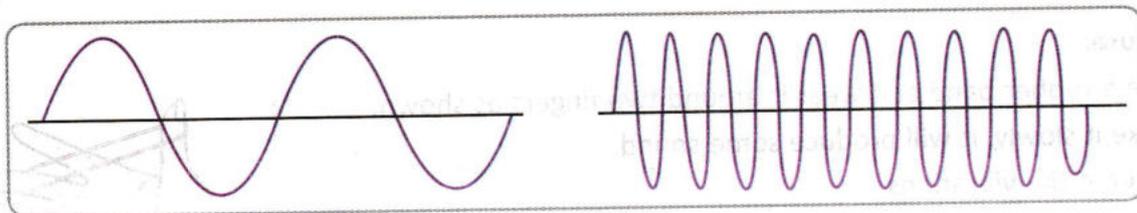
Without looking in the sky we can identify the sound is of a thunder, or without looking at the dog we can identify the sound of a bark. This is because different objects produce different kinds of sounds. The three main factors that affect the sound are pitch, loudness and quality.

### Do you know?

A German scientist Heinrich Hertz is also called the father of frequency. The S.I. unit of frequency is named after his name, Hertz.

### Pitch

Pitch is determined by the frequency of the sound waves. Pitch of the sound refers to how shrill and bass the sound is. The frequency of the sound waves determines the pitch of the sound. When a sound wave is produced, the particles in the medium vibrate. We can also say the particles in the medium oscillate. The number of oscillations they take in a second is called its frequency. If the frequency of the vibration is higher, the sound will have a higher pitch. Shrill sound is created by higher frequency. On the other hand, if the frequency of the vibration is low, the sound will have a low pitch. This will create flat or grave sound.



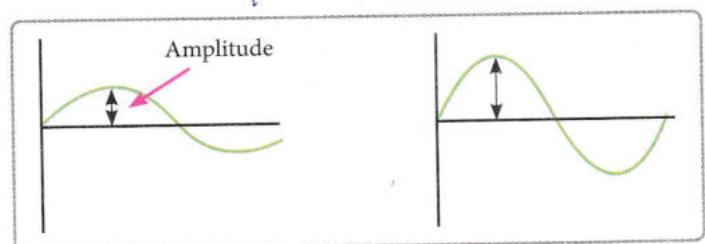
Low frequency

High frequency

### Loudness

The amplitude of the sound waves decides the sound of the body. The loudness of the sound depends on the amplitude of the vibration that produces it. The greater the amplitude of the sound wave, louder the sound is. The S.I. unit of amplitude is decibels (dB).

The roar of a lion has a low pitch but higher amplitude. This makes its voice louder and thus



Quieter

Louder

it can be heard from a good distance. However, the sound produced by a sparrow has high pitch but low amplitude. This is why their voice cannot be heard from far away.

Similarly, when we whisper we produce low amplitude sound and when we shout we produce high amplitude sound.

The loudness of the sound is directly proportional to the square of the amplitude of the sound produced. This means when the amplitude becomes four times, the loudness increases by 16 times.

## Quality

The source of the sound determines the quality of the sound. Two sources of sound that may have the same frequency and amplitude may have different sounds. This characteristic of sound enables us to differentiate between two sounds that have relatively same characteristics. The quality of sound is also called its tone. Some devices produce sound of the same frequency whereas some can produce sound with multiple frequencies such as a tuning fork produces a sound of a single frequency whereas string instruments like guitar and violin produces sound with multiple frequencies.

### Activity



**Aim:** To identify and classify soft and loud, low and high pitch sounds produced by given objects.

Material producing sound	Low pitch	High pitch	Soft sound	Loud sound
Tabla and violin				
Whistle and flute				
Buzz of a Bee and Roar of a Lion				

### Check Point



Fill in the blanks.

- Human ear is divided into three parts, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
- The nerve that passes sound waves to the brain is called \_\_\_\_\_ nerve.
- The S.I. unit for amplitude of sound is \_\_\_\_\_.
- The S.I. unit for frequency of sound is \_\_\_\_\_.
- The depthness and shrillness of sound is determined by \_\_\_\_\_.

## MUSICAL SOUND

As we know, the vibration of the particles creates sound. When the vibrations occur at regular time intervals the produced sound is called musical sound. When the vibrations do not occur at regular intervals the produced sound is called noise. Nobody likes to hear noise but everybody enjoys music. As we have learned in the earlier section that tuning fork produces sound with a single frequency whereas violin produces sound with multiple frequencies. The sound produced by the tuning fork is very flat which makes it boring. On the other hand, the sound produced by a violin is rich. It has harmony, which makes it interesting. The harmonious sound created by the violin is not just due to its strings but due to the entire instrument. We hear the sound produced by the cumulative vibrations of the entire instrument.

## Musical Instruments

There are various musical instruments. Some or the other part of the instrument causes vibrations that gives a unique sound to the instrument. Based on the parts that are responsible for the production of sound, all the musical instruments are divided into the following groups:

### String instrument

Guitar, violin, sitar, *ektara*, *sarangi* and *chikara* are a few string instruments. String instruments produce sound through vibrating strings. These strings pass the vibrations to the air. As the strings are stretched onto a hollow box or body of the instrument the vibrations pass through the whole body of the instrument. This produces the harmonic sound that we hear. The length of the string also plays a significant role in these instruments. The smaller the length of a string, the more sound the instrument produces.



String instruments



Percussion instruments

### Percussion Instruments

Drum, tabla and *dholak* are some of the commonly used percussion instruments. All these instruments have a taut membrane. The taut membrane is tightly stretched across the mouth of the hollow body of the instrument. When the taut membrane is stroked, it vibrates and creates vibrations in the hollow part of the body as well. The vibration of the entire instrument produces the unique sound that we hear in these types of instruments.

### Wind Instrument

Flute, *Shehnai* and saxophone are a few wind instruments. They have a special tubular structure. When air is blown in the tubular structure, the body of the instrument vibrates. This vibration creates sound. Some of the wind instruments have holes on them. Different sound can be produced by covering different holes at the same or different times. This action controls the intake of air that subsequently changes the pitch of the sound.



Wind instruments

## Activity

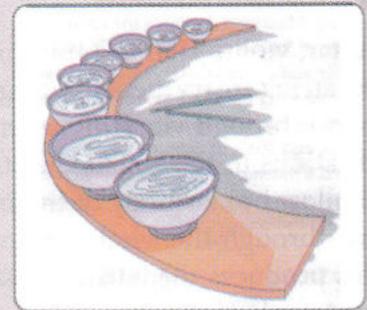


**Aim:** To make a *jal tarang*.

**Materials required:** Eight bowls of different sizes ranging from small to large, some water and a wooden stick.

### Procedure:

- Arrange all the bowls in a semi-circle from smaller to the bigger. (Number of bowls is not restricted)
- Fill all the bowls with water. Fill less water in the first bowl and increase the amount till last bowl.
- Using stick, tap the mouth part of the bowls in a series to reach the last bowl from the first.
- Change the sequence or change the amount of water in the bowl.
- Observe the change.

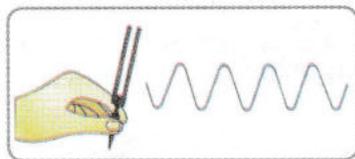


**Conclusion:** The vibration produced in the bowls by striking the stick on them produces sound. The amount of liquid present in the bowls changes the sound produced by them.

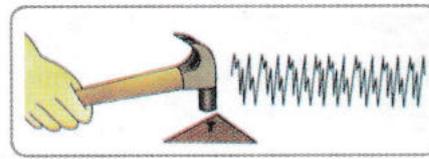
## NOISE

Have you ever wondered why the sound of a piano makes you relax whereas the honking of vehicles takes your peace away? Both are sources of sound than what is it in the sound of playing a piano that makes it soothing while excess honking makes us irritable?

Any loud sound that produces irregular vibrations produces noise. Noise is unpleasant to ears as it produces irregular vibrations. A pleasant sound has a regular wave pattern in contrast to noise that has an irregular wave pattern.



Pure sound



Noise

## Noise Pollution

Noise that creates any sort of discomfort or disturbance to human or animal life is called noise pollution. It is a recognized form of pollution which is very hard to measure. As the discomfort caused by the noise is subjective to individuals. Some have a good tolerance against noise pollution and some have weak tolerance. Usually sound above 90 dB causes noise pollution. Any sound above 120 dB becomes painful for the ear and above 150 dB can cause serious stress and damage to the ears. Sound produced by drill machines, aircrafts, rocket engines and honking of vehicles are some of the examples of noise.

### Harmful Effects of Noise Pollution

Some of the harmful effects of noise pollution are:

- It can lead to certain health issues such as severe headache, nerve irritation, heart problems and high blood pressure.

### Do you know?

The people with total hearing impairment communicate through sign language.

- Loud music during the day disturbs children in their studies and at night it disturbs sleep.
- It can also cause lack of concentration during work or studies.
- A person exposed to noise pollution for a long time may get temporary or permanent hearing problems and can also become deaf.

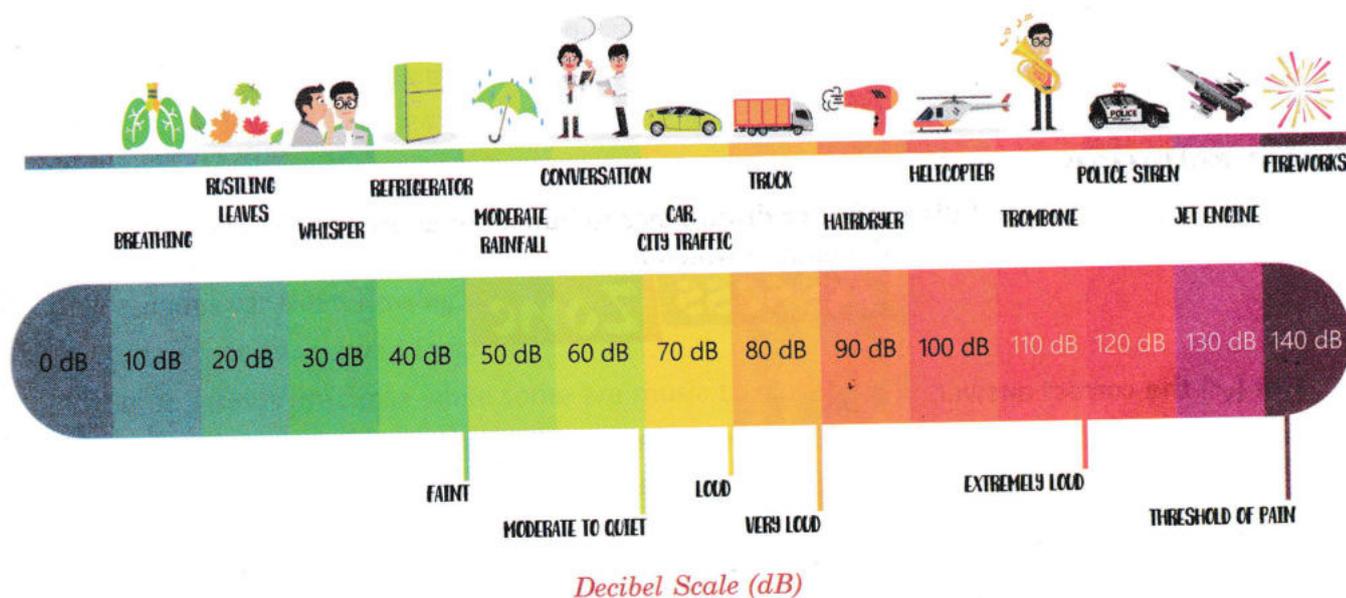
## Ways to Control Noise Pollution

Some of the ways to control noise pollution are:

- Never play television and other audio devices on volume that may be too loud.
- Never honk unless required
- Replace harsh horns with soft horns and put silencer on the vehicles to reduce the noise produced by them.
- Huge factories and industries should be established away from cities and other populated regions.
- Minimize the use of honks in and around silence zones, i.e., hospitals and schools.

## AUDIBLE AND INAUDIBLE SOUND

Everything in our near vicinity is vibrating at a certain level. Some are vibrating with high frequency whereas some are vibrating with even higher frequency. All these vibrations cause sound. However our human ear cannot hear all types of sounds. The sound produced by a vibrating frequency lower than that of 20 Hz or above than that of 20,000 Hz is inaudible to humans. However, some animals can hear sound from in this range. Human ears are capable of hearing any sound between 20 Hz to 20,000 Hz. This range is called the **audible range**. The low frequency sound that humans are not capable of hearing, i.e., below 20 Hz is called **infrasonic**. The inability to hear infrasonic sound help us avoid the sound created by our own body for various life functions. Some natural events such as earthquakes, volcanoes and meteor lightning also produce infrasonic sounds. The high frequency sound that humans are not capable of hearing, i.e., above 20,000 Hz is called **ultrasonic sound**. Some animals like dogs and bats can hear sound at ultrasonic range. We use the application of ultrasonic sound in various ways. A medical investigation of internal body parts or a developing fetus is also done with the help of ultrasonic sound.



## Key Terms



- **Amplitude:** The maximum displacement of a vibrating object on either side of the mean position.
- **Frequency:** The number of vibrations made in one second.
- **Time period:** The time taken to complete one vibration
- **Larynx:** The voice box in human beings
- **Noise:** The harsh and unpleasant sound produced by irregular vibrations
- **Music:** The pleasant sound produced by regular vibrations
- **Pitch:** The characteristic of sound that determines the shrillness or depthness of a sound.

## Recall



- Sound is a form of energy that is produced by the vibration of a body or an object.
- Sound requires a medium to travel. Its speed is the highest in the solids, medium in the liquids and lowest in the gases.
- Sound cannot travel through vacuum.
- The three basic elements of a sound are frequency, amplitude and time period.
- The three basic characteristics of sound are pitch, loudness and quality.
- Pitch depends on the frequency of vibrations.
- Loudness depends on the amplitude of vibration.
- Quality depends on the source of the sound.
- Humans have vocal cords in their voice box to produce sound.
- Human ears have three distinctive parts that travel the vibration from outside to the auditory nerves. These nerves give message to the brain to get information.
- The regular vibrations caused by the body produce music.
- The irregular vibrations caused by the body produce noise.
- Humans can hear sound from 20 Hz to 20,000 Hz. It is called the audible range.
- Any sound below 20 Hz is inaudible to humans and is called infrasonic.
- Any sound above 20,000 Hz is also inaudible to humans and is called ultrasonic.

## Assess Zone

### A. Tick (✓) the correct answer.

1. The speed of sound is the highest in which of the following?  
a. Water                      b. Air                      c. Steel                      d. Vacuum
2. The hearing range of human is  
a. less than 20 Hz                      b. more than 20,000 Hz  
c. less than 20 Hz and more than 20,000 Hz                      d. between 20 Hz and 20,000 Hz

3. Sound is a kind of
  - a. power
  - b. work
  - c. energy
  - d. force
4. This part of the ear passes the vibrations to the auditory nerves.
  - a. Outer ear
  - b. Inner ear
  - c. Middle ear
  - d. None of these
5. The speed of sound depends on
  - a. state of the medium
  - b. frequency of the sound
  - c. amplitude of the sound
  - d. quality of the sound
6. The sound below 20 Hz is called
  - a. ultrasonic
  - b. audible sound
  - c. infrasonic
  - d. none of these
7. When an object vibrates with low frequency, the sound produced is
  - a. shrill
  - b. loud
  - c. flat
  - d. there is no relation between sound and frequency
8. The sound waves do not travel through
  - a. vacuum
  - b. ice
  - c. water
  - d. steam
9. Above which value a sound become noise?
  - a. 60dB
  - b. 90dB
  - c. 50 dB
  - d. 150 dB
10. Ultrasonic devices work on which of the following frequency?
  - a. Less than 20 Hz
  - b. More than 20 Hz to 20,000 Hz
  - c. More than 20 Hz to less than 20,000 Hz
  - d. More than 20,000 Hz

**B. Fill in the blanks.**

1. \_\_\_\_\_ is the unit of loudness.
2. Sound travels from one place to another with the help of \_\_\_\_\_.
3. The unpleasant and discomfort sound is called \_\_\_\_\_.
4. \_\_\_\_\_ vibrations make the sound musical.
5. When we decrease the length of the string instrument, its pitch \_\_\_\_\_.
6. The speed of sound is \_\_\_\_\_ in solid medium.
7. \_\_\_\_\_ is the S.I. unit of frequency.

**C. Give reasons for the following.**

1. We cannot hear sound in space.
2. Some sounds are noise while some are music to our ears.
3. Air is not an effective medium for the sound to travel.
4. Different kinds of instruments produce different sounds.
5. Our inability to hear infra and ultrasonic sounds is good for us.

**D. State the difference.**

1. Music and noise
2. Audible and inaudible sound
3. Infrasonic and ultrasonic
4. Frequency and amplitude
5. Pitch and loudness
6. Stringed instrument and wind instrument

**E. Answer the following questions in one word or a single sentence**

1. Name the instrument used in the laboratory to produce sound of a fixed frequency.
2. How is sound produced?
3. What is the use of a hollow box in string instrument?
4. Why sound needs a medium to travel?
5. What do you mean by noise pollution?
6. What is noise?
7. How pitch can be altered in wind instruments like flute?
8. Name the three bones present in human ear.

**F. Answer the following questions in brief.**

1. How is the loudness of sound related to its amplitude?
2. How are frequency and time period related?
3. Why is the voice in females generally shriller than that of males?
4. How is the roar of a lion audible over long distances?
5. How do vocal cords produce sound?
6. How do we hear the sound of a vibrating object that is at a distance?
7. What is the voice box?
8. List three harmful effects of noise pollution.
9. State four ways to control noise pollution.
10. Explain string instruments.
11. Describe the making of a *jal tarang*.

**G. Answer the following questions in detail.**

1. Explain the structure and functioning of human ear.
2. How human produces sound?
3. What are the three characteristics of sound? Explain.
4. What are the three basic features of sound? Explain.
5. Explain how different musical instrument works?

## Out of The Box

1. How is shrillness affected by the frequency?
2. If some explosion occurs in the outer space will be able to hear it on the earth? Justify the response.

## Subject Enrichment

### Activity Zone

Using a tape, a sheet of paper and a pair of scissors make your own megaphone. What do you observe when you speak with the paper megaphone. What happens when you place the paper megaphone on your ear?

### Project Zone

1. Using different materials make a simple and easy musical instrument. Produce a variety of sound through it.
2. Create a chart or a model to show the inner anatomy of the human ear. Display it in your classroom.

## In Real Life

It has been recently studied that music affects the growth of plants. How can you nurture and increase the plant growth for some of the plants around you?

## Crosslinks

How do naval forces use sound to navigate underwater?

## Web-links

- Sound travelling in different media: <https://www.youtube.com/watch?v=q9ezMbDpIHl>

### Teacher's Note

Students could be encouraged to produce sound by vibrating or striking different kinds of objects and notice the quality of sound on the basis of loudness and pitch.

The relation between thin strings of a violin and a guitar and the higher pitch produced on playing them could be explained.

# Worksheet 4

(Unit 4 – Moving things, people and ideas)

## Demonstrating Air Friction

Let us perform a very simple activity to understand this concept.

### Materials:

- Two pieces of paper
- Timer

Air friction (or air resistance or drag) is a type of fluid friction. This is a very easy way to show friction in action. The shape of the paper will determine how much friction is caused as it falls.

1. Crumple one of the pieces of paper into a ball. Leave the other piece of paper as is. Ask your friend to be ready with a timer to measure the time.
2. Hold both the pieces of paper above your head.
3. Drop the pieces at the same time.

The paper ball will fall to the ground immediately. The flat piece of paper will flutter down more slowly because it has more surface area to create friction or drag on the air as it drops. You can also try dropping the pieces of papers from a higher spot, like while standing on a table or over a balcony.

Does the time difference become more noticeable this way?

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Try other shapes of paper. What differences do those make?

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How can you make them to drop faster?

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How can you make them to drop slower?

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## Unit Test Paper 4 (Unit 4 – Moving Things, People and Ideas)

### A. Tick (✓) the correct answer.

- Which of the following is known as the strength of an applied force?  
a. Push                      b. Pull                      c. Magnitude              d. Speed
- Which of the following is inversely proportional to area?  
a. Pressure                  b. Mass                      c. Force                      d. Distance
- Which of the following is a form of energy produced by vibrations of a body?  
a. Friction                  b. Force                      c. Sound                      d. Pressure
- Which of the following is a non-contact force?  
a. Muscular                  b. Friction                      c. Gravitational              d. None of these
- The force of attraction exerted by the Earth on objects present on the earth towards its centre is called?  
a. Friction                  b. Gravity                      c. Magnet                      d. Pressure

### B. Are the following statements true or false? Correct the false statements.

- Sound cannot travel through vacuum
- Loudness does not depend on the amplitude of vibration.
- Fluid friction can be reduced by streamlining an object.
- Weather forecast depends on pressure variations.
- On heating, gases produce lesser pressure.

### C. Give one word or one example for the following.

- The Force that comes into play even from a distance, that is without physical contact
- Friction that acts when an object slides on a surface.
- An instrument to measure pressure
- A voice box in humans
- Low frequency sounds that humans are incapable of hearing without the help of machines.

### D. Answer the following questions.

- What are the various types of forces? Explain with examples.
- What is friction? What are the various methods applied to reduce friction?
- Explain with the help of a diagram how gases exert pressure.
- What are the various applications of atmospheric pressure?
- What are the various methods to control noise pollution?

## 14

Chemical Effects  
of Current

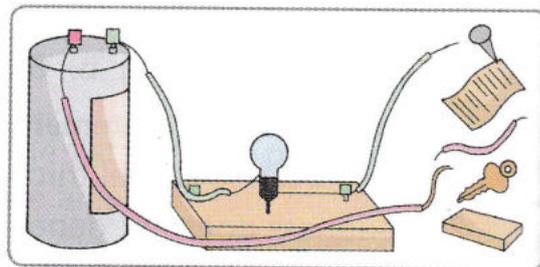
## Chapter Focus

- Electrical Conductivity in Liquids
- Electrolysis
- Applications of Chemical Effects of Current

## Kick-off Activity

## Making your own tester

Connect a dry cell to a flashlight bulb and socket, leaving two bare ends of copper wire, as shown in the illustration. Briefly touch these ends together to make sure



that the bulb lights. You now have a tester with which you can use to find out whether certain materials allow electricity to flow.

Collect a few items in your house which are solids such as a clip, a fork, a coin, a piece of cloth, wood, glass, rubber band, leather heel and chalk and test them for conduction of electricity using this tester you have just made. Then select a few solutions such as salted water, lemon juice and vinegar and similarly test them for conduction of electricity. What do you observe and conclude in each case? Make a table in your notebook and note down your recordings for each item.

We are dependent on many electrical gadgets such as refrigerators, fans, air conditioners, electric bulbs and geysers for our daily needs. All these gadgets use electricity to run. Electricity is basically electrical energy and is the most efficient form of energy.

In the previous classes we learnt about some solid materials through which electricity can pass and they are known as conductors and some other materials through which electricity cannot pass known as insulators. So let us learn about some more materials such as liquids and see whether they conduct electricity or not.

**ELECTRICAL CONDUCTIVITY IN LIQUIDS**

As we learnt in the previous class not all solids conduct electricity, similarly there are only a few liquids that let electric current pass

through them. For example, pure water does not conduct electricity but tap water, pond water or well water conduct electricity because of the presence of small impurities. Let us perform a few activities to see what liquids conduct electricity and which do not.

### Activity

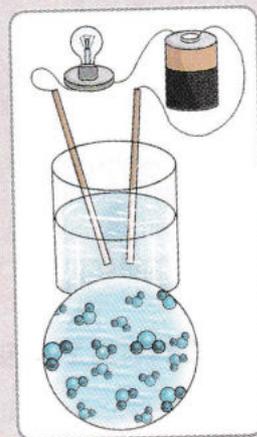
**Aim:** To show that distilled water does not conduct electric current.

**Material required:** A container, a battery, one-LED, connecting wires and distilled water

**Procedure:** Connect one end of the battery to the LED bulb and dip the other end in the distilled water as shown in the image.

