Science

Class Six

National Curriculum and Textbook Board, Bangladesh

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as a textbook for class six from the academic year 2013

Science

Class Six

Revised for the year 2025

NATIONAL CURRICULUM & TEXTBOOK BOARD, BANGLADESH

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Preface

The importance of formal education is diversified. The prime goal of modern education is not to impart knowledge only but to build a prosperous nation by developing skilled human resources. At the same time, education is the best means of developing a society free from superstitions and adheres to science and facts. To stand as a developed nation in the science and technology-driven world of the 21st century, we need to ensure quality education. A well-planned education is essential for enabling our new generation to face the challenges of the age and to motivate them with the strength of patriotism, values, and ethics. In this context, the government is determined to ensure education as per the demand of the age.

Education is the backbone of a nation and a curriculum provides the essence of formal education. Again, the most important tool for implementing a curriculum is the textbook. The National Curriculum 2012 has been adopted to achieve the goals of the National Education Policy 2010. In light of this, the National Curriculum and Textbook Board (NCTB) has been persistently working on developing, printing, and distributing quality textbooks. This organization also reviews and revises the curriculum, textbook, and assessment methods according to needs and realities.

Secondary education is a vital stage in our education system. This textbook is catered to the age, aptitude, and endless inquisitiveness of the students at this level, as well as to achieve the aims and objectives of the curriculum. It is believed that the book written and meticulously edited by experienced and skilled teachers and experts will be conducive to a joyful experience for the students. It is hoped that the book will play a significant role in promoting creative and aesthetic spirits among students along with subject knowledge and skills.

The purpose of science education is to develop observational skills, problem-solving skills, and interest of the students about natural phenomena and various elements of the environment through creating curiosity. In addition to the theoretical aspects of science, this textbook for class VI also provides different hands-on activities to increase their creativity and imagination, as well as investigative work to develop the student's curiosity and adherence to science. Students will be able to acquire the necessary skills and positive attitudes to secure personal and social safety and overcome various adverse situations through science practice.

It may be mentioned here that due to the changing situation in 2024 and as per the needs the textbook has been reviewed and revised for the academic year 2025. It is mentionable here that the last version of the textbook developed according to the curriculum 2012 has been taken as the basis. Meticulous attention has been paid to the textbook to make it more learner-friendly and error-free. However, any suggestions for further improvement of this book will be appreciated.

Finally, I would like to thank all of those who have contributed to the book as writers, editors, reviewers, illustrators and graphic designers.

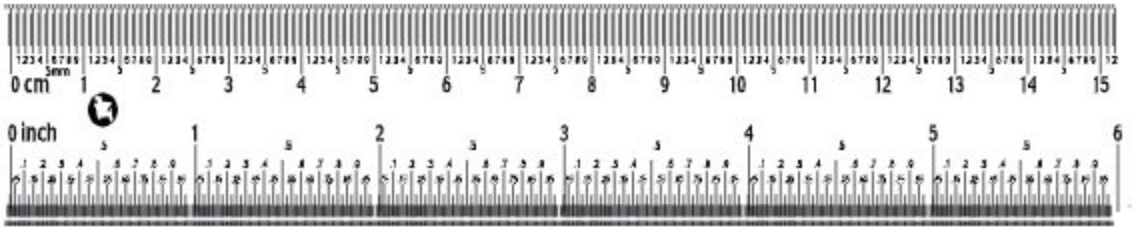
October 2024

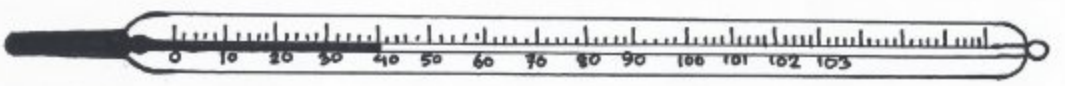
Prof. Dr. A K M Reazul Hassan
Chairman
National Curriculum and Textbook Board, Bangladesh

CONTENTS

CHAPTER ONE
Scientific Proccess and Measurment

We are to find out the answers to various questions in our daily life. We often need to answer questions such as, "What is your height?", "What is your weight?", "What is the time now?" or "What is the temperature today?". In order to answer these questions, measurements of height, weight, time and temperature are vital. We are dependent on such measurements in our day to day life. Actually we can quantify things through measurements. Measurement is the process of determining the ratio of a physical quantity. We are familiar with various forms of measuring things in different situations of our life. For example, we have to depend on measurements while buying rice or cooking oil from the grocers or putting orders to our tailors for making clothes.





By the end of this chapter we will be able to-

- explain the scientific process and experiments.
- explain the various steps of scientific process.
- explain the necessity of measurements and importance of units.
- explain fundamental and derived units.
- measure length, mass and time.
- measure the volume of different sizes of solid.
- measure the volume of liquid.
- measure the temperature.

LESSON 1: WHAT IS SCIENCE?

The word "science" means specialized knowledge. Do you know what knowledge is? Information, data, and skills about a subject, along with the understanding of that subject, make up the knowledge of that subject. So, what is science about? Science is the knowledge about nature and various natural phenomena. You have previously learned about different living and non-living things. Additionally, you have learned about various natural phenomena, such as how rain occurs, how plants prepare food, etc. All these are parts of science.

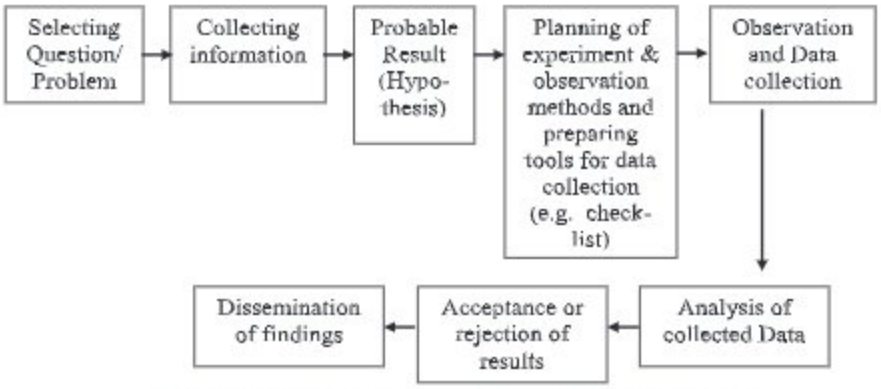
However, any information or perception about nature is not science. If someone gives an imaginative explanation of a natural phenomenon, it is not science. To be scientific knowledge, it must be obtained either through experimentation or observation, or it must be supported by data obtained from experiments or observations. You might have heard many stories about how rain occurs. But are such explanations science? No, such explanations are not science because they are not derived from experiments or supported by any experiments.

How do we acquire this knowledge? We acquire scientific knowledge through experiments, observations, and logical thinking. These are the processes of science. Just as knowledge is science, the process of acquiring knowledge is also science.

For acquiring scientific knowledge, scientific processes are needed, as well as a scientific attitude or mindset, which means thinking logically. Valuing others' opinions and admitting one's own mistakes are essential in this regard. This is also known as a scientific attitude. So, what can science be defined as? Science is the knowledge about nature and natural phenomena, which is obtained from observations and experiments or supported by experiments, and a scientific mindset. Scientific knowledge is important, and so is the process of acquiring knowledge. And the most important is the scientific attitude.

STEPS OF SCIENTIFIC PROCESS

Is there only one particular process or more than one processes to acquire the knowledge of science? Different scientists enquired the scientific knowledge in different methods and systems. But there were similarities among them in many areas. On the basis of those similarities, scientific process may be illustrated as follows:



Flow Chart : Steps of scientific process

LESSONS 2-3: EXPERIMENT

Experiment is an important method of finding new knowledge in science. In this method, a scientist, at first, takes a probable decision (hypothesis) in the light of known or existing information in order to answer a certain question. Then, he verifies the validity of the hypothetical decision through experiments. If the hypothesis is not supported by the data, he may decide to take a new probable decision. After that he again verifies the new decision through further exprements. The main characteristic of experimental method is in it only one variable is changed keeping all the other constant. The various steps of experimental method are described below.

Experiment: The experiment on whether water is necessary for a plant to survive.

Things required for the experiment: Two small pots, two flower plants, water, dry soil.

1. **Problem selection:** In the first step of the experimental method you have to select the problem. In this case the problem is, "Why does the flower plant die after being planted?"

2. **Known/existing information:** You try to gather relevant information from books or by asking questions to your teachers and parents on why plants die. You have come to know that plants may die in absence of water.

3. **Taking probable decision (potential outcome):** From the known information that you have explored so far, you take a probable decision (Hypothesis). Here the hypothesis is- without water plants die.

4. **Planning the experiment:** Now you draft a plan for conducting the experiment. Remember that, in order to conduct your experiment you will need two separate pots for the two plants. You may differentiate the two pots in terms of only one condition while rest of the conditions will be the same for both the pots. Otherwise you will not be able to attest what you are looking for.

5. **Experiment:** Take two similar small pots. It is better to take clay pots or small plastic tubs. Make small holes beneath the pots and fill them in with dry soil. Now plant two similar flower plants, one in each pot. Pour water to one pot and leave the other pot dry. Keep both the plants away from sunlight. Observe the plants on the next day. One of the plants is about to die, isn't it? The other plant looks lively and fresh.

6. **Data analysis and taking decision:** Both the pots were filled in by the same kind of soil. Both the plants were kept in the same place. The only difference between the two was supply of water. One of the plants was watered whereas the other one was not. What decision may we come to from this? We come to the decision that one of the plant is about to die due to want of water.

7. **Publication of result:** You can publish your result of the experiment in the bulletin board of your school.

These are the steps that an experimental method may involve. These are also the steps of scientific process.

LESSONS 4-5: NECESSITY OF MEASUREMENT

We usually depend on our assumptions while measuring things in various common situations in life. For example, the length of your reading table or the time you start for school, etc. In such cases you are most likely to answers the questions on the basis of your assumption.

We feel the necessity of valid measurement in some sphere of our life. Take the examples of purchasing rice or 'dal' from the grocers, making clothes, or starting and finishing classes in time. In each of these cases, it is essential to measure accurately. Without proper measurement it is difficult to decide how many pairs of table-bench will be accommodated in a class-room, how many rooms can be built within the certain area of a house or which room will be of what size. Moreover, while cooking, it is essential to add exact amount of spices to the curry. Life saving medicine is also manufactured by following specific measurements and patients have to take medicines in exact amounts as prescribed by the physician. In fact, proper measurement is necessary in every sphere of our life.

Task: Make a list of ten events of your daily life where accurate measurement is essential.

