

9

MOTION AND TIME



In class VI, you learnt about different types of motions. You learnt that a motion could be along a straight line, it could be circular or periodic. Can you recall these three types of motions?

Table 9.1 gives some common examples of motion. Identify the type of motion in each case.

Table 9.1: Some examples of different types of motion

Example of Motion	Type of motion Along a straight line/circular/periodic
Soldiers in a march past	
Bullock cart moving on a straight road	
Hand of an athlete in a race	
Pedal of a bicycle in motion	
Motion of the earth around the sun	
Motion of a swing	
Motion of a Pendulum	

It is common experience that the motion of some objects is slow while that of some other is fast.

9.1 SLOW OR FAST

We know that some vehicles move faster than others. Even the same vehicles may move faster or slower at different times. Make a list of ten objects moving along a straight path. Group the motion of these objects as slow and fast. How did you decide which object is moving slowly and which one is moving fast?

If vehicles are moving on a road in the same direction, we can easily tell which one of them is moving faster than the other.

ACTIVITY 9.1

Look at **Fig. 9.1**. It shows the position of some vehicles moving on a road in the same direction at some instant of time. Now look at **Fig. 9.2**. It shows the position of the same vehicles after some time. From your observation of the two figures, answer the following question:

Which vehicles is moving faster of

all? Which one of them is moving the slowest of all?



Fig. 9.1 : Vehicles moving in the same direction on a road

The distance moved by objects in a given interval of time can help us to decide which one is faster or slower. For example, imagine that you have gone to see off your friend at the bus stand. Suppose you start pedalling your bicycle at the same time as the bus begins to move.



Fig. 9.2 : Position of vehicles shown in Fig. 9.1 after some time

The distance covered by you after 5 minutes would be much smaller than

that covered by bus. Would you say that the bus is moving faster than the bicycle?

We often say that the faster vehicle has a higher speed. In a 100-metre race it is easy to decide whose speed is the highest. One who takes shortest time to cover the distance of 100 metres has the highest speed.

9.2 SPEED

You are probably familiar with the word speed. In the example given above, a higher speed seems to indicate that a given distance has been covered in a shorter time, or a large distance covered in a given time.

The most convenient way to find out which of the two or more objects are moving faster is to compare the distances moved by them in a unit time. Thus, if we know the distance covered by two buses in one hour, we can tell which one is slower. We call the distance covered by an object in a unit time as the **speed** of the object.

When we say that a car is moving with a speed of 50 kilometers per hour, it implies that it will cover a distance of 50 kilometers in one hour. However, a car seldom moves with a constant speed for one hour. Infact, it starts moving slowly and then picks up speed. So, when we



say that the car has a speed of 50 kilometers per hour, we usually consider only the total distance covered by it in one hour. We do not bother whether the car has been moving with a constant speed or not during that hour. The speed calculated here is actually the average speed of the car. In this book **we shall use the term speed for average speed.** So, for us the **speed is the total distance covered divided by the total time taken.** Thus,

$$\text{Speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$

In everyday life we seldom find objects moving with a constant speed over long distance or for long durations of time. If the speed of an object moving along straight line keeps changing, its motion is said to be **non-uniform**. On the other hand, an object moving along a straight line with a constant speed is said to be in **uniform motion**. In this case, the average speed is the same as the actual speed.

We can determine the speed of a given object once we can measure the time taken by it to cover a certain distance. In class VI you learnt how to measure distance. But, how do we measure time? Let us find out.

9.3 MEASUREMENT OF TIME

If you did not have a clock, how would you decide what time of the day it is? Have you ever wondered how our elders could tell the approximate time of the day by just looking at shadows?

How do we measure time interval of a month? A year?

Our ancestors noticed that many events in nature repeat themselves after definite intervals of time. For example, they found that the sun rises everyday in the morning. The time between one sunrise and the next was called a day. Similarly, a month was measured from one new moon to the next. A year was fixed as the time taken by the earth to complete one revolution of the sun.

Often we need to measure intervals of time which are much shorter than a day. Clocks or watches are perhaps the most common time measuring devices. Have you ever wondered how clocks and watches measure time?

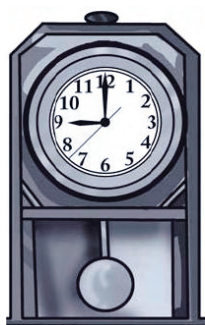
The working of clocks is rather complex. But all of them make use of some periodic motion. One of the most well-known periodic motions is that of a **simple pendulum**.

A simple pendulum consists of a small metallic ball or a piece of stone



suspended from a rigid stand by a thread {Fig 9.4 (a)}. The metallic ball is called the **bob** of the pendulum.

Fig 9.4 (a) shows the pendulum at rest in its mean position. When the bob



(a) Wall clock



(b) Table clock



(c) Digital clock

Fig. 9.3: Some common clocks

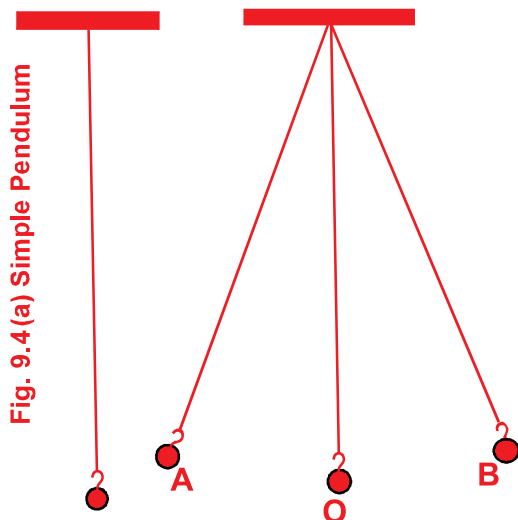


Fig. 9.4 (a) Simple Pendulum

Fig. 9.4(b): Different positions of the bob of an oscillating simple pendulum

of the pendulum is released after taking it slightly to one side, it brings to move to and fro [Fig. 9.4(b)]. The to and fro motion of a simple pendulum is an example of a periodic or an **oscillatory** motion.

The pendulum is said to have completed one **oscillation** when its bob, started from its mean position O, moves to A, to B and back to O. The pendulum also completes one oscillation when its bob moves from one extreme position A to the other extreme position B and comes back to A. The time taken by pendulum to complete one oscillation is called its **time period**.

ACTIVITY 9.2

Set up a simple pendulum as shown Fig 9.4 (a) with a thread or string of length nearly one metre. Switch off fans nearby. Let the bob of the pendulum come to rest at its mean position. Mark the mean position of the bob on the floor below it or on the wall behind it.

To measure the time period of the pendulum we will need a stopwatch. However, if a stopwatch is not available, a table clock or a wristwatch can be used.

To set the pendulum in motion, gently hold the bob and move it slightly

to one side. Make sure that the string attached to the bob is taut while you displace it.

Now release the bob from its displaced position. Remember that the bob is not to be pushed when it is released. Note the time on the clock when the bob is at its mean position. Instead of the mean position you may note the time when the bob is at one of its extreme positions. Measure the time the pendulum takes to complete 20 oscillations. Record your observations in **Table 9.2**. The first observation shown is just a sample. Your observation could be different from this. Repeat this activity a few times and record your observations. By dividing the time taken for 20 oscillations by 20, get the time taken for one oscillation, or the time period of the pendulum.

Is the time period of your pendulum nearly the same in all cases?

Note that a slight change in the initial displacement does not affect the time period of your pendulum.

Nowadays most clocks or watches have an electric circuit with one or more cells. These clocks are

called quartz clocks. The time measured by quartz clocks is much more accurate than that by the clocks available earlier.

Table 9.2

Time period of a simple pendulum

Length of the string = 100 cm

S.No.	Time taken for 20 oscillations	Time period
1.	42 s	2.1 s
2.		
3.		

UNITS OF TIME AND SPEED

The basic unit of time is a **second**. Its symbol is s. Larger units of time are minutes (min) and hours (h). You already know how these units are related to one another.

What would be the basic unit of speed?

Since the speed is distance/ time, the basic unit of speed is m/s. Of course, it could also be expressed in other units such as m/min or km/h.

You must remember that **the symbols of all units are written in singular**. For example, we write 50 km and not 50 kms or 8 cm and not 8cms.



There is an interesting story about the discovery that the time period of a given pendulum is constant. You might have heard the name of famous scientist Galileo Galilei (A.D.1564-1642). It is said that once Galileo was sitting in a church. He noticed that a lamp suspended from the ceiling with a chain was moving slowly from one side to the other. He was surprised to find that his pulse beat the same number of times during the interval in which the lamp completed one oscillation. Galileo experimented with various pendulums to verify his observation. He found that a pendulum of a given length takes always the same time to complete one oscillation. This observation led to the development of pendulum clocks. Winding clocks and wristwatches were refinements of the pendulum clocks.

Yasir is wondered how many seconds there are in a day and how many hours in a year. Can you help him?

Different units of time are used depending on the need. For example, it is convenient to express your age in years rather than in days or hours. Similarly, it will not be wise to express in years the time taken by you to cover the distance between your home and your school.

How small or large is a time interval of one school? The time taken in saying aloud “two thousand and one” is nearly by one second. Verify it by

counting aloud from “two thousand and one” to “two thousand and ten”. The pulse of a normal healthy adult at rest beats about 72 times in a minutes that is about 12 times in 10 seconds. This rate may be slightly higher for children.



Saba wondered how time was measured when pendulum clocks were not available .

The smallest time interval that can be measured with commonly available clocks and watches is one second. However, now special clocks are available that can measure time intervals smaller than a second. Some of these clocks can measure time intervals as small as one millionth or even one billionth of a second. You might have heard the terms like microsecond and nanosecond. One microsecond is one millionth of a second. A nanosecond is one billionth of a second. Clocks that measure such small time

intervals are used for scientific research. The time measuring devices used in sports can measure time intervals that are one tenth or one hundredth of a second. On the other hand, times of historical events are stated in terms of centuries or millenniums. The ages of stars and planet are often expressed in billions of years. Can you imagine the range of time intervals that we have to deal with?

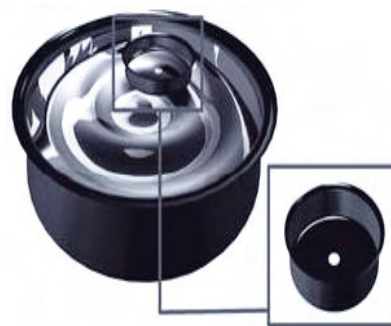
Many time measuring devices were used in different parts of world before the pendulum clocks became popular. Sundials, water clocks and sand clocks are some examples of such devices. Different designs of these devices were developed in different parts of the world (**Fig 9.5**)



(a) Sundial at Jantar Mantar, Delhi



(b) Sand clock



(c) Water clock

Fig 9.5 : Some ancient time-measuring devices

9.4 MEASURING SPEED

Having learnt how to measure time and distance, you can calculate the speed of an object. Let us find the speed of a ball moving along the ground.

ACTIVITY 9.3

Draw a straight line on the ground with chalk powder or lime and ask one of your friends to stand 1 to 2m away from it. Let your friend gently roll a ball along the ground in a direction perpendicular to the line. Note the time at the moment the ball crosses the line and also when it comes to rest (**Fig. 9.6**). How much time does the ball take to come to

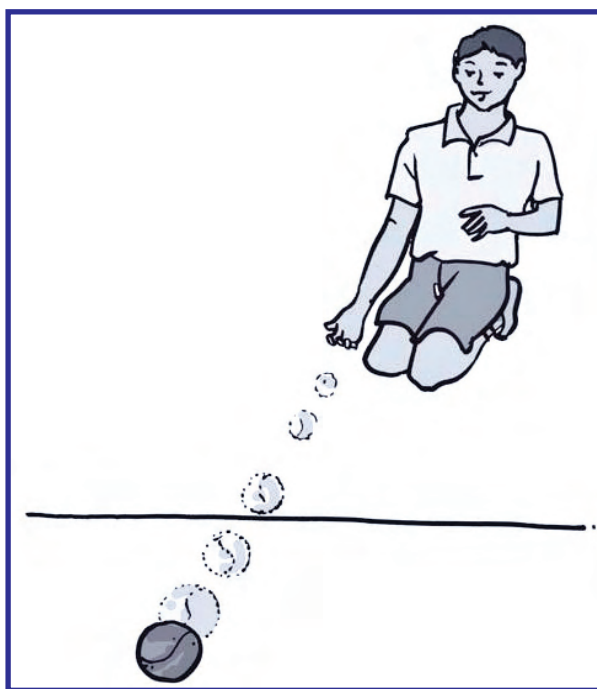


Fig. 9.6 : Measuring the speed of a ball

rest?

Measure the distance between the point at which the ball crosses the line and the point where it comes to rest. You can use a scale or measuring tape. Let different groups repeat the activity. Record the measurements in **Table 9.3**. In each case calculate the speed of the ball.

You may now like to compare your speed of walking or cycling with that of your friends. You need to know the distance of the school from your home or from some other point. Each one of you can then measure the time taken to cover that distance and calculate your speed. It may be interesting to know who amongst you is the fastest. Speeds of some living organisms are given in **Table 9.3** in km/h. You can calculate the speeds in m/s yourself.

Rockets, launching satellites into earth's orbit, often attain speeds up to 8km/s. On the other hand, a tortoise can move only with a speed of about 8cm/s. Can you calculate how fast is the rocket compared with tortoise?

Once you know the speed of an object, you can find the distance moved by it in a given time. All you have to do is to multiply the speed by time. Thus,
Distance covered = Speed x Time.

Table 9.3: Distance moved and time taken by a moving ball

Name of the group	Distance moved by the ball (m)	Time taken (s)	Speed = Distance/ Time taken (m/s)



Yasir wants to know whether there is any device that measures the speed.

You can also find the time an object would take to cover distance while moving with a given speed.

$$\text{Time taken} = \text{Distance} / \text{Speed}$$

You might have seen a meter fitted on top of a scooter or a motorcycle. Similarly, meters can be seen on the dashboards of cars, buses and other vehicles. **Fig 9.7** shows the dashboard of a car. Note that one of the meters has km/h written at one corner. This is called a **speedometer**. It records the speed directly in km/h. There is also another meter that

Table 9.4: Fastest speed that some animals can attain

S.No.	Name of the object	Speed in km/h	Speed in m/s
1.	Falcon	320	$\frac{320 \times 1000}{60 \times 60}$
2.	Cheetah	112	
3.	Blue fish	40 - 46	
4.	Rabbit	56	
5.	Squirrel	19	
6.	Domestic mouse	11	
7.	Human	40	
8.	Giant tortoise	0.27	
9.	Snail	0.05	

measures the distance moved by the vehicle. This meter is known as an **odometer**.

While going for a school picnic, Saba decided to note the reading on the odometer of the bus after every 30 minutes till the end of the journey. Later on she recorded her readings in **Table 9.5**.

Can you tell how far the picnic spot from the school was? Can you calculate the speed of the bus? Looking at the table, Yasir teased Saba wheather she can tell how far they would have traveled till 9:45 AM. Saba had no answer to this question. They went to their teacher. She told them that one way to solve this problem is to plot a distance-time graph. Let us find out how such a graph is plotted.

Table 9.5 : Odometer reading at different times of the journey

Time (AM)	Odometer reading	Distance from the starting point
8:00 AM	36540 km	0 km
8:30 AM	36560 km	20 km
9:00 AM	36580 km	40 km
9:30 AM	36600 km	60 km
10:00 AM	36620 km	80 km

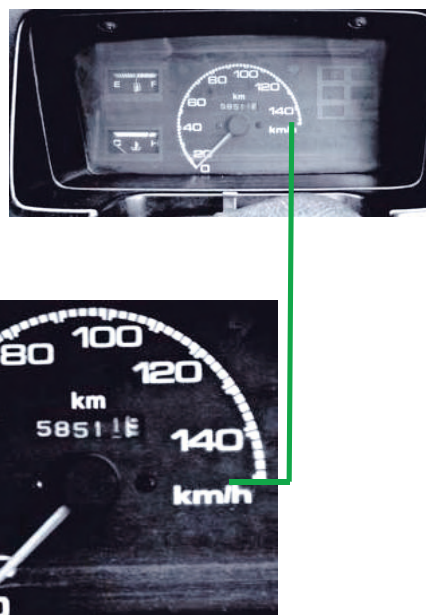


Fig. 9.7 : The dashboard of a car

9.5 DISTANCE-TIME GRAPH

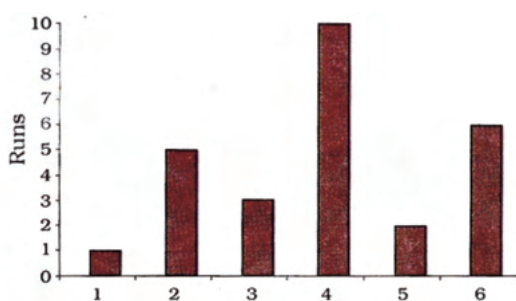
You might have seen that newspapers, magazines, etc., present information in various forms of graphs to make it interesting. The type of graph shown in **Fig. 9.8** is known as a bar graph. Another type of graphical representation is a pie chart

(**Fig. 9.9**). The graph shown in **Fig. 9.10** is an example of the line graph. The distance time graph is a line graph. Lets us learn to make such a graph.

Take a sheet of graph paper. Draw two lines perpendicular to each other on it, as shown in **Fig. 9.11**. Make the horizontal line as XOX'. It is known as the x-axis. Similarly mark the vertical line

YOY'. It is called y- axis. The point of intersection of XOY' and YOY' is known as origin O. The two quantities between which the graph is drawn are shown along these two axes. We show the positive values on the X-axis along OX. Similarly, positive values on the y-axis are shown along OY. In this chapter we shall consider only the positive values of quantities. Therefore, we shall use only the shaded part of the graph shown in **Fig. 9.11**.

Fig. 9.8: A bar graph showing runs scored by a team in each over



Yasir and Saba found out the distance traveled by a car and the time taken by it to cover that distance. Their data is shown in **Table. 9.6**.

Table. 9.6 The motion of a car

S.No.	Time	Distance
1.	0	0
2.	1 min	1 km
3.	2 min	2 km
4.	3 min	3 km
5.	4 min	4 km
6.	5 min	5 km

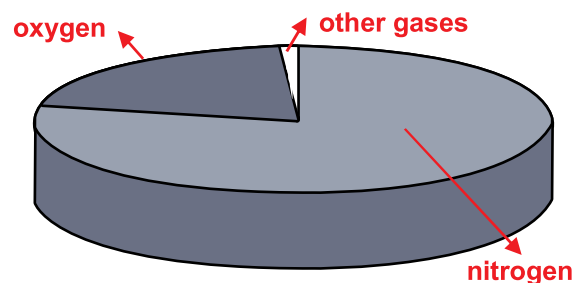


Fig. 9.9 : A pie chart showing composition of air

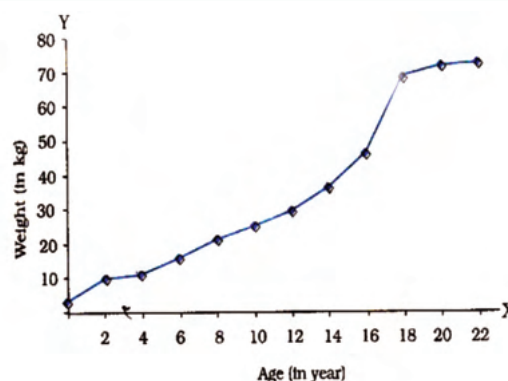


Fig. 9.10 : A line graph showing change in weight of a man with age

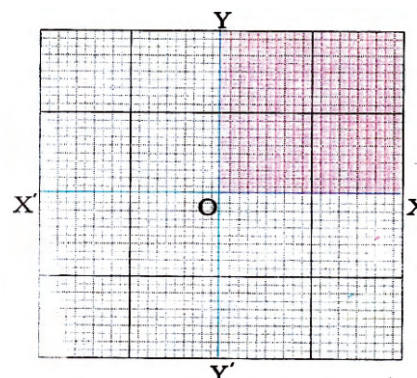


Fig. 9.11 : x-axis and y-axis on a paper

You can make the graph by following the steps given below:

- ◆ Draw two perpendicular lines to represent the two axes and mark

them as OX and OY as shown in **Fig. 9.11**.

