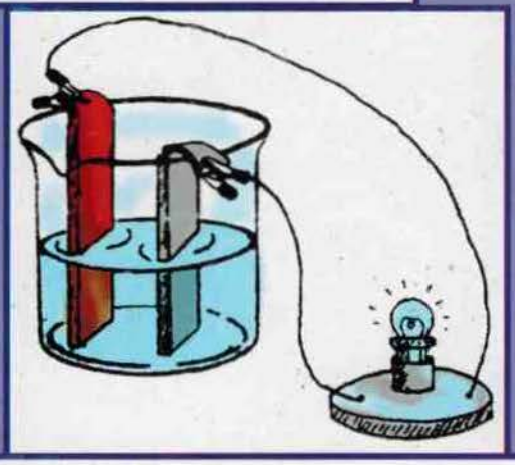
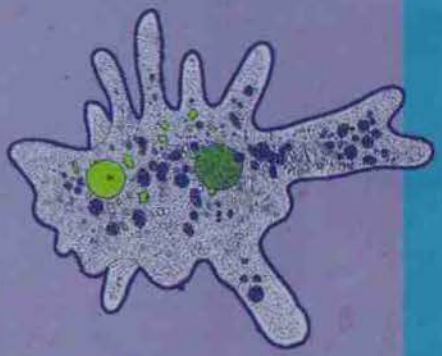
OUR science

New Edition 8





Grade Eight

Our Science

Grade 8

This English version has been prepared by
Janak Education Materials Centre Ltd.

Publisher

Government of Nepal
Ministry of Education
Curriculum Development Centre
Sano Thimi, Bhaktapur, Nepal

First Colour Print Edition (English Version) : 2061
Reprint : 2062/2063/2064/2065
Second & Revised Edition : 2066/2067
Reprint : 2069

JEMC welcomes any suggestions regarding the book.

Printed & Distributed By:
Nepal Sahitya Prakashan Kendra
Kathmandu, Nepal Tel: 4435856, 4411652, 4417709
Fax: 977-1-4420990, Email: nspk@mail.com.np

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About the book

School level textbooks have been revised and updated in line with the recommendations given by the National Education Commission-2049, and the High Level National Education commission 2055. Education should foster the feelings of generosity through democratic norms in order to produce competent, disciplined and accountable human resources required for the development of country. This book has been developed to meet the challenges of contemporary society.

An attempt has been made to incorporate the practical activities related to day-today life with examples. Most of the exercises included in this book can be taught by using local materials. Originally written by Dr. Ganesh Bahadur Mali, Ms Sunita Malakar, Mr. Jibanhari Shrestha and Mr. Uddhav Karki in 2053 BS, this book has been thoroughly revised by a revision panel comprising Mr. Rakesh Shrestha, Mr. Shankarman Shrestha, Mr. Nandakaji Shrestha, Mr. Rabindra Kshetri, Mr. Ramesh Kumar Shrestha and Ms Achala Thapa. Its additional revision work was done by the subject committee comprising Dr. Sharada Devi Maharjan, Mr. Kedargovinda Amatya, Mr. Gopal Prasad Adhikari, Ms Krishna Sharma and Mr. Tilak Shashanka. The language was edited by Mr. Bharat Nepali Pyakural, Mr. Shambhu Dahal and Mr Bishnu Adhikari. The CDC heartily extends its gratitude to all those involved in developing this book.

Since a textbook is only a tool for teaching learning process, an experienced teacher can teach the subject matter specified by the curriculum successfully by utilizing different resources. However, most of our classroom teachings are found entirely based on the textbook only. In this context, possible endeavor has been done to bring this book up to the standard. Despite our sincere effort, there might be some errors both in language and the subject matter. Therefore, Curriculum Development Centre invites constructive suggestions form the valued readers.

Government of Nepal
Ministry of Education
Curriculum Development Centre
Sano Thimi Bhaktapur

Preface

Now that the overwhelming majority of people in Nepal question the quality of education, it is, indeed, desirable to do something about it. One of the major tasks of the government is to provide quality education to all the people. In this context, Curriculum Development Center (CDC) is the authorized institution in the country to design and develop textbooks and teachers' guides used throughout the kingdom to meet this challenging need. Likewise, Janak Education Materials Centre (JEMC) also plays an equally crucial role by printing and distributing the textbooks to all the public schools across the country. To cater to the needs of both private and public schools, the JEMC has come one step forward by translating the authorized version of Nepali books into English. The Centre is confident that it will be able to provide English version books in different subjects to the learners as reference materials step-by-step.

JEMC really feels proud of accomplishing a substantial job of translating public school textbooks into English for English medium learners across the country. The Centre also looks forward to working in the similar field and serving the needy pupils in the days to come.

This book is translated by Bal Krishna Baidhya, Shankarman Shrestha, Rakesh Shrestha, Keshar Khulal from Nepali version Hamro Bighyan of Grade 8. We are highly grateful to Krishna Sharma, Bishnu Prasad Parajuli and Bhim Bahadur Basnet. who were involved in subject- matter and language editing. The JEMC invites positive suggestions from all concerned to make the book ever better.

We would like to express our sincere thanks to the teachers of some renowned schools of 5 Development Regions who have assisted in evaluation of the proposed translated lessons and all the others who have also contributed to the preparation of these books.

Finally, we would also like to express our gratitude to the CDC for giving us an opportunity to translate the government textbooks into English in order to cater the needs of the pupils with English school background.

Janak Education Material Centre
Sano Thimi, Bhaktapur

Date: 2062, Baishakh

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Unit 1 Measurement

In class six you briefly studied about measurement and its importance, definition, and locally used measuring tools. You will study about measurement in greater detail in this unit.

Definition and Importance of Measurement System

We frequently make use of measuring things in our daily activities. For example, we make use of different types of measurements while buying things in the market, while playing and studying in the school, and while doing various household activities. A ruler is used while making a shirt, trousers or skirt for us. Balance and weights are used while buying fruits, vegetables and cereals, and a watch is used to see time during examinations. The exact quantity of substance can only be known through measurement. Therefore, in physics, objects that are around us and can thus be studied are called physical quantities.

The study of physical science requires frequent and precise measurement of different physical quantities because while carrying out an experiment one has to make correct observations and measurements, and draw correct conclusions. To take measurement of an object is to compare it with the standard quantity. For example, we use a metre ruler/scale if we have to measure the length of our bedroom or classroom. If the length of a room is 5 metres then a metre scale has to be used 5 times from end to end. Therefore, while writing the measurement of any quantity we have to write the name of the standard quantity along the number or figure, for example, 40 centimeters, 3 kilograms, 500 grams, etc.

In the past people used hands, feet and finger spans to measure distance and quantity of matter. This made the exact measurement difficult because the size of human organs varies from person to person. Therefore, people chose certain measurements as standard measurements, for example-mile, yard, foot, inch, etc.

In order to ensure that a particular object has the same measurement all over the world forever, the need for standard measurements was felt. Therefore, units were introduced for length, mass and time to measure physical quantities. The units of these measurements are independent and hence they are called fundamental units. All other units are based on these three units and they are called derived units. For example, unit for area is square metre (m^2) and unit for density is kilogram per cubic metre ($\frac{kg}{m^3}$).

System of units

The combination of fundamental units makes a system of units. There are four types of system of units.

(i) CGS system of units
(ii) MKS system of units
(iii) FPS system of units
(iv) SI system of units

Except in SI system, the first letter indicates the fundamental unit for length, the second letter indicates the fundamental unit for mass and the third letter indicates the fundamental unit for time. In CGS system C stands for centimeter, G for gram and S for second. In MKS system M stands for metre, K for kilogram and S for second. Likewise, in FPS system F stands for foot, P for pound and S for second. The extended version of MKS system is called SI system. Besides metre, kilogram and second the other fundamental units are ampere (A) for the measurement of electric current, Kelvin (K) for temperature, candela (Cd) for brightness of light, and mole (mol) for amount of substance.

Different systems of units are listed in the table below.

System of units	Unit for length	Unit for mass	Unit for time	Other units
CGS	centimeter (cm)	gram (gm)	second (s)	–
MKS	metre (m)	kilogram (kg)	second (s)	–
FPS	foot (ft)	pound (lb)	second (s)	–
SI	metre (m)	kilogram (kg)	second (s)	other four units

Sub-units of metre

1 metre = 10 decimetres (dm)
1 metre = 100 centimetres (cm)
1 metre = 1000 millimetres (mm)

Multiple units of metre

10 metre = 1 decametre (Dm)
10 decametre = 1 hectometre (Hm)
10 hectometre = 1 kilometre (km)

or, 1 km = 1000m = 10^3 m
1 Hm = 100m = 10^2 m
1 cm = 10mm = 10^{-2} m

Likewise, the sub-units and multiple-units of kilogram are as follows:

1 tonne = 1000 kilograms (kg)
1 kilogram = 1000 grams (gm)
1 gram = 1000 milligrams (mg)
1 gram = 10,00,000 micrograms (μg)

Units of time

Time is generally measured in second, minute and hour, but in physics time is measured only in second.

1 mean solar day = 24 hours
= 24 × 60 minutes = 1440 minutes
= 1440 × 60 seconds = 86,400 seconds

Therefore, 1 second is equal to 1/86,400 of an average solar day.

Activity 1

Using your scale obtain the correct measurements, fill up the following table, and draw a suitable conclusion.

Objects	Measurement in			
	metre	centimetre	millimetre	inch
Length of your science book				
Your height				
Span of your fingers				
Length of your sole				

(a) What is the similarity between the measurements obtained in metre, centimeter and millimeter?
(b) Small units, such as centimeter, are most suitable for measuring the length of what type of objects?
(c) Large units, such as metre, are most suitable for measuring the length of what type of objects?

Regular and Irregular Objects

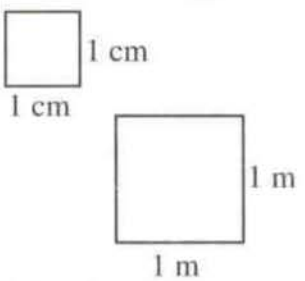
Objects that have fixed length, breadth and height have regular shapes. In physics, such objects are called regular objects, for example, a book, exercise book, a room's length, breadth and height, shape of a ball, etc. Objects that do not have a fixed shape or fixed length, breadth and height are called irregular objects, for example, a piece of brick, a piece of torn paper, piece of rock, etc.

Area, Volume and Mass

Area

In physics, the space occupied by a plane surface is called area. Area is measured in square centimetre or square metre units.

If a certain plane object is one centimetre long and one centimetre wide then its area is one square centimetre. Similarly, if a body is one metre long and one metre wide then its area is one square metre.



Area = length × breadth
= 1 cm × 1 cm
= 1 cm^2 (square centimetre)

Area = length × breadth
= 1 m × 1 m
= 1m^2 (square meter)

Volume

The total space occupied by an object is called its volume . Volume is measured in cubic centimeter (cm^3) or cubic metre (m^3) units. Generally the volume of a regular object is worked out by measuring its length, breadth and its height. For example, the volume of a brick or your book can be calculated by measuring their length, breadth and height. The volume of regular objects is calculated by using following formula.

Volume = length × breadth × height (depth) [V= l × b × h]

(Note: While measuring the volume of a regular object the same type of unit has to be used everywhere.)

Mass

Mass of an object means the quantity of matter contained in it. Mass is measured in gram and kilogram units. A beam balance is used to measure mass. When an object placed on one pan of the beam balance is balanced by adding standard masses on the other pan, the mass of the object becomes equal to the total standard mass on the second pan.

Generally, for an irregular object area is worked out from a graph and volume is measured using a measuring cylinder. Mass of an irregular object too is measured with the help of a beam balance.

Activity 2

Workout the area of the first page of your science book using the formula. Similarly, workout the area of any four other regular objects and draw a suitable conclusion.

Activity 3

Find the volume of your science book using the formula. Similarly, workout the volume of any four other regular objects and draw a suitable conclusion.

Activity 4

Using a beam balance and measuring cylinder, find the mass and volume of an irregular object (a piece of stone for instance), and complete the following table.

Object	Mass	Reading on the measuring cylinder		Conclusion
		(Before)	(After)	
Piece of stone		..... cm^3	..... cm^3	

Summary

1. Exact quantity of an object can be known only through measurement.
2. To take measurement of an object means to compare it with the standard measurement.
3. Measurement is expressed in number/figure followed by a unit. For example, 2m, 4 kg, 5s.
4. A fixed measurement is known as the standard measurement.
5. Independent units of measurement of length, mass and time are called fundamental units.
6. CGS, MKS, FPS, and SI are the different systems of units.
7. SI system of units is the extended version of MKS system of units.
8. An object can be regular or irregular.
9. Area, volume and mass of regular as well as irregular objects can be found.

10. The formula for the area of a regular rectangular object is, $A = l \times b$ and the formula for volume is $V = l \times b \times h$.
11. For an irregular object, area is worked out from a graph, and volume from a measuring cylinder.
12. Mass is measured with the help of a beam balance.

Do, observe and learn

Take a new eraser. Find its volume using the formula. If the eraser sinks in water then find its volume by immersing it in the water in a measuring cylinder. Compare the results and draw a suitable conclusion.

Exercise

1. Write a short answer to:

(a) What is the importance of measurement in our daily life?
(b) What is a physical quantity?
(c) What does it mean by "the length of an object is 2 metre"?
(d) What are the different units of SI system of units?
(e) How is the mass of an object measured?
(f) How is the volume of a regular object and irregular object measured?

2. Express in metre.

(a) 300 cm
(b) 2.46 km.
(c) 3.12 mm

3. If a brick is 18 cm long, 8cm wide and 5 cm thick then,

(a) what is the area of the largest face?
(b) what is its volume? ($144cm^2$, $720cm^3$)

4. In the given figure, what is the volume of the object immersed in water? Why?

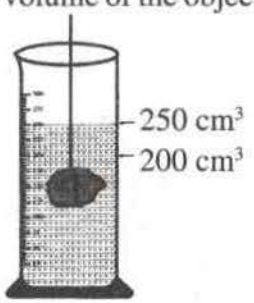


Fig. No. 1.1

5. Give reason:

(a) Volume of an irregular object is measured by using a measuring cylinder.
(b) MKS and CGS systems of measurment are widely used and are considered easier too.

Unit 2

Motion

Stationary and moving objects

In our daily lifes, we see some objects stationary and some in motion. To know whether an object is moving or stationary, we have to compare it with the state of other objects around it. A house, tree, etc. can be called stationary because they are not changing position with respect to the objects around them. But a running vehicle, a flying bird, running water, etc. are all changing position with respect to the objects around them. Therefore, these objects are moving objects.

An object which is not changing its position with respect to a fixed point, called a 'reference frame', is called a stationary object and one which is changing its position is called a moving object.

Uniform and Variable motion

Study the figures given below and answer the following questions.

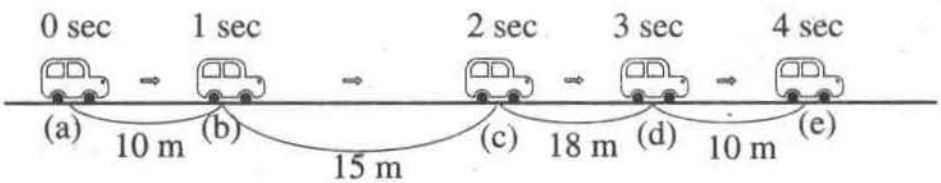


Fig. No. 2.1

The diagram shows the distance covered by a van in every second while moving from position 'a' to 'e'.

At which position, and between which two positions, is the motion of the vehicle slowest? Give the possible reason for your answer.

When is the motion of the vehicle fastest?
Which motion is slower; from a to b or c to d? How?
How is the motion of the vehicle between position 'a' and position 'c'?
How is the motion of the vehicle between position 'a' and position 'b'?
How is the motion of the vehicle between position 'b' and position 'd'?
Is the motion of the vehicle shown in the figure uniform?

Let's study another diagram.

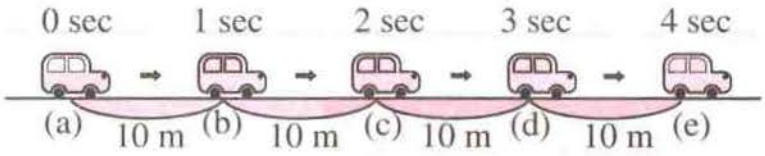


Fig. No. 2.2

This diagram shows the time taken by a vehicle to move from position 'a' to 'e'. What is the difference between the motion of the vehicle from position 'a' to 'b' and the motion from position 'd' to 'e'? How is the motion like from position 'a' to 'e'? Why?

If the distance covered by an object in every second is the same from start to end, the motion of the object is called uniform motion. However, if the distance covered by an object in every second varies, the motion of such object is called variable motion.

Motion of objects can be uniform or variable

In general, most of the objects have non-uniform or variable motion. The motion of human beings, the motion of vehicles, the swaying of trees in the wind, etc. are all examples of variable motion. The motion of stars, planets and motion produced by machines is usually uniform.

Activity 1

Roll a small ball slowly on a table. Is the initial motion of the ball same as the final motion? When is the motion fast and when is it slow? Observe and answer the questions.

On a plain ground mark five points at an interval of 50cm each. Roll a ball slowly from one end of the marked area. With the help of a stop-watch, measure the time taken by the ball to pass each mark. Four different persons should be used so that one person takes time for only one mark. Write down what you learned from this activity.

Speed

1. If a person takes 10 minutes to cover a distance of 1200m, what distance does the person cover in every second?

   Distance covered = 1200 m

   Time taken = 10 min. = 600 sec

   Distance moved in one second $= \frac{1200}{600} = 2\text{m}$

   or, that person moves 2 metre per second.

2. If a vehicle travelled 3 km in 5 minutes, what distance did it cover in 1 second?

Distance moved = 3 km = 3000 m

Time taken = 5 min = 300 sec

Distance moved in 1 second $= \frac{3000}{300} = 10$ m

In above examples, we calculated the distance moved in 1 second.
Distance covered in unit time (1 second) in any direction is called speed. Speed has only magnitude but no direction. Therefore speed is a scalar quantity. It is not necessary to specify the direction while talking about speed.

As mentioned earlier, objects in our daily lives do not have uniform motion. Therefore, we calculate average speed rather than speed at every segment.

$$\text{Average speed} = \frac{\text{total distance covered (m)}}{\text{total time taken (s)}}$$

Velocity

In everyday life terms 'speed' and 'velocity' are often used synonymously but in science they have different meanings. The distance moved by an object in unit time in a fixed direction is called velocity. As it has magnitude as well as direction, it is a vector quantity. So direction has to be specified while talking about velocity.

The diagram below, a vehicle is moving from point A to B with an average speed of 10 m/s.

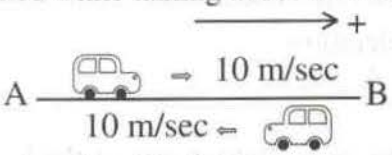


Fig. No. 2.3

If the direction from A to B is considered positive (+), the average velocity of the vehicle becomes +10 m/sec. However, when the vehicle returns from point B to A (in exactly the opposite direction to AB) its average velocity becomes -10 m/sec.

Acceleration

While riding a bicycle down a sloppy road, motion does not remain uniform. The bicycle starts from rest (stationary state) and once it starts moving its velocity increases continuously. Same thing happens with any vehicle (bus, truck, car). The rate of change of velocity in unit time is called acceleration.

Letter 'a' symbolizes acceleration.

If velocity of a bicycle changes from **u** *m/s* to **v** *m/s* in time **t** then the change in velocity in **t** seconds is **v** *m/s* – **u** *m/s*, or (v-u) m/s.

Using this in the form of an equation,

$$\text{acceleration} = \frac{\text{change in speed (m/s)}}{\text{time taken (s)}}$$

$$\text{Or, acceleration} = \frac{\text{final velocity - initial velocity}}{\text{time taken}}$$

$$\text{or, acceleration} = \frac{(v-u)}{t} \quad \frac{(m/s)}{(s)}$$

$$a = \frac{v-u}{t} \quad m/s^2$$

The unit of acceleration is metre per second per second.

Example 1

A vehicle starts to move from rest. If its velocity after 5 seconds is 1000 metre per second, what is its acceleration?

Given,
Initial velocity = 0
Final velocity = 100 m/s
Time = 5 sec
Acceleration = ?

We know,
by the formula,

$$a = \frac{v-u}{t}$$

$$a = \frac{100-0}{5}$$

$$= \frac{100}{5}$$

$$= 20 \text{ m/s}^2.$$

Therefore, acceleration of the vehicle is 20 m/s^2.

Example 2

A car starts from rest. If the acceleration of the car remains 2 m/s^2 for 10 seconds, what will be its final velocity?

Given,
Initial velocity (u) = 0
Time (t) = 10s
Acceleration (a) = 2 m/s^2
Final velocity (V) = ?

We know,
by the formula,

$$a = \frac{v-u}{t}$$

$$\text{or, } v = u+at$$

$$= 0+2\times10$$

$$= 20 \text{ m/s}.$$

Therefore, final velocity of the vehicle will be 20 m/s.

Uniform/constant velocity

If an object moving in a fixed direction covers equal distance in every unit time, then such velocity is called uniform velocity. In other words, what ever distance the object travels in one second, it travels the same distance in other seconds too.

Variable velocity

If distance traveled by an object in every unit time is different then such velocity is called variable velocity. In such situation, average velocity is used and it can be calculated by using the formula

$S = Ut$ or, $U = \frac{s}{t}$

Where U = average velocity, s= total distance travelled and t = time taken.

Example 1

A man leaves home on a car and reaches his office in 30 minutes. If the office is 25 km away form his home, calculate the averages speed of his car.

Given,

Time (t) = 30 minutes = 1800s

Distance (s) = 25km = 25000m

Average velocity (U) = ?

We know by the foumula,

$U = \frac{s}{t}$

$U = \frac{25000}{1800}$

$= \frac{125}{9}$

$= 13.89 m/s$

Therefore, the average velocity of his car is 13.89m/s.

Example 2

If a vehicle moves ahead with a speed of 20m/s, how far does it go in one hour?

Given,

Speed (u) = 20m/s

time (t) = 1 hour = 3600s

Distance (s) = ?

We know by the formula,

$s = u \times t$

$= 20 \times 3600$

$= 72000$ m

$= 72$ km

Therefore, the vehicle travels a distance of 72 km.

Relative motion

The velocity of an object described relative to a reference frame is called relative motion. Line PQ in the following examples represents a reference frame.

1. Let us look at Figure (a).

Initially, both the vehicles are standing on line PQ. If the direction to the right is considered "+", then the velocity of vehicle A becomes -10 m/sec and the velocity of vehicle B becomes +15 m/sec.

Figure (b) shows the situation after 1 second. Vehicle A has travelled 10m to the left of line PQ and vehicle B has travelled 15m to the right of line PQ. From vehicle A, vehicle B appears to have travelled 25m in 1second. Here, relative to A, the velocity of B is 25 m/sec.

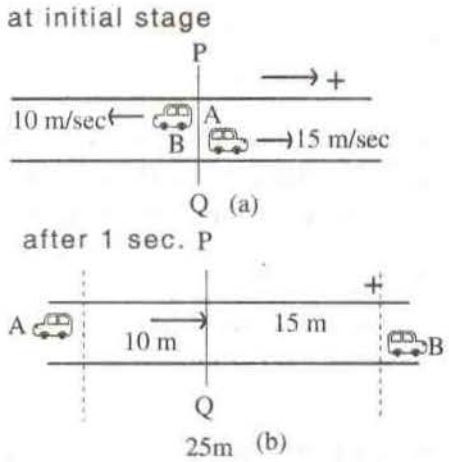


Fig. No. 2.4

2. Figure (a) shows the initial stage. If the direction to the right is considered "+", the velocity of vehicle A becomes 10 m/sec and the velocity of vehicle B becomes 15 m/sec.

   Figure (b) shows the situation after 1 second.

   Looking from vehicle A what does the motion of B appear to be?
   What is the velocity of vehicle B relative to vehicle A?

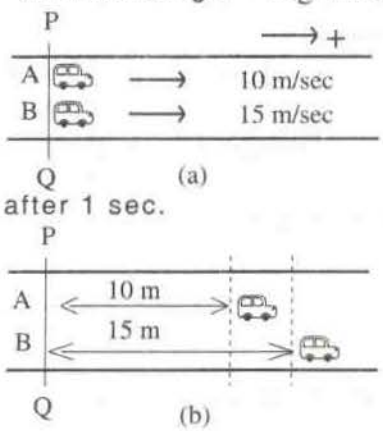


Fig. No. 2.5

3. Figure (a) shows the initial stage. In the figure if the direction to the right is taken as "+" ,then the velocity of vehicle A becomes +10 m/sec, and also the velocity of vehicle B becomes +10 m/sec.

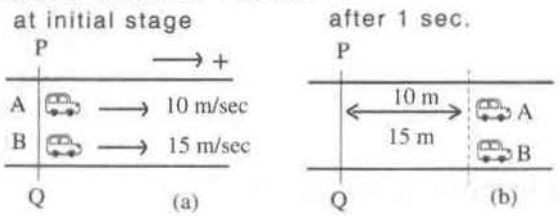


Fig. No. 2.6

Figure (b) shows the situation after 1 second. Both the vehicles have covered the same distance (10 m) from line PQ. Therefore, looking from vehicle A vehicle B does not seem to have travelled any distance at all. In other words, relative to vehicle A, vehicle B has zero velocity.

Summary

1. An object which does not change its position with time or it remains at the same place, is called a stationary object.
2. An object which changes its position with time is called a moving object.
3. The distance moved by an object in unit time is called speed.
4. The distance moved by an object in unit time in a fixed direction is called velocity.
5. If an object has the same speed from start to end then the motion is said to be uniform.
6. The rate of change of velocity in unit time is called acceleration.
7. The velocity in which equal distance is covered in every unit time is called uniform velocity.
8. The velocity in which different distances are covered in every unit time is called variable velocity.
9. If the motion of an object keeps changing, its motion is said to be variable motion.
10. The motion of an object relative to a place or another object is called relative motion.
11. The motion of an object might be different relative to different objects.
12. While talking about velocity a fixed direction has to be mentioned. If one direction is considered "+", the direction exactly opposite becomes "-".

Do, Observe and Learn

1. Mark a distance of 100 m in an open field or on a road. Measure how long it takes to walk 100m distance. From this, calculate your velocity.
   Find out how long it takes you to cycle or run the same distance. Calculate your velocity.
2. Put two marks at an interval of 100m. Mark another point exactly in the middle of these two marks. Starting from the mark in the middle ask two of your friends to run in opposite directions. Find out the time taken by each of them to run a distance of 50m. Work out the velocity of both. Also, work out their speeds relative to each other. (The same activity can be carried out even in shortar distance.)

Exercise

Write short answers.

(a) What kind of object is said to be stationary and what kind of object is said to be moving?

(b) Define 'speed' and 'velocity' and hence, state their difference.

(c) What is a variable motion? Give one example of it.

(d) Two vehicles are running in the same direction. The speed of the first vehicle is 12 m/sec and that of the second vehicle is 8 m/sec. What is the velocity of the first vehicle relative to the second vehicle? What would have been the relative velocity if they were moving in opposite directions? [4 m/s, 20 m/s]

(e) The velocity of one vehicle is 20 m/sec towards the east and the velocity of the other is 15 m/sec towards the west. If both the vehicles start from the same point at the same time, what will be the distance between them after 2 minutes? What distance will each of them have travelled during that time? [4200m, 2400m east and 1800m west]

(f) If the velocity of a vehicle starting from rest reaches 10 m/sec in 10 seconds, is the velocity of the vehicle uniform? Explain with reasons.

(g) If a motorcycle travels 4.8 km in 10 minutes, what distance does it travel in 1 second? [8m]

Unit 3

Machines

We use different kinds of simple tools and equipments to make our work easier in our everyday life. Such tools and equipments are simple machines. They help us make our work easier in different ways. By using simple machines -

(a) heavy loads can be lifted making only a small effort.
(b) the speed of work can be enhanced.
(c) effort can be applied at a suitable point in a suitable direction to lift a load.

The lever, pulley, inclined plane, wedge, wheel and axle, screw, etc. are examples of simple machines, and most of these were mentioned in class seven textbook.

Basic working principle of simple machine

Suppose a box diagram represents a simple machine. A force is applied at a certain part of the machine. This force is called input force (F_i) of effort E. As a consequence of input force, an output force (F_o) appears at some other part of the machine. The outpur force is equal to the load (L).

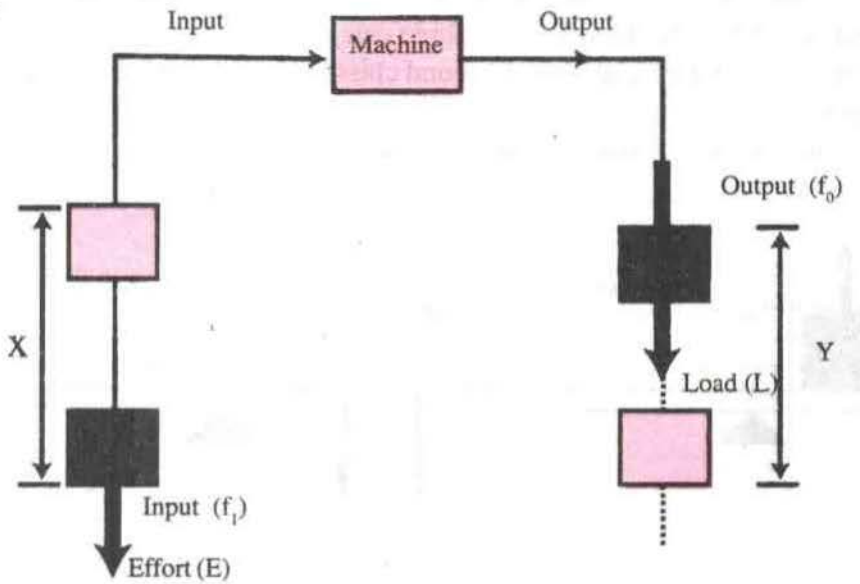


Fig. No. 3.1 A simple machine

Force, Fi is used in doing work against the load (L) on the machine. The input force (F_i) moves through distance X and in exactly the same time the outpur force (F_o) moves through distance Y.

Work dome on the machine = input force × distance
$= F_i \times X$
Similarly, work done by the machine = output force × distance
$= F_o \times Y$

If there is no loss of energy or no friction in a machine, according to the principle of and ideal machine,

Input work = output work
$F_i \times x = F_o \times y$
or $E \times = L \times y$

The input force is also called effort (E) and output force is called load (L).
Here, X represents the effort distance and Y represents the load distance. If effort is smaller than load (L), then the effort distance has to cover a longer distance in order to pull the load through a fixed distance.

Lever

Lever is the simplest and the most ordinary device. It is simply a straight or a bent bar that can rotate about a fixed point called fulcrum (F). Fulcrum is represented by the symbol F. Lever is classified into three categories on the basis of their practical uses. For example, first class lever, second class lever and third class lever. For each class lever,
load × load distance = effort × effort distance.

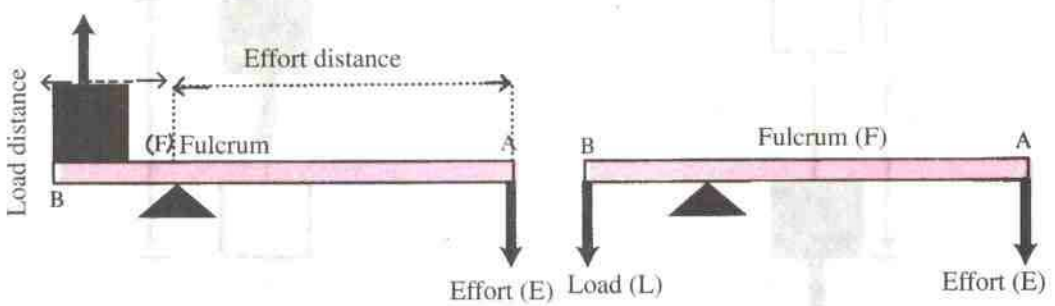


Fig No. 3.2 Diagram of lever

Types of lever

The distance from the fulcrum (F) to the load is called load distance and the distance from the flucrum to the effort is called effort distance.

(a) **First class lever:**

Levers in this class have the fulcrum in between the load and effort.

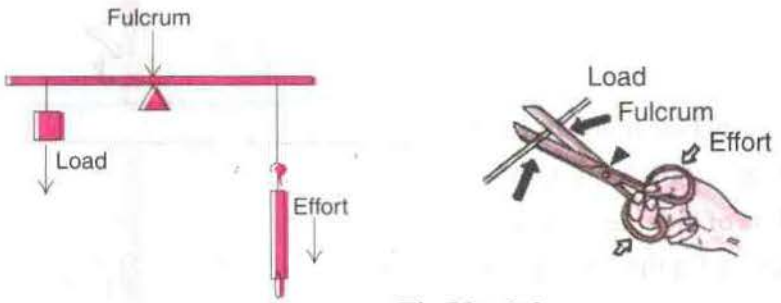


Fig No. 3.3

(b) **Second class lever:**

Levers in this class have the load in between the fulcrum and effort.

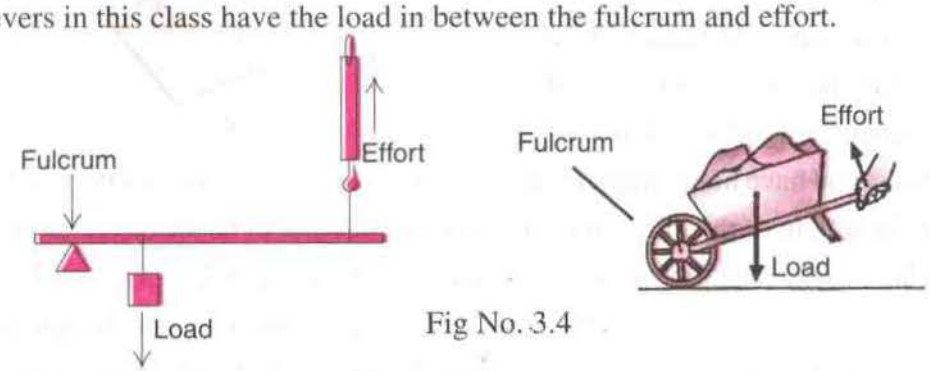


Fig No. 3.4

(c) **Third class lever:**

Levers in this class have the effort in between the fulcrum and load.

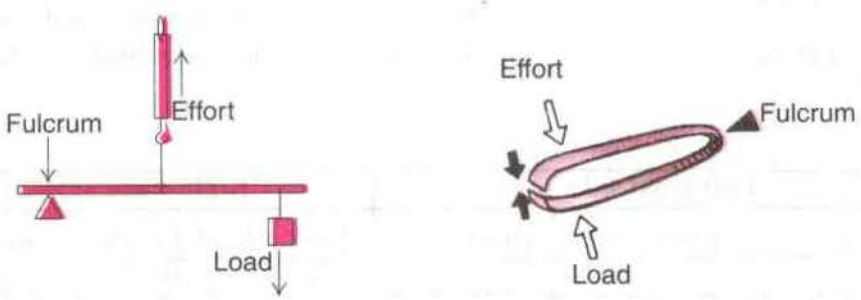


Fig No. 3.5

A lever has three fixed points; the load point (point where the load acts), fulcrum point (point where the fulcrum is) and the effort point (point where the effort is applied). The distance between the load point and the fulcrum point is called the load distance and the distance between the effort point and the fulcrum point is called the effort distance. The part of the lever from the fulcrum towards the effort is called the effort arm and the part towards the load is called the load arm.

Activity 1

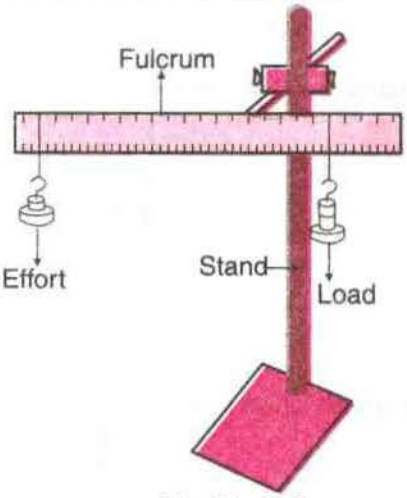


Fig No. 3.6

As shown in the figure, take a 30 cm long ruler. Drill a hole over the 15 cm line so that it is in the middle of the ruler. The hole should be large enough for the tip of a dot-pen to go freely. By inserting the tip of a dot-pen or a piece of wire in the hole, hang the ruler on a stand and balance it. Now hang different masses on both sides of the ruler and balance it. Find the effort (weight) of the masses you have hung. Remember a 100 gram mass gives you an effort of 1N. Consider the weight of the mass on the left side of the ruler to be the effort and that on the right side, the load. Record your observations in the table shown below. Keep the load at different distances from the fulcrum and balance the ruler with the effort.

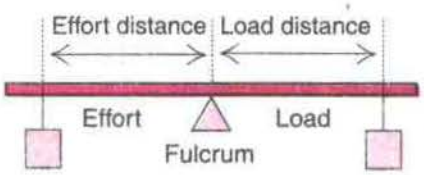


Fig No. 3.7

If this activity is carried out correctly, generally you will find **effort × effort distance = load × load distance**. But, because of friction and other reasons, effort × effort distance will only be approximately equal to load × load distance.

Example:

Left-hand side			Right-hand side		
effort (N)	effort distance	effort × e. d.	load	load distance	load × l. d.
5	6	30	3	10	30

If the effort distance is small, a large effort is needed. However, if the load distance is short, even a large load can be lifted with a small effort. In this class (first class) lever, the effort distance can be made shorter or longer than the load distance according to the need. The above equation, load × load distance = effort × effort distance, applies in second and third class levers as well.