UNITS OF MEASUREMENT

Task: Each of you will measure the length of a piece of rope (about 20 ft) using your hand as the scale. What results have you got? How long is the rope as each of you have measured it? As the size of each of your hand is different, you will have different results every time a member of your group measures the rope.

As a result, one student might say that the rope is 16 hands long while another student finding it 17 hands long.

What decision can we reach from the above exercise? How this difference in measurement can be eliminated? Basically a standard amount is considered in measurement in order to eliminate this type of difference. A suitable quantity (or a minimal fraction) of measuring something is considered as a standard. This known small fractional quantity of the standard is the unit of measurement.

Generally while measuring something, a certain fraction of the measurable article is considered as standard. In case of measuring the length a convenient length, in case of measuring the mass a convenient mass and in case of measuring the time a convenient time is considered to be a standard. The length, mass, time and temperature of various things are measured in terms of the respective standard quantity.

In each case of measurement, the result is expressed by a unit. For example, let us think that you are measuring the length of a room. You have found that the room is 10 meters in length. But if you say the room-length is only 10, it will not mean anything. Hence, in order to express measurement of any quantity there must be one magnitude (number) and one unit.

Task: At least 10 of you measure the length of your classroom each by your own foot and write the results in a table.

LESSON 6: FUNDAMENTAL AND DERIVED UNITS

What we measure is generally called a quantity. For example, the length of a table is a quantity, and height is a quantity. There are different units for measuring these quantities. Any unit can be used to directly measure something. For example, the length of an object can be directly measured with units. The units of length, mass, time, temperature, electric current, luminous intensity, and the amount of substance are currently considered fundamental units. Other quantities cannot be measured with just a single fundamental unit. For example, measuring the area of a classroom depends on the product of two units of length. In the case of volume, the product of three units is needed. These combined units are called derived units. For example, the unit of area is the product of the units of length and width. Similarly, the unit of volume is the product of the units of length, width, and height of an object. The unit of velocity is the ratio of the unit of length to the unit of time.

INTERNATIONAL SYSTEM OF UNIT

There exist various systems of unit for measurement. For example, the question, "What is your height?" can be answered in a number of ways. Usually, may answer this question by saying the length such as, "5 ft 4 inch". Again, while filling in the form for the passport or national identity card, we have to mention our height and we write our height as "1 meter 67 centimeters". What does it mean? There are various systems of unit for measurement. These are conventionally named as Meter, Kilogram, Second, Foot, Pound, Second and Centimeter, Gram, Second system and these different systems of unit are followed in different countries of the world. That means, different countries would use different units to measure the same quantity. Considering the problems caused by these differences in unit for measurement, one common system of unit was introduced for all the countries of the world in 1960. This is known as S. I, or, International System of Unit. In this system one particular unit is fixed for a quantity of all physical quantities. For example, as per the S.I: the unit of length is meter, the unit of mass is kilogram, the unit of time is second, the unit of temperature is Kelvin, the unit of electric charge is columb, the unit of luminous intensity is candela and the unit of amount of substance is mole. These are known as fundamental units in S.I. system.

Unit of length

At present in international system of unit is used for measurement of length. In this system the unit of length is meter. In 1875 the scientists of different countries sat together and fixed the length of one meter. They marked both the end of a rod made by mixed metal of platinum iridium. They fixed the distance between those two points at zero degree Celsius as one meter.

The multiples and sub-multiples of length unit

When we measure the length of a cloth, a table or a room then we use meter as a unit. But to measure the length of a pencil we use centimeter (cm). Again, when we measure the thickness of a coin, we use a smaller unit than the previous ones and that unit is called millimeter (mm).

On the other hand, while measuring a long distance (For example: the distance between Dhaka to Sylhet), we use the unit kilometer (km). The uses of kilometer, meter, centimeters and millimeters are frequently found in our everyday situation. The relationship among these units are shown below:

1 kilometer (km) = 1,000 meter (m)
1 meter (m) = 100 centimeter (cm)
1 centimeter (cm) = 10 millimeter (mm)

LESSON 7: UNIT OF MASS

As per the international system of unit, the unit of mass is kilogram. In short form it is written as kg. The fixed mass kept in the office of International Association of weight and measurement situated at Sevres in French is considered to be the standard of kilogram. The used unit of smaller mass is gram. On the other hand in case of measuring big bodies, quintal and metric ton are used as units.

1 metric ton = 10 quintal 1 kilogram = 1000 gram	1 quintal = 100 kilogram 1 gram = 1000 milligram

Unit of Time

As described earlier The unit of time is second in all the systems of units. But the multiple unit of second (For example: minute, hour, day, month, year etc.) rather than second itself is used more in our real life. The time taken by the earth to rotate once round its own axis is equivalent to one day. The one twenty-fourth part of a day is one hour and the one sixtieth part of an hour is one minute. The one sixtieth part of a minute is our fundamental unit of time that is one second. Hence,

1 day = 24 hour
1 hour = 60 minutes
1 minute = 60 seconds

LESSONS 8-9: MEASUREMENT OF LENGTH, MASS AND TIME

Measurement of length

Task: First draw a straight line on white paper. Now place a scale on the line. measure the length of the straight line. Make sure to fix your eye at the correct position.

Correct method Wrong method

Fig.1.1 Measurement of length

Task: Make a pile of some 50 paisa coins as shown in the picture and measure the height of the pile.
Total no. of coins =
Total height =
Thickness of a coin =

Fig. 1.2: Determination of the thickness of a coin

Measurement of mass:

Task: Put a weight of 100 gram on the left pan of the balance. Now give marbles one after another on the right pan of the balance until the left and right pan of the balance becomes equilibrium.
100 gram = ... numbers of marble
Hence, the mass of 1 marble = ..., gram

Timestamping

Task: Set a stick vertically in your school ground in the sun-light as shown in the figure. You will observe that a shadow of the vertical stick is formed. Now put a mark at the end point of the shadow and record the time using a clock. Go and observe the shadow after each period, put a mark at the end point every time you observe and write the time. In this way make a sun clock by marking the shadows of the stick every one hour and keeping a record of the times when the shadow was marked. With this sun clock, you will be able to tell the time by looking at the position of the shadow.

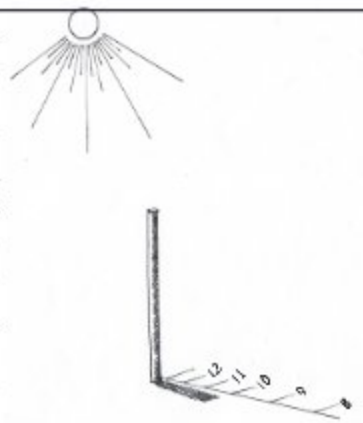


Fig. 1.3 : Sun-clock

LESSON 10: AREA AND ITS MEASUREMENT

Put your class six mathematics book on your study table. Now try to see how many books of similar size can be placed side-by-side on the table. Again, can you tell how many tables of the size of your study table can be accommodated in your reading room? Are you confused thinking how to solve this problem? In fact, you need to determine the area of your study table in order to solve this problem. By measuring the area you will be able to know how much space is occupied by the surface of the table and the floor of the room. In order to measure the area you are to multiply the length with the breadth. Hence,

Rectangular area = length x breadth

LESSON 11: VOLUME AND ITS MEASUREMENT

It is generally comprehensible that your geometry-box occupies lesser space than your science book. Again two bricks occupy more space than that of one. The space occupied by a body is known as its volume. So we can say that the volume of the geometry-box is less than that of the science book or the volume of one brick is less than the volume of two bricks. To get volume we are to multiply the area with the height.

volume = area x height = length x breadth x height

In international system of unit the unit, of volume is cubic-meter. The space occupied by a cubical body of 1 meter length, 1 meter breadth and 1 meter height is equal to 1 cubic-meter (m^3). 1 cubic-meter = 1 meter x 1 meter x 1 meter. In C.G.S system the unit of volume is cubic-centimeter. In short it is cc (cubic-centimeter). The volume of a liquid is measured in liter. 1000 cc = 1 liter . One cc is also called as one milliliter. Hence, 1 liter = 1000 cc = 1000 milliliter.

Measuring the volume of solids of different size

It is easy to determine the volume of regular cubic shaped body like brick or classroom by measuring their length, breadth and height and multiplying them. But how the volume of a body of irregular shape can be determined?

Task: First we will measure the volume of a regular shaped body so that we become confident about using this method through verification. Tie a rectangular piece of brick with a thread. Now take water in a measuring flask and mark the water level. Keep record of the water level. Now immerse the piece of brick in the measuring flask by the help of the thread and take the reading of water level again. The volume of the rectangular piece of brick can be found from the difference between the two readings. Now to find out the volume of the rectangular brick, measure the length, breadth and height of the brick by a scale and compare the two result. Now immerse two irregular shaped solid bodies-one at a time only, in the measuring flask to measure their volume. Determine their volume by calculating the differences of the readings separately.

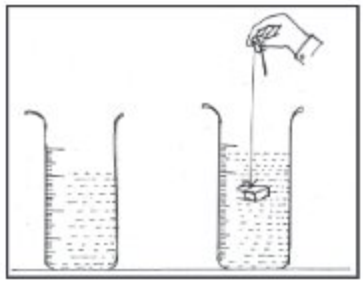


Fig 1.4 : Measuring flask

Precaution: The reading of the measuring flask should be recorded carefully. Firstly, the measuring flask must be placed vertically on a plane surface. Secondly, eye should be placed parallel to the water surface at the time of taking reading.

LESSON 12: DETERMINATION OF THE VOLUME OF LIQUID

Usually we use a line-marked measuring flask to determine the volume of a liquid. Use the measuring flask below to measure the volume of liquids is the other cylin- ders and write the results in your notebook.

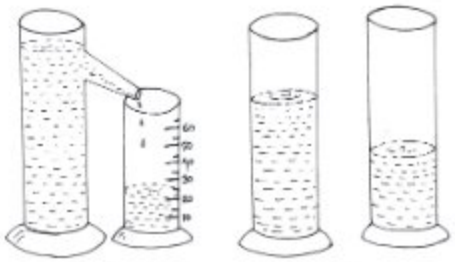


Fig 1.5: Volume of liquid

Measurement of temperature

Probably you are familiar with the word 'temperature' in various ways. For example: the day's temperature is reported in television or radio news. Moreover, we have to often measure the temperature of someone suffering from fever. As per the international system of measurement, the unit of temperature is Kelvin.

However, Celcius or Fahrenheit unit is widely used all over the world till now for practical purposes, especially to determine day's temperature or fever.