- ◆ Decide the quantity to be shown along the x-axis and that to be shown along the y-axis. In this case we show the time along the x-axis and the distance along the y-axis.
- ◆ Choose a scale to represent the distance and another to represent the time on the graph. For the motion of the car scales could be
Time : 1 min = 1 cm
Distance 1 km = 1 cm
- ◆ Mark values for the time and the distance on the respective axes according to the scale you have chosen. For the motion of the car mark the time 1 min, 2 min, ... on the x-axis from the origin O. Similarly, mark the distance 1 km, 2 km ... on the y-axis (**Fig. 9.12**).

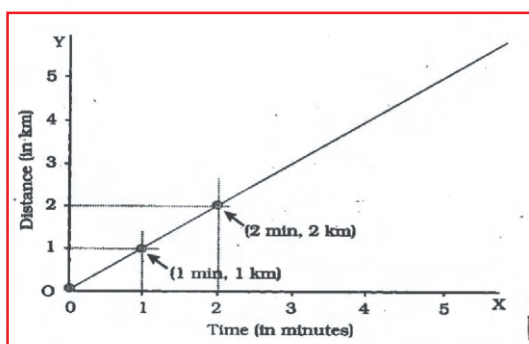


Fig. 9.12 : Making a graph

- ◆ Now you have to mark the points on the graph paper to represent each set of

values for distance and time. Observation recorded as S.No. 1 in **Table 9.6**. Shows that at time 0 min the distance moved is also Zero. The point corresponding to this set of values on the graph will therefore be origin itself. After 1 minute, the car has moved a distance of 1 km. To mark this set of values look for the point that represents 1 minute on the x-axis. Draw a line parallel to the y-axis at this point. Then draw a line parallel to the x-axis from the point corresponding to distance 1 km on the y-axis. The point where these two lines intersect represents this set of values on the graph (**Fig 9.12**). Similarly, mark on the graph paper the points corresponding to different sets of values.

- ◆ **Fig. 9.13** shows the set of points on the graph corresponding to positions of the car at various times.

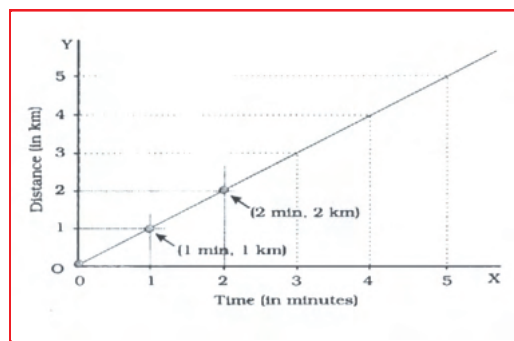


Fig. 9.13 : Making a graph

- ◆ Join all the point on the graph as shown in **Fig. 9.13**. It is a straight

line. This is the distance-time graph for the motion of the car.

- If the distance-time graph is a straight line, it indicates that the object is moving with a constant speed. However, if the speed of the object keeps changing, the graph can be of any shape.

Generally, the choice of scale is not as simple as in the example given above. We may have to choose two different scales to represent the desired quantities on the x-axis and the y-axis. Let us try to understand this process with an example.

- Let us again consider the motion of the bus that took Saba and her friends to the picnic. The distance covered and time taken by the bus are shown in Table Fig. 9.5. The total distance covered by the bus is 80 km. If we decide to choose a scale $1\text{ km} = 1\text{ cm}$, we shall have to draw an axis of length 80 cm. This is not possible on a sheet of paper. On the other hand a scale $10\text{ km} = 1\text{ cm}$ would require an axis of length only 8 cm. This scale is quite convenient. However, the graph may cover only a small part of the graph paper. Some of the points to be kept in mind while choosing the most suitable scale for drawing a graph are:
- the difference between the

highest and the lowest value of each quantity.

- the intermediate values of each quantity, so that with the scale chosen it is convenient to mark the value on the graph, and
- to utilize the maximum part of the paper on which the graph is to be drawn.

Suppose that we have a graph paper of size 25 cm x 25 cm. One of the scales which meets the above conditions and can accommodate the data of Table 13.5 could be

Distance: 5 km = 1 cm, and

Time: 6 min = 1 cm

Can you now draw the distance-time graph for the motion of the bus? Is the graph drawn by you similar to that shown in **Fig. 9.13** ?

Distance-time graph provide a variety of information about the motion when compared to the data presented by the table. For example, **Table 9.5** gives information about the distance moved by the bus only at some definite time intervals. On the other hand, from the distance-time graph we can find the distance moved by the bus at any instant of time. Suppose we want to know how much distance the bus has traveled at 8:15 AM. We mark the point



corresponding to the time (8:15 AM) on the x-axis. Suppose this point is A. Next we draw a line perpendicular to the x-axis (or parallel to the y-axis) at point A. We then mark the point, T, on the graph at which this perpendicular line intersects it (**Fig. 9.14**). Next, we draw a line through the point T parallel to the x-axis. This intersects the y-axis at the point B. The

distance corresponding to the point B on the y-axis, OB, gives us distance in km covered by the bus at 8:15 AM. How much is this distance in km? Can you now help Saba to find the distance moved by the bus at 9:45 AM? Can you also find the speed of the bus from its distance-time graph?

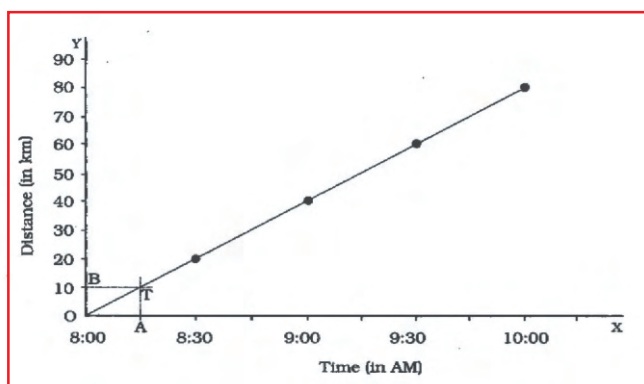


Fig. 9.14 : Distance-time graph of the bus

KEYWORDS

Bar graph

Oscillation

Time period

Graphs

Simple pendulum

Uniform motion

Non-uniform motion

Speed

Unit of time

What you have Learnt

- ✍ The distance moved by an object in a unit time is called its speed. Speed of objects help us to decide which one is moving faster than the other.
- ✍ The speed of an object is the distance traveled divided by the time taken to cover that distance. Its basic unit is metre per second (m/s).
- ✍ Periodic events are used for the measurement of time. Periodic motion of a pendulum has been used to make clocks and watches.

-  Motion of object can be presented in pictorial form by their distance-time graphs.
-  The distance-time graph for the motion of an object moving with a constant speed is a straight line.

EXERCISES

1. **Classify the following as motion along a straight line, circular or oscillatory motion:**
 - (i) Motion of your hands while running.
 - (ii) Motion of a horse pulling a cart on a straight road.
 - (iii) Motion of a child in a merry-go-round.
 - (iv) Motion of a child on a see-saw.
 - (v) Motion of the hammer of an electric bell.
 - (vi) Motion of a train on a straight bridge.
2. **Which of the following are not correct ?**
 - (i) The basic unit of time is second.
 - (ii) Every object moves with a constant speed.
 - (iii) Distance between two cities are measured in kilometers.
 - (iv) The time period of a given pendulum is not constant.
 - (v) The speed of a train is expressed in m/h.
3. A simple pendulum takes 32 s to complete 20 oscillations. What is the time period of the pendulum?
4. The distance between two stations is 240 km. A train takes 4 hours to cover this distance. Calculate the speed of the train.
5. The odometer of a car reads 57321.0 km when the clock shows the time 08:30AM. What is the distance moved by the car. If at 08:50 AM, the odometer reading has changed to 57336.0 km?
Calculate the speed of the car in km/min during this time. Express the speed in km/h also.
6. Geeta takes 15 minutes from her house to reach her school on a bicycle. If the bicycle has a speed of 2 m/s, calculate the distance between her house and

the school.

7. Show the shape of the distance-time graph for the motion in the following cases :

- (i) A car moving with a constant speed.
- (ii) A car parked on a road side.

8. Which of the following relations is correct?

- (i) Speed = Distance x Time (ii) Speed = $\frac{\text{Distance}}{\text{Time}}$
- (iii) Speed = $\frac{\text{Time}}{\text{Distance}}$ (iv) Speed = $\frac{1}{\text{Distance} \times \text{Time}}$

9. The basic unit of speed is:

- (i) km / min (ii) m / min
- (iii) km / h (iv) m / s

10. A car moves with a speed of 40 km/ h for 15 minutes and then with a speed of 60 km/ h for the next 15 minutes. The total distance covered by the car is:

- (i) 100 km (ii) 25 km
- (iii) 15 km (iii) 10 km

11. Suppose the two photographs, shown in **Fig.9.1** and **Fig. 9.2**, had been taken at an interval of 10 seconds. If a distance of 100 metres is shown by 1 cm in these photographs, calculate the speed of the blue car.

Fig. 9.15 shows the distance-time graph for the motion of two vehicles A and B.

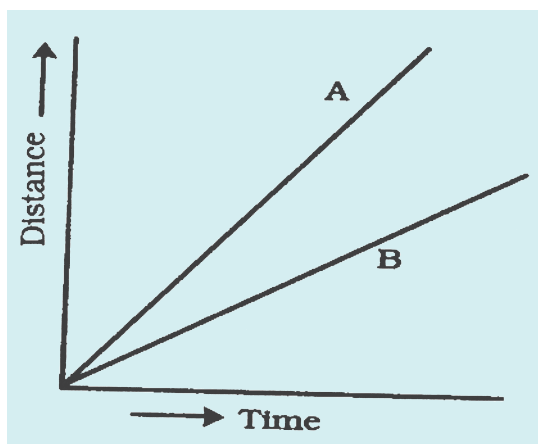
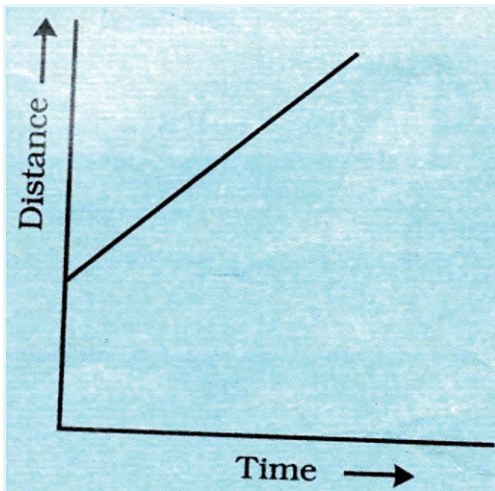


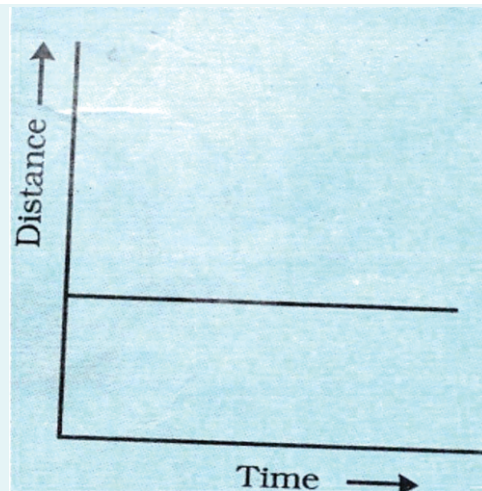
Fig. 9.15 : Distance -time graph for the motion of two cars

Which one of them is moving faster?

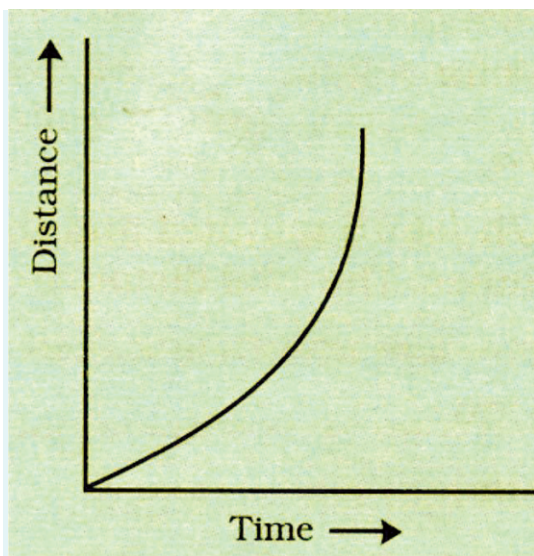
12. Which of the following distance time graph shows a truck moving with speed which is not constant?



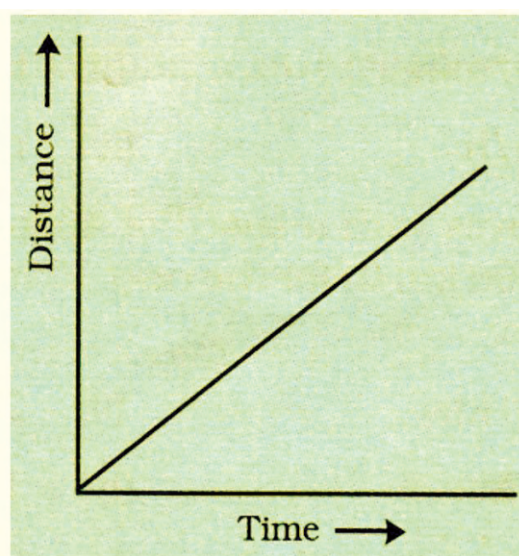
(i)



(ii)



(iii)



(iv)

Extend Learning - Activities and Projects

1. You can make your own sundial and use it to mark the time of the day at your place. First of all find the latitude of your city with the help of an atlas. Cut out a triangular piece of a cardboard such that its one angle is equal to the latitude of your place and the angle opposite to it is a right angle. Fix this piece, called **gnomon**, vertically along a diameter of a circular board as shown in **Fig. 9.16**. One way to fix the gnomon could be to make a groove along a diameter on the circular board.

Next, select an open space, which receives sunlight for most of the day. Mark a line on the ground along the North-South direction. Place the sundial in the sun as shown in **Fig. 9.16**. Mark the position of the tip of the shadow of the gnomon on the circular board as early in the day as possible, say 8:00 AM. Mark the position of the tip of the shadow every hour throughout the day. Draw lines to connect each point marked by you with the centre of the base of the gnomon as shown in **Fig. 9.16**. Extend the lines on the circular board up to its periphery. You can use this sundial to read the time of the day at your place. Remember that the gnomon should always be placed in the North-South direction as shown in **Fig. 9.16**.

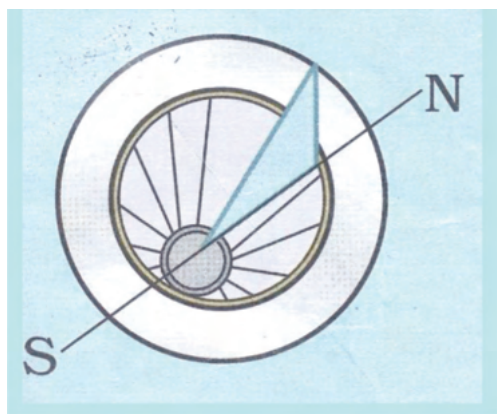


Fig. 9.16

2. Collect information about time-measuring devices that were used in the ancient times in different parts of the world. Prepare a brief write up on each

one of them. The write up may include the name of the device, the place of its origin, the period when it was used, the unit in which the time was measured by it and a drawing or a photograph of the device, if possible.

3. Make a model of a sand clock which can measure a time interval of 2 minutes (**Fig. 9.17**).



Fig. 9.17

4. You can perform an interesting activity when you visit a park to ride a swing. You will require a watch. Make the swing oscillate without anyone sitting on it. Find its time period in the same way as you did for the pendulum. Make sure that there are no jerks in the motion of the swing. Ask one of your friends to sit on the swing. Push it once and let it swing naturally. Again measure its time period. Repeat the activity with different persons sitting on the swing. Compare the time period of the swing measured in different cases. What conclusions do you draw from this activity?

DO YOU KNOW ?

The time keeping services in India are provided by the National Physical Laboratory, New Delhi. The clock they use can measure time intervals with an accuracy of one millionth of a second. The most accurate clock in the world has been developed by the National Institute of Standards and Technology in the U.S.A. This clock will lose or gain one second after running for 20 million year.

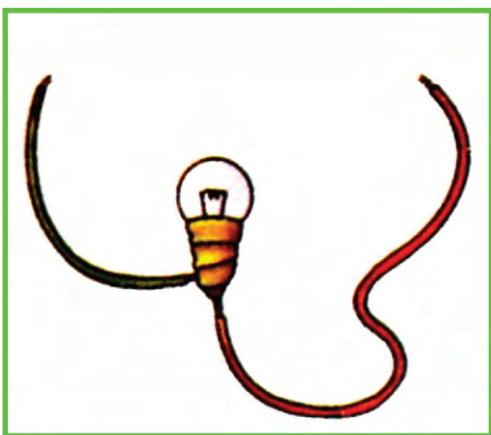


10

ELECTRIC CURRENT AND CIRCUITS

You might have learnt about electric current and circuits. Do you remember the conditions that are required to make an electric current flow in a circuit?

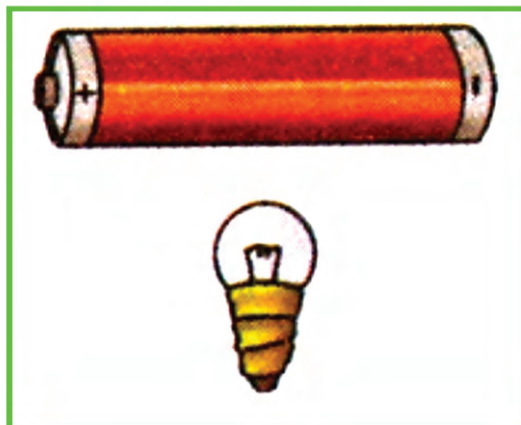
Look at the following pictures.



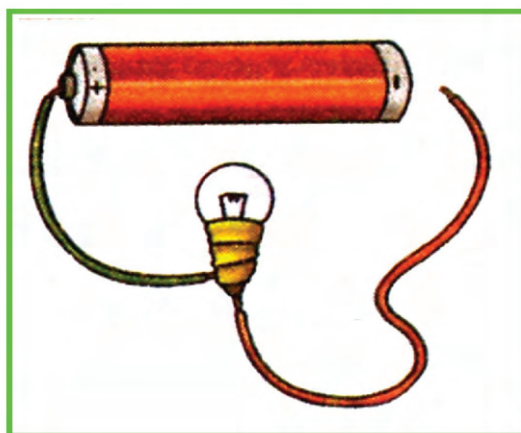
(a)

What do you see in these figures? Does the bulb glow in any of the figure shown? Can you say why?

In (a), the source that produces electric current is missing. In (b), there is no wire for electric current to flow through. In (c), the path is broken or incomplete. Thus, the bulb does not glow in any of the figures shown above.