**Observations:** The bulb does not glow.

**Conclusion:** The distilled water does not allow the current to pass. That is, the circuit of the LED and the battery is incomplete and hence the LED does not glow. Since pure or distilled water does not contain any impurities the electricity does not get any medium to pass through.



### Activity

**Aim:** To show that lemon juice and water containing salt conduct electricity

**Material required:** Two beakers, a battery, some water containing common salt, lemon juice, copper connecting wires, an LED bulb

**Procedure:** Pour water containing salt in one beaker and lemon juice in the other beaker. Now connect one end of the battery to the LED and dip the other end in the water containing salt. Connect another wire to the other end of LED and dip its free end in the lemon juice. What do you observe?

**Observations:** The LED glows in each case.

**Conclusion:** This activity shows that lemon juice and water with common salt dissolved in it are good conductors of electricity.

Thus, from the above activities we find that pure water does not conduct electricity, but water with salt dissolved in it and lemon juice conduct electricity.

The liquids which conduct electricity are known as **electrolytes**.

Similarly, if we perform the same test for an acid like hydrochloric acid the result will be the same, that is, conduction of electricity with the bulb glowing brightly. In fact, you will notice that the bulb glows dim with saline water and lemon juice but glows bright with hydrochloric acid solution. This tells us that hydrochloric acid solution is a very good conductor of electricity while water with salts dissolved in it and lemon juice are weak conductors of electricity. Also, we can simply say hydrochloric acid is a strong electrolyte while saline water and lemon juice are weak electrolytes.

In order to test conduction of electricity through weak conducting liquids like saline water and lemon juice you can use LEDs instead of normal bulbs as LEDs can glow even in weak current. LED is a light emitting diode which can be used in place of a torch bulb to detect weak currents.

Let us list down a few differences between a solid conductor and an electrolyte.

Solid Conductors	Liquid Conductors or Electrolytes
The charge carriers are free electrons	The charge carriers are positive and negative ions
No chemical change takes place on passing current through solids	Chemical change takes place on passing current through liquids

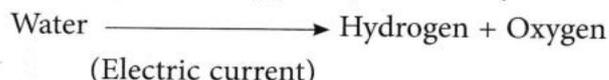
### Do you know?

Rain water is the purest form of water. However, while falling through the atmosphere the acidic gases present in the atmosphere such as carbon dioxide, sulphur dioxide and nitric oxide dissolve in the rain water to form carbonic acids, sulphuric acid and nitric acid, respectively. This makes the rain water a good conductor of electricity.

## ELECTROLYSIS

When electric current is passed through a conducting solution, some chemical reaction takes place. These chemical reactions which are a result of passing electric current through an electrolyte are known as chemical effects of current.

Let us pick the simplest example. The chemical effect of electric current on passing through water produces hydrogen and oxygen represented by the chemical equation as:



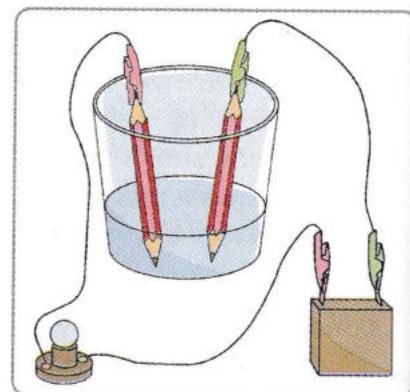
As we can see in the above reaction, the original compound water changes into elements hydrogen and oxygen which have properties different from water. Thus, it is a chemical reaction. The above chemical reaction is in fact a decomposition reaction due to chemical effects, so it is chemical decomposition.

More precisely we define the process of electrolysis it as:

The chemical decomposition of a compound on passing electric current through an electrolyte is called **electrolysis**. The result of electrolysis of water is the production of hydrogen and oxygen.

If electric current is passed through a metal salt solution, then the metal gets deposited at the positive electrode dipped in the electrolyte. For example, when electric current is passed through a solution of copper chloride then copper gets deposited on the positive electrode.

Another chemical effect of current can be a change of color. Thus, from the above discussion we conclude that passage of current through a liquid conductor produces chemical effects. Chemical decomposition and change of color are a few observable chemical effects brought about by passing current through an electrolyte.



## APPLICATIONS OF CHEMICAL EFFECTS OF CURRENT

Electrolysis or chemical effects of electric current have a large number of applications in our real life. Following are a few applications of electrolysis in the industry:

- Electroplating
- Electrorefining of metals
- Extraction of metals from their ores
- Decomposing chemical compounds

## Electroplating

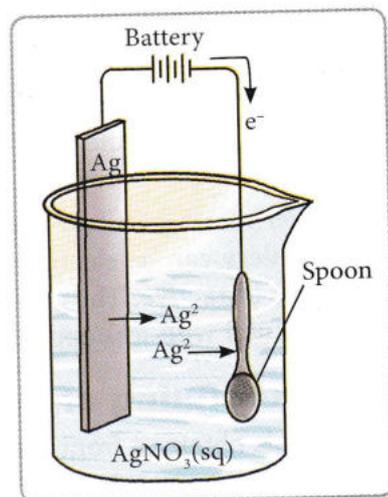
Electroplating is the process of coating a cheaper metal with a more expensive or desired metal using the process of electrolysis.

During electroplating, the object to be coated is made the negative electrode and dipped in the electrolyte and the desired metal which has to be coated on the top of the object is made the positive electrode or the anode. The electrolyte is a metal salt solution selected such that the salt is of the metal to be coated on the object.

For example, if a steel spoon has to be plated with silver metal, then the electrolyte used is that of silver nitrate. The steel spoon is made as cathode (-) and the silver metal strip is made as anode (+).

Now, when electric current is passed through the electrolyte silver nitrate, the silver from anode dissolves in the salt solution and deposits over the cathode that is the steel spoon to be electroplated. Thus, the coating of the desired metal silver is obtained over another metal, in this case a steel spoon.

The following activity will help you understand the process of electroplating even better.



### Activity

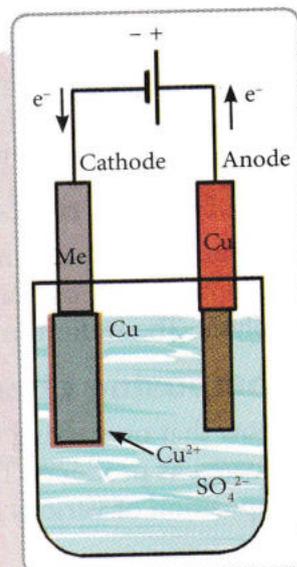
**Aim:** To make a coating of copper on an iron rod through electrolysis

**Material required:** A battery, a beaker, a copper rod, an iron rod, connecting copper wires, dilute sulphuric acid and copper sulphate solution.

**Procedure:** Pour the copper sulphate solution containing a few drops of dilute sulphuric acid. Connect the iron rod to the negative terminal of the battery so it acts as cathode. Connect the copper rod to the positive terminal of the battery so that it acts as anode. Dip both the rods in the copper sulphate electrolyte. Now, let the current pass through the electrolyte for some time.

**Observations:** A thin layer of copper deposits on the iron rod.

**Conclusions:** The iron rod has been electroplated with copper metal.



The most widely used metals for coating the metal articles are gold, silver, copper, tin and nickel.

### Do you know?

Graphite can also be electroplated with copper. If in place of iron rod, a carbon (graphite) rod is made cathode, then copper metal will deposit over the carbon rod. It is because carbon rod is a good conductor of electricity though it is a nonmetal. Even some special plastics have been developed which conduct electricity and hence can be electroplated with metals.

Some of the most important applications of electroplating are:

1. Iron and steel articles are coated with chromium metal.

Generally some machine parts, parts of a motor cycle, taps, rims of the wheel, etc. are originally made of iron and steel but coated with chromium



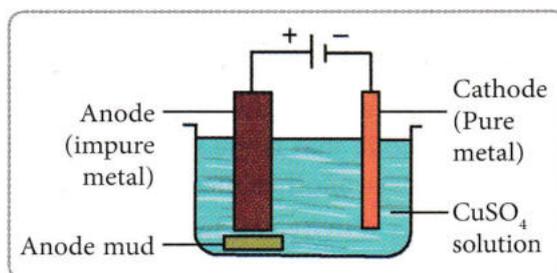
using electroplating. The electroplating of iron and steel objects with chromium protects them from rusting and corrosion and also makes them look shinier and attractive.

2. The process of coating iron and steel objects with zinc, for a protective covering is called galvanisation. Automobiles and water pipes are galvanised to protect them from rusting. Galvanisation is another application of electroplating.
3. Silver metal jewellery can be electroplated with gold metal and other metal jewellery can be electroplated with silver metal to make the appearance more attractive. Thus, an attractive gold and silver plated jewellery can be obtained with less expensive metals using the process of electroplating.



## Electrorefining of metals

The metals obtained from their ores are generally impure. These impure metals have to be refined. One of the processes involved in refining of metals is electrolysis. In this process of refining a metal, the impure metal is made as thick anode and a thin strip of pure metal is made as cathode. The metal salt of the metal to be refined is taken as electrolyte.



When current is passed through the solution, the impure metal from the anode dissolves in the electrolyte and the dissolved metal from the electrolyte deposits on the cathode in the pure form. Thus, with time the thickness of anode goes on decreasing and that of cathode goes on increasing. More often copper, aluminium and zinc are refined using the process of electrolysis.

## Extraction of metals

Certain metals like sodium, aluminium and magnesium are extracted from their ores using the chemical effects of current. For example, sodium is extracted from the molten sodium chloride by the process of electrolysis. The sodium metal ions being positively charged deposits over the negative cathode.

## Decomposing chemical compounds

We know that on passing electric current through water, water decomposes to give hydrogen and oxygen as products. Thus, the chemical effects of electric current can be used for chemical decomposition of various compounds.

### Check Point



Fill in the blanks.

1. Graphite is a non-metal but a \_\_\_\_\_ conductor of electricity.
2. \_\_\_\_\_ can detect even a small current.
3. Distilled water \_\_\_\_\_ electricity.
4. \_\_\_\_\_ are the liquids which allow the electricity to pass through them.
5. Pure copper metal can be obtained from impure copper through the process of \_\_\_\_\_.
6. The positive terminal of the battery is called \_\_\_\_\_.
7. \_\_\_\_\_ is used to coat metal jewellery with silver metal.
8. The parts of machines are generally coated with \_\_\_\_\_.

## Key Terms



- **Electrolysis:** Decomposition of an electrolyte on the passage of current through it.
- **Anode:** The positively charged electrode
- **Cathode:** The negatively charged electrode
- **Electrolyte:** The liquid through which electricity can pass
- **LED:** Light emitting diode that can detect weak currents
- **Galvanisation:** The process of coating iron with zinc to protect the rusting of iron.

## Recall



- Pure water does not conduct electricity but tap water and water with salt in it conduct electricity.
- The liquids which conduct electricity are known as electrolytes.
- When electric current is passed through a conducting solution, some chemical reaction takes place. These chemical reaction which are a result of passing electric current through an electrolyte are known as chemical effects of current.
- Electroplating is the process of coating a cheaper metal with a more expensive or a desired metal using the process of electrolysis.
- Electroplating is used for making objects attractive and anticorrosive.

## Assess Zone

### A. Tick (✓) the correct answer.

- Which of the following is not an electrolyte?
  - Solution of common salt in water
  - Solution of lemon juice
  - Sugar solution
  - None of these
- Electroplating is an application of
  - chemical effects of current
  - heating effects of current
  - electromagnetic effects of current
  - mechanical effects of current.
- Which of the following conducts electricity?
  - Tap water
  - Sea water
  - Rain water
  - All of these
- Charged ions are the current carriers in:
  - copper wire
  - aluminum wire
  - copper sulphate solution
  - sugar solution
- During electroplating the metal which forms coating is made
  - cathode
  - anode
  - electrolyte
  - cannot be predicted
- Electrolysis of water produces hydrogen and oxygen as result of
  - chemical combination
  - neutralisation
  - chemical decomposition
  - redox reaction

7. Which of the following is an application of electrolysis?
  - a. Electroplating
  - b. Purification of metals
  - c. Extraction of metals
  - d. All of these
8. Metal used for galvanisation of iron and steel to protect from rusting of objects
  - a. tin
  - b. chromium
  - c. zinc
  - d. titanium
9. Which of the following is a weak electrolyte?
  - a. Lemon juice
  - b. Copper sulphate
  - c. Sulphuric acid
  - d. None of these
10. For an iron key to be plated with copper the electrolyte used should be
  - a. nitric acid solution
  - b. copper sulphate solution
  - c. iron sulphate solution
  - d. sulphuric acid solution

**B. Fill in the blanks.**

1. Acids, bases and salts \_\_\_\_\_ electricity.
2. When an electric current is passed through an electrolyte, it produces \_\_\_\_\_ effects.
3. Pure water or distilled water is a \_\_\_\_\_ conductor.
4. Purification of metals can be done by \_\_\_\_\_.
5. During electrolysis of water, the hydrogen gas collects at \_\_\_\_\_.

**C. State whether the following statements are true or false.**

1. Sea water is a good conductor of electricity.
2. A torch bulb can glow even with a weak current.
3. Iron and steel objects are coated with aluminium in various machine parts and for taps, etc. to make them look shinier.
4. Lemon juice and vinegar cannot be used as electrolytes as they do not conduct electricity.
5. Electroplating metal objects with silver turns out to be very expensive.

**D. Match the following.**

- |                  |  |
|------------------|--|
| 1. Anode         | a. To prevent rusting                      |
| 2. Cathode       | b. Liquid through which electricity passes |
| 3. Galvanisation | c. Positively charged electrode            |
| 4. LED           | d. Negatively charged electrode            |
| 5. Electrolyte   | e. Light emitting diode                    |

**E. Answer the following questions in one word or sentence.**

1. Define electrolysis.
2. Name two weak electrolytes and two strong electrolytes.
3. Name the following metals:
  - a. Used for coating water pipes and automobiles
  - b. Used for coating ornaments
4. How can you convert pure water from a non-electrolyte to an electrolyte?

5. Write the applications of chemical effects of current.
6. Define electroplating.
7. What is the use of galvanisation?
8. Write the equation for electrolysis of water.

**F. Answer the following questions in brief.**

1. State one difference between a solid conductor and an electrolyte.
2. Name the device used for detecting weak currents.
3. Write down four objects around you that are electroplated and name the metal used for coating in them.
4. How is chemical effect used for decomposition of compounds? Give an example.
5. Write two uses of electroplating and give example for each.
6. Is the glowing of a torch bulb an example of the chemical effect of current? Justify your answer.
7. Which effect of current is used for purification of metals? How will you arrange the pure and impure metals in the set up to refine the impure metal?

**G. Answer the questions in detail.**

1. How do you detect whether the liquids conduct electricity or not/ how will you detect the weak currents through liquids?
2. Explain the process of electroplating with the help of an example.
3. How can you purify an impure piece of copper? Explain in detail with a diagram.
4. What are the various uses of electroplating?
5. Can carbon rod be used as a cathode in place of copper rod? Give an explanation for your answer.

**H. Give reason for the following.**

1. Electrical conductivity of sea water is more than the drinking water.
2. Bathroom fittings and wheel rims are usually coated with chromium.
3. Cans for storing food are made from iron coated with tin.
4. It is dangerous to handle electrical appliances with wet hands.

### Out of The Box

1. Rain water is pure water but still it conducts electricity. Why?
2. After electroplating an iron strip with copper metal, if the connections of electrodes are interchanged, what will you observe?

### In Real Life

The disposal of the used electrolytes from the electroplating factories is a major problem. This waste causes pollution. What are the steps to be taken to implement strictly the specific disposal guidelines to protect the environment?

## Subject Enrichment

### Activity Zone

1. Ahana was playing with a screw driver when she scratched her almirah. She found that on scratching the almirah, the green colour was gone and iron metal was visible. After a few days during the rainy season she found that the almirah got rusted from where it was scratched. What do you think was the coating made of on the almirah and why was the coating done? Name the process involved,
2. Take the students to a gold plating factory to visualize and understand how the process of electrolysis is important.

### Project Zone

Prepare a chart on the process of electroplating. Explore the various kinds of electroplating being done and their applications in the industry. Display your chart in the classroom.

### Web-links

- Electrolysis of water: <https://www.youtube.com/watch?v=T-OwWOYHhMI>

### Crosslinks

How did the refining of metals used to take place in ancient times? Explore and write a report on the various methods. Are some of these methods still implemented?

### Teacher's Note

Show various experiments discussed in the chapter in the classroom and encourage students to observe and conclude the findings of each experiment on their own.

# Worksheet 5

(Unit 5 – How things work)

## Copper Plating

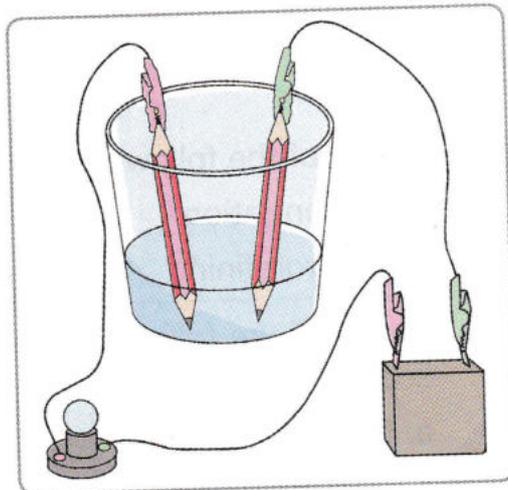
The activity demonstrated here shows how electricity can be used to split the components of a chemical, in this case, copper sulphate. Graphite pencils are used for electrodes. The process is called electrolysis and is commonly used in industry to extract pure metals and to electroplate objects to produce a metallic coating.

Take two pencils and attach a clip (a crocodile clip) to the tips of each pencil. Now, complete the circuit by touching the pencil tips together to light a bulb as shown.

Dip the pencils in the copper sulphate solution.

Observe what happens to the tips of the pencils after some time.

When an electric current is sent through copper sulphate solution, copper is deposited on the tip of the pencil.



What happens if you replace the copper plated pencil with a metal object?

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What happens if you change over the pencils?

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---

Find out how electroplating is used in industry.

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# Unit Test Paper 5

(Unit 5 - How Things Work?)

## A. Tick (✓) the correct answer.

- Which of the following is not an application of chemical effects of current?
  - Electroplating
  - Extraction of metals
  - Sedimentation
  - Electrorefining
- Which of the following metals is used for machine coating?
  - Zinc
  - Silver
  - Gold
  - Iron
- Which of the following is a process of getting pure copper from impure form?
  - Galvanisation
  - Electroplating
  - Electrorefining
  - Distillation
- Which of the following process is used to extract sodium from the molten sodium chloride?
  - Electrolysis
  - Electroplating
  - Electrorefining
  - Galvanisation

## B. Are the following statements true or false? Correct the false statements.

- The distilled water does not allow the current to pass.
- The gases which conduct electricity are known as electrolytes
- Chemical effect of current can also be change in the colour.

## C. Give one word or one example for the following.

- The chemical decomposition of a compound on passing electric current through an electrolyte
- The positively charged electrode
- Light emitting diode that can detect weak currents
- The process used for making objects attractive and anticorrosive

## D. Answer the following questions.

- What are the various applications of chemical effects of current?
- What is electro-refining of metals?
- Explain with the help of a diagram the process of electroplating.
- What is galvanisation?

# 15

## Some Natural Phenomena

### Chapter Focus

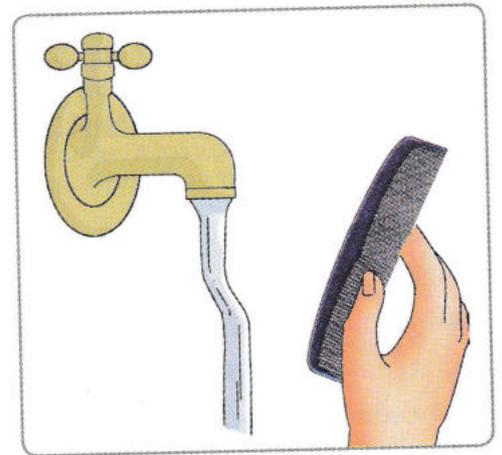
- Electric Charge
- Types of Charges and their Properties
- Transfer of Charges
- Lightning
- Gold Leaf Electroscope
- Lightning Conductor
- Earthquakes
- Protection against Earthquakes

### Kick-off Activity

#### What is a spark?

Rub a comb with a piece of wool or fur. Hold it near a water tap or a doorknob. What do you observe? There will be a small spark produced with this action.

By rubbing the comb, it gets charged producing electricity. The spark is made when the charge jumps from the comb (charged object) to the water tap or doorknob (the neutral or uncharged object). A spark is nothing but a passage of an electrical charge between two objects.



You must have observed the crackling while combing your hair sometimes. This is an example of static electricity.

Though nature and most of the natural phenomena are really wonderful and important for the survival there are still some natural phenomena that can be dangerous to life and property. In this chapter you will learn about lightning and earthquakes which are the two highly destructive natural phenomena. It is important for us to learn these phenomena and some precautions that can be taken to minimize the losses.

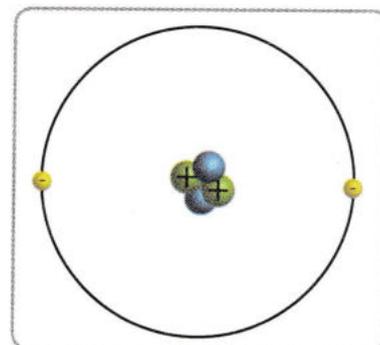


## ELECTRIC CHARGES

**Electric charge** is a physical property of an object that makes it attract or repel another object with or without touching or any physical contact. It is a property based on the protons and electrons in the atoms of an object. A **proton** has a positive electric charge while an **electron** has a negative electric charge. In a neutral atom the number of electrons and protons are equal but when energy is supplied to an atom, the free electrons present in an atom move out and transfer to the atoms of the neighbouring objects. Thus, an imbalance of positive and negative charges is created in the atom which gives rise to a charge in the object. For the transfer of electrons energy needs to be supplied to the atoms in the form of heat and light.

An object which contains atoms with equal number of electrons and protons carries no electric charge and hence it is called a neutral or uncharged body.

An object which contains atoms with unequal number of electrons and protons carries an electric charge and hence it is called a charged body. If the number of electrons present in the body is more than the number of protons then it is **negatively charged** and if the number of protons present in the body is more than the number of electrons then the body is **positively charged**.



*An atom with protons and neutrons in the nucleus and electrons in the orbit*

## TYPES OF CHARGES AND THEIR INTERACTION

Let us begin with an activity.

### Activity

**Aim:** To demonstrate how charged objects interact with each other

**Material required:** Two balloons and threads, a piece of wool

**Procedure:** Take two inflated balloons and suspend them with the help of a thread. The balloons should be placed in such a way that they are closely spaced but not touching each other. Now rub both the balloons with a piece of wool and release. What do you observe?

Now bring the piece of wool near the balloons. What do you observe?

**Observations:** When the two balloons rubbed with wools are brought closer, they move away from each other but when the same balloons are brought near the wool piece, they attract the piece of wool. It happens because the charge on the two balloons is same but the charges on the balloons and the woollen piece are different.