Summary

1. **With the help of a simple machine,**
   (a) we can lift a heavy load using only a small effort.
   (b) we can apply a force at a suitable point in a suitable direction to lift a load.
   (c) we can change the speed of doing work. To increase the speed of the work a large effort is needed but, if we reduce the speed of doing work then even a small effort is sufficient.
2. According to the law of levers,
   Effort × effort distance = Load × load distance.
3. Effort is magnified when effort distance is large.

Do, Observe and Learn

1. Hold a short wooden or metal rod as shown in the figure. Hang a small load on it at a point 10 cm away from your hand.

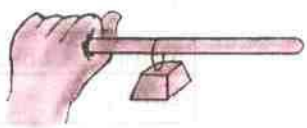


Fig. No. 3.8

   (a) How does it feel when the load is 10 cm away from your hand?
   (b Move the load further away from your hand in steps of 10 cm. How do you feel every time you move the load?
   (c) Is it possible to hold the load even when it is almost at the end of the rod?
   (d) Write down what you learned from this activity.
   (e) Make a list of different simple machines used at your home and catagorize them into different groups according to their structure and function.

2. Take a long stick, a small stone and a bucket full of sand. As shown in the figure, tie the bucket at one end of the stick and make a lever out of it by considering the stone on a table to be the fulcrum.

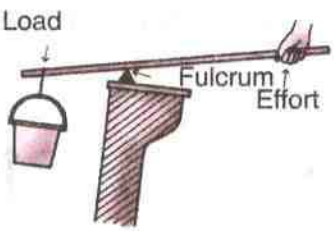


Fig. No. 3.9

Balance the lever by pressing down the other end with your hands. Is there any difference in keeping your hands close to the fulcrum or far away from the fulcrum? Note down your observation.

Exercise

1. Write short answers.

(a) If a 500 kg load is to be lifted with a 100 N effort using a first class lever, at what distance from the fulcrum must the effort be applied when the load is 20 cm away from the fulcrum? Show your answer in diagram form. [1 m]

(b) Give the defination of "a lever".

(c) Draw neat diagrams of different class of levers.

(d) Make a list of different levers used in your home and classify them according to their structure and function.

(e) A load of 500 kg is lifted up using a first class lever. Different effort distances and their corresponding efforts are shown in the table below. How far is the load from the fulcrum? Also, find the values of A, B, C and D.

Effort distance	10 cm	A	40 cm	C	100 cm
Effort	1000 N	500 N	B	200 N	D

(Load distance = 20 cm, A = 20 cm, B = 250 N, C = 50 cm and D = 100 N)

2. Give reasons:

(a) Iron cutting scissors have a short cutting edge whereas cloth cutting scissors have a long cutting edge.

(b) In a single-wheel barrow, the more we shift the load towards the wheel the easier it becomes to lift the load.

3. Solve.

(a) Ojashwi of weight 350 N and Saksham of weight 250 N got on a see-saw. If Ojashwi sat on the see-saw 2 m away from the fulcrum, how far must Saksham be seated from the fulcrum in order to balance the see-saw? (2.8 m)

(b) Calculate the magnitude of the effort in the given figure

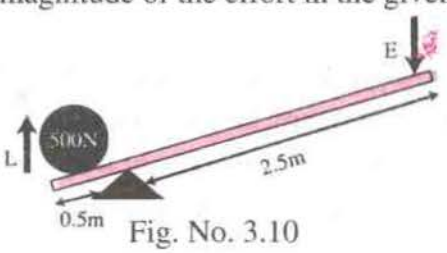


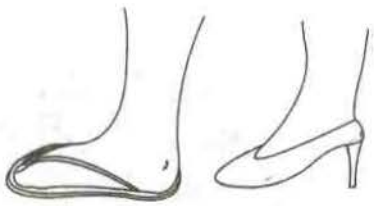
Fig. No. 3.10

(100 N)

Unit 4

Pressure

How do a man wearing slippers and a woman wearing high heels feel while walking on a soft soil? Even if they have an equal weight, the woman's feet sink deeper into the soil. What could the reason be?



Man in slipper Woman wearing high heel

Fig. No. 4.1

Pressure and its Unit

Pressure is the force applied per unit area. Force measured in unit is called newton (N). The unit obtained by measuring mass in kg and acceleration in m/s^2 is called newton (N). **Force = mass × acceleration**. Similarly, area has to be measured in square metre (m^2). If force is worked out per unit area, then we get the value of pressure. The unit of pressure is 'newton per square metre (N/m^2)'. This is also called 'pascal' (Pa). ($1Pa = 1\ N/m^2$).

Suppose, force applied on certain place = F
area of that place = A
and pressure = P

then, $P = \frac{F}{A}$

Force is measured in newton (N) and area in square metre (m^2).

Example 1

A sack of cement weighing 5000N is kept first in a big box having an area of 10 m2, and then in a small box with an area of 5 m^2. Calculate the pressure in each case.

For the big box

$F_1 = 5000\ N$

$A_1 = 10\ m^2$

$P_1 = \frac{F_1}{A_1} = \frac{5000N}{10m}$

$= 500\ N/m^2$ or 500 Pa.

For the small box

$F_2 = 5000\ N$

$A_2 = 5\ m^2$

$P_2 = \frac{F_1}{A_2} = \frac{5000N}{5m^2}$

$= 1000\ N/m^2$ or 1000 Pa.

Even though we used the cement of same weight, the pressure exerted by it varies because of the difference in the area of the boxes. Study the figure given below and find the pressure for each case.

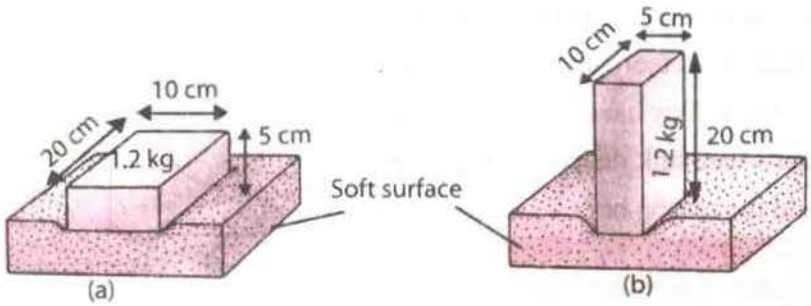


Fig. No. 4.2

Liquid pressure

When a solid object is placed on any surface, it exerts pressure on the surface because of its weight. Similarly, air and gases exert pressure because of their weight. Liquids, too, exert pressure.

Force exerted per unit area of a container due to the weight of the liquid in it is called liquid pressure.

Pressure exerted by regular objects is given by the formula $P = \frac{\text{Force (F)}}{\text{Area (A)}}$

But liquids don't have fixed shape of their own. So, the above formula can not be applied directly. However, the same formula can be modified to obtain a suitable formula for calcualting liquid pressure. For example,

Pressure (P) $= \frac{\text{Force (F)}}{\text{Area (A)}}$

Or, Pressure (P) $= \frac{\text{mass(m)} \times \text{acceleration due to gravity (g)}}{\text{Area (A)}}$ [because, F=mg]

Or, Pressure(P) $= \frac{\text{density(d)} \times \text{volume(V)} \times g}{A}$ [because, density = $\frac{\text{mass}}{\text{volume}}$; so, mass = density × volume]

or, Pressure (P) $= \frac{d \times V \times g}{A}$

or, Pressure (P) $= \frac{d \times A \times h \times g}{A}$ [because, $V = A \times h$]

$\therefore$ Pressure(P) = dhg

Liquid pressure is equal to the product of desity of the liquid, depth and acceleration due to gravity. In other words, liquid pressure depends on density, depth and acceleration due to gravity. When depth of liquid increases, its pressure increases too. Likewise, liquid pressure increses if its density increases.

Example 1

What is the water pressure in the given figure?
Density of water = 1000 kg/m^3, g=10m/s^2

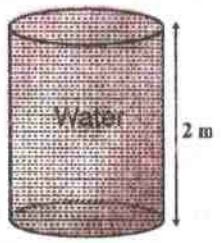


Fig. No. 4.3

Given,

Density(d) $= \frac{1000\ kg}{m^3}$

Depth of water (h) = 2m

Acceleration due to gravity (g) = 10 m/s^2

Water pressure (P) = ?

We know,
by the formula,

Water pressure = h×d×g
= 1000 × 2 × 10
= 20,000 N/m^2
= 20,000 pascal

Therefore, water pressure in the given figure is 20,000 pascal.

Example 2

Calculate the pressure at the depth of 6 metres in a liquid of density 800 kg/m3.

Given,

Density(d) = 800 kg/m^3
Depth of water(h) = 6m
Acceleration due to gravity (g) = 10 m/s^2
Water pressure(P) =?

We know,

by the formula,
Water pressure = h.d.g.
= 800 × 6 × 10
= 48,000 N/m^2
= 48,000 pascal

Therefore, pressure of the above liquid is 48,000 pascal.

Example 3

The dimensions of a certain water tank is 3m × 2m × 2m. What is the pressure at the bottom of the tank if the tank is half filled?
Density of water = 1000 kg/m3 and g= 10 m/s^2.

Given,			We know,
Density(d)	= 1000 kg/m^3		by the formula,
Depth of water(h)	= 1m	Water pressure	= h.d.g.
Acceleration due to gravity(g)	= 10 m/s^2		= 1000 × 1 × 10
Water pressure(P)	= ?		= 10,000 N/m^2 or pascal

Therefore, 10,000 N/m^2 (pascal) pressure is exerted at the bottom of the tank.

Example 4

A drum has a certain liquid in it. If the liquid has a pressure of 5000 N/m2 at the depth of 2m, what is its density?

Given,		We know,
p	= 500 N/m^2	by the formula,
h	= 2m	P = h.d.g.
g	= 10 m/s^2	Or d = $\frac{P}{h.g.}$
d	= ?	d = $\frac{500}{2 \times 10}$
		d = 25 kg/m^3

Therefore, the density of the liquid is 25 kg/m^3.

Activity 1

If a tin can with small holes on all faces is filled with water and pressed from above, as shown in the figure, water spouts out evenly from every hole. This is because liquid applies pressure equally in all directions. In a lake, animals such as fish, frogs, crocodiles, etc. are pressed by water equally from all sides.

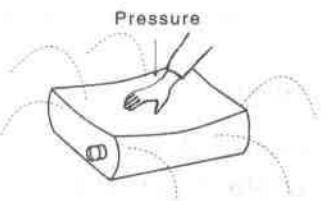


Fig. No. 4.4

Activity 2

Take a small cylindrical metal can or a polythene container. Drill 3 to 4 holes in it at different heights, as shown in the figure, and keep them closed.

Fill the can with water. When the can is full, open all the holes at once. Observe what happens.

From the above experiment, we learn that water coming out from hole A has lesser pressure than water coming out from holes B, C and D. Similarly, water coming out from hole B has a lesser pressure than that from holes C and D but a higher than that from hole A. Water coming our from hole C has a lesser pressure than that from hole D but a higher pressure than the water from holes A and B. Therefore, water pressure depends on its depth.

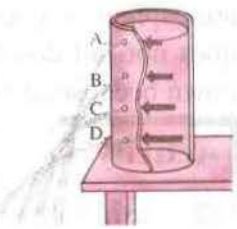


Fig. No. 4.5

Air Pressure

Earth is surrounded by air. The layer of air surrounding the earth is called the atmosphere. Air has weight. The atmosphere extends up to a height of about 1000 km from the surface of the Earth. Because of the weight of air, the atmosphere exerts pressure. Atmospheric pressure is greatest on the surface of the Earth and it decreases as we go up. Because of the changes in atmospheric pressure wind blows from one place to another.

Atmospheric pressure

Air has weight and force is produced because of weight. Force exerted by air on unit surface area of the earth is known as pressure. At sea level, atmospheric pressure is 101, 3000N per square metre or every metre square sea surface experiences 101, 3000N. force. The formula for calculating atmospheric pressure is also $P = dgh$. We do not feel the atmospheric pressure because the pressure inside our body is equal to the pressure outside. Let us carry out an experiment to show that there is atmospheric pressure.

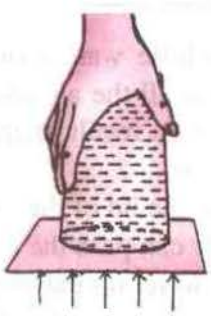


Fig. No. 4.6

Take a glass and fill it with water. There should be no empty space for air in the glass. Cover the glass carefully with a piece of cardboard so that no air can get in.
Hold the glass with one hand and press the cardboard against the glass with the other hand. Now, slowly turn over the glass. Remove the hand that is supporting the cardboard. Observe what happens.

The cardboard does not fall off. It supports the weight of the water in the glass. The cardboard does not fall off because of the atmospheric pressure, and so the water does not fall.

It becomes clear from this experiment that the atmosphere exerts pressure. The atmosphere is exerting pressure on every object from every direction. The water does not fall down in the above experiment even when the glass is made upside down because of the atmospheric pressure on the cardboard.

Activity 3

Fill a basin with water. Sink an empty beaker into the water holding it upside down. What do you notice? Water does not go into the beaker easily. But when you press the beaker down, water enters the beaker slowly and you see air bubbles coming out.

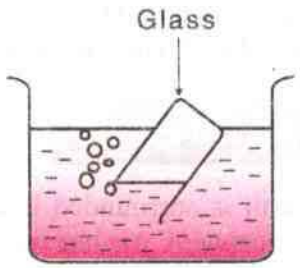


Fig. No. 4.7

When water enters the beaker air is pushed out by water. That is why the air bubbles come out. Even though the beaker appears empty, it is actually full of air. From this experiment we can deduce that air occupies space.

Activity 4

Air can be compressed into a very small space. Air which is compressed in this way has a greater pressure than the ordinary air.

Take a football and fill it with air. Once filled with air, the football becomes heavier. Air inside the football exerts pressure on all sides of the football. Similarly, the tyres of a bicycle are filled with air. The air pressure helps the tyres of vehicles such as motorcycles, tricycles to run. These vehicles cannot run if there is no air in the tyres.

Activity 5

Put a little water in a small rectangular can and heat it. Once the water starts to boil, almost all the air inside the can comes out. As a result, there will be no air in the can.

Close the lid of the can securely so that no air can pass the can, and pour some cold water on the outer part of the can. Now, observe what happens.

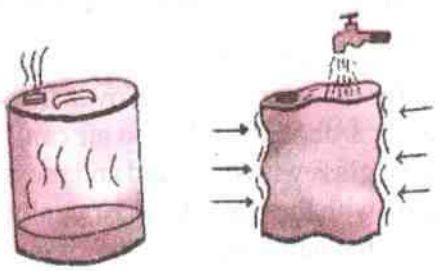


Fig. No. 4.8

The can collapses (gets crushed in) because of the difference of pressure inside and outside the can. Before the can was heated, atmospheric pressure inside the can was equal to the atmospheric pressure outside the can. Hence, the can retained its shape. Once water was put in the can and heated, the air that was inside

the can came out, making the can empty. When the lid was closed air could not enter the can from outside. As a result, a difference was created between the air pressure inside and outside the can. This crushed the can.

Atmospheric pressure changes according to height. We cannot live in places of very high or very low pressure. Aeroplanes usually fly at great heights. Therefore, air pressure inside planes has to be specially adjusted to make it suitable for our bodies. Hence, we can breath easily inside aeroplanes.

Activity 6

Take some water in a beaker. Put a plastic straw or a piece of hay straw in the beaker. Now suck the air out from the straw. Observe what happens.

When air from the pipe is sucked out, the air pressure inside the straw becomes less than the outside pressure. Hence, because of the strong push of the atmospheric pressure on the surface of water, water enters the straw and comes into the mouth. Similarly, while filling ink in a pen pressure in the tube becomes less than the outside pressure and atmosphere pushes the ink into the tube.

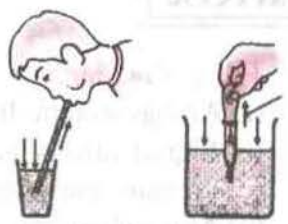


Fig. No. 4.9

Summary

1. Air occupies space and has weight, too.
2. Earth is surrounded by air. There is air up to about 1000 km above the surface of the Earth. The layer of air around the earth is called the atmosphere.
3. Force and pressure are interrelated. Force gives motion to a stationary object or stops a moving object. If force acting over a unit area is measured ,it gives the pressure .

   Pressure (N/m^2 or Pa) $= \frac{\text{Force(N)}}{\text{Area}(m^2)}$
4. Force is measured in newton. Pressure is measured in newton per square metre (N/m^2). This is also called 1 pascal (Pa).
5. Air in the atmosphere is always exerting pressure on all objects on the earth. This pressure is called atmospheric pressure. Atmospheric pressure at sea-level is 101300 N/m^2.
6. Like any other substance, liquid too exerts pressure.

Do, Observe and Learn

1. Fill a balloon with air and tie up its mouth. Now press the balloon slowly. What happens? Why does this happen?
2. Fill a bucket with water. Slowly immerse an empty bottle into the water. Observe what happens as water fills the bottle.
3. Find a plastic bucket with a tap. Fill the bucket with water. Tie a balloon tightly on to the nozzle of the tap. Open the tap slowly and observe carefully what happens to the balloon.
4. Blow a balloon. If you keep on blowing the balloon, it will finally burst. Why ?

Exercise

1. Fill in the blanks with suitable words.

(a) Air has weight. It exerts ..... on any object.
(b) Liquid adjusts its own .....
(c) Pressure caused by air in the atmosphere is called .....
(d) Atmospheric pressure changes with .....

2. Mark tick(✓)for the correct and cross (×) for the wrong statements.

(a) Only closed containers have air pressure.
(b) A bicycle tube bursts if there is too much air in it.
(c) Pressure $= \frac{\text{Area}}{\text{Total force acting on the surface}}$
(d) Atmospheric pressure decreases as we go up from the surface of the earth.

3. Select the correct answer.

(i) What is the unit of pressure?
(a) N (b) Nm
(c) Nm^2 (d) N/m^2

(ii) Liquid exerts pressure
(a) only in upward direction.
(b) only in downward direction.
(c) only at the sides.
(d) in all directions.

(iii) What is the pressure at a point in water where depth is 100m and g is 10 m/s^2?
(a) 10^6 N/m^2 (b) 10^5 N/m^2
(c) 10^4 N/m^2 (d) 10^3 N/m^2

4. Give reasons:

(a) Pressure exerted by a liquid varies with depth.

(b) When cold water is poured over the surface of a thin metal can after having taken out air by heating, it collapses.

5. Answer in brief.

(a) What is atmospheric pressure? Explain with an example.

(b) How can we show that liquid exerts pressure?

(c) How can we show that there is atmospheric pressure ?

(d) In what unit is pressure measured?

6. Solve the following problems.

(a) A box has 300 kg mass. The surface area of the box is 150 m^2. What is the pressure exerted by the box on the floor?

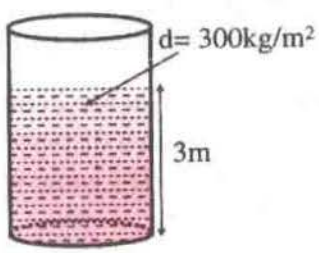
($20\ N/m^2$ or Pa)

(b) A certain object has 500 kg mass. When it is kept on a table it occupies an area of 25 m^2. What pressure does the object exert on the table?

($200\ N/m^2$ or Pa)

(c) If a certain well has water to the depth of 10ml calculate the pressure exerted by water? ($10^5\ N/m^2$ or pascal)

(d) Calculate the pressure exerted by the liquid at the bottom of the container shown in the figure. (9×10^3 Pascal)



Unit 5

Work, Energy and Power

Work

According to scientific definition, work, force and distance covered are very closely related. For work to be done, a force has to be applied on an object and as a result of that the object has to cover a certain distance.

Fig. No. 5.1

Work is said to be done if a force acting on an object displaces it in the direction of force. For example, lifting an object from the floor and putting it on the table or pushing an object through a certain distance is work.

Work and energy will always be related and this will again be discussed in the 'energy' section as well.

By the above definition of work, if a man lifts, pushes or pulls a box, he or she is said to have worked. Therefore, points related with the work done are as follows:

(a) In SI units force is measured in newton (N).
(b) Height or distance moved is measured in metre (m).
(c) Work done is measured in joules (J).

Work done = force × distance moved

Therefore, $W\ (J) = F\ (N) \times D\ (m)$.

Force is measured in newton (N), distance in metre (m) and work done in joules (J). If a certain object is moved through a distance of 1 metre by applying a 1N force, then 1 newton metre work is done. The same work is called 1 joule.

$1\ (N) \times 1\ (m) = 1\ (J)$.

Types of Work

Generally, work can be divided into two groups: work done against friction and work done against gravity.

While pulling or pushing an object, an opposing force will be acting on the object. This opposing force is called friction. Therefore, if an object is brought into motion by pulling or pushing it, work is done against friction.

While lifting an object, gravity will be acting against it. Therefore, work is done against gravity in lifting an object from the floor.

Let's look at the following activities which are related to work against friction or gravity.

Activity 1

Work Against Friction

Take a spring balance and a rectangular wooden plank. Tie the plank firmly with a fine cord. Then, attach the spring balance to the other end of the cord. Drag the wooden block uniformly across the surface of a table by pulling it with the spring balance. The block will only move when a force is applied against friction.
If the indicator of the spring balance shows a force corresponding to 16 kg and the wooden block is moved through a distance of 40 m, how much work is done?

By the equation of work, $W = F \times d$

W (work) = (J)

F (force) = (N)

d (distance) = (m)

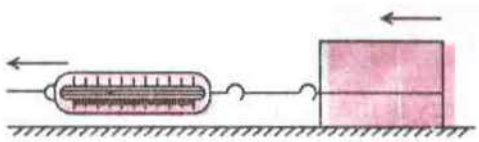


Fig. No. 5.2

To move an object of 1 kg mass with an acceleration of 1 m/sec^2, a force of 1 N is needed. Acceleration produced by gravity on any object is 9.8 m/sec^2. Therefore, the force of gravity acting on an object of 1 kg mass is 9.8 N. For simplicity, this can be rounded off to 10 N.

Therefore, $F = 16 \text{ kg} \times 10 \text{ m/sec}^2$

$= 160 \text{ N}$

$W = F \times D$

$= 160 \text{ N} \times 40 \text{ m}$

$= 6400 \text{ J}$

Therefore, 6400J of work is done in taking the plank 40m away.

Activity 2

Work Against Gravity

Take a stone and tie it firmly with a string. Take a spring balance and hook it to the string. Lift the spring balance up slowly. While lifting the stone up with a spring balance gravity will be pulling the stone down. The stone will only be lifted up if a force is applied against the gravity.

Suppose, as indicated by the spring balance, the mass of a stone is 16 kg. If the stone is lifted up by 4 metres, how much work is done?

F	=	16 kg × 9.8 m/sec^2
	=	156.8 N
d	=	4 m
W	=	F × d = 156.8 N × 4 m
	=	627.2 J

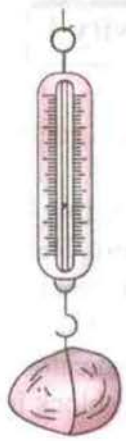


Fig. No. 5.3

Energy

Energy is the capacity to do any work. A raised object, a moving object, a stretched object, etc. have capacity to do work. How is work achieved? Where does the energy for the work come from?

We wind a watch and the tight spring gains energy that enables the watch to work. The ability to perform all these kinds of work is called energy. The method, formula and unit for the measurement of energy are all the same as those for work.

Kinds of Energy

Energy comes in different forms in nature. Mechanical energy, heat energy, electrical energy, nuclear energy, chemical energy, magnetic energy etc. are forms different of energy.

Mechanical energy is used while stretching a catapult's rubber by using external energy, stretched rubber has potential energy. When it is let to go, the mud ball in it flies off. Flying mud ball has kinetic energy. In this way, mechanical energy is converted to potential energy and potential energy to kinetic energy.

Fig. No. 5.4

Different types of energy are as follow:

a) electrical energy
b) heat energy
c) sound energy
d) light energy
e) magnetic energy
f) chemical energy
g) nuclear energy

a) **Electrical Energy**

Trains and many other machines can be run with electricity. Trolley buses are plying with the help of electricity. We get light by lighting a bulb with electricity. In summer we operate fans and in winter, we light heaters with the help of electricity. Electricity is used as a form of energy.

b) **Heat Energy**

Heat energy can be obtained from flammable objects such as coal, kerosene oil, oil, gas, etc. When water is heated by burning coal, water vapour is produced. Water vapour can drive engines. It drives trains. Similarly, many machines are operated by producing heat energy from petrol, diesel, etc. Heat energy from the sun can be used for cooking food, drying things and many other purposes.

c) **Sound Energy**

Sound is a form of energy. If we place a piece of thin paper near the mouth and shout, it shakes. It shakes because of sound. Sheets of objects vibrate in the telephone, television and radio, and produce sound.

d) **Light Energy**

Green plants prepare their food with the help of solar energy trapped by chlorophyll. Therefore, plants use light energy that is present in solar energy to prepare their food. Coal, oil, gas, etc. have stored the sun's light energy in them. You must have seen people using these fuels to produce energy.

e) **Magnetic Energy**

A magnet is a source of energy. Goods can be lifted with the help of a magnet. Electrical energy can be produced from magnetic energy. Very heavy loads can be lifted with the help of an electromagnet. Magnets are used as a form of energy in many devices such as telephone, radio, telegraph, etc.

f) **Chemical Energy**

Everything is made up of small particles. Coal, wood, gas, oil, etc. have energy stored in them. That energy comes out when we burn these things. After burning, there will be a change in their form. Energy obtained from such changes is called chemical energy. Chemical reactions take place in our bodies and produce heat when the food we have eaten combines with the oxygen that we inhale while breathing. In this way, our body gets energy to work as well as heat to keep itself warm.

g) **Nuclear Energy**

Elements are made up of very small atoms. When these atoms undergo fission (breaking of smaller pieces) energy is obtained. This energy is called nuclear energy.

Examples of Work and Energy

1. Work from a Raised Object

As shown in the figure, if an object is dropped from a height it can push other objects into the ground. In other words, a raised object can do some work and therefore has energy.

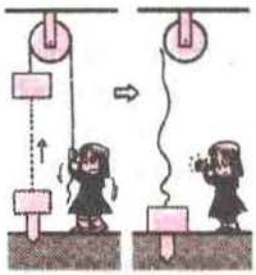


Fig. No. 5.5

2. Work from a Stretched Object

When a small stone, securely tied to the lower end of a stretched rubber band, is released while the other end of the rubber band is still held by the other hand, the stone goes up. Both force and distance are involved in pulling the stone up. Therefore, a stretched object can do work.

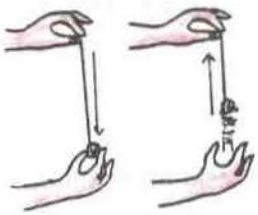


Fig. No. 5.6

3. Work from a Moving Object

If a paper fan is kept on a stand facing the direction of the wind, it gradually starts to spin.
Windmills operate on the same principle. Wind energy can also be harnessed. By using this technique, water can be drawn from a well and even electricity can be generated. Therefore, a moving object can do work. In other words, a moving object has the capacity to do work.

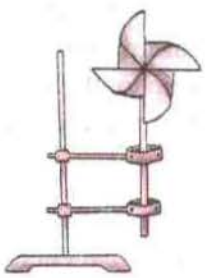


Fig. No. 5.7

4. Work from a Flammable Object

You might have seen the lid of a cooking pot being pushed up while food is being cooked or the lid of the teapot being lifted up while water is being boiled at your home. The figure above shows a similar event. Heat energy is produced by burning fuels like oil, gas, spirit, wax, coal, etc. On the basis of the same principle heat engines (engines that are driven by heat energy) are built. All machines and vehicles have motion because of heat energy. Therefore, work can be done by producing heat energy from flammable fuels.

Fig. No. 5.8

5. Work from Magnetic Energy

When a magnet is brought near iron filings or nails it attracts them. Here, magnetic force is used to move the iron objects. Therefore, by the definition of work, magnetic energy too can do work.

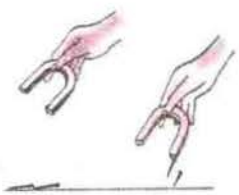


Fig. No. 5.9

6. Work from Running Water

Grains are ground in a watermill. Likewise, if the watermill is operated by rotating a turbine, electricity can be produced from water. Therefore, running water can perform work and has energy.

7. Work from Electricity

You must have seen people lifting things, carrying heavy loads or doing many other similar tasks by using the force of their muscles. Such work can also be done without any human effort by using electricity. Electricity-driven trolley buses, machines pumping out underground water or water from tanks, machines grinding stones, etc. can all be considered as the work being done. Therefore, different types of work can be done with the help of electricity. Electricity has made human life much easier.

8. Work from Solar Energy

You must have noticed water vapour from rivers, lakes, seas and the earth's surface rising up towards the sky. You must have seen water vapour rising up from a wet place when the sun is shining. Heat is received from the sun. Because of the sun's heat, water heats up, becomes vapour and rises up towards the sky. This formation of vapour from water can also be considered a type of work. Therefore, solar energy can also perform work.

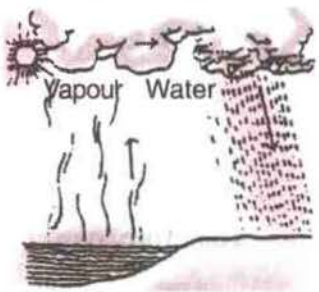


Fig. No. 5.10

Power

The power of an object indicates the amount of work that the object can complete every second. Power is also called the rate of doing work. Likewise, the amount of work a person or a machine can complete in unit time is known as the power of that person or machine.

$$\text{Work (watt)} = \frac{\text{work done (J)}}{\text{time taken (sec)}}$$

Unit of Power

Work done is measured in joules (J) and time in seconds (sec). Therefore, power is measured in joules per second (J/sec). One joule per second is called 1 watt (W).

To measure large power, units like the kilowatt (KW) and the megawatt (MW) are used. Engine power is often measured in horse power.

1 KW (kilowatt) = 1000 W = (10^3 W)

1 MW(megawatt) = 1,000,000 W = (10^6 W)

1 H.P = about 750 W

Example 1

If a crane lifts a load of 600N to a height of 10 m in 20 seconds, what is the power of the crane?

Here,

Force (F) = 6000 N

Distance moved (d) = 10 m

Time (S) = 20 s

P = ?

Work done = F × d

= 6000 N × 10m

= 60000 J

Now, Power (P) $= \frac{\text{workdone (j)}}{\text{time taken(s)}}$

$= \frac{60000\ \text{J}}{20\ \text{s}}$

= 3000W

= 3 KW

Therefore, power of the crane is 3 KW.

Example 2

Suppose each step of a staircase is 12 cm in height. The staircase has 15 steps in total. Therefore, the total height of the staircase = 15 × 12 cm = 180 cm. Let us suppose it took you 9 seconds to climb the staircase. Also, let us suppose that your body has 40 kg mass. Now your power of climbing the staircase can be calculated as follows:

Force (F) = 40 kg × 9.8 m/sec^2

= 392 N

Distance (d) = 180 cm = 1.8 m

Work (W) = F × d

= 392 N × 1.8m

= 705.6 J

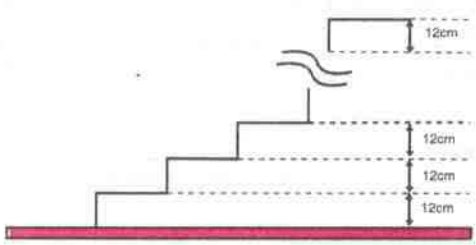


Fig No. 5.11

Now,

Power (P) $= \frac{\text{Work done (W)}}{\text{Time taken (T)}} = \frac{705.6\text{J}}{9\text{s}} = 78.4\ \text{W}$

In this example, your power appears to be 78.4 W.

Summary

1. When a force acts on an object and it moves through a certain distance then the work is done.
2. Work is done in different ways. For example, to lift, to stretch, to move, to burn something, or to use solar energy, electrical energy or magnetic energy, etc.
3. Work is calculated using the following formula:
   $W\ (J) = F\ (N) \times D\ (m)$
   The work done in moving any object by 1 m with a force of 1 N is equal to 1 Joule.
4. The capacity to perform work is called energy.
5. **Mechanical energy is divided into kinetic and potential energy. Other forms of energy are:**
   (a) Electrical energy
   (b) Heat energy
   (c) Sound energy
   (d) Light energy
   (e) Magnetic energy
   (f) Chemical energy
   (g) Atomic energy
6. **We obtain energy in different ways:**
   (a) heat energy and light energy from the sun.
   (b) energy from running water and wind.
   (c) heat energy from flammable fuels.
   (d) electrical energy from electricity.
7. **The amount of work completed by any object or person per second is called its power. Power is calculated by using the following equation,**

$$\text{Power (watt)} = \frac{\text{work done (J)}}{\text{time taken (s)}}$$

8. **Units of power:**
   Power is measured in watts. Large power is measured in kilowatts and megawatts . However, the power of a machine is usually measured in horse power unit.

1 KW (kilowatt)	=	1000 Watt = 10^3 W
1 MW(megawatt)	=	1,000,000 Watt = 10^6 W
1 H.P.(horse power)	=	about 750 W

Do, Observe and Learn

1. Drag a brick across the floor with the help of a spring balance. Calculate the work done.
2. Drag an object first over a rough surface and then over a smooth surface. Find out on which surface more work is done.
3. Study a running flour mill and note different types of energy involved in it.

Exercise

1. Fill in the blanks.

(a) A rolling object has ..... energy.
(b) Energy in a stretched object is called .....
(c) Energy is .....
(d) ..... and ..... are related to work.
(e) Work is measured..... unit.

2. Tick(✓)the corr ect answer.

(a) How much work is done when an object is moved through 1 m using a force of 1N?

Fig. No. 5.12

A. 2 J B. 1 J
C. 3 J D. 0 J

(b) If a man is standing while holding a 50 kg load at a height of 1 m from the floor, then how many joules of work is done?

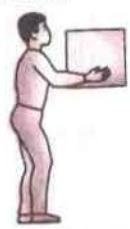


Fig. No. 5.13

A. 500 J B. 50 J C. 150 J D. 0 J

3. Calculate the following problems.

(a) How much work does a man do when he moves a certain object through a distance of 15 m applying a force of 20 N? If it takes him 2 seconds to do this work, what is his power? [300 J, 150 W]
(b) A crane lifts a load of 75 N to the height of 20 m in 100 seconds. What is its power? [15 W]
(c) A porter can carry 40 bricks at a time. Each brick weighs 10 N. He moves a basket of 40 bricks to 75 m in 50 seconds. What is his power? [600 W]

4. Mark tick(✓)for the correct and cross (×) for the wrong statements.

(a) According to the scientific definition of work, sitting in the same spot is also work.
(b) Work is related to force and distance moved.
(c) If 1 N is multiplied by 1 m it becomes 1J.
(d) Work cannot be obtained from running water.
(e) Nuclear energy is produced from the splitting of atoms.

5. Complete the following equations

(a) Power $= \frac{\text{Work done (in joules)}}{\text{.....}}$

(b) Work = ... × distance.

6. Differentiate between

(a) magnetic energy and chemical energy
(b) force and work
(c) work from flammable objects and work from moving objects.

7. Fill in the table given below with statements that show the difference between work, energy and power.

Work	Energy	Power
1	1	1
2	2	2
3	3	3
4	4	4

8. Answer the following questions.

(a) What is work?
(b) In how many ways can work be done?
(c) What is energy?
(d) Classify energy into different groups.
(e) What is power? Give one example of power.

Unit 6

Heat

Heat and Temperature

Heat is a form of energy. We can feel heat. As for example an iron rod whose one end is hot and other end cold cannot be distinguished just by seeing it with the eyes. In the same way beakers containing hot and cold water can't be distinguished as they donot look different.

Hot and cold objects are easily detected by touching them. A hot object when touched, the heat is transferred to the skin and from skin heat is transferred to cold object. Our skin can feel the change in heat.

Matter consists of molecules. Heat causes vibrations in molecules of the matter. The vibration increases with the increase in heat and slows down if it is reduced. The vibrating molecules have kinetic energy.

The sum total of kinetic energy of all the vibrating molecules of a matter is heat energy but the degree of hotness or coldness of a body is called its temperature. A body with high temperature has molecules in vibration faster.

Activity 1

Take take two identical beakers one with 50gm and the otherwith 100gm water respectively. Note the temperature of water in both the beakers. Heat the beakers with identical heat source such as spirit lamp. Note the change in temperature at 2-minute intervals.

Which one of the two showed fast rise in temperature, which one has more heat energy? Though equal amount of heat is supplied temperature of small mass of matter rises faster than the large mass. The matter showing high temperature has more heat energy.

Thermometer

An instrument or device which is used for measuring temeprature of a body is called thermometer. In the figure simple ordinary thermometer is shown. A long glass tube with both ends closed and one end called the bulb with thin wall contains liquid substance. The heat is transferred through the thin bulb wall to the liquid in it. As the bulb gains heat the liquid in the bulb expands in capillary tube. The change in temperature is seen as the change in the level of liquid in the glass tube. The change in the level of liquid does not wet (stick to) the glass tube. Mostly mercury or

coloured alcohol is used as liquid in the thermometer. Mercury freezes at -39°C and boils at 357°C but alcohol freezes at -115°C and boils at 78°C. To measure a temperature below -39°C an alcohol thermometer is used and mercurial thermometer is used to measure temperature above 78° C.

Thermometer

Fig 6.1

Types of Thermometers

Thermometers of different shapes and sizes are available. They are all used for different purposes.