(b)



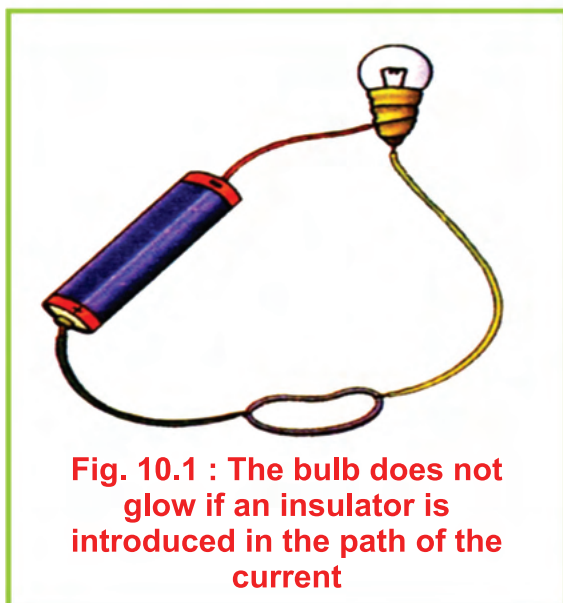
(c)

There are three conditions that need to be fulfilled for electric current to flow: **a source, an unbroken path, and a metal wire**. Why do you need a metal wire? What will happen if we introduce a rubber band in the path as shown in Fig 10.1. Will the bulb glow? No! Can you say why? The bulb does not glow as the rubber band is

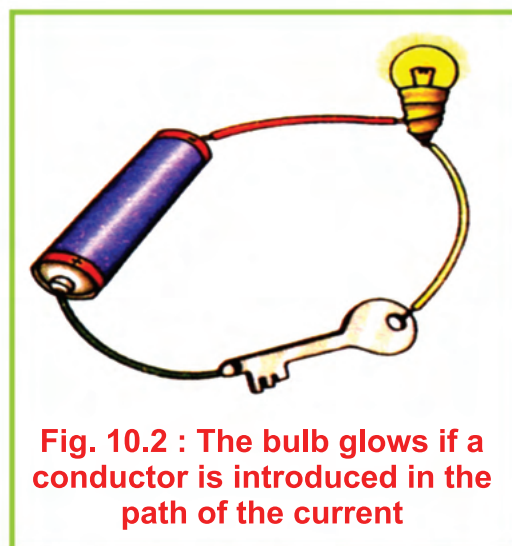


insulator. It does not allow electric current to flow through it.

If we replace the rubber band with metal key (**Fig. 10.2**), will the bulb glow? Yes! the metal key, being a conductor, will let the electric current to flow through it, thus fulfilling all the conditions required to make the bulb glow.



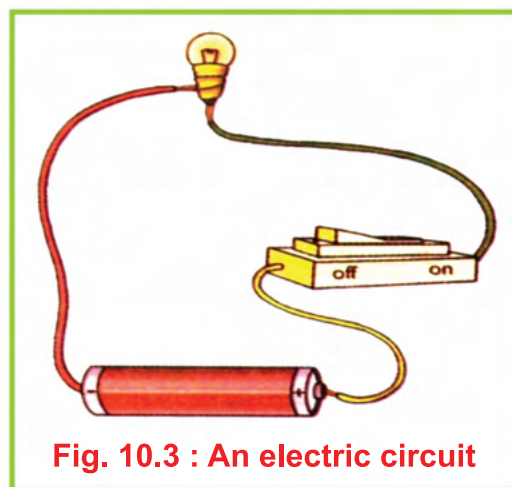
The unbroken path through which electric current can flow is called an **electric circuit**. Figure 10.2 shows an electric circuit consisting of a cell, a bulb, wires, and a conductor.



In this chapter, we will learn a little more about electric circuits, how to represent them conveniently, and the effects produced by electric currents.

10.1 ELECTRIC CIRCUIT DIAGRAMS

You know what an electric circuit is. Look at the electric circuit in Fig. 10.3. It consists of a cell, a small torch bulb, and a switch. Can we represent the circuit in some other way? Let us find out.



For the sake of simplicity, scientists have developed a standard method of drawing an electrical circuit. This is known as **circuit diagram**. In a circuit diagram, the various components of the circuit are represented by standard symbols. **Table 10.1** gives the standard symbols used for some common electrical components. These are also called **elements** of an electrical circuit.

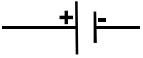
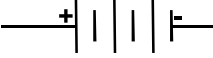
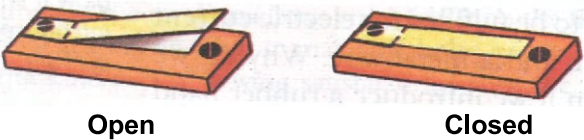
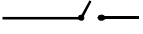
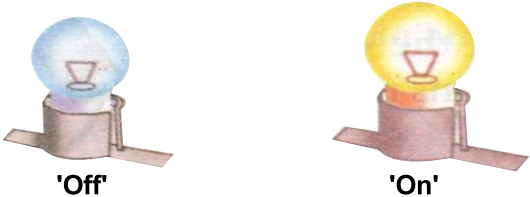
Using these symbols, we can draw the circuit diagram for the circuit given in **Figure 10.3** as shown in **Figure 10.4**. This is when the switch is ON. Can you draw a circuit diagram for a circuit given in **Figure 10.3**, but with switch OFF?

You can practice drawing circuit diagrams with a various elements in it.

The important points to remember are:

1. There should be a source, that is, one or more electric cells.

Table 10.1: Standard symbols used for some basic components of electric circuits

Component	Symbol
Cell 	 The shorter line denotes the negative terminal and the longer line denotes the positive terminal
Battery 	 Two or more cells joined together form a battery.
Switch (also called key)  Open Closed	  Open Closed
Bulb  'Off' 'On'	  'Off' 'On'
Wire 	

- The wires should not have any discontinuity (gaps).
- The only component that can have discontinuity is the switch. When it is open, there is a discontinuity and current does not flow in the circuit.

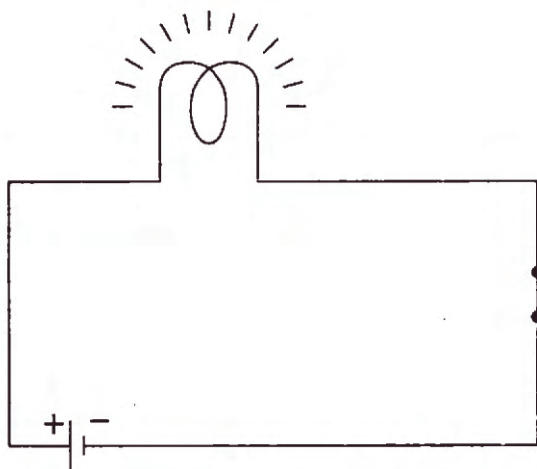


Fig.10.4: Circuit diagram

10.2 HEATING EFFECT OF CURRENT

Try touching two torch bulbs, one which is lighted and other that is not. Be careful when you touch the lighted bulb. Do you feel that lighted bulb is hot to touch? Can you say why?

This is because when an electric current passes through a wire, the wire gets heated up. You will come across many appliances at your home in which electric current causes heating. Can you think some of appliances that get heated up just

like a bulb when electric current passes through them? Electric toasters, electric irons, hot plates, electric hairdryers, electric ovens are some appliances that get hot when electric current passes through them. See **Figure 10.5**.

This kind of heating is called **Ohmic heating** or **Joule heating**.

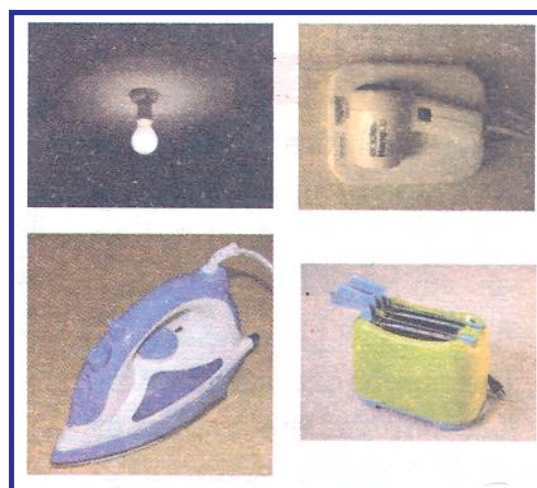


Fig.10.5: Appliances that work on the heating effect of current

ACTIVITY

Aim: To show the heating effect of current (adult supervision required)

Material required: 1.5 V cell, two pieces of wire, a small torch bulb, insulation tape/adhesive tape.

Procedure:

1. Strip the insulation at both ends of the wire so that 1 cm of metal portion is exposed.
2. Connect the negative end of the cell to the threaded portion of the bulb with one of the wires. Secure both ends with insulation /adhesive tape.
3. Connect the positive end of the cell to the bottom portion of the bulb with second piece of wire. Secure both ends with insulation /adhesive tape.
4. You will find that the bulb glows. If it does not, check to see if the connections are tight or need to be tightened. Adjust the connections till the bulb glows.
5. Touch the bulb to see how hot it is just when the connections are complete.
6. Leave this arrangement (with the bulb glowing) for some time and then touch the bulb. You will find that the bulb is little warmer now than at the beginning. This is because the passage of electric current has heated it up.

NOTE: Follow the precautions given below while doing this activity.

- ❖ Touch only the insulated part of the wire connected to the terminals of the cell.
- ❖ Do not perform activity near inflammable materials such as kerosene, petrol, or the gas cylinder.
- ❖ Do not use a cell of higher voltage than specified (1.5 V).
- ❖ Do not use the plug points of your house/school.

10.3 ELECTRIC FUSE

You know that electric appliances work when an electric current passes through them. But have you ever wondered what will happen if a large amount of electric current passes through an appliance such as an electric iron, refrigerator, television, or a hairdryer? If a large amount of current is drawn inside an

appliance, it causes the wires to get overheated, and the appliance gets damaged. This situation arises as a result of some fault in the circuit and can be extremely dangerous as it can lead to a fire.

To prevent electric appliances from getting damaged as a result of excessive passage of current through them, we use a safety device called a **fuse**.



A **fuse** is a safety device used in an electric circuit.

See **Figure 10.6**. It shows some electric fuses.

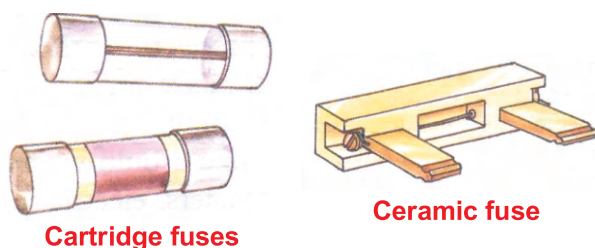


Fig.10.6: Electric fuses

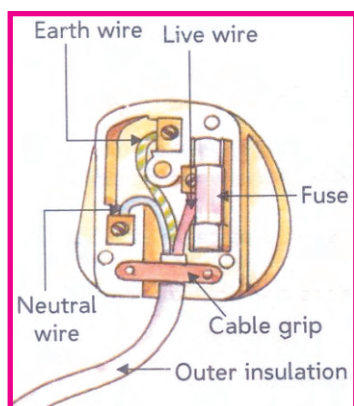
Fact File

If you look carefully at a cartridge fuse, you will find a number stamped on it. Can you say what this number signifies?

The number stamped on a fuse signifies the amount of current (measured in amperes, A) that can flow through the fuse before it melts.

Where would you commonly find an electric fuse?

Fuses are commonly found inside electric plugs.



Can you think of any other place where electric fuses are likely to be found?

An electric fuse prevents a large amount of current from flowing into any appliance or device in your house as it cuts off the supply of electric current, thus preventing further damage.

Principle of an Electric Fuse

As you know, a wire gets heated up if an electric current passes through it. The amount of heating up caused depends on the amount of current flowing through the wire. The greater the current the more is the heating caused. The electric fuse works on the principle of heating effect of current.

An electric fuse consists of a thin wire usually placed inside a glass or ceramic cartridge. The wire is made of a material that melts easily when heated. It is designed such that only a certain maximum amount of current can flow through it. If the current exceeds this maximum amount, the heating in the wire causes it to melt. We say that the fuse blows. This breaks the circuit and stops the flow of current in the circuit. Simple, isn't it?

The common symbol used for an electric fuse is



Miniature circuit breaker

A miniature circuit breaker is an automatically operated electric switch that protects an electric circuit during an overload or short circuit. Circuit breakers are available in different sizes, and can protect small household appliances to high voltage circuits. The advantage circuit breakers have over fuses is that they can be reset (manually or automatically) to restore normal operation, whereas fuses need to be replaced after single operation.

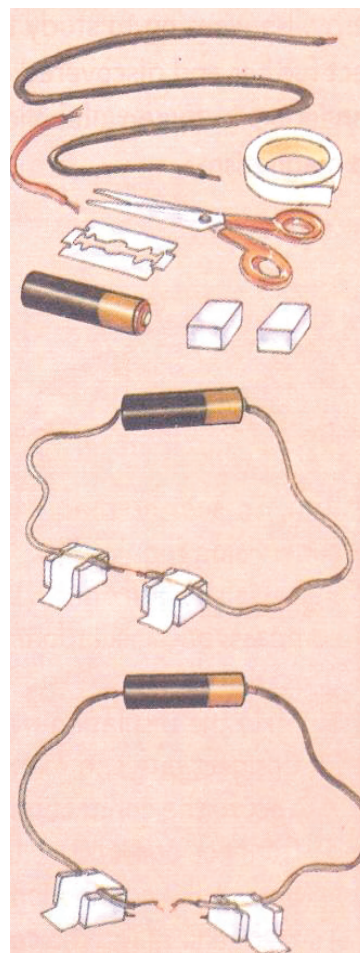
ACTIVITY

Aim: To make an electric fuse (adult supervision required).

Materials required: a pencil cell, about 6-8 inches length of wire with single strand, a short piece of wire with multiple strands, a pair of scissors, insulation/adhesive tape, a blade, two pieces of paper folded up many times (to hold the cell if it gets very hot), and two small pieces of pencil eraser (you can take one and cut it into two pieces).

Procedure:

1. Cut the single strand wire into two pieces and strip the insulation from all four ends.
2. Take the wire with multiple strands and strip the insulation (about 2 inches) from one end. Cut the strands from the wire and pick out just one strand. We will use this strand as the fuse wire.
3. Take one single strand wire. Twist the tip of the wire with one tip of the fuse wire. Take the other single strand wire and do the same with the other tip of the fuse wire.
4. Fix the two single strand wires on the two pieces of erasers with the insulation tape. Make sure the fuse wire is held taut between the two wires.
5. Connect the loose end of one of the single strand wires to the negative terminal of the pencil cell. Secure the connection with an insulation tape.
6. Now touch the loose end of the other single strand wire to the positive terminal of the pencil cell.
7. What do you see? You will see that the fuse wire becomes red hot and then breaks. An electric fuse works on very similar lines.



LET'S ANSWER**(I) Match the following**

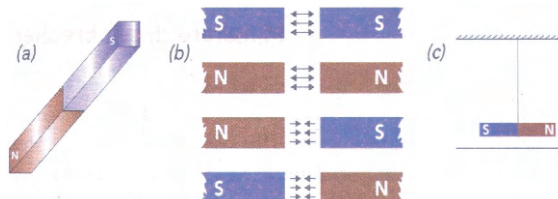
Column A	Column B
1. Circuit diagram	(a) Heating of a conductor due to an electric current
2. Joule heating	(b) Fuse
3. Safety device	(c) Fuse wire
4. Melts easily	(d) A drawing of an electrical circuit with standard symbols

(II) Draw the standard symbol used to represent each of the following components in a circuit diagram

1. Electric cell
2. An open switch
3. A closed switch
4. A bulb
5. A wire

Hans Christian Oersted
1777-1851


During a classroom demonstration of an experiment to his students, Oersted noticed that a compass needle was deflected when an electric current was switched on nearby. He went on to study this effect further and discovered the connection between electricity and magnetism.



1. A magnet has two poles, namely the _____ pole and the _____ pole.
2. Like poles of a magnet _____ each other and unlike poles _____ each other.
3. A magnet when suspended freely aligns itself in the _____ direction.

10.4 MAGNETIC EFFECT OF ELECTRIC CURRENT

Do you remember what you studied about magnets in Class 6? Look at the following pictures and fill in the blanks.

So far, you have studied about electricity and magnetism separately. But did you know that electricity and magnetism are closely related? Perform the following experiment to understand this.



ACTIVITY

Aim: To see the magnetic effect of current passing through a wire (adult supervision required).

Materials required: 1.5 V cell, two pieces of insulated wire, a small magnetic compass, and insulation/adhesive tape.

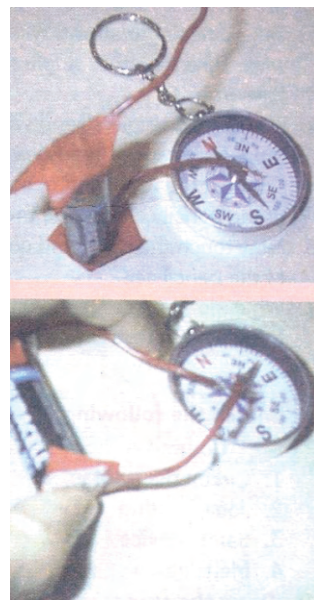
Procedure:

1. Strip the insulation from the two ends of both the wires.
2. Connect one end of one of the wires to the negative terminal of the cell. Secure the connection with the insulation/adhesive tape.
3. Connect one end of the other wire to the positive terminal of the cell. Secure the connection with the insulation tape.
4. Place the magnetic compass near the wire.
5. Keep an eye on the needle of the magnetic compass and touch the free ends of the wires connected to the positive and negative terminals of the cell.

What do you see? You will see that when you touch the wire to the positive terminal of the cell, the needle of the magnetic compass gets deflected (moves). This is because when a current passes through the wire, it behaves like a magnet and therefore deflects the magnetic needle of the compass.

Note: Follow the precautions given below while doing this activity.

- Touch only the insulated parts of the wire connected to the terminal of the cell.
- Do not perform the activity near inflammable materials such as kerosene, petrol or the gas cylinder.
- Do not use a cell of a higher voltage than specified (1.5V).
- Do not use the plug points of your house/school.



ELECTROMAGNET

We have seen in the previous activity that a current-carrying wire behaves like a magnet, that is, it can deflect a compass needle. Do you think it can also attract iron pieces like a magnet does? Let us find out.

Wrap a wire around a soft iron piece (known as the core). When an electric current is passed through the wire, the iron

piece behaves like a magnet. A magnet made by using such an arrangement is called an *electromagnet*. See **Figure 10.7** Can an electromagnet attract iron pieces?

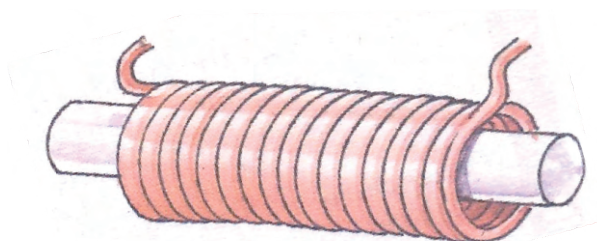


Fig.10.7: An electromagnet



DO YOU KNOW WHAT A SOLENOID IS?

It is a device made of a long wire that has been wound many times into a tightly packed coil; it has the shape of a long cylinder. Solenoids are used in doorbells; door locks, telephones, loudspeakers, etc.

ACTIVITY

Aim: To make an electromagnet (adult supervision required).

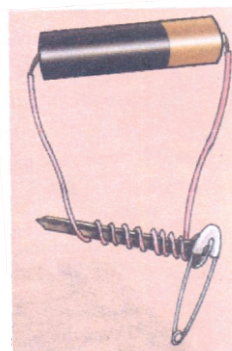
Materials required: 1.5 V cell, iron nail, a safety pin, and a piece of wire.

(There are two types of wires commonly available. In one type, if you strip the insulation you will see many thin metal strands, and in another type there is only one thick wire. Get the one with a single thick wire).

Procedure:

1. Take a piece of wire and strip the insulation from the two ends.
2. Wind the wire around the iron nail.
3. Connect the two ends of the wire to two terminals of an electric cell
4. You have now made an electromagnet.
5. Bring this close to a safety pin.

What do you see? The safety pin gets attracted to the iron nail.