Task: At first, take a clinical thermometer. Now try to understand how temperature can be determined by it. Usually, this thermometer is scaled by line-marks ranging from 94 to 108 degree Fahrenheit. Even some of the thermometers are simultaneously scaled by line-marks from 35 to 42 degree Celsius. You will see a mercury column inside the thermometer. It rises up with the increasing temperature. Now place the thermometer under your armpit or tongue and leave it there for one minute. Observe the thermometer after one minute. Can you see any change taking place in the height of the mercury column? From this you will be able to measure your body- temperature.

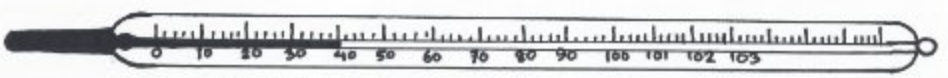


Fig 1.6 : Thermometer

New words: measurement, fundamental units, derived units, S.I system, metric ton, quintal.

What we have learnt in this chapter

- Accurate measurement is essential in every sphere of our life.

- One known fractional amount or quantity of a standard is considered to be the unit of measurement.
- There are seven fundamental units.
- Derived units. are formed by adding more than one fundamental unit.

EXERCISES

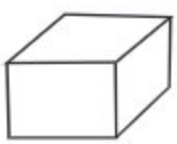
Fill in the gaps

1. There are two types of unit of measurements _____ and _____.
2. As per the international system the number of fundamental S.I units is _____.
3. In all the systems of measurement the unit of time is _____.

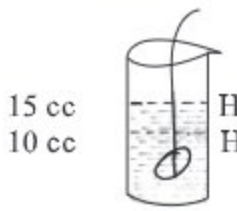
Multiple choice questions

1. Which one is the unit of mass?
   a) kilometer b) kilogram
   c) kelvin d) candela
2. The space occupied by a brick is called.....
   a) area b) volume
   c) mass d) length

Answer questions 3 and 4 from the figures below.



A



B

3. What is the volume of the stone in fig B.
   a) 5 cc b) 10 cc
   c) 15 cc d) 20 cc

4. To determine the volume of the substance in fig A, multiplication of how many units is required?
   a) One b) Two
   c) Three d) Four

Short answer questions

1. Why is correct measurement necessary in every field? What is the problem if it is not measured correctly.
2. What are the fundamental units?

3. Why are the multiples and sub-multiples of units necessary?
4. What is the main difference between area and volume in case of measurement?

Mathematical problems

1. The length of a rectangular surface is 5 meters and breadth is 4 meters. What is the area of the surface?
2. The area of a room is 20 square meters. If the length of the room is 5 meters then what will be the breadth of the room?
3. A box is 20 cm long, 10 cm broad and 5 cm high. What is the volume of 100 similar boxes?

Creative questions

1. The area of Farhan's reading room is 40 square meters and its length is 10 metres. The length of his reading table is 1 meter and breadth is 50 cm. Farhan's mother put another table of same size in that room.

   a. What is the unit of length?
   b. Why is it essential to measure?
   c. What is the breadth of Farhan's reading room?
   d. How much area will remain unoccupied in the room after keeping the two tables?

2. Hossain Uddin Sarker is an exporter. He has exported 5 metric tons of jute in this year. Now he uses M.K.S system though he used to follow F.P.S system previously for business and commercial purposes.

   a. What is candela?
   b. Explain derived unit?
   c. How many kilograms of jute was exported this year by Hossain Uddin Sarker.
   d. Which system is advantageous between the two systems mentioned in the above stem? Analyse your decision.

CHAPTER TWO

Living World

This world is incredibly diverse. If we just look around, we can see wonderful examples of this diversity. Among these objects, some have life, while others do not. Chairs, tables, plants, buildings, cars, glasses, pens are examples of inanimate objects. On the other hand, humans, cows, trees, fish, mosquitoes, ants are examples of living organisms. There are also some living organisms that cannot be seen with the naked eye, such as bacteria, amoeba, etc. From small to large, from soil to water, the living world is made up of various types of organisms present in the air. This chapter discusses all these.

By the end of this chapter we will be able to –

- explain the main characteristics of life.
- classify the living organisms on the basis of their main characteristics.
- explain the characteristics of flowering and non flowering plants.
- differentiate between vertebrates and invertebrates.
- be aware of the living world around us and realize its importance.
- classify the organisms or living things around school campus and make posters on them.

LESSON 1: WHAT IS A LIVING BEING?

An entity that has life is called a living organism. For example: plants, cows, fish, insects, mushrooms, bacteria, etc. But if we ask the question, what is life? It is not possible to answer this question in one word. To define life, we must mention several characteristics of living organisms. Those who exhibit these characteristics are identified as living organisms. The characteristics exhibited by a living organism are discussed below.

Figure 2.1: Some animate and inanimate objects

LESSON 2: MAIN CHARACTERISTICS OF LIVING BEINGS

1. Nutrient Acquisition: Living organisms obtain nutrition to survive. They gain nutrients from food. Some organisms produce their own food; they are autotrophs. On the other hand, heterotrophic organisms gain nutrition by consuming other organisms.

2. Growth and Development: Living organisms grow. Each organism is made up of structural units called cells. Over time, through biological processes, the number of cells in the organism's body increases, leading to growth and development into a fully mature organism.

3. Energy Conversion: Living organisms transform the energy produced in their bodies. For example, the energy produced in an animal's body is used for various functions of the body.

4. Reproduction: Reproduction occurs in living beings. Through this process, living beings propagate their species. Humans propagate their lineage through the production of Childs.

5. Response to Environment: Living beings respond to changes in the external environment. When a mosquito sits on our body, we are eager to kill it. Plants grown in dark environments, grow rapidly towards light to find light.

6. Adaptation: Each living organism has the ability to adapt. To survive in the changes of the environment, organisms have acquired adaptive abilities over thousands of years. For example, most plants that grow in deserts have flat and spiny leaves. These characteristics help them conserve water. These features have been incorporated into plants through long-term adaptation.

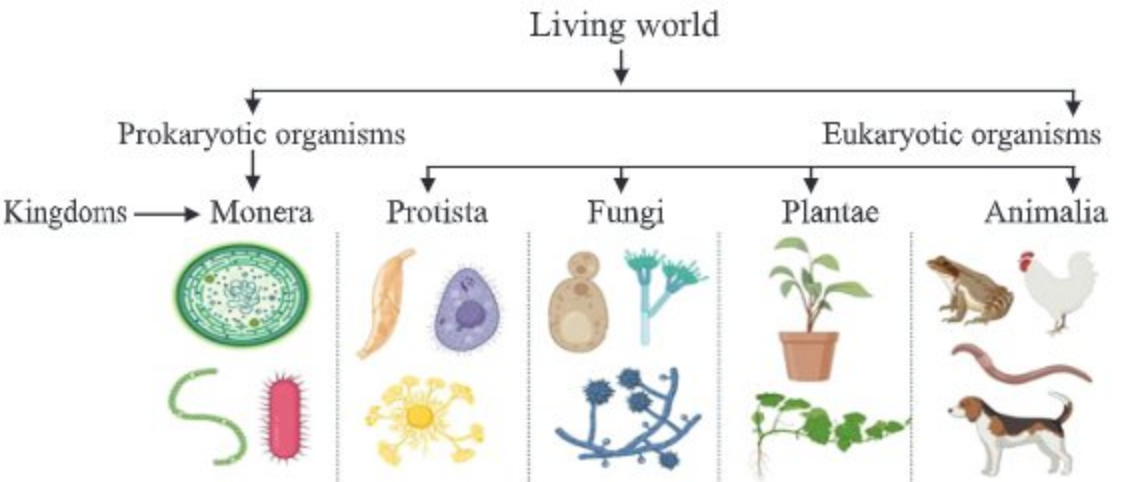
These mentioned characteristics are seen in all living organisms. On the other hand, these characteristics are not observed in inanimate objects.

Figure 2.2: Food intake of organisms

Activity: Group work
Collect a plant from your surroundings. Write the characteristics of living things on the poster paper and display it on the board.

LESSON-3: CLASSIFICATION OF LIVING BEINGS

According to scientists, there are approximately 8.7 million different species of living organisms on Earth. To understand this diverse array of organisms more easily, scientists have attempted to classify all living organisms on Earth based on their characteristics. In 1969, scientist Whittaker introduced the five-kingdom classification system. In 1974, scientist Margulis reorganized this classification and introduced the modern classification system of the living world. The modern classification system is as follows:



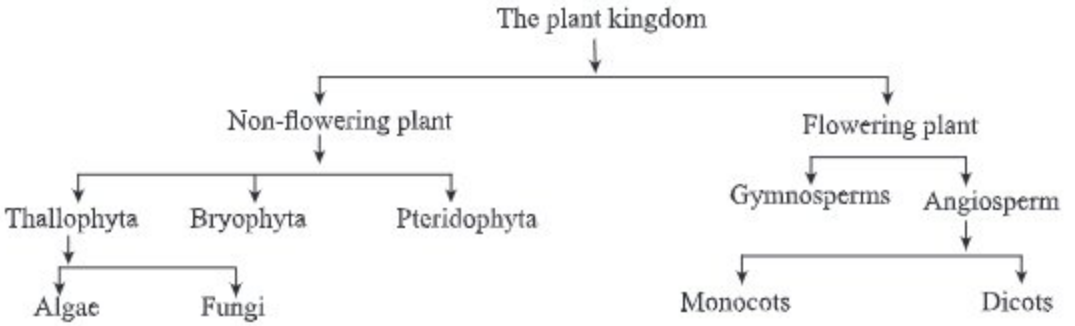
kingdom-1: Monera: The characteristics of the organisms classified under this kingdom are a) The organism is unicellular and lacks a well-defined nucleus in its cells. b) They are very small and cannot be seen without a microscope. Examples: Bacteria, Cyanobacteria, Spirogyra, etc.

Kingdom-2: Protista: Organisms classified under this kingdom have cells with a well-defined nucleus. They can be unicellular or multicellular. They may contain chlorophyll and exist individually or in groups. Examples: Euglena, Amoeba, etc.

Kingdom-3: Fungi: Their bodies have a well-defined nucleus. They are usually unicellular or multicellular. They do not contain chlorophyll, so they are heterotrophic. Examples: Yeast, Penicillium, mushrooms, etc.

Kingdom-4: Plantae (Plant Kingdom): Most plants can produce their own food. Their bodies are made up of numerous cells. Their cell walls are made of cellulose. Their cells have a well-defined nucleus and vacuoles. Plants have chlorophyll, so they can produce food. Examples: Mango, Jamun, Jackfruit, etc.