(a) Clinical Thermometer

The thermometer used to measure human body temperature is called the clinical thermometer. They are available in both Celsius and Fahrenheit scales. The Celsius clinical thermometer's scale extends from 35°C to 42°C while the Fahrenheit clinical thermometer's scale extends from 94°F to 108°F. The normal body temperature is 37°C (98.6°F).

The clinical thermometer has a narrow constriction near the bulb. Because of this, mercury that has risen in the capillary tube does not fall itself. It only falls when we jerk it or shake it hard. It is not cylindrical but prism shaped. That is why even the very thin mercury thread looks thick.

(b) Maximum-Minimum Thermometer

This thermometer is used to measure the minimum and maximum temperatures reached within 24 hours at any place. One arm of this thermometer, whose shape is as shown in the figure, records the maximum temperature and the other arm records the minimum temperature. Each arm has an index to show temperature.

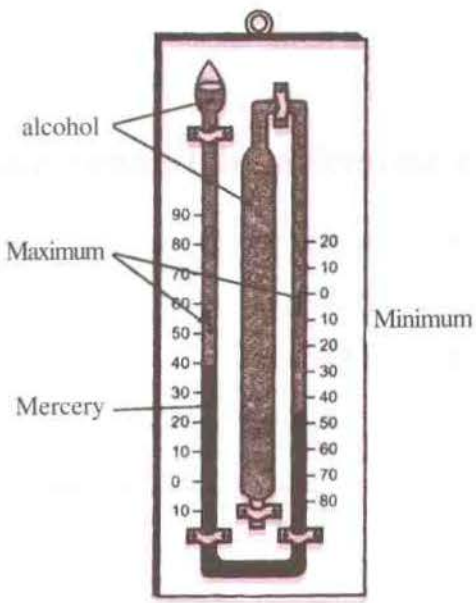


Fig No. 6.2
Maximum-Minimum Thermometer

To set the thermometer, both the indexes have to be pulled down with the help of a magnet so that they are just touching the mercury surface. While measuring the temperatures, the values indicated by the lower ends of the indexes are the maximum and minimum temperatures.

Activity 2

Take a maximum and minimum thermometer and carefully study its different parts. Adjust the indexes with the help of a magnet. Discuss how temperature is measured with it.

(c) Laboratory Thermometer

This is an ordinary thermometer. It is generally round and long in shape. Laboratory thermometers have mercury in them. The volume of mercury increases or decreases with temperature. Mercury automatically rises in the capillary when the bulb heats up and falls automatically when the bulb cools down. Therefore, the temperature of both hot and cold can be measured with it. Usually, it has a Celsius scale and generally this extends from -10°C to 110°C. To measure the temperature accurately and to make it respond quickly to the change in temperature, its capillary tube is made hair-thin. Part of the capillary tube above the mercury surface has a vacuum. This makes the rising of mercury in the tube easier. The wall of the bulb is also made very thin. What could be the reason for this ? If the wall of the bulb is thick, it cannot respond quickly to the change in temperature because glass is a poor conductor of heat.

Conversion of Temperature Scale Units

A thermometer has fixed scale and units. Generally a thermometer uses two types of scale.

a) Celsius Scale.

Fig 6.3 Celsius scale

In this scale the lower fixed point (melting point of ice) is 0° c and the upper fixed point (standard boiling point of water at normal atmospheric pressure) is 100° c.

b) Fahrenheit scale

In this scale lower fixed point (melting point of ice) is 32° F and upper fixed point (boiling point of water at standard atmospheric pressure) is 212° F.

Fig. 6.4 Fahrenheit scale

In the Celsius scale, the temperature between the melting point of ice and the boiling point of water is divided into 100 equal parts where as in Fahrenheit it is divided into 180 equal parts. Further, the '0' of Celsius corresponds to '32' of Fahrenheit. Therefore, the relation between Celsius and Fahrenheit can be expressed in the following equation:

$$\frac{(C-0)}{100} = \frac{(F-32)}{180}$$

For example

(a) Change 37 °C into Fahrenheit.

By the formula, $\frac{(C-0)}{100} = \frac{(F-32)}{180}$

From this, $\frac{(37-0)}{100} = \frac{(F-32)}{180}$

or $F = \frac{(37-0)}{100} \times 180 + 32$

$= 66.6 + 32$

$= 98.6\,^{\circ}F$

Therefore, $37\,^{\circ}C = 98.6\,^{\circ}F$

(b) -40° C is equal to how much Fahrenheit?

By the formula, $\frac{(C-0)}{100} = \frac{(F-32)}{180}$

From this, $\frac{-40-0}{100} = \frac{(F-32)}{180}$

$F = \frac{-40-0}{100} \times 180+32$

$= -72 + 32$

$= -40\,^{\circ}F$

Therefore, $= -40\,^{\circ}C$

Importance of Thermometer

- it is used to measure temperature of a body.
- It is used to measure the body temperature.
- It is used to note the maximum and minimum temperature of the environment.
- It is used to know and note the temperature of the water in the aquarium.
- It is used to measure the room temperature.

Summary

1. The sum total kinetic energy of all the vibrating molecules of a matter is Heat energy.
2. The hotness or coldness of a body is its temperature.
3. Temperature measuring instruments are called thermometers.
4. Thermometers are constructed on the basis of the principle that when a liquid is heated its volume increases.
5. Alcohol thermometers are used for measuring temperatures of very cold places and mercury thermometer for measuring the temperatures of very hot places.
6. At standard atmospheric pressure, pure water boils at the temperature of 100° C and freezes at the temperature of 0° C.
7. A clinical thermometer has a narrow neck near the bulb and because of this the mercury column in the capillary does not fall even when the bulb is cooled.

Exercise

1. Give the definition
   (a) Heat (b) Temperature
2. Write two difference between Heat and Temperature
3. Write four differences between clinical and simple thermometer.
4. Write the advantages of using mercury instead of alcohol.
5. What is the function of alcohol or mercury in the maximum-minimum thermometer.
6. What is the role (function) of index in the maximum-minimum thermometer?

Light

Light is a form of energy. It helps us to see things around us. Light travels in straight lines. Light does not bend. It is easier to draw diagram as light travels straight. A single light ray is denoted in diagram by a straight line. It is called a ray. A collection of parallel rays is called beam.

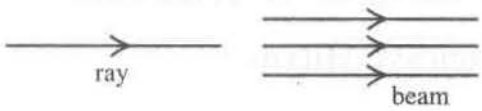


Fig. No. 7.1

Activity 1

Make the room slightly dark. Spread a white sheet of paper on the table. Place a plane mirror vertically as shown in the diagram. Switch on the torch such that its light strikes the mirror. Place a pinhole cardboard in between torch and mirror such that only a beam of light emerges from the hole of the card board that strikes the mirror at 0. Adjust the torch and card board until it is at 0. Indicate this as P. Mark R for the reflected light beam after striking the mirror.

Draw a normal ON on the point O. Join the points PO and OR on the paper. The straight line segment PO is incident ray, ON the normal ray and OR is the reflected ray.

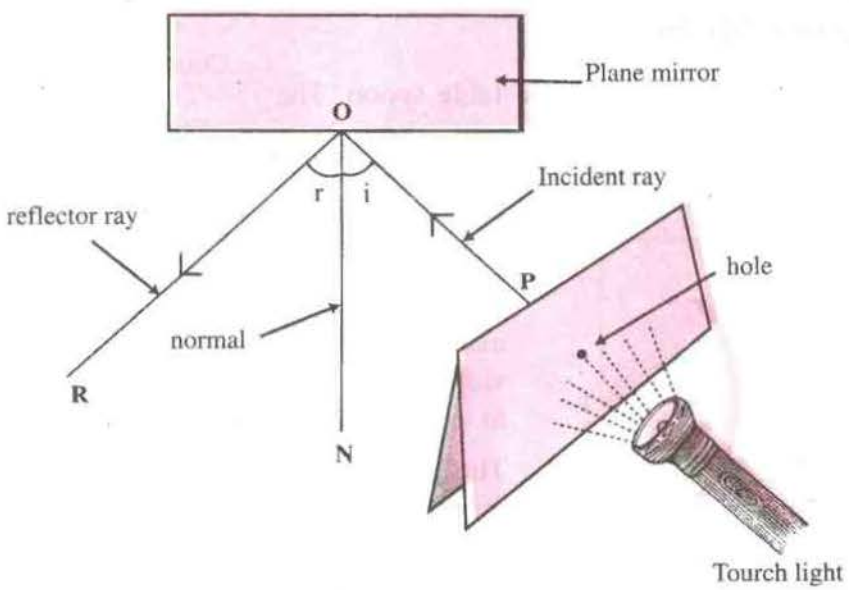


Fig. No. 7.2

Spherical Mirrors

Plane mirrors are used as a looking glass, because they help us to see exact image. However, all mirrors are not the same. There are spherical mirrors, which are very useful.

Spherical mirrors are of two kinds.

1. Concave Mirror

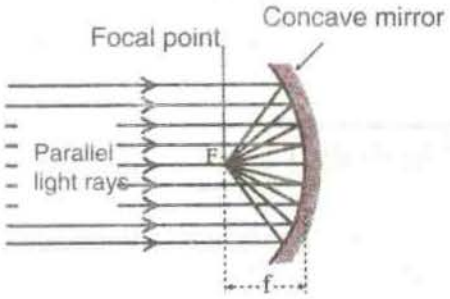


Fig. No. 7.3

Look at a table spoon, its middle part is sunken. In the same manner, there are certain mirrors whose middle parts are sunken and thinner than the edge parts. These mirrors are known as concave mirrors. When parallel light rays strikes, the concave mirror reflects to focus at a single point. The point is called principal focus (F). The distance between the principal focus and the centre of the mirror is called focal length. It is represented by 'f'.

As the concave mirror converges the light rays at a single point, it is known as converging mirror. The light rays that emerges from the principal focus after reflection propagates as parallel light rays. The torch light has nearly concave surface. The electric bulb is nearly at the principal focus. The light rays from the bulb after reflecting through the shiny surface propagate far away as parallel light rays.

2. Convex Mirror

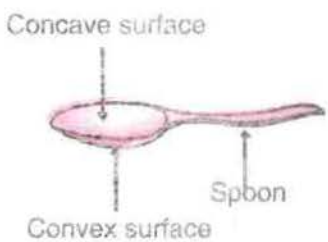


Fig. No. 7.4

Observe the other side of the table spoon. The middle part is bulging. Some of the mirrors have such regular bulging part. This type of mirror is called a convex mirror.

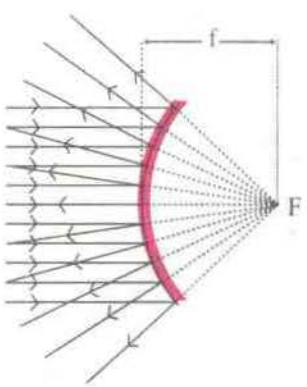


Fig. No. 7.5

Such mirrors are used as side viewing mirrors on the left and right of the vehicle to view clearly the back scenes.

The parallel light rays diverge from the convex mirror after reflection. This type of mirror is called diverging mirror. The reflected light rays seem to emerge from a point behind the mirror. That point is called the principal focus. (F)

Activity 2

Take a concave mirror. Place it nearly 50 cm away and see your face in it. Write what you observed. Do you see a big or small image? Do you see an erect or inverted image?

Now bring the mirror near your face. Place it at about 30 cm distance and see. Write the difference that you observed before and now. Bring the mirror very near to you. Place it nearly at 10 cm distance and see. Write the difference you see. Bring the mirror more closer and see. What can you learn from this?

Different types of images are formed by concave mirror.

Activity 3

Face (turn) the concave mirror towards the window. Place a thick white paper at a distance of 20-30 cm in front of the mirror. Make the reflected light of mirror fall on the paper. Shift the mirror far or near. You will observe the outside scenes on the paper. Measure the distance between the mirror and paper when you see a sharp image. This distance is called the focal length. Can you make the same type of image with a plane mirror? Perform the activity and observe.

The image that is made on the white paper during the activity with the concave mirror is called the real image. Concave mirror forms real image, but plane mirror does not form the real image.

Ray Diagram of Concave Mirror

To draw the ray diagram of concave mirror, it is necessary to know four things:

1. Concave mirror is similar to a part of sperical mirror. The centre 'C' of sphere lies in front of the mirror. This is called the centre of curvature. The centre of the mirror 'P' is called the pole of the mirror. The distance from P to centre of curvature 'C' is two times of radius of curvature of PF. PC is called the principal axis.
2. The light rays parallel to the principal axis reflect back after passing through principal focus.

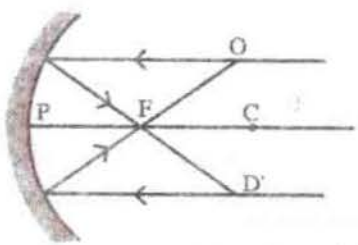


Fig. No. 7.6

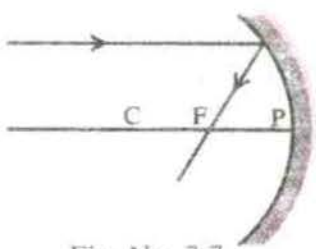


Fig. No. 7.7

3. The light rays emerging from the principal focus after reflection propagates parallel to the principal axis.

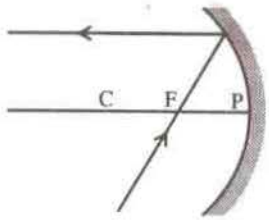


Fig. No. 7.8

4. The light rays emerging from the centre of curvatrue make 90° with surface of the mirror and reflect back along the same path.

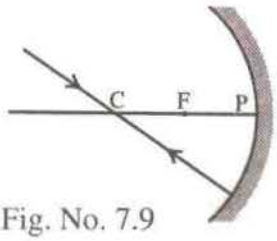


Fig. No. 7.9

Procedure to draw Ray Diagram

1. As shown in the fig. draw concave mirror AB with the help of compass. The fixed point made by the compass is marked it as C. From P, the middle point of AB, draw principal axis PC. Mark the middle point F on PC.
2. Place an object OQ on the principal axis slightly away from C.
3. Draw a line OM parallel with the principal axis (PC) from 0. This is incident ray. The line made by joining M and F is reflected ray.
4. Draw another line ON joining O and F. This is incident ray passing through the principal focus F. Draw NO'F passing through N parallel to principal axis, this is also reflected ray.

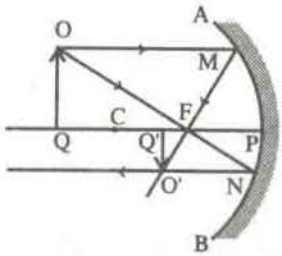


Fig. No. 7.10

5. Two reflected rays intersect at O^1. This point is the tip of the image.
6. Draw Q'O' perpendicular to O^1.
7. Measure the size and position of image O^1Q^1. The image is small, inverted and real. The image lies between F and C.

Activity 4

Place the object at the following position, draw ray diagrams, write the type of images formed.

a) Object when placed at C The Image
- forms at C.
- is inverted.
- is real.
- is of same size as object.

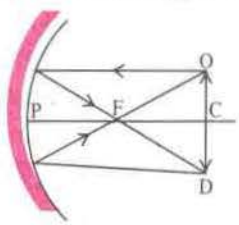


Fig. No. 7.11

b) Object when placed between C and F

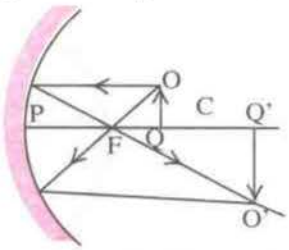


Fig. No. 7.12

The Image
- forms away from C.
- is inverted.
- is real.
- is bigger in size than the object. (or magnified)

c) Object when placed at F

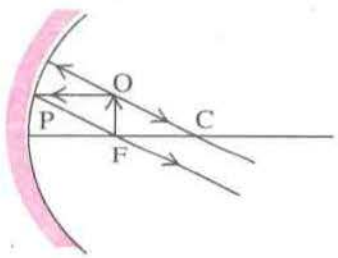


Fig. No. 7.13

The Image -
- forms at infinity.
- is inverted.
- is real.
- is highly magnified.

d) Object when placed between P and F

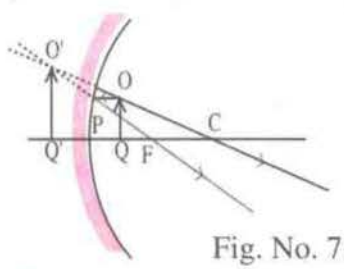


Fig. No. 7.14

The Image -
- forms behind the mirror.
- is erect.
- is virtual.
- is magnified (bigger).

Ray Diagram of Convex Mirror

The following points are to be kept in mind to draw ray diagram for convex mirror.

1. Convex mirror is also a part of spherical mirror, whose centre lies behind the mirror.
2. The light rays reflected by the mirror parallel to the principal axis seem to appear (emerge) from the principal focus.
3. The light rays moving towards the centre of curvature strikes at an angle of 90°. Light rays reflects back along the same path.

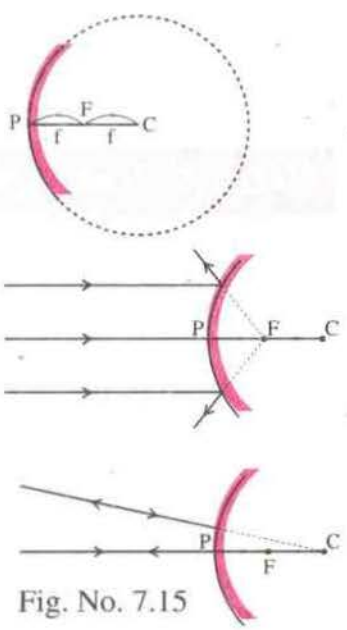


Fig. No. 7.15

Procedure to Draw Ray Diagram

Only one type of image is formed by convex mirror. Ray diagrams are drawn in the same manner as that for concave mirror. The image formed by this mirror is always small, erect and virtual.

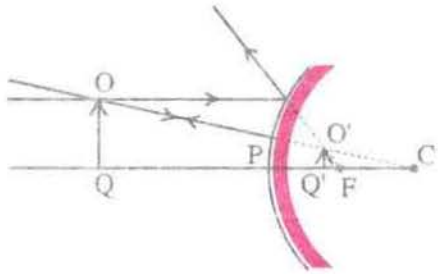


Fig. No. 7.16

Uses:

Concave mirror can be used for the following purposes:

1. Concave mirror is used as reflector in large astronomical telescope, radio telescope, etc.
2. Concave mirror is used to disperse light rays far away in torch light, search light, headlight of vehicles.
3. Concave mirror is used to observe internal organs by reflecting light rays inside nose, ear, mouth and neck.
4. Concave mirror is used to see enlarged face during shaving or make up of the face.

Convex mirror is used for the following purposes

1. Convex mirror forms erect and diminished image. Large scene can be observed in small forms. That is why in the vehicles these mirrors are used to have a clear view of the traffic behind.

Refraction of light

The depth of water in the pond, river, etc. seems less than actual depth, why? The stick inside water seems bending, why? To get the answers for the various questions, one should know how light ray travels from one medium to another medium. You know light ray travels in a straight line in the same single medium. But the light ray as it travels from one medium to another bends at the surface where the two mediums separate. This phenomena is called refraction of light. The object through which light passes is called the medium. The medium with high density is called denser medium and with low density is called rarer medium. Air is rarer medium when compared with water medium. Glass, water, etc. are denser medium in relation to air medium.

Activity 5

Spread a with sheet of paper on the table, place a glass slab at the middle of the paper as shown in the figure. Trace its outline on the paper with a pencil.

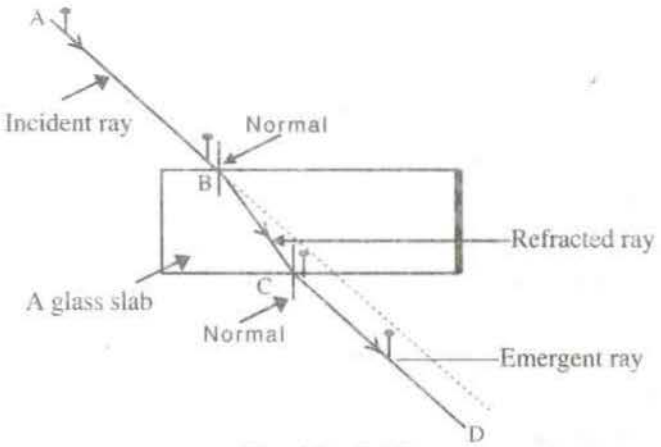


Fig. No. 7.17

As shown in the figure, fix two pins vertically on the paper near one end of the slab. As you view from the opposite side of the slab adjust your view to see the two pins lie in one straight line. Now fix two more pins vertically at a distance of nearly 8 cm. The last pin fixed should hide the rest of the three pin when viewed. Now remove the slab and draw line along the pencil marks of pin holes on the paper. Show the path of the ray inside the glass slab by joining points at which these lines touch the edge of the slab. Does the ray follow the same path inside and outside the glass slab? What may be the reason for this?

We see the ray bending while entering and emerging from the glass slab. Glass slab is denser medium and air is rarer medium. The speed of light changes when the medium changes. The light ray entering the glass slab is incident ray and denoted by AB. The light ray (BC) inside the glass slab in refracted ray and the light ray (CD) emerging from the glass slab is called emergent ray.

Refraction of Light follows the following Laws:

1. The light ray making a certain angle with normal bends when it passes from one medium to another medium. It bends towards normal when passes from rarer medium to denser medium and bends away from normal when passes from denser medium to rarer medium.
2. The incident ray, the normal ray and the refracted ray all lie in the same single plane (surface).

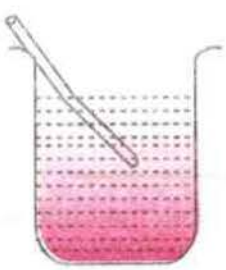


Fig. No. 7.18

Activity 6

Take a beaker with water nearly half-filled. Dip a pencil half inside water and observe the water surface how it looks, draw a diagram. Write what is seen when observed from the top.

Why does half immersed pencil in water look bent?

In the figure. the BC portion of pencil AB is inside water. The light ray coming from the tip B of the pencil during refraction bends between points P and Q and strikes the observer. The tip of the pencil is seen at B^1 where the two refracted ray PR and QS are straight. Therefore, observer from outside will see the pencil AB as if broken at point C.

During refraction of light half immersed pencil in water seems to be broken or bent at the surface of the water.

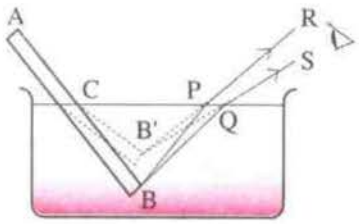


Fig. No. 7.19

Activity 7

Place a cup on the table. Let a person stand nearby the edge of the table. Put a coin (one Rupee Coin) in the cup. Shift the cup from the person in such a way that he cannot view the coin in the cup.

Now ask another person to fill the cup with water without disturbing the position of the coin. At what level of water in the cup makes the man standing see the coin, observe. Discuss the cause of this and write.

When cup is filled with water the coin seems to be raised, why? The depth of water seems lesser than actual, why?

Suppose coin is at position A. Coin is not visible when the cup is empty because the light rays from the coin strikes the surface of the cup and do not reach the observer. As water is filled the light from the coin refracts and bends at the surface of the water. The refracted light ray reaches the observer. The divergent rays appear to come from B which is the virtual image of the coin. This makes the coin raised from its position. Due to refraction of light rays the depth of the pond seems less than the actual depth. That is, the bottom of the ponds seems to be raised.

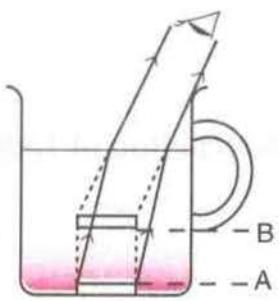


Fig. No. 7.20

Summary

1. A straight line denotes the light ray.
2. A collection of parallel light rays is called beam.
3. The light ray that strikes the surface of the mirror is called incident ray.
4. The light coming back after striking the surface of the plane mirror is called reflected ray.

5. The parallel light rays when reflected by a concave mirror converges at a single point and seems to diverge from a single point in case of reflected light from convex mirror. Those points are principal focus.
6. The rays coming from the principal focus after reflecting from the concave mirror travels parallel.
7. A ray passing through the centre of curvature (C) is reflected back along the same path.
8. The image that can be collected on the screen is called the real image and that which cannot be collected on the screen is called virtual image.
9. Concave mirror forms real and virtual, big or small, types of images. Convex mirror forms only small and virtual image.
10. The process of bending of light rays passing from one medium to another medium is called Refraction of Light.
11. Light bends towards normal when it passes from rarer to denser medium and away from the normal when it passes from denser to rarer medium. The light rays do not bend while passing through normal.
12. The stick dipped in water seems bent and water depth lesser due to refraction of light.

Do, Observe and Learn

Take a beaker or a glass half filled with water. Place the beaker or glass above the page with letters and observe. How does the letter look when viewed from water and outside? What is the cause of it?

Exercise

1. What is the difference between 'ray' and 'beam'?
2. Write the definition - a) incident ray
   b) reflected ray

3. Answer the following questions.

a. At what positions when object placed near a concave mirror-
   i) forms big and erect image?
   ii) forms big and inverted image?
b. When the angle of incidence of a ray is 30°, the corresponding angle of refraction will be 20°. If the mediums were air and water, write with diagram from which medium light emerged and in which medium it entered.
c. What is the reason for using convex mirrors as side view mirrors in vehicles? What happens if concave mirrors are used instead?
d. If a man throws the spear at the place where he sees the fish inside the water, is it possible that it will hit the fish ? Write with reason.

e. Why do we use plane mirror daily to see our face? Why do not we use concave and convex mirror?

f. Why are concave mirrors used in torch light as a reflector ? Where should the bulb be placed?

g. A student 5 ft tall went for swimming in a swimming pool. He saw the depth of water in the pool less than 5 feet. Will he sink or not? Write with reason.

4. Write answer with diagram.

a. What type of image is formed when an object is placed at the following positions? Write with ray diagram.
   i) away from the centre of curvature
   ii) at centre of curvature 'C"
   iii) between C and F
   iv) at F
   v) between F and P

b. What type of image is made by convex mirror. Write with diagram.

c. Why does the stick immersed in water look bent? Write with ray diagram.

Sound

Everyday we hear different types of sound. Sound is produced from different sources such as ringing bell, machines when on, flying aeroplanes, plying vehicles, playing of musical instrument. All these different materials are sources of sound. Sound is produced when these materials vibrate. Waves are produced due to vibration. Sound energy is carried by these waves and reaches our hearing sense organ, ear.

Activity 1

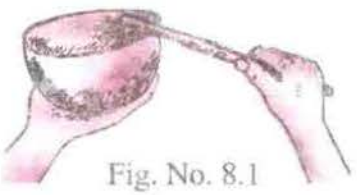


Fig. No. 8.1

Take a metal bowl on the open palm. Strike the rim of the bowl with a small stick. Sound is produced from the bowl. Gently touch the bowl and feel the vibration. Once you touch the bowl vibration ceases and production of sound also stops.

Conditions for the Transmission of Sound

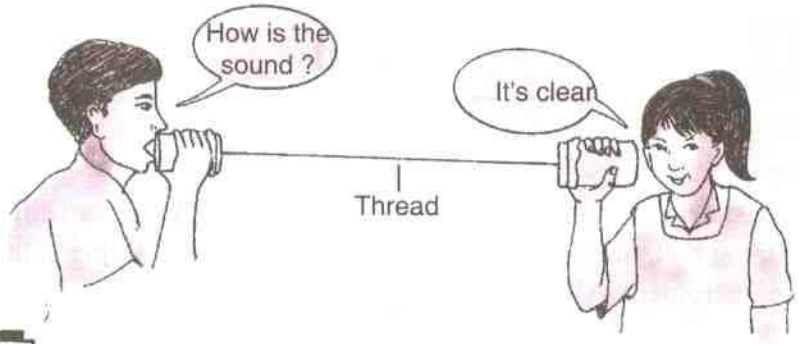
You have already learned in class 7 about how sound is produced. Now, how does sound propagate? Let us see the activity whether a medium is necessary for sound propagation or not.

Transmission of Sound through Solid

Activity 2

Take two empty tin cans or matchboxes or bamboo cylinder pieces. Close one end of the cylinder or tincan or matchbox with a thick polythene sheet. Insert a toothpick tied to the thick thread at the centre of the polythene sheet covering the one end of the matchbox or tincan or bamboo cylinder.

Ask two men to stand apart carrying the boxes in such a way that the thread joining the boxes remains stretched. Ask one to keep the matchbox or tincan or bamboo cylinder near the mouth and another near the ear. The person who has held the box near the month speaks. See whether the other person can hear it or not. Now hold the thread in the middle and see whether spoken matter can be heard or not.



Activity 3

Ask your friend to place the ear against one end of the table. Now scratch slowly the other end of the table with something. Observe whether the sound is heard or not. Scratch slowly on the table Can you hear the sound by resting the ear on the table?

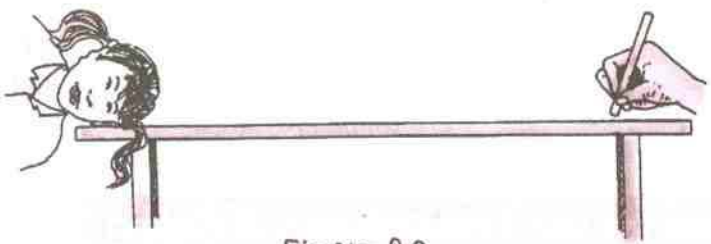


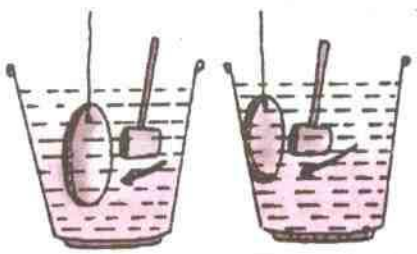
Fig No, 8.3

This experiment also proves that sound travels from the solid objects. Sound propagates through solids. Solid materials are sound propagating medium. The speed of sound in steel is nearly 5200 m/s.

Transmission of Sound through Liquid

Activity 4

Fill water in a big bucket of about 10 liter capacity. Insert a bell and ring it. Can you hear the sound of the bell outside the bucket? Does sound transmit through water? Now ring the bell once touching the side of the bucket and another time without touching. Write whether the sound transmitted is high or low.



The bucket is not touched by the bell | The bucket is touched by the bell

Fig. No. 8.4

The sound can be transmitted in liquid medium as it does in solid medium. The speed of sound in liquid is less than that in solid. The speed of the sound in water is nearly 1500 m/s.

Transmission of Sound in Gas

The sound we hear through our ear is mostly transmitted through air medium. Like air other gases also transmit sound. The speed of sound in gas is less than that of solid and liquid. The speed of sound in air is nearly 332 m/s.

Medium is Necessary for the Transmission of Sound

(If necessary materials are available perform this activity and observe):

As shown in the figure a small bell inside the bell jar is hanged. The sound is heard when the switch is pressed (switch is on). But when the air of the bell jar is evacuated (drawn out) with a vaccum pump the shaking of the bell can be seen but sound is not heard. It is vacuum inside the bell jar so sound is not heard. Medium is absent to transmit the sound. This activity proves that sound cannot transmit without a medium.

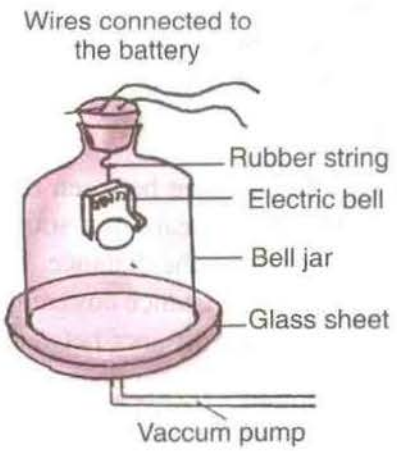


Fig No. 8.5

Reflection of Sound and Echo

Sound also reflects as light. Reflection of sound can be experienced (heard) in long tunnels, deep wells, deep ridges of the mountains, calm nights, deep forest, etc. In those places if we spell out the word 'science', that word will be reflected after striking somewhere at a distance. We can hear those sound repeatedly. The sound reflected after striking an obstacle at a certain distance (17m far) is called echo.

Activity 5

As shown in the figure, place an alarm clock inside the paper or polythene hollow pipe and close its mouth. At nearby the open end, place 'A' end of another pipe on the other side,in such a way that it makes an angle of 60°. Place the ear at 'B' end and listen. Can the sound be heard?

Place a mirror or glass piece where the two pipes meet. Can you hear sound this time? Why? The sound coming from one pipe after reflection can be heard from the other pipe. Reflection of sound can also takes place in big rooms, halls, and newly built rooms. In those places, if there are no furnitures, the sound we produce reflects and mixes with our own sound after striking the walls. This makes the sound a little longer. This type of reflected sound is called reverberation. During reverberation both the sounds are not heard clearly. Big halls are constructed in such a way that sounds after striking the walls create reverberation. This produces musical sounds. The sound reflected at less than 17m distance produces reverberation, speak near the mouth of a big tincan, reverberation can be heard.

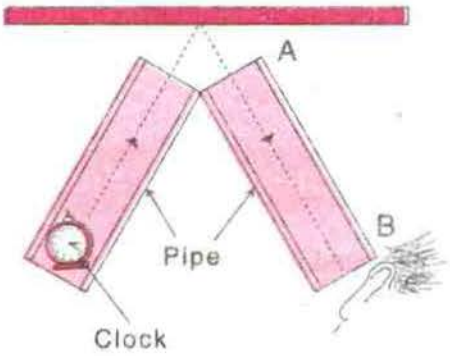


Fig No. 8.6

Simple mathematical problems related to Echo.

Suppose the distance between the source of sound and reflecting surface is at 'd' metre. An echo is heard of a sound coming from a source. To hear the echo, sound has to travel twice the distance.

During echo the distance covered by sound is 2d metre. The following equation can be used to find the distance between the source of the sound and the reflecting surface.

$$\text{Speed of sound} = \frac{\text{distance travelled by sound}}{\text{time taken to travel that distance}}$$

$$\text{or, } v = \frac{2d}{t}$$

$$\text{or } d = \frac{v.t}{2}$$

Example

A man sitting nearby a cave of a mountain hears the clear echo of his whistle sound in 0.2 seconds. How far is he from the mountain. (Take v=332m/s).

Given

time(t) = 0.2s.

speed of sound (v) = 332m/s

distance (d) = ?

By formula,

$$d = \frac{v.t}{2}$$

$$= \frac{332 \times 0.2}{2}$$

$$= \frac{66.4}{2}$$

$$= 33.2\text{m}$$

Therefore the man is 33.2 m away from the mountain.

Summary

1. The hearing sense organ ear that feels the sensation called sound.
2. Medium is necessary for the transmission of sound.
3. Sound is transmitted from all the three materials solid, liquid and gas. The speed of sound is greatest in the solid and least in the gas medium.

material	steel	water	air
speed of sound	5200 m/s	1500 m/s	332 m/s

4. Sound is not transmitted in vacuum.
5. Sound also reflects.
6. The reflected sound is called echo to hear echo the minimum distance between the source and reflecting surface should be more than 17m, away.
7. The long lasting sound is called reverberation. The distance between the source and reflecting surface should be less than 17m, for reverbration.
8. Velocity of sound (v) = distance covered/ time taken or v= 2d/t

Do, Observe and Learn

1. Make a device as shown in the figure, one person should speak and two persons should hear.

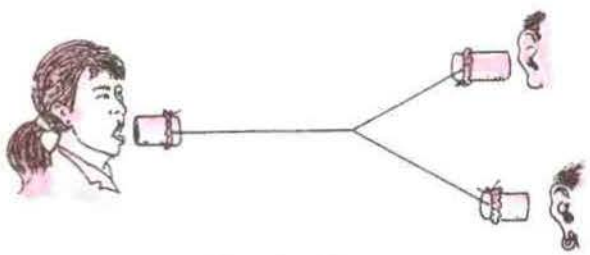


Fig. No. 8.7

2. Light a candle as shown in the figure. In a closed room, place a madal, or drum or any other suitable instrument near it and play, does it affect the candle? Why?

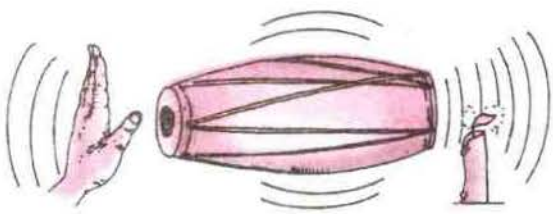


Fig No. 8.8

3. Produce sound nearby any one of these tunnel, jungle (forest) ridge of a hill, etc. Is echo produced ? Observe. If these places are not available, then use a big tin can placed either a material that makes sound or insert your head and produce sound. What difference is in the sound produced outside and inside? Write.

Exercise

1. What is sound?
2. **Write short answer.**
   a. When a ringing bell is caught by hand, sound ceases, why?
   b. Why sound do not propagate in vacuum? write.
   c. How is echo heard?
3. Explain the statements "sound waves cannot propagate in vacuum"
4. Explain an activity to demonstrate sound can transmit through water.
5. An Echo is heard after 0.1 s when a man shouts near the mouth of the deep well. What is the distance between the man and the surface of water in the well? (16.6m).

Unit 9

Magnetism and Electricity

Molecular Theory of Magnetism

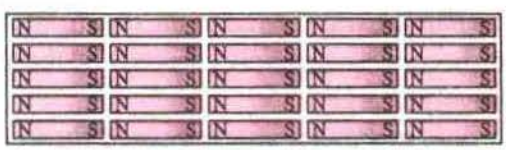
So far you have learned different methods of making magnets from magnetic substances in class 7. A magnetic substance brought near a strong magnet forms (becomes) a temporary magnet. Magnetic induction takes place in that substance. How does magnetic property develop in magnetic substance? How does magnetic induction take place? To know and learn about these, it is essential to know the magnetic substance and arrangement of magnetic molecules.