What do you observe in the above activity? We see that by passing electric current through the coil, we can produce a magnetic effect in the nail which enables it to attract the safety pin. [A coil is a piece of wire twisted (or wrapped around) to form a circle. A coil can have one or many turns.]

The strength of an electromagnet depends on the number of turns of the wire around the core and the amount of current passing through it. More the number of turns more will be the magnetic effect. See **Figure 10.8**. But can you say what will happen if the current passing through the coil is switched off? Will it still

attract the safety pin? No, the iron piece will lose its magnetic effect, i.e., it will stop behaving like a magnet and, thus, will not attract the safety pin.



Fig.10.8: An Iron nail attracts more safety pins when wrapped with a coil with more number of turns

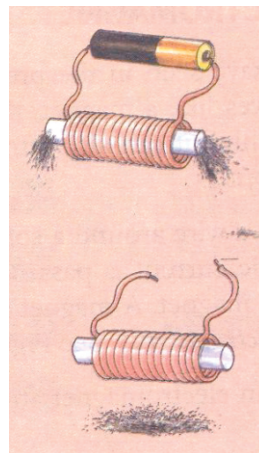
ACTIVITY

Aim: To study the behavior of an electromagnet when the current is switched off (adult supervision required).

Materials required: An electromagnet, iron filings, wires, cardboard, and a pencil cell.

Procedure:

1. Take an electromagnet. Connect the free ends of the wire to the terminals of a pencil cell.
2. Take a cardboard and sprinkle some iron filings on it.
3. Now bring the electromagnet near to the iron filings. Do the filings get attracted to the electromagnet?
4. Now remove the pencil cell from the circuit. Do the filings still get attracted to the electromagnet? No, because the electromagnet loses its magnetic effect when the source of electric current is removed.



USES OF ELECTROMAGNETS

Electromagnets have a wide range of uses in all sorts of devices. Can you think of some devices from everyday life where we use electromagnets? Have you seen cranes that use electromagnets to pick up cars in scrapyards?

Here are a few examples of devices that use magnets and electromagnets.

In telephones: A typical telephone handset consists of two parts - the receiver and the microphone. The receiver consists of an electromagnet.

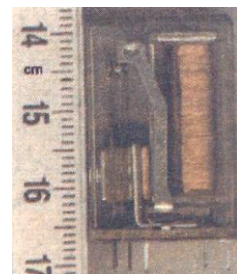


In electric motors: Electric motors use magnets, and find wide application in



electric fans, washing machines, refrigerators, etc.

In relays: A relay is an electrically operated switch. Some relays use electromagnets to control the operation of the switch. Some of the first computers ever built used relays.



In loudspeakers: An electromagnet is used in a loudspeaker which is used to amplify the signals.



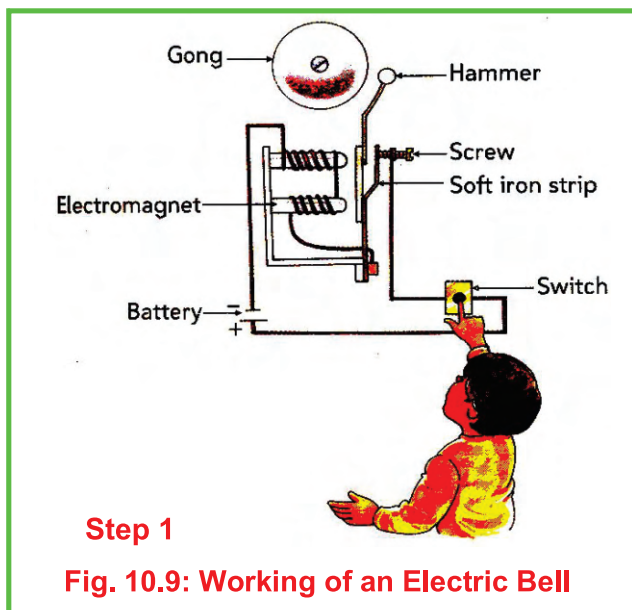
Electromagnets are also used in electric bells to pull a strip of iron which makes the hammer hit the gong to ring the bell. Let us now see how an electric bell works.

10.5 ELECTRIC BELL

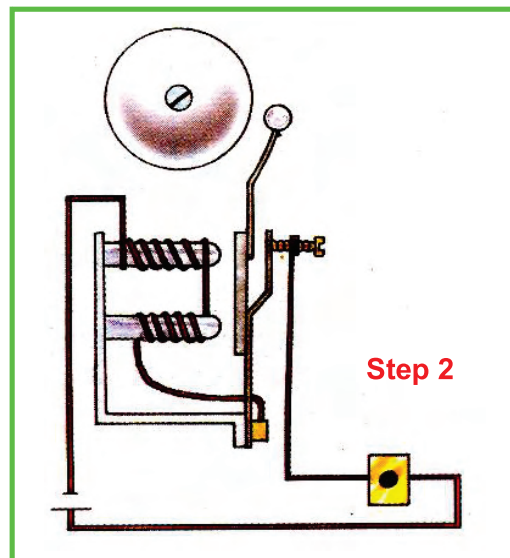
What do you do when you reach your friend's house to let him/ her know that you are at the door? Do you ring the doorbell? Do you know what makes the bell ring?



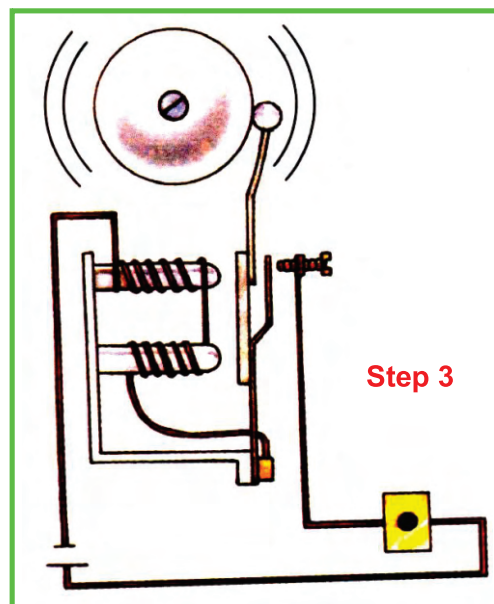
Let us see how an electric bell works:



Step 1. When you push the switch of the bell, the electric current flows to the electromagnet.



Step 2. The electromagnet attracts the soft iron strip. The hammer attached to the strip then hits the gong, causing a ring.



Step 3. When the soft iron strip gets attracted to the electromagnet, it no longer touches the screw (interrupter) and hence the circuit is broken, (much like a switch being turned off).

This turns off the electromagnet and it can no longer attract the soft iron strip. The soft iron strip returns to its initial position, touching the screw (interrupter). This results in the circuit being complete and current flows again.

Steps 1 to 3 repeat in quick succession as long as the switch is on.

This is how we hear a continuous ring of the bell.

ELECTRIC BUZZER

Nowadays, we use electric buzzers and music bells, which work on a principle different from that of the electric bell described here. Buzzers are of different types. Can you think of some places where you use electric buzzers?

(a) (b) (c)

LET'S ANSWER

State whether the following statements are true or false.

1. An electromagnet attracts a safety pin even when the current is turned off.
2. The strength of an electromagnet does not depend on the number of turns on the coil wrapped around it.
3. An electromagnet is used in a loudspeaker to amplify the signals.
4. In an electric bell, the hammer hits the gong when the electromagnet attracts the soft iron strip.
5. When the soft iron strip gets attracted to the electromagnet, it gets detached from the hammer.

KEYWORDS

Electric circuit

Circuit diagram

Ohmic or Joule heating

Electric fuse

Electromagnet

Coil

What you have learnt

- ◆ There are basically three conditions required to make electric current flow in a circuit : a source to provide electric current, an unbroken path for electric current to flow, and a conducting wire.

Electric circuit diagrams

- ◆ For the sake of simplicity, scientists have developed a standard method of drawing an electrical circuit. This is known as a circuit diagram.
- ◆ In a circuit diagram, the various components of the circuits are represented by standard symbols.

Heating effect of electric current

- ◆ When an electric current passes through an electric conductor, the conductor gets heated up. This is called Ohmic heating or Joule heating.
- ◆ Electric irons, room heaters, electric ovens, water heaters, etc. use the heating effect of current to work.

Electric fuse

- ◆ A fuse is a safety device.
- ◆ An electric fuse prevents a large amount of current from flowing into any appliance or device in your house.
- ◆ An electric fuse consists of a thin wire made of a material that melts easily when heated.
- ◆ The wire in an electric fuse is designed such that only a certain maximum amount of current can flow through it. If the current exceeds this maximum amount, the heating in the wire causes it to melt and break the electrical circuit.

Magnetic effect of electric current

- ◆ A current carrying wire can behave like a magnet deflecting the needle of the compass.

Electromagnet

- ◆ An electromagnet consists of a piece of soft iron (called the core), with an insulated wire wound around it.
- ◆ The soft iron piece acts like a magnet when a current passes through the wire.



- ◆ A coil is a piece of a wire twisted (or wrapped around) to form a circle.
- ◆ Electromagnets are used in cranes, relays, electric motors, telephones, loudspeakers, electric bells, etc.

Electric bell

- ◆ An electric bell consists of a battery, an electric switch, an electromagnet, an adjusting screw (interrupter), a soft iron strip, a hammer, and a gong.

EXERCISES

A. Fill in the blanks:

1. A drawing of an electrical circuit with standard symbols is called a/an _____ (Circuit diagram/ electric diagram).
2. Hot plates, electric toasters, and electric irons get hot when switched on because of the _____ effect of current. (Magnetic/heating)
3. A fuse is a _____ device. (Safety/heating).
4. A wire twisted in the form of a circle is called a/an _____ (coil/electromagnet).
5. An _____ consists of a soft iron core with an insulated wire wound around it. (Electromagnet/electric magnet).

B. Choose the correct answer:

1. A circuit diagram is
 - (a) a picture of a circuit
 - (b) a drawing of a circuit with standard pictures for the different electrical components.
 - (c) a diagram of an electrical circuit with standard symbols for the different electrical components.
 - (d) a difficult representation of an electrical circuit.
2. When an electric current passes through a wire, the wire gets hot. This is called

(a) Joule heating	(b) conduction
(c) electricity	(d) thermal heating



3. An electric fuse is
 - (a) a safety device
 - (b) an appliance
 - (c) used to produce electric current
 - (d) use to heat a room
4. When we bring a magnetic compass near a current carrying wire,
 - (a) it deflects the magnetic needle of the compass
 - (b) it makes the magnetic needle point North
 - (c) it makes the magnetic needle point South
 - (d) it has no effect on the magnetic needle
5. A coil refers to
 - (a) an electrical wire
 - (b) a fuse
 - (c) a current carrying conductor
 - (d) a wire twisted in the form of a circle
6. An electromagnet acts like a magnet
 - (a) when a current is passed through the coil
 - (b) all the time
 - (c) because it has a magnetic core
 - (d) only if a current does not pass through the coil.
7. In an electric bell, we have
 - (a) an electromagnet
 - (b) a hammer
 - (c) an interrupter
 - (d) all of these
8. In an electric bell, which of these gets attracted to the electromagnet?
 - (a) the hammer
 - (b) the gong
 - (c) the soft iron strip
 - (d) the screw
9. Which of these does not use heating effect of current?
 - (a) electric toaster
 - (b) electric fan
 - (c) electric Iron
 - (d) room heater
10. An electric fuse wire melts if the amount of current flowing through it.
 - (a) more than a minimum amount
 - (b) less than a minimum amount
 - (c) more than a maximum amount
 - (d) less than a maximum amount

C. Answer the following questions

1. What is an electrical circuit?
2. Draw an electrical circuit with an electrical cell, a bulb, and an 'ON' switch.
3. Why does an electric bulb get hot if it is kept 'ON' for a little while?
4. Name three appliances that use the heating effect of electric current.



5. What is an electric fuse?
6. Draw an electric fuse and explain briefly how it works.
7. How can you show that an electric current has a magnetic effect?
8. What is an electromagnet?
9. Name two factors on which the strength of an electromagnet depends.
10. Explain the working of an electric bell using diagrams.

Think and Answer

1. We have seen that the heating effect of electric current has been put to use in many appliances like toasters, heaters, etc. This kind of heating can also be a waste in many places. Can you think of one example?
(Hint: Think of appliances, electrical wires, etc. Where there is excessive heating.)
2. You know that the strength of an electromagnet depends on the amount of current flowing in the coil. Do you think the magnetic strength will increase/decrease if the amount of current in the coil is increased?
(Hint: Think what happens if the current is totally switched off. Then think what will happen if we slowly increase the current.)
3. Do you think all electrical fuses should have the same maximum current?
(Hint: Different appliances require different amount of current.)

Fun Time

Following is a story of a professor and his students. At the end of it, you will have to solve a puzzle. But before we start with the story, let us introduce you to a device that is used to measure electric current.

An *ammeter* is a device used to measure the flow of electric current in a circuit. It is represented by the Symbol $\textcircled{A}$

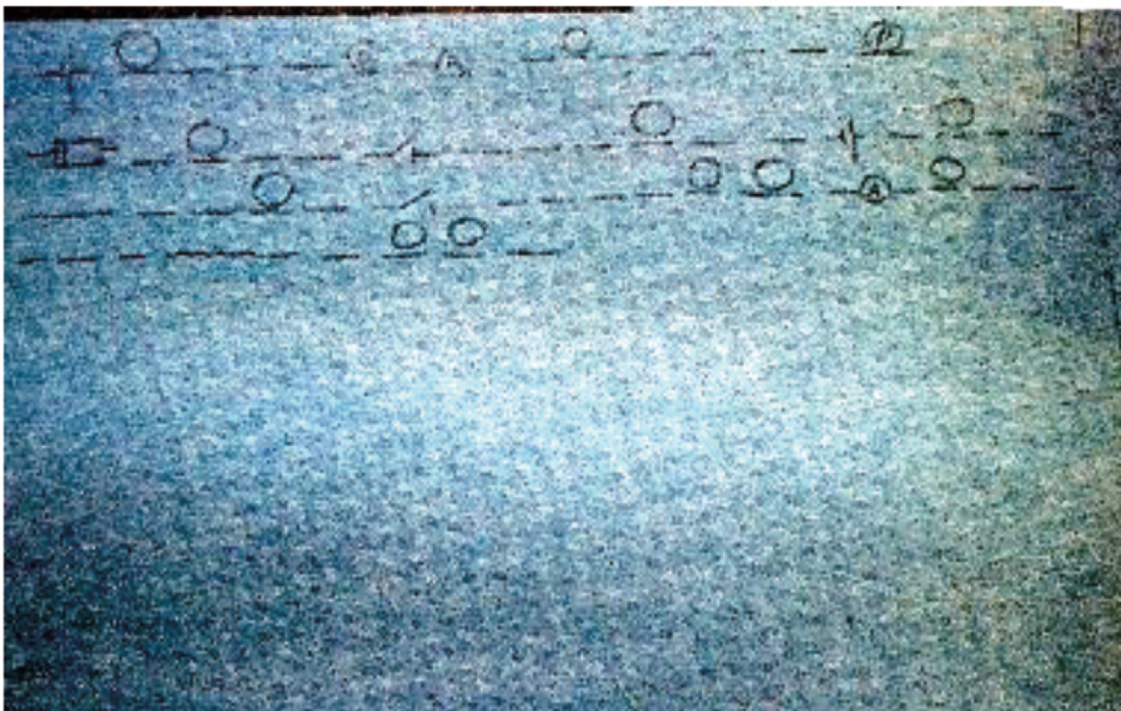
You will find this bit of information useful when you solve the puzzle.

Here is the story of the professor and his students.

Once upon a time there lived a brilliant professor called Sheen Proton. He was a wonderful teacher and also a great inventor. Along came a year when there was a very famous science fair and the professor and his students toiled day and night to



invent a very powerful device which would surely win them a prize in the fair. On the night before the big day, Prof. Proton was putting final touches on the device when he heard some strange sounds at his front door. He knew that his rival, an evil professor, and his students from a neighboring school were desperate to get his device. He quickly hid the device and jotted down something on a sheet of paper and left it on his computer table. He was confident that neither the evil professor nor his students would be able to decipher it. Then he slowly slipped out of the back door. The desperate intruders broke open the door and searched the house thread bare. However, they found nothing unusual but a sheet of paper with some strange symbols and circles. They could not make head or tail of this and went away dejected. Here is what Prof. Sheen Proton had written on the sheet of paper. Can you decode his message and tell where the device was hidden?



Project Ideas

To explore the advantages and disadvantages of the heating effect of electric current.

Materials required: Two big chart papers, the Internet, encyclopedias, books (on

subject related to the topic mentioned), and bright colourful pictures of appliances using the heating effect of electric current.

Procedure:

- (a) Find out as many appliances and devices as possible, used by us, which are based on the heating effect of electric current. Get colourful pictures of them, and stick them on a chart paper. Write a few lines below each picture explaining what each appliance / device is used for. Title this chart 'Uses of Heating Effect of Electric Current.'
- (b) Make a second chart with the title 'Heating Effect of Electric Current-Disadvantages'. In this chart explain how the heating effect that can be so useful in many devices can also be a disadvantage in many other places.

Outdoor Activity

Go to an electrical repair shop and ask the technician to show you different type of fuses. Try to gather some information about these fuses and where they are used.

For more information:

<http://www.tpub.com/doeelecscience/electricalscience236.htm>.

(accessed 15 Sep. 06)

Teacher's Notes

- ✓ Take simple electrical components like cell, switch, fuse, wire etc. to the class. Make cards with the symbols for each of these. Ask the students to match the components with their corresponding symbols.
- ✓ Have a discussion in the class on the advantages and disadvantages of the heating effect of electric current.
- ✓ Take an electric cell, a piece of wire, and a magnetic compass and show how a current in the wire can produce a deflection in the compass needle.
- ✓ Show an electric bell of the kind described in this chapter (many school bells are of this type) and show the students how it works.



11

LIGHT



You might have seen a beam of sunlight when it enters a room through a narrow opening or a hole. You may have also observed beams of light from the headlamps of scooters, cars and engines of trains (**Fig.11(a)**).



Fig.11.1 (a): Rail Engine

Similarly, a beam of light can be seen from a torch. Some of you may have noticed a beam of searchlight from a light house or from an airport tower (**Fig.11.1 (b)**).

What do these experiences suggest?

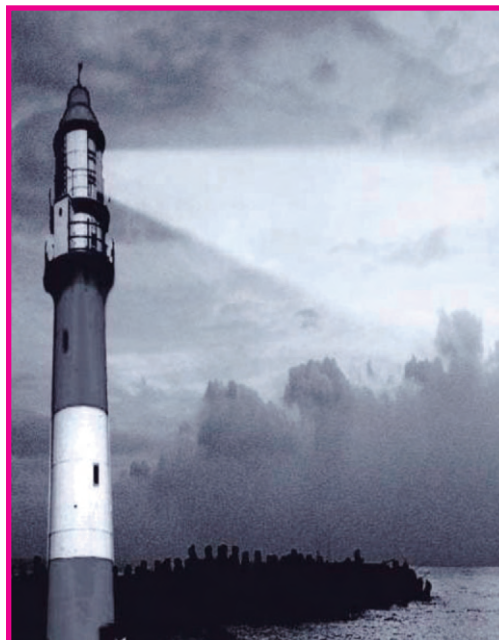


Fig. 11.1 (b): Light House

11.1 Light Travels Along A Straight Line

Yasir recalls an activity, in which he looked at a lit candle first through a straight pipe and then through a bent pipe (**Fig.11.2**). Why was Yasir not able to see the candle flame through a bent pipe?



Fig.11.2: Looking at a candle through a straight and bent pipe

This activity showed that light travels along a straight line. How can we change the path of light? Do you know, what happens when light falls on a polished or a shiny surface?