**Conclusions:** Like charges repel and opposite charges attract.

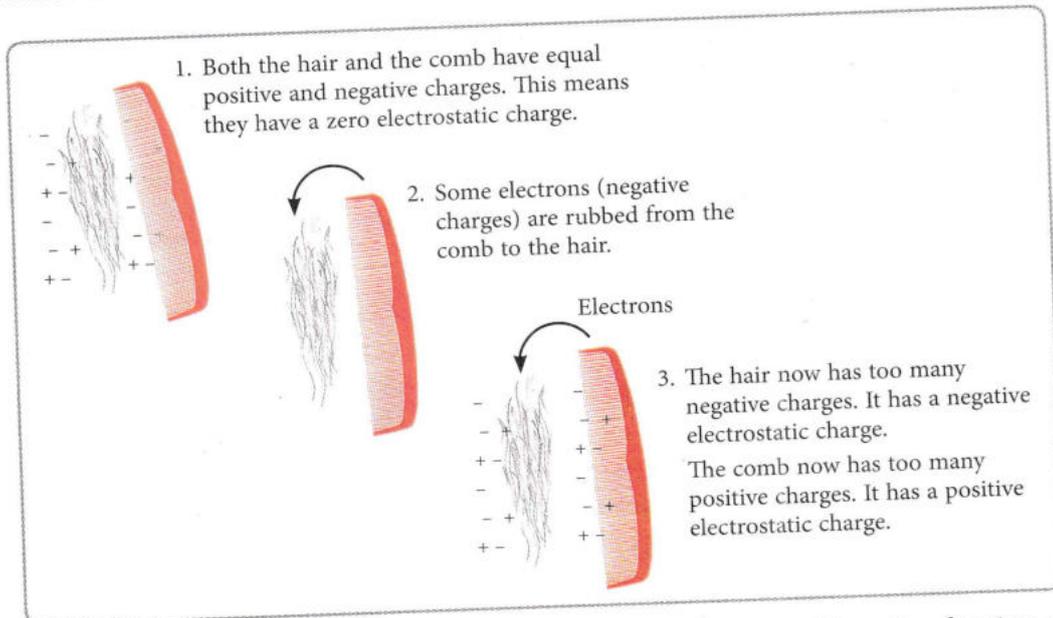
Hence from the above activity, we conclude that there are two types of phenomena occurring here, attraction and repulsion. This means there are two types of charges that exist. These are positive and negative charges.

On rubbing two objects, the one which loses its free electrons acquire the positive charge and the one which gains electrons acquires the negative charge. Further, the charged bodies interact such that two positively charged bodies repel each other and so do two negatively charged bodies. But a positively charged body is attracted to a negatively charged body.

## Charging by rubbing or friction

You must have experienced charges running through your hand on a cold winter day when you rubbed your hands against a woolen blanket or sweater. You might have experienced the same effect while combing your hair on a dry winter day.

Some of the outer electrons in a few atoms are held loosely as compared to the outer electrons in some other atoms. For example, the outer electrons of the atoms in our hair are held more loosely than the outer electrons of the atoms in a plastic comb. Therefore, when you run a plastic comb on your hair some of the outer electrons from the atoms the comb get rubbed off, and they stick to the atoms in your hair.



This happens because rubbing of plastic comb with hair causes friction. Thus, the friction produced on rubbing between hair and the comb creates more of positive charge on the comb and more of the negative charge in your hair.

This charging of an object by rubbing it with another object is called charging by rubbing.

The charge so produced stays bound to the surface of the object and cannot flow. Therefore it is known as static electricity. The flowing of electric charges constitute electric current.

### Do you know?

A charged object can attract an uncharged object by creating an opposite charge on the nearer end of the neutral object by the process of induction. When a comb rubbed with dry hair attracts small bits of paper which are uncharged. Therefore, repulsion is the surest test to detect the presence of charge on two interacting bodies as repulsion can happen only when two bodies carry the same charge.

## TRANSFER OF CHARGES

Though the electric charge created by rubbing cannot flow easily but we can transfer this charge from one charged object to another uncharged object through a metal conductor. When a charged object touches another uncharged object, the electrons flow from the body with higher concentration of electrons to the body with lower concentration of electrons.

This causes a transfer of charge from the charged body to the uncharged body on touching. It is known as charging by conduction.

The following activity will help you understand the transfer of charge through a metal conductor.

## Activity



**Aim:** To demonstrate that charge can be transferred through a metal conductor.

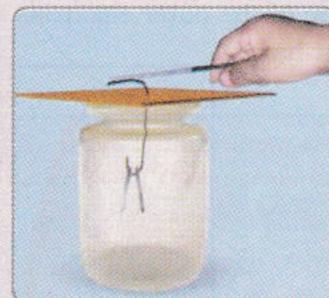
**Material required:** A glass jar, 2-3 metal paper clips, a cardboard, aluminum foil strips and a pen refill.

**Procedure:** Place a small piece of cardboard on the mouth of a glass jar. Make a small hole in the cardboard and insert the paper clip through the hole which hangs the strips of aluminum foil as shown in the image.

Now charge the pen refill by rubbing it across your hair and then touch it with the paper clip.

**Observations:** On touching the charged pen refill to the paper clip the aluminum strips move away from each other showing the charge getting transferred. Since the aluminum strips carry the same charge they move away from each other.

**Conclusion:** Charge is transferred from the pen refill to the aluminum strips through the metal paper clip. Hence charge can be transferred through metal conductors.



In the above activity we observe that the aluminum foil becomes charged when a charged body touches the paper clip. This means the charge from the refill has been transferred to the paper clip and aluminum foil. This type of transfer of charges is known as charging by conduction.

## Gold leaf electroscope

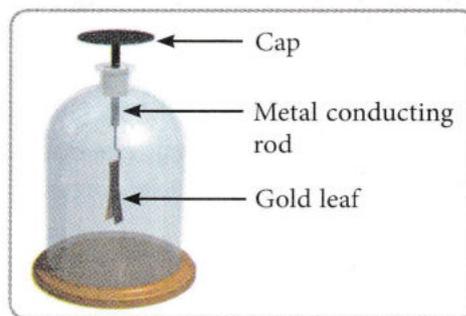
Can charges transfer without physically touching the other body? Yes, they can. In order to understand this let us first understand what a gold leaf electroscope is.

A gold leaf electroscope is a device used to detect the presence and nature of charge on an object.

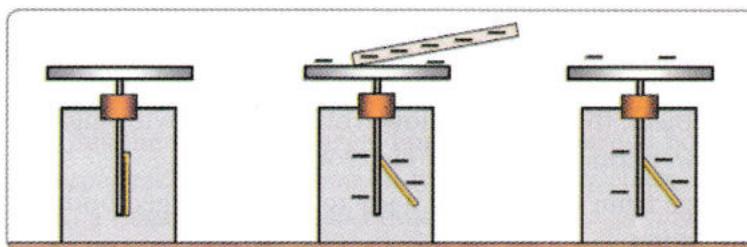
In this device, a metal disc at the top known as the cap is connected to a narrow metal plate through a copper conducting rod. A thin piece of gold leaf is fixed to the metal rod at one end but is free to move at the other end.

The whole set up of the electroscope is insulated from the body of the instrument. Now, let us see how the electroscope detects the charge on a body.

Bring a charged ebonite rod after charging it by rubbing with a woollen cloth. When this charged ebonite rod touches the metal cap on the top of the electroscope, the gold leaf rises away from the plate as seen in the image.



*A gold leaf electroscope*



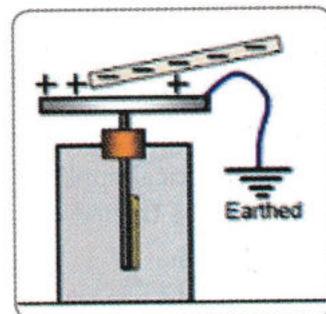
This means that both the gold leaf and the metal plate have the same charge as like charges repel. Further, greater the magnitude of charge on the charged body, farther will the leaf move from the plate. The whole action shows that the body touched with the electrostatic is a charged body.

Similarly if a positively charged glass rod is touched with the metal cap of the electrostatic, the gold leaf will again rise away from the metal plate. This tells us that same charge is transferred to the metal plate and the gold leaf.

Thus, an electrostatic detects the presence of charge on a body, whether it is positively charged or negatively charged, by the movement of the gold leaf.

Had there been no charge on the body touching the metal cap of the electrostatic, the gold leaf would remain in place touching the metal plate always.

This process of transferring the charge from a charged object to the earth or ground is known as earthing.



## LIGHTNING

We all have seen flashes of light and heard thunder during the rainy seasons. This bright flash of light accompanied by a thundering sound is called lightning. Lightning is just an electric spark in the sky.



During a thunderstorm, the air currents move upwards and the water droplets move downwards. Due to this vigorous motion of water droplets electric charges are produced due to friction. The smaller water droplets acquire a positive charge. They move upwards with the winds being lighter while the bigger water droplets acquire a negative charge and move down being heavier.

As a result of this movement of water droplets, the positive charges collect near the upper edge and the negative

charges accumulate near the lower edge of the cloud.

When the charges developed across the clouds become very large they flow to meet, thereby producing electric sparks in the form of lightning and thunder.

Generally, the lightning occurs in the sky but sometimes the lower end of the clouds become highly negative very near to a tall building or a tree, this electric charge can then flow from the storm cloud to the building or the tree and strikes them. This action can completely destroy the object being touched by the lightning and hence we say that the lightning is dangerous.

### Do you know?

Lightning strikes are very frequent in the hills because in hilly areas clouds are closer to the ground. Therefore the electric charge can flow easily between the clouds and the ground in the hilly areas.

## Lightning safety

Striking of lightning on the earth can be very dangerous. If lightning strikes a tall building or a tree, it can set them on fire as it carries a huge amount of electric energy. If a person is outside in an open place, then he/she can get struck by lightning and die due to the passage of electric energy through his body. Thus it is important for us to be alert and take care of the following things during lightning and thunder storms:

1. Since an open place is unsafe during lightning and thunderstorm, we should rush to a safer place such inside a house or a building nearby when we see lightning in the sky and remain indoors.

- Travelling in covered vehicles like a car or a bus is safe while lightning, so we should just keep the door and windows of the car or bus closed.
- If in case we are out in the open we should stay away from trees, poles and other metal objects. Though taking shelter under a short tree can be better as lightning generally strikes the taller tree.
- If no other option is available for shelter during a thunder storm and lightning, then the person should sit down with the heels on the ground, and place his hands on the knees and the head between the hands. This will make the person the shortest possible object in the surroundings and reduce the probability of being stricken by lightning.
- All electrical appliances such as the television sets and computers should be turned off and unplugged as they may get burnt during lightning.
- We should not touch any metal pipes in a building during thunderstorm and lightning as lightning can strike the metal pipes. Therefore it is unsafe to touch them.
- One should not take a shower at the time of lightning as it can be dangerous to come in contact with the running water from the metal pipes.



## Lightning conductors

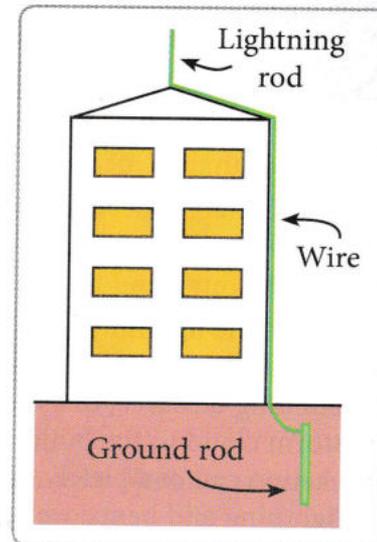
Since lightning can be dangerous for tall buildings, therefore high rise buildings are provided with lightning conductors.

A lightning conductor is a safety device which protects a building from the dangers and damages caused by lightning. It was invented by Benjamin Franklin.

A lightning conductor consists of a long and thick metal rod which is taller than the building and has spikes on the top. This long metal rod extends from the top to the bottom of the building. At the lower end the rod is connected to a copper or aluminum plate buried deep under the earth.

During lightning and thunder storm, if the lightning strikes the building, then the metal spikes of the lightning conductor being at the highest point catches the electric charge from the clouds and pass it straight down to the earth through the long metal rod. This saves the building from any damages that could have been caused to the building in the absence of lightning conductor.

The principle of a lightning conductor is simple. We know that metals are good conductors of electricity therefore the lightning conductors are made of metal, thus, when charge is transferred to the lightning conductor from the clouds, they pass this charge straight to the ground.



## EARTHQUAKES

An earth quake is a sudden ground movement or sudden trembling of the earth that lasts for a very short period of time. This movement is caused by the sudden release of immense energy stored in the rocks deep inside the earth. When a lot of stress builds up in the rocks it leads to an earthquake. Most of the times the earthquakes are so minor that they are not even noticeable and sometimes they are so strong that they can be very dangerous leading to a huge loss of life and property. Earthquakes can even cause landslides and tsunamis.

Unfortunately, earthquakes are unpredictable destructive natural phenomenon. However, we can study and understand about them to avoid large scale destruction as much as possible. To learn the cause of earthquakes we shall first understand the structure of Earth.

## Structure of the Earth

The structure of the earth consists of following 3 regions:

1. Crust
2. Mantle
3. Core

### CRUST

Crust is the outermost layer or the upper most part of the earth. The thickness of earth crust is not same in every area. It is because the whole earth crust is not made in one piece but is made up of many huge flat rocks called tectonic plates. It is the convection currents deep under the earth that cause the plates to move.

### MANTLE

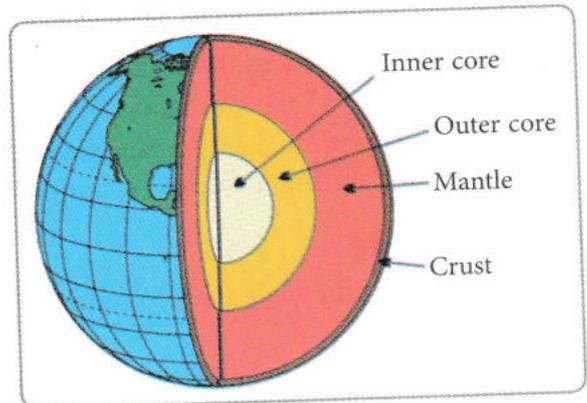
The mantle is the middle layer of the earth between the core and the crust of the earth. Dense solid rocks and the molten rocks form the mantle. Large convection currents are set up due to the heat received from the core of the earth.

### CORE

Core is the inner most part of the earth. Core of the earth consist of heavy metals and mostly iron. Core consists of two parts,

1. Outer core
2. Inner core

Outer core is in molten state mostly molten iron and its thickness is 2100 km while the inner core is in solid state or solid iron pressed under high pressure.

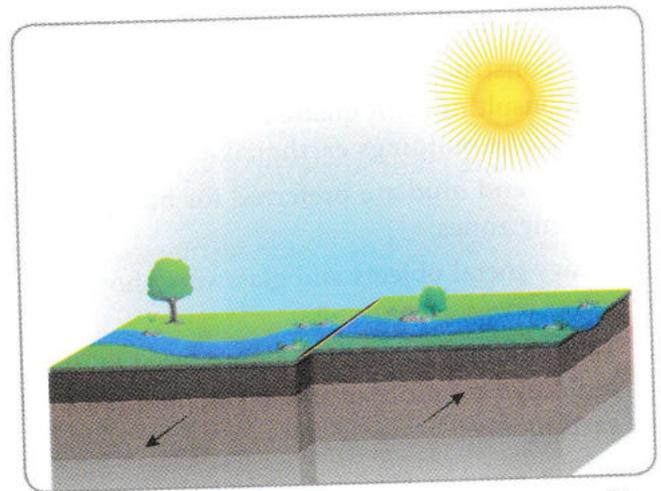


## Cause of earthquakes

We know that the convection currents set up due to the intense heat of the inner core of the earth, the tectonic plates are in continual motion. So, they sometimes brush past one another and sometimes collide. Due to rough edges of the plates, while sliding over each other, the rocks get deformed. Gradually so much of the strain builds up that it leads to rupture. Hence, finally the rocks break with a big jolt leading to an earthquake accompanied by a tremendous amount of energy. This large amount of energy causes vibrations which release seismic waves shaking the earth.

Another reason for the earth quakes is the collision of two tectonic plates moving in opposite directions. Two plates collide such that they fuse and form a mountain which causes the earthquake.

The earthquakes are more likely to occur in the zones where boundaries of the plates are located. These zones are weak zones and are called the seismic zones or fault zones.



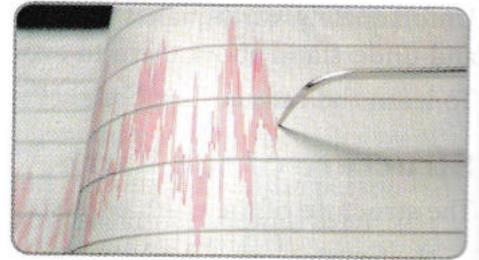
### Do you know?

In Himalayan region the tectonic plates collide against one another and raise the mountain and cause earthquakes.

The vibrations caused by an earthquake are associated with seismic waves and the instrument that records the seismic waves is known as a seismograph.

The origination of vibrations of the earthquake happens at a point called the focus of the earth quake and the point vertically above the focus on the surface of earth is called the epicenter. The epicenter experiences the maximum damage during an earthquake.

Though mostly earthquakes are caused by the movement of tectonic plates, sometimes, tremors on earth can be felt during a volcano eruption or an underground nuclear explosion.



## Richter scale

A Richter scale is the scale used to measure the intensity of an earthquake.

The Richter Scale was invented by Charles. F. Richter. It is not linear but logarithmic which means that the whole number jumps indicate a tenfold increase. For example, the earthquake of magnitude 2 on the Richter scale denotes an earthquake of strength 10 times more than that of magnitude 1 and an earthquake of magnitude 3 on the Richter scale tells that strength is 100 times that of magnitude 1.

Richter ratings only give you a rough idea of the impact caused by an earthquake.

## Protection against earthquakes

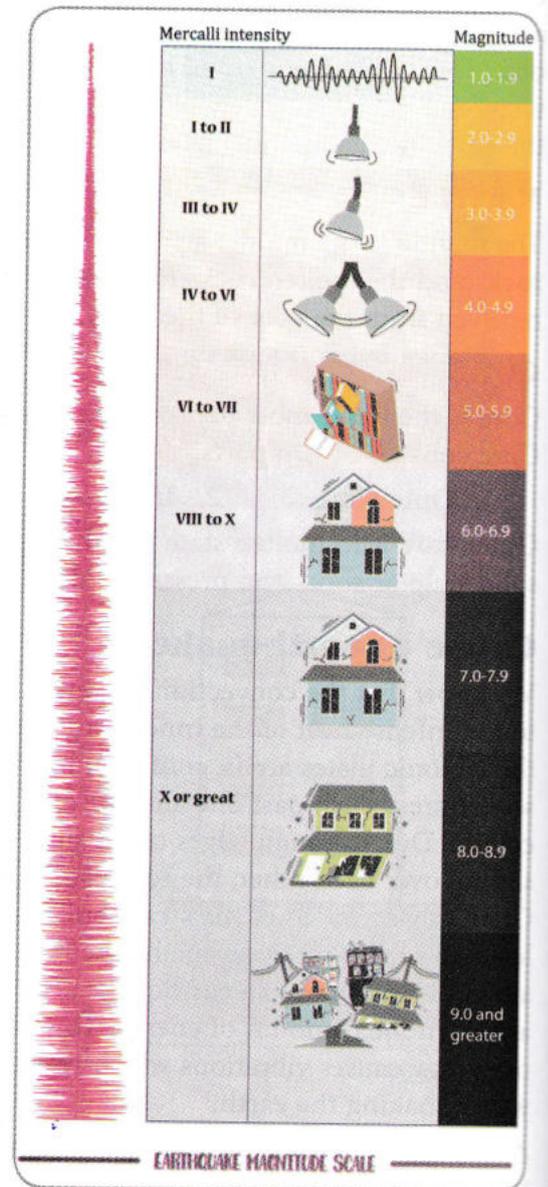
An earthquakes is a highly destructive and unpredictable natural phenomenon. It is thus essential that we take some precautions and keep ourselves safe during earthquakes.

1. The construction of buildings and houses should be done by consulting with qualified architects and engineers who can make buildings earthquake resistant.
2. Wood and mud are preferred for building houses in the seismic zones.
3. Heavy metal objects and glassware should be placed at lower levels.
4. Tall buildings should have functional firefighting system as buildings are more prone to catching fire during a major earth quake.

## General precautions to be taken at home during an earthquake

1. It is advisable to take a shelter under a heavy table.
2. Stay away from objects hanging up high as they may fall.
3. Protect your head with a pillow when on the bed.

If you are outside during an earth quake just go to an empty and a clear spot away from poles and buildings. If you are inside a car or a bus, then stay inside the earthquake stops.



## Check Point

Fill in the blanks.

1. There are \_\_\_\_\_ kinds of charge.
2. Like charges \_\_\_\_\_ and unlike charges \_\_\_\_\_.
3. Charging caused by rubbing is called \_\_\_\_\_ electricity.
4. \_\_\_\_\_ is a device for detecting electric charge on an object.
5. The process of transferring charge to the earth is called \_\_\_\_\_.
6. The bright flash of light in the sky is called \_\_\_\_\_.
7. The middle layer of the earth is called \_\_\_\_\_.
8. Earthquakes are measured on the \_\_\_\_\_ scale.

## Key Terms

- **Frictional electricity:** Electric charges produced by rubbing
- **Electroscope:** A device used to detect the presence of charges
- **Lightning:** A bright flash of light produced by electric discharge between the clouds
- **Core:** The innermost layer of the Earth
- **Mantle:** The middle layer between the core and the crust
- **Crust:** The outermost layer of the Earth
- **Earthquake:** The sudden shaking of the ground due to vigorous movement of tectonic plates
- **Epicenter:** The point vertically above the focus of earthquake, where the maximum impact of an earthquake occurs

## Recall

- An electric charge is a physical property of an object that makes it attract or repel another object with or without touching.
- The charge produced by rubbing stays bound to the surface of the object and cannot flow. Therefore it is known as static electricity.
- Like charges repel each other and unlike charges attract each other.
- A charge can be transferred through metal conductors.
- Gold leaf electroscope is a device used to detect the presence and nature of charge on an object.
- The process of transferring the charge from a charged object to the earth or ground is known as earthing
- Lightning conductor is a safety device which protects a building from the dangers and damages caused by lightning.
- The vibrations caused by an earthquake are associated with seismic waves and the instrument that records the seismic waves is known as a seismograph.

## Assess Zone

### A. Tick (✓) the correct answer.

1. During a thunderstorm, what does a loud thunder follows with?  
a. Earthquake                      b. lightning                      c. tornado                      d. all of these
2. Which of the following device is used for protecting a building from lightening?  
a. An electroscope                      b. A seismograph  
c. A lightning conductor                      d. Richter scale
3. A charged object attracts another body which is?  
a. Oppositely charged                      b. similarly charged  
c. uncharged                      d. both a and c
4. Which of the following devices can detect the presence and nature of charge on a body?  
a. Seismograph                      b. electroscope                      c. barometer                      d. spectroscope
5. The solid iron constitutes the part of earth called  
a. Inner core                      b. outer core                      c. mantle                      d. crust
6. Vibrations releasing seismic waves are associated with  
a. earthquakes                      b. lightning                      c. cyclones                      d. thunderstorm
7. Lightning is very dangerous as it consists of a huge amount of  
a. electric energy                      b. tidal energy                      c. nuclear energy                      d. heat energy
8. The most dangerous place during lightning is  
a. elevated ridge                      b. inside a car                      c. under a short tree                      d. all of these
9. The cause of lightning is:  
a. electric discharge                      b. movement of tectonic plates  
c. cyclones                      d. none of these
10. The earthquakes are caused by continual movement of tectonic plates which occurs due to  
a. friction                      b. convection currents  
c. conduction currents                      d. induction currents

### B. Fill in the blanks.

1. When two objects are charged by rubbing there is a transfer of \_\_\_\_\_.
2. Lightning conductor was invented by \_\_\_\_\_.
3. Earthquakes are associated with \_\_\_\_\_ waves.
4. Charge in a gold leaf electroscope is transferred to the gold leaf by the process of \_\_\_\_\_.
5. The electric discharge occurs in the clouds due to movement of \_\_\_\_\_ between the clouds.

### C. State whether the following statements are true or false.

1. Like charges repel each other and unlike charges attract each other. \_\_\_\_\_
2. Gold leaf electroscope protects a building from the lightning. \_\_\_\_\_
3. One should lie on the ground to save himself during thunderstorm and lightning. \_\_\_\_\_

4. During an earthquake we should never take shelter under a heavy table.
5. The magnitude of earth quake is expressed on the Richter scale.

**D. Match the following.**

- |                           |                            |
|---------------------------|----------------------------|
| 1. Lightning conductor    | a. Maximum damage          |
| 2. Seismograph            | b. Safety device           |
| 3. Richter scale          | c. Charge                  |
| 4. Gold leaf electroscope | d. Intensity of earthquake |
| 5. Epicenter              | e. Shock waves             |

**E. Give reasons for the following.**

1. A balloon rubbed with wool sticks to the wall.
2. One should not stand under a tall tree during lightning and thunderstorm.
3. A charged body becomes neutral when we touch it.
4. Lightning conductors are provided on high rise buildings.