Magnet Magnet broken into pieces

Fig No. 9.1

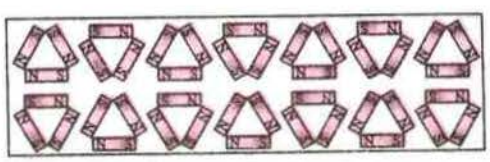
If a bar magnet is cut into two equal halves, do the poles separate?

Both pieces of the magnet develop new poles. As we break down and make pieces of the magnet until a small particle, each will retain its north and south poles. Each molecule by itself is a complete magnet. The molecular north pole remains at one end and molecular south pole of the magnet remains at the other pole. The ends of the magnet are called north and south pole.



Molecular magnets

Fig. No. 9.2



Molecules in a magnetic substance

Fig, No. 9.3

Magnetic substances are also made by the molecular magnets but in them the molecular magnets are arranged at different directions. The north pole of one molecular magnet is attached to the south pole of another molecular magnet forming ring.

So, the attractive force of north and south poles are absent at the two ends of the magnetic substance. There is absence of north and south pole at the ends. It has no magnetic property.

The molecules of the magnetic substance retain magnetic property. They are called molecular magnets. When molecular magnets align in rows, then those substances exhibit magnetic property. When the molecular magnets are placed haphazardly, they donot exhibit magnetic property. This is called molecular theory of magnetism.

Static Electricity

Activity 1

Rub either a plastic comb or a ball-pen on dry hair. Bring the comb nearby the tiny pieces of paper or dust particles kept on the table. What happens? Observe. Does the comb attract the pieces of paper and the dust particles? Why? The property developed in the comb is called charge. The comb attracts the dust particles and pieces of paper due to those charges.

How does charge develop in the comb while combing the hair? The electrons of the atoms of the hair are transferred to the comb and the comb becomes negatively charged and the hair positively charged.

How does negatively charged comb attract the pieces of paper and dust particles?

At first, there is no charge in paper pieces, but, when the comb with negative charge is brought near, the charge is developed. Due to the influence of negative charge of the comb positive charge accumulates at the edge of paper and negative charge at the other end. Unlike charges (negative and positive) attract and like charges repel.

Thus the dust particles get attracted.

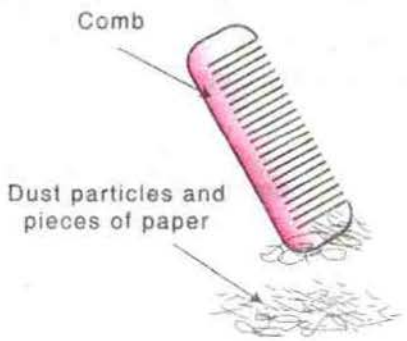


Fig. No. 9.4

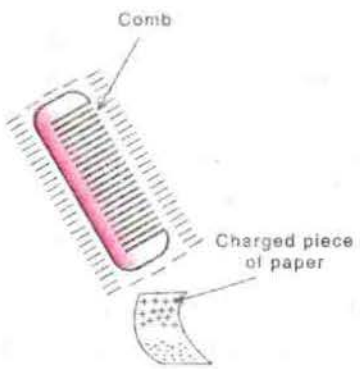


Fig. No. 9.5

Charged matter

Charge is developed in non metals like plastic, wool, nylon, polyester, ebonite, etc. and in insulators when these materials are rubbed against each other. You might have heard the clicking sounds tik-tik' while putting off your polyester or acrylic dress materials. These materials get charged due to friction with the body for the

whole day. While putting off these dresses transfer of charges takes place so the sound is heard. More charges are developed through friction between dry materials.

Simple Cell

Activity 2

Take 100 ml of dilute sulphuric acid in a large beaker. (Make dilute acid by mixing 10ml of acid in 100 ml of water. But care should be taken while mixing water in acid as there is danger (fear) of burst. It should be handled carefully because it may make holes in clothes and burn the body.)

Now dip copper and zinc plates in the acid. Connect those plates with a wire (conductor) alongwith the bulb of a torch as shown in the figure.

Does the bulb glow? Identify the positive and negative terminals.

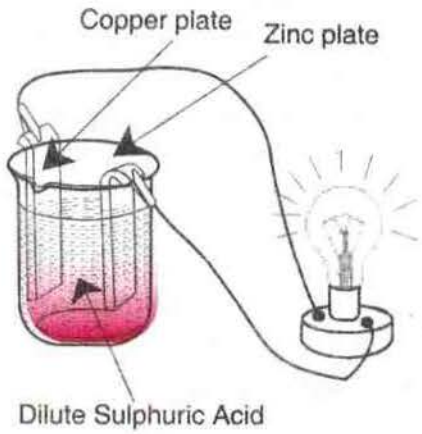


Fig. No. 9.6

In this way a simple cell can be constructed with copper plate, zinc plate and dilute sulphuric acid. It is not possible to produce current for a long time from this type of cell, because it has two defects.

a) **Polarization:**
During chemical reaction within the cell hydrogen gas is produced and accumulates around the copper plate. Due to insulation property of the gas, the flow of the current is obstructed.

b) **Local action:**
Generally, zinc plate is used in a simple cell which has metal particles as impurities. This tarnishes the zinc plate continuously. The life of the cell is thus reduced.

Dry Cell

Liquid acid is used in a simple cell. It makes the cell not suitable to carry from one place to another. There is every chance that the acid in it may spill. A cell can be made without using liquid. This type of cell is known as dry cell. Dry cell is constructed as following:

To construct a dry cell, a zinc can is taken and a carbon rod is fixed in the centre without allowing it to touch the can. The mixture of carbon powder and Magnesedioxide is put inside the can which forms a layer around the carbon rod. Again over it a layer of NH_4Cl is formed. The open end of the zinc can is sealed with wax, tar, plastic etc. to stop the inside materials coming out Now the zinc can acts as a negative terminal and the carbon rod with brass cap acts as a positive terminal.

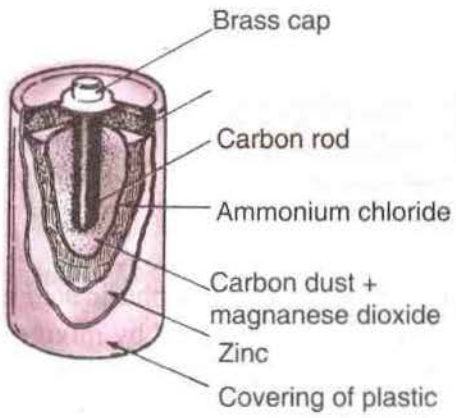


Fig. No. 9.7

No liquid acid is used in it. So it is easy to use. The presence of manganese dioxide in this type of cell prevents polarization. But local action takes place though the cell is not in use, so its life decreases.

Combination of Cells

In daily life more than two cells are used for different purposes. In these situations two or more cells are used by connecting them. This arrangement is called connection of cells. This is done in two ways, they are:

a) Series combination

In series connection, the negative terminal of one cell is connected to the positive terminal of another cell. The potential difference of a single cell is 1.5 volt. It will be 3 volts when two cells are connected and 6 volts when four such cells are connected. In the series connection, as the cell number increases the brightness of the bulb also increases.

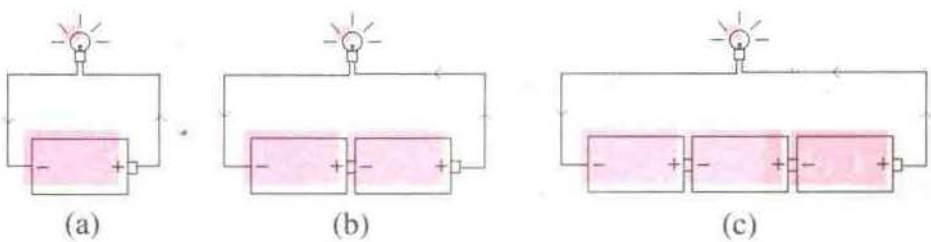


Fig. No. 9.8

The connection of cells in fig b and c is the series connection.

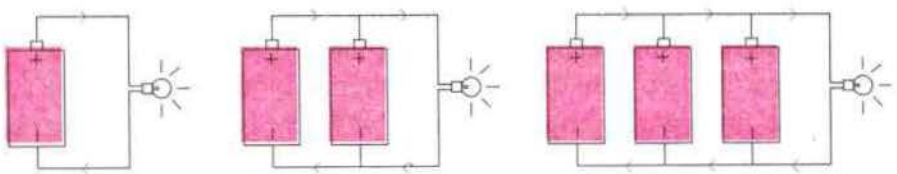
Activity 3

As in fig. a, b and c, connect the bulbs with different combination of cells. Tabulate the results in the following table.

Figure	number of cells	Brightness	Conclusion
a	1		
b	2		
c	3		

b) Parallel combination

In the parallel cell connection the negative terminal of all the cells are connected at one side and the positive terminals of all the cells connected on the other side. In this type of cell connection, the bulb glows for a long period. In the parallel connection whatever is the increase in number of cells the brightness of the bulb will not increase.



(a) (b) (c)

Fig. No. 9.9

Activity 4

Fill in the table as follows:

Fig	Number of cells	Brightness	Conclusion
a	1		
b	2		
c	3		

The connection of cell in b and c is known as parallel connection.

Summary

1. Magnet and magnetic substance, are made from molecular magnets. When all the molecular magnets align in one direction magnetic substances become the magnet.

2. Friction (rubbing) between different substances develops charge.
3. Like charges repel and unlike charges attract.
4. Defects such as local action and polarization are present in simple electric cell.
5. Polarization in the dry cell is removed by using manganese dioxide.
6. In series cell combination, the bulb glows brighter but in parallel cell combination, the brightness and electric potential do not increase.

Do, Observe and Learn

1. Put off the woolen sweater or polyester shirt in a dark place after wearing for the whole day. While putting off your dress, you hear "tik tik" sound along with tiny flashes. What may be the cause of this? Write.
2. Release a very small stream of water from the tap. Rub a comb on the dry hair of the head. Bring the comb near the water coming out from the tap. What effect is seen? What is the cause of this?
3. Take a dry cell used in a torch. Cut open the cell. Use hacksaw to open it. List the names of the materials found inside the cell.
4. Bring near the two unlike poles each other and join them. Test the strength of magnetic force with compass at the point where two unlike poles meet.

Exercise

Write short answer:

1. Why do the poles of a magnet, when broken down into pieces, not get separated from each other?
2. Molecular magnets when arranged gives magnetic substance. Why do magnetic substance not exhibit the property of magnet?
3. Why does an air-filled balloon rubbed against the wall remain stuck on it for some short duration of time?
4. What are the defects of a simple cell? List them.
5. There is no polarization in a dry cell. Why?
6. Draw a neat, clean figure to show the position of molecules in a magnet.
7. What is parallel combination of cells?
8. Write one advantage of parallel combination of cells
9. Write one difference between the series combination and parallel combination of cells.

Unit 10 Matter

Elements are pure substances made up of only one kind of atoms and can not be further broken or split into anything simpler. Hydrogen, oxygen, sodium, chlorine, gold, silver, mercury etc. are examples of element. Altogether 109 elements have been discovered which are both natural and man made. The substance made from the chemical reaction between two or more elements is called the compound. Example- water, salt, carbon dioxide, chalk, copper sulphate, etc. Many compounds are made from 109 elements.

Atom

The smallest particle of an element is called an atom. It can take part in a chemical reaction. Atoms of the same element are identical in all respects. But the atoms of different elements have different kinds of atoms. For example, hydrogen atom, oxygen atom, etc. There are 109 elements and each element has its own type of atom. In this way there are 109 types of atoms.

Molecule

The smallest particle containing the characteristcs of an element or a compound is called a molecule. A molecule of an element is formed by the combaination of two or more similar atoms. For example- a hydrogen molecule is formed by two hydrogen atoms. Similarly a molecule of a compound is formed by the combination of two or more dissimilar atoms. For example- a water molecule is formed by the combination of two hydrogen atoms and one oxygen atom.

Structure of an atom

An atom is made up of three types of sub-atomic or elementary particles called proton, neutron and electron. The mass of subatomic particles are very small. As for example, the mass of an electron nearly 1/1837 part of the mass of light hydrogen atom. That is, the mass of 1837 electrons is equal to 1 hydrogen atom, but the mass of one proton is nearly equal to that of one hydrogen atom being very small the mass of proton, electron and neutron are not expressed in gram instead they are expressed in a different unit atomic mass unit (amu).

1 gm = 6×10^{23} a.m.u.
that is, nearly 6,00,00,00,00,00,00,00,00,00,00,000 a. m. u. equals to 1 gram.
Now, the mass of one proton = nearly 1 a.m.u.

Then nearly the mass of 6×10^{23} protons = 1 gram. From this it will be clear how tiny protons are. The mass of one proton is nearly equal to the mass of one neutron, but the mass of one electron is 1837 times smaller.

Proton and electron carries unit +ve and -ve charge. It is measured in coulomb. In short it is written as coul.

Nearly 6.25×10^{18} electrons = 1 coulomb.

= 6,250,00,00,00,00,00,000 electron.

The neutron is chargeless. It is neutral in character. As it has no -ve or +ve charge so it has been named neutron but the mass of one neutron is nearly equal to one proton.

The table below shows mass and charge of proton, neutron and electron.

su-batomic particle	symbol	mass	charge	location
proton	p+	1 a.m.u (approx.)	+	nucleus
electron	e-	1/1837 a.m.u	-	shell
neutron	n°	1 a.m.u	nil	nucleus

Scientists can make models of atom by the subatomic particles. Different atoms have different arrangements of proton, electron and neutrons.

A neutral atom consists of same number of protons and electrons. That is why, generally, atom is electrically neutral. It is due to equal amount of positive and negative electric charge. The number of neutrons may vary. The mass of the substance depends on the number of neutrons and protons. But the mass of electron which has (1/1837) a.m.u. is negligible.

Importance of an atom

A molecule is formed by the combination of atoms. Similarly different molecules combine to form a matter. Matters combine or decompose chemically to form a new substance. Atoms of the respective matters are the ones which participate in the chemical reaction.

In the table below the number of proton, electron and neutrons of the first 20 elements is displayed.

Table

S.N.	Name of the element	Symbol	Atomic number	No of protons	No of neutrons	No of electrons	Atomic mass
1	Hydrogen	H	1	1	0	1	1
2	Helium	He	2	2	2	2	4
3	Lithium	Li	3	3	4	3	7
4	Berilium	Be	4	4	5	4	9
5	Boron	B	5	5	6	5	11
6	Carbon	C	6	6	6	6	12
7	Nitrogen	N	7	7	7	7	14
8	Oxygen	O	8	8	8	8	16
9	Fluorine	F	9	9	10	9	19
10	Neon	Ne	10	10	10	10	20
11	Sodium	Na	11	11	12	11	23
12	Magnesium	Mg	12	12	12	12	24
13	Aluminium	Al	13	13	14	13	27
14	Silicon	Si	14	14	14	14	28
15	Phosphorus	P	15	15	16	15	31
16	Sulphur	S	16	16	16	16	32
17	Chlorine	Cl	17	17	18	17	35
18	Argon	Ar	18	18	22	18	40
19	Potassium	K	19	19	20	19	39
20	Calcium	Ca	20	20	20	20	40

Atomic Number

The atomic number of an atom denotes the number of proton present in it. Atomic number = number of protons = number of elections.

Atomic Weight

The atomic weight of an atom denotes the sum of the number of proton and neutron present in it. Atomic weight = number of proton + number of neutron. The mass of electrons present in an atom is so small that it is not taken into account while calculating the weight of an atom.

Molecular Weight

The weight of the atoms present in a molecule is called the molecular weight. Hence it is calculated by adding the atomic weight of the atoms present in a molecule. Example ; The atomic weight of a hydrogen atom is one. Since there are two hydrogen atoms in a hydrogen molecule, its molecular weight is two.

The position of proton, electron and neutron in atomic structure

The facts discovered by scientists are as follows.

a) The neutron and proton remain attached to each other and are centrally located. The group of proton and neutron that lie at the centre is called nucleus.

b) The electrons revolve round the nucleus at high speed.

c) As the electrons move round the nucleus they remain at different distance from the nucleus.

d) According to Bohr's model, the electrons spinning at high speed establish a permanent path (shell). These paths of electrons around the nucleus are named K, L, M, N etc.

The first K shell can hold up to 2, the second L shell can hold up to 8, third M shell can hold up to 18 and the fourth N shell can hold up to 32 electrons. The rule of this number is also called $2n^2$ rule. Where 'n' means number of shell (first, second, ...). This rule holds true for a few elements only.

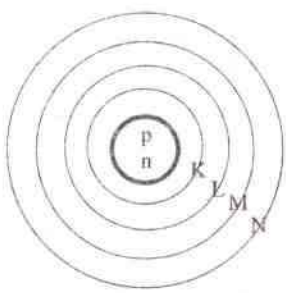
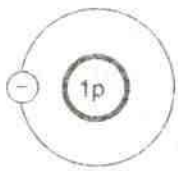


Fig. No. 10.1

Shell	n number	no. of electron
1st shell(K)	n = 1	$2n^2 = 2 \times 1^2 = 2$
2nd shell(L)	n = 2	$2n^2 = 2 \times 2^2 = 8$
3rd shell(M)	n = 3	$2n^2 = 2 \times 3^2 = 18$
4^{th} shell(N)	n = 4	$2n^2 = 2 \times 4^2 = 32$

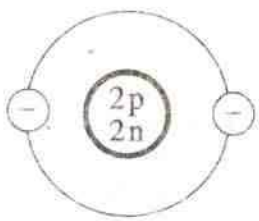
According to this rule, the structure of some atoms can be shown as follows:

There is one proton in the nucleus of the hydrogen atom, which moves in K shell path. It has no neutron.



Hydrogen
Fig. No. 10.2

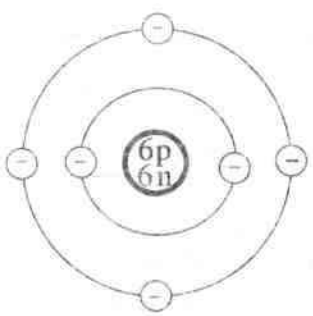
Helium atom nucleus has 2 protons and 2 neutrons as shown in the figure. It has 2 electrons in motion in K shell. Actually the path of the electron in motion are different.



Helium atom
Fig. No. 10.3

Both electrons are in K shell area and both have different paths. For simplicity only in the figure, the shell is represented by one circle and both electrons are placed in that path.

Also the same electron will not follow the same path every time. The path may be different keeping the distance the same. Actually each electron as it moves round makes nucleus lie at one edge. (Like Planets revolving around the sun and the moon revolving around the earth)



Model of carbon atom
Fig. No. 10.4

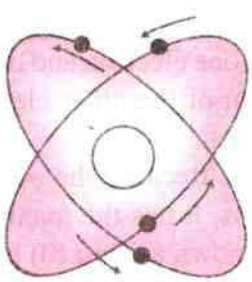


Fig. No. 10.5

In fact, the shells are not circular but they are elliptical as shown in the illustration. However the shell is drawn circular for the sake of easy demonstration.

Activity 1

Making a model of carbon atom.

1. Make small beads of clay to represent proton, neutron and electron and colour each of them differently.
2. At the centre of a cardboard, glue a piece of thick thread or wire to represent a nucleus.
3. Stick beads of six protons and six neutrons (clay beads) on the cardboard inside the nucleus.
4. Make two circles around the nucleus using a piece of thick thread or wire and glue them. Stick beads of two electrons on the inner cirle and beads of four electrons on the outer circle.

Classification of Elements

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
H (1)							He(2)
Li(3)	Be(4)	B(5)	C(6)	N(7)	0(8)	F(9)	Ne(10)
Na(11)	Mg(12)	Al(13)	Si(14)	P(15)	S(16)	Cl(17)	Ar(18)
K(19)	Ca(20)						

In the above table, elements falling in the same group had nearly the same physical and chemical properties. In the periodic table, as we go from left to right and from top to bottom there is a change in properties, respectively.

As for example, elements lying in group 1, H, Li, Na and K are all electro positive. The outermost shell of the atom of these elements have only one electron and during chemical reaction it donates (gives) its electron to the atom of the other element. Again Li, Na and K when react with water displaces hydrogen.
In the same way, elements lying in group 8 are inert gases. Because the outmost orbit of these are always full (saturated) (complete). That is, it has the maximum electrons that it can hold (accommodate). Group 8 is also known as zero (0) group. Elements falling under group 7 all combine with hydrogen to form acids, for example, hydrochloric acid, hydrobromic acid, etc.

With the help of the periodic table, elements lying sidewise and vertically the property of any element can be predicted. As for example, hydrogen oxide is formed when hydrogen atom combines with oxygen atom, hydrogen combines with sulphur to form hydrogen sulphide. There are two electrons in the outermost shell of the Mg and so also for Ca. Sodium hydroxide (alkali) is formed from sodium, potassium hydroxide (alkali) is formed from potassium, etc.

Summary

1. Atomic subparticles such as electron, protons and neutrons are present inside atom. The mass of these are measured in amu unit and charge in coulomb unit.

2. The mass of the proton of an atom is nearly 1 a.m.u. The mass of the neutron is also nearly 1 a.m.u. and the mass of electron is nearly 1/1837 a.m.u.

3. The proton of an atom has 1.6×10^{-19} (coulomb) equivalent positive electric charge and one electron has 1.6×10^{-19} coulomb equivalent negative electric charge. Neutron has no charge.

4. Ordinarily, an atom has equal number of protons and electrons but the number of neutron differs.

5. Atomic number of an atom is the number of protons and atomic mass of atom is equal to the sum total number of protons and neutrons.

6. Atomic structure: In the nucleus of atom lies the protons and neutrons while electrons move around the nucleus at different distance. These electrons in motion make different shells at different distance around the nucleus.

7. $2n^2$ law (rule): The capacity to hold maximum electrons in 1st shell is 2 electrons, 2^{nd} shell is 8 electrons, 3^{rd} shell is 18 electrons and 4^{th} shell is 32 electrons.

Modern Priodic Table

I A	II A	III B	IVB	V B	VI B	VII B	VIII			IB	IIB	IIIA	IVA	VA	VI A	VII A	O
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Te	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La ⊗	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac ⊕	104 Rf	105 Ha	106 Sg	107 Bh	108 Hs	109 Mt									

⊗ Lanthanide elements (57-71)	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
⊕ Actinide elements (89-103)	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Do, Observe and Learn

1. Make a chart to show the structure of elements from 1 to 20.
2. Make models of He, Ne and 0 atoms using fine iron wire and mud balls. Show the proton, neutron and electron with different colours.

Exercise

Write short answer.

1. Make it clear with example the difference between element and compound.
2. What is the smallest part called which has the property of a compound? What will it form if this is also broken down by chemical reaction? Give example.
3. What is the difference between atom and molecule?
4. What are subatomic particles called? Make a table to show the mass and charge of these particles.
5. How are electrons, protons and neutrons are arranged in atoms? Draw atoms of H, He, Li and Na to show the subatomic particles.
6. Draw the atomic structure of the first 10 elements.
7. Give definitions of atomic number and atomic weight.
8. What is $2n^2$ rule? Make it clear with three examples.
9. Which elements are represented by the following nucleus? Write.

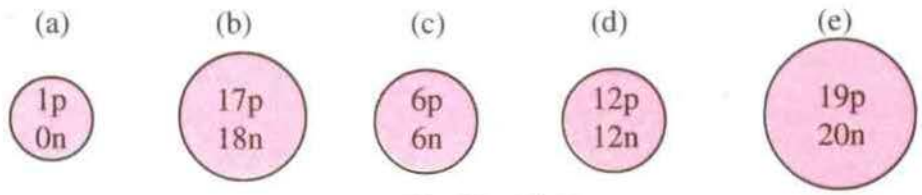


Fig. No. 10.6

10. Match the following:.

Atoms	Atomic Numbers
H	3
Li	17
Na	20
Ca	15
Mg	11
	12
	1

11. What is the name of position where electrons are situated?
12. A portion of periodic table is given below, in which some real elements are represented by (X, Y, Z). See the table and write properties and the number of electrons in the outermost shells.

group 6	group 7	group 8
		z
O	F	Ne
x	y	Ar

Unit 11 Methods of Separation of Mixture

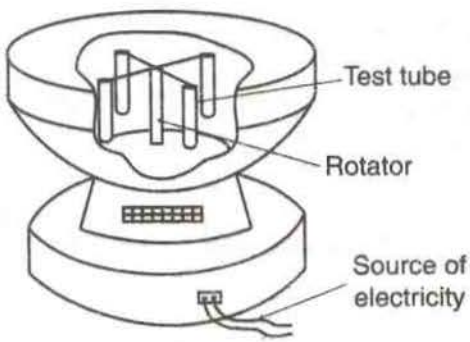
In this unit, crystallization, chromatography and centrifugation method of separating the mixture will be explained. These methods are used according to the special properties of the constituents of the mixture.

Centrifuging

Observe in a dairy how cream is separated from milk. This method of separating constituents of a mixture by whirling round with high speed is called centrifuging.

What will happen if a small stone-tied rope is whirled strongly? The stone pulls the rope, if the rope is released, the stone will fly away, why? Whirled with the same speed light objects (wood, paper, etc.) and heavy objects (stone, iron, etc.). Heavy objects will fly away farther than the light objects. Cream is lighter than milk. Now think why cream separates from milk while centrifuging.

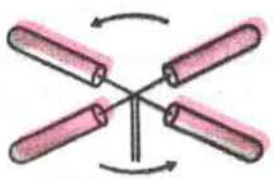
Fig. No. 11.1



Centrifuge

Fig. No. 11.2

Perform another experiment. In a plastic bottle, put sand, chalk powder and water. Now tie the mouth of the bottle with a rope, whirl it fast for some minutes. You will observe sand settled down at the bottom of the bottle and chalk powder settles down above the sand. Does this method separate the two substances having equal weight?



While rotating

Fig. No. 11.3

Nowadays electric motors fitted machines are used for centrifugation. This machine is called centrifuge. Mixture to be separated is placed in test tubes and fixed to the machine. Due to fast rotation heavy and light particles of the mixture are separated and deposed at the buttoms of the test tube.

Chromatography

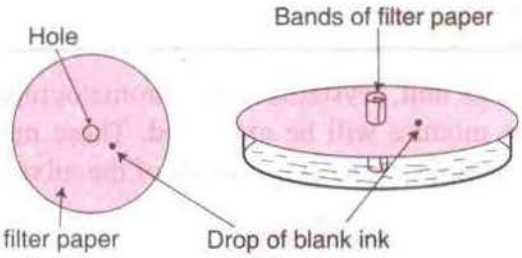


Fig. No. 11.4

The method of separating different colours from a given solution is called chromatography. Perform an experiment with the help of chromatography to seperate the constituents of a mixture.

Make a hole in the middle of the filter paper. Make a small roll of another filter paper and insert in the hole of the first filter paper. Place a drop of black ink and let it dry. Now, put some water in a beaker or petridish and keep the filter paper with the roll as shown in the figure. Leave it undisturbed for 1-2 hours.

The separation of different colours present in the black ink can be observed on the centre of the filter paper. Some coloured materials move faster through capillaries of the filter paper than the other colours which is the main cause of colour separation. Fast moving colours move more distance from the centre than that of slow-moving colours. Different coloured materials have different speed to spread in the water as a result the separation of colour is possible.

The above example is paper chromatography.

Activity 1

Take a vessel and mix two drops of red ink and two drops of blue ink in 5 ml of water. Now place a strip of filter paper half inside water and half outside water. While doing so the paper strip should not touch the sides of the vessel.

After sometimes red ink and blue ink are seen separately in the filter paper. Instead of filter paper a tube filled with alumna (aluminum oxide), silica gel, cellulose powder or chalk medium, is taken and a solution containing two or more dissolved substances is poured into the tube. The constituent mixture then gets separated. The different constituents of the mixture have different adhesive capacity with filter paper, alumina, etc. that helps to seperate mixtures through chromategraphy.

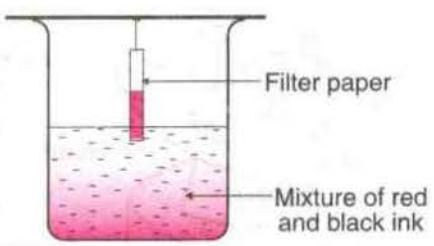


Fig. No. 11.5

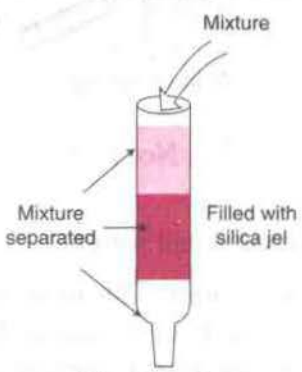


Fig. No. 11.6

Crystal

Observe the crystals of salt, sugar, alum substances with the help of hand lens; You can see small particles in the form of regular geometric shape as shown below.

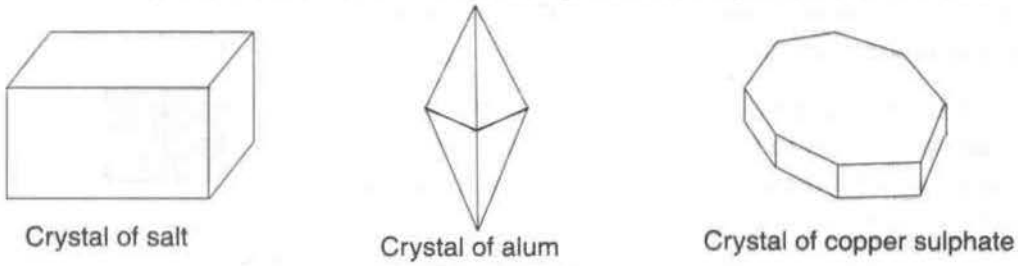


Fig. No. 11.7

The crystals of a substance are all of the same type. These crystals are of fixed geometric shapes and you can see plane surface and edges as that in diamond. Different substances have crystals of different shapes and sizes. They may be cubic, rhombic, octahedral and so on. From the structure of a crystal, it can easily be identified which substance the crystal is made of.

Crystals are those small particles of the substance which have a fixed geometrical shape, the word crystal is originated from the Greek word 'krystalos'.

Crystallization

Take a porcelain basin with some water and heat it. Put copper sulphate little by little and stir it. When the solution is saturated, a drop of solution is cooled. During crystal formation crystals are seen all around the drop of solution. Cool the basin and crystals can be observed. Most of the substances (salt, magnesium sulphate, alum, etc) are used in the same manner to prepare crystals.

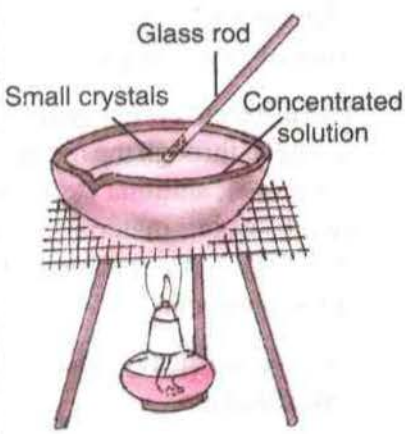


Fig. No. 11.8

When vapour of iodine is cooled crystals are formed. Iodine crystals are prepared by sublimation.Crystallization method is used to seperate the pure substance when mixed with other impure substance. Crystals do not contain impurities. Saturated solutions when cooled slowly give big crystals. Saturated solutions are the solution, which cannot further dissolve the solute in it.

Activity 2

Prepare solution by dissolving alum in hot water and go on adding more alum to make saturated solution. If necessary, filter the solution to make it clear and pure. As shown in the figure, hang a piece of thread with a knot at the end in the solution.

As the solution cools, crystal is formed at the tip of the thread. If the solution is not disturbed, the crystal size grows bigger but the shape remains the same. In this way, crystals of different substances can be made.

If crystal giving substances are in a mixed form with other substances, this method of crystallization can be used to seperate pure crystals.

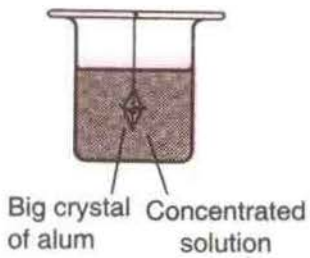


Fig. No. 11.9

Summary

1. To separate mixture, knowledge about the properties of the constituents is necessary.
2. The same type of geometrical-shape particles of a substance is called crystal.
3. A substance will have only one type of crystal.
4. Crystals are developed by cooling hot saturated pollution.
5. Big (large) crystals are developed when hot saturated solution is slowly cooled at room temperature.
6. The substance which can give crystals is obtained form a mixture in its pure form by crystalization.
7. The different components of the colour or paint (mixture) have different speed to spread through the medium (eg.water) or absorbing materials (like filter paper, chalk dust, alumina etc.) When a mixture of paint in solution is passed through the absorbing materials, the components of paint spread with different speed and they get seperated. This process of separation of mixture is called chromatography.
8. To separate heavy and light particles through fast whirling method is called centrifugation.
9. In modern centrifugation method, machines are fitted that works on electric power. This type of machine is called centrifuge.

Do, Observe and Learn

1. Grind a rose flower and leaf in a pestal. Use the solution for paper chromatography and observe. How many colours are separated?
2. Prepare crystals of copper sulphate and observe the crystal through a handlens.
3. Prepare large crystals from saturated solution of sugar.

Exercise

1. Write short answer.

a) How are crystals prepared?
b) How can you obtain big crystals ?
c) What type of mixtures are separated by chromatography ?
d) What kind of mixture is separated by using centrifugation method ?
e) Which method is used for separating cream from milk ?

2. Match the following.

i) sand and sugar	a) distillation process (method)
ii) iodine and salt	b) filtration process (method)
iii) alcohol and water	c) chromatography
iv) blue and red ink	d) centrifugation process (method)
	e) sublimation process (method)

3. One should know the properties of the constituents of a mixture to separate the mixture, explain with example.

4. Explain with diagram how the following mixtures are separated.

a) water and sugar
b) sand and sawdust
c) iodine and salt
d) alcohol and water.

5. What is a crystal? How can crystals be prepared?
6. Explain with diagram how can pure alum be prepared from impure (dust mixed) alum powder.
7. What type of mixture is separated by chromatography?
8. How will you use simple filter paper to demonstrate chromatography? Explain with diagram.
9. If two different substances move with the same speed through a medium, why chromatography process is not suitable?
10. What type of mixture in spearated by centrifuging process?
11. Which method do you use to seperate pure salt from rocksalt? why?

Acid

An acid is a substance which gives off one or more hydrogen ions or protons (H^+) when dissolved in water.

Name	Formula
Hydrochloric acid	HC1
Sulphuric acid	H_2SO_4
Nitric acid	HNO_3

Some of our food stuffs also contain acids which are as follows:

Name	Sources
Lactic acid	sour milk
Acetic acid	sour pickles, vinegar
Citric acid	Lemon

Generally, an acid denotes a substance which tastes sour, however in chemistry, the meaning of acid is not limited to this concept only. Usually acids are sour, e.g. citric acid (acid found in the lemon), hydrochloric acid (acid found in the stomach), tartaric acid (acid found in fruits like 'bhogate'), oxalic acid (acid found in 'chari amilo'), ascorbic acid (acid found in the fruits having vitamin 'C'), etc. The sour milk contains lactic acid. The sour pickles contain acetic acid or vinegar. There are also some acids which are not sour, e.g. stearic acid, boric acid, salycylic acid, etc.

In this unit, we study the properties of some common acids (e.g.hydrochloric acid, nitric acid, sulphuric acid) which are used in the laboratory.

Activity 1

Usually acids are sour. Add little water in ascorbic acid or citric acid. Taste a drop of this mixture. It is dangerous to taste other acids.

Activity 2

A paper painted with a chemical substance named litmus is known as a litmus paper. The litmus paper is an indicator which turns into red colour in the acid but turns into blue colour in the alkali.

Take a little dilute hydrochloric acid in a test tube. Dip a blue litmus paper in it. Observe the change in the colour of the litmus paper. Write what you observed.

Activity 3

Take a little dilute acid in a test tube. Add few drops of methyl orange in it. Observe the change in colour.

Activity 4

Take a little dilute acid in a test tube. Add few drops of phenolphthalein in it. Is there change in colour?
Based on the observations of above activities, complete the following table.

Indicator	colour of the indicator	colour changed when added acid
(a) Blue litmus		
(b) Phenolphthalein		
(c) Methyl orange		

Indicator

An indicator is a substance which is used to identify whether an object is acidic or basic. Litmus paper, methyl orange, and phenophthalein are some indicators.

Properties of an acid

Physical Properties

1. Acids taste sour, but the laboratory acids are dangerous to taste.
2. An acid turns blue litmus paper into red.
3. An acid turns methyl orange into red.
4. An acid is neutral to phenolphthalein.

Chemical Properties

1. An acid reacts with a metal like zinc, magnesium etc. and forms hydrogen gas.
2. The reaction between an acid and a base results in the formation of salt and water.
3. An acid when dissolved in water gives off hydrogen ion (H^+).

Some acids that are used in daily-life

Acid	Source
Citric acid	lemon, tamato
Acetic acid	vinegar, sour pickle
Carbonic acid	soda water
Tartaric acid	fruits
Formic acid	secretion through ant-sting
Ascorbic acid	sour fruits
Lactic acid	sour milk

Base

A base is metallic oxide or hydroxide

Base	formula
Sodium oxide	Na_2O
Sodium hydroxide	NaOH
Potassium oxide	K_2O
Magnesium oxide	MgO
Magnesium hydroxide	$Mg(OH)_2$

Activity 5

Take little samples of base in three test tubes. Dip a red litmus paper in one of the test tubes. Observe the change in the colour of the red litmus paper. Similarly, add one or two drops of phenolphthalein in the second test tube and methyl orange in the remaining one. Observe the change in the colour of the samples.