The vast plant kingdom can be further divided into various groups based on their characteristics. According to the natural classification by George Bentham and Dalton Hooker, the plant kingdom is divided into the following groups.



Non-flowering plant

Plants that do not produce flowers, fruits and seeds are called non-flowering plants. Example: moss, fern etc. They reproduce by spores. Non-flowering plants are divided into three groups.

Thallophyta: The body of these plants cannot be divided into roots, stems and leaves. Among them, those that have chlorophyll, so they can make their own food, are algae. Example: Spirogyra. And those who do not have chlorophyll in their body, so they cannot make their own food, they are fungi. Example: Agaricus.

Spirogyra

Agaricus

Figure 2-3: Thallophyta

Bryophyta: Their bodies can be divided into stems and leaves. But they do not have roots, instead of roots they have rhizoids. Usually, they grow on soft linings like carpets on old wet walls. For example: Bryam.

Fern Plants: The Fern plant body is divided into root, stem and leaves. They have transport tissue in their body and young leaves are coiled. They can be found growing in semi-shaded areas near houses and on the walls of old buildings. For example: Terris.

Fig -2.5 : Moss and Fern

Task : Collect some Dryopteris, Red amarnath (lal shak), bottle groud leaves, wheat and mustard plants, mushroom etc. Write which of them is not fern.

Flowering plants

Plants are divided into flowering and non-flowering depending on the presence and absence of flowers. Plants that produce flowers are called flowering plants. For example: Mango, Jackfruit, Paddy, Coconut etc. Their bodies are clearly divided into roots, stems and leaves. They are reproduced through the process of pollination through flowers. Depending on the seed coat, flowering plants are further divided into gymnosperms and angiosperms. Flowers of gymnosperms do not produce fruit because they do not have an ovary. So the seeds remain naked. Example: Cycas, Pinus etc. And because the flowers of the herbaceous plants have a uterus, the fruits are produced and the seeds are covered. Example: Mango, blackberries, Betel nut etc.

Figure 2-5: Herbaceous plants

Figure 2-6: Gymnosperms

Kingdom-5: Animalia (Animal Kingdom): The cells of these organisms do not have a cell wall made of cellulose. Generally, these cells also lack plastids. Therefore, they directly or indirectly depend on plants for food. Examples: Fish, birds, cows, humans, etc.

The animal kingdom can be divided in various ways. Based on the presence of a backbone, the animal kingdom is divided into two groups: vertebrates and invertebrates. Fish, frogs, birds, lizards, cows, goats, humans, etc., have a backbone, and thus they are called vertebrates. Mosquitoes, flies, butterflies, shrimp, crabs, earthworms, etc., do not have a backbone and are called invertebrates.

Task: Make Some groups of 4 - 5 students. Each group will go around the school campus and make a list of the animals they have seen. Now divide the animals that have been seen into invertebrates and vertebrates and present the list to the whole class. Other students may ask questions on relevant issues.

Invertebrates Animals

Invertebrates do not have vertebral columns. These animals do not have any skeleton. Their eyes are simple. Sometimes they have many small eyes gathered together into one eye, which is a compound eye. They do not have tails.

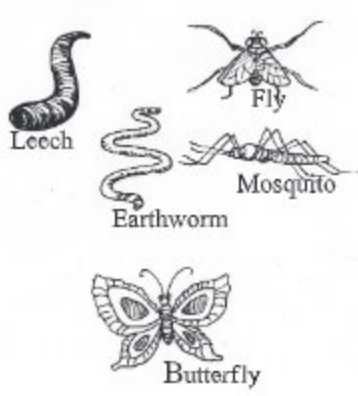


Fig 2.7 : Some invertibrate animals

Invertebrates can be of different kinds. Many of them are so tiny in size that they cannot be seen with bare eyes. Amoeba is an example of such animal. Earth worm and leech belong to another group of animal. Their bodies are divided into many segments. Snail and oyster fall into yet another group. Their bodies are not segmented and usually covered with hard shells. They have muscular foot. Butterfly, mosquito, fly, cockroach, white ant, bee etc. are insects. In the animal kingdom this kind of animals are the largest in number. Their body is divided into three parts e.g. head, thorax and abdomen. They have joint foot and compound eyes. Some of these insects are useful. They are called useful insects. Examples: bee, silk worm etc. On the contrary, mosquito and fly spread various diseases among us. Some other insects such as white ant, leda insect, rice hispa etc. cause damages to our houses, furniture and crops. There are some marine animals whose integument is spiny. Star fish and

sea urchins belong to this group. Jelly fish and corals are different types of invertebrates. They have a body cavity coelenteron. They have a single opening which is used for both intaking food and expelling off wastes.

Vertebrates Animals

they have vertebral columns, skeletons within the bodies. They have wings or two pairs of appendages. Their eyes are simple. Except humans, all other vertebrates have tails. They respire by gills and lungs.

Vertebrates can be divided into many classes on the basis on their diverse characteristics. All fishes belong to group named Pisces. They live in water. Most of them have scales. Examples- hilsa, ruhi, koi etc. However some of them have no scales. For example: magur, singh, tengra, boal etc. They use gills for respiration. They also have fins which they use to swim.

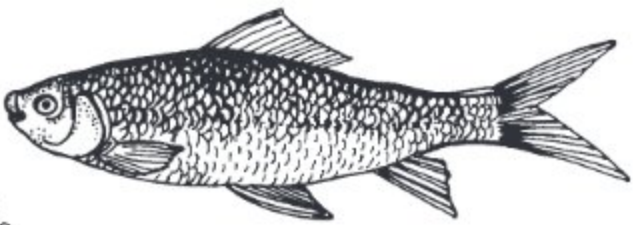


Fig - 2.8 : Ruhi fish

Frogs are Amphibians. They spend some parts of their life in water and some on the land. They do not have any hair, scales or feather on integuments. They have two pairs of legs. There is no nail on their phalanges. At the primary stage of their life cycle the tadpole respires by gill and at the adult stage they respire by lungs.

Fig- 2.9 : Toad

Wall Lizard, crocodile, snake, salamander etc. are the reptiles. These animals move by putting their weight on trunk. They have claws on their toes, lay eggs and hatch them to give birth to the young ones. They respire through lungs.

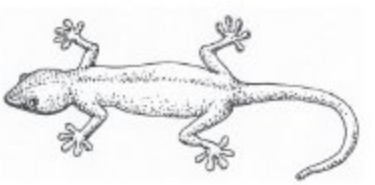


Fig- 2.10 : Lizard

Duck, chicken, pigeon, doel etc. fall under the class of Aves. Their body is covered by feathers. Having feathers is the main identifying feature of birds. Except birds, no other animals have feathers. Most of the birds can fly. Ostrich, penguin and some other birds cannot fly. Birds lay eggs. They hatch eggs to give birth to babies.

Fig- 2.11 : Duck and Hen

Monkey, rat, dog, cat, cow, goat etc. are Mammals. Humans also fall into this class of animals. Mammals have hair on their body, feed mother's milk to their babies and the female give birth to babies. Mammals are more intelligent than fish, frog, snake and bird. Their brains and bodies are well developed.

Fig- 2.12 : Man and Rat

Draw the following table in your notebook and fill it in. Put a tick mark (✓) on any one of the three characteristics corresponding to the animals listed below. For example, if Ruhi has scales, put a tick mark (✓) next to scales.

	Crow	Ruhi	Lizard	Frog	Hilsa	Dog	Chicken	Snake	Goat	Toad
Body Cover have hair										
have feather										
have scales										
Appendages have wings										
have legs										
have fins										
none of the above										
Buccal Cavity teeth are visible										
have small teeth										
have no teeth										

New words: saprophyte, parasite, holozoic.

What we have learnt in this chapter

- Living organisms can move nutrition, reproduction, respiration, sense, adaptation growth and excretion.
- The five kingdoms of living world are: Monera, Protista, Plante, Fungi and Animalia.

- Non flowering plants e.g. thallophyta, moss and fern.
- Flowering plants e.g. gymnosperms and angiosperms.

EXERCISES

Fill in the blanks

1. Snails have _____ and _____ in the body.
2. Mammal's _____ is well developed.
3. Plants have green pigments, so they are _____.
4. Fungi are non green, so they can not produce their own _____.

Multiple choice questions

1. Which kingdom does *Euglena* fall into?
   a) Monera b) Protista c) Plante d) Fungi

2. The characteristics of saprophyte is, they -

i. can produce food in presents of sunlight.
ii. absorb food for living organism.
iii. take dead organisms.

Which of the following is correct?

a) i and ii b) i and iii c) ii and iii d) i, ii and iii

Read the following text and answer questions 3 and 4

When Zayan went to his village, he saw his uncle having one type of animal as pet which has joint foot and compound eyes. It can fly and lay eggs. He saw another animal on the branch of a tree which can fly but cannot lay eggs but it suckles its young on milk.

3. Which animal did Zayan's uncle have as pet?
   a) rice hispa b) white ant c) butter fly d) bee

4. The animal on the branch ---

i. has Fingers with claws ii. has body hair iii. gives birth to babies

Which one is correct?

a) i and ii b) i and iii c) ii and iii d) i, ii and iii

Short answer questions

1. Cover a frog, a sapling, a pair of spectacles with a glass jar for 15 days. What results will you have? Write the result in your note book.
2. Write the characteristics of Amphibia.
3. What are the differences among Moss, Algae and Fern.
4. Write down the differences between invertebrata and vertebrata.
5. Write down the characteristics of Angiosperm and Gymnosperm plants.

Fig -A

Fig -B

Creative questions

1.

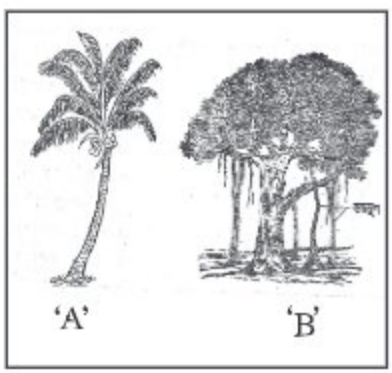
a. What are invertebrates?

b. Why is toad called amphibia. Explain.

c. Write down the differences between the animals shown in figurers A and B.

d. Discuss the importance of animal in a figure B.

2.



a. What are flowering plants?

b. Write down two characteristics of A.

c. Write down the differences between A and B.

d. Write down the importance of A in your life.

Do it yourself.

1. Complete the following tables with the names given in the list:

Tiger, Goat, Cow, Snake, Hilsha, Elephant, Whale, Lizard, Frog, Iguana, Crocodile, Rupchanda, Camel, Crow, Cuckoo, Starling, Monkey, Parakeet, Eagle, Koi, Singh, Ruhi, Deer, Jackal.