11.2 REFLECTION OF LIGHT

One way to change the direction of light is to let it fall on a shiny surface. For example, a shining stainless steel plate or a shining steel spoon can change the direction of light. The surface of water can also act like a mirror and change the path of light. Have you ever seen the reflection of trees or buildings in water (**Fig.11.3**)?



Fig.11.3: Reflection of objects in water

Any polished or a shiny surface can act as a mirror. What happens when light falls on a mirror?

You might have learnt that a mirror

changes the direction of light that falls on it. This change of direction of light by a mirror is called **reflection of light**. Can you recall the activity in which you got the light of a torch reflected from a mirror? Let us perform a similar activity.

Saba remembers the story of the lion and the rabbit from the Panchtantra, in which the rabbit befooled the lion by showing him his reflection in water (Fig.11.4).



Fig.11.4: Reflection of lion in water

Activity 11.1

Take a torch. Cover its glass with a chart paper which has three slits as shown in **Fig.11.5**.

Spread a sheet of chart paper on a smooth wooden board. Fix a plane mirror strip vertically on the chart paper (**Fig.11.5**). Now direct the beam of light on

the mirror from the torch with slits. Place the torch in such a way that its light is seen along the chart paper on the board. Now adjust its position so that the light from the torch strikes the plane mirror at an angle (Fig.11.5).

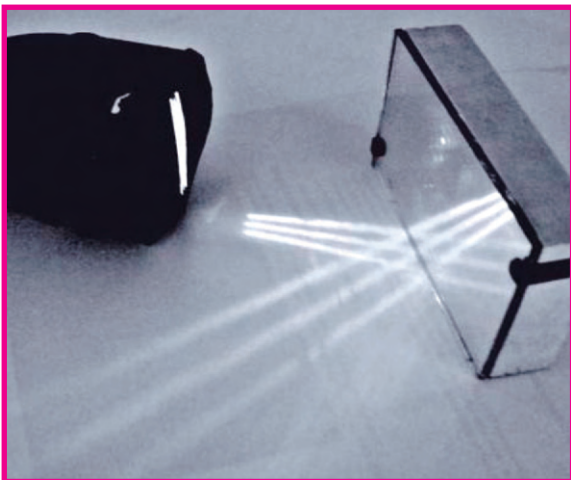


Fig.11.5: Reflection of light from a mirror

Does the mirror change the direction of light that falls on it? Now move the torch slightly to either side. Do you find any change in the direction of reflected light?



Saba wants to know, what makes things visible to us? Yasir thinks that objects are visible only when light reflected from them reaches our eyes. Do you agree with him?

Look into the mirror along the direction of the reflected light. Do you see the slits in the mirror? This is the image of

the slits.

This activity shows how light gets reflected from a plane mirror.

Let us play around with the images formed in mirrors and know a little more about them.

Activity 11.2

CAUTION

Handle the lighted candle with care. It is better if this activity is performed in the presence of a teacher or an elder person.

Place a lighted candle in front of a plane mirror. Try to see the flame of the candle in the mirror. It appears as if similar candle is placed behind the mirror. The candle, which appears behind the mirror, is the **image** of the candle formed by the mirror (Fig.11.6). The candle itself is the **object**.



Fig.11.6: Image of a candle in a plane mirror

Now move the candle to different positions in front of the mirror. Observe

the image in each case.



Yasir noted in his note book: Is it not surprising that my image is of the same size as me, whether the mirror is small or large?

Was the image upright in each case? Did the flame appear on top of the candle as in the object? Such an image is called **erect**.

An image formed by a plane mirror is erect and of the same size as the object.

Now place a vertical screen behind the mirror. Try to obtain the image of the candle on this screen. Can you get the candle on this screen? Now place the screen in front of the mirror. Can you get the image on the screen now? You will find that the image of the candle cannot be obtained on the screen in either case.

What about the distance of the image from mirror? Let us perform another activity.

Activity 11.3

Take a chart paper, if a chess board is not available. Draw on a chart paper 64 (8x8) squares of equal size. Draw a thick line in the middle of the

paper. Fix a plane mirror vertically on this line. Place any small object, such as a pencil sharpener, at the boundary of the third square counting from the mirror (**Fig.11.7**). Note the position of the image. Now shift the object at the boundary of the fourth square. Again note the position of the image. Did you find any relation between the distance of the image from the mirror and that of the object in front of it?



Fig.11.7: Locating image in a plane mirror



Saba made a note in her notebook: In a plane mirror the image is formed behind the mirror. It is erect, of the same size and is at the same distance from the mirror as the object is in front of it.

You will find that the image is at the same distance behind the mirror as the object is in front of it. Now verify this by placing the object anywhere on the chart paper.

11.3 RIGHT OR LEFT

When you see your image in a

plane mirror, is it exactly like you? Have you ever noticed that there is one interesting difference between you and your image in a mirror? Let us find out.

Activity 11.4

Stand in front of a plane mirror and look at your image. Raise your left hand. Which hand does your image raise (**Fig. 11.8**)? Now touch your right ear. Which ear does your hand touch in your image? Observe carefully. You will find that in the mirror the 'right' appears 'left' and the 'left' appears 'right'. Note that only sides are interchanged; the image does not appear upside down.



Fig.11.8: Left hand appears on the right side in the image

Now write down your name on a piece of paper and hold it, in front of a plane mirror. How does it appear in the mirror?



Yasir saw an ambulance on the road. He was surprised to see that the word 'Ambulance' in front was written in a strange manner

Can you now understand why the word 'AMBULANCE' is written as in **Fig. 11.9**? When the driver of a vehicle ahead of an ambulance looks in her/his rear view mirror, she/he can read 'AMBULANCE' written on it and give way to it. It is the duty of every one of us to allow an ambulance to pass without blocking its way.



Fig.11.9: An ambulance

You might have observed that in the side mirror of a scooter or a car, the images of all the objects appear smaller than the objects themselves. Have you ever wondered why it is so?

11.4 PLAYING WITH SPHERICAL MIRRORS

Saba and Yasir were waiting for their dinner. Yasir lifted steel plate and saw his image in it. Oh! This plate acts as a plane mirror. My image is erect and is of the same size. Saba saw her image using back side of a steel spoon. “Yasir look here! you can also see my erect image though it is smaller in size. This spoon also acts as a mirror of some kind”, said Saba.

You can also use a spoon or any curved shining surface to see your image.

Activity 11.5

Take a stainless steel spoon. Bring the outer side of the spoon near your face and look into it. Do you see your image in it (**Fig. 11.10**)? Is this image different from what you seen in a plane mirror? Is this image erect? Is the size of the image the same, smaller or larger?

Now look at your image using the inner side of the spoon. This time you may

find your image is erect and larger in size. If you increase the distance of the spoon from your face. You may see your image inverted (**Fig. 11.11**). You can also compare the image of your pen or pencil instead of your face.



Fig. 11.10: Images from the outer side of a spoon

Fig.11.11: Images from the inner side of a spoon

The curved shining surface of a spoon acts as mirror. The most common example of a curved mirror is a spherical mirror.

If the reflecting surface of a spherical mirror is concave, it is called a concave mirror. If the reflecting surface is convex, then it is called a convex mirror (**Fig.11.12**).

The inner surface of a spoon acts like a concave mirror. While its outer surface acts like a convex mirror.

We know that the image of an



object formed by a plane mirror cannot be obtained on a screen. Let us investigate if it is also true for the image formed by a concave mirror.

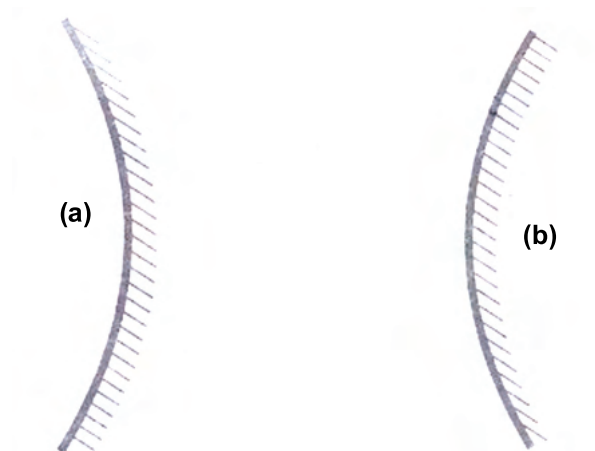


Fig.11.12: A concave and a convex mirror

Why are concave and convex mirrors called spherical mirrors?

Take a rubber ball and cut a portion of it with a knife or a hacksaw blade (Fig.11.13 (a)) (Be careful. Ask an elder person to help you in cutting the ball). The inner surface of the cut ball is called concave and the outer surface is called convex (Fig.11.13 (b)).

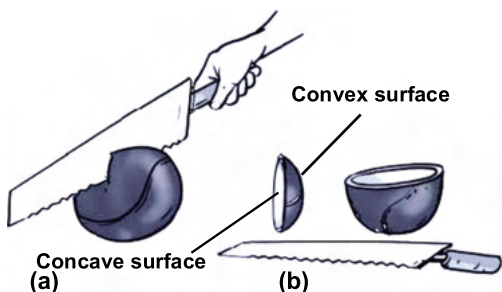


Fig.11.13: A spherical mirror is a part of a sphere

Activity 11.6

CAUTION

You will conduct **Activity 11.6** in the sunlight. Be careful; never look directly towards the sun or its image as it may damage your eyes. You may look at the image of the sun when it is drawn on a screen or a wall.

Take a concave mirror. Hold it facing the sun. Try to get the light reflected by the mirror on a sheet of paper. Adjust the distance of the paper until you get a sharp bright spot on it (Fig.11.14). Hold the mirror and the sheet of paper steady for a few minutes. Does the paper start burning?

This bright spot is in fact the image of the sun. Notice that this image is formed on a screen. An image formed on a screen is called a **real image**. Recollect that in **Activity 11.2** the image formed by a plane mirror could not be obtained on a screen. Such an image is called a **virtual image**.

Now let us try to obtain on the screen the image of a candle flame formed by a concave mirror.



Fig.11.14: A concave mirror forms a real image of the sun

Activity 11.7

Fix a concave mirror on a stand (any arrangement to keep the mirror steady would do) and place it on a table (**Fig.11.15**). Paste a piece of white paper on a cardboard sheet (say about 15 cm x 10 cm). This will act as a screen. Keep a lighted candle on the table at a distance of about 50 cm from the mirror. Try to obtain the image of the flame on the screen. For this, move the screen till a sharp image of the flame is obtained. Make sure that, the screen does not obstruct the light from the candle falling on the mirror. Is this image real or virtual? Is it of the same size as the flame?



Fig.11.15: Real images formed by a concave mirror



Now move the candle towards the mirror and place it at different distances from it. In each case try to obtain the image on the screen. Record your observation in **Table 11.1**. Is it possible to obtain the image on the screen when the candle is too close to the mirror (**Fig.11.16**)?



Fig.11.16: Virtual image formed by a concave mirror

We see that the image formed by a concave mirror can be smaller or larger in size than the object. The image may also be real or virtual.

Concave mirrors are used for many purposes. You might have seen doctors using concave mirrors for examining eyes, ears, nose and throat. Concave mirrors are also used by dentists to see an enlarged image of the teeth (**Fig.11.17**).



Fig.11.17: A dentist examining a patient

The reflectors of torches, headlights of cars and scooters are concave in shape (**Fig.11.18**).

Yasir observed his image in the shiny surface of the bell on his new bicycle.



Fig. 11.18: Reflector of a torch

He found that his image was erect and smaller in size. He wondered if the bell is also a kind of spherical mirror. Can you recognize the type of the mirror?

Note that the reflecting surface of the bell is convex.

Activity 11.8

Repeat **Activity 11.7** now with a convex mirror in place of a concave mirror (**Fig. 11.19**).



Fig.11.19: Images formed by a convex mirror

Record your observations in a table similar to **Table 11.1**.

Could you get a real image at any distance of the object from the convex mirror? Did you get an image larger in size than the object?

Can you now recognize the mirrors used as side mirrors in scooters? These are convex mirrors. Convex mirrors can form images of objects spread over a large area. So, these help the drivers to see the traffic behind them (**Fig. 11.20**).



Fig.11.20: Convex mirror as side view mirror

Table 11.1: Image formed by a concave mirror for object placed at different distance from it

Distance of the object from the mirror	Smaller/larger than the object	Character of the image	
		Inverted/ Erect	Real/Virtual
50 cm			
40 cm			
30 cm			
20 cm			
10 cm			
5 cm			

11.5 IMAGES FORMED BY LENSES

You might have seen a magnifying glass. It is used to read very small print (**Fig. 11.21**). You might have also used it to observe the body parts of a cockroach or an earthworm. The magnifying glass is actually a type of lens.

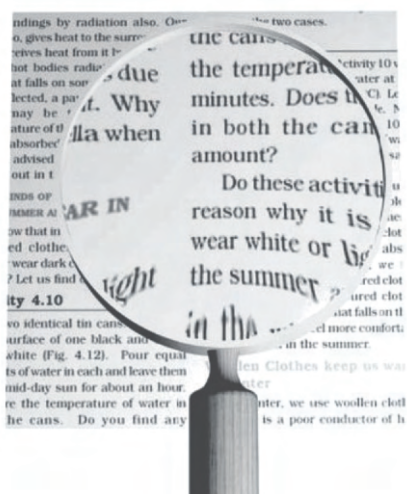


Fig.11.21: A magnifying glass

Lenses are widely used in

spectacles, telescopes and microscopes. Try to add a few more uses of lenses to this list.

Get some lenses. Touch and feel them. Can you find some difference just by touching? Those lenses which feel thicker in the middle than at the edges are convex lenses (**Fig.11.22(a)**). Those which feel thinner in the middle than at the edges are concave lenses (**Fig.11.22(b)**). Notice that the lenses are transparent and light can pass through them.

Let us play with lenses.

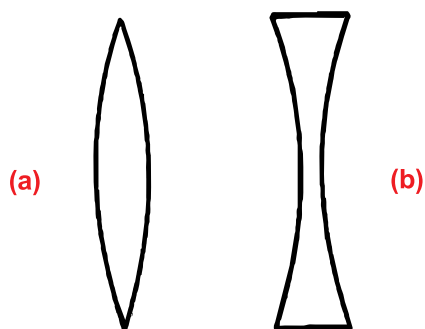


Fig.11.22: (a) A convex lens and (b) A concave lens

CAUTION

It is dangerous to look through a lens at sun or a bright light. You should also be careful not to focus sunlight with a convex lens on any part of your body.

Activity 11.9

Take a convex lens or a magnifying glass. Put it in the path of sunrays. Place a sheet of paper as shown in (Fig.11.23). Adjust the distance between the lens and the paper till you get a bright spot on the paper. Hold the lens and the paper in this position for a few minutes. Does the paper begin to burn?



Fig.11.23: Real image of the sun by a convex lens

Now replace the convex lens with a concave lens. Do you see a bright spot on the paper this time, too? Why are you not getting a bright spot this time?

We have seen in the case of mirrors that for different positions of the object the nature and size of the image change. Is it true for lenses also?

Let us find out.

A convex lens converges (bends inward) the light generally falling on it (Fig.11.24 (a)). Therefore, it is called a **converging lens**. On the other hand, a concave lens diverges (bends outward) the light and is called a **diverging lens** (Fig. 11.24 (b)).

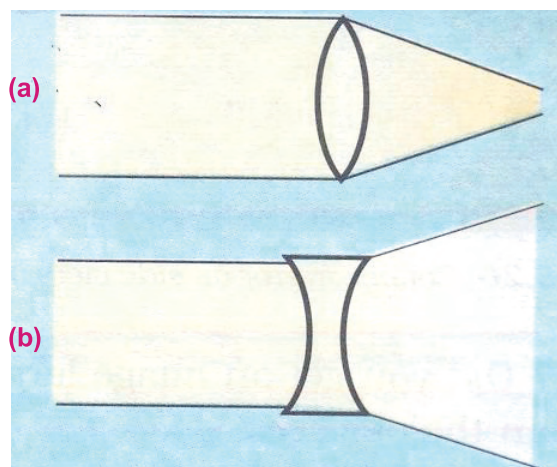


Fig.11.24

Activity 11.10

Take a convex lens and fix it on a stand as you did with the concave mirror. Place it on a table. Place a lighted candle at a distance of about 50cm from the lens (Fig. 11.25 (a)). Try to obtain the image of the candle on a paper screen placed on the other side of the lens.

You may have to move the screen towards or away from the lens to get a sharp image of the flame. What kind of image did you get? Is it real or virtual?

Now vary the distance of the candle from the lens (Fig.11.25 (b)). Try to



(a)



(b)

Fig.11.25: Image by a convex lens for object placed at different distances from it.



Fig.11.26: A virtual image formed by the convex lens

obtain the image of the candle flame every time on the paper screen by moving it. Record your observations as you did in **Activity 11.7** for the concave mirror.

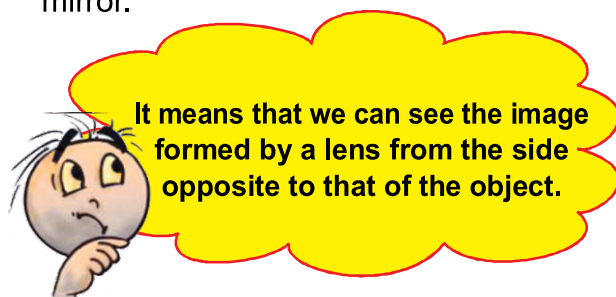


Fig.11.27: Image formed by a concave lens

Did you get in any position which was erect and magnified (**Fig.11.26**). Could this image be obtained on a screen? Is the image real or virtual? This is how a convex lens is used as a magnifying glass.

In a similar fashion study the images formed by a concave lens. You will find that image formed by a concave lens is always virtual, erect and smaller in size than the object (**Fig. 11.27**).

11.6 SUNLIGHT-WHITE OR COLOURED?

Have you ever seen a rainbow in the sky? You might have noticed that it appears usually after the rain when the sun is low in the sky. The rainbow is seen as a large arc in the sky with many colours (Fig.11.28).



Fig.11.28: A rainbow

How many colours are present in a rainbow? When observed carefully, there are seven colours in a rainbow, though it may not be easy to distinguish all of them. These are- red, orange, yellow, green, blue, indigo and violet. [VIBGYOR]



Does this mean that the white light consists of seven colours?

You might have seen that when you blow soap bubbles, they appear

colourful. Similarly, when light is reflected from the surface of a compact disk (CD), you see many colours (Fig. 11.29).

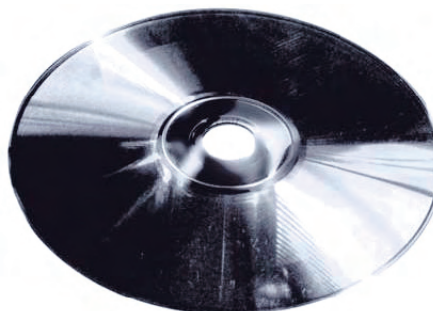


Fig.11.29: A CD placed in sun

On the basis of these experiences, could we say that the sunlight is a mixture of different colours? Let us investigate.

Activity 11.11

Take a glass prism. Allow a narrow beam of sunlight through a small hole in the window of a dark room to fall on one face of the prism. Let the light coming out of the other face of prism fall on a white sheet of paper or on a white wall.



Saba wants to tell you that you can see a rainbow only when your back is towards the sun

What do you observe? Do you see colours similar to those in a rainbow (Fig.11.30)? This shows that the sunlight consists of seven colours. The sunlight is said to be white light. This means that

white light consists of seven colours. Try to identify these colours and write their names in your notebook.

Can we mix these colours to get white light? Let us try.