Record your observations in the following table.

Indicator	colour of the indicator	colour changed when added alkali
(a) Red litmus		
(b) Methyl orange		
(c) Phenolphthalein		

A base turns the red litmus paper into blue colour, turns phenolphthalein into pink colour and turns methyl orange into yellow colour.

Properties of a Base

Physical Properties

1. A base tastes bitter.
2. The solution of base and water is slippery.
3. A base turns the red litmus into blue.
4. It turns methyl orange into yellow colour.
5. It turns phenolphalein into pink colour.

Chemical Properties

1. The reaction between a base and an acid results in the formation of salt and water.

2. A base reacts with carbon dioxide and forms carbonate.

Some bases that are used in our daily life are:

Base	Use
Potassium hydroxide	fire wood ash which is used in washing clothes.
Sodium hydroxide	for making soaps.
Aluminium hydroxide	as medicine-antacid against gastric disease.

Salt

Salt is a neutral substance i.e. it is neither acidic nor basic. Some salts taste salty while many of these taste bitter.

Activity 6

Observe the colour of different indicators with edible salt (sodium chloride, NaCl), potassium chloride (KCl), and copper sulphate ($CuSO_4$) separately. Prepare individual salt solution with water. Take a little sample of each in a test tube.

Then note the colour of the indicator when it is brought into contact with each salt solution sample.

Indicator	Colour of the indicator	Colour after contact with the salt
(a) Red litmus		
(b) Blue litmus		
(c) Phenophthalein		
(d) Methyl orange		

Some examples of acid, base and salt that are used in daily life are as follows:

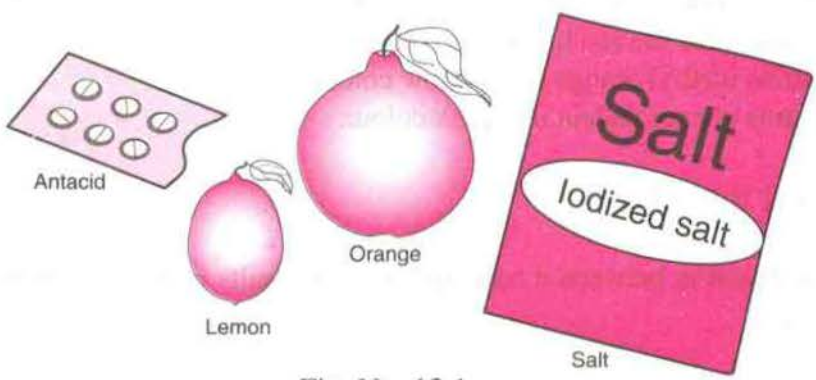


Fig. No. 12.1

Properties of Salt

1. Some salts taste salty. Most of the salts taste bitter.
2. Salts are neutral to litmus paper, methyl orange, and phenophthalein.
3. Some salts are white in colour whereas some are colourful.
4. Salts are mostly soluble in water.

Some salts used in our daily life:

Salt	Use
1. Sodium chloride (edible salt)	in preparing food. (common salt)
2. Copper sulphate	in the form of insecticide.
3. Magnesium sulphate	medicine against constipation.
4. Calcium sulphate (gypsum)	plaster to join the fractured bones.

Summary

1. Acids are usually sour, bases are bitter; and salts are salty or tasteless, however, there are some exceptions too.

2. The following table shows how acid, base and salt affect indicators.

Indicator	Acid	Base	Salt
Red litmus	neutral	turns into blue colour	neutral
Blue litmus	turns into red colour	neutral	neutral
Phenolphthalein	colourless	turns into pink colour	neutral
Methyl orange	turns into red colour	turns into yellow colour	neutral

3. Some of the acids, bases and salts are used in our daily life.

Do, Observe and Learn

1. Develop a chart which shows the effects of acid, base and salt on indicators – litmus paper, phenophthalein and methyl orange.
2. Observe how acid and base affect a piece of cloth soaked in turmeric solution.
3. Collect coloured petals of the flowers. Extract the fluid from the petals by pressing them. Paint a piece of paper or cloth with the extract. Drop one or two drops of acid, base and salt solution on the coloured piece of paper or cloth separately. Observe what happens.

Exercise

1. What is an acid? Give four examples of acid.
2. Write three names of common acid, base and salt. Mention their uses in our daily life.
3. What is the difference between an acid and a base ?
4. What is an indicator? Write the names of any three indicators that are used in the laboratory.
5. Show with the help of a chart how acid, base and salt affect indicators.
6. Correct the following if necessary.
   (a) Water when added to an alkali forms a base.
   (b) There are bases in fire-wood ash.
   (c) Milk is a neutral substance.
   (d) The solution of washing soda is alkaline.
   (e) An acid turns phenophthalein into pink colour.
   (f) All salts taste salty.
   (g) Bases are usually rough while they are touched.
   (h) There is hydrochloric acid in our stomach.
   (i) The sodawater is sour because it is acidic in nature.

Unit 13

Air

Composition of air & experiment

Air is a mixture of several different gases. Air is important for all living beings. All living beings take in oxygen from air while breathing, and they throw away carbon dioxide when they breath out. All green plant take in carbondioxide while making their food. Air contains water vapour too.

Composition of air

Of all the gases that make air nitrogen takes the largest share. About four out of five parts of air is nitrogen. About one fifth of air is oxygen. Carbondioxide, inert gases and many other gases are also found in air.

The composition of air by volume is as follows:

Gas	Volume(percentage)
Nitrogen	78.10
Oxygen	20.90
Carbon dioxide	0.03
Inert gases	0.95
Other gases	0.02

The composition of air is the same in most parts of the atmosphere. However, the amount of water vapour and carbon dioxide varies from place to place.

The oxygen in air helps in respiration, burning things, and rusting. Carbondioxide is essential for plants to make their food.

Besides nitrogen, oxygen and water vapour, traces of other gases such as helium, neon, orgon, krypton etc. are also found in air. These gases are called inert gases.

Activity 1

Rusting

A clean piece of iron or a nail, if left in a moist place, changes to a reddish-brown after a few days. This reddish-brown substance is called rust. The process by which rust takes place is called rusting. We can observe this phenomena by carrying out an experiment.

Take a test-tube, pour some water in it and make its inner surface moist. Put some clean iron filings or steel wool into the test-tube. Shake the test-tube so the iron filings stick to the inner part of the tube. Invert the test-tube into a beaker filled with water. Mark the level of the water inside the test-tube with a rubber band.

After one or two days, the steel wool will be found rusted and that the level of water inside the tube risen. When rusting occurs, oxygen present in the air is used up. In fact, the rusting occurs because of the oxygen. Put a thumb on the mouth of the test–tube and remove the test tube from the beaker. Hold the test-tube upright, remove the thumb and insert a lighted splint or a matchstick into the tube. The splint goes off.

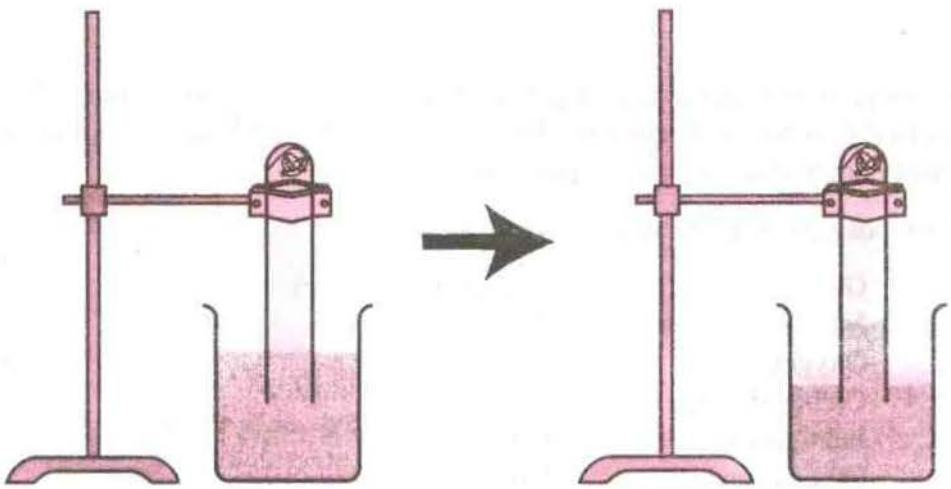


Fig. No. 13.1

The lighted splint goes out since there is no oxygen in the test-tube. The oxygen

Activity 2

There is oxygen in the air

Put a candle in a small container. Transfer it to another container with some water in it and cover it with a bell jar. Mark the water level on the bell jar. Light the candle and close the open end of the jar. It burns with a yellow flame. While it is burning, the water level drops slowly. The burning candle gives heat and expands the air

inside and pushes the water level down. After a while the candle stops burning and the air in the bell jar cools down. Then the water level slowly rises. The burning candle uses oxygen and the volume of air decreases.

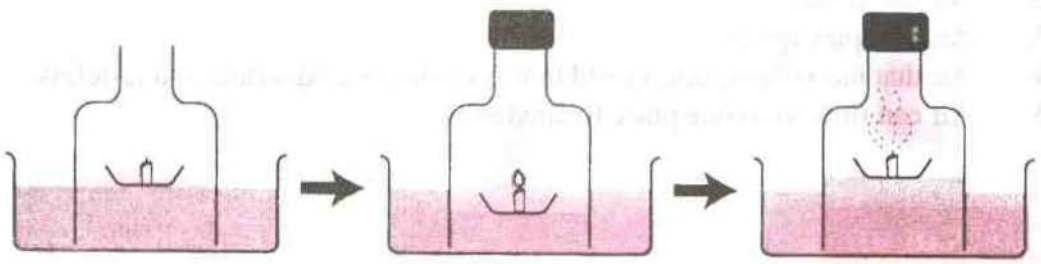


Fig. No. 13.2

Remove the lid from the bell jar. Insert a burning splint. It goes off. This proves that the air in the bell jar does not contain oxygen.

Activity 3

Air contains Water Vapour

Put some water and a few pieces of ice in a steel glass. Leave it on a table. After sometime water droplets will be seen on the outer wall of the glass. How are the water droplets collected on the wall? Those water droplets are due to the condensation of water vapour present in the air. As the outer surface of the glass is cooler than the air, the water vapour has condensed. Dew drops on the plants and grasses in the morning are also due to the condensation of the vapour in the air.

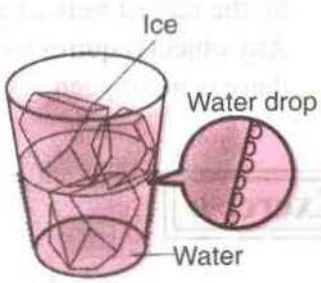


Fig. No. 13.3

Activity 4

Air has weight

Take an empty ballon and weigh it. Then, fill it up with air and weigh it again. This time the ballon is going to be heavier than before. This shows that air has weight. More over, air occupies the space inside the ballon.

Characteristic Properties of air

1. Air is a mixture of different gases. These gases can be separated from air.
2. Air has weight.
3. Air occupies space.
4. Air that has nothing else mixed in it is colourless, odourless and tasteless.
5. Air can flow from one place to another.

Uses of air

1. Air is necessary for burning things. The oxygen in air helps things to burn.
2. All living things use oxygen from air during respiration.
3. All green plants use carbondioxide during photosynthesis.
4. All living things, directly or indirectly, use nitrogen to manufacture protein.
5. Air is used for inflating tire tubes, football etc.

Summary

1. Air contains nitrogen, oxygen, carbon dioxide and other gases. Nitrogen makes up the largest bulk of air.
2. Any object requires oxygen for burning. Things does not burn in places where there is no oxygen.

Exercise

1. **Fill in the blank**

(a) Plants use ..... while making their food.
(b) Helium, orgon, ... are called inert gase.
(c) Nitrogen makes ..... percent of air.
(d) Human being throw away ..... gas while breathing.

2. Match the following:

gas	Volume (Percent)
Nitrogen	0.95
Oxygen	0.03
Carbondioxide	0.02
Inert gases	78.10
Other gases	20.90

3. Write short answers:

(a) What would happen if plants were not to use the carbon dioxide found in air?
(b) How does rusting take place?
(c) Write any 3 characteristic properties of air.
(d) How do you show that air contains water vapour? Explain.
(e) Write any two uses of air.

Major plants and animals found in Nepal

Nepal covers an area of 1,47,181 square kilometer. The Himalayas, mountains and hills cover 73% of total area and terai and inner terai cover rest 27%. Our country, Nepal, is apprximately 800 km long and 200km wide. There are places in the country that experience heat most of the time. There are also places with snows throughout the year. Nepal can be geographically divided into terai, mountain and himalayan region. These regions have different geographical structure and climate. Wide varities of plants are found in these places. Similarly different kinds of animals live there. Rivers, lakes and vegetation are also varied in these areas. The enviroments too are different from place to place. The plants and the animals found in these areas are different due to there being different enviroment. According to geographical regions, variety of plants are found in Nepal. The plants found in your area may be different from the plants found in other places.

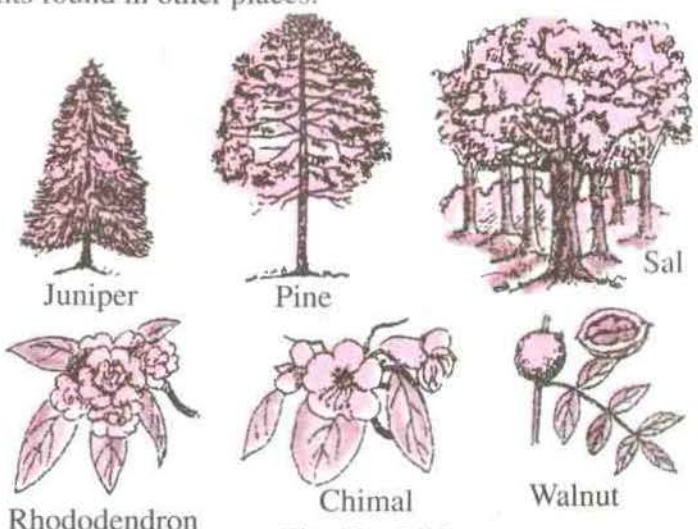


Fig. No. 14.1

1. Timber Trees

The soil in terai is fertile and climate is very hot. In terai, a large variety of good quality trees like sal, simal, (silk cotton), sisau (sisam), Jamun (silk plum) Emli , Harro, Barro etc are found. In mountain regions there are big valleys and narrow plains. Here the forests are occupied by trees such as Banjha, Phanlat, Katus, chanpa, Okhar, chilauni and so on.

In the himalayan region, there are world famous peaks. Trees like Rai sallo, thigure sallo, bhojpatra are found in this region. Timber wood is of different types. Some timber wood is used for making furniture and some is used as beam. Low quality wood is used as fire wood. Small plants grow into big trees. We get timbers from trees, so that we should not cut trees indiscriminately for getting wood or timber. New plants should be planted after cutting a tree at the place. Timber and wood is received later from these plants. Plants like Mango, katus, devdar, walnut, chilaune, painyu (cherry) gurans (Rhododendron), pine tree etc could be used as source of wood.

Activity 1

Find out different types of plants in your home area. What are they used for. Observe and fill in the names in the given table.

Plant name	Useful part	Use
1. 2.		

2. Medicinal Plants

There are variety of medicinal plants in the forest of Nepal. It is guessed that there are more than 800 species of medicinal plants in Nepal.

Some of them are cultivated by people while others are wild. Some of the raw medicinal plants are exported to India. Similarly some of the plants are also exported to overseas countries. It is said that about 60 varieties of the medicinal plants are exported abroad.

Medicinal plants found in hot place and cold place are different. Harro, barro, rajbriksha, sarpagandha, amala, chutro and so on are found in terai. Chutro, dhaturo, chiraito, bojho, sugandhawala, timur etc. are found in Himalayan range and cold places. The climate of the Himalayan region is always cold. The plants such as panchaaunle, padamchal, jatamasi etc are found in this region.

The medicinal plants found in the northern mountain, himalayan range and terai region are exported abroad. Sarpagandha, Jatamasi, laghupatra, panchaunle, bhyakur, eklebir etc are exportable herbs. These plants as well as other medicinal plants are exported to Hongkong and Singapore. Export of plants are also done to other countries according to their demand. Uncontrol and illegal practice of collection of plants

have lead some valuable plants to extinction. Even in the existence of laws, some plants are disappearing permanently day by day due to lack of effectivencss in implemeatation.

Zimbu, oppium, rose, bhuinkafal, sarpamakai, mushroom are used as medicine. Medicinal plants have a big importance in the economy of Nepal. Lapsi, chutro, kafal, mayal, chiuri, katus amala, inselu, jurekafal etc. are the wild fruits found in the forest.

Activity 2

Prepare a list of the medicinal plants found in your area by asking with your senior. Write down their medicinal uses in the given table:

Plants used as medicinal plants	parts used	uses

3. Ornamental Plants

Different types of plants are found in the terai, mountain and himalayan regions of Nepal. Some plants are planted for decoration also used as flower. You must have seen the plants such as alupate, Asare, koiralo, laligurans etc. The flowers of these plants add beauty and colour to the environment of home area. We plant beautiful flowering plants like sayapatri, makhamali, godawari etc. around our home for decoration.

Activity 3

Find out the names of plants used for decoration in our locality. Collect and preserve the leaves and flowers of these plants. Identify the names of the plants by consulting your teacher or other people. Then hold discussion in your classroom.

Activity 4

Note down the names of the decorative plants commonly seen around your house. Ask your class mates too about these flowers and plants. Then prepare a list of the plants according to their uses.

Prepare a list of the plants and flowers planted for decoration at home. In consultation with your friends. Write down a list of the plants and flowers found at your friends place. Then prepare a list of the plants according to their uses.

4. Food plants

The plants are the main source of food. The food plants are mainly classefied into cereals, legumes, vegetable, and fruit etc. The food plants include paddy, wheat, maize etc. They are monocot plants. The legumes include pulses, soyabean, gram, peas etc. and they are dicot plants.

Different parts of different plants are used as food. Leaves of rayo, spinach and cabbage are used as vegetables, whereas stem of ginger and root of sweet potatos are used as food. Fruits of tomato, cucumber, pumpkin, brinjal, capsicum and so on are used as vegetables. Mango, pineapple, guava, banana etc are fruit found in the terai.

In the mountain region, apple, orange etc. are avilable. The main agriculture crop of Nepal are maize & paddy. Besides these barley, millet and wheat are also food plants

Animals

Different types of animals are found in the forests. In the forest and residential area, there are 844 species of birds, 184 types of fish and 181 kind of mamals are found. The one horned rhion and danfe (lophophorus) are well known in the world.

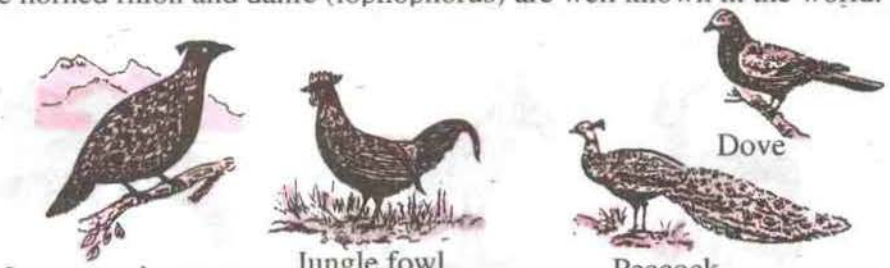


Fig. No. 14.2

In Nepal, due to the climate and forests of terai, there are varieties of birds. Among them some of the birds such as jungle fowl, peocock, dove, wild duck, etc are important ones. Among the wild life, wild buffalo is found in Kositappu. It is considered as rare animal.

The number of the black buck (Krishnasar) number is also declining. In terai region, wild animals such as elephants. Rhinoceros, blue bull (Nilgai), tigers are found. These days the number of wild life is decreasing. The wildlife conservation programme has assisted in protection of wildlife. Different types of wild life are found in the terai of Nepal.

Leopard, boar, Jackal, beer, tiger etc are wild animals found in the mid Mountain region. Phesant and jungle fowl are major birds of this area. Different types of animals are found in the mountains of the northern region of Nepal. Among them few important animals such as red panda, wild yak and musk deer are becoming rare. In the northern part and himalayan region danfe (impeuan pheasant) monal (crimson horned pheasant), cheer pheasant, blood pheasant and other variety of birds are found.

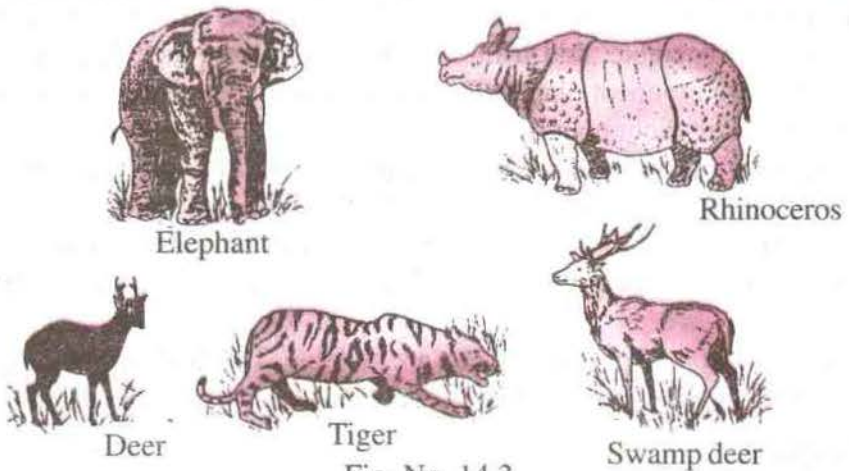


Fig. No. 14.3

Endangered Animals

Destruction of forest as well as habitat has created lack of suitable environment for wild life. As a result of this, some of the wildlife are about to extinct and some have already disa

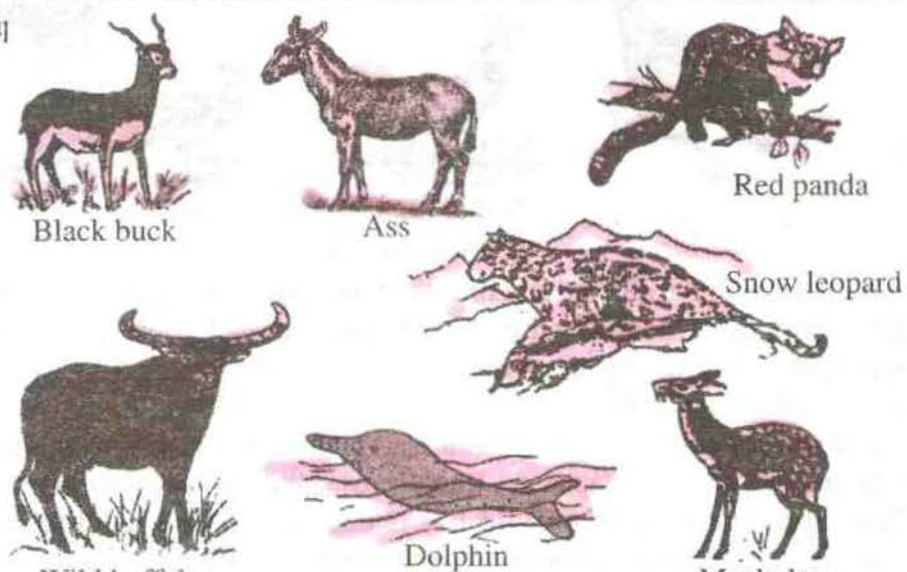


Fig. No. 14.4

In Nepal the animals such as black buck, pygmy hog, wild ass, hispid hare have started to be extinct, similary wild elephant, rhinoceros, tigers, leopard, wild buffalo, blue sheep, snow leopard, blue sheep, snow leopard, swamp deer, musk deer gangetic dolphin and so on are on the verge of extinct.

Endangerd animals and birds

Mammals	Birds	reptiles
Asamese monkey	Black stork	Python
Pangolion	Crane	Gharical crocodile
Hispid hare	Cheer pheasant	Monitor lizard
Wolf	Empeyan pneasant	
Leopard cat	Hornbill	
Snow leopard	Crimson-horned pheasant	
Black buck		
Tiger		

Activity 5

Prepare a list of wild life found in your locality. You can enquire with people and prepare a list of deforestation in your area.

Attempts to conserve wildlife

The increasing population has been gradually affecting the wildlife. People from mountain have migrated to terai and they have destroyed terai forest for agriculture. This activity has contributed to the disappearanee of wild life. As a result of the deforestation animals such as the one horned rhino, tiger, crocodile, black buck are about to be extinct. As the destruction of wild life speeded up.
Government established the National Parks and Wild life Reserves to preserve wild life. The protected areas for conservation of wild life are as follow:

(a) Chitwan National Park
(b) Sagarmatha National Park
(c) Langtang National Park
(d) Rara National Park
(e) Shey-Phoksundo National Park
(f) Khaptad National Park

(g) Makalu Varun National Park
(h) Bardiya National Park
(i) Koshi Tappu National Park
(j) Shukla Phanta National Park
(k) Parsa Wildlife Reserve
(l) Dhorpatan Hunting Reserve
(m) Shivapuri Watershed and Wildlife Reserve
(n) Annapurna Conservation Area
(o) Makalu Varun Conservation Area.

Activity 6

Prepare a chart depicting different activities being performed for the wildlife conservation in your locality.

Economic Importance

Natural environment includes natural resources and wildlife. This type of natural environment is important for study and research works. People within a country or abroad all can gain economic benefit by finding new discoveries from natural envorinment.

Various medicinal herbs are found in the forests. If these herbs are properly managed it can contribute alot to the economy of the country. Wildlife, mountains and natural beauty are valuable assets of the country. They are the centre of attraction for the tourists. Tourists come to Nepal for enjoying the natural beauty. Wildlife and forest resources are valuable assets. So it is important to conserve them from economic point of view.

Life Cycle of a Plant

There are various types of plants around us. We get most of our food from the plants. Many plants are cut by the humans whereas some die themselves. Even though they don't decrease in number, in fact, they are increasing. How does this happen? You might have seen various plants around your house, some bear flowers and some don't. Flowering plants have flower buds, branches, roots etc. This type of plants grow from the seeds. Now you'll study the life cycle of flowering plants. It is necessary to study the structure of flowering plants before studying its life cycle.

Flower

Flower is a reproductive part of a plant. Generally they are divided into four parts. These four parts lie one after another in four rounds called whorls and are landing on a thalamus. The four parts of flower are as follow:

Calyx: It is the outermost part the flower. It consists of sepals which are generally green in colour. It protects the inner developing parts of the flower in bud stage.

Corolla: It is the part inner to the calyx. It consists of petals which are bright in colour. Some plants even have glands secreting nectar. Flowers like rose, jasmine have sweet fragrance. The bright colour, fragrance and nectar attract the insects and they help in pollination.

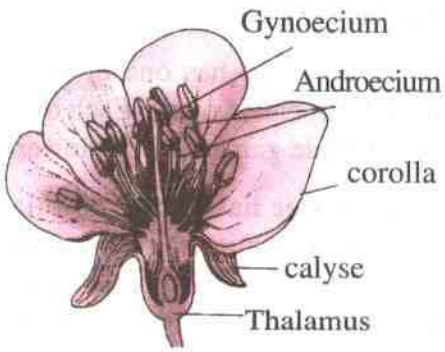


Fig. No. 14.5

Androecium is the third whorl of a flower and is inside the corolla. It is the male reproductive part and consists of stamens. Each stamen has two parts. Long and thin stalk like part is called filament and the round swollen part above is called anther. The two swollen part of the anther is joined by a connective.

There are two pollen grain sacs in each anther. Pollen grains are a mass of fine yellowish powdery or dust like particles. After the maturation of anther male gametes are formed.

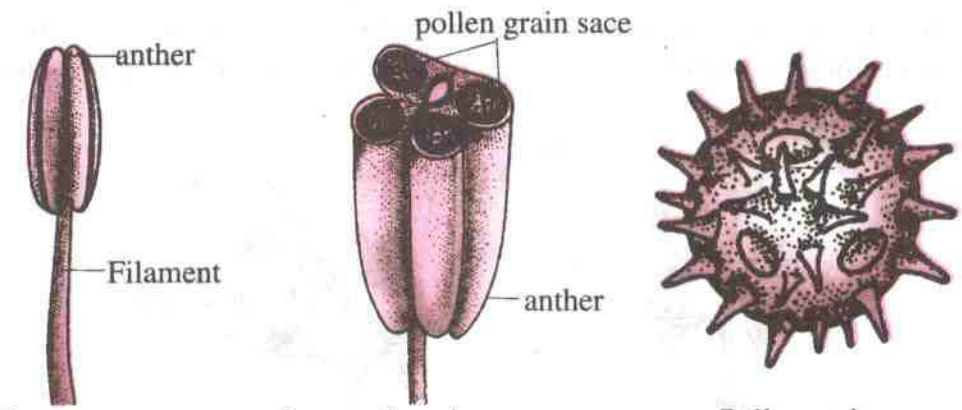
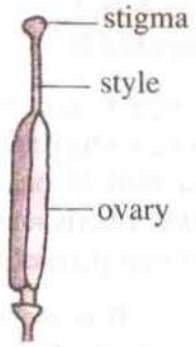


Fig. No. 14.6

Gynoecium: The innermost whorl of a flower is gynoecium. It is the female reproductive part of the flower. It consists of one or more carpels or pistils. Each carpel has ovary, style and stigma. The lower swollen part is ovary, long middle part is style and upper spreading region is called stigma.



Gynoecium
Fig. No. 14.7

A mature ovary has one or more, circular or oval, shaped part called ovule. Each ovule has ovum. Ovum is the female gamete of the flower.

If the flower has calyn, corolla, androecium and gynoecium then it is called a complete flower. If any one of the part is missing then the flower is called incomplete flower. If the flower has both female and male parts then it is called bisexual flower, if only one of the sexes exists then it called unisexual flower.

Pollination

You must have seen bees and butterflies flying in the garden. They are hovering around the flowers to suck the nectar but indirectly they are helping in the important processes of pollination.

The process of transfer of pollen grains from an anther of a stamen to the stigma of a pistil is called pollination. Besides insects; air, water, animals and birds also help in the pollination.

Pollination is of two types: Self pollination and cross pollination.

Self pollination: If the pollen grains of a flower reach the stigma of the same flower or if there is pollination between two flowers of the same plant, then it is called self pollination. Self pollination usually takes place in bisexual flower. eg peas, barley, wheat.

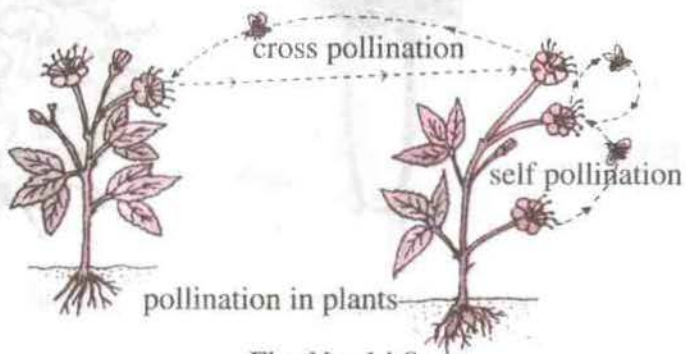


Fig. No. 14.8

Cross pollination: If the pollen grains are transferred from anther of one flower to the stigma of the another plant's flower of the same species through an agent then this process is known as cross-pollination. It takes place in both unisexual and bisexual flowers.

Fertilization

Fertilization is the process of fusion of male gamete and female gamete to form a zygote. After pollination, a fine pollen tube emerges from each pollen grain. Then the pollen tube makes its way towards the ovary. There are two male sex cells in the end of the pollen tube. Similarly there are lots of female sex cell in an ovule. In the ovule the end of pollen tube ruptures and it dissapears. Then the fusion of male sex cells and female sex cells takes place and zygote is formed. This process is called fertilization.

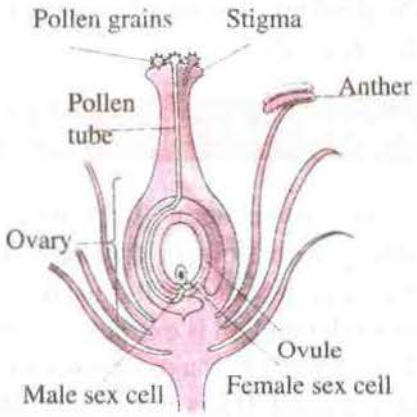


Fig. No. 14.9

After some changes in the zygote, an embryo is formed. After fertilization the sepals, petals, male part and stigma of the flower wither and fall off. Then every fertilized ovule develops into a seed and overy develops into fruit. The emebryo in the seed is the initial form of the future plant. The seed does not grow into plant immediately. The seed sprouts only under suitable environment.

The formation of new plant takes place after the germination of the seeds on the availavility of suitable

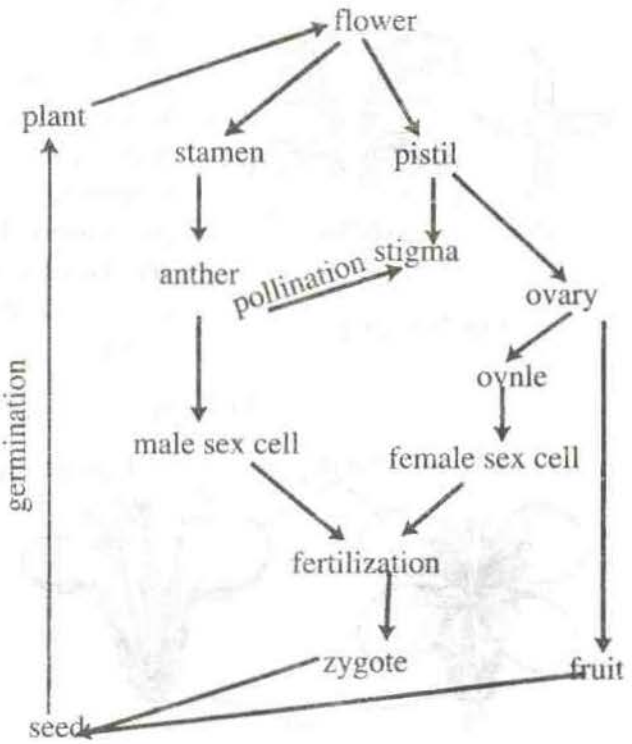


Fig. No. 14.10

heat, light, air and water. In this way seed initiates the life cycle of a plant, then again in the full grown plant seed formation takes place after flower changes into fruit. Seed grows into a new plant. In this way the life cycle of the plant completes.

Lifecycle of a mustard plant.

You must have seen the mustard plants blooming with flowers. Mustard forming is done a lot in out country It is used as vegetable while tender and oil is extracted from seeds. It is a kind of herb. It is a dicotydedonous (dicot) flowering plant. It has a main root which bears numerious branches called secondary roots and tertiary roots. The mustard flower is bisexual and complete. It has four green sepals. It protects the flower bud. The flower has four yellow and bright petals with fragrance, which help to attract insects towards the flowers. It helps in pollination. There are six stamens in circles or whorls. Two pistils are fused and situated in the middle of the flowers.

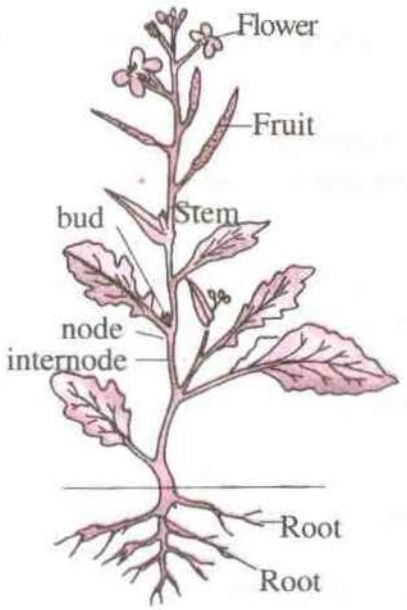


Fig. No. 14.12

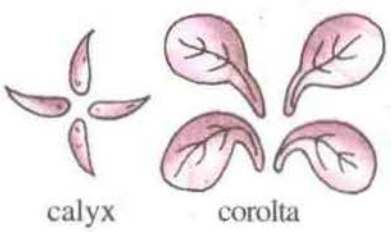


Fig. No. 14.11

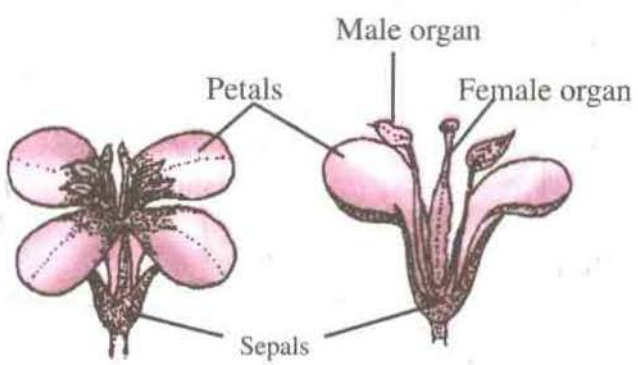


Fig. No. 14.13

After the stamen of the mustard flower gets matured anther bursts and pollen grains come out. With the help of the agents like wind or insects the pollen grains from the anther are carried away to the stigma of the same or similar kind of another

flower. This process is known as pollination. Insect, wind water etc. help in carrying out this process. The insects get attracted towards the smell and the colour of the flower. So, the insects keep on roaming around different flowers and help to carry out pollination. In this process even though insects damage some parts of stigma and anther, the pollen grains will reach to the stigma.