Name of the Animal	Fish	Amphibia	Reptile	Aves	Mammals

CHAPTER THREE

Cellular Organization of Plants And Animals

All visible living organisms around us, as well as microorganisms that cannot be seen with the naked eye, are composed of cells. Cells are the structural units of living organisms, and within the cells, all the biochemical activities necessary for the survival of the organism take place. In this chapter, we will try to gain a basic understanding of the cells of living organisms.

By the end of this chapter we will be able to-

- explain what is cell.
- explain the different characteristics of plant and animal cells.
- explain the role of cells in living organisms.
- understand the role of cells in living organisms.
- draw and label diagrams of plant and animal cells.

LESSON-1: CELLS

The cell is the structural and functional unit of a living organism. There are many organisms on Earth that are composed of just a single cell, such as bacteria and protozoa. On the other hand, many organisms are made up of numerous cells, such as humans, plants, and birds. Cells connect with one another to form the body of a living organism. It's like a building made of bricks.

Think of your school building. Whether it's one story or five, it's built brick by brick. So, we can say that bricks are the unit of construction for the building. Similarly, the foundation of both known and unknown small and large organisms lies in these structural units. Your entire body, your favorite pet, or the tree in the field all are built on these units as their basis of structure.

Most plant and animal bodies in the living world are composed of numerous different types of cells. These cells are involved in various physiological activities necessary for the survival of the organism. Depending on their functions, the shapes of the cells in multicellular organisms are different. For a multicellular living organism to live healthily, all types of cells need to perform their functions properly and in coordination.

Cells are microscopic entities. That means, they cannot be seen without a microscope. The English scientist Robert Hooke first observed cells under a microscope. In 1665, while examining a cork with a microscope, he saw numerous chambers arranged like a honeycomb. He named these structural units of the cork 'cells'.

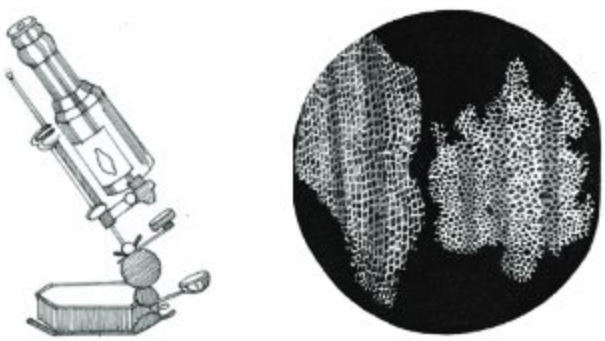


Figure 3.1 Robert Hooke's Microscope and Robert Hooke's Cell in a Bottle

Microscope

A microscope is a device that allows us to view very small objects in a larger scale. The microscope was invented in the 16th century. Later, Antonie van Leeuwenhoek played a significant role in improving the microscope. Through the efforts of many others over time, today's compound microscopes were developed. With the help of these microscopes, we can easily observe cells from unicellular bacteria to multicellular plants and animals.

Even large organisms have countless small cells. If you look at different cells through a microscope, you will see variations in their shapes. Some cells are elongated, some are spherical, some are rod-shaped, and there are various other shapes. Some cells do not have a definite shape, that means, their shape is variable.

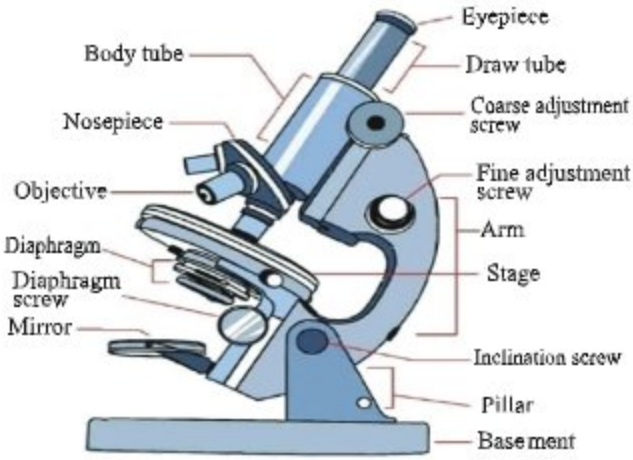


Fig- 3.2 : A compund Microscope

Task: With the help of your teacher examine different parts of the microscope and write their names in your notebook.

LESSON-2: TYPES OF CELL

On the basis of the presence or absence of nucleus, cells can mainly be divided into two types; proto cell and eucell. The nucleus is not well developed in protocells and the nuclear membrane is absent, example: bacteria. In eucell the nucleus is well developed and surrounded by nuclear membranes. Depending on their functions, the eucell can again be divided into two groups; somatic cells and reproductive cells. Somatic cells take part in growth and development of our body structure. Due to the cell division the organisms grow. Reproductive cells take part in reproduction. Many different forms of cells are found in living organisms. It is natural to find differences in the shapes and sizes of cells. Different shapes of cells include round, oval, rectangular, etc. Generally, cells are so small that they cannot be seen with naked eyes.

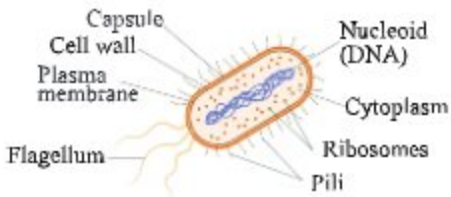


Fig. 3.3: A bacterial cell as seen under a microscope.

New words: protoplasm, somatic cells, reproductive cells, microscope.

LESSONS 3-6: STRUCTURE OF A CELL

A living cell is so tiny in size that it is not visible to the naked eye. However, people are not sitting idle. Cells can be observed very clearly with the help of microscopes. At present, the organelles of a cell can be easily observed using an electronic microscope. As a result, many small organelles have been discovered. Lets us, discuss the main parts of the cells now.

a. Cell wall: It is only present in plant cells. Animal cells do not have any cell wall. It is made up of non living materials. Some cell walls have pores in them. The function of the cell-wall is to give the cell its shape and regulate the passage of liquid materials in to and out of the cells. It also protects the inner part of the cells.

b. Protoplasm: It is a jelly-like, sticky, semi-liquid substance surrounded by cell wall. Protoplasm is the basis of life. It has three parts; cell membrane, cytoplasm and nucleus.

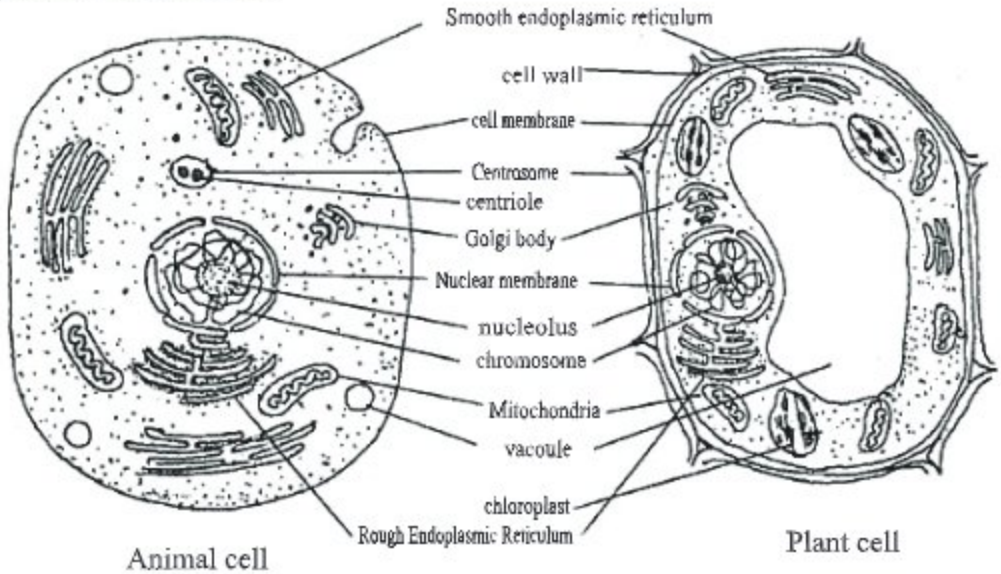


Fig- 3.2 : Plant and animal cell seen under Microscope

1. Cell membrane - The living soft membrane just below the cell wall, surrounding the whole protoplasm is called the cell membrane. It controls the flow of water, minerals and gases both in to and out of the cells.

2. Cytoplasm - It is the part of the protoplasm that remains outside the nucleus and is surrounded by cell membrane. Its function is to hold many small organelles and performs few physiological functions, such as

photosynthesis. Discussions on some organelles found in cytoplasm are given bellow.

A. Plastids: Plastids are also known as colour bearer. Generally, animal cells do not have plastids. Plastids are a unique characteristic of plant cells. The colours of plant leaves, flowers and fruits of different colours that we see are due to plastids. Green plastids help in manufacturing food. The coloured plastids make plant parts colourful and attractive. Colourless plastids store food.

> **Task:** Make a model of cell with mud so that it contains cell wall, cell membrane, plastids and nucleus.

B. Vacuole: If you examine a cell of an onion, you will see an open space inside a cell. This open space is called vacuole. In a plant cell, vacuole may be small in size or completely absent in an immature cell. But in a mature plant cell, the size of vacuole is bigger while in animal cell vacuole is absent, however, in an animal cell even it is present is very small in size. The fluid present inside the vacuole is called cell sap. Vacuole is an important characteristic of the plant cell. It acts as cell sap tank and controls any pressure applied on the cell.

C. Mitochondria : It is called the power house of the cell. Most of this energy producing reactions take place inside it. Its shape may be rod like, globuler, star like etc. Each mitochondrion is bounded by double membrane the outer one is smooth while the inner on has many foldings towards the cavity of mitochondrion. Main function of mitochondrion is to help respiration. It is the major site of respiratory activities in the cell. So it helps releasing energy through respiration. It is also called the reservoir of energy.

LESSONS 7-8: NUCLEUS

The circular dense substance suspended on protoplasm is nucleus. It controls all the physiological functions of the cell. In a newly formed cell, nucleus is located at the centre of the cell. However, in a mature cell this location may change. Nucleus is generally circular in shape; it can be also semicircular or tubular in shape under some circumstances. Some cells have no nucleus. A nucleus is usually consist of a) nuclear membrane, b) nucleoplasm, c) chromosome, and, d) nucleolus.

Nuclear membrane: This membrane surrounds the nucleus. This membrane separates cytoplasm from the nucleus and also controls the passage of materials in and out of the nucleus.