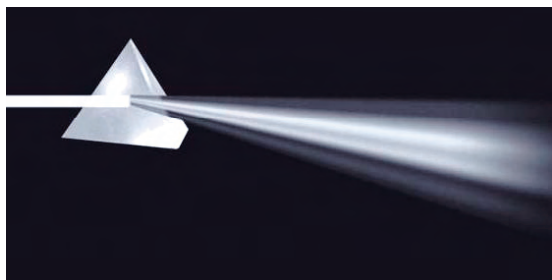


Fig.11.30: A prism splits sunlight into seven colours

Activity 11.12

Take a circular cardboard disc of about 10 cm diameter. Divide this disc into seven segments. Paint the seven rainbow colours on these segments as shown in **Fig.11.31 (a)**. You can also paste-coloured papers on these

segments. Make a small hole at the centre of the disc. Fix the disc loosely on the tip of a refill of a ball pen. Ensure that the disc rotates freely (**Fig. 11.31 (a)**). Rotate the disc in the daylight. When the disc is rotated fast, the colours get mixed together and the disc appears to be whitish (**Fig.11.31 (b)**). Such a disc is popularly known as Newton's disc.



Fig.11.31: (a) A disc with seven colours (b) it appears white on rotating

Saba has a brilliant idea! She has prepared a small top with a small circular disc with seven rainbow colours painted on it (**Fig.11.32**). When the top rotates it appears nearly white.

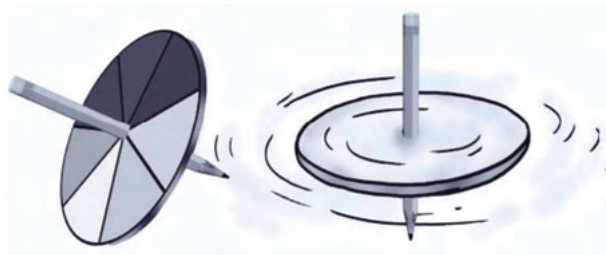


Fig.11.32: A top with seven colours

KEYWORDS

Concave lens	Magnified image	Rear view mirror
Concave mirror	Magnifying glass	Side mirror
Convex lens	Prism	Spherical mirror
Convex mirror	Rainbow	Virtual image
Erect image	Real image	

What you have learnt

- ✍ Light travels along straight lines.
- ✍ Any polished or a shining surface acts as a mirror.
- ✍ An image which can be obtained on a screen is called a real image.
- ✍ An image which cannot be obtained on a screen is called a virtual image.
- ✍ The image formed by a plane mirror is erect. It is virtual and is of the same size as the object. The image is at the same distance behind the mirror as the object is in front of it.
- ✍ In an image formed by a mirror, the left side of the object is seen on the right side in the image, and right side of the object appears to be on the left side in the image.
- ✍ A concave mirror can form a real and inverted image. When the object is placed very close to the mirror, the image formed is virtual, erect and magnified.
- ✍ Image formed by a convex mirror is erect, virtual and smaller in size than the object.
- ✍ A convex lens can form real and inverted image. When the object is placed very close to the lens, the image formed is virtual, erect and magnified. When used to see objects magnified, the convex lens is called a magnifying glass.
- ✍ A concave lens always forms erect, virtual and smaller image than the object.
- ✍ White light is composed of seven colours.

EXERCISES

1. Fill in the blanks:

- (a) An image that cannot be obtained on a screen is called _____.
- (b) Image formed by a convex _____ is always virtual and smaller in size.
- (c) An image formed by a _____ mirror is always of the same size as that of the object.
- (d) An image which can be obtained on a screen is called a _____ image.
- (e) An image formed by a concave _____ cannot be obtained on a screen.

2. Mark 'T' if the statement is true and 'F' if it is false:

- (a) We can obtain an enlarged and erect image by a convex mirror. (T/F)
- (b) A concave lens always form a virtual image. (T/F)
- (c) We can obtain a real, enlarged and inverted image by a concave mirror. (T/F)
- (d) A real image cannot be obtained on a screen. (T/F)
- (e) A concave mirror always forms a real image. (T/F)

3. Match the items given in Column I with one or more items of Column II

Column I	Column II
(a) A plane mirror	(i) Used as a magnifying glass.
(b) A convex mirror	(ii) Can form image of objects spread over a large area.
(c) A convex lens	(iii) Used by dentists to see enlarged image of teeth.
(d) A concave mirror	(iv) The image is always inverted and magnified
(e) A concave lens	(v) The image is erect and of the same size as the object.
	(vi) The image is erect and smaller in size than the object.

- 4. State the characteristics of the image formed by a plane mirror ?
- 5. Find out the letters of English alphabet or any other language known to you in which the image formed in a plane mirror appears exactly like the letter itself.



Discuss your findings ?

6. What is a virtual image? Give one situation where a virtual image is formed?
7. State two differences between a convex and a concave lens?
8. Give one use each of a concave and a convex mirror?
9. Which type of mirror can form a real image?
10. Which type of lens always forms a virtual image?

Choose the correct option in question 11-13

11. A virtual image larger than the object can be produced by a
 - (i) Concave lens (ii) Concave mirror
 - (iii) Convex mirror (iv) Plane mirror
12. David is observing his image in a plane mirror. The distance between the mirror and his image is 4 m. If he moves 1 m towards the mirror, then the distance between David and his image will be
 - (i) 3 m (ii) 5 m
 - (iii) 6 m (iv) 8 m
13. The rear view mirror of a car is a plane mirror. A driver is reversing his car at a speed of 2 m/s. The driver sees in his rear view mirror the image of a truck parked behind his car. The speed at which the image of the truck appears to approach the driver will be
 - (I) 1 m/s (ii) 2 m/s
 - (iii) 4 m/s (iv) 8 m/s

Extending Learning - Activities and Projects

1. Play with a mirror

Write your name with a sketch pen on a thin sheet of paper, polythene or glass. Read your name on the sheet while standing in front of a plane mirror. Now look at your image in the mirror.

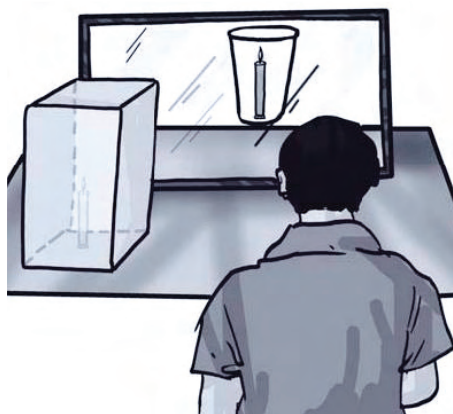


Fig.11.33: Candle burning in water

2. A burning candle in water

Take a shoe box, open on one side. Place a small lighted candle in it. Place a clear glass sheet (roughly 25 cm x 25 cm) in front of this candle (**Fig.15.33**). Try to locate the image of the candle behind the glass sheet. Place a glass of water at its position. Ask your friends to look at the image of the candle through the sheet of glass. Ensure that candle is not visible to your friends. Your friends will be surprised to see the candle burning in water. Try to explain the reason.

3. Make a rainbow

Try to make your own rainbow. You can try this project in the morning or in the evening. Stand with your back towards the sun. Take a hosepipe or a water pipe used in the garden. Make a fine spray in front of you. You can see different colours of rainbow in the spray.

4. Visit a laughing gallery in some centre or a science park or a village mela.

You will find some large mirrors there. You can see your distorted and funny images in these mirrors. Try to find out the kind of mirrors used there.

5. Visit nearby hospital.

You can also visit the clinic of an ENT specialist, or a dentist. Request the doctor to show you the mirrors used for examining ear, nose, throat and teeth. Can you recognize the kind of mirror used in these instruments?

6. Role play

Here is a game that a group of children can play. One child will be chosen to act as object and another will act as the image of the object. The object and the image will sit opposite to each other. The object will make movements, such as raising a hand, touching an ear, etc. The image will have to make the correct movement following the movement of the object. The rest of the group will watch the movements of the image. If the image fails to make the correct movement, she/he will be retired. Another child will take her/his place and the game will continue. A scoring scheme can be introduced. The group that scores the maximum will be declared the winner.

You can read more on the following websites:

www.glenbrook.k12.il.us/gbssci/phys/mmedia/optics/ifpm.html

www.glenbrook.k12.il.us/gbssci/phys/class/refln/u1311b.html

DO YOU KNOW?

The mirrors can be used as weapons. Archimedes, a Greek scientist, is said to have done just that more than two thousands years ago. When the Romans attacked Syracuse, a coastal city-state in Greece, Archimedes used mirror arranged as shown in **Fig. 11.34**. The mirrors could be moved in any direction. They were positioned in such a way that they reflected the sunlight on the Roman soldiers. The soldiers were dazzled by the sunlight. They did not know what was happening. They got confused and ran away. This was an example of triumph of ideas over military might.

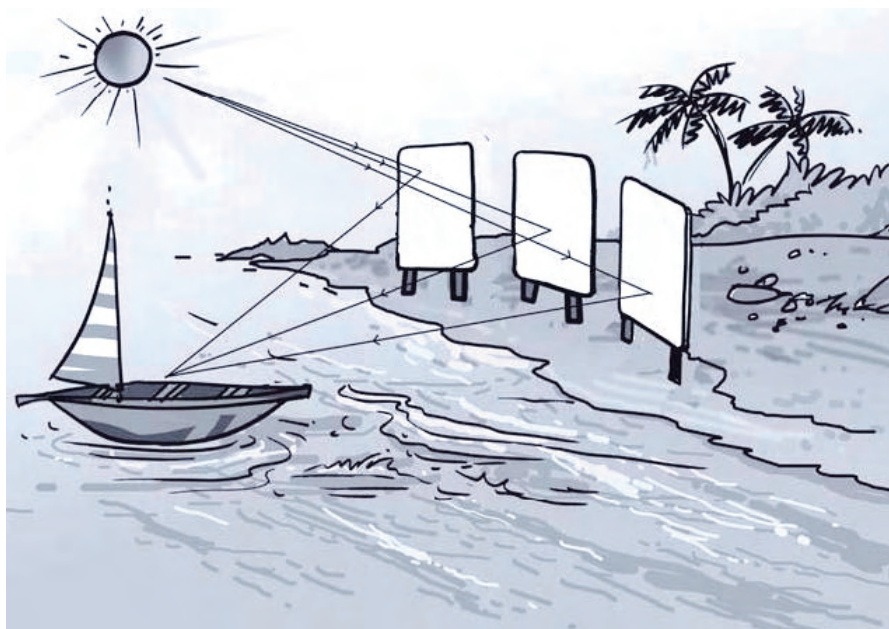


Fig.11.34: Archimedes mirrors

12

FORESTS: OUR LIFELINE



The word forest is derived from a latin word foris which means “out of door”. One evening Yasir entered the park with an elderly person. He introduced him to his friends. Prof. Ahmad was a scientist working in the university. The children started playing while Prof. Ahmad sat on the bench in the corner. He was tired as he had participated in the golden jubilee celebrations of the town. After a while, the children also came and sat around him. They wanted to know about the celebrations. Prof. Ahmad told them that after the cultural programme, the senior people discussed the town's unemployment problem. A plan was proposed to put up a factory by clearing an area of the forest just outside the town. This would give the increasing population of the town a chance to get jobs. The children were very surprised when Prof. Ahmad told them that many people had objected to this idea.

“This is because the forests serve as green lungs and water purifying systems in nature”. Prof. Ahmad explained. The children were confused.

Prof. Ahmad realized that the children had not visited a forest. The children also wanted to know more about the forest, so they decided to visit it with Prof. Ahmad.

12.1 Visit to a Forest

One Sunday morning, the children packed a few things like a knife, a hand lens, a stick, a notebook and walked together through a forest trail near a village. On their way, they met Ayman, a young boy of their age group, of a nearby village, who was taking a cattle for grazing along with his aunt. He was very agile, running here and there to keep the herd together. When he saw the children, Ayman also started walking along with them while his aunt went on a different path. As soon as they entered the forest, Ayman raised his hand and signalled them to keep quiet because noise could disturb the animals living in the forest.

Ayman then took them to a place at a height to show them the broad view of the forest. Children were surprised because they could not see any land (**Fig.12.1**). The different treetops had formed green cover over the land.



However, the cover was not uniformly green. The environment was peaceful and a cool breeze was blowing. This made the children quite fresh and happy.



Fig. 12.1 : A view of a forest

While coming down, they got excited on hearing a sudden sound of birds and some noise from the top

branches of the trees. Ayman told them to relax since it was a normal phenomenon here. Because of the children's presence, some monkeys had climbed higher up on the trees where they disturbed the birds. Animals often give this type of warning call to alert other animals. Ayman also told them that many other animals like boars, bison, jackals, porcupines and elephants live in the deeper areas of the forest (**Fig. 12.2**). Prof. Ahmad cautioned children that they should not go deep into the forest.

Yasir and Saba remembered that they have studied about forest as an example of a habitat (**Fig. 12.3**). They



Fig. 12.2 : Some forest animals



could see now how the forest provides a home for many animals and plants.



Fig. 12.3 : Forest as habitat

The land where the children were walking was uneven and covered with many trees. Ayman helped them to identify sal, teak, semal, sheesham, neem, palash, fig, khair, amla, bamboo, kachnar (**Fig 12.4**). Prof. Ahmad pointed out that there are several other trees, shrubs, herbs and grasses in the forest. The trees were also covered with different types of creepers and climbers. The sun was barely visible through the leaves of the trees, making it quite dark inside the forest.

Activity 12.1

Observe the various things in your home and make a list of those which are made



Neem



Bamboo



Sheesham



Simal

Fig. 12.4 : Some forest plants

from material which may have been obtained from the forest.

The area under forest cover is 21% of the total area of Indian subcontinent. According to an estimate, total area under forests in J&K is 20,230 sq. km i.e., 19.95% of state area.

You might have many wooden items on your list like plywood, fuel wood, boxes, paper, matchsticks, and furniture. Do you know that gum, oils, spices, fodder for animals and medicinal plants are also some of the products which we get from the forest (**Fig. 12.5**).

Saba wondered who would have planted these trees. Prof. Ahmed replied that in nature trees produce enough seeds and the forest floor provides favourable conditions for them to germinate and develop into seedlings and saplings. Some grow up into trees. He added that branchy part of a tree above the stem is known as the **crown** of the tree (**Fig. 12.6**).



Fig. 12.5 : Forest products

Prof. Ahamd asked children to look up and observe how the branches of the tall trees look like a roof over the plants in the forest. He told them that this is called a **canopy** (**Fig. 12.6**).

Activity 12.2

Visit a forest or a park in your neighbourhood. Observe the trees and try to identify them. You can take the help from some elder person or consult books on trees. List the characteristics of the trees that you observe, such as the



Fig. 12.6 : Some crown shapes

height, shape of leaves, crown, flowers, and fruits. Also draw the crowns of some trees.

Prof. Ahmad pointed out that trees had crowns of different types and sizes. These had created different horizontal layers in the forest. These are known as understoreys (**Fig. 12.7**). Gaint and tall trees constituted the top layer followed by shrubs and tall grasses, and herbs form the lowest layer.

"Would we see similar trees in every forest ?" asked Yasir. Prof. Ahmad said, "No, due to different climatic conditions there are variations in the types of trees and other plants. The types of animals also differ from forest to forest".

The forest of J&K grows numerous kinds of plants & trees. Some of them are : Pine, Deoder, Poplar, Fir, Chinar. These provide excellent shelter to various animal species such as Musk Deer, Nilgai, Snow Leopards, etc.

A few children were busy watching beautiful butterflies fluttering here and there on the flowers of shrubs and herbs. They had a close look at the bushes. While doing that their hair and clothes had seeds and shrubs clinging to them.

They came across numerous insects, spiders, squirrels, ants and various other small animals on the bark of the trees, plants leaves and on decaying leaves of the forest floor (**Fig. 12.8**). They started making sketches of these



Fig. 12.7 : Canopy and under storeys in a forest

creatures. The forest floor seemed dark coloured and was covered with a layer of dead and decaying leaves, fruits, seeds, twigs and small herbs. The decaying matter was moist and warm.



Fig. 12.8 : Forest floor

Children picked up various seeds and leaves for their collection. Walking over the dead leafy layer on the forest floor was like walking over a spongy carpet!

Is the decaying matter always warm? Prof. Ahmad suggested that the children could perform an activity to get an answer for this question.

Activity 12.3

Dig a small pit. Put vegetable waste and leaves in it. Cover it with soil. Add some water. After three days, remove the upper layer of the soil. Does the pit feel warm inside?

Saba asked. “ There are so many trees here. Also, there are many forests

like this. What difference will it make if we cut some trees for a factory?”

Prof. Ahmed said, “You have read about autotrophs, heterotrophs and saprotrophs. You have learnt how green plants produce food. All animals, whether herbivorous or carnivores, depend ultimately on plants for food. Organisms which feed on plants often get eaten by other organisms, and so on. For example, grass is eaten by insects, which in turn, is taken by the frog. The frog is consumed by snakes. This is said to form a food chain:

Grass → insects → frogs → snakes → eagle.
Many food chains can be found in the forest. All food chains are linked. If any one food chain is disturbed, it affects other food chains. Every part of the forest is inter-dependant on the other parts. If we remove one component, say trees, all other components would be affected.”

Prof. Ahmad asked children to pick up leaves from the forest floor and observe them under a hand lens. They found tiny mushrooms over the decaying leaves. They also saw an army of tiny insects, millipedes, ants and beetles on them. They were wondering how these organisms live there. Prof Ahmad explained that apart from these animals which are easily seen, there are several



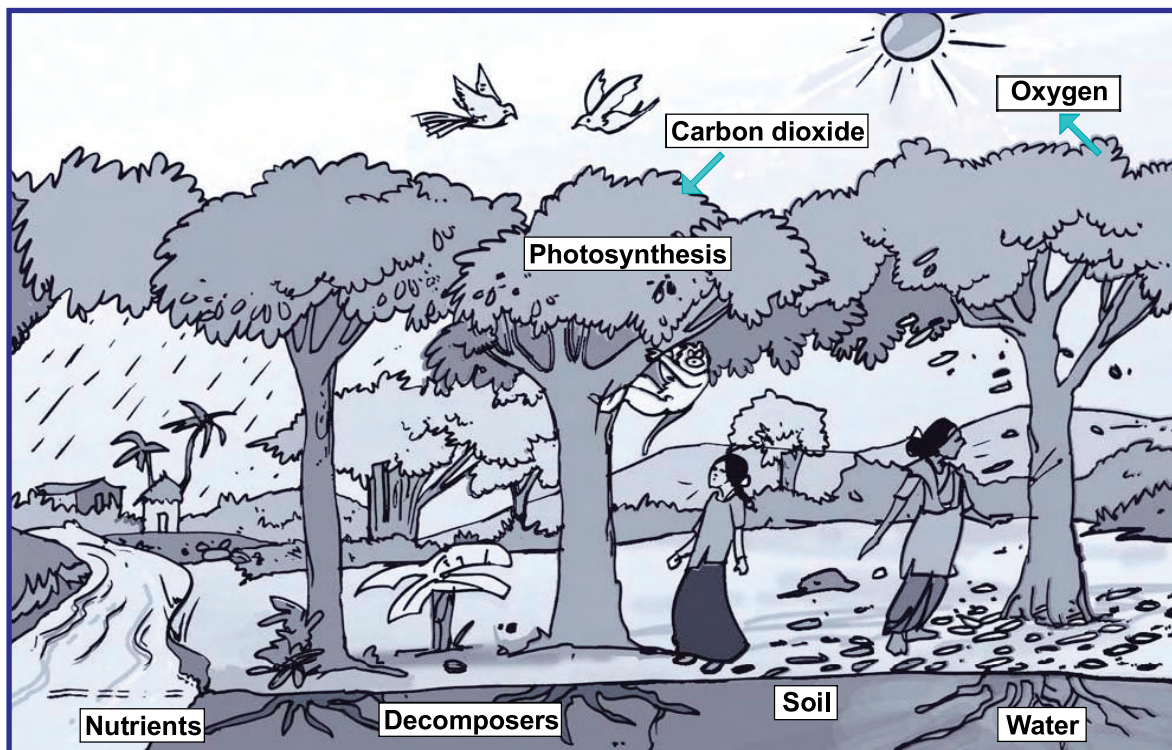


Fig. 12.9 : Interrelationship of plant, soil and decomposers in a forest

organisms and micro-organisms that live in the soil. Saba wondered what mushroom and other micro-organisms eat. Prof. Ahmad replied that they feed upon the dead plants and animal tissues and convert them into a dark coloured substance called **humus**.