For reproduction to take place the male sex cell in the pollen grains must be developed. Similarly, in the ovule there is female sex cell. After male sex cell fuses with female sex cell, a zygote is formed.

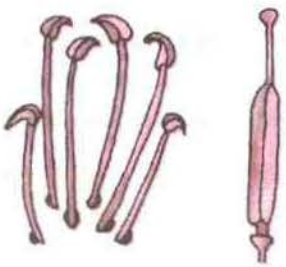


Fig. No. 14.14

After the mustard flowers are fertilized, they change into fruit, which is elongated in shape and the tip is slightly pointed. The seeds are arranged in a line inside the fruit. After mustard seeds get matured, the fruit dries up and bursts to release the seeds. When there is a suitable climate, temperature etc these seeds germinate and start a new life cycle.

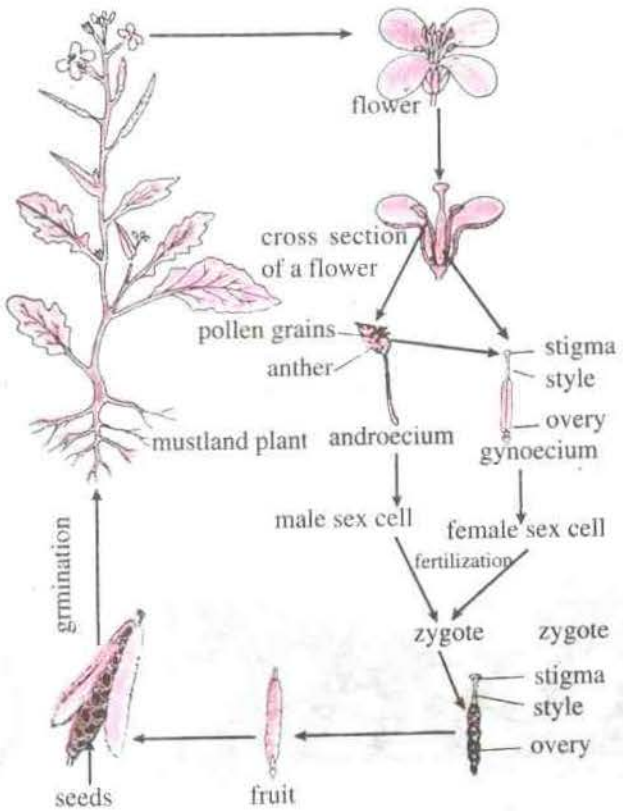


Fig. No. 14.15 life cycle of a mustard plant

When the required amount of warmth, light, water and air are recieved by the seed, it germinates to form a new mustard plant. In this way life cycle starts from a mustard seed. In a fully developed plant, flower turns into fruit and seeds. From the seeds new plants grow. In this way, life cycle of a plant is completed.

Activity 7

Collect some mustard flowers and identify the different parts. Use forceps to seperate petals, sepals, male organs and female organs. If possible study the parts with the help of a magnigying glass or dissecting microscope.

Classification of Plants

We can find different types of plants on the earth. From small microscopic plants to huge trees fall under the plant kingdom. In terms of flowers, the plant kingdom can be divided into two sub-kingdoms.

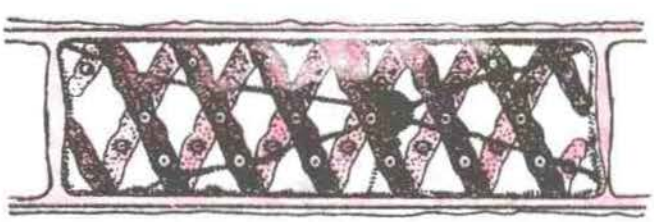
(1) Cryptogams ie non flowering plants.
(2) Phanerograms ie flowering plants.

Cryptogams

The least developed plants fall under this category. There plants do not bear flowers or seeds. According to the development level, the subkingdom is divided into three division.

1) Division-Thallophyta

* It includes unicellular or multicellular simple plants.
* The plant body cannot be differentiated into roots, stem and leaf.
* Both green and non-green plants fall under this category.



Spirogyra

Chlamydomonas

Fig. No. 14.16

a) Sub-division-Algae

* The plants are green as they contain chlorophyll. They carry out photosynthesis.
* They are found in water or moist places.
* We need microscope to view them properly.
* Unicellular chlamydomonas and multicellular spirogyra fall under this subdivision.

Activity 8

Put a drop of water in the middle of a clean glass slide. Now lift a filament of spirogyra with the help of a tooth pick and put it on the water slide. If possible put a drop of safranin or red ink and cover it with a cover slip. Observe it under the microscope and draw what you see.

b) Sub division- Fungi

* Chrolophyll is absent in the plants.
* They are usally white, grey or black in colour.
* Since they are unable to prepare their own food, they are saprophytic in nature.

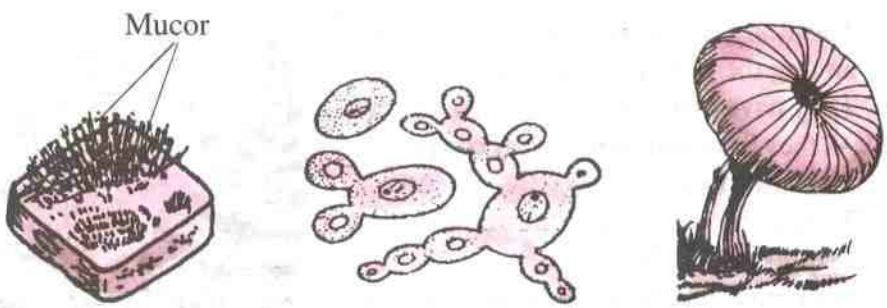


Fig. No. 14.17

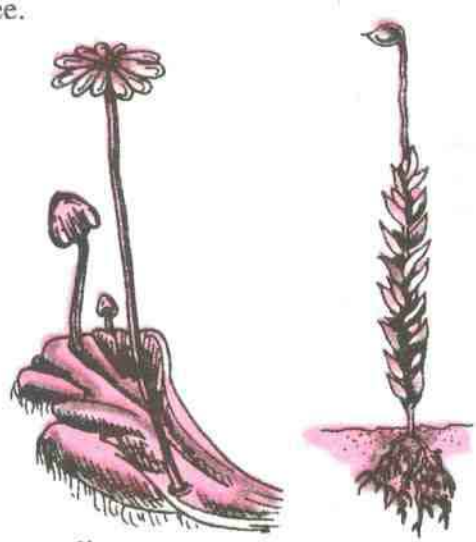
Mucor, Yeast and mushroom are the plants which come under this sub-division. We can view mushroom with our eyes where as to view mucor and yeast we need a microscope.

Activity 9

Take a piece of bread or the skin of an orange. Moist them and keep it in a warm place. After few days, you can see few black spots on them. View them with the help of a magnifying lens and draw what you see.

2) Division- Bryophyta

* Plants under this are multicellular and consists chlorophyll.
* They grow in moist places and as they require water for reproduction, they are also called Amphibian plants.
* They have Rhizoids to absorb food, minerals, water and make them able to fix and stand on the ground.

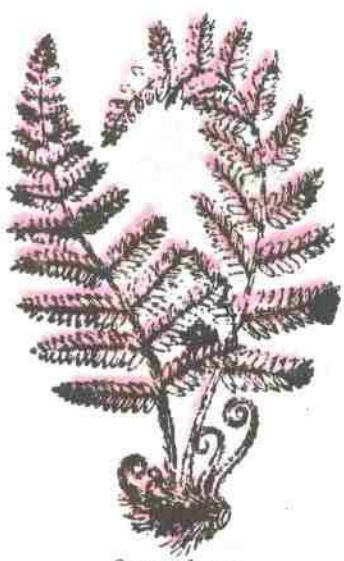


liver worts moss

Fig. No. 14.18

3) Division- Pteridophyta

* These are the advanced form of plants among the non-flowering plants.
* They have distinct root, stem and leaves.
* As they have chlorophyll they can prepare their own food.
* They differ very widely in size and grow in moist and cold places.
* Fern, pani amala are examples of plant under this division.



fern plant

Fig. No. 14.19

Activity 10

Look around the shady and moist wall or grounds of your home or school buildings. If you find liverwort, moss or fern bring them to your classroom and draw their picture.

Phanerograms

This sub-kingdom includes advanced plants. They are flowering plants. They bear flowers or cones. They are categorised into division depending upon whether they bear flowers or cones.

1) Division Gymnosperm

* They have cones instead of flowers. As they don't have proper fruits, seeds are bare.
* The plants range from a medium to a very large size.
* Leaves are needle-shaped.
* They are found in dry places.
* Pines and cycas fall in this group.

Cycas

Pine

Fig. No. 14.20

2) Division Angiosperm

* These plants have flowers.
* These plants bear seeds that are enclosed in fruits.
* They range from small, medium to large trees.
* They are found in both aquatic & terrestial habitat.

Angiosperm is sub-divided according to the number of cotyledons present in the seeds.

a) Monocotyledonous plants

* They have fibrous roots.
* They have long and narrow leaves with parallel venation.
* They have a single cotyledon or seed leaf.

Rice, wheat, maize, bamboo, onion etc are its examples.

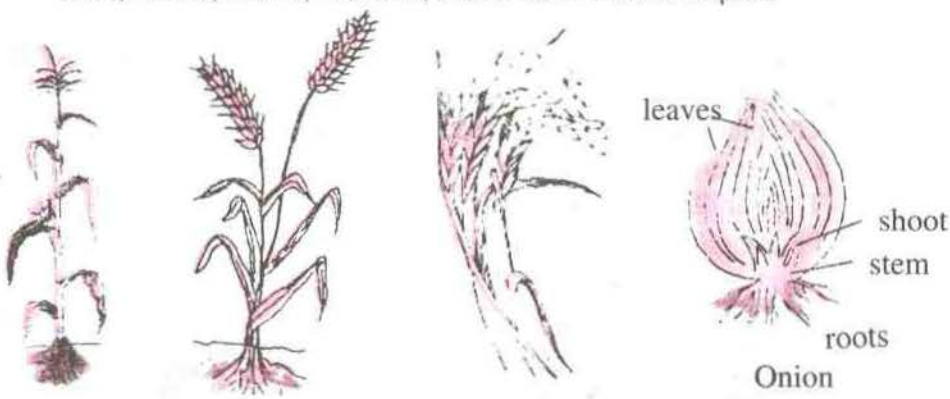


Fig. No. 14.21

b) Dicotyledonous plants

* These plants have tap root.
* They have wide leaves with reticulate venation.
* Two cotyledons are present in the seeds.
* Pea, mustard, mango, lemon, orange etc are its examples.

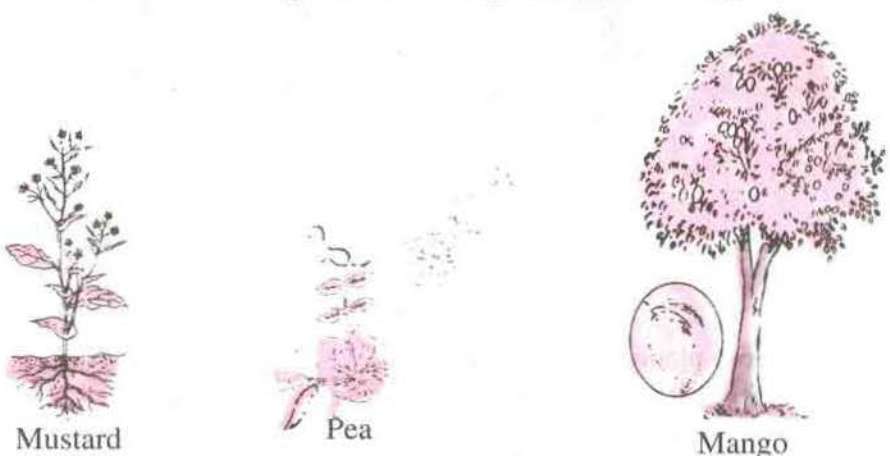


Fig. No. 14.22

Activity 11

Observe the following plants and fill in the table

Plants Name	Type of root	Shape of leaf	Venation	Seed leaves (cotyledous)
Rayo	Tap root	wide	reticulate	dicot
onion				
pea				
maize				

Inverterbrates

Around us there are different types of animals. Cow, buffalo, dog, goat, bird, fish etc all have vertebral column.

Animals like mosquito, housefly, bee, earthworm etc don't have vertebrae. Unicellular organisms like amoeba, paramecium etc also belong to the group of invertebrates.

Animals who donnot have vertebrae are divided into nine phyhum.

Phylum 1 - Protozoa

- The protozoans are microscopic unicellular organisms.
- They are mostly found in water. Some even live in damp soil.
- Micro organisms like malarial parasites are parasitic in nature. They live in the bodies of other animals.

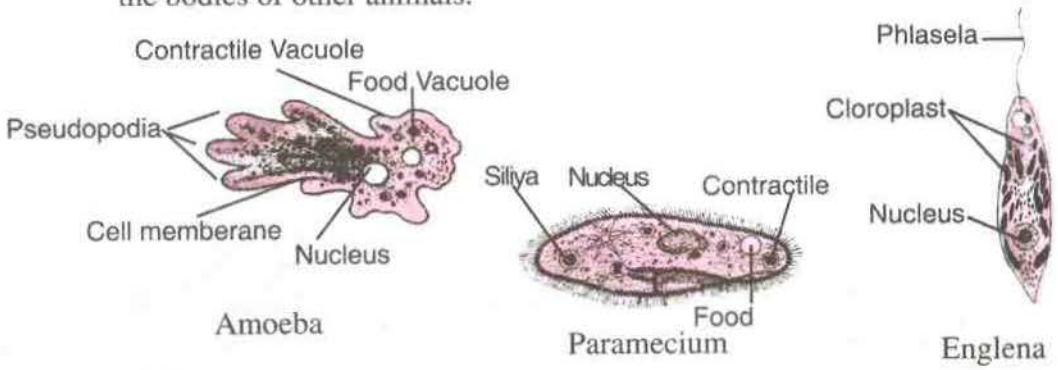


Fig. No. 14.23

Some protozoans like euglena, volvox contain chloroplast and are capable of manufacturing food (carbohydrate) by themselves.

Amoeba causes cholera, dysentry whereas malarial parasite causes sleeping sickness.
Examples: amoeba, paramecium, euglena, malarial parasite, plasmodium etc.

Phylum 2- Porifera

- Multicellular animals belong to this phylum.
- They are the sponges which have numerous pores in their body.
- Mostly, the sponges are found in sea water and some are found in the fresh water.
- The organism in adult stage get fixed to a place or substratum and are immovable.
- They have hollow bag like body with numerous pores in them.
- The water enters the body through these pores. Excess water passes out from osculum, which is a large opening at the free end in their body.
- They depend on the micro-organisms which enter into their body along with the water.
- The presence of fibres, calcium and silicon make the sponge body hard and strong.

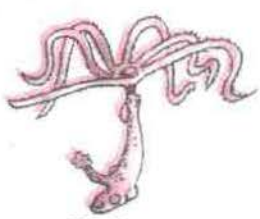
Sponge group
Fig 14.24

Example: sponge, sycon etc.

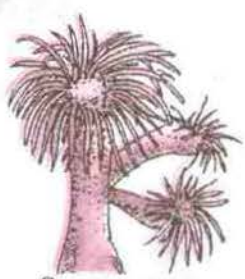
Phylum-3 Coelenterata

- This phylum includes multicellular and marine animals.
- They have hollow cylindrical body with a single opening to the exterior and have an opening which serves for both ingestion & egestion of food.
- They have digestive canal inside their body which contains a hole that acts as a mouth or an exit.

Coral



Hydra



Sea anemore

Fig. No. 14.25

They have stinging cells in them. They sting their enemies and make them unconscious.

Examples: Coral, sea anemone, jellyfish, hydra etc.

Phylum 4- Platyhelmenthes

The animals with flat bodies fall under this phylum. So, they are called flat worm as well.

- They have soft, dorsoventrally flattened and elongated body.
- They are hermophrodite i.e. having both the male and female reproductive organs in the same individual.
- There is a small head at the anterior end.
- Most of the animals are parasitic in nature.

Liver Fluke

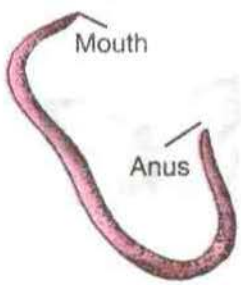
Tapeworm

Fig. No. 14.26

Example: liver fluke and tapeworm.

Phylums 5 - Nemathelminths

- They have cylindrically elongated and unsegmented body.
- Some are parasitic in nature whereas some are found independantly in the soil and water.
- They are unisexuxal animal i.e. the sexes are separate.
- They have both the mouth and anus.



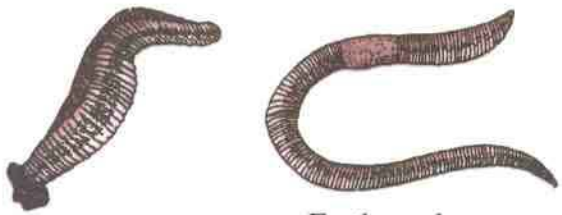
Round worm

Fig. No. 14.27

Example: Ascaris (round worm)

Phylum 6 - Annelida

- The annelids have elongated cylindrical and segmented body.
- They are found in the water or in the moist soil.
- They have developed blood circulatory system and nervous system to some extent.
- Annelida like leech are parasitic in nature.
- Respiration takes place through their skin.



Leech Earth work

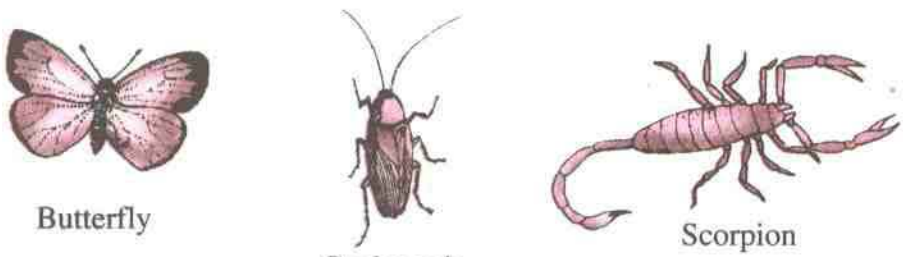
Fig. No. 14.28

- Some animals are unisexual and some are bisexual eg: earthworm is a bisexual animal.

Examples: Earthworm, leech.

Phylum 7 - Arthropoda

- The animals with jointed appendages are included in this phyhum.
- The body is covered with hard exoskeletion.
- These animals are found in air, water and land.
- Same insects like bed bug and flea are parasitic in nature.
- Their body is divided into three segments head, thorax and abdomen. The legs arise from the thorax.
- There is presence of wings in the thorax of some arthropods. In some insects the wings are present just for a certain period of time only.



Butterfly Cockroach Scorpion

Fig. No. 14.29

- The animals are unisexual i.e. the sexes are seperate.
- The animals have compound eyes in their head. They can easily distinguish daylight & darkness.
- They breathe through spiracles which are the tiny holes present at the extreme side of the abdomen.
- They have mandibles and some bare proboscis.

Examples:- fly, butterfly, bee, flea, bedbug, beetle, cockroach, scorpion, spider, ant, gnats, grasshopper etc.

Phylum-8 Mollusca

- They have soft body usually protected by a hard covering or hard shell made up of calcium.
- The animals are found in fresh water, sea or land.
- Animals like octopus lacks hard shell.
- They move from one place to other with the help of muscular foot.

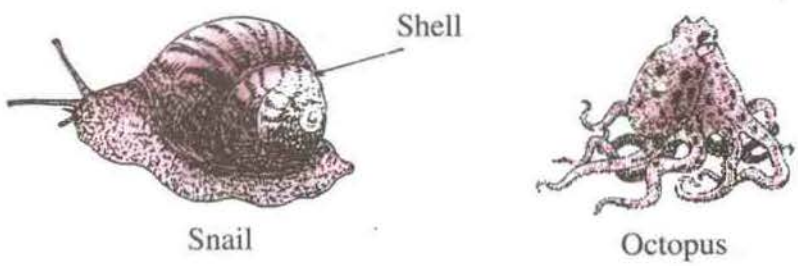
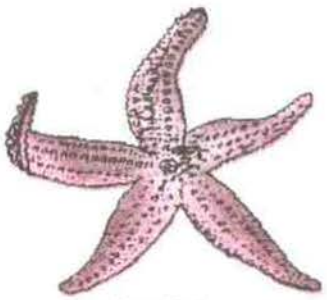


Fig 14.30

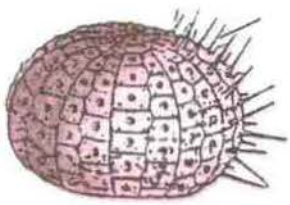
Examples:- Snail, Octopus, cuttlefish, squid etc.

Phylum - 9 Echinodermata

- They have soft body protected by hard spiny covering.
- Their body can be segmented into five parts.
- They have both mouth and anus.
- They are found in ocean only.
- The cover of the body is rough and made of calcium.



Starfish



Sea urchin

- Most of the animals move with the tube feet projected from their body.

Fig. No. 14.31

Example:- Starfish, Sea Urchin

Summary

1. In Nepal, various types of plants are found in different geographical regions. Due to this variation, we can find sal, sisau, emli in the Terai whereas trees like katus and banjh are found in the hill. Bhojpatra and thingure sallo (pine) are found in the himalaya.
2. There are about 844 species of birds, 184 species of fish and 181 species of mammals.
3. We can find about 800 species of herbs in Nepal. The country can be benefitted if only these herbs are utilized propertly. More money can be earned by exporting these herbs to foreign countries.
4. Varieties of animals are found on different geographical regions. Animals like wild fowl, pecacock, dove, elephant, rhinoceros, tiger etc are found in the Terai whereas animals like boar, jackal, bear, pheasant etc are found in the hilly region. Similarly musk deer, naur, lophophorus, pheasants etc are found in the himalayan region.
5. Different kinds of animals are in the verge of extinction eg. snow leopard, hispid hare, crane, lophophours and gharial crocodile etc.
6. Overuse of the forest products such as wood & timber herbs and fodder has lead to the depletion of forest. As a result, habitat of the wild life is being destroyed and the existence of wild life is threatned.

7. For the conservation of these animals, 8 national parks, 4 reserves, 1 hunting reserve and 2 conservation areas have been set up in Nepal. So, there are 15 areas where animals are protected.

8. Among the different phanerogams, mustard is one of them.

9. The process of transfer of pollen grains by wind, water, insects etc. from anther to the stigma of the same or different flower is known as pollination.

10. The process of the fusion of male gamete and female gamete is known as fertilization. After fertilization, the seed is developed. The seed contains an embryo, which is also called as future plant.

11. The plants can be classified into two subkingdoms. They are- crytogams and phanerogams.

12. The cryptogams can be further divided into three divisions. They are:- Thallophyta, Bryophyta and Pteridophyta.

13. The phanerogams can be divided into two divisions they are:- Gymnosperm and Angiosperm.

14. The invertebrates are classified into 9 phyla. They are as follow:

    a) Phyhum Protozoa- unicellular animals eg. amoeba paramecium etc.
    b) Phylum Porifera- having numerous pores in the body eg. sponge.
    c) Phylum Coelenterata - cylindrical shaped animals eg. hydra, jellyfish etc.
    d) Phylum Platyhelminthes - animals with flat bodies, eg liver fluke, tapeworm etc.
    e) Phylum Nemathelminthes- round worm eg. ascaris, hookworm etc.
    f) Phylum Annelida- body is segmented eg. earthworm, leech, etc.
    g) Phylum Arthropoda- animals with jointed appendages eg. fly, mosquito, butterfly etc.
    h) Phylum Mollusca- soft body with hard shell covering eg. snail slug etc.
    i) Phylum Echinodermata- having hard cover on their body. eg. starfish, sea urchin etc.

Do, Observe and learn

1. Observe the plants found around your place and write their names.
2. Write down about the uses of the forest products found in your area.
3. Collect pictures of invertebrates. After collecting pictures of the animals belonging to different phyla present them in a tabular form with their diagram and names.

Exercise

1. Fill in the gap with suitable word.

a. According to geographical regions different types of _____ found.
b. In the high himalayan region bhojpatra, _____ etc plants are found.
c. Due to lack of alternative energy more _____ has been destroyed.
d. The forest is the _____ of wildlife.
e. In terai, harro, barro, sal, _____ are found.

2. Put a tick ✓ mark for right and a cross × for wrong statement.

a. In the forest of Nepal more than 1000 wild life are found.
b. The main objective of wild life conservation is to protect the wildlife.
c. In terai, wild life like fox, black buck are found.
d. In the northern himalayan region, animals like tiger, leopard etc. are found.
e. Deferestation helps increasing wildlife.

3. Identify the mdeicinal herbs found in your area and write down their uses

4. Write down the differences between

(a) cereals and pulses
(b) Self pollination and crosspollination.

5. Give reason:

(a) There is a close relation between forest and wildlife.
(b) Human activites have made the existence of wildlife difficult.

6. Answer the following questions:

(a) What is the cuase of deforestation?
(b) What should be done to protect forest?
(c) What types of medicianal herbs are found in Nepal?
(d) Explain the importance of medicinal herbs.
(e) What steps have been taken to conserve wildlife?
(f) Explain the life cycle of the mustard plant.
(g) What are subdivisions of cryptogams?
(h) What are the characters of the plants belonging to the group pteridophyta?
(i) To which, subkingdom, division and subdivision, does the mustard plant belong to?

7. Identify any five invertebrates found in your home area and classify them in their respective phylum with reasons.

8. Into how many phylum are the invertebrates divided? Write down the names of phylum with two eharacteristics each.

9. Write down two characteristics of the following:
(a)Porifera (b) coelenterata (c) Mollusca (d) Nemathelmenthis
(e) Echinodermata

10. Name the phylum to which the following animals belongs to.

amoeba, hydra, sponge, jellyfish, liverfluke, tapeworm, earthworm, ascaris (roundworm), ant, cockraoach, snail, starfish.

11. What do you understand by the term hermaphrodite? Which group or type of animals belong to it?

Cell

The bodies of every plant and animal are made up of cells. As the cells are microscopic, they cannot be seen with naked eyes. To observe it an instrument called microscope is used. A normal cell contains nucleus, cytoplasm, cell membrane or cell wall. Different types of cells are made up of different materials.

Plant Cell

a) Cell Wall

The outer covering of a plant cell is thick and strong. That is why it is called cell wall. It is made up of cellulose. Celluose is also a type of carbohydrate. So, a cell wall is made up of non-living substance. It's stiffiness (hardness) increases as the cell grows older.

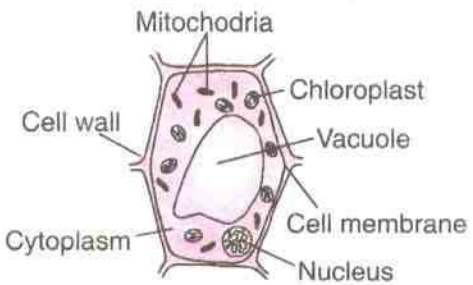


Fig. No. 15.1

Functions:

1) Gives shape to the cell.
2) Protects cell membrane and other internal parts.
3) Water, minerals, salts and other necessary nutrients for cell get into the cell through tiny holes in the cell wall and the unnecessary substances get out of the cell through the cell wall.
4) Maintains the amount of water in the cytoplasm.

b) Cell Membrane

Plant cells are bounded by a thin cell membrane. In a cell, the cell membrane is a living substance.

Functions:

1) It gives a fixed shape to cell.
2) It protects cell's internal parts.
3) It helps taking in outer substances which are important for the cell and by releasing unnecessary substances.

C) Cytoplasm:

Cytoplasm is one of the vital parts of a cell. A newly formed plant cell is full of cytoplasm. In a mature plant cell, the space between vacuole and cell membrane is filled up by cytoplasm.

The cytoplasm is a transparent and semiliquid substance. It is like the white portion of an egg. It is a living substance. It shows reactions towards outer stimulations. Seventy to ninty percentage of it is water. Important substances such as proteins, fats, carbohydrates and minerals make up the cytoplasm. Along with mitochondria many other substances are present in the cytoplasm. When the amount of water in the cytoplasm decreases it gets dried up and the cell dies. Mitochondria carries out respiration.

Many activities such as respiration, nutrition, growth and reproduction are carried out by substances present in the cytoplasm.

Functions:

1) Endoplasmic reticulum increases cell's area for metabolism.
2) Ribosome synthesizes protein.
3) Motochondria stores energy for all types of cell activities.

d) Vacuole

Most portion of a plant cell is occupied by a vacuole. It is present in the plant cell on a permanent basis. Even though a vacuole appears empty, it is filled with water, minerals, salts, glucose and other substances. There may not be a vacuole in a new cell. The size of vacuole increases in proportion to the increment in the size of the cell. A completely developed cell possesses a big single vacuole.

Functions:

1) Maintains turgidity of the cell.
2) Maintains the amount of water in the cell.
3) Maintains the amount of glucose.
4) Stores waste materials of cell.

E) Nucleus:

A spherical structure inside cytoplasm is called a nucleus. Protoplasm found in the nucleus is called nucleoplasm. In a nucleus, thread like structures are found. They are called chromosome. Chromosome number depends on the plant species. Cell division is carried out by the nucleus. It takes direct participation in reproduction. Hereditary characters are also carried by the nucleus. Father's and mother's characters get transferred on to their offsprings by chromosomes present in the nucleus.

Like some unicellular plants, nucleus is absent in bacteria and viruses but chromatin substances are present which act as nucleus.

Functions:

1) Plays direct role in reproduction.
2) Takes part in cell division.
3) Performs other activities inside the cell.

f) Plastid:

Plastids are found only in plant cells. They are of different shapes like oval and round. They have ability of division. According to colour, plastids are classified into three types they are: a) leucoplast b) chromoplast and c) chloroplast.

a) Leucoplast:

It is a colourless plastid. There are no coloured pigments in it. It stores starch and usually found in roots. It is abundantly found in potatoes.

b) Chromoplast:

It is a coloured plastid. The coloured pigments are such as yellow, orange, red, etc. They are usually found in flower petals and in fruit.

c) Chloroplast:

Green coloured plastids are called chloropasts. Green coloured pigments called chlorophyll are found in these chloroplasts. These chloroplasts are found in most parts of the plant where the rays of light falls, like leaves. Green coloured and other coloured plastids are also found in leaves and unriped fruits but these are not visible in chloroplasts due to the dominance of green colour.

Activity 1

Pluck some green tomatoes and green chillies and keep them in a room. Observe how their colour changes slowly. They become ripe slowly and the green colour disappears and changes in to red.

Animal Cell

(a) Cell membrane

Animal cell doesn't have a cell wall. It has cell membrane only. The cell membrane is a living material. Water and different gases pass through it. Cell membrane is made up of protein and lipid. Cell membrane of an animal cell works similarly as the cell membrane of a plant cell.

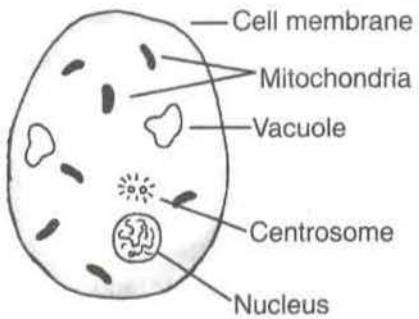


Fig. No. 15.2

(b) Cytoplasm

The protoplasm lying outside a nucleus is known as cytoplasm. Maximum portion of a cell is covered with cytoplasm. Plastid is absent in the cytoplasm of an animal cell. Therefore, animals can't make their food on their own. Its structure and functions are similar to that as in a plant cell.

(c) Vacuole

Vacuoles present in animal cell are small. Its structure and functions are as in a plant cell.

(d) Nucleus

Nucleus lies around the center of a cell. Threadlike structure made from chromatin material are found inside the nucleus. They are called chromosomes. The nucleus of an animal cell works similarly as in a plant cell.

(e) Centrosome

There is a centrosome near the nucleus in an animal cell. Cell division starts from this centrosome. Centrosome divides to form two centrioles. Centrosome is absent in plant cells.

Different chemical and physical activities conducted by animals and plants are actually carried out by cells. If the cells die, these activities cannot be carried out. The body of living organisms is made up of cells. Some living organisms are made up of only one cell. The existence of living organisms is not possible without cells. Therefore, a cell is called the unit of life.

Amoeba

Amoeba is a unicellular animal. Its body is made up of only one cell. Like other organisms, amoeba also carries out all the functions like nutrition, digestion, excretion, respiration, etc. and conducts life processes independently.

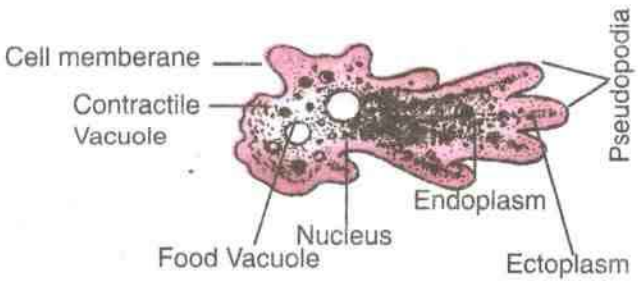


Fig. No. 15.3

Structure

Amoebae are very small. They cannot be seen with naked eyes. As they are colourless and transparent, it is difficult to see them even through a microscope.

Amoeba sends out and with draws finger like false feet called pseudopodia from its body. Due to this, the shape of its body changes frequently.

Amoeba's body is covered with thin cell membrane. Protoplasm lies inside it. Oxygen, carbondioxide, water, etc. pass through the cell membrane. Protoplasm in the outer part is called ectoplasm and in the inner part, it is called endoplasm. There are two types of vacuoles in the protoplasm and they are contractile vacuole and food vacuole. There are excretory substances in contractile vacuole. Occasionally, contractile vacuole moves towards the side. When it reaches near the cell membrane, the excretry substances are thrown out of the body. There are food substances and water in a food vacuole. Digestive juice secreted by protoplasm digests the food. The digested food is absorbed by the protoplasm itself.

There is a round nucleus in endoplasm. There are chromatin materials in it. Nucleus carries out the functions of growth and reproduction.

Where are amoebae found?

There are many kinds of amoebas. Some are found in water while others are found in soil. Entamoeba histolytica, a type of amoeba is found in human intestine. It is a parasitic amoeba. It causes dysentry. These amoebae enter our body when we drink polluted and unsafe water.

Effects of amoeba on human beings.

All types of amoebas are not harmful to human beings. Although entamoeba coli is usually found in the large intestine of human beings, they are not harmful. They stay there and consume the undigested food which has reached the large intestine. Another type of amoeba of histolitica found in intestine attacks the walls of intestine. Therefore, they are the main human parasites. They cause dysentry. A person suffering from the disease faces problems like diarrhoea and weakness. These amoebae enter our body if we drink polluted and unsafe water or when we have contaminated food by flies.

Summary

1. Plant cell is covered with cell wall. Animal cell is covered with thin cell membrane only.
2. Cell wall is made up of cellulose. Cell membrane is made of protein and lipid.
3. Plastid is found in plant cell. Chlorophyll lies inside the plastid. Animal cell doesn't have plastid.
4. Plant cell doesn't have centriole but animal cell has.
5. Protoplasm conducts physical and chemical activities in a cell.
6. Nucleus carries out the function of cell division and reproduction. It also transfers the hereditary characters to the offsprings.
7. Cell is the unit of life.
8. Amoeba is a simple unicellular animal.
9. Amoeba is either independent or parasitic.
10. Amoeba is a very small, colourless and transparent animal without a definite shape.
11. All the life processes of amoeba like nutrition, excretion, respiration, reproduction, etc. are carried out by a single cell.
12. Entamoeba histolytica, a type of amoeba, causes dysentry.

Do, Observe and Learn

1. Boil an egg. Peel off its shell. Cut it into two equal halves. Draw its picture and write which parts can be compared with nucleus, cytoplasm and cell membrane.

2. Uproot a small healthy plant. Keep it in sun for sometime. Now, write about the change in the condition of the plant? Write why did the plant wilt? What is the relation between drying of the plant and the cytoplasm inside the nucleus? Write.

3. Use thread, beads, beans, pulses to represent different parts of amoeba. Using gum, paste them on a thick paper and make a model of an amoeba.

Exercise

1. Answer the following questions:

(a) Write four differences between plant cell and animal cell.
(b) Write two differences between cell wall and cell membrane.
(c) Is it necessary for a cell to have a nucleus? What happens if there is no nucleus?
(d) Why is a cell called the unit of life?
(e) What is the function of a vacuole in plant cell?
(f) What is the function of the contractile vacuole in an amoeba?
(g) How many types of plastids are there? Where are they found?

2. Draw a well-labelled diagram of:

(a) Plant cell
(b) Animal cell
(c) Amoeba

Unit 16

Life Process

Protoplasm

Protoplasm is understood as a substance found in living organisms. Living substance or protoplasm is found in cells. Purkinje was the first scientist to do research on protoplasm.

Protoplasm is translucent, generally colourless and appears light grey or brown in colour. Its chemical composition is very complex. Though the chemical composition of protoplasm of a cell is different from another cell, the protoplasm is made of different substances. Elements like Oxygen, Carbon, Hydrogen, Nitrogen, sulphur, Iron and phosphorous are present in the human body in the form of carbohydrate, fat and minerals in aqueous form.

In human body, 65% weight is constituted by oxygen, 18% by carbon, 10% by Hydrogen, 3% by Nitrogen and remaining 4% by other chemicals.

During the life span of every living being different processes are being carried out. Digestion, respiration, movement, reproduction and other life processes are carried out by the protoplasm.

Need and Importance of Protoplasm

Important and complex activities of any living being is carried out inside the protoplasm. The activities carried out inside the living cell are known as metabolism. These activities include respiration, digestion, excretion, growth, excretion, sensitivity, circulation, reproduction, coordination and others. During metabolism some chemical changes occur due to which protoplasm is created and destroyed.