**F. Answer the following questions in one word or a single sentence.**

1. Define an electric charge.
2. How do charges interact?
3. Name the electric discharge that causes flashes in the sky.
4. Name the device for protecting buildings from lightning. Define it.
5. Why do we hear a crackling sound when we take off a woollen sweater during winters?
6. Define the process through which lightning conductor saves a building from lightning.
7. Name the three layers of the earth structure.
8. Name the point through which earthquake originates and the point vertically above the origin.



**G. Answer the following questions in brief.**

1. Define frictional or static electricity.
2. What is the cause of an earthquake?
3. Name the scale for measuring earthquake and explain how the strength varies with the magnitude from 1 to 2 and 3.
4. Explain the working of a lightning conductor.
5. What causes earthquakes?
6. Define focus and epicenter of earthquakes.
7. Explain in brief the two ways of movements of tectonic plates that cause earthquakes.

**H. Answer the following questions in detail.**

1. Suggest some safety measures for protection during an earth quake.
2. Explain the working of a gold leaf electroscope.
3. Explain the cause of lightning.
4. What are the precautions and steps to be taken during lightning and thunderstorm?
5. What causes earthquakes? Explain the whole phenomenon in detail.

## Out of The Box

1. If air and clouds were conducting then lightning would happen or not? Explain your answer.
2. How a charged body does attract an uncharged body?
3. When a gold leaf electroscope is charged, the gold leaf flies away from the metal strip. But when you touch the cap on the top of GLE, the leaf collapses back to stick to the plate. Why?

## In Real Life

1. Varun was stuck in the traffic when suddenly thunderstorm started and lightning could be seen in the sky. What should have been the steps taken by Varun to make sure that he was safe?
2. Earthquakes are unpredictable and destructive natural phenomena. Though it is caused by the movement of tectonic plates deep inside the earth, can you think of some human activities that can cause earthquakes?

## Subject Enrichment

### Activity Zone

Gather information about all the effects caused by earthquake that happened in 2001 in India and the magnitude of this earthquake on the Richter scale. Which places suffered maximum damages and why?

### Project Zone

Make your own gold leaf electroscope and observe the charge transfer to uncharged bodies from charged bodies.

## Web-links

- The science of lightning: <https://www.youtube.com/watch?v=h-0gNI5f4BU>
- Earthquakes 101: <https://www.youtube.com/watch?v=e7ho6z32yyo>

## Crosslinks

Write a report on the structure of the earth and the types of tectonic plates. Find out about the earthquake prone zones all over the world and point them out in your report. Include a map of India in your report and find out the earthquake prone zones specific to India. Close your report by making suggestions on how earthquake caused by man-made activities should be prevented.

### Teacher's Note

Demonstrate the charging of objects by rubbing. Show the lightning conductor installed on the top of the school building or any other tall buildings in the vicinity and show the earthing at the bottom of the lightning conductor to the students.

## Chapter Focus

-  Laws of Reflection
-  Regular and Diffused Reflection
-  Formations of Image Formed by a Plane Mirror
-  Kaleidoscope
-  Human Eye and its Defects
-  Refraction of Light

## Kick-off Activity

### Making your own pinhole camera

Take a white plain chart paper and cut it into half. In one of the halves, cut a square hole in the middle of the chart paper. Tape a small piece of aluminum foil over the hole in a way that the hole is covered completely. Use a pin to poke a hole in the aluminum foil. Place the other half of the chart paper on the ground and hold the piece with the aluminum foil above it (foil facing up).

Stand with the Sun behind you and view the projected image on the chart paper below. Note that the farther away you hold your pinhole camera, the bigger image will be projected below.



You could also to make things fun create different patterns of dots on the aluminum foil instead of just one hole. You could also enjoy a solar eclipse without wearing any safety glasses (make sure you do not look at an eclipse directly with your naked eyes) through this pinhole camera of yours.

We see things around us when light falls on them. We can say that light is a form of energy that creates a sensation of vision. Most of the objects we see are visible because they reflect light falling on them. Let us study the phenomenon of reflection of light in detail.

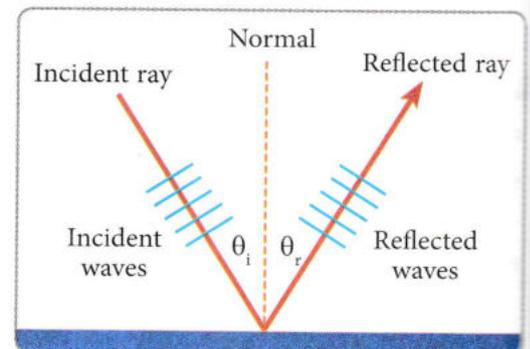


## LAWS OF REFLECTION

The people who design these signs use the concept of light reflection off the shiny surfaces, including water, to make the sign legible. The phenomenon responsible for this is reflection of light.

Reflection of light is bouncing back of light from an opaque obstacle. Reflection of light does not just happen randomly but follows some laws. However, before we learn the laws of reflection let us get ourselves acquainted with some following important and related terms:

- The ray of light that strikes a mirror or any barrier is called an incident ray.
- The point at which the incident ray falls is called the point of incidence.
- The ray that reflects off the mirror is called the reflected ray.
- The line drawn at right angle to the mirror surface is called the normal ray.
- The angle that an incident ray makes with the normal is called the angle of incidence  $\theta_i$ .
- The angle that a reflected ray makes with the normal is called the angle of reflection  $\theta_r$ .



Now that we know some important keywords let us learn about the two important laws of reflection.

1. The incident ray, reflected ray and the normal to the mirror at the point of incidence, all lie in the same plane.
2. The angle of incidence is equal to the angle of reflection,  $\theta_i = \theta_r$

Thus, we can conclude that if a ray is incident at  $45^\circ$  it will be reflected at  $45^\circ$ . Also, if a ray falls along the normal ( $\theta_i = 0$ ) then it will retrace its path along the normal ( $\theta_r = 0$ ).

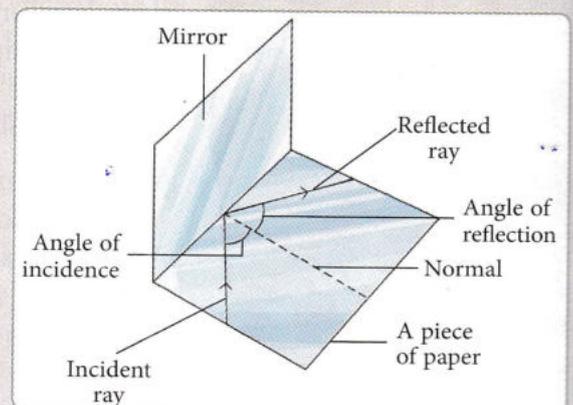
### Activity



**Aim:** To verify that the angle of incidence is equal to the angle of reflection,  $\theta_i = \theta_r$ .

**Material required:** A drawing board, a white sheet of paper, a few pins, a protractor, a pencil and a plane mirror.

**Procedure:** Fix a white sheet of paper on the drawing board. Place a plane mirror on it and trace its outline on the paper. Now, remove the mirror and draw the normal to the mirror with the help of a protractor. (Normal is the  $90^\circ$  vertical line drawn to the outline of the mirror.) Now place the mirror again on the outline. The normal will be reflected clearly on the mirror. Now, draw a straight line at an angle of  $30^\circ$  to the normal. Place two pins on this straight line. Thus, the pins are incident at  $30^\circ$  to the normal. Next place two



pins on the other side of the normal in such a way that these two pins are in a straight line with the reflection of the two pins on the other side of the normal.

Now remove the mirror and the pins and join the pin marks to the normal. Measure the angle of reflection. What do you observe?

**Observation:** The angle of reflection comes out to be  $30^\circ$ . Thus, we say that the angle of incidence is equal to the angle of reflection.

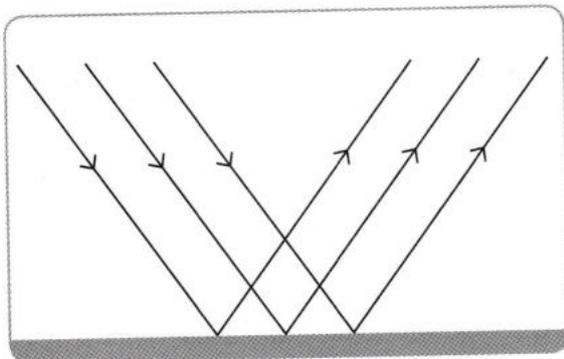
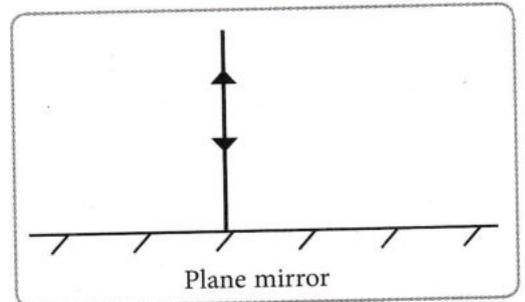
**Conclusion:** This proves the second law of reflection which states that the angle of incidence is equal to the angle of reflection.

## REGULAR REFLECTION AND DIFFUSED REFLECTION

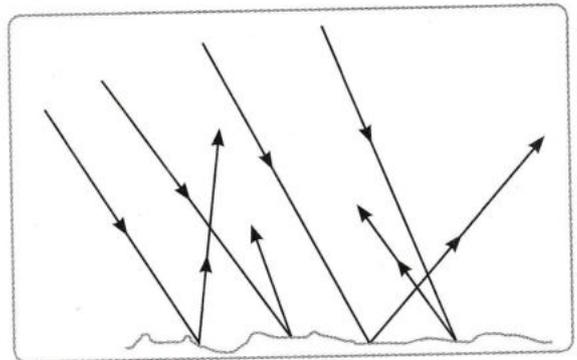
When the reflecting surface is smooth, the reflection will be a regular reflection, in which a parallel incident beam is reflected back as a parallel beam.

However, if the reflecting surface is rough, the reflection will be a diffused reflection, in which the rays after reflection do not remain parallel but reflect in random directions.

Reflection from a smooth surface such as a mirror and new steel utensils is regular reflection while reflection from a rough and uneven surface such as a wall, a table, a chair or old steel utensils, etc. is a diffused reflection.



*Regular reflection from plane mirror*



*Irregular reflection from rough mirror*

We see our image only when regular reflection occurs such as a mirror but no image is formed in diffused reflection. That is why we cannot see our image in a wall or any rough surface.

### Do you know?

A wet asphalt road forms a smooth reflection but the same asphalt road when dry forms a diffused reflection. When the road is wet, the surface becomes smooth and shiny and a beam of light from the opposite direction strikes the wet road and creates a smooth reflection. On a freshly painted road a glare can be caused in the eyes of the driver thus making driving difficult especially at night.

## FORMATION OF IMAGE IN A PLANE MIRROR

When an object is placed in front of a mirror, the light through the object falls on the mirror. The light follows a regular reflection from the plane mirror and an image of the object is seen on the mirror. The reflection of light from the mirror is governed by the laws of reflection. Let us understand this from the given image.

Light from an object falls on the mirror. The ray which is incident along the normal to the mirror reflects back along the normal and the reflected ray which falls at an angle reflects back from the mirror at the same angle.

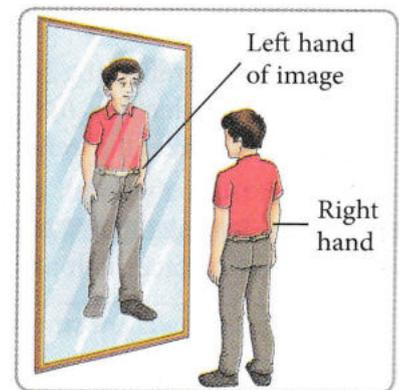
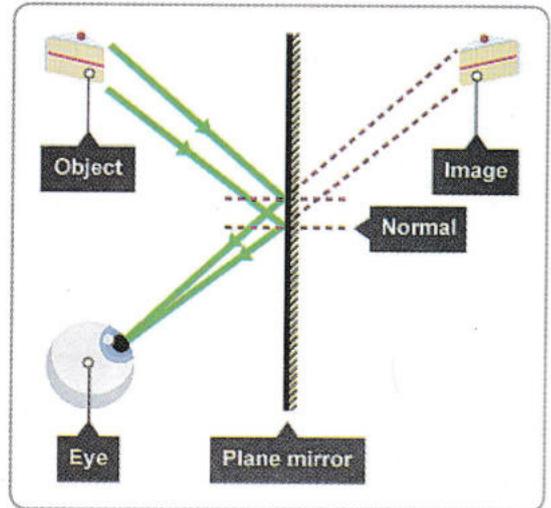
The reflected rays diverge from the mirror but when the reflected rays are extended backwards they meet to form an image behind the mirror. This image is the image of the object.

The image so obtained is a virtual image as the rays appear to meet behind the mirror but they do not actually meet.

The important characteristics of the image formed by a plane mirror are:

1. The image formed by a plane mirror is erect or upright.
2. The image formed by a plane mirror is virtual as the rays appear to diverge from the mirror.
3. The image formed by a plane mirror is of the same size as that of the object.
4. The image is formed at the same distance behind the mirror as the distance of object in front of it.

The image formed in a plane mirror is laterally inverted. For example in the picture here, the man's right hand looks like his left hand in the mirror. Thus the image in a plane mirror suffers a left-right reversal.



### Reflected light can be reflected again

You might have noticed that when you visit a hair dresser, he/she makes you sit in front of a mirror. Once your hair cut is complete they place a mirror at your back to show you how your hair at the back look like.

Another example of using two mirrors is that of a periscope which we learnt in earlier classes. The periscope enables you to see objects which are not visible directly but are at a height above the ground. These two examples simply tell us that when rays of light reflected by a plane mirror are incident on another plane mirror, then the rays are reflected again. In simple words reflected light can be reflected again by using two plane mirrors.

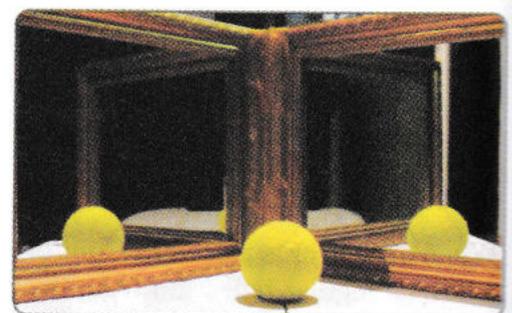
We know that a single plane mirror forms one image of an object but if two plane mirrors are placed at some angle with respect to each other, then many images can be formed and the number of images formed by a combination of two mirrors depends on the angle between the mirrors.

Let  $\theta$  be the angle between two mirrors, then the number of images formed is given by

$$n = \left( \frac{360^\circ}{\theta} \right) - 1 \dots\dots\dots (i)$$

Therefore, when two mirrors are placed perpendicular to each other, i.e.  $\theta = 90^\circ$ , then the number of images formed is

$$\left( \frac{360^\circ}{90^\circ} \right) - 1 = 4 - 1 = 3$$



## Check Point ✓

Fill in the blanks.

1. The bouncing back of light into the same medium is called \_\_\_\_\_.
2. If a ray is incident along the normal, then the angle of reflection is \_\_\_\_\_.
3. If two plane mirrors are placed parallel to each other then \_\_\_\_\_ images are formed.
4. Images are formed only during \_\_\_\_\_ reflection.
5. Angle of incidence is always \_\_\_\_\_ the angle of reflection.

## KALEIDOSCOPE

A kaleidoscope is an optical device which is used to create colourful and beautiful patterns formed due to multiple reflections by combination of plane mirrors. It consists of a cylinder with three plane mirrors and some loose, colored beads or pebbles and bits of glass. When you view a kaleidoscope from one end the light entering from the other end creates a colorful pattern, due to multiple reflection of the coloured objects. The mirrors here are set at different angles. When you rotate the tube, the glass pieces tumble and form beautiful colored patterns.



## Activity

**Aim:** To make a kaleidoscope

**Material required:** A circular tube of cardboard, three rectangular plane mirrors, small bits of colored glasses, a cellophane sheet and a cardboard disc

**Procedure:** Fix three mirrors so as to form a prism. Cover one end of the circular cardboard tube with a cardboard disc but keep a small hole to see through. Fix a circular plane glass plate at the other end. Place small bits of colored glasses on the glass plate and close it.

**Observations:** Your kaleidoscope is ready to make colorful patterns. Rotate the tube to see different patterns.

**Conclusion:** A pattern is never repeated in a kaleidoscope.



## Dispersion of Light

The sun appears to be red at the dawn, in the noon it gives the golden white shimmer. Also we see a colorful rainbow when the sun shines after the rainfall. The Sun always surprises us with its display of colours! So what is the color of the sun actually?

The activity given on the next page will tell you the exact answer.

## Activity



**Aim:** To demonstrate dispersion of white light with a plane mirror

**Material required:** A white sheet, a bowl filled with water and a plane mirror

**Procedure:** Place a bowl filled with water near a window. Now place the plane mirror in the bowl such that the sunlight from the window falls on it. Now, adjust the bowl such that the light reflected from the plane mirror falls on the wall. What do you observe?

**Observations:** Light is reflected on the wall with many colors visible on the wall

**Conclusion:** Sunlight consists of seven colors, VIBGYOR, that is, violet, indigo, blue, green, yellow, orange and red.

From the above activity we conclude that a beam of sunlight splits into seven colors on passing through water and getting reflected from a plane mirror.

The splitting of white light into seven colours or VIBGYOR is called the dispersion of light.

A rainbow formed during or just after the rain is an example of the phenomenon of the dispersion of light.



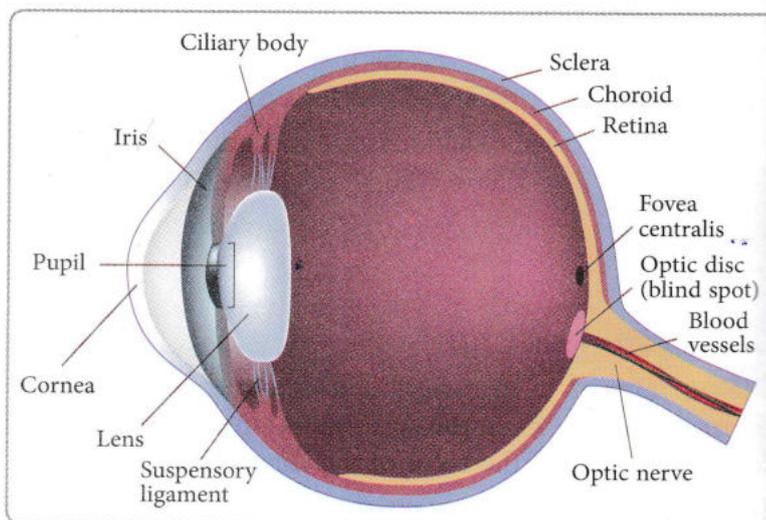
## HUMAN EYE

Just like glass windows, the eyes let the light in and allow us to see our beautiful world. Eyes can be said to be the most important organ of our body.

The light gets reflected from objects around us and enters our eyes that makes the things visible to us. Let us learn more about how the human eye works.

Each part in the structure of the human eye has a specific function explained as follows:

- **Sclera:** The sclera is an opaque outer covering that protects the eye. It is white in color and tough. It keeps light out of the eye except at the center front of the eye.
- **Cornea:** The cornea is a transparent outer covering of the front of the eye which is clear like glass. It protects the eye and also acts as a convex lens. There are no blood vessels in the cornea.
- **Pupil:** The pupil is an opening in the front of the eye behind the cornea. It looks black because it transmits all the light and does not reflect any light at all. The function of the pupil is to control the amount of light that enters the eye. It automatically gets bigger in the dark and smaller in the bright light to let more or less light in, respectively.
- **Iris:** The iris is a dark muscular structure behind the cornea. It controls the size of the pupil and gives its distinctive color. For example, a person with brown eyes has basically a brown coloured iris.
- **Lens:** The lens of our eye is a convex lens which is just behind the pupil of the eye. It focuses the light to form an image at the back of the eye. Tiny muscles contract and relax in order to focus the images of close or distant objects.



- **Retina:** The retina is a screen at the back of the eye on which the image is formed. The retina has nerve cells that change images to electrical signals. The two kinds of cells on the retina are called cones and rods. The rods are good at sensing dim light while cones can sense colors.
- **The optic nerve:** The optic nerve carries electrical signals from the rods and cones to the brain. There is a spot at the junction of the optic nerve and the retina at which there are no cells. This is called the blind spot as no vision is possible at that spot.

### Do you know?

Night birds like owls can see easily at night but not so much during the day as pupil of an owl's eyes is enlarged to allow more light to enter the eyes and there are more number of rods in the retina which are sensitive to the dim light than the cones which are sensitive to the bright light.

- **Eyelids and eyelashes:** Eyes are very precious so they are provided with protection. Eyelids and eyelashes protect our eyes from dust. Eyelids help us to sleep as they shut and keeps the light away. Eyelids trap any dust entering the eye.

### Do you know?

The most active muscles in our body are the muscles that control our eyes. Your eyes are always moving even when they are closed.

## Persistence of vision

Persistence of vision is an interesting phenomenon of the eye due to which an image persists in our eyes for about twenty fifth part of a second. Actually retina retains the image for a  $\frac{1}{25}$  fraction of a second after the actual image is formed.

Presentation of a sequence of still images in a quick succession, helps us to see a continuous moving image. This is the same principle that enables cinematography. This is the reason why we can see a moving picture, when multiple images move across our eyes at the same time.

## Power of accommodation and defects of eye

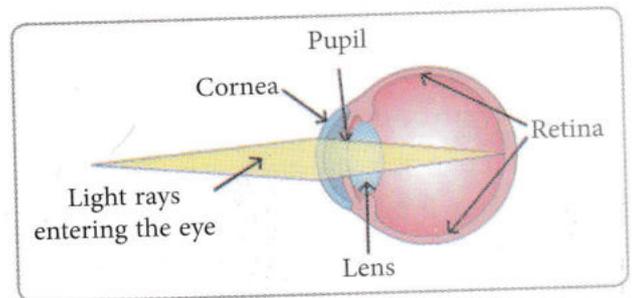
Ciliary muscles are present in the middle of the eye and help control accommodation for viewing objects at varying distances. This process of auto adjustment of the eye to form a clear image of near and far objects is called the accommodation of the eye.

For a normal eye the minimum distance for clear vision is 25 cm and the maximum distance to see an object clearly is infinity.

The farthest point up to which a normal eye can see clearly is called the far point. And the nearest point up to which an object can see clearly is called the near point. Thus, far point of a normal eye is infinity and near point of a normal eye is 25cm. However, the near and far points varies from a person to person. Eyes with vision defects have different near point and far point.

The common defects of the human eye are:

- **Myopia or Near-Sightedness:** When far-off objects appear blurred but objects nearby can be seen clearly, then the person suffers from myopia or near sightedness. It happens when the eyeball is too long or the eye lens's refractive power is too high such that the image is formed in front of the retina instead of forming on the retina. Myopia can be corrected by wearing glasses made of concave lens so as to help focus the image on the retina.



- **Hypermetropia or Longsightedness:** Hypermetropia is a defect of vision when it is difficult to see objects that are near but one can clearly see far objects. This happens when the eyeball is too short or eye lens's refractive power is too weak that the image is formed behind the retina instead of on the retina. Hypermetropia can be corrected by wearing glasses containing convex lenses.

## Care for the eyes

Eyes are a very sensitive and essential part of our body. Hence we should take proper care of our eyes. We can take care of our eyes in the following manner:

- We should keep our eyes clean. We should wash our eyes with clean and cold water.
- Never use too bright light as it can injure the retina. Neither use too dim light while reading or doing work as dim light can cause eye strain and headaches.
- Avoid reading while traveling in a moving vehicle.
- Never rub your eyes if a dust particle goes inside instead wash your eyes with clean cold water thoroughly.
- Always consult a doctor in case of any injury to the eyes.
- Taking nutritious food is extremely important for your eye health. Good nutrition keeps the eye in good condition. You should consume food rich in vitamin A. Green vegetables, eggs, milk, curd and cheese are a few of the foods rich in vitamin A. In addition, you should consume fresh fruits to keep your eyes healthy.