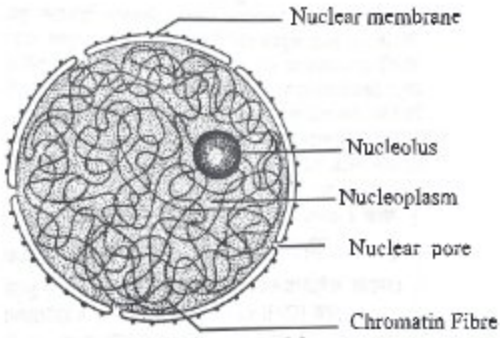


Fig - 3.5 : A Nucleus

Nucleoplasm: The transparent, liquid material inside the nucleus is nucleoplasm. It contains chromosomes and nucleolus.

Nucleolus: It is the small, dense round body that remains attached with the chromatin fibre.

Task: Make a clay-model of nucleus with chromatin fibre and nucleolus.

Chromatin fibre - The thread like coiled structure that floats in the nucleoplasm is chromatin fibre. It carries the characteristics of the organisms and passes it on to the next generation. It regulates cellular growth or any other activities.

Task: Draw a plant and an animal cell and show the deferences between them in a table.

New words: cell, chromatin fibre, nucleolus nucleoplasm, cytoplasm.

LESSONS 9-10: THE ROLE OF CELLS IN ORGANISMS

You have so far learnt about what a cell is. When a group of similar cells perform similar functions, they are known as tissue. Similarly, when a group of tissues perform the same functions, they are called an organ. Some of the important functions of cells are discussed below:

Formation of tissues: A group of similar cells sometimes group together and carry out the same functions. This group of cells forms tissues and tissue system. Their function is to help transportation and to provide balance and support to animal bodies.

Formation of organs: A group of tissues performing a particular function is called an organ. For example; root, leaves, flowers etc. Similarly, eyes, nose, face, hand, leg, heart, liver, speen, kidney, Lung etc. are different organs of animals.

Development of organism's body: An organism's life originates from a small cell. Gradually, the growth of organism develops from this cell.

Preparation of food: Green plants can prepare their own food. Green plants contain a type of plastids called chloroplasts which help them prepare carbohydrates in the presence of sunlight, water and carbon dioxide in air.

Formation of energy : Energy is needed for life. Organisms derive this energy from food.

Conservation of food and water: Some plant cells can store water in them. Some cells can also store food. for example; potato phylloclade (phonimonosa) etc.

Secretion of necessary enzymes and fluids: There are some special cells in animals that secrets necessary enzymes and fluids, for example; bile, insulin, gastric juice etc.

Things learnt from this chapter

- The structural and functional unit of life is called cell.
- Our body is made up of millions of cells.
- Cells can mainly be divided into two types; protocells and eucells.
- Cytoplasm and nucleus combine together to form the protoplasm.
- Cytoplasm of a plant cell contains plastids, cell, vacuole etc.

EXERCISES

Fill in the blanks

1. _____ cells have cell wall.
2. Plastids are characteristic to _____ cells.
3. Generally _____ cells do not have cell vacuole.
4. Cell wall is made up of _____ materials.
5. There is nucleolus and chromosomes in _____.

Short answer questions

1. Draw and label an animal cell in your notebook.

2. Explain the characteristics of plastids.
3. Name some organelles that are present in plant cells but absent in animal cells, and some that are present in animal cells but absent in plant cells.

Multiple choice questions

1. The onion cell is a plant cell because it has

(i) Cell wall (ii) No plastids

(iii) No cell vacuole (iv) Mitochondrion

2. Who discovered cell?

(i) Isaac Newton (ii) Robert Hooke

(iii) Lewin Hooke (iv) Carolus Linius

3. What is the function of nucleus?

(i) To maintain the shape and size of cell (ii) to act as food reserve

(iii) to control all the functions of the cell (iv) to hold the protoplasm

Creative questions

1. Ayaz went to the botanical garden with her father. She saw plants of different colours. After that she went to a nearby zoo. There she saw different animals.

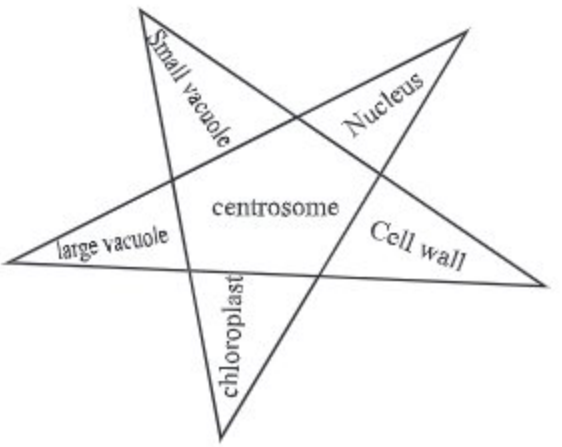
a. What is nucleus?

b. What is the power house of a cell? Describe it.

c. Explain the cause of plants of different coloures observed by Ayaz.

d. Write the identifying characteristics of the organisms that Ayaz saw.

2.



a. What is cell?

b. What do you mean by reproductive cell?

c. Draw a labelled diagram of animal cell using the organelles given in the star.

d. Which of the organelles shown is responsible for manufacturing food in a plants? Explain with diagram.

Do it yourself

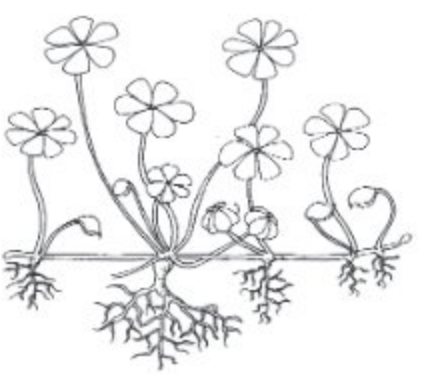
1. Make a model of a cell with clay and highlight its different parts by using flags.

2. Form a group and write down the importance of plant cells and present it to the class.

CHAPTER FOUR

Morphology of Plants

You have already learnt about the characteristics and classification of plants. You have also learnt that higher plants can be divided into two types such as, gymnosperms and angiosperms. In this chapter we will learn about the external features of angiosperms, considering them as ideal plants. We will also learn about the locations of different parts of flowering plants and discuss the types, functions and the contributions of the main parts of plants in human life.



By the end of this chapter we will be able to-

- explain the external features of plants.
- explain the main features of roots, its parts, types and functions.
- explain the features, different parts, types and functions of stem.
- explain the features, different parts, types and functions of leaves.
- explain the use and importance of roots, stem and leaves.
- understand the need for developing sympathetic attitude towards plants and animals.

LESSON 1: EXTERNAL STRUCTURE OF AN IDEAL FLOWERING PLANT

We can see numerous plants around us. Significant differences are observed among their size and shape. Some plants have roots, stems and leaves. They have fruits, flowers and seeds. They are flowering plants, for example; mango, black berry, gram, bottle gourd, paddy, wheat plants etc. Paddy, wheat, grass plants etc. are monocotyledonous; while mango, jackfruit, mustard and chilli plants are dicotyledonous. Closed seed flowering plants are as considered ideal plants.

Different Parts of a typical flowering plant

An ideal flowering plant can be divided into root, stem, leaves, flower and fruit etc.

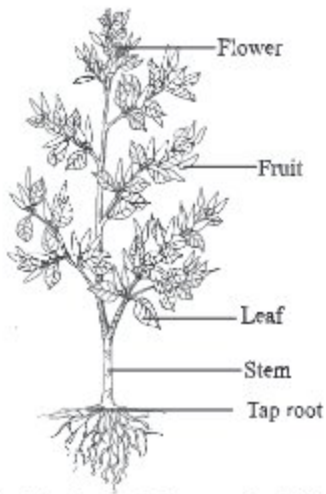


Fig 4.1 : External feature of a chilli plant

Shoot: The part of the plant that remains above the soil is called shoot. Shoot consists of stem, leaves, flower and fruit. The stem has node, inter node and apical bud. The flowers grow at the axis of the leaves. Flowers have calyx, androcium, corolla and ovary. Let us examine the parts using the diagram of the chilli plant given.

1. Stem: It is the part of the plant connected to the tap root and remains above the soil. Stem has node and inter node. Leaves originate from the nodes. Stem bears the weight of leaves and branches.

2. Leaves: It is a thin, extended green outgrowth of the stem and the branches. Food is produced in the leaves.

3. Flower: In chilli plant, small white flowers grow out of the axis of the leaves. These flowers mature into fruit, e.g. chilli.

4. Fruit: When flower matures, it falls off. The remaining part of the base of the fallen flower becomes fruit. After maturity, ovary turns into fruit. The fruit of the chilli plant is the chilli itself.

5. Root: The part of the plant with no node, inter node and apical bud is the root. Generally, people think that the part of the plant that remains below the soil is the root. In most cases, this is worth saying. However, in special cases, stem, leaves, flower and fruit grows under the soil. For example; ginger, turmeric, onion etc. You will learn more about it in higher class.

Task: Pluck a small plant with its root. Now draw a labelled diagram of the plant showing its different parts.

Roots usually develop from radicle. Leaves, fruits or flowers do not grow on roots. Roots, generally grow downwards. The radicle grows into the tap root. Secondary root originates from tap (primary) roots; similarly, tertiary root originates from secondary roots.

New words: ideal flowering plant, shoot, stem, node, inter node, radicle.

LESSON 2: DIFFERENT PARTS OF A TYPICAL ROOT

Root is divided into different parts. A cap-like structure at the tip of the root is the root cap. Its function is to protect the root from being damaged. The plain, smooth region behind the root cap is growth region. Growth occurs in this region. The minute, hairy region at located the back of this region is root hair region. Plant absorbs water with the help of root hair. The permanent region of root is located behind this region. From this permanent region, branches and lateral branches of the root grow.

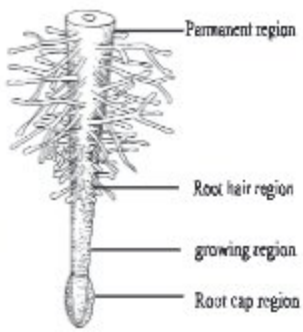


Fig- 4.2 : Different Parts of a Typical Root

New words: root hair, root cap.

LESSONS 3- 4: TYPES AND FUNCTIONS OF ROOT

Do the roots of all plants have similar characteristics and functions? Are the roots of a mango tree and paddy similar? Basically, the prop root of banyan tree is also a type of root. These roots are modified according to the need of the plants. The prop roots of banyan tree, stilt roots of screw pine tree, and aerial roots of beetle leaf plant have all been modified due to specific needs.