Protoplasm is formed when green plants containing chlorophyll prepare food by photosynthesis. This formation of protoplasm is called anabolism. (Its detail description is given in unit 17). During internal respiration in living cells oxygen and carbohydrate with the help of different enzymes, are borken down and protoplasm decomposes. This decomposition is known as catabolism. (Its detail description is done in unit 17).

Anabolism and catabolism need to be carried out continuously in the protoplasm for the survival of a living organism, these processes are jointly called metabolism. This process is of utmost importance for the existence of living organisms. The protoplasm plays a vital role in conducting life processes.

Transport System

In every living organisms, unicellular or multicellular, nutritious substances and unwanted substances have to be transported from one place to another that means in cells, activities like taking in of oxygen, food materials, etc. to different parts of the body and removal of carbondioxide and unwanted substances are necessary.

Transportation in Developed Animal.

Transport of oxygen, water and food substances including other different substances and removal of carbondioxide and other substances after matabolism from the cells of developed animals is done by the transport system. Blood plays a vital role in this process.

Transportation in unicellular organisms

Amoeba, paramaecium, clamydomonas and other unicellular organisms receive food by the movement of cytoplasm whereas exchange of gases is being done by diffusion. Digested food materials is also excreted by the process of diffusion.

Transportation in Plants

In developed plants, tissues join together to work as tubes. These tubes transport materials. Xylem tissue transports water and minerals absorbed by the roots via stem to leaves whereas phloem transports food materials prepared in the leaves to different parts such as roots, stem, flower, fruit, etc.

Activity 1

Take a fresh-cut leaf with a stalk or white flower a stalk with. Dip the stalk in the beaker or glass containing water. Put 2-3 drops of red ink in the water and leave the beaker undistubed for 1 day. Later, you will observe red colour in leaf or in the flower spreaded in all directions. What did you understant from the activity?

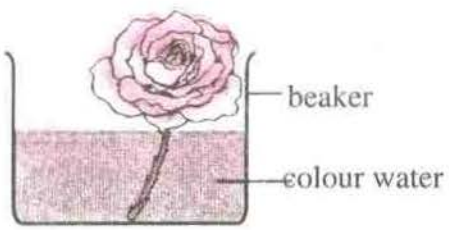


Fig. No. 16.1

Blood circulatory System

The process of carrying necessary materials such as oxygen, nutritients, hormones etc, to different parts of living organisms and removing unwanted materials and taking them to excretory organs is carried out continuously by the process known as

transportation. Transportation is simple in unicellular organisms whereas complex in multicellular organisms.

Blood circulates in the developed animals. The blood transport necessary substances to different parts of the body and removes unwanted substances and transport to exeretory organs.

Blood

The blood is composed of plasma and blood cells. Yellow coloured, transparent liquid plasma contains highest percent of water as well as other substances like protein, fat, minerals and carbohydrate. Plasma absorbs and transports all nutritious materials except oxygen to different parts of the body. Similarly, plasma controls the amount of water in blood, helps in blood clotting in wounds and protects the body from infective mocirobes or pathogens.

Blood also contains blood cells other than plasma. Blood cells are of three types: red blood cells (RBC), white blood cells (WBC) and platelets.

Red blood cells are found in larger number than other blood cells in blood. The red blood cells are very small and donot have nucleus. They contain haemoglobin due to which the cells are red. Haemoglobin absorbs oxygen from the lungs. The blood cells are formed in bone marrow. Anaemia is caused due to lack of red blood cells in humans.

White blood cells are colourless and are bigger than Red blood cells. They contain nucleus and donot have a definite shape. They are also formed in bone marrow. White blood cells combat and destroy disease causing microbes.

Platelets are small cells and they lack nucleus. They donot have definite shape. They help to clot the blood in cuts and wounds. They are also formed in the bone marrow.

These are the parts which are involved in the circulatory system of human body.

(i) heart (ii) veins
(iii) arteries (iv) capillaries.

Heart

Heart is an important organ of our body. The heart does the job of transporting all the pure blood to different parts of bodies through capillaries, and taking away all the impure blood to the lungs from all the cells of the body. During this the different food materials and waste materials also get transported.

Heart is a strong muscular pumping organ situated between the two lungs of our body slightly towards the left. The heart is enclosed in a thin memberane called the pericardium and a thick and transparent fluid present in between them is called the pericardial fluid. This fluid protects the heart.

The heart has four chambers. They are:

(i) right auricle
(ii) left auricle
(iii) left ventricle
(iv) right ventricle.

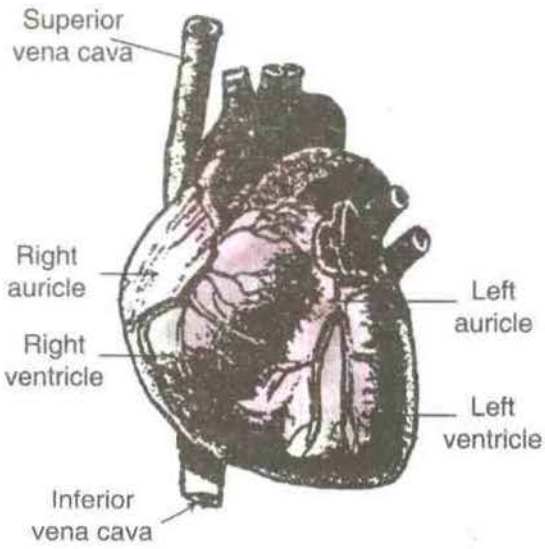


Fig. No. 16.2

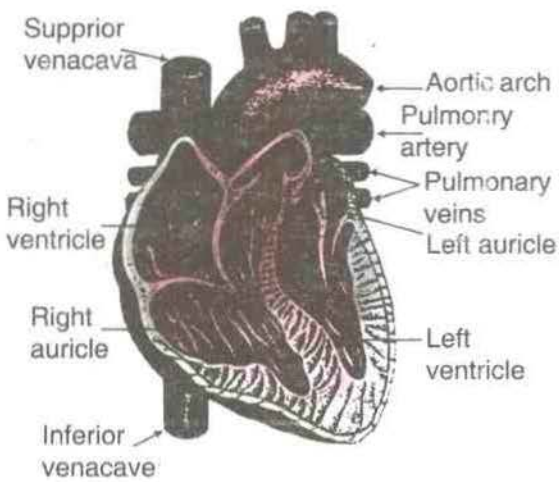


Fig. No. 16.3

The right auricle is situated above the right ventricle. Similarly, the left auricle is situated above the left ventricle. The left and right chambers are separated by a wall. In the chambers in the right side, impure blood is brought from throughout the body is collected, whereas towards the left oxygenated blood is collected. There is rhythmic motion of contraction and relaxation in the muscles of the heart. This motion is called the beating of the heart. Due to this motion the heart can pump the blood and approach it to different parts of the body. In the process of pumping blood, the blood can go from the auricle to the ventricle, but it cannot return back to the auricle from the ventricle. This is due to the valve that is situated between the auricle and ventricle and which lets blood flow through one way only. Similarly, valves are present in the parts of the heart where from blood leaves the heart.

Blood vessels.

When the heart pumps the blood the blood reaches to different parts of the body through blood vessels. These blood vessels are of three types:

(i) arteries
(ii) veins
(iii) capillaries

The arteries devide into small arterioles when they reach into the different parts of the body. These arterioles too, further divide into small capillaries. These blood vessels transport oxygenated blood and food to the cells. Arteries are spreaded in the inner parts of the skin, and are made up of thicker muscles than of the veins. The vessels that collect blood from different part of the body and bring it to the heart are called veins. Half of the cappillaries bring blood to the heart from different part of the body whereas half of the capillaries carry the blood brought by the arteries to the cells of the body.

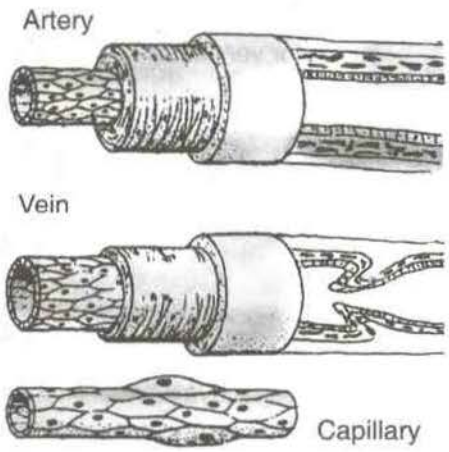


Fig. No. 16.4

Activity 2

Study of the heart

1. Bring a heart of a goat from a butcher's place and examine the external parts.
2. Cut the heart carefully along it's length: Now study the auricles and the ventricles.
3. Compare the thickness of the muscles of the right ventricle and left ventricle.
4. What are the big vessels joining to the heart? Find out.

Circulation

The impure blood its brought to the right auricle throgh the veins and then it goes to the right ventricle. From the right ventricle it reaches the lungs via the pulmonary artery and in the lungs the gaseous exchange takes place- blood gives away its carbon

dioxide gas co_2 and takes in oxygen gas. The oxygenated blood reaches left auricle through pulmonary viens. The blood comes to the left ventricle from left auricle. The heart pumps the blood to the rest of the body. Now the blood is transported to different parts of the body comesback to the right auricle through venules.

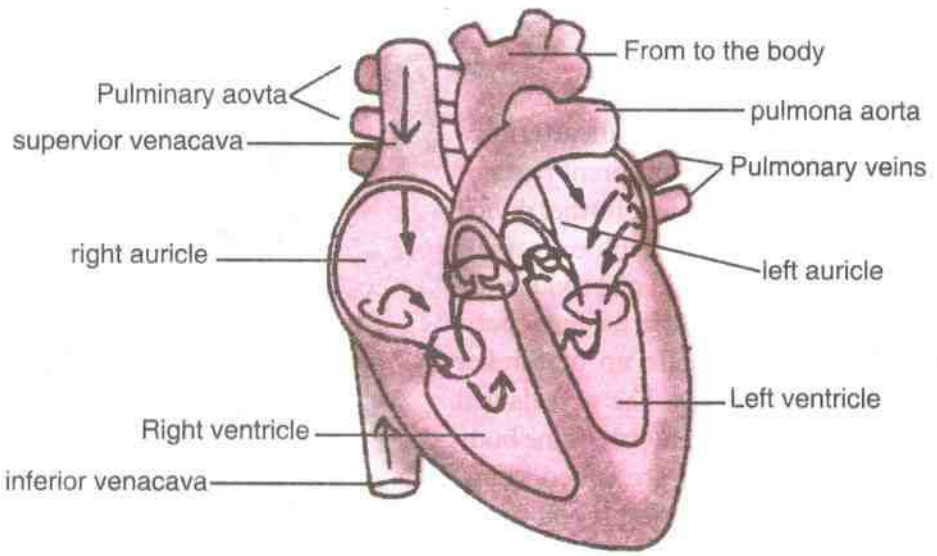


Fig. No. 16.5

Reproductive System

Reproduction is the process by which living beings of one generation produce the next generation of their own kind. Had there been no reproduction, continuation of a race would have been impossible.

Reproduction takes place in all from primitive uni-cellular. Organisms to advanced species. Reproduction in organism is of two types:

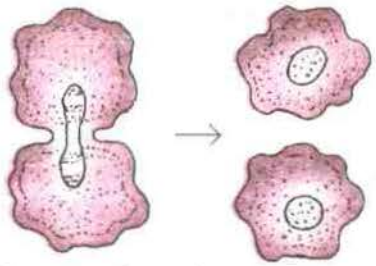
(i) asexual
(ii) sexual

Asexual reproduction:

The reproduction that takes place without the fusion of male and female gametes is called asexual reproduction. Primitive unicellular organisms reproduce by dividing their body from one to two, from two to four and so on. This process is called fission.

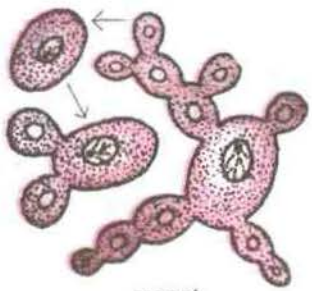
Organisms like amoeba, bacteria, paramecium, spirogyra reproduce by this process.

Similarly other plants and animals also reproduce asexually. In the organisms like hydra and yeast the formation of bud takes place. It develops gradually and after the complete development of a bud, it detaches from the parent body and grows into a new offspring. This process of asexual reproduction is budding.

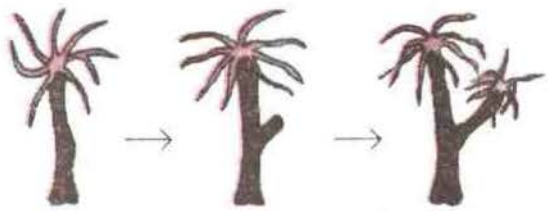


mother amoeba daughter amoeba

Fig. No. 16.6



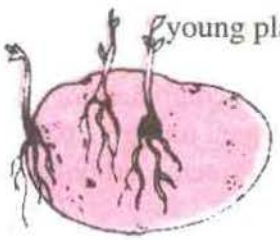
yeast



hydra

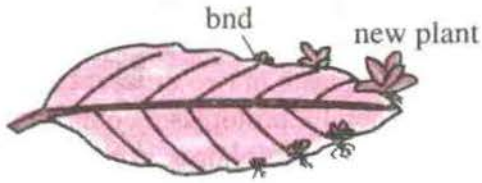
Fig. No. 16.7

Simple plants like mucor, moss etc contain spores. Mature spores germinate in a favourable condition and form new plants. Such asexual reproduction is called sporulation.



potato

onion



leaf of bryophullum

Fig. No. 16.8

Some developed plants form new plants from their different parts like roots, stem and leaves. Such process is called vegetative propagation. Sweet potato and Dahlia have vegetative propagation through roots. Potato, ginger, rose have propagation by stem cuttings. Similarly Bryophyllum propagates through leaves.

When animals like tapeworm and hydra are cut into two or more than two parts each fragment develops into a completely new animal. This process is called regeneration.

Sexual Reproduction.

The process which involves the fusion of sperm and ovum to produce offspring is called sexual reproduction. Most of the animals and developed plants have sexual reproduction. In most of the developed organisms male and female are seperate or in other words male and female sex organs are in different individuals. Such organisms are called unisexual organism. Human, bird, frog, pumpkin, papaya are some examples of this type.

In most of the developed plants and organisms sperm and ovum develop in the same organism. Such animals are called bisexual or hermaphrodite organism. Mustard, buckwheat, earthworm, hydra and so on are some examples of bisexual organisms.

In sexual reproduction sperm and ovum fuse together. This process is called fertilization. There are two types of fertilization in animals and they are: external fertilization and internal fertilization.

The fusion of sperm and ovum outside the animal body is called external fertilization. Example: Fish and frog. The fusion which takes place inside an animal body is called internal fertilization. Example: Human beings, birds, mammals.

After fertilization the zygote develops into an embryo which later develop into an offspring or baby.

Summary

1. A light grey coloured and translucent liquid present inside a cell is called protoplasm.
2. Protoplasm in two different cells have different chemical combination.
3. Generally protoplasm contains following elements oxygen, nitrogen, carbon, sulphur, phosphorus, iron etc and compounds like water. Protein, carbohydrate, fats, minerals and salt etc.
4. The exchange of useful and unuseful substances is called transportation.
5. Transportation is developed and complex in higher organisms whereas it is simple in lower ones.
6. Blood, heart, veins, arteries and capillaries take part in blood circulation.
7. Besides plasma blood contains RBC, WBC and platelets.
8. RBC lacks nucleus. The haemoglobin present in it absorbs oxygen.
9. White blood cells have nucleus. Their main function is to destroy pathogens.
10. Platelets help to clot blood.

11. The heart is an important organ. It has four chambers which are right auricle, left auricle, right ventricle and left ventricle.
12. The vessels which carry oxygenated blood to different parts of the body are called arteries. The veins except pulmonary veins bring deoxygenated blood to the heart from organs. Capillaries connect arteries with veins in a network pattern.
13. The heart expands and contracts regularly.
14. The system which takes part in reproduction is called reproductive system.
15. There are two types of reproduction. They are sexual and asexual.
16. Asexual reproduction involves budding, sporulation, regeneration and vegetative propagation.
17. In developed organisms sexual reproduction takes place as a result of fusion of sperm and ovum.

Do Observe and Learn

1. Feel your pulse rate. Did you get it? Find the number of beats per minute. Run for a minute and again take the note of your pulse rate. Did you find any differnece? Why? Discuss.
2. Observe the plants and animals found in the neartest forest or a damp place. Find the process by which they reproduce. Make a list of it.

Exercise

1. What is protoplasm? Why is it important?
2. What do you mean by transport system?
3. What substances constitute blood?
4. Draw a well labelled diagram of a human heart clearly showing its four chambers.
5. Name four types of asexual reproduction.
6. What is vegetative propagation? Name any two organisms which do not reproduce by this method.
7. What is sexual reproduction? Name any two organisms which reproduce sexually.
8. **Differentiate between**
   i) RBC and WBC
   ii) artery and vein
   iii) fission and budding
   iv) sexual and asexual reproduction.

Unit 17 Metabolism

The digestion is a good example of metabolism in human body. Destruction of the cells and tissues in the body, their replacement, conversion of absorbed food into cells and tissues and to convert food into energy needed by the body are being continuously taking place inside the body.

Metabolism indicates the following processes taking place in the body.

(a) Formation of the necessary cells and tissues takes place in the body as a result of the chemical reaction of various nutritious food.
(b) The old cells and tissues become useless in the body.

The study of the types of nutritious food, such as carbohydrate, fat, protein, minerals and vitamins and how they are converted into useful materials as needed in the body is dealt under digestive system.

Nutrition in Human Body

Mouth, throat, oesophagus, stomach, small intestine and large intestine are the organs involved in human digestive system. When we eat some food, the juices produced by the digestive glands in the above organs convert it to simple forms and with the help of the substances called enzymes the food is digested. Salivary glands secret saliva when we chew the food. Saliva contains enzyme called amylase that helps to digest starch.

S.N.	Digestive gland	Where found juice	Secreted digestive present or absent	Digestive jice
1	Salivary glands	Mouth	Saliva	present
2	Gastric glands	Stomach wall	Gastric juice	present
3	Liver	Right side of abdomen	Bile	absent
4	Pancreas	Below the stomach	Pancreatic juice	present
5	Intestinal glands	Small intestine	Intestinal juice	present

The food is chewed in the mouth. It reaches to the stomach when swallowed . In the stomach the food gets churned and turns into a paste like substance. The stomach wall secrets juice which contains the enzyme pepsin to digest protein. Then, the food passes to the duodenum and later to the small intestine. On the way, it mixes with bile flowing from the liver and pancreatic juice from pancreas. The juice contains various enzymes and they are trypsin to digest protein, amylase to digest starch and

lypase to digest fats and oils. The glands in the wall of the small intestine, also secret juice containing enzymes to digest food. Maximum digestion of food takes place in the small intestine. After this the food moves along the long and small intestine. The digested food needed for the body is absorbed through villi on the intestine and mixes with blood. The remnant moves to the large intestine where most of the water in the food is absorbed. The remaining part of the food becomes semisolid. Finally, the substances useless to the body are ejected from the body through the anus.

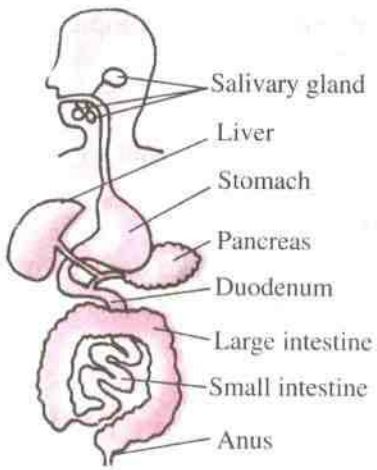


Fig. No. 17.1

In this way, during the process of digestion, the nutrious food we take in is changed into useful substances for the body by the action of enzymes which are secreted by different digestive glands. Glucose, fructose, amino acids, glycerol, lactose, etc are formed during digestion and reach blood circulation via villi. The blood carries digested food to cells all over the body.

Functions of some nutritive substances are given below:

1. Carbohydrate containing food supplies energy to the cells in our body. Physical work cannot be effective when there is shortage of carbohydrate in the diet.
2. Fats and oils add energy in the body and help protect internal heat of the body.
3. Protein enriched food helps in the growth of cells and repair of the damaged tissues in the body.
4. Minerals such as iron, calcium, phosphorus, etc help in keeping blood, teeth and bones healthy and strong.

Photosynthesis

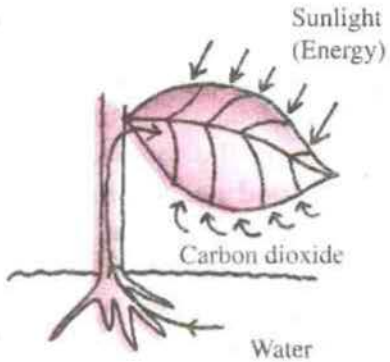
The green plants make their own food. They make their food from atmospheric carbon dioxide and water absorbed from soil in presence of sunlight. The food prepared is called starch. The process is called photosynthesis. It takes place in green leaves. The energy required to carry out this process is absorbed from the sunlight by the chlorophyll present with green plants. Oxygen gas is formed during this process.

The whole process photosynthesis can be explained in a very simple way:

For example:

Carbon dioxide + Water + sun light (energy) = starch + Oxygen.

Green plants make their own food, hence are called autotroph.



$(CO_2+H_2O+Energy \rightarrow starch+O_2)$

Fig. No. 17.2

Things Necessary for Photosynthesis

a) **Raw Materials**

Carbon dioxide and water are the raw materials needed for photosynthesis. The source of carbon for plants is the carbon dioxide in the air. The plants can not survive on other carbon compounds in absence of carbon dioxide. Only the hydrogen present in water can combine with carbon dioxide to give carbohydrate. Plants need other minerals containing substances as well to form protein containing products.

b) **Energy**

The green plants change solar energy into chemical energy while making their food. They act like nature's kitchen. The bodies of plants and animals have been made in such a way that growth, movement and other activities are possible only with the energy from the food. Human beings including many other animals depend upon green plants for survival. They get energy from the food that is supplied from the green plants.

c) **Chlorophyll**

Photosynthesis process is possible only with chlorophyll containing plants. Chlorophyll is present in the chloroplasts of green plants. They absorb solar energy and convert it into chemical energy. Chlorophyll contributes active role to photosynthesis.

Starch Test

Activity 1

Materials: Leaves, forceps, beaker, hot water container, ethanol 90%, iodine, plate, water, spirit lamp etc.

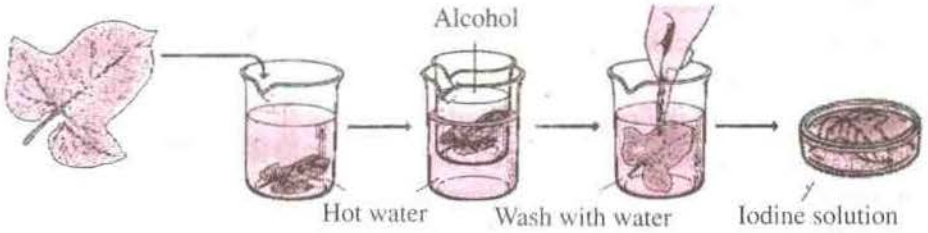


Fig. No 17.3

Method: Pluck a leaf from a plant kept in the sunlight. Dip it in the boiling water for five minutes. It makes the leaf soft. After sometimes take the leaf out of the hot water and keep it in lukewarm ethanol for some time. After that wash the leaf with some water. Put it in a plate containing some iodine. It will change into blue black colour. The colour of the leaf changes because of the presence of starch.

Necessity of Sunlight for Photosynthesis

Activity 2

Materials: A pot plant with leaves, thick sheet of black paper or aluminium foil and materials for starch test.

Method: Put a pot plant in a dark place for two days. Pluck a leaf of that plant and carry out the test for starch as in experiment one. Observe the change in the colour of the leaf. Did you see any change in the colour of the leaf?

Clip two strips of black paper in the middle part of a leaf as shown in the diagram. Keep the plant out in the sunlight for few hours. Remove the strips of black paper and dip the leaf in iodine soluion. Observe carefully which part of the leaf has changed its colour.

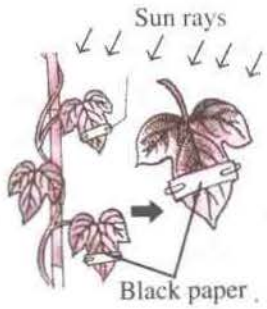


Fig. No. 17.4

This proves that green leaves can make food in presence of light or sunlight.

Oxygen is given out during Photosynthesis

Activity 3

Materials: Beaker, test -tube, glass funnel, water plant (hydrilla or eladio), water, pieces of plasticine or wood.

Method: Put a few pieces of fresh hydrilla or aquatic plant in a big beaker or a big mouth bottle containing water. Invert glass funnel in the beaker covering all the pieces of plant in the water. Fill a test-tube full with water and invert it over the tip of the funnel. There should be no air bubbles in the test-tube. While it is kept on the funnel, keep the experiment out in the sun for sometime.

Gas bubbles evolved from the plant get collected in the test-tube. Water level in the test-tube slowly drops. Why does this happen?

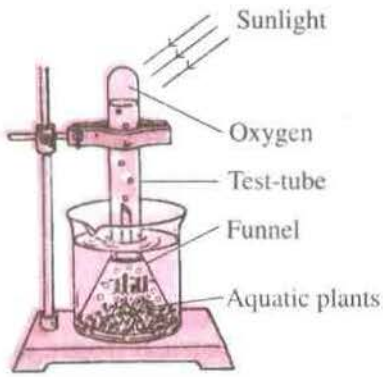


Fig. No. 17.5

Glowing matchstick burns brightly when it is taken close to the test-tube containing the gas. It proves that the gas is oxygen. The experiment works faster if some sodium bicarbonate is added into the water.

Carbon Dioxide is needed for Photosynthesis

Activity 4

Materials: Pot plant, plastic bag, caustic potash (KOH) and starch test kit.

Method: Place a pot plant in a dark room for about two days. Keep some caustic potash in a plastic bag. Insert a large leaf into the bag from the plant and tie the mouth of the bag tightly so that it is air tight. Leave it in the sun for a few hours. After sometime, carry out starch test on two leaves, one that is inside the bag and another one that is not inside the bag. Which leaf will show the presence of starch and why?

Why should the caustic potash be used? Find out the reason.

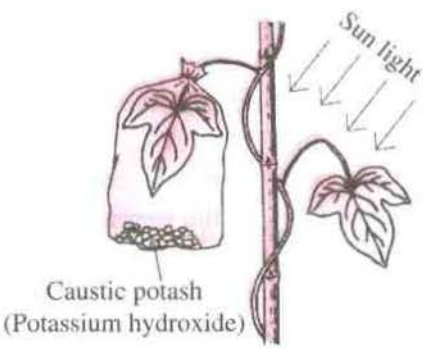


Fig. No. 17.6

Internal respiration

Respiration is a process, during which the cells get energy that they need for different activities. This process takes place in the mitochondria of the cells. This process is

called internal respiration or tissue respiration. During this process, carbohydrate (glucose) breaks down forming carbon dioxide and water to give energy.

Carbohydrate + Oxygen = Carbon dioxide + Water + Energy

This is an example of internal combustion which takes place in every cell. The body gets heat and other types of energy from it.

To throw carbon dioxide out and to take oxygen in, lungs should help to breath out and breath in. This process is known as external respiration. The external respiration assists the internal respiration. To make the process possible, circulation of blood is extremely necessary. The blood circulation transports the carbon dioxide formed in the cells to the lungs and glucose molecules formed during digestion to every cell and tissue.

In this way, the digestive system, blood circulation and respiration have to work hand in hand to keep the body alive.

Summary

1. Digestion is necessary to make the substances needed by the body from the nutritive substances.
2. Digestive juices are secreted from the digestive glands situated in the different organs involved in digestion.
3. These digestive juices contain enzymes. They react with nutrients which are present in the food and convert them into the substances which the body cells can use.
4. Photosynthesis is very important for the life of plants and animals.
5. During internal respiration, energy is released from carbohydrate in the cells and tissues.

Do, Observe and Learn

1. Prepare a table to show the different glands that help in digestion.
2. Pluck a leaf of a plant at night or before dawn. Pluck another leaf of the same plant in a sunny day between 2 to 3 pm. Now test both the leaves for starch. What differences did you find?
3. Put a pot plant out in the sun and put another one in a dark room. After two weeks, check which plant has grown more ? What are the causes of this change? Is it due to photosynthesis ?
4. Put a small quantity of rice, corn, wheat flour and sugar separately in water glass and carry out starch test separately.

Exercise

1. What is metabolism? Give one example of metabolism that takes place in the human body.
2. What are nutritive elements? Why are they called so?
3. In which part of the body the digestive juices are found?
4. How is blood circulation related with digestive system?
5. What is the role of the sunlight in photosynthesis?
6. Why is photosynthesis process consideed as opposite to respiratory system?
7. What is Iodine - starch test? How is it carried out ?
8. Describe an experiment with a diagram to show the role of the sunlight in photosynthesis.
9. Describe an experiment with a diagram to show the role of carbon dioxide in photosynthesis.
10. What is internal respiration? Where does this process take place in the body?
11. Describe the experiment with diagram to show that oxygen is given out during photosynthesis.
12. Explain briefly how you will know that the food prepared by the plants is starch or not.
13. How would you know that plants take in carbon dioxide during photosynthesis process? Explain with illustration.

Rock

The substances that make the Earth's crust are called rocks. In the past people used to call hard objects as rocks. Most of the Earth's surface is made of rocks. It is found from the seabeds to the bases of the peaks of Himalayas. This hard part of the Earth is covered with soil.

'The soil in the uppermost part is known as the *topsoil* and the middle layer as the *subsoil*. The bottom layer of soil is termed as the *bedrock*. Soil is formed from the disintegration of rock. This is why the small rocks are found in soil.

Rocks are of different shapes and colours. From small stones to minute pieces of gravel are found in the soil. You must have seen the use of gravel in the construction of rocks. Similarly, sand is used while building houses. Sand is a miniature form of rock.

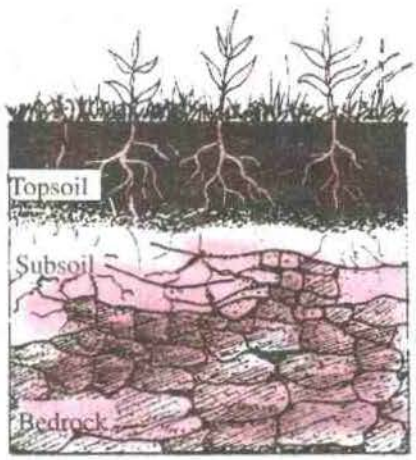


Fig. No. 18.1

The Structure of Rock

According to geologists, it is estimated that 92 elements combine to form cocks. However, the ratio of these elements in rocks could vary from one to another. The percentages of the few elements found in the rocks are given below:

Elements present in the rock:

Elements	Symbol	Percentage
Oxygen	O	46.6
Silicon	Si	27.7
Aluminium	Al	8.1
Iron	Fe	5.0
Calcium	Ca	3.6
Sodium	Na	2.8
Potassium	K	2.6
Magnesium	Mg	2.1
Other elements	–	1.5
Total		100.0

In the above table, 98.5% of the composition is covered by 8 elements and only 1.5% is taken up by the other elements to form the crust. From the crust elements, animals and plants

receive the substances which are necessary for existence. Similarly, plants growing in soil require the presence of various elements. Calcium, Sodium, Potassium and Magnesium make the soil fertile, and increase its productivity. Rocks help living organisms to survive.

On the basis of origin and formation, rocks can be classified as:

1) Igneous rock 2) Sedimentary rock 3) Metamorphic rock

1) Igneous Rocks

The outer surface of the Earth is hard and cold and its inside part is very hot so that the Earth's interior parts have all substances in a molten state. Gases and liquid mix to form a mixture called the *magma*. The molten magma sometimes escapes out onto the surface of the earth, for various reasons. The magma is now called *lava*. Hot ash-like material, steam and magma, rising through narrow channels, escapes at weak points in the Earth's crust. When these materials cool down, igneous rock is formed. The point at which lava escapes, forming large holes, are called *craters*.

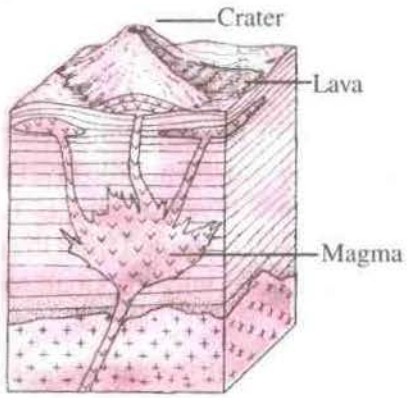


Fig. No. 18.2

Igneous rock has been forming since prehistoric times, so it is also called primary rock. At the time of the formation of the Earth larger proportion of igneous rock was found. As the Earth began to cool down, then other kinds of rocks began to form.

Sometimes, lava cools down inside the Earth and forms rock. This type of rock is called plutonic rock. Granite is an example of this rock. Granite is black and brown in colour. It is hard and strong, so it is used in construction. Similarly, pumice is another kind of igneous rock. It has pores and holes. It is a light rock. Obsidian is a glass-like and brittle rock . It is also called volcanic glass.

Igneous rock is granular. It is found in plenty in volcanic areas. It does not contain any fossils in it as it is formed from lava. Water cannot penetrate this type of rock. However, if igneous rock is exposed on the Earth's surface for long periods of time, then the outer part becomes relatively soft.

2) Sedimentary Rocks

Materials on the Earth's surface are constantly wearing and breaking because of the wind, water, heat and other forces. The materials that break off in this way are carried away from one place to another by rivers, rain and wind. When these activities

continue for a long time, these materials settle to form different layers. These layers are closely packed together by pressure to form sedimentary rock.

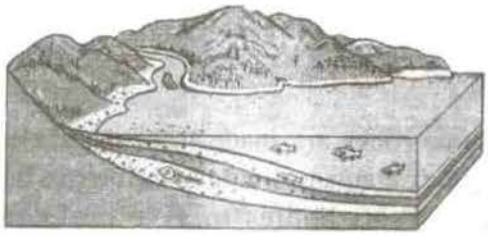


Fig. No. 18.3

You must have seen the streams, rivers and waterfalls flowing from higher to lower elevations. Water flowing in this way also washes small particles of soil, sand and rocks. These materials settle at the bottom of rivers and oceans. As time goes on, layers of these settled material, which form the ocean bed, slowly begins to rise. These processes have gone on for millions of years. Water also exerts pressure on these layers, so the materials become hard and form sedimentary rock.

Fossils may be found in sedimentary rock. So, the age of the rocks can be determined. The sedimentary rock is relatively soft compared to other rocks. The various layers can be observed in this rock.

Fig. No. 18.4

Sedimentary rock are of following kinds:

a. Conglomerates

The conglomerate is also known as concrete rock as it is formed from bits of rocks, pebbles and sand stuck together. The quartz binds small pieces of stones to form conglomerates. If the constituents are bound together by silica, the conglomerate is very hard.

Fig. No. 18.5

b. Sandstone

Sand particles bind together with cementing material to form sandstone. The layers of sand are bound together by materials such as silica.

Well-cemented particles form hard sandstone and loose or weakly cemented particles make soft sandstone.

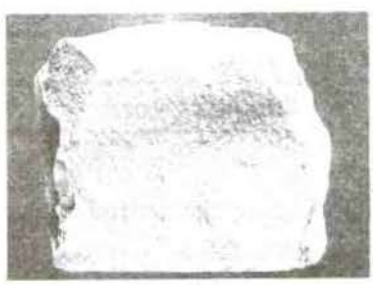


Fig. No. 18.6

c. Shale

Particles smaller than grains of sand are called silt particles. Particles smaller than silt join to form a

soil known as clay. Rocks formed by combining silt and clay are known as shale. It is black and soft.

d. Limestone

Some rocks are made from the shells of organisms. Some organisms living in the oceans have shells which cover soft bodies to give protection. When the organisms die, layers of the shells and skeletons are formed on the ocean bed. Under pressure, these layers form limestone. The rock is fine and granular. It is red, brown, white or black in colour.

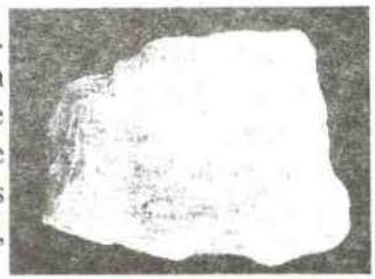


Fig. No. 18.7

3) Metamorphic Rock

Heat and pressure change sedimentary and igneous rock into metamorphic rock. This type of rock, gets changed from one form to another. Such changes can occur in some or all parts of the rocks involved. The rock, which is formed by changing one kind of rock to another, is known as metamorphic rock. The metamorphic rocks are found under the deep crust of the Earth.

Process of Forming Metamorphic Rock

i) Sedimentary or igneous rock remain under great heat and pressure for a long time to form metamorphic rock.

Rock	*Metamorphic Rock*
Silica	Quartzite
Limestone, Dolomite	Marble
Coal	Graphite
Graphite	Diamond
Granite, Deorite	Gneiss, Schist

ii) The rocks formed from sedimentary or igneous rock can again change systematically into different kinds of metamorphic rock. Rocks formed from fine grains and arranged in layers such as slate and schists can also undergo changes. Marble, graphite and diamond are examples of metamorphic rocks.

Activity 1

Write down the properties of igneous, sedimentary and metamorphic rocks in the table below.