## REFRACTION OF LIGHT

Light travels in a straight line. This is one of the properties of light. However, this does not mean that the light rays never bend or change their paths. Light will travel in a straight line until it is in the same medium. If light rays moves from one medium to another, they will bend or change their path at the boundary of the two mediums. The phenomenon of bending of light while travelling from one transparent medium to another is called refraction of light. Let us understand this with the help of an activity.

### Activity

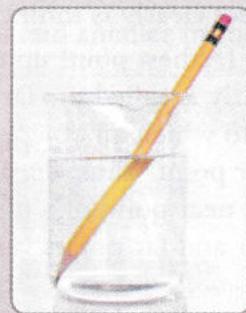
**Aim:** To understand the refraction of light.

**Procedure:**

1. Take a glass
2. Fill 1/4th part of the glass with water
3. Put a pencil in the glass.
4. Observe it from above.

**Observation:** You will observe that the pencil is bent in the water.

**Conclusion:** The pencil seems bent because light rays changes their direction while travelling from air to water. This change in the direction of light occurs because of refraction.



The main reason of the refraction of light is the speed of light in different mediums. In different mediums, the speed of light is different. For example, speed of light in air is  $3 \times 10^8$  m/s, while it is  $2.25 \times 10^8$  m/s in water and  $2 \times 10^8$  m/s in glass.

While comparing two mediums, the medium in which the speed of light is more is called optically rarer medium or rarer medium while the other medium in which the speed of light is less, it is called optically denser medium or denser medium. So, while comparing air and water as a medium, water is optically denser medium than air or air is optically rarer medium than water. Similarly, glass is optically denser medium than air or air is optically rarer medium than glass.

### Refraction of light in Daily Life

There are various examples of refraction of light in our day to day life. Some of these examples are:

- Legs of a person standing in a swimming pool look shorter
- A river looks less deeper than its original depth
- While diving in a river or sea, anything inside the water looks 25% larger than its original size
- Any object submerged in water appears to be raised.

### Do you know?

The Sun appears oval in shape during morning and evening but round in noon. This is because of atmospheric refraction. In the morning or evening, the Sun is near the horizon and thus the light coming from its upper and lower edge bends unequally while travelling in the atmosphere. Thus, the Sun seems to have an oval shape due to the atmospheric refraction. However, during the noon, the Sun is at overhead and its rays fall normally and do not bend; thus sun seems to be in circular shape.

### Check Point

State whether true or false.

1. Reflected light cannot be reflected again. \_\_\_\_\_
2. Splitting of white light into seven colours causes rainbow formation after rainfall. \_\_\_\_\_
3. A person suffering from myopia cannot see nearby objects clearly. \_\_\_\_\_
4. Hypermetropia can be corrected by using concave lens. \_\_\_\_\_
5. The image in human eye is formed on the retina. \_\_\_\_\_

### Key Terms

- **Incident ray:** The ray of light that strikes the mirror is called the incident ray.
- **Point of incidence:** The point at which the incident ray falls is called the point of incidence.
- **Reflected ray:** The ray that reflects off the mirror is called the reflected ray.
- **Normal:** The line drawn at right angle to the mirror surface is called the normal.
- **Angle of incidence:** The angle which incident ray makes with the normal is called the angle of incidence  $\theta_i$
- **Angle of reflection:** The angle which reflected ray makes with the normal is called the angle of reflection  $\theta_r$
- **Dispersion:** White light of the Sun consists of seven colors. The splitting of white light into its constituent seven colors is called the dispersion of light.
- **Myopia:** Defect of vision in which one cannot see distant objects clearly.
- **Hypermetropia:** The vision defect in which one cannot see nearby objects clearly.

## Recall



- **Laws of reflection:**
- The incident ray, reflected ray and the normal to the mirror at the point of incidence, all lie in the same plane.
- The angle of incidence is equal to angle of reflection  $\theta_i = \theta_r$
- Image formed by a plane mirror is virtual, erect, same size and laterally inverted.
- If  $\theta$  be the angle between two mirrors, then the number of images formed is:  
$$n = (360^\circ/\theta) - 1$$
- White sunlight consists of seven colors and the splitting of white light into its constituent colors is called dispersion of light.
- The farthest point up to which a normal eye can see clearly is called the far point. And the nearest point up to which an object can see clearly is called the near point.
- Far point of a normal eye is infinity and near point of a normal eye is 25 cm.
- Myopia can be corrected by wearing glasses made of concave lens so as to help focus the image on the retina.
- Hypermetropia can be corrected by wearing glasses made of convex lens so as to help focus the image on the retina.

## Assess Zone

### A. Tick (✓) the correct answer.

1. The angle of reflection is
  - a. always equal to angle of incidence
  - b. always greater than angle of incidence
  - c. always less than angle of incidence
  - d. sometimes equal to and sometimes greater than angle of incidence.
2. The image formed by a plane mirror is
  - a. virtual, inverted and same size
  - b. virtual, erect and same size
  - c. real, erect and same size
  - d. virtual, erect and bigger than the size of object
3. A toy is placed at 5 cm in front of a plane mirror. What is the distance of image from the real toy?
  - a. 5 cm
  - b. 10 cm
  - c. 15 cm
  - d. 20 cm
4. Which of the following is based on the concept of multiple reflections?
  - a. Telescope
  - b. Microscope
  - c. Kaleidoscope
  - d. All of these
5. Which of the following part of human eye acts as the screen?
  - a. Optic nerve
  - b. Convex lens
  - c. Retina
  - d. Cornea

6. The amount of light entering the eye is controlled by
  - a. pupil
  - b. cornea
  - c. eye lids
  - d. optic nerve
7. If two plane mirrors are kept perpendicular to each other, then the number of images formed is
  - a. 2
  - b. 3
  - c. 4
  - d. infinite
8. Rainbow is formed due to
  - a. reflection of light
  - b. refraction of light
  - c. dispersion of light
  - d. scattering of light
9. Myopia can be corrected by using
  - a. periscope
  - b. concave lens
  - c. convex lens
  - d. binoculars
10. We are able to see a movie because of the phenomenon of
  - a. reflection
  - b. dispersion
  - c. persistence of vision
  - d. cataract

**B. Fill in the blanks.**

1. The angle of \_\_\_\_\_ is always equal to angle of \_\_\_\_\_.
2. Image formed by a plane mirror is \_\_\_\_\_ inverted.
3. \_\_\_\_\_ is an aid for visually challenged persons in which characters are represented by patterns and dots.
4. \_\_\_\_\_ is the outer coat of eye covering which is white and tough.
5. Kaleidoscope is an instrument which creates beautiful colored patterns due to \_\_\_\_\_.

**C. State whether the following statements are true or false.**

1. Far point of a normal eye is 25 cm. \_\_\_\_\_
2. Diffused reflection cannot produce an image. \_\_\_\_\_
3. Cones cause the sensation of color of objects in our eyes. \_\_\_\_\_
4. The number of images formed by a combination of mirrors depends on the angle between the mirrors. \_\_\_\_\_
5. Image formed by a plane mirror becomes real when the object is very close to the mirror. \_\_\_\_\_

**D. Match the following.**

- |                 |                    |
|-----------------|--------------------|
| 1. Concave lens | a. Dispersion      |
| 2. Convex lens  | b. Non optical aid |
| 3. Plane mirror | c. Hypermetropia   |
| 4. Prism        | d. Myopia          |
| 5. Braille      | e. Kaleidoscope    |

**E. Give reasons for the following.**

1. A ray incident along the normal to a plane mirror retraces its path.
2. We cannot see our image in old utensils of steel.
3. A night bird like owl can see very well during the night but not during the day.
4. Too little or too much light is bad for eyes.

**F. Answer the following questions in one word or a single sentence.**

1. Define reflection.
2. State the second law of reflection.
3. Write all the characteristics of the image formed by a plane mirror.
4. Define angle of incidence.
5. Name two instruments that work on multiple reflections.
6. How many colours constitute white light? Name all the colours.
7. State two ways in which you can take care of your eyes.
8. If a coin is placed between two parallel mirrors at 30 cm separation, then how many images of the coin will be formed?

**G. Answer the following questions in brief.**

1. Distinguish between two types of reflections.
2. With the help of a ray diagram show the formation of image in a plane mirror.
3. What is meant by lateral inversion? Give an example
4. Illustrate multiple reflections with an example from real life.
5. If the angle between the reflected ray and incident ray is  $90^\circ$ , then what is the angle of reflection?
6. Show that white light from the sun constitutes seven colours. Name the phenomenon which demonstrates the constituents of white light.
7. Define the two types of defects of vision.

**H. Answer the following questions in detail.**

1. Draw a diagram to show the reflection of light from a plane mirror. Define the following terms: incident ray, reflected ray, normal, angle of incidence and angle of reflection.
2. Draw a labelled diagram of human eye and write the function of each part.
3. Define blind spot. What distinguishes the vision of day light birds from night birds?
4. Explain an activity to show persistence of vision. Write one application of persistence of vision.
5. Explain the working of a kaleidoscope. State some applications of kaleidoscope.

### Out of The Box

1. When you wave your hand very fast in front of your eyes, the fingers appear to be blurred. Why?
2. If angle of incidence is  $30^\circ$ , then what angle does the reflected ray makes with the mirror?
3. Name the lens present in human eye. Where is the image formed in case of a normal eye. How does the position image vary for a myopic and hypermetropic eye?

## In Real Life

1. Vishal found that his grandfather was not able to read the newspaper clearly. He took him for an eye check-up. The Doctor checked him and asked him to wear spectacles. What is the defect in the vision of his grandfather? Which lens would have been used in his spectacles to correct the defect?
2. Replacing all the incandescent light bulbs in your home with energy-efficient compact fluorescent lamps or LED light bulbs contributes to carbon emissions and interfering with delicate ecosystems through light pollution. What are the possible causes and effects of light pollution?

## Subject Enrichment

### Activity Zone

Check if you can convert a rough surface into a smooth and shiny surface. Observe the difference in the reflection between the rough surface and when the rough surface changes to smooth surface. When do you see your image?

### Project Zone

Using the concept of multiple reflections make your own periscope with two plane mirrors. Also check if laws of reflection hold good for the periscope.

## Web-links

- Image formed by a plane mirror: <https://www.youtube.com/watch?v=2ek0EsEMTBc>
- Working of kaleidoscope: <https://www.youtube.com/watch?v=uxdGpXSTc0Q>

## Crosslinks

1. How are multiple reflections useful for the defense services?
2. How do painters use colors to create reflections or shadows to add life and dimension to their paintings?

## Teacher's Note

Demonstrate the laws of reflection of light. Guide the students to make their own kaleidoscope. Also, make them aware and encourage them to take care of their eyes from time to time.

## Chapter Focus

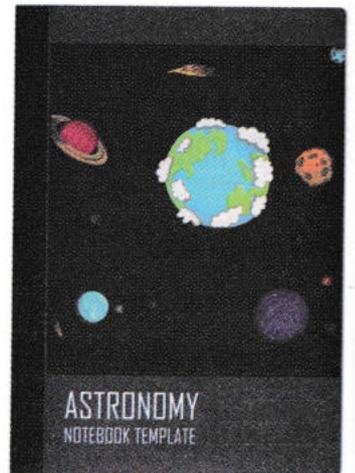
-  The Moon
-  Stars
-  Constellations
-  The Solar System
-  Some Other Members of Our Solar System

## Kick-off Activity

### Making your own Moon Journal

You have learnt in the earlier classes about the different phases of the moon. Now, let us try and make our own Moon Journal. You will have to be very patient for this activity and will have to observe the Moon for its complete cycle, that is, 28 days. For this, you will need to start from the full moon day. (You can ask your teacher, parents or guardian about the full moon day of the month and then start observing the moon.) Draw the shape of the Moon for each day. Record your observations in your Moon Journal.

What do you observe and what do you conclude from the full month's observations of the shapes of the Moon?



When you observe the sky on a clear day, you can only see the bright Sun and some clouds. However, when you look at the sky at night, you can see a large number of stars all over the sky. Some stars appear bright and twinkling and some do not twinkle. The objects that are visible in the night sky as stars but do not twinkle are actually planets. However, our Sun, the ultimate source of energy on the planet Earth is actually a star.

All these heavenly bodies such as stars, planets, satellites like moon, asteroids and comets are known as celestial bodies. Let us study about these celestial bodies in detail.

## THE MOON

The Moon is the only natural satellite of the Earth. The Moon does not emit light of its own. It reflects the light falling from the Sun on it. It is still the second brightest object after the Sun in the sky

followed by Venus. In fact, the Moon is the nearest celestial object to the Earth. The distance of the Moon from the Earth is approximately 400,000 km.

Its size is one fourth of the Earth and its mass is one-eighth of the mass of the Earth. Since gravity on the Moon is too less to hold any gases, Moon has no atmosphere and no air. Also, there is no water on the Moon. Thus, in the absence of air and water life could not be possible on the Moon.

The Moon is full of craters and mountains.

Earth revolves around the Sun and the Moon revolves around the Earth in its orbit and the force of gravitation between the Moon and the Earth holds the Moon in its orbit. The Moon completes one orbit around the Earth in 29 days.

### Do you know?

Neil Armstrong was the first man to land on the Moon. He was an American astronaut who landed on the Moon in July 1969.

## Phases of the Moon

If you carefully observe the Moon in the sky for a month to your surprise you will find that the Moon appears to be different every day. In fact its shape changes every day. These different shapes of the Moon are known as the phases of Moon which can be seen in the image below:



We can see that there are some nights on which we can see the full bright moon, while on some others we see only half moon and still other nights when the Moon is only partially visible or not visible at all. Let us find out why is it so.

We know that the Moon does not emit its own light, whereas the Sun and other stars do. We can see the Moon only because of the sunlight falling on it gets reflected towards us. Therefore, only that part of the Moon is visible which reflects the sunlight falling on it.

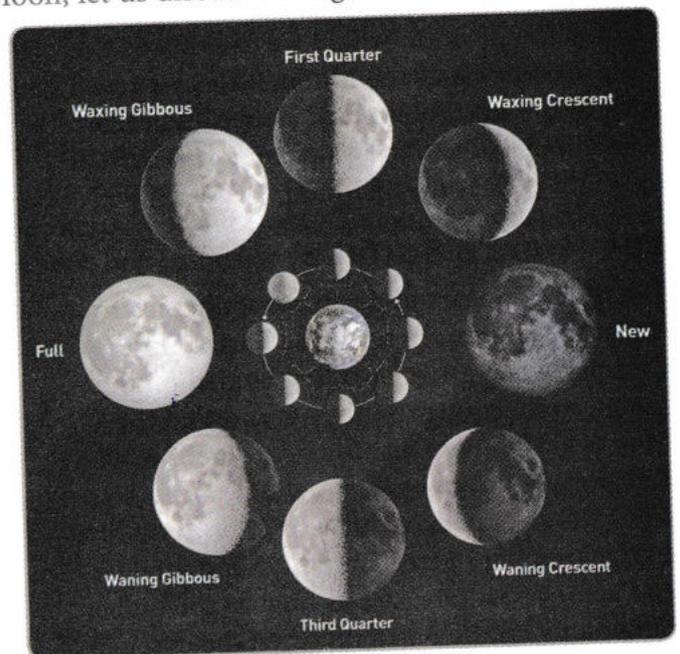
Based on the relative positions of the Earth and the Moon, let us discuss the eight distinct phases of the moon as follows:

### New moon

When the Moon moves between the Earth and the Sun, the side of the Moon facing the Earth becomes completely dark. This is called the **new moon**. Thus, on a new moon day the Moon is not visible at all in the sky. Also we can say that on a new moon day, the Sun and the Moon both rise and set simultaneously.

### Waxing Crescent

After a few days of the new moon day; the Moon appears like a crescent. After the new moon day some part of the Moon gets illuminated as the Earth starts moving away from the line between the Sun and the Moon. We are able to see a silvery arc which keeps growing for the next few days. This phase is called the **waxing crescent moon**.



### Quarter moon

Within about a week from the new moon day, one fourth of the Moon's orbit around the Earth gets completed. Thus, we can see half of the moon now due to its illumination from the sunlight. This is called the **first quarter moon**.

### Waxing gibbous moon

After the first quarter, with the further movement of the Moon, the greater part of the Moon gets lit up by the sunlight falling on it. Thus, the illuminated portion of the Moon continues to grow until the Moon is full. This phase of the Moon is called the **waxing gibbous moon**.

### Full moon day

After two weeks of the new moon day, the Moon has completed half of its orbit around the Earth. At this time the illuminated part of the Moon coincides with the face of the Earth. Hence we can see the **full moon**. During this part of the cycle, the rising time of the full moon coincides with the time of sunset.

### Waning gibbous moon

After the full moon day, the reverse journey starts. That is the Moon moves such that the illuminated part of the Moon will keep on becoming less visible. Thus, now the illuminated part of the Moon starts decreasing. In simple words we say it starts waning. This phase is called the **waning gibbous moon**.

### Last quarter moon

Three weeks after the new moon, the three-fourth journey of the lunar orbit is complete. Again the Moon moves into the position such that only half of the illuminated part of the Moon is visible on the Earth. Therefore, we again see only the half-lit moon. This phase is called the **last quarter** or the **third quarter**.

### Waning crescent moon

Finally, the Moon approaches the end of its orbit and the illuminated part of the moon again reduces to a thin silver arc. This phase is called **waning crescent moon**.

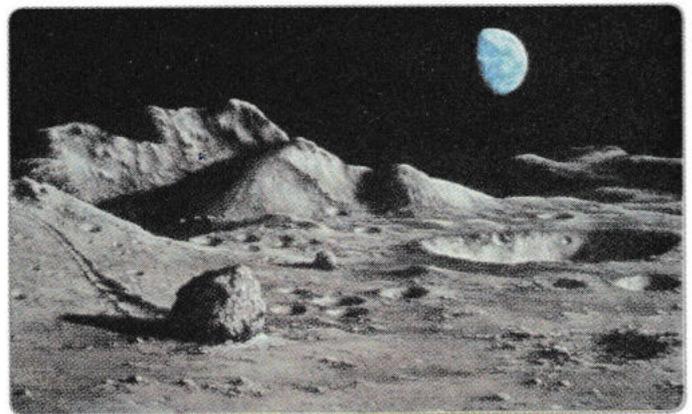
After the waning crescent the Moon again reaches the position where we cannot see the illuminated part of the Moon. Thus, we reach back to the new moon day. Hence, the cycle gets completed in 29 days passing through all the eight phases of the Moon.

### The Moon's Surface

The Moon appears to be an attractive silvery object for all of us here on the Earth. On the contrary when astronauts first landed on the moon, to their surprise they found that the Moon's surface was just the opposite of what we had imagined it to be. It is a dusty and barren place full of craters of different sizes. It also has a large number of steep and high mountains and some mountains are as high as the highest mountains on the Earth. Further, the absence of

### Do you know?

Most festivals in India are celebrated based on the different lunar phases. For example, Diwali is celebrated on the new moon day, while Budh Poornima and Guru Nanak's birthday are celebrated on the full moon day; Maha Shivratri is celebrated on the thirteenth night of the waning moon.



air and water on the Moon makes it unfit for life to sustain here. But interestingly, due to the absence of water the Moon is able to preserve most of its ancient features. In fact the footprints of the astronauts visiting the moon also remain intact.

## STARS

A star is a huge celestial body. There are billions of stars in the sky out of which many are bright and shiny while some are faint. The stars shine because they produce a lot of heat. The Sun is also a star and it is the nearest star to the Earth. It is at a distance of approximately 149,600,000 kilometers from us. Though the stars are present in the sky even during the day but because of the bright light of the Sun, we do not see them.

After the Sun, Proxima Centauri (also known as Alpha Centauri) is the nearest star to the Earth. It is at a distance of 4.3 light years from the Earth. A light year is the distance travelled by light in one year. Distances of all stars are usually expressed in terms of light years.

One light year =  $9.46 \times 10^{15}$  m.

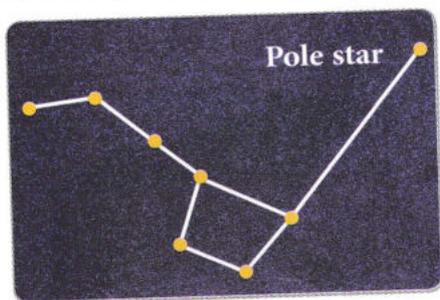
The light from the Sun takes about 8 minutes to reach the Earth.

The size of the stars are much bigger as compared to the Earth.

Some stars are even bigger than the Sun but Sun appears to be bigger than other stars as it is closest to the Earth while other stars are very far away.

Though the life of stars is millions of years, they are not permanent. Since the stars are formed from gases, when the gases such as hydrogen run out low as they keep on fusing into helium, the core of the star begins to shrink. The temperature of the collapsing core rises so much that it makes the outer portion of the star to expand greatly. At this point the star is called a **red giant**.

After passing the red giant stage, the fusion ends and the core starts shrinking due to gravity. The shrinking core ends up the star finally as a **neutron star** or a **white dwarf star**.



Just as a consequence of the relative motion, all stationary objects appear to be moving in opposite directions, similarly since the Earth rotates from west to east, the celestial bodies appear to move from east to west with the exception of the Pole Star which remains fixed at its position. This happens because the pole star lies on the imaginary axis of the rotation of the Earth. The pole star is only visible from the northern hemisphere.

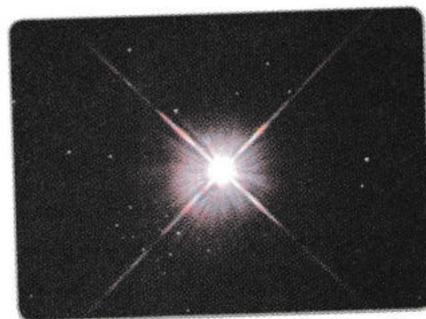
### Activity

**Aim:** To demonstrate the direction of relative motion of objects

**Procedure:** Stand below a stationary fan. Start moving in a rotational motion below the fan while observing the fan carefully. What do you observe?

**Observation:** The fan will appear to move in a direction opposite to your direction of rotation.

**Conclusion:** Stationary objects appear to move in a direction opposite to your direction of motion.



*Alpha or Proxima Centauri*  
(Source: By ESA/Hubble, CC BY 4.0,  
<https://commons.wikimedia.org/w/index.php?curid=29263039>)

### Do you know?

In ancient times, sailors and travellers used the pole star to find way when they had to travel during the night.

## CONSTELLATIONS

Many times you might have noticed that a group of stars appear to form certain patterns in the night sky. Such a group of stars which resemble a certain familiar shape is called a constellation. Hindi name for constellations is nakshatras. There are 88 recognised and named constellations.

The important features of constellations are:

- All the stars in a fixed pattern or constellation always stay together
- The constellations stay the same night after night.
- The names of constellations are derived from the figure or pattern they resemble.
- Constellations appear to move from west to east.

### Activity



**Aim:** To demonstrate the stationary nature of pole star.

**Material required:** An umbrella and white paper.

**Procedure:** Draw at least 15 small star shapes and 1 big star on a white sheet of paper. Cut out the small star shapes from the white sheet and paste them at different points on the umbrella. Cut out the one big star and paste it at the center of the umbrella such that it coincides with the central rod of umbrella, that is, it lies on the axis of the umbrella. Now, if you rotate the umbrella holding from the central rod, what do you observe?



**Observations:** The big star pasted at the center does not appear to move at all.

**Conclusions:** The Pole star appears to be stationary as it lies on the axis of the rotation of earth.

The four important constellations are:

- Ursa Major or great bear
- Orion
- Cassiopeia
- Leo

### Ursa Major

One of the most famous constellations which is visible during the summer nights is Ursa Major with its Indian name *Saptrishi*.

Ursa Major is constellation of seven stars arranged in a pattern whose shape resembles that of a bear. Ursa Major is visible all year in the Northern hemisphere.

Sometimes Ursa Major is also known as big dipper as it resembles the shape of a ladle. The four stars that appear as four vertices of a quadrilateral make the bowl of the ladle and the remaining three stars make the handle. The pole star being fixed in the sky lies on the northern end of the extended line drawn through two stars at the end of Ursa Major.