If you observe, you will see that the roots of all the plants are not the same. The root of a mango or chilli plant is different from that of paddy, corn or grass. Owing to such differences, roots can be mainly divided into two types in terms of their origin and location. The two types of roots are 1) Tap root and 2) Adventitious root.

1. Tap root: The radicle of this type of root grows directly as it goes down the ground and lateral branches grow out of it. For example, the roots of radish, mango, black berry, chili, mustard etc. The roots of dicotyledonous plants are tap roots.

Dicotyledonous plants have two cotyledons. The tap root system is formed by the tap root of dicotyledonous plant and its lateral roots. The root system of mango, black berry, chili, mustard and nayantara trees have this type of root.

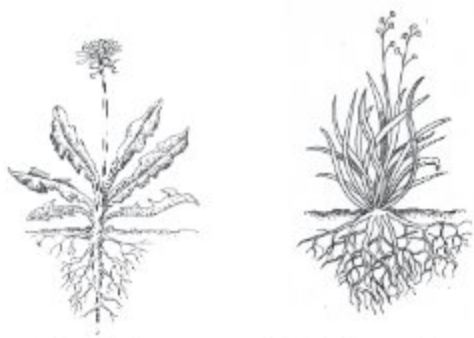


Fig-4.3 : True root and adventitious root

Task: Collect the seedlings of chilli and paddy plants. Observe the differences between them and write them down in your notebook.

2. Adventitious root: This type of roots originates not from the radicle rather from the stem and leaf. Examples of such roots are the roots of coconut, tap root of banyan tree and stilt root of screw pine tree. It is of two types - (a) Fibrous root and b) Non Fibrous root.

(a) Fibrous root: If you watch the roots of paddy, grass, bamboo etc, you will notice, a group of fibre like roots growing from the stem. These are fibrous root. This type of roots may grow when the radicle is lost and a group of fibre like roots grow from the same place. Generally fibrous root is seen in monocotyledon. Generally fibrous root is seen in monocotyledon. Examples roots of paddy, coconut and betel nut plants.

(b) Non Fibrous root: The adventitious roots that do not grow in a cluster, rather develop separately from one another are non fibrous roots. Example - Stilt root of screw pine, prop root of Banyan tree are of this kind.

Task: Pluck out a sapling of paddy, mustard, grass with their roots and observe them. Compare these roots with coconut root. Make a list about the functions of roots with your friends.

Roots usually perform the following functions:

1. The root anchors the plant firmly to the ground. Hence, the plant do not bent down readily during strong wind and storm.

2. The root helps to absorb water and minerals from the soil in different ways. We know, there is a part called hair region in a root. In this region, fine root hair grows, and plants collect water and minerals through it.

New words: primary root, tap root, adventitious root, absorb, root hair.

LESSON 5: DIFFERENT PARTS OF A STEM

When we climb up a mango or a guava tree, we do so by holding on to the long straight parts of the tree. This part is the stem of the tree. If you have experienced sitting on a tree while tasting its fruit, the long extended parts you sat on are branches. Branches are also parts of the stem. The place from which branches and leaves grow is stem. It has node, inter node and buds.

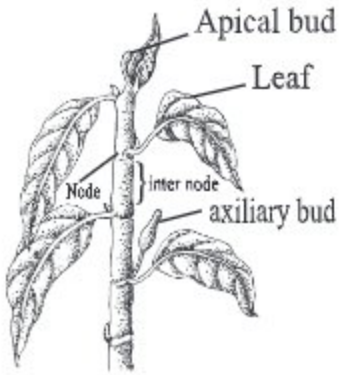


Fig - 4.4 : A stem

1. Node - The place from where the leaves grow is node.

2. Inter node - The space between two nodes is inter node. The inter node helps the plant to grow and keeps it erect. No roots, leaves or branches grow from the inter node.

3. Bud - The angle formed by the stem and the leaf is called axil of a leaf. Generally, buds grow in the axil. However, it may also grow at the apex of the stem. The axiliary bud grows in the axil and apical bud grows in the apical position of the stem or branch.

Task: Take a small branch of a tree and examine its different parts. Now draw a labelled diagram of the branch.

New words: apical bud, node, inter node, axillary bud.

LESSON 6: CLASSIFICATIONS OF STEM

Observe the stems of a mango tree, a bottle gourd plant and a coconut tree. Some are strong, some are weak and some has no branches. From this it might be understood that stems can be of several types. However, stems can be primarily divided in to two groups, e.g. strong stems and weak stem.


Fig-4.5 : Caudex, excurrent, deliquescent stem

1. Strong stem - This type of stems are strong and keep the plant erect firmly on ground e.g.

mango, berry, coconut, palm etc. Some of these stems have branches and some do not.

a) Caudex: The stem is erect, strong and has a crown of leaves at the top. Examples- coconut, palm and betel nut.

b) Branched stem

i Excurrent: This type of stems develop branches in such a way that they become a cone like structure and look like temples. The branches at the lower part of the tree are longer and the branches at the upper part become increasingly shorter. The whole tree takes the shape of a temple as it narrows down gradually from the bottom to the top. Examples of such stem include willow oak, tulip poplar, sweet gum, and southern magnolia.

ii Deliquescent: The stems of some trees are short and strong and the branches and sub branches are arranged from the stems in such a way that the trees look like domes. This types of stems are found in mango, jack fruit and berry trees.

iii Culm: In these erect and unbranched stems nodes and internodes are very distinct. Adventitious roots grow from the nodes. Examples of such stems include bamboo, sugar cane etc. In certain cases the stems could be either void or solid.

2. Weak stem: Plants with this type of stem can not stand upright and they grow either on the ground or creep on machan. Usually these stems contain no timber in them and that is why they are so weak and feeble. Some of them are trailers, some are creepers or climbers.

Fig-4.6 : Trailer stem

Fig- 4.7 : Creeper stem

i. Creepers: These Stems grow horizontally on the soil surface and produce fibrous roots from each node. Examples- doob grass (Durba), oxalis (amruli) etc.

ii. Trailer: These stems grow and spread parallel to the soil surface but do not produce roots from nodes. Examples - Basella (Puin), peas etc.

Fig-4.8 : Climber stem

iii. Climber : These are weak stems that grow upward with the help of some forms of support. Examples- betel leaf (Pan), bean etc.

Task: Go and observe a locality nearby to observe the stems of different plants. Write down which plant bears what type of stem. Classify them after returning to the class.

LESSON 7: FUNCTIONS OF STEM

Guess the functions of the stem and write down in your note book. Then compare your points with the list of functions given below.

1. Stem bears the weight of branches, leaves, flowers and fruits.
2. Stem spreads out branches and leaves in such a way that they can get enough sunlight.
3. Stem dispatches water and mineral salts to the branches, leaves, flowers and fruits.
4. When young, green stems produce a little quantity of food through photosynthesis.

New words : food storage, mechanical support, self defence, vegetative reproduction, conduction.

Task: Observe the stems of palm, mango and betel nut and make a list of their functions.

LESSON 8: DIFFERENT PARTS OF A LEAF

The laterally flat shaped organ originate from the node of the stem or its branches is leaf. Usually leaf is flat and green. Lower plants have no leaf. But in fern and moss, there are leaf-like organs, though the leaf of moss is not true leaf. An ideal leaf has three parts e.g. leaf base, petiole and lamina. Examples of such leaves can be found in mango and China rose (Jaba) plants.

Different parts of a leaf

Observing a china rose leaf will help us recognize its three parts 1) Leaf base, 2) petiole and 3) Lamina or leaf blade.

1. Leaf base: This part of the leaf is attached to the stem or the branch. In some plants a leaf like growth arises from the side of the leaf base. These are stipules. This type of stipule is noticed at the leaf base of pea.

2. Petiole: The cylinder like part of a leaf is petiole. It connects the leaf base and lamina. The petiole of lotus, shapla etc. are very long. The sial kanta leaf has no petiole.

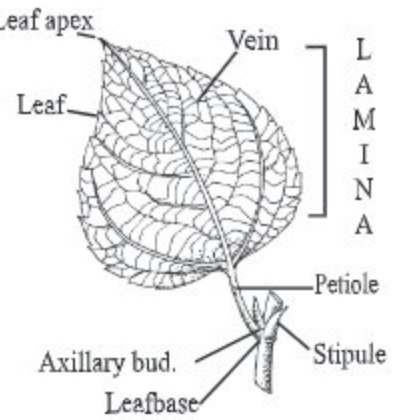


Fig-4.9 : Different parts of a leaf

Task: Collect any leaf from the surrounding area of school, observe and draw a labelled diagram of the leaf.

Petiole helps position the leaf in such a way that it can get sufficient sunlight. Moreover, its main function is to pass on the water and minerals produced in the stem to the leaf blade.

3. Lamina or Leaf blade: The flat and extended green part next to the petiole is lamina. The vein that runs from the tip of the petiole to the other end of leaf blade is mid vein. From the mid vein originates veins and vein inlets. The edge of the lamina is the leaf margin.

Functions of leaf

The general functions of a leaf are described below :

1. The main function of leaf is to produce food. It produces food through photosynthesis.

2. Gaseous exchange is an important function performed by leavess. During respiration plants intake oxygen and give out carbon di-oxide. Again when leaf manufactures food it consumes carbon di-oxide and gives out oxygen.

3. Transpiration is another important function of leaf. Plants absorb excess water. Leaves help the release of excess water in the form of vapour.

New words: leaf base, petiole, lamina.

LESSON 9: KINDS OF LEAVES

Take a mango leaf and a tamarind leaf to observe them. You will see that the lamina in the mango leaf is not lobed while the lamina in the tamarind has more than one leaflets.. On the basis of the characteristic of leaf blades, leaves can be divided in to two groups-1) Simple leaf and 2) Compound leaf.

a) Simple leaf: A Simple leaf contains only leaflet. Leaves of mango and Jack fruit trees are simple leafs. The edge of a simple leaf is either totally unbroken or moderately incised.

b) Compound leaf: Observe the leaves of rose, neem, tamarind (tetul) flametrce coconut and moringa (sajna) plants. You will see that each of these leafs has many small laminae. These are leaflets. The lamina of a compound leaf is completely divided and the divided parts make the leaflets which are separated from one another. The branch like structure bearing the leaflets is called the rachis or axis. There are different types of pinnate compound leafs. According to the arrangement of the leaflets, compound leafs are of two kinds- i) Pinnate compound leaf and ii) Palmate compound leaf.

Fag-4.10 : Different types of Pinnate Compound leaf

Fag-4.11 : Different types of Palmate Compound leaf

Now words : simple leaf, compound leaf, mid vein.