You have learnt about humus in chapter 9. In which layer of the soil would you find humus? What is its importance to the soil?

The micro-organisms which convert the dead plants and animals into humus are known as **decomposers**. These micro-organisms play an important role in the forest. Soon, Saba removed

some dead leaves and discovered under them a layer of humus on forest floor. The presence of humus ensures that the nutrients of the dead plant and animals are released into the soil. From soil these nutrients are again absorbed by the roots of the living plants. "What happens if an animal dies in the forest?" Sheila asked. Ayman replied that the dead animals become food for vultures, crows, jackals and insects. In this way, the nutrients are cycled. So, nothing goes waste in a forest (**Fig. 12.9**).

Saba reminded Prof. Ahmad that he had explained why forests are called



green lungs. Prof Ahmad explained that plants release oxygen through the process of photosynthesis. The plants help to provide oxygen for animal respiration. They also maintain the balance of oxygen and carbon dioxide in the atmosphere (**Fig 12.10**). That is why forests are called lungs.

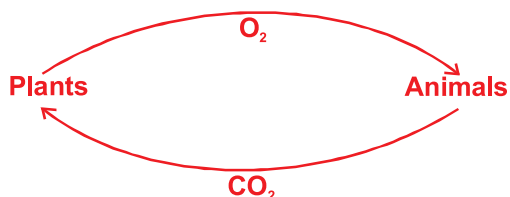
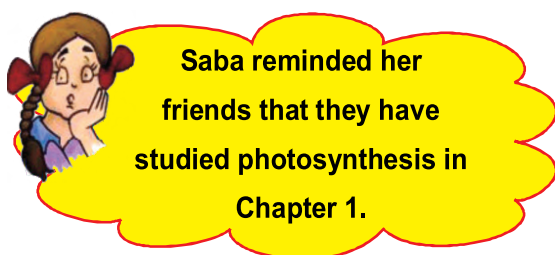


Fig 12.10 : Balance of oxygen and carbon dioxide

The children saw clouds forming in the sky. Yasir recalled what he had learnt about the water cycle in class VI. Trees take in water from their roots and release water vapour into the air through evaporation.

If there were fewer trees, how will the water cycle be affected?

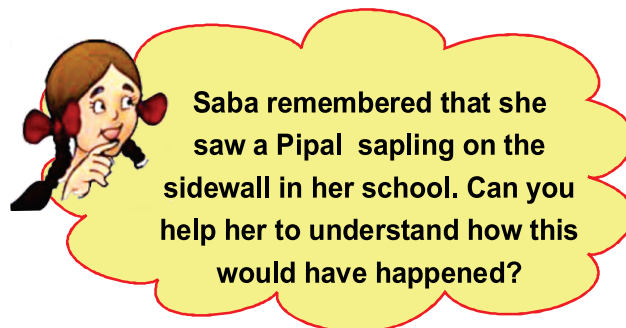
Ayman told them that the forest is not just home to plants and animals. Many people also live in the forest. Some of them may belong to different tribes. Ayman explained that these people

depend mostly on the forests. The forest provides them with food, shelter, water and medicines. They have traditional knowledge about many medicinal plants in the forest.

While Yasir was drinking water from a small stream, he saw some deer crossing the stream (**Fig 12.11**). They disappeared into the bushes. The dense bushes and the tall grasses provide animals with the food and shelter. They also protect them from carnivores that live in the forest.



Fig 12.11: Deer in a forest



Ayman then started looking closely at the forest floor. Soon he called and showed the children droppings of some animals, and explained the difference between various types of droppings. Prof. Ahmad informed them that the forest officers could recognise the presence of some animals in the forest by their dropping and footprints.

Yasir called every one and showed them a large, decaying heap of animal dropping. Several beetles and grubs were feeding on the heap and a bunch of seedlings which were sprouting. "These seedlings are of the herbs and shrubs. The animals also disperse the seeds of certain plants and help the forest to grow and regenerate. The decaying animal dung also provides nutrients to the seedlings to grow," said Prof. Ahmad.



Fig.12.12 : A sapling on a wall

After listening to this, Yasir noted in his notebook, "By harbouring greater variety of plants, the forest provides greater opportunities for food and habitat for the herbivores. Larger number of herbivores means increased availability of food for a variety of carnivores. The wide variety of animals help the forest to regenerate and grow. Decomposers help in maintaining the supply of nutrients to the growing plants in the forest. Therefore, the forest is a '**dynamic living entity**'- full of life and vitality."

It was about afternoon and the children wanted to go back. Ayman suggested another route for going back. While they were going back, it started raining. However, surprisingly, they saw that the raindrops were not hitting the forest floor directly. The uppermost layer of the forest canopy intercepted the flow of raindrops, and most of the water was coming down through the branches and the stems of the trees. From the leaves it was dripping slowly over branches of the shrubs and herbs (**Fig.12.13**). They found that the ground was still dry. After about half an hour, the rain stopped. They noticed that the layer of dead leaves over the forest floor appeared wet now. But water did not stagnate in the forest.



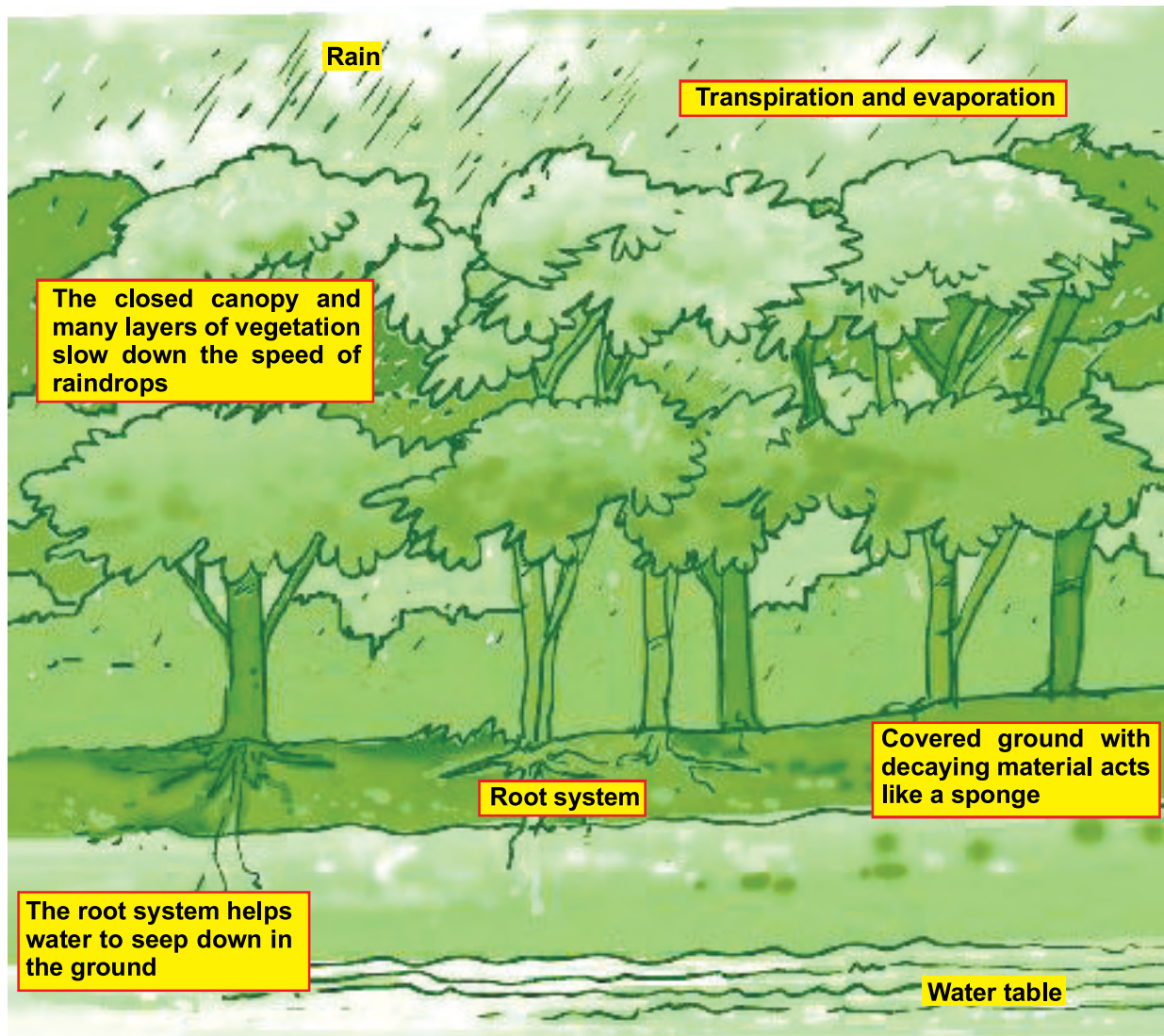


Fig. 12.13 : Rainwater drips from the trees and seeps into the ground

Yasir thought that if it had rained so heavily in his town, it would have flooded the drains and roads.

What would happen if it rains heavily in your town?

Prof. Ahmad told them that the forest also acts as a natural absorber of rainwater and allows it to seep. It helps to maintain the water table throughout the

year. Forests not only help in controlling floods but also help to maintain the flow of water in the streams so that we get a steady supply of water. On the other hand, if trees are not present, rain hits the ground directly and may flood the area around it. Heavy rain may also damage the soil. Roots of trees normally bind the



soil together, but in their absence the soil is washed away or eroded.

The children spent an hour at Ayman's village on their way back. The weather of the village was quite pleasant. Villagers told them that due to the surrounding forest, they receive good rainfall. The air also remained cool. Noise pollution, too is less because the forest absorbs the noise of the nearby highway.

The children learnt about the history of the village. It surprised them that the villages and the agricultural fields of that area were created after clearing the forest about sixty years ago. Ayman's grandfather told them that when he was young, the village was not as large as it was now. It was also surrounded by forests. Construction of roads, building, industrial development and increasing demand of wood created pressure on the forest and it started vanishing. He was not happy that the forest adjoining their

village is not regenerating and is on the verge of disappearing due to overgrazing of animals and indiscriminate felling of trees. Prof. Ahmad said that if we did things wisely we could preserve forest and environment as well as have development.

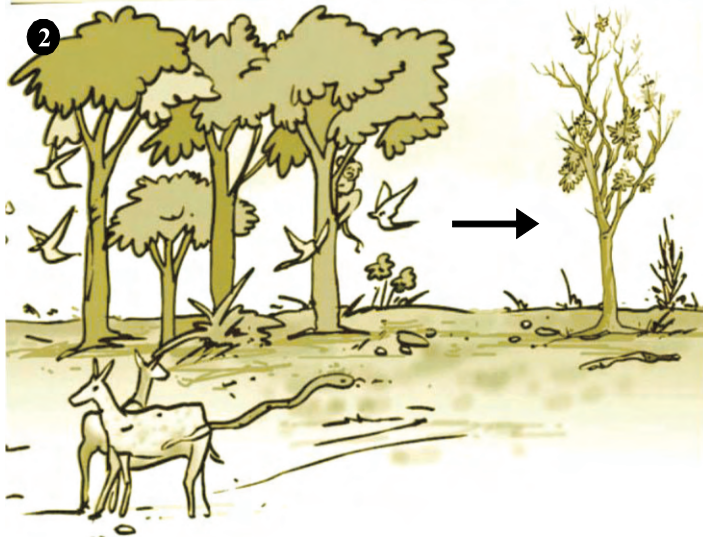
Children prepared a few pictures to show the consequences of such an event.

At the end of the visit, Prof. Ahmad asked children to sum up the importance of forests. The children wrote: forests provide us oxygen. They protect the soil and provide habitat to a large number of animals. Forests help in bringing good rainfall in the neighbouring areas. They are a source of medicinal plants, timber and many other useful products. We must preserve our forests.



What would happen if forests disappear ?





1. If forests disappear, the amount of carbon dioxide in air will increase, resulting in the increase of earth's temperature.
2. In the absence of trees and plants, the animals will not get food and shelter.
3. In the absence of trees, the soil will not hold water, which will cause floods.
4. Deforestation will endanger our life and environment. Think, what we can do to preserve our forests.



KEYWORDS**Canopy****Deforestation****Seed dispersal****Crown****Humus****Soil erosion****Decomposers****Regeneration****Understorey****What you have learnt**

- We get various products from the forests surrounding us.
- Forest is a system comprising of various plants, animals and micro-organisms.
- In a forest, tree form the upper most layer, followed by shrubs. The herbs form the lowest layer of the vegetation.
- Different layers of the vegetation provide food and shelter for animals, birds and insects.
- The various components of the forest are interdependent on one another.
- The forest keeps growing and changing, and can regenerate.
- In the forest, there is an interaction between soil, water, air and living organisms.
- Forests protect the soil from erosion.
- Soil helps the soil to grow and regenerate.
- Forests are the life line for the forest-dwelling communities.
- Forests influence climate, water cycle and air quality.

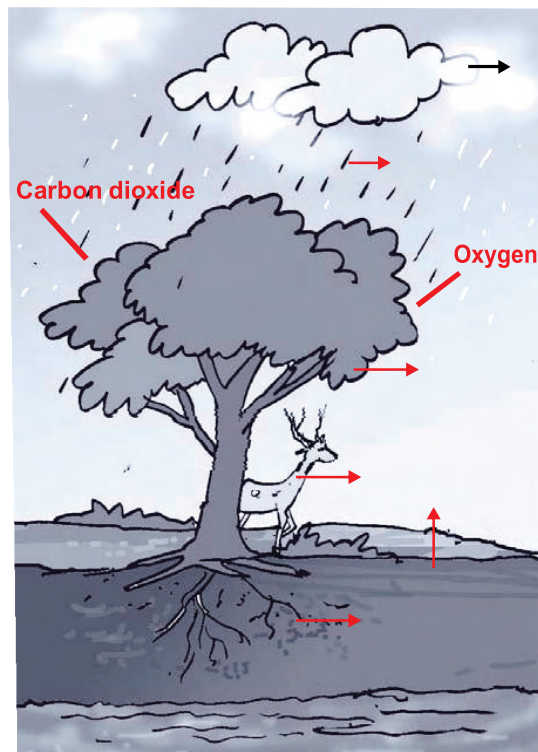
EXERCISES

1. Explain how animals dwelling in the forest help it grow and regenerate.
2. Explain how forests prevent floods.
3. What are the decomposers? Name any two of them. What do they do in the forest?
4. Explain the role of forest in maintaining the balance between oxygen and carbon dioxide in the atmosphere.
5. Explain why there is no waste in a forest ?
6. List five products we get from forests ?



7. Fill in the blanks:

- (a) The insects, butterflies, honeybees and birds help flowering plants in_____.
- (b) A forest is a purifier of _____ and _____.
- (c) Herbs form the _____ layer in the forest.
- (d) The decaying leaves and animal droppings in a forest enrich the _____.
8. Why should we worry about the conditions and issues related to forests far from us?
9. Explain why there is a need for variety of animals and plants in a forest.
10. In **Fig 12.15**, the artist has forgotten to put the labels and directions on the arrows. Mark the directions on the arrows and label the diagram using the following labels:
- clouds, rain, atmosphere, carbon dioxide, oxygen, plants, animals, soil, roots, water table.

**Fig 12.15**

11. Which of the following is not a forest product?

- (i) Gum
- (ii) Plywood
- (iii) Sealing wax
- (iv) Kerosene

12. Which of the following statements is not correct?

- (i) Forests protect the soil from erosion.
- (ii) Plants and animals in a forest are not dependent on one another.
- (iii) Forests influence the climate and water cycle.
- (iv) Soil helps forests to grow and regenerate.

13. Micro-organism act upon the dead plants to produce?

- (i) Sand (ii) Mushrooms (iii) Humus (iv) Wood

14. Tick mark (✓) the correct choice

(1) Micro-organism which converts dead plants, animals into humus are known as:-

- | | |
|-----------------|----------------|
| (a) Decomposers | (b) Omnivores |
| (c) Herbivores | (d) Carnivores |

(2) Which of the following is not a forest product?

- | | |
|-------------|--------------|
| (a) Plywood | (b) Gum |
| (c) Teak | (d) Gasoline |

(3) Deforestation results in

- (a) Increase in rainfall
- (b) Global warming
- (c) Increase in water level
- (D) Conservation of soil

(4) A food chain includes :

- (a) Producers and herbivores
- (b) Producers and carnivores
- (c) Producers and decomposers
- (d) Producers, herbivores and carnivores



Extended Learning - Activities and Projects

1. The department of environment is to decide whether some portion of a forest in your area could be cleared for a housing complex. Write a letter to the department explaining your point of view as a concerned citizen.
2. Visit a forest. Here is a list of points that would make your visit more fruitful.
 - (a) Make sure that you have permission to go in to the forest.
 - (b) Make sure that you can find your way around. Get a map and go along with some one who is familiar with the area.
 - (c) Keep a record of things you see and do. Observations make the visit interesting. Sketches and photographs are useful.
 - (d) You may record the bird calls.
 - (e) Collect different kinds of seeds or hard fruits like nuts.
 - (f) Try to recognize various types of trees, shrubs, herbs etc. Make a list of plants from different places in the forest and of different layers. You may not be able to name all the plants, but it is worth recording and seeing where they grow. Make a record of approximate height of plants, crown shape, bark texture, leaf size, and flower colour.
 - (g) Learn to recognise the animal's droppings.
 - (h) Interview the forest official and the people of surrounding villages and other visitors.

You must never collect birds eggs, and their nest should never be disturbed.

**You can read more on the following website:
www.wild-india.com**



DO YOU KNOW?

In India the area under forest cover is about 21% of the total area. It had steadily been falling since independence. But people now seem to have realized the importance of the forest cover. Reports suggest that the area under forest cover has slightly increased in recent years.



13

WASTEWATER STORY



Existence of life can not be imagined without water. But what we are doing with it. All of us use water in our homes and make it dirty.

Dirty! Are you surprised?

Rich in lather, mixed with oil, black brown water that goes down the drains from sinks, showers, toilets, laundries is dirty. It is called **wastewater**. Basically used water is wastewater. This used water should not be wasted. We must clean it up by removing pollutants. Have you ever thought where the wastewater goes and what happens to it?

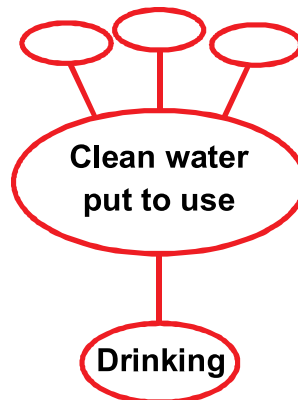
13.1 WATER OUR LIFELINE

Clean water is a basic need of human beings. Let us make a mind-map of the many uses of clean water.

Activity 13.1

(We have given one example of the use of clean water. You can add many more.)

Clean water that is fit for use is unfortunately not available to all. It has been reported that more than one billion of our fellow human beings have no access to safe drinking water.



This accounts for a large number of water-related diseases and even deaths. Women and girls walk for several kilometers to collect clean water, as you have read earlier. Is it not a serious matter for human dignity?



WATER FOR LIFE
2005-2015

You have already studied about the increasing scarcity of fresh-water due to population growth, population, industrial development, mismanagement and other factors. Realizing the urgency of the situation on the World Water Day, on 22 March 2005, the General Assembly of the United Nations proclaimed the period 2005-2015 as the International Decade for action on “**Water for life**”. All



efforts made during this decade aim to reduce by half the number of people who do not have access to safe drinking water.