Igneous rock	Sedimentary rock	Metamorphic rock
1	1	1
2	2	2
3.	3	3
4.	4	4
5.	5	5

Collect rocks from your surroundings. Classify them into above groups.

Uses of Rocks

Rocks are used for different purposes. Some of the uses are as following:

a) Hard rocks are used in the construction of houses and buildings. It is crushed to pieces and used in the construction of roads.

b) Idols can be carved on rocks and sold for money.

c) Different kinds of marble are used for decorative purposes, especially in houses.

d) Granite is used to build pagodas and temples.

e) Slate can be used in schools for writing purpose.

f) Several valuable gems are found.

Soil

Most part of the Earth's crust is covered with soil. Plants get their nutrients from the soil. So it is very important. Soil is a mixture of small pieces of crushed rocks, sand, minerals, remains of living and dead organisms. It is soft and coarse.

Activity 2

Soil is formed from the crumbs of rocks. So it takes many years to form the soil. Carry out the following experiment to find out if the soil is formed from rocks. Fill a bottle halfway with clean water. Collect some soil and put it in the bottle. Shake the bottle gently for sometime. Then place the bottle to a side. After a while, look at the bottle. What do you observe? The soil in the bottle has separated into different layers. Heavier grains and particles are found settled at the bottom of the bottle. Sand is found above this layer. Silty soil is seen as a distinct layer above the sand. Water is above the soil layer. Thus, we can see that soil is made of different components.

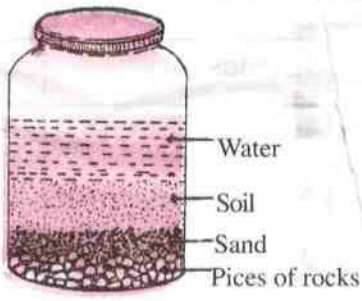


Fig. No. 18.8

Activity 3

Repeat Activity 2, but use soil from a different source. Copy the given table in your exercise book and note the sizes of the particles in the different layers:

Large particles	Largest particles	Small Particles	Smallest Particles

Soil is the source for nutrients necessary for the life processes and growth of many living organisms. The soil is formed by various ways. Streams, rivers and waterfalls wash away large rocks from the mountains. These rocks rub against each other and form smaller stones. These processes continue in the formation of gravel and particles to make soil. The alternation of heat by day and cold by night goes on for years. This affects the rocks and splits them into smaller parts. Water flows through the holes and channels in rocks and breaks them to form soil. Plants also grow in the cracks and crevices of rocks and make the rock weak. Air also helps to break the rocks. The wind blows on and through the rocks and erodes them removes. Crushed rocks and organic matters form soil which contains air and water. After many years, sand particles change into soil.

Elements in the soil vary according to the nature of the soil. Soil contains many different layers. The topmost layer contains much organic materials, the second layer contains living materials, the roots of plants, insects and other materials. In the third layer of soil, elements such as iron and aluminium and living materials are found. The lowest layer is composed of the bedrock layer, and disintegrated non-living materials. Various changes are always taking place in soil. That is why different elements are found in soil at different places. The soil is non-living but during formation, decaying organic substances mix up. It also contains minerals and decayed plants, leaves and other organic matters. Apart from living organisms, we can find the decomposing remains of animals and plants.

Activity 4

Take two hard stones and rub them against each other. Now take another two soft stones and rub them against each other. Describe what happens.

Fig.No. 18.9

Volcano

Magma and molten rocks come out from inside of the Earth through weak points in the crust. The phenomenon whereby molten rocks ooze out continuously onto the Earth's surface through a narrow passage is called a volcano. When a volcano erupts, the Earth's surface vibrates and the molten rocks push out with such force that even the hard rocks in the crust give way. The molten material then escapes and piles up onto the Earth's surface and hardens to form a volcanic mountain. When a volcano erupts, gas, hot ash and molten materials are ejected. These materials spread out in all directions and the point from which they escape forms a hole called a crater. From the crater, more molten materials may be ejected from time to time. Volcanos thus, bring changes in the Earth's structure.

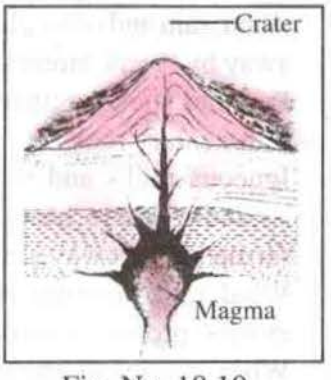


Fig. No. 18.10

There are many reasons for the eruption of volcanoes. It is very hot inside the Earth. Because of this heat, the materials melt to form hot liquid. Chemical reactions produce heat inside the Earth. So, molten rocks and hot gases exert pressure on the Earth's crust from inside. The molten rocks find weak points in the crust and rush out of the Earth.

The rain water, water from rivers and oceans find their way into the Earth through channels in the crust. The excessive heat inside the Earth turns the water to steam. Water vapour needs more space than water. The increased volume cannot remain trapped within the Earth. This leads to the eruption of volcanoes.

Effects of Volcano

- It causes the change in earth's surface i.e., formation of volcanic mountain in the plain or ocean.
- It causes the destruction of human-built constructions.
- It destroys the fertile land and forests by covering these with lava.
- It causes the earthquake.
- The atmosphere is polluted with dust, smoke and ashes due to volcanic eruption.
- There is unnatural change in the climate because of the polluted atmosphere.

Summary

1. The hard substances which form the Earth's surface are called rocks. The different kinds of rocks are igneous rocks, sedimentary rocks and metamorphic rocks.
2. Extreme heat inside the Earth melts rocks. These molten rocks cool down and harden to form igneous rocks.
3. Wind, rain and other climatic elements erode rocks gradually and they are washed away by rivers, streams and wind. It is deposited as sediment in rivers and seas. Particles stick together due to pressure. Rocks formed in this process are called sedimentary rocks.
4. Igneous rocks and sedimentary rocks show partial or total changes in their structure due to heat and pressure from external elements over years. Rocks formed in this way are known as metamorphic rocks.
5. Wind, rain, pressure, rivers, waterfalls, etc wear away rocks continuously. This erosion process goes on for years gradually and soil is formed.
6. When a volcano erupts, molten materials inside the Earth escape as lava onto the surface.
7. Volcanoes indicate that the Earth's interior is extremely hot. The materials in the Earth are in a molten liquid state.

Do, Observe and Learn

1. Go to a nearby hillside, field or hillock and study the following:

   a) The type of soil b) The rocks

2. Look around the place you live. List the uses of the rocks in your exercise book.
3. Collect different kinds of rocks and study their structures. Try to identify them.
4. Collect soil from different sources. Keep the samples separate. Find out the differences among the samples.
5. Draw a volcano. Label your drawing.

Exercise

1. Fill in the blanks.

a) The rocks are of different kinds. They are igneous rocks, _____ and metamorphic rocks.
b) Molten hot rocks are called _____.
c) Different substances settle in layers and form _____.
d) Soil is formed from the erosion of _____.
e) The _____ of organisms are also mixed in rocks.
f) Because of extreme heat inside the Earth, _____ melts and forms magma.
g) Melted rocks inside the Earth try to take up more _____.
h) Heat increases inside the Earth because of _____.

2. Distinguish between

(a) Igneous rock and sedimentary rock.
(b) Sedimentary rock and metamorphic rock.

3. Classify the following rocks:

Marble, pumice, slate, obsidian and lime stone.

4. Give brief answer:

(a) What is a rock?
(b) Write with example how matamorphic rock is formed?
(c) What are the uses of the rocks?
(d) How is the soil formed?
(e) Why is the soil important to us?
(f) What is a volcano?
(g) What are the effects of volcano?

Unit 19 Atmosphere

The earth has land, water and air on and near its surface. The earth is surrounded by different layers of air. The different layers of air is called Atmosphere.

Atmosphere

The atmosphere has different types of gases, water vapour and dust particles. Difference can be observed in different layers of atmosphere at different height from the surface of the earth. As the height increases the layer of the atmosphere becomes thinner and in each different layer the temperature, humidity and composition of the air differs.

The atmosphere is divided into five different layers as follows on the basis of height.

Troposphere

This layer is the bottom layer of the atmosphere. It is spread upto a height of nearly 16 km from the surface. This layer consists large amount of heavy gases, water vapour, dust particles. Different weather related activities such as winds, cloud formation, lighting, rain, fog formation, hail storms, happen in this layer. The temperature decreases as the height increases in this layer.

Stratosphere

This layer is just above the troposphere layer. It is called stratosphere layer. This layer stretches between 16-50km upwards. The temperature increases with the increase in height in this layer. The upper most layer of this stratosphere helps check the penetration of dangerous radiation of the sun for living being. This layer acts as the protective layer for the living beings.

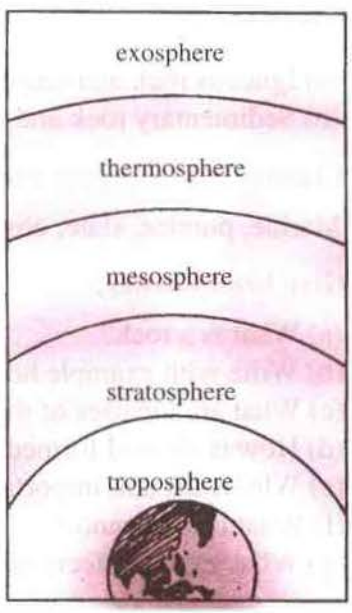


Fig. No. 19.1

Mesosphere

The layer just above the stratosphere is called mesosphere. It spreads vertically between 50-80km. The temperature decreases with the increase in the height. Strong winds blows in this layer.

Thermosphere

The layer just above the mesosphere is thermosphere. This layer spreads vertically between 80-720km. It is the upper most layer of the atmosphere. This layer contains thin amount of air. This layer has high temperature due to solar radiation activity.

Exosphere

It is the outer most layer just outside thermosphere. It stretches vertically beyond 720km to space. The presence of air is negligible in it. It contains thin rare amount of molecular and atomic gas.

Wind

Hot air is light and cold air is heavy. So, the hot air moves upwards and cold air moves downwards to take up the place of the hot air. Such movement of air is called convection. One of the main reasons for movement of air is convection. During day time the ground gets hot.The air above the ground also gets warm but the sea is less warm than the land. So the air above the sea is cold and heavy. The hot air above the ground moves upward and the air from the sea moves to the land.

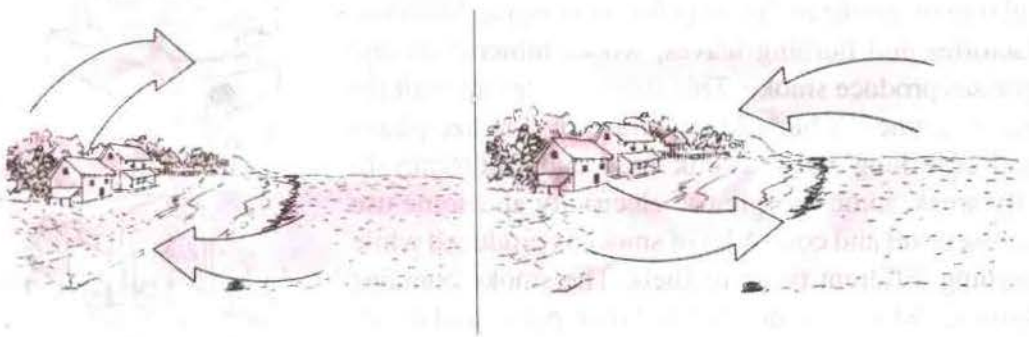


Fig. No. 19.2

During daytime, the sea gets gradually warmer and cools down slowly in the evening. The land cools faster after the sun sets. The land cools faster than the sea. So the air above the sea is warmer than the air above the land. This makes the air move from the land to the sea.

Air Pollution and its Effect

Air is made up of different gases. There is nitrogen, oxygen, carbon dioxide and several other gases. The effects of external materials on the normal air is known as

air pollution. Waste materials produced by human activities help pollute the air. You must have noticed dust, smoke, bad smell, contaminated substances and other waste materials given out by factories and transport. The air mixes up with the above substances and gets polluted. Such air is known as polluted air.

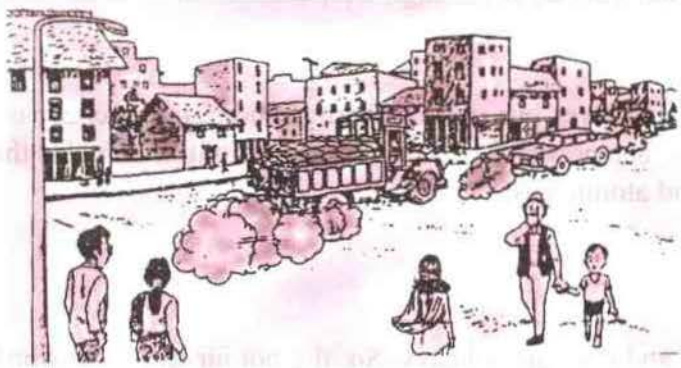


Fig. No. 19.3

Causes of Air Pollution

There are various causes of air pollution. Out of these, mixing of smoke in the air is the main cause. Vehicles, factories and burning leaves, wood, mineral oil and grasses produce smoke. This smoke mixes up with the air. At home we burn wood, straw, dry maize plants and cow dung cakes to cook food and heat rooms. In city areas, some people use electricity and some use kerosene oil and coal. A lot of smoke is produced while burning different types of fuels. The smoke contains particles which are not burnt. When petrol and diesel are not completely burnt they produce poisonous gas like carbon monoxide. Smoke also contains poisonous gas like sulphur dioxide. So smoke pollutes the air.

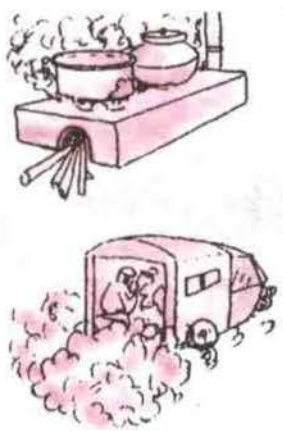


Fig. No. 19.4

Activity 1

It is already learnt from the above explanation that smoke pollutes the air. We can see the smoke mixing with the air but we cannot observe the changes taking place because of the smoke. However, we can know whether air is polluted or not by its effects. You can observe burning of wood in and around your house. You will see black substances around the place. You can also see black particles floating in the

air near a fire or a lighted kerosene stove. You can also observe these particles and smoke mixing up with the air. This pollutes the air. Now you observe the smoke given out by running vehicles and burning wood. Make notes of what you see and discuss in the class.

Fig. No. 19.5

Mixing of Dust in the Air

Dust is another main factor to pollute the air. Demolishing old buildings, constructing roads, plying vehicles and a storm cause plenty of dust to float and mix in the air. You must have seen plenty of dust floating in the air when there is a storm. Brick and cement factories, stone mines and cleaning of roads, too, generate dust. This dust mixes with the air which already has some dust in it, thereby increases the pollution in the air.

Activity 2

(a) As the dust gets added to the air, the volume of pollution increases. Plenty of dust particles are floating in the air. These particles pollute the air. One can observe a beam of sunlight entering through a hole into a darkroom.

(b) Dust produced by different activities of human beings pollute the air. Some of the dust particles remain in the air, and some can be seen on walls, some on roofs and some on branches and leaves of trees. Look at the leaves of plants around your school and see if there is any dust there or not.

Mixing of foul Smell in Air

Different types of wastes give out bad smell. Domestic waste is often disposed of in an unorganised way. Sewage and drainage systems lack proper management. Waste is increasing every day in the cities.

There are piles of garbage lying in streets and on roadsides. Contaminated water or waste from industries is mixed to streams and rivers. Dead animals and rotten things are not properly disposed of. While walking you can see the dumping of waste materials by the sides of roads. In villages, people pass urine and feces in the open due to the lack of proper toilets. The smell given out by all kinds of wastes pollutes the air. The gases and particles produced by rotten things contain sulphur dioxide, nitrogen dioxide and carbon. These gases mix in the air and pollute the air. Places in and around get polluted by the gases and the environment is affected.

Acitivity 3

(a) Wastes pollute the air. So the air around the wastes gets polluted. Look at the given picture. Write what you see in it and make a note of it and discuss in the class.

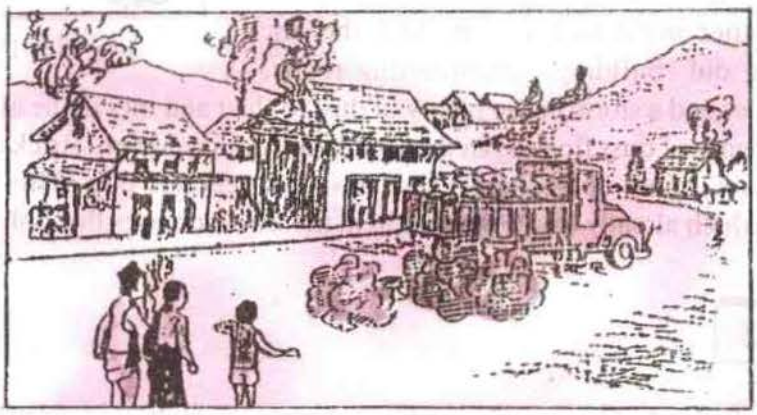


Fig. No. 19.6

(b) Observe the place where you are living. Is the waste there deposited in a disorganised way? If yes, write what you see there.

Effects of Air Pollution on the Environment

Air pollution spoils things around us. The dust and particles present in the contaminated air affects the growth of plants. They have bad effect on things around us. Polluted air contains carbon dioxide, nitrogen dioxide, carbon and other particles. Polluted air contains contaminated elements. Unburnt particles of coal and wood and poisonous gases are also present in the contaminated air. Animals and plants are badly affected by polluted air.

Air contains floating gases and dust particles. The atmosphere is polluted by contaminated air and this makes air dim and hazy. Bowl shaped places and valleys like Kathmandu are badly affected by pollution. Polluted air consists of dust, gases and particles of lead.

Lead particles enter a person's body while he/she is breathing. They are poisonous to humans. It disturbs the work of the muscles and makes the human body weak. It can cause anaemia, affect kidneys and cause mental problems.

Polluted air spoils the metal parts of monuments and temples. It causes metal works to erode and be destroyed fast. Air pollution deposits carbon dioxide gas and other gases at the upper layer of the atmosphere. It allows the solar heat energy to reach the surface of the Earth but the heat cannot return to the atmosphere. As a result, a green house effect is created and the temperature of the atmosphere will increase. A rise in the temperature of the atmosphere makes all living organisms to feel difficult to survive.

Ways to protect from Air Pollution

It is difficult to protect oneself from polluted air. So air pollution must be stopped. If air pollution is controlled, the effects of polluted air on living organisms can be stopped. The following methods must be adopted to control air pollution:

(a) Fire wood, kerosene, etc on combustion give out smoke. The use of improved modern stoves can reduce the smoke.

(b) Petrol and diesel are used in the vehicles. Techniques to produce less exhaust should be adopted. Similarly, ways should be adopted to control the smoke from the factories.

(c) Smoke and water wastes from cement industries, brick industries and tanneries must be controlled. Spraying of water before sweeping helps to reduce dust particles in the air. Thus air pollution decreases.

(d) Proper steps should be taken to control the wastes and polluted water released from domestic and industrial use. These substances should be recycled for future use. This will help to reduce air pollution. It will also help to reduce the effects of polluted air on the health of plants and animals.

Activity 4

(a) Observe the place where you reside. Find out the type of factories that are around. Prepare a list of the type of factories that can pollute the air.

(b) Write down the ways to control air pollution from the factories that you observed in your area. Discuss in your class.

Summary

1 The different layers of air around the earth is called atmosphere..
2 The atmosphere of the earth comsists of differeent gases, water vapour and dust particles. The atmosphere is divided into different layers according to height as tropsphere, stratosphere, mesosphere, thermosphere and exosphere.
3 The cause of wind is the movement of air from a cold place to a hot place.
4 When substances other than air components mix with the air, the air gets polluted. Polluted air contains poisonous gases, dust particles and smoke.
5 Polluted air includes carbon dioxide, sulphur dioxide, nitrogen dioxide and lead particles. The air mixed with these gases is harmful to all living organisms.
6 Air also gets polluted by dust, smoke and bad smell from waste materials.
7 Petrol and diesel used in vehicles give out smoke. Fuel substances such as wood, cow dung cakes, dead maize plants, and kerosene give out smoke while burning. They mix with air and pollute it.
8 Air is polluted with dust from running vehicles, from cleaning places and construction works.
9 Bad smell is given out by garbage, decomposing substances and improperly disposed corpses of animals.
10 Polluted air spoils the environment. It harms the health of living beings.
11 Polluted air destroys our cultural heritage: monuments and temples, buildings and houses. It spoils the metallic parts of temples.
12 By controlling smoke, dust and garbage, air pollution can be controlled. Industrial waste must not be disposed of in an improper way. Old vehicles should be kept out of the road.

Do, Observe and Learn

Smear some vaseline on a sheet of whitepaper and stick it on a wall or a tree near your school. Look at the surface of the paper after one hour. What do you see on the paper? What kind of particles are there? Can you separate them? Why has there been a change on the surface of the paper ?

Exexcise

1. Fill in the blanks

(a) The atmosphere consists of different gases, water vapour and .....
(b) Rain, cloud, ice, lighting ..... takes place in troposphere.
(c) ..... lies just below stratosphere.
(d) The layer above stratosphere helps stop dangerous ..... .

2. Look at the picture below and answer the questions

Fig.No. 19.7

(a) Which substances shown in the picture cause air pollution?

(b) What should be done to control air pollution ?

3. Tick mark (✓) the correct answer

(a) What gases are found in larger volume in polluted air ?
- i. Oxygen and Nitrogen
- ii. Nitrogen and Argon
- iii. Carbon dioxide and Sulphur dioxide

(b) What gas is produced when petrol and diesel are not completely burnt ?
- i. Nitrogen
- ii. Hydrogen
- iii. Carbon monoxide

(c) What happens when pollution is increased ?
- i. Volume of air is increased
- ii. Air becomes poisonous
- iii. Air becomes thin

4. Observe and write

Look around your area of residence. Find the causes of air pollution. What steps should be taken to control air pollution? Prepare your suggestions.

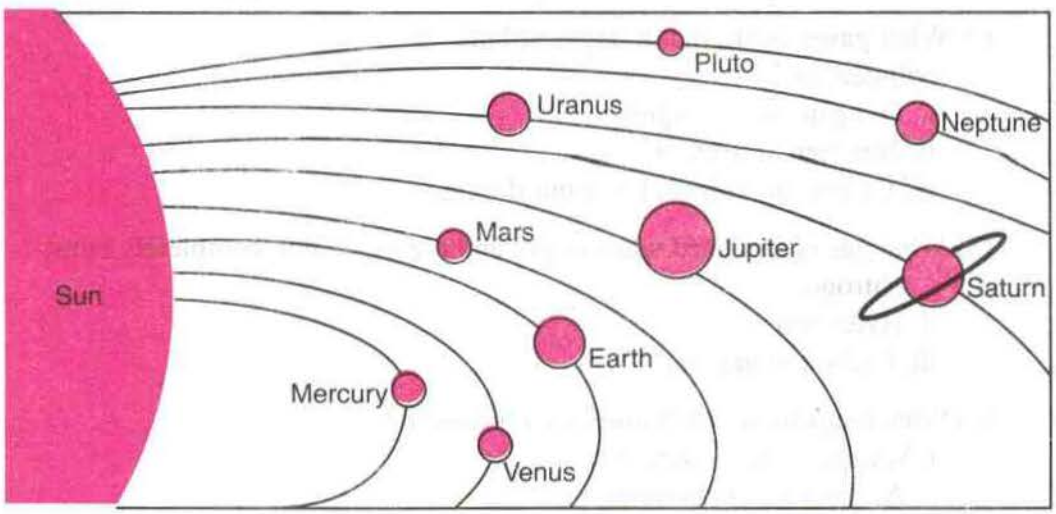
5. Answer the following questions.

(a) In how many layer is the atmosphere divided in terms of height?
(b) Write two characteristics of stratosphere.
(c) Why does the air blow from one place to another?
(d) What is air pollution ?
(e) What will be the effects of air pollution on the health of living organisms?
(f) Why does air pollution pollute the environment ?
(g) What measures can be adopted to control air pollution?

Unit 20 Planets, Stars and Constellations

Let us remember about solar system and its members from class seven.

Family formed by the collection of the Sun, planets, satellites and many other smaller celestial bodies is called the solar system. All the planets, satellites and other celestial bodies of the solar system rotate on their own fixed axis and at the same time they revolve around the sun in their own orbits. They are orbiting the Sun due to the effect of the gravitational pull of the Sun.



Solar system

Fig. No. 20.1

The large bodies which orbit the Sun are called planets. Smaller bodies which orbit the planets are called satellites. Planets and satellites rotate about their own axes as well. Asteroids, comets, meteors and meteorites are also included in the solar system.

Planet and star

Planet

All the members of the solar system go round the sun. The planets follow a definite time period and distance as they go round the sun. There are nine planets that orbit the sun. Except the planet mercury and venus all the planets have natural satellites or moons. Almost all planets recieve heat and light from the sun. The planets are visible due to solar light reflected by them.

Heavenly bodies that orbit the Sun are called planets. Nine planets that orbit the Sun are as follows:

1. Mercury	2. Venus	3. Earth
4. Mars	5. Jupiter	6. Saturn
7. Uranus	8. Neptune	9. Pluto

The largest planet is the Jupiter and the smallest is the Pluto. Planets can be observed with the help of a telescope.

Planets do not have their own heat and light. They shine with the help of sunlight. Planets go around the Sun in an oval orbit.

Star

You must have seen stars twinkling in clear sky at night. They are different from planets. Stars are made up of hot and bright gases. The Sun is a kind of star. Innumerable stars in the sky look like dots from the Earth. They appear so small because they are too far away from the Earth. Actually some stars are smaller and some are larger than the Sun. We receive heat and light from the sun because it is a star too. It is the closest to the Earth. We do not get heat and light from other Sun like stars because they are too far away from the Earth.

The distance between stars are measured in light year. Stars are of different colours. The range from red to blue colour. The colour of the star determines (indicates) the temperature. example.

colour	Blue	white	yellow	orange	red
Temperature	25000°c	11000° c	6,000° c	4,000° c	3,000° c

Stars are considered cold and very hot stars. As for example sta having temperature of 3000°c or less than, is considered cold star. Stars having the temperature of 25,000°c and above are considered as very hot stars.

Brilliance of Star

Different stars have different brilliance. Brilliance of a star depends on its surface temperature, size and distance from the Earth. Although a star is very bright it might still appear dim because it is too far away. Likewise, even a dim star might appear bright because it is close to the Earth.

Distance of Star

Stars are very far away from the Earth. It is difficult to measure their distances in kilometers. Therefore, distance between stars is measured in a unit called "light year". Fifty–five stars are found within a distance of 16 light years. The nearest star from our Sun is 4.3 light years away.

Light year

Light travels 300 000 000 m in 1 second. With this speed, light travels a distance of 9.5×10^{12} km in a year. This distance is called light year.

Difference between planet and star

	Planets	Stars
Surface colour Temperature size	Different type Different -220°c to- 420°c 2,288km to 57,200km	covered with gas Blue, white, yellow, orange, red 3000°c to 25,000°c Larger than sun and smaller than earth (greater than 13,82,400km size of sun to less than 12,756km) size of earth

Constellations

In the clear sky at night one can see a large group or clusters of stars always in a fixed pattern. The fixed pattern of a group of stars is called constellation. If these constellations are cerefully observed, they resemble closely the shapes of different imaginary objects and animals. Such figures are imaginary. Astrologers have called these figures constellations. 88 constellations can be seen in the sky. Twelve of these constellations are used as the signs of the zodiac.

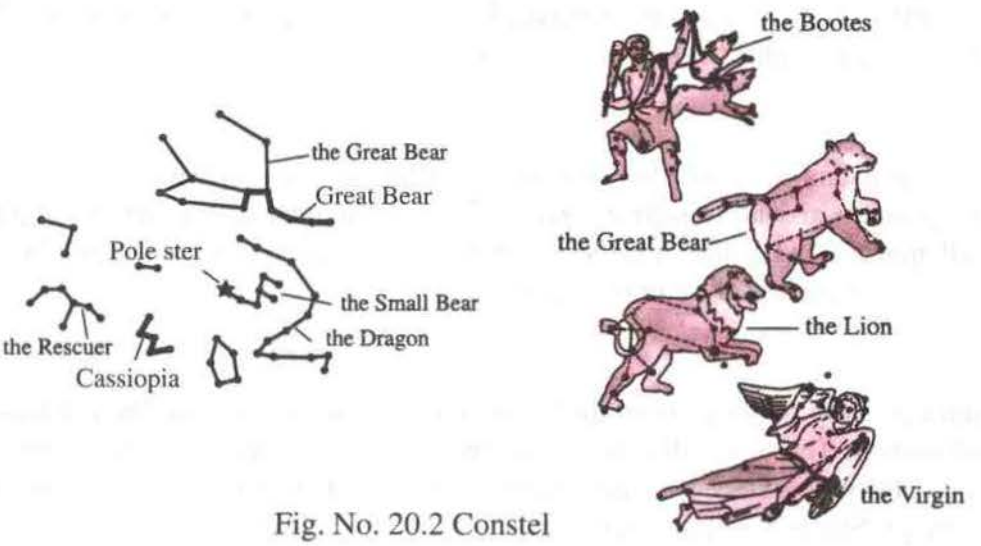


Fig. No. 20.2 Constel

Constellation identification procedure

Before identification of different constellation in the sky (space) it is essential to identify two or three constellation. This can be done with the help of star map. The constellation that can be easily identified in The Great Bear. It shape is in the form of sup eatiy spoon. Among the seven stars of the Great Bear, four are in the form of bowl and three are in the shape of handle.

In the figure the line joining the Great Bear can help identify the polestar and this star is called the pointer. The pole star lies in the tail of seven faint stars. This group of star.

Great Bear

The constellation that resembles the shape shown in the figure and can be seen over the northern hemisphere is called Great Bear. This constellation looks like a frying pan. Four of its stars makes a rectangle and three other stars extend from one corner to another like a tail of a kite. If a line joining the topmost two stars is extended towards the north, where there is no tail, by about 5 times the distance between these two stars, the Pole Star is reached. This is how the Pole Star can be located.

Fig. No. 20.3

Cassiopia

Cassiopia is the W shaped constellation. If the line joining the Great Bear and the pole Star is extended further, it ends at the W shaped figure. This is the Cassiopia constellation. Cassiopia and the Great Bear are almost at equal distance from the Pole Star.

Fig. No. 20.4

Orion

Orion is one of the most distinct and interesting constellations in the sky. Its imaginary shape is that of a **hunter**. On the belt of the hunter are three bright evenly spaced stars. Above the belt are three stars in a vertical line. Stars called Betelgeuse is on its right shoulder and a bright star called Rigel is on the knee.

Fig. No. 20.5

Method of Identifying constellations

There are various ways of locating different constellation in the night sky. However, in all these methods, it is necessary to first locate two or three most obvious constellations. This is done with help of a maps. The first and the easiest to spot is the Great Bear. It resembles a soup spoon. Of the seven bright stars in the Great Bear, four of them resemble a bowl and the other three make a handle.

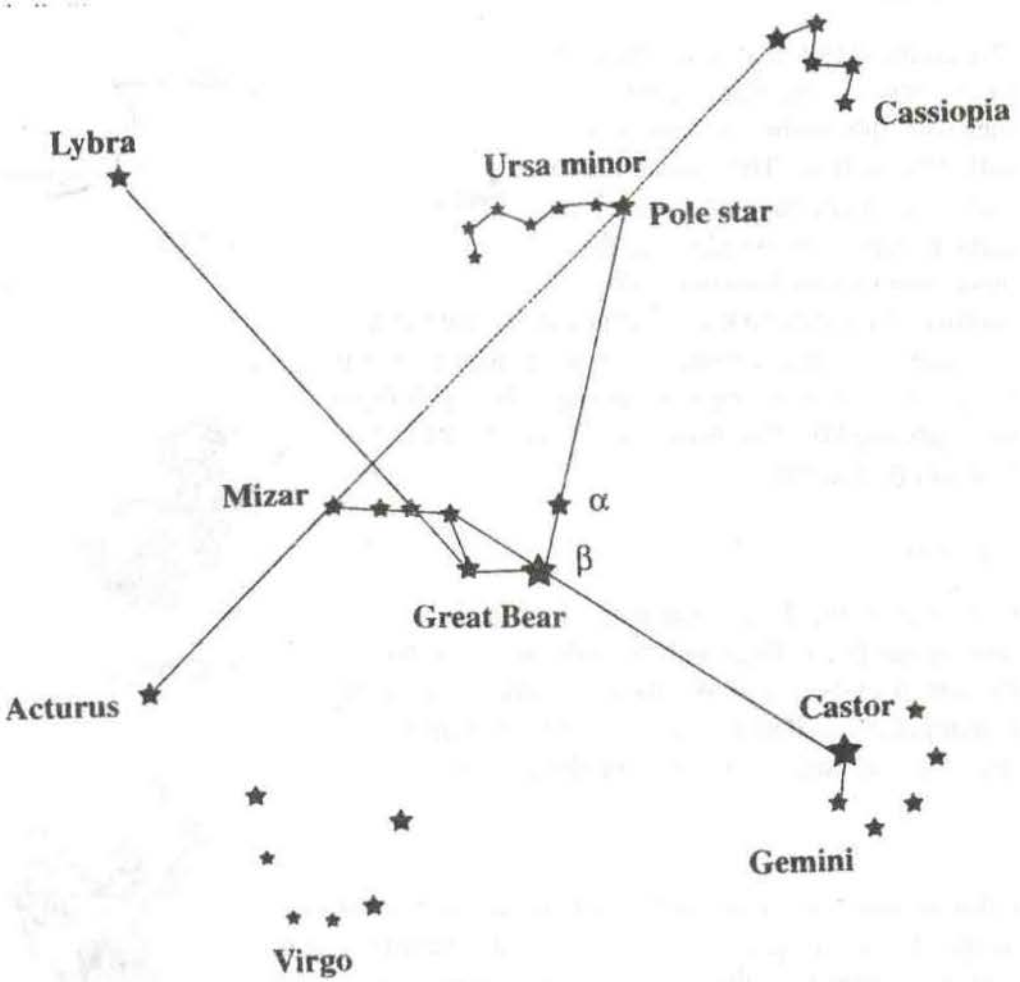


Fig. No. 20.6

The imaginary line shown in the diagram helps to locate the pole star and thus it is called the pointer. Pole star lies at the tail end of the seven bright star. The group of these seven stars is called ursa minor (the small bear.)

The straight line joing Mizar and pole star if produced further meets cassiopia which resembles the shape of an english latter'w. following the same procedure, other constellativons are also identified. Fig 20.7 represents another constellation where orion is taken as pointer.

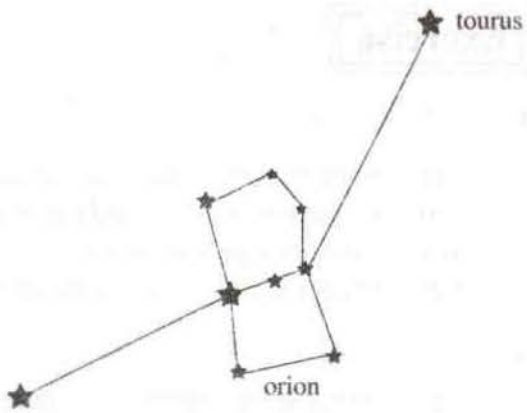


Fig. No. 20.7

Summary

1. Solar system is a large family of the Sun, planets, satellites and other heavenly bodies. Objects that orbit the Sun are called planets. There are 9 such planets. They are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.
2. Satellites orbit the planets just the way the planets orbit the Sun. There are 66 such satellites.
3. Planets do not have their own light but they shine by reflecting the light from the Sun.
4. Stars can be studied in the form of imaginary groups. Such groups are called constellations. If they are observed collectively, they appear to have the shapes of animals and objects such as frying pan, scorpion, swan, hunter, etc. There are 88 constellations in the sky. Twelve of them make the signs of the zodiac.
5. Stars are at different distances from the Earth. There are differences between their heat and light. They even appear different from the Earth. Some stars are many times larger than the Sun. Therefore, the distances cannot be measured in kilometers. That is why, distance of a star is measured in light years. One light year is equal to 9.5×1012 km.

Do, Observe and Learn

1. Observe the sky at clear night and sketch the shapes of any 3 constellations.
2. Observe the stars in the sky at night with naked eyes or with the help of a telescope. What different colour of stars did you observe? Write down their colours.

Exercise

1. Mark a tick (✓) against true statements and a cross (×) against false ones.

(a) Solar system is made up of only planets and satellites.
(b) Objects that go around the Sun are called planets.
(c) Satellites are stationary.
(d) Object which orbits a planet is called satellite.

2. Tick (✓) the correct answer.

(a) What is the number of planets that go around the Sun?

A. 7 B.9 C.10 D.6

(b) What causes the planets to orbit the sun?

A. The sun is very big. B. To get sun light
C. Gravitational influence of the sun D. Being close to the sun.

(c) Amongst the following ..... is the smallest plannet.

A. Jupiter B. Pluto C. Mercury D. Saturn

(d) The largest planet of the solar system is .....

A. Jupiter B. Venus C. Uranus D. Pluto

3. Fill in the blanks with suitable words.

(a) Group of stars and the shapes formed when the stars are viewed collectively are called .....
(b) One light year is equal to .....
(c) Great Bear has the shape of a .....

4. Differentiate between

(a) solar system and constellation.
(b) Planet and star

5. Write the answer.

(a) How many zodiac can be seen from the earth?
(b) Describe the important features of a star.
(c) Why is the distance of a star measured in light years?