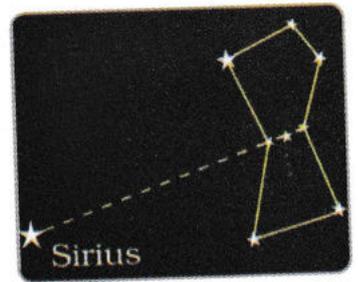
### Orion

Another well-known constellation is Orion that can be seen during winter nights.

Orion is one of the most magnificent constellations in the sky which consists of seven or eight bright stars.

Another name for Orion is Hunter as the three middle stars resemble a shape of the belt of a hunter. The four bright stars appear to be arranged in a quadrilateral pattern.

The brightest star in the night sky is 'Sirius' and can be located with the help of the Orion constellation. When you imagine a straight line through the three middle stars of Orion and look in the east direction, you can see a very bright star on the imaginary line which is actually Sirius.



### Cassiopeia constellation

Cassiopeia is another prominent constellation in the northern sky which can be seen during winters in the early part of the night. The arrangement of stars is such that it looks like a distorted letter W or M. This constellation is imagined to represent an ancient queen whose name was Cassiopeia.



### Leo constellation

Leo constellation is a constellation consisting of 9 stars which form a pattern resembling the outline of a big lion. It is visible during summer nights and lies in the northern sky.

### Check Point



Fill in the blanks:

1. Moon has \_\_\_\_\_ atmosphere.
2. There are \_\_\_\_\_ distinct phases of the moon.
3. When no moon is visible, it is called a \_\_\_\_\_ moon day.
4. The nearest star to the Earth is the \_\_\_\_\_.
5. Recognizable patterns of a group of stars are called \_\_\_\_\_.
6. Ursa Major is also known by the name of \_\_\_\_\_.
7. The brightest star in the sky located close to Orion is \_\_\_\_\_.

## THE SOLAR SYSTEM

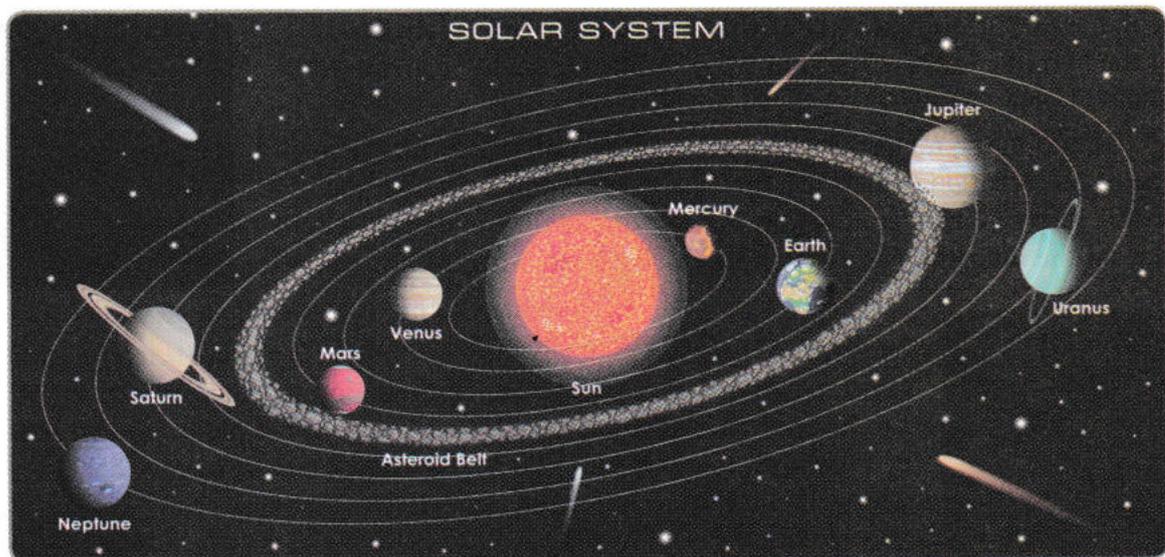
Our universe is unimaginably and infinitely big. It is a sum total of all existence. The universe consists of many galaxies, planets, stars, meteorites, satellites and various other things.

Our solar system is a part of the Milky Way galaxy. The solar system consists of eight planets and their satellites revolving around the Sun. The Sun is the Solar System's central star which holds all the planets by gravitation and it is the most massive component. Other celestial objects such as stars, meteors, asteroids and comets are also a part of the solar system.

The eight planets that revolve around the Sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

### Sun

The Sun is the nearest star to the Earth. Hydrogen inside the Sun fuses to form Helium. This process of fusion inside the Sun releases a tremendous amount of heat energy. This makes the temperature of the



Sun extremely high. Also, the Sun is the most massive component of the solar system. Thus, it holds the entire solar system with a strong gravitational pull.

## Planets

The four planets that are closest to the Earth are—Mercury, Venus, Earth and Mars. They are also known as inner planets. They have solid surfaces with rocks, thus they are known as terrestrial planets. The far-away planets, Uranus and Neptune are coldest being away from the Sun. They are known as ice giants while the middle planets, Mars, Jupiter and Saturn are known as gas giants.

Let us discuss all eight planets one by one.

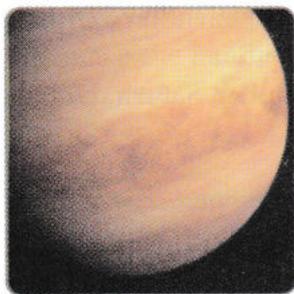
### Mercury

The smallest planet and the planet nearest to the Sun is Mercury. The Sanskrit name of mercury is *budh*. Due to its proximity to the Sun, it is not visible because of the Sun's bright light. However, after the sunset and before the sunrise, it can be observed near the horizon. When mercury is seen in the morning before sunrise, it is called the morning star in the Eastern sky and when it is seen in the evening after the sunset it is called the evening star in the Western sky.

Mercury is the fastest of all the planets to complete its orbit around the Sun as it is closest to the Sun, that is, it has the smallest orbit. Mercury is mainly made up of iron. It has no atmosphere and no satellites of its own. Though its orbit is small, it rotates very slowly such that one day on Mercury equals about 59 days on the Earth. The revolution of Mercury around the sun is completed in 88 earth days.



### Venus



Venus is the second planet from the Sun. It got its name from the Roman goddess of beauty and love. The Sanskrit name of Venus is *shukra*. The size of Venus is almost the same as that of the Earth. Since it is very close to the Earth it appears as a brightest planet in the sky as it largely reflects the sunlight from the clouds. The atmosphere of Venus is quite thick due to which it is the hottest of the inner planets. Venus rotates from East to West and it has no moon or natural satellites. One rotation of Venus is completed in 243 earth days and one revolution around the Sun is completed in 224.7 days.

## Earth

The third planet from the Sun is our Earth. The Earth is the only planet in the solar system which sustains life as it has all the essential requirements to do so. The Sanskrit name of the planet Earth is *prithvi*. The temperature on the Earth is perfect for water and life due to its appropriate distance from the Sun. Further, the force of gravitation of the Earth is exactly the magnitude required to hold the atmospheric gases for the survival of life. Some of the important features of the Earth are:

- 70% of the Earth is covered in water.
- Earth has a thin layer of atmosphere which contains all the gases we need to live and the ozone layer protects us from dangerous gases and extremely harmful ultraviolet radiations and heat in space.
- Earth is the largest planet among the inner planets.
- Air, water and land make up the most essential features of the Earth that sustain life on the planet.
- Unlike other planets, the Earth is neither too hot nor too cold. Rather the temperature of the Earth is perfect for life to exist.
- The axis of the Earth does not lie on the plane of its orbit but it is tilted at 23.5 degrees.
- Earth has its own natural satellite that is moon. The Moon revolves around the Earth just like Earth revolves around the Sun.

The Earth rotates about its own axis in 24 hours which make day and night. The revolution of the Earth around the Sun is completed in 365 days which make one year. The different seasons on the Earth like summer, winter, spring and autumn are a result of motion of the tilted Earth around the Sun.

## Mars

The planet whose surface appears to be red is Mars. Mars is the fourth planet from the Sun and the neighbour of the Earth. Due to the red appearance of its surface Mars is known to be the red planet. The Sanskrit name of Mars is *mangala*.

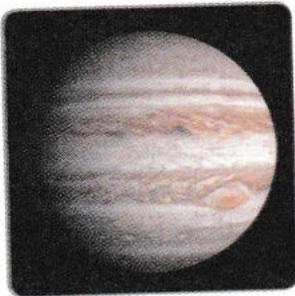
Mars is a small planet, although it is big as compared to the Earth, with a small amount of mass. Since it is quite far away from the sun, it is very cold. Similar to the Earth, Mars also contains the essential matter for existence of life, that is, oxygen. Nitrogen, carbon dioxide, water vapour and noble gases though all these are also present in small amounts.

Though scientists have not been able to prove any existence of life on mars, but investigations are on. Mars has two natural satellites.



## Jupiter

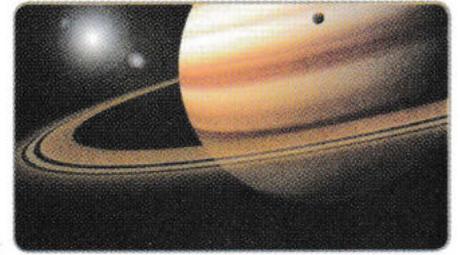
The biggest planet of the solar system is Jupiter. Jupiter is the first of the outer planets, and the fifth planet from the Sun. The Sanskrit name of Jupiter is *brihaspati*. An interesting fact about Jupiter is that it is twice as large as all other planets put together and it is much heavier than all the other planets together. Since Jupiter has a very thick layer of atmosphere, it reflects most of the sunlight falling on it. This makes Jupiter the brighter object in the night sky. Thus, we can easily see Jupiter in the sky. Jupiter is very far from the Sun, so it is too cold to sustain life. Further the presence of poisonous gases like methane and ammonia makes it unfit for most life.



Jupiter has 79 known satellites and it rotates rapidly around its axis. If we observe through a telescope, four moons of Jupiter are visible which are almost as big as planets.

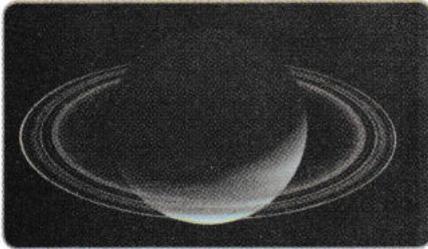
## Saturn

The second biggest planet after Jupiter is the Saturn. It is the sixth planet from the Sun. Like Jupiter, Saturn is also composed of mainly hydrogen and helium. Saturn is well known for its visible colorful rings. Saturn's rings are made up mostly of ice. The Sanskrit name of Saturn is *shani*. Saturn has 62 moons. Due to its lighter weight and speed, Saturn is not round but it is wider in the middle.



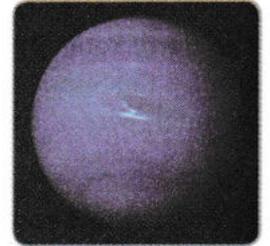
## Uranus

Uranus is the seventh planet from the Sun and the only planet named after a Greek god, meaning god of the sky. The Sanskrit name of Uranus is *indra*. Uranus has a unique feature that it rotates horizontally from east to west. Uranus was the first planet to be discovered with a telescope. Uranus is the third biggest planet of our solar system. It is believed that on the surface of Uranus there could be a huge ocean. However, poisonous gases surrounding the planet makes it unfit for life. It takes Uranus 84 years to orbit the Sun. Uranus has 27 satellites.



## Neptune

Neptune is the outermost planet of the solar system or we can say it is the eighth planet from the Sun. Neptune is mainly made up of liquid and frozen hydrogen and helium. Since it is farthest from the Sun, it is the coldest planet. The Sanskrit name of Neptune is *varun*. Neptune has eight satellites and some rings around it. Neptune is the second planet to be discovered with a telescope. It looks like a blue ball.

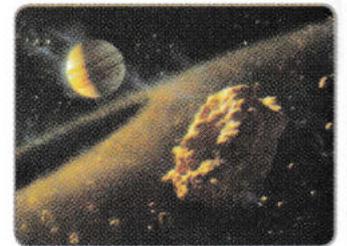


## SOME OTHER MEMBERS OF OUR SOLAR SYSTEM

Apart from planets and stars some other celestial bodies are also present in the solar system. Let us learn about them.

### Asteroids

Asteroids are a large number of small objects located in the vast space occurring between Mars and Jupiter called the asteroid belt. There are thousands of these ancient space rubble located in this belt formed around 5,000 years ago. Since asteroids also revolve around the Sun within the space between Mars and Jupiter, they are also known as minor planets.



### Comets

Small celestial objects mainly composed of gases and dust particles are comets. Comets also revolve around the Sun in an elliptical orbit. A comet develops a long glowing tail as it approaches the Sun which makes it visible.

It has a long bright tail with a head like a ball.

The period of revolution of comets are usually very large. For example, Halley's comet has a period of revolution of 76 years around the Sun, therefore it is seen after every 76 years. Comets gradually die down as and when they come closer to the Sun, their gases are lost and finally they burn out due to the air resistance and the heat produced by other meteors.

## Meteors and meteorites

Small chunks of rocks and debris in space are called meteoroids. While falling through the Earth's atmosphere, meteoroids become meteors which appear as a bright streak of light.

Meteors are also known as shooting stars. A meteor enters the Earth's atmosphere at a large speed which gives rise to a lot of air friction. Thus, a large amount of heat is produced due to which a meteor glows brightly and evaporates quickly. Every year showers of meteors can be seen periodically.

A meteor or a shooting star does not have light of its own like other stars. The light is produced due to the excessive heat caused by burning of particles entering the earth.

Generally meteors evaporate quickly before reaching the Earth but the one which reaches the Earth without evaporating is called a meteorite. Meteorites are like pebbles and big rocks falling from the sky.

It is commonly assumed that meteorites are a part of asteroids which separated from them during their orbit and fell to the Earth.



## Satellites

A satellite is a celestial body revolving around a planet in a similar manner to the revolution of planets around the Sun.

Moon is a natural satellite of the Earth, which revolves around the Earth due to its gravitational pull. The Earth has some artificial satellites too. An artificial satellite is a man-made space craft that is made to revolve around the earth in a set orbit.

An artificial satellite can be launched into an orbit using a rocket. Based on the purpose the altitude and design of a satellite is decided. Artificial satellites revolve around the Earth much closer than the Earth's natural satellite, the Moon.

A large variety of equipment such as cameras, sensors, relaying machines and telescopes are carried in these satellites which run on solar cells.

Life today is highly dependent on these artificial satellites as:

1. Long distance transmission of programs on televisions, radios and the Internet and mobile phones use artificial satellites.
2. Artificial satellites are used for weather forecasting.
3. Information about other planets, stars and galaxies are collected using artificial satellites.
4. Defence services use artificial satellites to keep track of the activities in neighbouring countries.

India has launched many artificial satellites till now. Aryabhata was the first satellite launched by India in 1975.

Some other important satellites launched by India are INSAT, IRS, Kalpana-1, EDUSAT and Bhaskara. The organization that launches satellites for India is ISRO—Indian Space Research Organization.



## Check Point

State whether the following statements are true or false.

1. Mars is the farthest and the biggest planet in the solar system.
2. A celestial body that revolves around a planet is called a satellite.
3. Pole star appears to move from East to West.
4. INSAT is a natural satellite of the Earth.
5. The mass of Jupiter is greater than the total masses of all other planets.
6. Meteors cannot be seen during the day due to the bright light of the Sun.
7. On a waning crescent, the Moon is visible as full moon.
8. Stars emit light only at night.

## Key Terms

- **Phases of the Moon:** Changing shapes of the moon
- **Planets:** Celestial bodies moving around the sun
- **Meteoroids:** Little chunks of rocks and debris in space
- **Asteroids:** Small objects that revolve in a celestial belt between Mars and Jupiter
- **Artificial satellites:** Man-made satellites launched with the help of rockets
- **Light year:** The distance travelled by light in one year
- **Constellation:** A group of stars that form some recognizable patterns

## Recall

- The moon is the only natural satellite of the Earth.
- Moon has no atmosphere and no air and water.
- Moon completes one orbit around the earth in 29 days.
- Based on the relative positions of the Earth and the Moon there are eight distinct phases of the Moon.
- After the Sun, Proxima or Alpha Centauri is the nearest star to Earth. It is at a distance of 4.3 light years from the Earth.
- Light year is the distance travelled by light in one year. Distances of all stars are usually expressed in terms of light years. One light year =  $9.46 \times 10^{15}$  m.
- A group of stars that resemble a certain shape is called a constellation.
- The four important constellations are: Ursa Major or great bear, Orion, Cassiopeia and Leo.
- The eight planets that revolve around the Sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
- Apart from planets and stars, asteroids, comets, meteorites, meteors and satellites are also a part of our solar system.

## Assess Zone

### A. Tick (✓) the correct answer.

- The brightest planet in the universe is  
a. Venus                      b. Mars                      c. Jupiter                      d. Saturn
- Which one of the following is not a planet?  
a. Mercury                      b. Earth                      c. Orion                      d. Neptune
- Which of the following is a constellation?  
a. Ursa major                      b. Orion                      c. Cassiopea                      d. All of these
- Asteroids are the celestial bodies found between  
a. Mercury and Venus                      b. Earth and Mars  
c. Mars and Jupiter                      d. Saturn and Neptune
- The planet with colorful and clearly visible rings is  
a. Earth                      b. Venus                      c. Mars                      d. Saturn
- The brightest star in the night sky is  
a. Sirius                      b. Alpha centauri                      c. Proxima centuari                      d. Ursa major
- The largest planet in the solar system is  
a. Saturn                      b. Jupiter                      c. Mars                      d. Earth
- Which of the following is not an artificial satellite?  
a. Moon                      b. INSAT                      c. EDUSAT                      d. None of these
- The second nearest star to the Earth after the Sun is  
a. Alpha centauri                      b. Proxima centauri                      c. Orion                      d. Sirius
- The star that appears to be stationary in the sky is  
a. Alpha centauri                      b. Sun                      c. Pole star                      d. Sirius

### B. Fill in the blanks.

- Saptrishi is the Sanskrit name of \_\_\_\_\_.
- The phase of the Moon that follows the new moon is known as \_\_\_\_\_.
- The brightest star Sirius is located close to \_\_\_\_\_ in the sky.
- One rotation of Venus is completed in \_\_\_\_\_ earth days.
- Weather forecasting is possible with the help of \_\_\_\_\_.

### C. State whether the following statements are true or false.

- Mars is the coldest planet. \_\_\_\_\_
- The festivals in India are decided on the basis of the position of the Sun. \_\_\_\_\_
- All stars appear to move from East to West. \_\_\_\_\_
- Our Earth and the Sun belong to the Milky Way galaxy. \_\_\_\_\_
- Constellation Ursa Major consists of five major stars. \_\_\_\_\_

**D. Match the following.**

- |              |                      |
|--------------|----------------------|
| 1. Leo major | a. Blue planet       |
| 2. Mercury   | b. Red planet        |
| 3. Meteors   | c. Constellation     |
| 4. Mars      | d. Evaporate quickly |
| 5. Earth     | e. Smallest planet   |

**E. Give reasons for the following.**

1. Sun appears to be bigger than other stars.
2. Stars are not visible in the sky during the day time.
3. Life on Mercury is not possible.
4. The shape of the Moon visible to us keeps on changing.

**F. Answer the following questions in one word or a single sentence.**

1. Define constellation.
2. What is the distance between the Earth and Proxima Centauri?
3. Name the four major constellations.
4. List all the members of solar system.
5. State the composition of Uranus.
6. Moon does not emit its own light. How do we see the Moon then?
7. What are asteroids?
8. Name the comet seen in 1986. What is its period of revolution?

**G. Answer the following questions in brief.**

1. Define a planet. Name all the planets of the solar system.
2. Distinguish between a star and a shooting star.
3. Explain the cause of lunar phases. How many lunar phases exist?
4. Draw a diagram to show the pattern of Orion and Ursa Major.
5. State the difference between a meteor and a meteorite.
6. Which planet has similar characteristics to the Earth? Name those similar characteristics.
7. Define the term artificial satellite. Name a few important artificial satellites launched by India.

**H. Answer the following questions in detail.**

1. Explain all the phases of the Moon in detail.
2. What are the applications of artificial satellites in our life?
3. Define meteoroids. Explain meteoroids in detail.
4. How is pole star different from other stars? How can you locate a pole star?
5. Compare the volumes of Jupiter and earth if radius of Jupiter is 11 times that of the Earth.

## Out of The Box

1. A group of stars is visible during late evenings of winter. The arrangement of the stars resembles a hunter.
  - a. Name the specific arrangement of stars.
  - b. In which category do these stars fall?
  - c. How many bright stars are there in this arrangement?
2. State the unit for measuring distances between stars. Define the unit. How much time does light take to reach the Earth from the Sun?
3. Though the stars are not permanent but still they appear to be permanent. Why?

## In Real Life

Alaya was checking out for the dates of Dussehra, Diwali and Christmas in the calendar. She got surprised and asked her mother that why the Christmas falls every year on the same date but Dussehra and Diwali fall on different dates. Why do you think the dates for Indian festivals are different every year?

## Subject Enrichment

### Activity Zone

1. You have learnt about the eight phases of the Moon. Explore and explain the cause of lunar and solar eclipses. When and why do they happen?
2. Plan a visit to a science museum or a planetarium where students can get to have an idea about the planets, stars and constellations.

### Project Zone

Using colourful and different sized buttons or balls to make a solar system model showing all the celestial objects in it. You could use wires or threads to show orbits of each planet. You could also use clay balls to show asteroid belt between Mars and Jupiter.

## Web-links

- Moon Phases: <https://www.youtube.com/watch?v=AQ5vty8f9Xc>
- Solar System 101: <https://www.youtube.com/watch?v=libKVRa01L8>
- Constellations: <https://www.youtube.com/watch?v=--MGQNhVs3s>

## Crosslinks

1. How is astronomy different from astrology?
2. How do celestial bodies cause ocean bulge?

### Teacher's Note

Teachers should introduce lunar phases by telling about the Indian festivals and how their dates are decided based on the moon phases. Tell the students about ISRO and how do they launch satellites.

# Worksheet 6

(Unit 6 – Natural Phenomena)

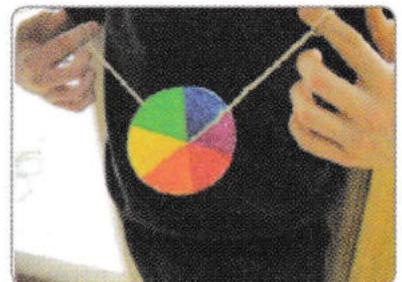
## Making a Disc of Colours

Light seems white but it is really made of 7 different colours – red, orange, yellow, green, blue, indigo and violet. If you spin a disc of different colours very fast, your eyes cannot see the separate colours anymore. They blur together and are seen as “white.”

To make a Whizzer Wheel you will need

A disc with 6-7 distinct colours (as shown in the image), scissors, a sharp pencil and a thin thread

1. Cut out the a coloured discs
2. In the centre of the disc make 2 black dots on top.
3. Using a sharp pencil, carefully make two small holes in the places shown by the dots by pushing the pencil through to the disc.
4. Thread the string up through one hole and down through the other
5. Tie the two ends together and trim the knot
6. Hook your loop of string over your two index fingers with the coloured disc in the centre.
7. Use your fingers to flip the disc until it is tightly twisted
8. Steadily pull your hands apart to make the disc spin rapidly
9. Move your hands inwards as the disc slows down (to make the string twist in the other direction) and then pull them apart once more
10. With practice you will be able to keep the disc spinning! Look at the disc while it is spinning fast. You will see only a creamy white colour! Your eye cannot pick out the different colours at that speed so it blurs all the colours together to form white light. Remember, white light is made of the 7 colours of the spectrum.