Cleaning of water is a process of removing pollutants before it enters a water body or is reused. This process of wastewater treatment is commonly known as "Sewage Treatment". It takes place in several stages

13.2 WHAT IS SEWAGE?

Sewage is wastewater released by homes, industries, hospitals, offices and other uses. It also includes rainwater that has run down the street during a storm or heavy rain. The water that washes off roads and rooftops carries harmful substances with it. Sewage is a liquid waste. Most of it is water, which has dissolved and suspended impurities. These impurities are called **contaminants**.

Activity 13.2

Locate an open drain near your home, school or on the roadside and inspect water flowing through it.

Record colour, odour and any other observation. Discuss with your friends and your teacher and fill up the following **Table 13.1**.

We know that sewage is a complex mixture containing suspended solids, organic and inorganic impurities, nutrients, saprophytic and disease causing bacteria and other microbes.

Organic impurities - Human faeces, animal waste, oil, urea (urine), pesticides, herbicides, fruit and vegetable waste, etc.

Inorganic impurities - Nitrates, Phosphates, metals.

Nutrients - Phosphorous and Nitrogen.

Bacteria - Such as which cause cholera

Table 13.1 : Contaminant survey

S.No.	Type of sewage	Point of origin	Substances which contaminate	Any other remark
1	Sullage water	Kitchen		
2	Foul waste	Toilets		
3	Trade waste	Industrial and commercial organizations		

Other microbes - and typhoid.
Such as which
cause dysentery.

living organisms are found in and
around it.

In case you do not have a sewerage
system in your locality, find out how
sewage is being disposed off.

13.3 Water Freshens Up - An Eventful Journey

In a home or a public building generally one set of pipe brings clean water and another set of pipes takes away wastewater. Imagine that if we could see through the ground. We would see a network of big and small pipes, called **sewers**, forming the **sewerage**. It is like a transport system that carries sewage from the point of being produced to the point of disposal, i.e. treatment plant.

Manholes are located at every 50m to 60m in the sewage, at the junction of two or more sewers and at points where there is a change in direction.

Activity 13.3

Study the sewage route in your home/school/building. Do the following:

- ☞ Make a line diagram of the sewage route.
- ☞ Walk down the street or survey the campus to find the number of manholes.
- ☞ Follow an open drain and find out where it ends and which

13.4 TREATMENT OF POLLUTED WATER

Perform the following activity. It will help you understand the processes that take place at the wastewater treatment plant.

Activity 13.4

Divide the class into groups to perform the activity. Record observation at each stage:

- ★ Fill a large glass jar $\frac{3}{4}$ full of water. Add some dirty organic matter such as grass pieces or orange peels, a small amount of detergent, and a few drops of an ink or any color.
- ★ Cap the jar, shake it well and let the mixture stand in the sun for two days.
- ★ After two days, shake the mixture and pour a small sample into the test tube. Label this test tube



“Before treatment; Sample 1”.

How does it smell?

- ★ Use an aerator from an aquarium to bubble air through the sample in the glass jar. Allow several hours for aeration; leave the aerator attached overnight. If you do not have an aerator, use a mechanical stirrer or a mixer. You may have to stir it several times.
- ★ The next day when aeration is complete, pour another sample into a second test tube. Label it as **“After aeration; Sample 2”**
- ★ Fold a piece of filter paper to form a cone. Wet the paper with tap water and then insert the cone in a funnel. Mount the funnel on a support.
- ★ Place layers of sand, fine gravel and finally medium gravel in the funnel (**Fig. 13.2**). (An actual filtration plant does not use filter paper, but the sand filter is several metres deep).
- ★ Pour the remaining aerated liquid through the filter into the beakers. Do not allow the liquid to spill over the filter. If the filtered liquid is not clear, filter it a few times till you get clear water.

- ★ Pour a sample of the filtered water into a third test tube labelled **“Filtered; Sample 3”**.
- ★ Pour another sample of the filtered water into a fourth test tube. Add a small piece of a chlorine tablet. Mix well until the water is clear. Label the test tube **“Chlorinated; Sample 4”**.
- ★ Observe carefully the samples in all the test tubes. **Do not taste!** Just smell them!



Fig. 13.2 : Filtration process

Now answer the following questions:

- (a) What changes did you observe in the appearance of the liquid after aeration?
- (b) Did aeration change the odour?
- (c) What was removed by the sand filter?
- (d) Did chlorine remove the color?
- (e) Did chlorine have an odour?

- (f) Was it worse than that of the wastewater?

13.5 WASTEWATER TREATMENT PLANT (WWTP)

Treatment of wastewater involves physical, chemical and biological processes, which remove physical, chemical and biological matter that contaminates the wastewater.

1. Wastewater is passed through bar screens. Large objects like rags, sticks, cans, plastic packets, napkins are removed (**Fig. 13.3**)



Fig 13.3 : Bar Screen

2. Water then goes to a grit and sand removal tank. The speed of the incoming wastewater is decreased to allow sand, grit and pebbles to settle down (**Fig 13.4**).



Fig.13.4 Grit and sand removal tank

3. The water is then allowed to settle in a large tank which is sloped towards the middle. Solids like faeces settle at the bottom and are removed with a scraper. This is the **sludge**. A skimmer removes the floatable solids like oil and grease. Water so cleared is called clarified water (**Fig. 13.5**).



Fig 13.5 : Water clarifier

The sludge is transferred to a separate tank where it is decomposed by the anaerobic bacteria. The biogas produced in the process can be used as fuel or can be used to produce electricity.

Shrinking Dal lake The present condition of the world famous Dal lake is a matter of great concern as the lake is shrinking at a very fast rate. Amongst the problems responsible for deterioration of Dal lake, the prominent are heavy sanitation, urbanization, over exploitation, over grazing, weed growth, loss of biodiversity etc. The status report of J&K LAWDA (Lakes & Waterways Development Authority) reports an annual silt deposition of 40,000 cubic meters.

4. Air is pumped into the clarified water to help aerobic bacteria to grow. Bacteria consume human waste, food waste, soaps and other unwanted matter still remaining in clarified water (**Fig. 13.6**)



Fig.13.6 : Aerator

After several hours, the suspended microbes settle at the bottom of the tank as activated sludge. The water is then removed from the top.

The activated sludge is about 97%

water. The water is removed by sand drying beds or machines. Dried sludge is used as manure, returning organic matter and nutrients to the soil.

The treated water has a very low level of organic material and suspended matter. It is discharged into a sea, a river or into the ground. Nature cleans it up further. Sometimes it may be necessary to disinfect water with chemicals like chlorine and ozone before releasing it into the distribution system.

Become an active citizen

Waste generation is a natural part of human activity. But we can limit the type of waste and quantity of waste produced. Often we have been repelled by offensive smell. The sight of open drains is disgusting. The situation worsens in the rainy season when drains start overflowing. We have to wade through the mud pools on the roads. Most unhygienic and unsanitary conditions prevail during this time. Flies, mosquitoes and other insects breed in it.



The water in a river is cleaned naturally by processes that are similar to those adopted in a wastewater treatment plant.



DO YOU KNOW?

It has been suggested that we should plant eucalyptus trees all along sewage ponds. These trees absorb all surplus wastewater rapidly and release pure water vapour into the atmosphere.

You can be an enlightened citizen and approach the municipality or the gram panchayat. Insist that the open drains be covered. If the sewage of any particular house makes the neighbourhood dirty, you should request them to be more considerate about others' health.



Don't add to the load of WWTP. Saba wonders how!

Mansabal lake is located in the Jhelum valley and is encircled by three villages viz., Jarokbal, Kondabal and Ganderbal and is stated to be the deepest lake in the Kashmir valley. World Wide Fund for Nature (WWF) conducted an extensive survey of the lake in 1997 and gave following reasons for its deterioration.

- (i) The flow of sewage
- (ii) Siltation

(iii) Large scale illegal encroachment

(iv) 80% of the lake was seen under the thick blanket of weed.

Tawi river is a major left bank tributary of river chenab flowing through the city of Jammu. Waste water from 12 nallahs as well as other waste of Jammu city are discharged into it without any treatment.

Jhelum River Conservation Plan (JRCP) for Jammu and Kashmir is formulated under the National River Conservation Plan (NRCP) of the Ministry of Environment (MOE), Govt. of India (GOI). The four towns, namely Anantnag, Srinagar, Sopore and Baramulla in Jammu and Kashmir have been identified as contributing pollution to river Jhelum and are therefore covered under Jhelum River Conservation Plan.

13.6 BETTER HOUSE KEEPING PRACTICES

One of the ways to minimize or eliminate waste and pollutants at their source is to see what you are releasing down the drain.

- ✓ Cooking oil and fats should not be thrown down the drain. They can

harden and block the pipes. In an open drain the fats clog the soil pores reducing its effectiveness in filtering water. Throw oil and fats in the dustbin.

- ✓ Chemicals like paints, solvents, insecticides, motor oil, medicines may kill microbes that help purify water. So do not throw them down the drain.
- ✓ Used tea leaves, solid food remains, soft toys, cotton, sanitary towels, etc. should also be thrown in the dustbin (**Fig. 13.7**).



Fig.13.7 : Do not throw everything in the sink

These wastes choke the drains. They do not allow free flow of oxygen. This hampers the degradation process.

13.7 SANITATION AND DISEASE

Poor sanitation and contaminated drinking water is the cause of a large number of diseases.

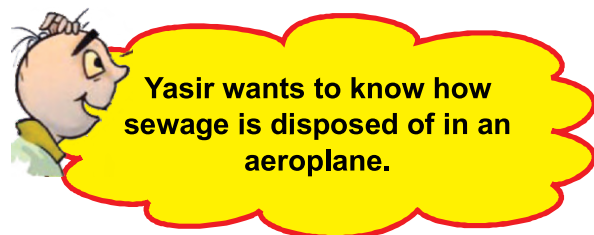
Let us look at our own country. A vast number of our people are still without sewerage facilities. Where do they relieve themselves?

A very large fraction of our people defecate in the open, on dry riverbeds, on railway tracks, near fields and many a times directly in water. Untreated human excreta are a health hazard. It may cause water pollution and soil pollution. Both the surface water and groundwater get polluted. Groundwater is a source of water for wells, tube wells, springs and many rivers. Thus, it becomes the most common route for water borne diseases. They include cholera, typhoid, polio, meningitis, hepatitis and dysentery.

13.8 ALTERNATIVE ARRANGEMENT FOR SEWAGE DISPOSAL

To improve sanitation, low cost **onsite sewage** disposal systems are being encouraged. Examples are septic tanks, chemical toilets, composting pits.

Septic tanks are suitable for places where there is no sewerage system, for hospitals, isolated buildings or a cluster of 4 to 5 houses.



Some organization offer hygienic on-site human waste disposal technology. These toilets do not require scavenging. Excreta from the toilet seats flow through covered drains into a biogas plant. The biogas produced is used as a source of energy.

13.9 SANITATION AT PUBLIC PLACES

In our country fairs are organized periodically. A large number of people participate in them. In the same way railway stations, bus depots, airports, hospitals are very busy places. Thousands of people visit them daily. Large amount of waste is generated here.

It must be disposed off properly otherwise epidemics could break out.

The government has laid down certain standards of sanitation but, unfortunately, they are not strictly enforced.

However, all of us can contribute in maintaining sanitation at public places. We should not scatter litter anywhere. If there is no dustbin in sight, we should carry the litter home and throw it in the dustbin.

Conclusion

We all have a role to play in keeping our environment clean and healthy. You must realize your responsibility in maintaining the water sources in a healthy state. Adopting good sanitation practices should be our way of life. As an agent of change your individual initiative will make a great difference. Influence others with your energy, ideas and optimism. A lot can be done if people work together. There is great power in collective action.



KEYWORDS**Aeration****Aerobic bacteria****Anaerobic bacteria****Biogas****Contaminant****Sanitation****Sewage****Sewer****Sewerage****Sludge****Wastewater****What you have learnt**

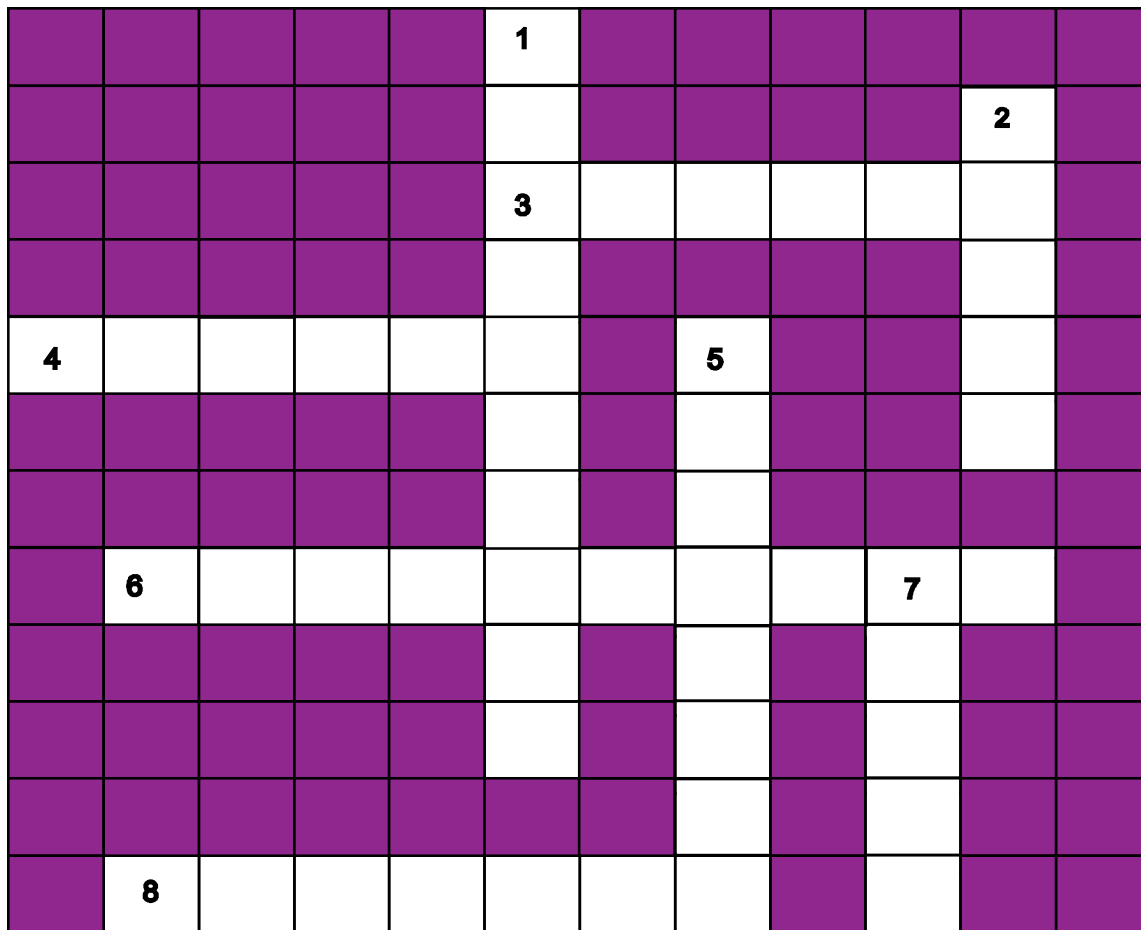
- o Used water is wastewater, Wastewater could be rescued.
- o Wastewater is generated in homes, industries, agricultural fields and in other human activities. This is called sewage.
- o Sewage is a liquid waste which causes water and soil pollution
- o Wastewater is treated in a sewage treatment plant.
- o Treatment plants reduce pollutants in wastewater to a level where nature can take care of it.
- o Where underground sewerage systems and refuse disposal systems are not available, the low cost on-site sanitation system can be adopted.
- o By-products of wastewater treatment are sludge and biogas.
- o Open drain system is a breeding place for flies, mosquitoes and organisms which cause diseases.
- o We should not defecate in the open. It is possible to have safe disposal of excreta by low cost methods.

EXERCISES**1. Fill in the blanks:**

- (a) Cleaning of water is a process of removing _____.
- (b) Wastewater released by houses is called _____.
- (c) Dried _____ is used as manure.
- (d) Drains get blocked by _____ and _____.

- 2. What is sewage? Explain why it is harmful to discharge untreated sewage into rivers or seas.
- 3. Why should oils and fats not be released in the drains? Explain.
- 4. Describe the steps involved in getting clarified water from waste water.
- 5. What is sludge? Explain how it is treated.
- 6. Untreated human excreta is a health hazard. Explain.
- 7. Name two chemicals used to disinfect water.

8. Explain the function of bar screens in a wastewater treatment plant.
9. Explain the relationship between sanitation and disease.
10. Outline your role as an active citizen in relation to sanitation.



11. Here is a crossword puzzle: Good Luck!

Across

3. Liquid waste products
4. Solid waste extracted in sewage treatment
6. A word related to hygiene
8. Waste matter discharged from the human body.

Down

1. Used water
2. A pipe carrying sewage
5. Micro-organisms which causes cholera
7. A chemical to disinfect water.



12. Study the following statements about ozone.

- (a) It is essential for breathing of living organisms.
- (b) It is used to disinfect water.
- (c) It absorbs ultraviolet rays.
- (d) Its proportion in air is about 3%.

Which of these statements are correct?

- (i) (a), (b) and (c)
- (ii) (b) and (c)
- (iii) (a) and (d)
- (iv) All four

13. Tick mark (✓) the correct answers.

1. The disease caused by polluted water
 - (a) Jaundice (b) Dysentery
 - (c) Cholera (d) All of these
2. Malaria can be triggered by
 - (a) Open drains (b) Closed drains
 - (c) Taps (d) Pipe lines
3. Waste that can be broken down by bacteria
 - (a) Biological (b) Biochemical
 - (c) Biodegradable (d) Chemical
4. Stage of wastewater treatment for removing large particles
 - (a) Disinfection (b) Secondary
 - (c) Primary (d) Chlorination

Extending Learning - Activities and Projects

1. Construct a crossword puzzle of your own using the keywords.
2. Then and now: Talk to your grandparents and other elderly people in the neighbourhood. Find out the sewage disposal systems available to them. You can also write letters to people living in far off places to get more information. Prepare a brief report on the information you collect.
3. Visit a sewage treatment plant.
It could be as exciting and enriching as a visit to a zoo, a museum, or a park. To guide your observation here are a few suggestions.
Record in your notepad.

Place _____ Date _____ Time _____

Name of the official at the plant _____ Guide/Teacher _____

- (a) The location of the sewage plant.
- (b) Treatment capacity.
- (c) The purpose of screening as the initial process.
- (d) How is air bubbled through the aeration tank?
- (e) How safe is the water at the end of the treatment? How is it tested?
- (f) Where is the water discharged after treatment?
- (g) What happens to the plant during heavy rains?
- (h) Is biogas consumed within the plant or sold to other consumers?
- (i) What happens to the treated sludge?
- (j) Is there any special effort to protect nearby houses from the plant?
- (k) Other observations.

For more information, consult:

Millennium Development Goals:

[http // www.un.org/millenniumgoals/](http://www.un.org/millenniumgoals/)

“water for life” International Decade for Action:

[http// www.un.org/waterforlifedecade/](http://www.un.org/waterforlifedecade/):

World Water Day Themes and Importance.

[http// www.worldwaterday.org/](http://www.worldwaterday.org/)

Through the ages Development of Sanitation:

[http // www.cep.unep.org/pubs/techreports/tr43en/Household%20Systems. htm.](http://www.cep.unep.org/pubs/techreports/tr43en/Household%20Systems.htm)

“By providing clean water and sanitation to the poorest people on the planet, we can reduce poverty and suffering and ensure education for all children”. -UNICEF

An early engineering feat: Indus valley civilization

One of the ancient civilizations, Harappa and Mohenjodaro had perhaps the world's first urban sanitation system. Within the city individual houses, or groups of houses, obtained water from wells. There was a separate room for bathing, and wastewater was directed to the covered drains which lined the major streets. The oldest toilet made of bricks is about 4500 years old.