# Unit Test Paper 6

(Unit 6 – Natural Phenomena)

## A. Tick (✓) the correct answer.

- Which of the following is an example of an instrument used for transferring charges?
  - Gold leaf electroscope
  - Gold leaf microscope
  - Optical microscope
  - Telescope
- Which of the following is an example of a optical device?
  - Electroscope
  - Kaleidoscope
  - Microscope
  - None of these
- A huge celestial body that emit its own light is called?
  - Planet
  - Asteroid
  - Satellite
  - Star
- Which of the following is an opaque outer covering that protects the eyes?
  - Choroid
  - Sclera
  - Retina
  - Cornea
- Which of the following nerves carry electric signals from our eyes to the brain?
  - Sensory nerves
  - Motor nerves
  - Auditory nerves
  - Optic nerves

## B. Are the following statements true or false? Correct the false statements.

- The angle of incidence is not equal to angle of reflection
- White light consists of seven colors
- Moon has atmosphere of its own
- Like charges repel and unlike charges attract

## C. Give one word or one example for the following.

- When far-off objects appear blurred but objects nearby can be seen
- When it is difficult to see objects that are near but one can clearly see far objects.
- A device used to detect the presence and nature of charge on an object
- The process of transferring the charge from a charged object to the earth or ground
- The instrument that records the seismic waves

## D. Answer the following questions.

- With the help of a diagram describe all the phases of the Moon.
- What is friction? What are the various methods applied to reduce friction?
- What is dispersion of light?
- What are the various laws of reflection?
- How is lightening caused?

## 18

Air and  
Water Pollution

## Chapter Focus

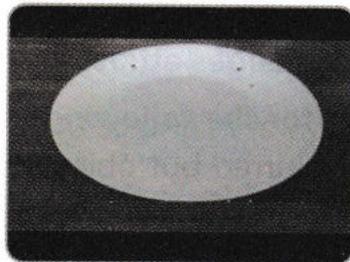
-  Air Pollution—Its Sources and Harmful Effects
-  Prevention of Air Pollution
-  Water Pollution—Causes and Prevention
-  Potable Water
-  Water Treatment Plant

## Kick-off Activity

## Making a pollution catcher

Take a plain coloured (white) paper plate and make two holes on one side of the plate around 4 cm apart using a hole puncher. Take a thread or a shoe lace and insert the thread into the holes in a way that you can hang the plate anywhere. Tie a knot on the loose ends of the thread. Now, smear Vaseline (petroleum jelly) all over the plate such that no part is uncovered.

You have just made your very own pollution catcher!



Locate a spot inside your house preferably near a window that remains open throughout the day and hang your pollution catcher by the window. Leave it for at least 2 weeks.

After two weeks you will notice tiny black particles have got stuck to your pollution catcher. These are the dirt particles present in the air we breathe. These particles are called pollutants.

With the help of this pollution catcher you can measure the amount of dirt particles in the air and take steps to make the air cleaner and protect yourself. You could make several pollution catchers and hang them at places that you feel need to be identified for the intensity of pollution.

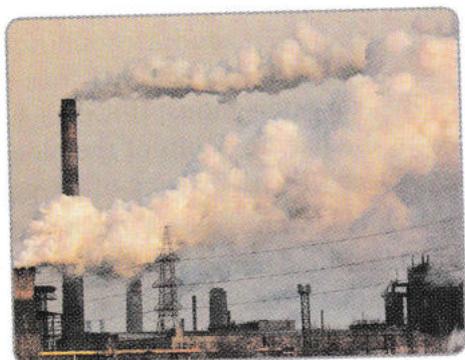
Two of the most important natural resources are the air and the water. The human population and the entire life on this Earth need air and water for survival. However, some of the human activities such as unchecked industrialisation and urbanisation have contaminated these natural resources, making them unfit for living organisms. The contamination of water bodies and air has caused global problems such as global warming, acid rain, etc.

For a healthy sustenance of life on the Earth, we need to ensure that air and water are pollution free. In this chapter, we will discuss the causes of air and water pollution and the effects of this pollution on our lives. We shall also discuss the different ways in which pollution can be prevented.

## AIR POLLUTION

Air pollution can be defined as the presence or introduction of substances that are harmful or poisonous. Some examples of such substances are smoke, dust and toxic gases. These toxic and harmful substances that pollute the air are called pollutants. These pollutants affect both living and non-living things.

Industrial emissions, automobile exhausts and burning of fossil fuels as a result of human activities lead to pollution of air. In addition to human-induced pollution, some natural phenomena also add pollutants to the air, for example, dust and smoke from volcanic eruptions or natural forest fires.



*Sources of human-induced air pollution*



*Natural sources of air pollution*

### Sources of Air Pollution

The following points discuss some of the most common sources of air pollution:

1. **Automobiles:** The exhaust that comes out of the vehicles is a result of burning of fuels such as petrol and diesel in their engines. The exhaust, thus, has poisonous gases such as carbon monoxide and nitrogen oxide. Both of these gases act as pollutants.

2. **Industries:** Many industries burn fuel to run their machines. Such industries release harmful gases through chimneys, thus polluting the air.
3. **Agriculture:** Sometimes, farmers burn the leftover crops to clear their fields for the next round of cultivation. This releases smoke into the air, thus polluting it. Excessive use of pesticides and insecticides also leads to the release of certain toxic gases in the air.
4. **Domestic Practices:** Use of wood, coal or dung cakes as a fuel for cooking releases smoke and fumes into the air.
5. **Natural events:** Volcanic eruptions and natural forest fires add a lot of dust and smoke in the air thus polluting it.
6. **Deforestation:** Deforestation disturbs the balance of gases (carbon dioxide and oxygen) in the air. This also leads to the pollution of air.
7. **Accidents:** Sometimes, harmful gases leak due to explosion in industries or otherwise. This add pollutants in the air in bulk.

## Harmful Effects of Air Pollution

Pollution in air is very harmful to all living beings as well as non-living things. Some of such effects are mentioned here.

### Health Hazards

Many health problems are caused due to air pollution.

1. **Carbon monoxide:** Although it is a colourless and odourless gas, it is very poisonous. If it is inhaled in excess, it becomes fatal. Carbon monoxide combines with the haemoglobin of the blood and forms carboxyhaemoglobin. This disables the blood to carry oxygen. The deficiency of oxygen in blood leads to unconsciousness and even death.
2. **Oxides of Sulphide:** Compounds like sulphur dioxide and sulphur trioxide damage lungs and are causes of numerous respiratory diseases. Sulphur dioxide is fatal to plants.
3. **Oxides of Nitrogen:** These compounds are responsible for the congestion in lungs, which leads to respiratory problems.
4. **Lead oxide:** Brain damage and mental disorders are caused by the lead oxide present in the automobile exhaust.
5. **Fumes:** Toxic fumes released from different types of industries cause irritation in eyes, nose and throat.
6. **Dust:** Fine dust particles are the main cause of bronchitis and many other respiratory problems. During winters, the smoke in the air combines with the fog and form smog. The smog has many pollutants as well as oxides of nitrogen. These cause many respiratory problems.

### Do you know?

Certain particles released in automobile exhausts are so small that they pass through even the hair of our nose. These particles cause irritation in our nose, throat and respiratory tract. Such particles even reach our internal organs and accumulate there, causing severe damage to our health. The stomata of plants are also blocked by these particles. These fine particles remain suspended in the air and thus are called Suspended Particulate Matter (SPM). Some examples of SPM are unburnt carbon particles, lime particle and cement particles.

### Acid Rain

When rainwater contains large amounts of dissolved acids, it is called acid rain. When we burn fossil fuels (petrol, diesel, etc.), large amounts of toxic compounds such as carbon dioxide, carbon monoxide,

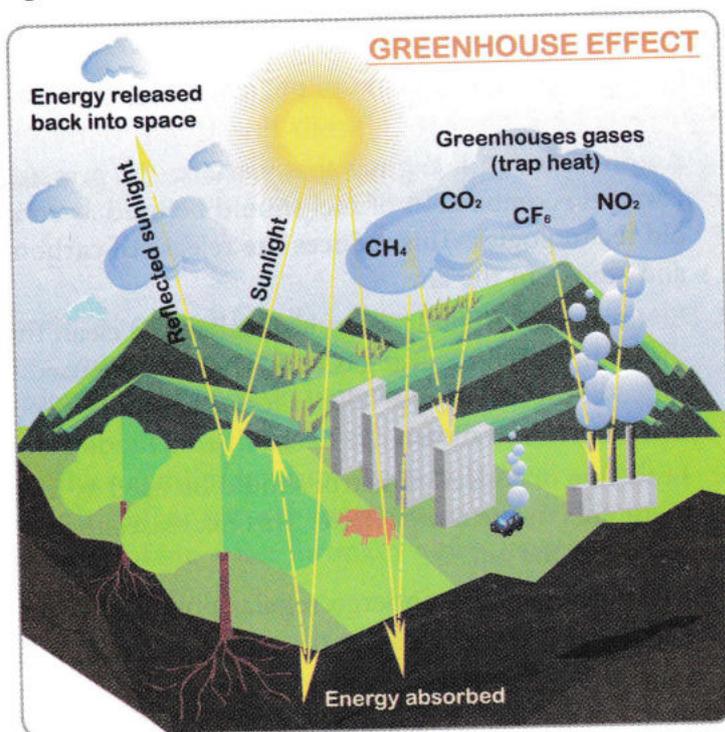
oxides of nitrogen and sulphur, and unburnt hydrocarbons are released in the air. These compounds rise higher in the atmosphere and react with the water vapour present in the atmosphere. Sulphuric acid and nitric acid are formed as a result. These strong acids pour down along with the rain, resulting in acid rain. Acid rain causes the following damages:

1. It makes the water of fresh water bodies such as lakes and rivers acidic in nature. This destroys the aquatic life forms.
2. It increases the acidity of the soil, making it infertile. Also, this further affects the plants and animals thriving and living on/in the soil.
3. Metallic structures and objects such as railway tracks, iron gates, bridges, etc., corrode at a faster rate, shortening the average life span of such structures.
4. Historical monuments and buildings are also greatly harmed by the acid rain. Acid rain leads to a phenomenon known as the **marble cancer**. (The marble cancer is a condition referring to the corrosion of buildings and statues made of marbles by the action of sulphuric and nitric acid.)

### Global Warming

Global warming is the overall rise in the average temperature of the Earth. This increase in the temperature is the result of the increased greenhouse effect. The greenhouse effect is the phenomena where the sun's radiations are trapped by the atmosphere of the Earth. Atmospheric gases such as carbon dioxide, water vapour, methane and chlorofluorocarbons (CFCs) trap the rays of the sun. This leads to the heating of the Earth's surface. Now, because of the excessive burning of fossil fuels, the percentage of atmospheric gases like carbon dioxide has increased in the atmosphere, leading to unbalanced proportion of gases. This disturbance in the balance of gases in the atmosphere has led to increased greenhouse effect, which in turn has increased the average temperature of the Earth's surface, leading to the following:

1. The increased surface temperature is melting the polar ice caps, which, in turn, is increasing the water level in oceans, leading to submerging of land.
2. This has also affected the water cycle and rain patterns, causing changes in climate and weather patterns.



*Greenhouse effect*

### Do you know?

Many people use large glass houses to grow their plants. The glass walls trap the sun rays and keep the inner temperature warmer than the outside. The warm temperature is a more suitable environment for growth of the plants.



3. Changing rain patterns are also disturbing the agriculture cycle, leading to food production problems, which may one day lead to food scarcity.
4. Tsunamis and increased frequency of cyclones, floods, and other such natural disasters is a result of global warming.

### Ozone Layer

Ozone is a gas that is present as a layer the stratosphere of the Earth's atmosphere. This ozone layer prevents the harmful ultraviolet (UV) rays from entering the Earth's atmosphere. However, this layer is being damaged by the CFCs released in the air by refrigerators, air conditioners and aerosol sprays. Ozone layer depletion has the following harmful effects:

1. Cataract, eyesight damage and skin cancer are some of the diseases that can be caused by UV radiations in humans.
2. UV rays can cause gene mutation by altering the gene structure of living organisms.
3. Early development stages of animals such as fish, crabs and some other animals can also be damaged by the UV radiations.

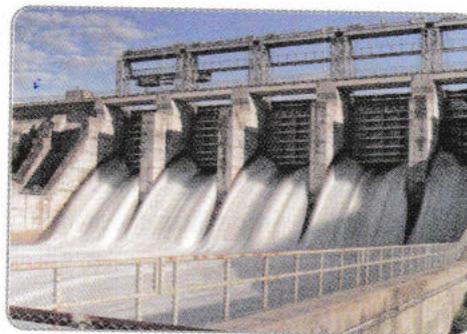
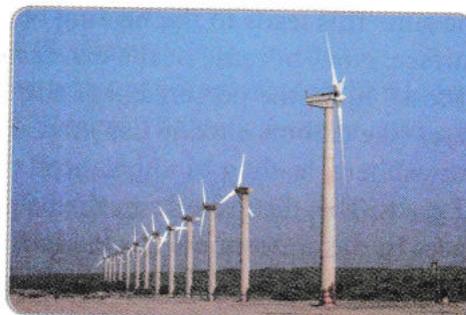
### Do you know?

An ozone hole appears every year in the spring season for 2–3 months over Antarctica. It is known as the Antarctic ozone hole. This hole has grown steadily in the past two decades.

### Prevention and Control of Air Pollution

Following steps can be taken to prevent and control the pollution of air:

1. Automobiles with engines that work on the principle of complete combustion of fuel should be used as compared to old technologies. This reduces the release of carbon monoxide and smoke in the air.
2. Environment-friendly fuels, also called the clean fuels, like the compressed natural gas (CNG) should be used. CNG is called clean fuel as it produces lesser amounts of pollutants than petrol and diesel.
3. Lead-free or unleaded petrol should be used as it releases less pollutants in the atmosphere. This decreases the toxic lead release in the air.
4. All vehicles should undergo regular pollution checks.
5. Lesser use of personal vehicles and more use of public transport reduces the number of vehicles on roads and thus decrease the amount of automobile exhaust in the air.
6. For domestic purposes, liquified petroleum gas (LPG) should be used instead of wood and coal.
7. Hydroelectric energy, solar energy and wind energy should be used as these are cleaner sources of energy.
8. Industrial chimneys should be fitted with gas filters.
9. Residential areas should be far away from industrial sectors so as to reduce health hazards due to air pollution.
10. Afforestation should be encouraged to reduce the greenhouse effect as well as the pollution in the air.



*Some clean sources of energy*

11. Use of recycled paper should be encouraged to discourage cutting down of trees.
12. Crackers should be banned as they produce a lot of smoke and dust.
13. Awareness campaigns should be organised to spread awareness about methods and ways to control and prevent air pollution.

### Do you know?

#### The Van Mahotsav

This tree-planting festival is celebrated in the first week of July every year in India since 1950. The objective of this festival is to 'Save the Mother Earth'. During this week, awareness drives are conducted throughout the country and people are encouraged to plant more trees and adapt eco-friendly ways of living.

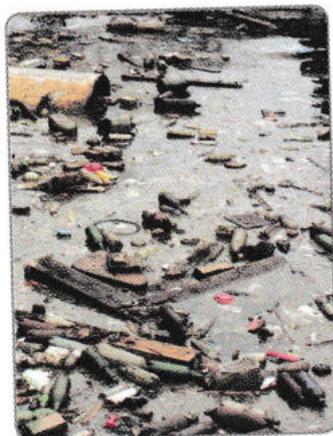
### Check Point

State whether the following statements true or false.

1. Pollutants affect both living and non-living things. \_\_\_\_\_
2. Use of wood, coal or dung cakes as a fuel for cooking is good for environment. \_\_\_\_\_
3. Carbon monoxide is a colourless and odourless gas. \_\_\_\_\_
4. CNG produces more amount of pollutants than petrol and diesel. \_\_\_\_\_
5. Crackers should be banned as they produce a lot of smoke and dust. \_\_\_\_\_

## WATER POLLUTION

The contamination of water by unwanted and harmful substances is called water pollution. Most common water pollutants are domestic sewage, industrial wastes, pesticides and fertilisers. These pollutants pollute the water, which has hazardous effects on both living and non-living things. Water is the most abundant natural resource. It covers about two-thirds of the Earth's surface. Pollution of water bodies greatly affects the life on the planet. The pollution in water seeps to the soil as well the water table present below the ground. Thus, polluting other natural resources as well. In the past few years, lakes, rivers and pond, which are sources of drinking water for many cities, have been contaminated, resulting in scarcity of drinking and clean water.



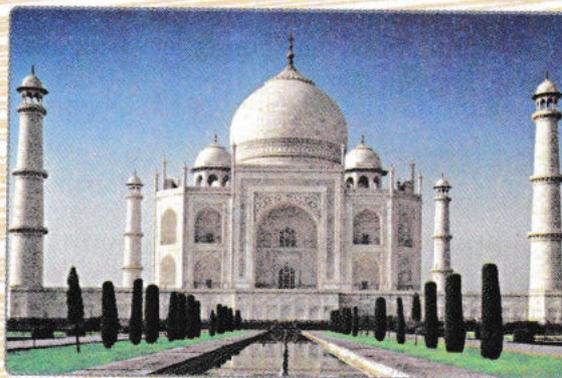
*Water pollution*

## Do you know?

The Taj Mahal in Agra, India is a world-famous heritage site. It is famous for its grandeur and white marble and sandstone. However, in the past few years, the white marble has started to become yellow. The reason for this is the various industries located around the historical monument. The industrial exhausts are turning the white stones yellow. The exhausts from Mathura oil refinery and other chemical, leather and automobile industries release sulphuric oxide and nitric oxide that form the acid rain. The acid rain slowly destroys the marble of Taj Mahal through the phenomenon called the marble cancer.

To save the Taj Mahal, the Supreme Court of India has taken several steps. Some of them are as follows:

- The Mathura Oil Refinery has been working towards reducing its exhausts.
- A Taj Nature walk has been made by planting 19,000 saplings around the Taj Mahal.
- The industries have started using clean fuels such as the CNG and LPG
- The public transport, i.e., the three-wheelers have also switched to CNG.



## Causes of Water Pollution

Some common causes of water pollution are discussed here.

### Industries

The release of untreated industrial discharge directly into water streams and bodies is one of the major causes of water pollution. Highly toxic chemicals such as arsenic, mercury, lead and some other compounds are released from paper, leather, textile and paint industries.

### Agriculture

Farmers use large quantities of pesticides and fertilisers to enhance their crop productivity. Excess of these chemicals wash down to nearby water bodies and contaminate them. Pesticides and fertilisers also seep through the ground, thus contaminating the underground water as well.

### Domestic Activities

Household wastes such as kitchen wastes and sewage are discharged directly into water bodies. This is a major source of water pollution.

### Human Activities

Another reason of water pollution is the bathing of humans and domestic animals in the local water bodies.

### Oil Spills

Another very important and dangerous source of water pollution is the spillage of oils from in-water rigs as well as from on-road or in-water accidents of large oil tankers that spill the oil directly or indirectly into water bodies. The oil spills cause death of large numbers of aquatic plants and animals.

### Atomic and Nuclear Tests

Atomic tests and nuclear test are conducted underwater in oceans. During these test, toxic gases are released that pollute the water.

## Activity



**Aim:** To test the quality of water from different sources

**Materials required:** Samples of water from different sources. Beakers, red and blue litmus papers

### Procedure:

1. Collect small samples of water from different water bodies such as lakes, ponds, tap water, drain water, filtered water, etc. in different beakers.
2. Label all the beakers.
3. With the help of a litmus paper, ascertain whether the sample is basic or acidic in nature.
4. Observe the colour of water samples.
5. Observe if they have any odour.

**Observation:** Make an observation table in your notebook as shown below and fill in your findings.

Sample Source	Colour	Odour	Acidic	Basic
Sample A				
Sample B				

**Conclusion:** Discuss your findings in the class.

## Harmful Effects of Water Pollution

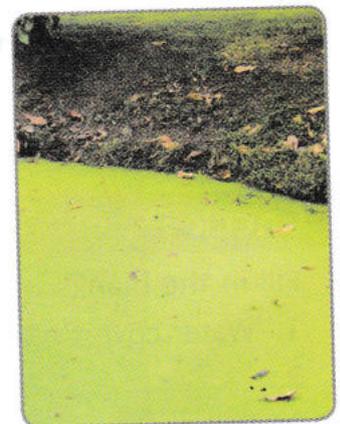
Water pollution has adverse effects on all kinds of life. Let us learn more about these.

### Human Health

Numerous health diseases such as cholera, typhoid, jaundice, gastroenteritis, dysentery and diarrhea are caused in human beings because of consumption of contaminated or polluted water.

### Eutrophication

When excessive fertilisers are washed off into water bodies such as lakes and ponds, the algae present in the water multiplies at a faster rate, resulting in **algal bloom**. This leads to a higher rate of consumption of the dissolved oxygen from the water by the increased algal population for respiration. This creates a scarcity of oxygen for other living organisms. In addition to this, when the algae dies, the microorganisms use much of the oxygen for decomposition of the dead algae. Thus, rest of the living organisms (aquatic plants and animals) face a scarcity of oxygen and start to die. This process is called **eutrophication**. Thus, eutrophication can be defined as the excessive richness of nutrients in a lake or other body of water, frequently due to runoff from the land, which causes a dense growth of plant life.



*Eutrophication*

### Biological Magnification

Biological magnification is the process in which certain substances such as pesticides or heavy metals when washed into lakes, rivers and the ocean, move up the food chain in greater concentrations as they are incorporated into the diet of aquatic organisms, which in turn are eaten by bigger fish, large birds, animals, or humans. With time, these toxics accumulate in tissues of organisms and sometimes prove to be fatal.

### Aquatic Life

As discussed earlier, oil leaks are a great threat to aquatic life. The oil, thus, leaked, form a thin layer on the surface of the water. This layer of oil, called the oil slick, cuts off the supply of air and light of the water body. Thus, killing the aquatic life. The oil slick is cleared mostly by using detergents. Even these detergents pollute the water.

### Soil pollution

The pollutants released into water from industries seep into the land and pollute the soil. This is hazardous as it make the soil infertile and also makes it inhabitable for organisms that live in the soil.

### Thermal plants

Thermal plants discharge hot water into water bodies that damages the aquatic life.

## Prevention and Control of Water Pollution

As we now know the hazardous effects of water pollution, let us now discuss some ways in which water pollution can be controlled and prevented.

1. The toxic industrial discharged should be first treated to make them toxin free and then released into water bodies.
2. Excessive use of pesticides and insecticides in agriculture should be discouraged.
3. Farmers should be encouraged to use eco-friendly pesticides and insecticides and follow organic farming methods.
4. Domestic sewage should be first treated in sewage treatment plants and then only released into water bodies.
5. Washing of clothes and utensils, bathing of humans and animals in water bodies such as lakes and rivers should be discouraged.
6. The faecal matter should never be discharged into water bodies.
7. Dead bodies should not be disposed of in water bodies. They should be either cremated or buried.
8. Atomic and nuclear explosion should be avoided.
9. Strict pollution control rules should be enforced by the government.
10. People should be made aware of the hazardous effects of water pollution and encouraged to follow environment friendly practices.

### Check Point

Fill in the blanks.

1. Water covers about \_\_\_\_\_ of the Earth's surface.
2. \_\_\_\_\_ cause death of large numbers of aquatic plants and animals.
3. Pollutants make the soil \_\_\_\_\_.
4. When the algae present in the water multiplies at a faster rate, it is called \_\_\_\_\_.
5. Excessive use of \_\_\_\_\_ and \_\_\_\_\_ in agriculture should be discouraged.

## POTABLE WATER

The water which is fit for drinking and suitable to cook food is called the potable water. Potable water does not cause any health hazards. Several methods are used to make water potable. Some of them are discussed here.

### Boiling

When water reaches a temperature of  $100^{\circ}\text{C}$ , it is said to be boiling. At this temperature, the disease-causing microorganisms or the pathogens are killed. This makes water cleaner. However, toxic impurities such as chemicals are not removed by boiling.

### Chlorination

In this method, halazone tablets containing chlorine are added to the water to kill the pathogenic bacteria.

### Potash Alum

Alum makes the impurities heavy and they settle at the bottom of the container. The clear water is slowly transferred to another container so as to leave the settled impurities behind in the first container.

### Lime and Potassium Permanganate

In wells, the addition of lime and potassium permanganate kills the pathogenic bacteria present in the water, making the water germ free.

### Domestic Filters

In homes, filters fitted with candles are used to clean the water and make it potable. Some UV filters are also available to clean water at homes.

## WATER TREATMENT PLANT

The water that we get in our homes first goes through a water treatment plant to purify it. In the water treatment plant, the water is made free of germs and toxins to make it potable. Water from rivers and lakes is brought into the treatment facility, where it undergoes a series of processes before reaching our homes.



*A water treatment plant in western India*

Following steps are followed for treating the water:

1. **Sedimentation:** The water from rivers and lakes is supplied to a sedimentation tank, where the water is allowed to stand for a day. This allows the heavier impurities to settle down at the bottom of the sedimentation tank. Some of the lighter impurities are still suspended in the water.
2. **Loading:** Loading is the process of making lighter impurities heavier by the addition of alum. The lighter particles adhere to the heavier particles of the alum. The alum then takes these impurities to the bottom of the tank.
3. **Filtration:** A filtration tank has layers of gravel, sand and charcoal. The water from the loading tank is passed through the filtration tank, where the different layers clean the water further by removing lighter suspended particles, which did not clear in the earlier step.
4. **Chlorination:** After filtration, the water is transferred to another tank, where chlorine is added to the water to kill any pathogens (germ-causing pathogens) present in the water. The water is now potable.
5. **Storage:** After chlorination, the now potable water is transferred to a clean storage tank from where it is distributed to our homes through pipes.

## Key Terms



- **Pollution:** Introduction of pollutants or contaminants into the natural environment leading to adverse changes.
- **Air pollution:** Air pollution can be defined as the presence or introduction of substances in the air that are harmful or poisonous. Some examples of such substances are smoke, dust and toxic gases.
- **Acid Rain:** When rainwater contains large amounts of dissolved acids, it is called acid rain.
- **Global Warming:** Global warming is the overall rise in the average temperature of the Earth.
- **Greenhouse effect:** The greenhouse effect is the phenomena where the sun's radiations are trapped by the atmosphere of the Earth leading to increase in the temperature on the Earth's surface.
- **Ozone layer:** Ozone is a gas that is present as a layer in the stratosphere of Earth's atmosphere. This ozone layer prevents the harmful ultraviolet (UV) rays from entering the Earth's atmosphere.
- **Water Pollution:** The contamination of water by unwanted and harmful substances is called water pollution.
- **Eutrophication:** The excessive richness of nutrients in a lake or other body of water, frequently due to run-off from the land that causes a dense growth of plant life.
- **Biological magnification:** The process in which certain substances such as pesticides or heavy metals when washed into lakes, rivers and the ocean, move up the food chain in greater concentrations as they are incorporated into the diet of aquatic organisms, which in turn are eaten by bigger fish, large birds, animals, or humans causing harmful effects to the organisms.
- **Portable Water:** The water which is fit for drinking and suitable to cook food is called potable water.
- **Water Treatment Plant:** Water from rivers and lakes is brought into the treatment facility, where it undergoes a series of process of purification before reaching our homes.

## Recall



- Air pollution is the presence or introduction of substances in the air that are harmful or poisonous such as smoke, dust and toxic gases. The toxic and harmful substances that pollute the air are called air pollutants.
- Air pollution is caused by vehicle exhaust, use of wood, coal or dung cakes as a fuel, release of harmful gases by industries, excessive use of pesticides and insecticides, volcanic eruptions and natural forest fires.
- Carbon monoxide, oxides of sulphide, oxides of nitrogen, lead oxide, fumes, dust are all pollutants that harm the human health.
- Carbon dioxide, carbon monoxide, oxides of nitrogen and sulphur and unburnt hydrocarbons react with the water vapour present in the atmosphere, forming sulphuric acid and nitric acid. These strong acids pour down along with the rain, resulting in acid rain.
- Disturbance in the balance of gases in the atmosphere has led to increased greenhouse effect, leading to melting of polar ice caps, affecting the water cycle and rain patterns, and disturbing the agriculture cycle and leading to food production problems.
- Ozone layer is being damaged by the CFCs released in the air by refrigerators, air conditioners and aerosol sprays.
- The contamination of water by unwanted and harmful substances is called water pollution. Most common water pollutants are domestic sewage, industrial wastes, pesticides and fertilisers.
- Some common causes of water pollution are industrial discharge, pesticides and fertilisers, kitchen wastes and sewage and oil spillage.
- Numerous health diseases are caused in human beings because of consumption of contaminated or polluted water.
- Eutrophication and biological magnification are results of water pollution by fertilisers and pesticides. The pollutants released into water from industries seep into the land and pollute the soil.
- The water which is fit for drinking and suitable to cook food is called the potable water.
- Several methods are used for making water potable—boiling, chlorination, alum, lime, potassium permanganate and domestic filters.
- Water is treated at a water treatment plant before being supplied into homes.

## Assess Zone

### A. Tick (✓) the correct answer.

1. Which of the following is not an air pollutant?  
a. Carbon dioxide      b. Dust      c. Oxygen      d. Smoke
2. Which of the following is a poisonous gas?  
a. Carbon monoxide      b. Carbon dioxide      c. Nitrogen      d. Oxygen
3. Which of the following is fatal to plants?  
a. Nitrogen oxide      b. Sulphur dioxide      c. Carbon dioxide      d. Oxygen



4. Acid rain causes which of the following conditions?  
a. Skin cancer            b. Bone cancer            c. Mouth cancer            d. Marble cancer
5. The frequency of tsunamis has increased because of which of the following factors?  
a. Heavy rains            b. Global warming            c. Thunders            d. Hurricanes
6. Which of the following is a greenhouse gas?  
a. Sulphur            b. Carbon dioxide            c. Nitrogen            d. Oxygen
7. Instead of wood and coal as domestic fuel, we should use which of the following fuels?  
a. Petrol            b. Diesel            c. Kerosene            d. LPG
8. Eutrophication is caused because of which of the following types of pollution?  
a. Air pollution            b. Water pollution            c. Soil pollution            d. Noise pollution
9. Which of the following is not a method for making potable water?  
a. Boiling            b. Chlorination            c. Straining            d. Addition of alum potash
10. The filtration tank in a water treatment plant does not have which of the following substances?  
a. Coal            b. Sand            c. Gravel            d. Charcoal

**B. Fill in the blanks.**

1. Human activities such as unchecked \_\_\_\_\_ and \_\_\_\_\_ have contaminated the natural resources.
2. The toxic and harmful substances that pollute the air are called \_\_\_\_\_.
3. Natural forest fires add a lot of \_\_\_\_\_ and \_\_\_\_\_ in the air.
4. Brain damage and mental disorders are caused by the \_\_\_\_\_ present in the automobile exhaust.
5. UV rays can cause \_\_\_\_\_ in living organisms.
6. For domestic purposes, \_\_\_\_\_ should be used instead of wood and coal.
7. \_\_\_\_\_ should be encouraged to reduce the greenhouse effect.
8. \_\_\_\_\_ and \_\_\_\_\_ seep through the ground and contaminate the underground water.
9. The \_\_\_\_\_ matter should never be discharged into water bodies.
10. Domestic filters are fitted with \_\_\_\_\_ filters to clean the water.

**C. Match the following.**

- |                             |                                      |
|-----------------------------|--------------------------------------|
| 1. Nitrogen oxide           | a. Carboxyhaemoglobin                |
| 2. Volcanic eruptions       | b. Acid rain                         |
| 3. Deforestation            | c. Germ-free well water              |
| 4. Carbon monoxide          | d. Greenhouse gases                  |
| 5. Dust                     | e. Water pollution                   |
| 6. Nitric acid              | f. Air pollution                     |
| 7. Chlorofluorocarbons      | g. Poisonous gas                     |
| 8. Ozone layer              | h. UV radiations                     |
| 9. Biological magnification | i. Bronchitis                        |
| 10. Potassium permanganate  | j. Disbalance of gases in atmosphere |

**D. Give reasons for the following.**

1. Soil erosion can lead to air pollution.
2. Overuse of packaged material can cause depletion of the ozone layer.
3. Chlorine helps clean water.

**E. Answer the following questions in one word or a single sentence.**

1. What are the natural causes of air pollution?
2. Which gas combines with haemoglobin of blood to form carboxyhaemoglobin?
3. Name any two greenhouse gases.
4. Name the particles that damage the ozone layer.
5. Name the types of filters used at homes for purification of water.

**F. Answer the following questions in brief.**

1. Define the following:
  - a. Air pollution
  - b. Water pollution
  - c. Pollutants
  - d. Algal Bloom
  - e. Eutrophication
  - f. Global warming
  - g. Acid rain
  - h. Biological magnification
  - i. Potable water

**G. Answer the following questions in detail.**

1. Write a short note on the sources of air pollution?
2. What are effects of air pollution on human health?
3. How is acid rain formed? What are its harmful effects?
4. Explain the phenomenon of global warming. How is it effecting the life on the Earth?
5. Where is ozone layer found? What is its important?
6. Write a few steps that can be taken to prevent and control air pollution.
7. What are the common causes of water pollution?
8. What are the effects of water pollution?
9. What are the different methods of making water potable?
10. Explain the different stages or steps of a water treatment plant.

### Out of The Box

Your class is going on a trip to a farmhouse. You will also be visiting nearby fields. How will you advise your classmates to prepare themselves so that you have an eco-friendly outing. Also, if you are to address the farmers about eco-friendly agricultural practices, what all will you talk about?

## In Real Life

The Ganges River Dolphins are one of the very few species of fresh water dolphins in the world. Unfortunately, the species has now become endangered. The building of hydroelectric and irrigation dams along the Ganges prevent the natural movement of these dolphins from up and down in the river and is thus the major reason for the reduction in their population.



Explore the effect caused due to human-induced pollutions and activities that has effected a few more indigenous species in the Ganges.

## Subject Enrichment

### Activity Zone

Organise a 'Cover the Manhole' Drive in your neighbourhood. Form a group and do a survey of the entire neighbourhood and count the number of manholes in the area. Prepare a list of open, damaged and closed manholes. With the guidance of an adult, submit this report to the local municipality office and ask for immediate repair and cleaning of the manholes.

### Project Zone

Prepare a chart on AIR POLLUTION and WATER POLLUTION, each with the causes and steps for prevention. Display them in your classrooms.

## Web-links

- Air Pollution 101: <https://www.youtube.com/watch?v=e6rglsLy1Ys>
- Water Pollution Documentary: <https://www.youtube.com/watch?v=h198sZXP7fU>
- The Yamuna, India's Polluted river: <https://www.youtube.com/watch?v=eHCalvPN2rY>

## Crosslinks

On the map of India, identify and mark all the important hydroelectric dams. List down the advantages and disadvantages of building these dams to surrounding flora and fauna.

### Teacher's Note

It is important that students of this age understand the effect of global warming and pollution effecting our Earth in the most severe manner. The daily livelihood of people, animals and plants is now getting effected due to the impact created by human-induced activities. Make them aware of this situation and encourage them to take appropriate steps from today as they are the torchbearers of the future generations.

# Worksheet 7

(Unit 7 – Natural Resources)

## Make your own water filter

Let us learn to make a simple and effective water filter at home.

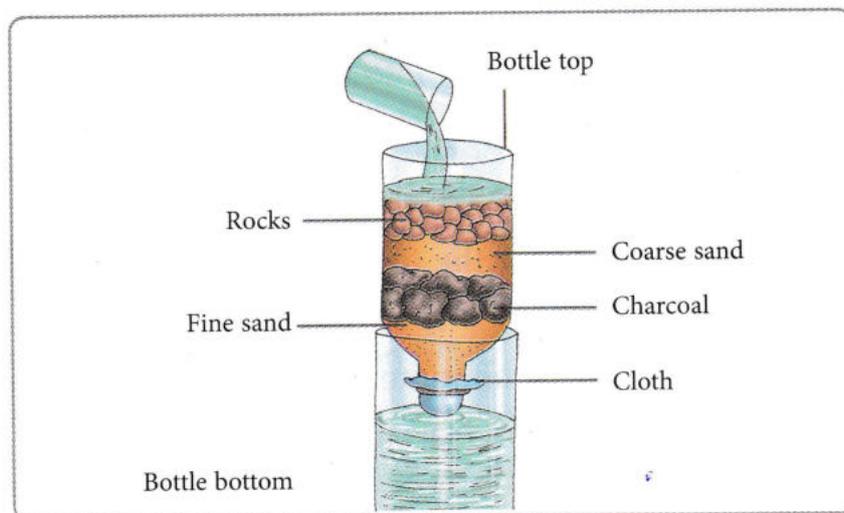
For this you will need

A plastic bottle, cotton, activated carbon or charcoal, fine sand, gravel or small rocks

1. Take a plastic bottle and cut its base.
2. Open the bottle from its mouth and put some cotton there.
3. Rinse the charcoal well and dry it. Now, add charcoal or activated carbon from the wide end of the bottle.
4. Add fine sand on top of charcoal or activated carbon
5. Rinse the gravel well and dry it. Now, add gravel or small rocks

Your simple water filter is ready.

Now, pour unclean or dirty water slowly from the wide end of the mouth. Keep a glass at the base of the bottle to collect the water. You will see that the glass contains clean water



# Unit Test Paper 7

(Unit 7 - Natural Resources)

## A. Tick (✓) the correct answer.

- The gas that forms carboxyhaemoglobin is
  - Oxygen
  - Carbon monoxide
  - Carbon dioxide
  - Nitrogen
- Sulphur dioxide and trioxides damage our
  - Lungs
  - Stomach
  - Liver
  - Kidneys
- Which of the following is not a pollutant?
  - Carbon monoxide
  - Oxygen
  - Sulphur dioxide
  - Lead oxide
- Marble cancer is caused by
  - Salts
  - Acids
  - Minerals
  - Bases
- Loading is done by
  - Alum
  - Potassium permanganate
  - Lime
  - Sulphate

## B. Are the following statements true or false? Correct the false statements.

- Thermal plants discharge cold water into water bodies
- The water which is unfit for drinking and suitable to cook food
- Purification of water is done in water treatment plants

## C. Give one word or one example for the following.

- A gas that is present as a layer the stratosphere of earth's atmosphere
- The contamination of water by unwanted and harmful substances
- Excessive richness of nutrients in a lake or other body of water, frequently due to run-off from the land, which causes a dense growth of plant life

## D. Answer the following questions.

- What is air pollution? What are the various ways of controlling air pollution?
- What is acid rain?
- What is global warming?



## Periodic Test 2

(Based on Chapters 4–6)

(Full Marks: 20)

### A. Choose the correct option.

(5 Marks)

- Which of these is the most reactive metal?
  - Platinum
  - Copper
  - Zinc
  - Potassium
- In how many zones can a candle flame be divided?
  - One
  - Two
  - Three
  - Four
- Which of these is called the lowest grade coal?
  - Anthracite
  - Coke
  - Bituminous
  - Lignite
- Which of these category of animals does not exist anymore?
  - Endemic
  - Endangered
  - Extinct
  - Vulnerable
- Which of these results in loss of biodiversity?
  - Afforestation
  - Pollution
  - Soil erosion
  - Deforestation

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

(5 Marks)

- The non-metal that exists in liquid state
- The process of burning fuel in the presence of oxygen
- The species of animals that do not exist anymore
- The gas produced when metal reacts with acids
- The mass movement of animals from one place to the other

### C. Answer the following questions in brief.

(4 Marks)

- Explain different causes of loss of biodiversity.
- Differentiate between exhaustible and inexhaustible resources.

### D. Answer the following questions in detail.

(6 marks)

- What is a flame? Explain the structure of flame with a diagram.
- What is corrosion? State its disadvantages. How can it be prevented?

# Half Yearly Paper

(Based on Chapters 1–9)

(Total Marks: 80)

## A. Choose the correct option.

(10 Marks)

- Which of the following is a *rabi* crop?  
a. Rice                      b. Spinach                      c. Potato                      d. Wheat
- Cold and flu are caused by which of these?  
a. Bacteria                      b. Virus                      c. Protozoa                      d. Algae
- Which of the following is not needed for corrosion?  
a. Soil                      b. Iron                      c. Air                      d. Moisture
- Which of these is absent in animal cells?  
a. Cell wall                      b. Cell membrane                      c. Vacuoles                      d. Cytoplasm
- Which of these secrete insulin?  
a. Thyroid gland                      b. Pancreas                      c. Pituitary gland                      d. Testes
- Which of the following is a synthetic fibre?  
a. Cotton                      b. Wool                      c. Rayon                      d. Silk
- Which of the following reproduces by budding?  
a. Cat                      b. Amoeba                      c. Hydra                      d. Dog
- What is the colour of the non-luminous flame?  
a. Red                      b. Yellow                      c. Blue                      d. Green
- Which of the following non-metal is a good conductor of electricity?  
a. Graphite                      b. Chlorine                      c. Iodine                      d. Bromine
- Which of the following metal exists in liquid state at room temperature?  
a. Bromine                      b. Mercury                      c. Graphite                      d. Gold

## B. Fill in the blanks.

(5 Marks)

- \_\_\_\_\_ is a synthetic fabric which uses plant material.
- \_\_\_\_\_ fabric is used to make bottles.
- The process of loosening and turning of soil is called \_\_\_\_\_.
- The \_\_\_\_\_ determines the sex of the baby.
- \_\_\_\_\_ are the organelles that give colours to the plants.

## C. Give one word for the following.

(5 Marks)

- The female reproductive organ.
- The male reproductive organ.

3. It is also called artificial silk.
4. The highest grade of coal.
5. Plants grown at a large scale on a big piece of land.

**D. Answer the questions in one or two sentences.**

**(20 Marks)**

1. What is agriculture? Name two crops.
2. Define polymerisation. Give two examples.
3. What is migration? Why does it happen?
4. What is malleability? How is it useful?
5. Define calorific value. State its unit.
6. What are species of animals? Give two examples.
7. Why is adrenal gland called the gland of emergency?
8. State the difference between renewable and non-renewable resources. Give examples.
9. What is ignition temperature? What is its importance?
10. State the difference between *kharif* and *rabi* crops with examples.

**E. Answer the questions in brief.**

**(15 Marks)**

1. Differentiate between *kharif* and *rabi* crops.
2. Explain the process of polymerisation and its types.
3. Define the following:
  - a. Endemic species
  - b. Extinct species
  - c. Endangered species
4. State the characteristics of an ideal fuel.
5. Describe three changes that take place in males, at puberty.

**F. Answer the questions in detail.**

**(25 Marks)**

1. Explain the process of external and internal fertilisation in organisms.
2. Explain the structure of a flame. Draw a labelled diagram to show different zones of a flame.
3. What are endocrine glands? Explain different endocrine glands with their importance.
4. Explain the steps involved in the process of crop production.
5. Explain the structure of a plant cell with a well-labelled diagram.

## Periodic Test 3

(Based on Chapters 10–12)

(Full Marks: 20)

### A. Choose the correct option.

(5 Marks)

- Which of these is a contact force?
  - Frictional
  - Gravitational
  - Electrostatic
  - Magnetic
- In which medium sound cannot travel?
  - Solid
  - Liquid
  - Gas
  - Vacuum
- If the amplitude of sound is higher, then sound will be
  - Louder
  - Lower
  - No effect
  - Slower
- Which of these forces is due to charges?
  - Frictional
  - Gravitational
  - Electrostatic
  - Magnetic
- What is the unit of pressure?
  - Newton
  - Metre
  - Hertz
  - Pascal

### B. Fill in the blanks.

(5 Marks)

- \_\_\_\_\_ force acts opposite to the motion of an object.
- The pressure can be measured by using a \_\_\_\_\_.
- The rapid to and fro movements are called \_\_\_\_\_.
- As we go up, the atmospheric pressure \_\_\_\_\_.
- Sound needs a \_\_\_\_\_ to travel.

### C. Answer the following questions in brief.

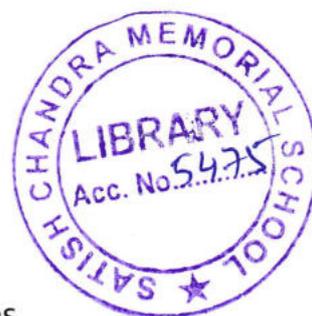
(4 Marks)

- Explain the methods of reducing friction.
- State applications of pressure in our daily life.

### D. Answer the following questions in detail.

(6 marks)

- Describe the characteristics of sound.
- Explain any three effects of force with examples.



## Periodic Test 4

(Based on Chapters 13–15)

(Full Marks: 20)

### A. Choose the correct option.

(5 Marks)

- Which of these is used to measure earthquake?
  - Seismograph
  - Richter scale
  - Barometre
  - Lightning conductor
- Which of these is an insulator?
  - Iron
  - Copper
  - Wood
  - Aluminium
- Why is electroplating done?
  - To make objects thick
  - To make objects resistant to corrosion
  - To make objects thin
  - To make objects shiny
- What results by the movement of electrons?
  - Electric current
  - Lightning
  - Earthquake
  - None of these
- Which of these is used to correct myopia?
  - Mirror
  - Concave lens
  - Convex lens
  - Prism

### B. Match the following.

(5 Marks)

- |                 |                      |
|-----------------|----------------------|
| 1. Cathode      | a. Richter scale     |
| 2. Anode        | b. Positive terminal |
| 3. Earthquake   | c. Spectrum          |
| 4. Dispersion   | d. Electric charge   |
| 5. Electroscope | e. Negative terminal |

### C. Answer the following questions in brief.

(4 Marks)

- State the laws of reflection.
- What is an earthquake? How is it measured?

### D. Answer the following questions in detail.

(6 marks)

- State the methods by which an object can be charged.
- What is electroplating? Explain its advantages.

# Yearly Paper

(Based on Chapters 10–18)

(Full Marks: 80)

## A. Choose the correct option.

(10 Marks)

- Pascal is the unit of which of these?  
a. Force                      b. Pressure                      c. Motion                      d. Electric current
- Which of these is an example of a non-luminous object?  
a. Moon                      b. Sun                      c. Stars                      d. Bulb
- Which of these is a greenhouse gas?  
a. Carbon dioxide                      b. Oxygen                      c. Hydrogen                      d. Helium
- Which of these is the topmost layer of the Earth?  
a. Mantle                      b. Core                      c. Crust                      d. Rocks
- To which of the following categories does a Dodo bird belong?  
a. Endemic                      b. Endangered                      c. Extinct                      d. Vulnerable
- Which of the following is a contact force?  
a. Electrostatic                      b. Magnetic                      c. Muscular                      d. Gravitational
- The number of oscillations per second is called  
a. Frequency                      b. Time period                      c. Pitch                      d. Amplitude
- Which of these is not a fossil fuel?  
a. Coal                      b. Petroleum                      c. Diesel                      d. Water
- Which of these reduces friction?  
a. Ball bearings                      b. Lubricants                      c. Treads                      d. Oiling
- Which of these is also called clean fuel?  
a. CNG                      b. Petrol                      c. Coal                      d. Diesel

## B. Match the following.

(5 Marks)

- |                   |                      |
|-------------------|----------------------|
| 1. Plastids       | a. Non-contact force |
| 2. Magnetic force | b. Richter scale     |
| 3. Muscular force | c. Barometer         |
| 4. Pressure       | d. Contact force     |
| 5. Earthquake     | e. Plant cells       |

**C. State true or false.**

**(5 Marks)**

1. Pressure exerted on an object does not depend on the depth.
2. We see our image in a mirror due to lateral inversion.
3. By greasing we can increase the frictional force.
4. Richter scale is used to measure earthquakes.
5. Electroplating is used to prevent corrosion.

**D. Answer the questions in one or two sentences.**

**(20 Marks)**

1. How do earthquakes occur?
2. What is the difference between reflection and refraction of light.
3. What is asexual reproduction? Name some types.
4. How does deforestation affect wildlife?
5. State any four safety measures to be taken during lightning.
6. What is global warming? How is it caused?
7. State the difference between linear polymerisation and cross-polymerisation.
8. What is potable water? State two ways to make water potable at home.
9. State the difference between outer and inner planets.
10. State the laws of reflection.

**E. Answer the questions in brief.**

**(15 Marks)**

1. Differentiate between thermoplastics and thermosetting plastics.
2. Describe dispersion of light.
3. What are different methods of charging an object. Explain each of them.
4. Define the following:
  - a. Amplitude
  - b. Time period
  - c. Frequency
5. How does sound travel through a medium?

**F. Answer the questions in detail.**

**(25 Marks)**

1. Explain the structure of an animal cell with a well-labelled diagram.
2. With a labelled diagram, explain the structure of the human ear.
3. Explain the process of electrolysis by taking an example. Draw a diagram to illustrate the process.
4. Explain the structure and function of the human eye.