LESSON 10: IMPORTANCE OF ROOT, STEM AND LEAF IN HUMAN LIFE

We are dependent on plants in many ways. Plants provide us with food, clothes, house building materials, medicine etc. The stuff that we get from animals are also indirectly contributed by plants.

a) Uses of roots: The roots of radish, carrot, turnip etc. are used as delicious vegetables. Costly medicine is extracted from the roots of satomuli, sarpagandha etc.

b) Uses of stems: Soft stem of herbs are used as food. We eat ginger, potato, Basella stem (Pauin Data) and arum stem as vegetables and spices. Date and sugarcane stems are used to prepare delicious as well as nutritious drinks. House building materials and furniture are made of wood. We get timber from large stems. The fibre obtained from jute and hemp stems are used in making ropes, sacs, clothes etc.

c) Uses of leaves : We have different kinds of leafy vegetables including bottle gourd leaf, basilla (Paui Shak), red leaf, spinach (Palong), jute leaf (Pat Shak), kalmni leaf in our daily meals. Fibers are obtained from palm, banana and pineapple leaves. Different luxury items are made of these fibres. You must have seen roofs made of Palm leaves and Gol pata. Biri, cigarettes are manufactured from tobacco leaf. Which are injurious for health. Beautiful mats are made of date leaves. Most of you have used fans made of palm leaves. Valuable medicine is also extracted from basak, nisinda, kurchi, thankuni, Marigold leaves.

New words: root, stem, root cap, sapling, vein, lamina, petiole, inter nodes, compound leaf.

LESSON 11: ATTITUDE AND BEHAVIOUR TOWARDS PLANTS AND ANIMALS

Plants are very useful to us. For this reason we need to be very much caring towards plants. Without any reason do not destroy tress or even distort its branches. No matter whether the tree is yours or mine; trees are our national resource and a very important agent for the protection of climate. Taking care of trees is much needed to guard us against various natural calamities such as cyclone, draught and tidal bores. Let us plant more trees, take care of them and encourage others in this regard. We have to be very careful in preserving and growing more plants. It is also important to be kind to animals and birds. Domestic animals and birds provide lots of benifits to us. The animals and birds of the forest are also natural resources. We must take care of them too. Do not destroy beasts and birds unnecessarily. It is necessary to motivate all concerned in this regard.

Task: Arrange a rally to raise awareness about plants.

What we have learnt from this chapter-

- Roots absorb water and fix the plants to the soil. Roots are mainly of two types-tap root and adventitious root.

- Stems bear the weight of branch, leaf, flower and fruits. Stems are of two types, strong stem and weak stem.
- Leaf is the lateral, flatened and green part of a tree that grows from node. Leaves are of two types, simple and compound.

EXERCISES

Fill in the blanks

1. The main vein of a simple leaf is called _____.
2. A leaf that has unbroken lamina is called_____.
3. When grows up, a tap root turns into a_____root.
4. A group of fibre like roots that is formed after its radicle is lost is called___. root.

Short answer questions

1. What is petiole? Where is it located?
2. What are the general functions of leaf?
3. What is known as the main vein of leaf?
4. What is rachis or axis of a compound leaf?
5. What is compound leaf?

Multiple choice questions

1. The angle between stem and leaf is -
   a) node b) bud c) inter node d) axis

2. Sugar cane is a culm because ------.
   i) it has short and huge stem.
   ii) its has distinct node and inter node.
   iii) its adventitious roots grow form node.

   Which one is correct?

   a) i and ii b) ii and iii
   c) ii and iii d) i, ii and iii

Read the passage given below and answer questions 3 and 4.

Nafisa Khanom planted pumpkin in the first year and planted Basella (Puin) in the following year.

3. Which type of stem does the plant have that Nafisa Khanom planted in the first year?

a) grass b) creeper
c) trailer d) climber

4. Regarding the stem of the plant that Nafisa Khanom grew in the second year, it can be said that ------

i) it spreads on land
ii) it's root does not grow from node
iii) it grows upward with the help of some supports

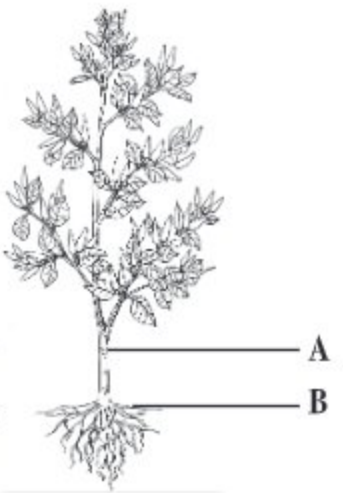
which one is correct?

a) i and ii b) i and iii
c) ii and iii d) i, ii and iii

Creative question

1.

a. What are the parts of a flowering plant?
b. What is shoot ?
c. What are the differences between A and B.
d. Discuss the importance of A and B.



2. Nohan and Nasif went to their village in the vacation. One day they walked round the village. While walking, they observed different types of stems- some of them were cone and temple shaped. So they were interested in the shapes and functions those stems.

a. What is root?
b. Describe the type of mango leaf?
c. Describe the functions of stem that Nohan and Nasif saw.
d. How will you make difference of arrangement of the branch and branchlet that Nohan and Nasif has observed. Explain.

3. Do it yourself

Go around the school campus in groups. Find out different types of stems, leaves and roots and observe which plant bears what type of root, stem and leaf. Write in your note book. Return to your classroom and classify them.

CHAPTER FIVE

Photosynthesis

Every living organism on Earth requires food to survive. Do you know where this food comes from? Generally, green plants can produce food. Besides green plants, green algae and some bacteria can also produce food. In this chapter, we will learn how green plants prepare food. Plants use the food they produce for their growth and other functions. In this chapter, we will learn how green plants produce food.

By the end of this chapter we will be able to-

- explain how plants prepare food.
- explain the dependence of the living world on photosynthesis.
- understand the contribution of plants in food production
- to be sensible toward plants.

LESSONS: 1-2: HOW PLANTS PRODUCE FOOD?

Energy is required for getting a work done either by a machine or an organism. Motor car runs on the energy produce from petrol or diesel. Fans in your classroom are also run by electricity. Energy is also essential for the movements we make and the works we do. Where does this energy come from?. We get energy from food. We know sun is the source of all energy. The biochemical process in which the green parts of plants, in the presence of sunlight, use water and carbon dioxide to produce carbohydrate food is called photosynthesis.

Green plastids inside the plant leaf take part in photosynthesis. Sunlight, carbon di- oxide and water take part in chemical reactions inside the plastid, and produce oxygen and glucose. Why is the leaf considered as the main location for photosyn- thesis? The reasons are given below:

1. As leaf is flat and extended it can absorb large amount of light and carbon di-oxide within a short time.
2. There are plenty of chlorophylls available in the leaf.
3. Leaf contains a large number of stomata that eases gaseous exchanges during photosynthesis.

LESSONS: 3-6: PROCESS OF PHOTOSYNTHESIS

Terrestrial plants absorb water from ground through their root hair. Submerged plants collect water through their body surfaces. For photosynthesis sunlight is an indispensable factor. Sun is the main source of light.

During Photosynthesis carbon di-oxide gas from the air enters the plant through stomata. There carbon di-oxide and the water inside the cell take part in chemical reaction to produce glucose. This glucose is produced using the energy that has been trapped from sunlight by chlorophylls. The process of photosynthesis can be explained by the chemical reaction given below:

$$\text{Carbon di-oxide} + \text{Water} \xrightarrow[\text{Chlorophyll}]{\text{Sun Light}} \text{Glucose} + \text{Oxygen}$$

Photosynthesis process occurs in two phases. The two phases are: (1) Light or photo phase and (2) Dark phase. You will learn about these phases in details in higher classes.

The following experiment helps you to understand the evolving of oxygen due to photosynthesis.

Experiment of evolving Oxygen in Photosynthesis:

Things required for the experiment: A glass-beaker, water, fresh Hydrilla plant, a funnel, a test tube, a glowing match stick.

Working process: Fill two thirds of the beaker with water. Place fresh Hydrilla plants in the beaker and cover them with a funnel in a way that the stems of the Hydrilla plants stay near the upper end of the funnel tube.

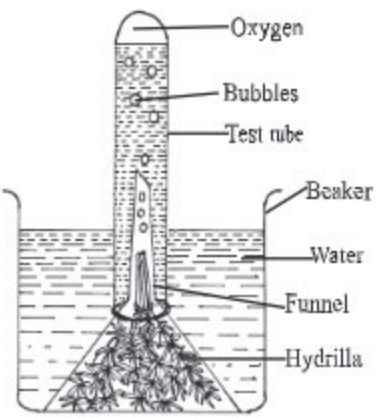


Fig: 5.1: Experiment to show that oxygen evolve during photosynthesis

Observation: After that add more water to the beaker so that the funnel tube completely goes under water. Now, fill in the test tube with water, close its opening with your thumb and invert the test tube over the funnel. Remove your thumb carefully so that water can not come out of the test tubex Now, leave the set up undisturbed in bright sunlight. After some time you will observe gas coming out in the form of bubbles from the Hydrilla plant. As gas bubbles are seen to rise and collect in the upper, closed part of the test - tube, the water level within the test tube goes

downward. When enough gas is collected, carefully remove the test tube covering the open end with your thumb. Now, as you place a glowing match stick in the test tube, it will bursts into flames. Why does the glowing stick bursts into flame? What is proved by this?

LESSON 7: SIGNIFICANCE OF PHOTOSYNTHETIC PROCESS FOR THE ANIMAL WORLD

It is through photosynthesis that a bond is established between the sun and the living world. The importance of photosynthesis can be realized from the brief description given below.

Preparation of food:

1. Carbohydrate, the primary food for the living world, is manufactured only by photosynthesis.

2. Any living organism whether it is plant or animal needs food for being active and hardworking. Because there is a close relationship between food and respiration. Energy is discharge by respiration. So plants and animals are completely depended on respiration which supplies them with heat and energy.

Gaseous exchange in environment

During photosynthesis plants absorb carbon dioxide and produce oxygen. Carbon di-oxide is harmful for animals. Plants absorb this carbon dioxide and let off essential oxygen into the atmosphere. In this way, plants filter the environment to make it pollution free.

From the above discussion it can be concluded that the existence of life is totally dependent on photosynthesis. If the process of photosynthesis comes to a close, the human civilization will undoubtedly be ruined. Therefore, we should be more mindful of our duties in protecting plants.

What we have learnt in this chapter

- Carbon di-oxide and water are absorbed again glucose and oxygen are produced through photosynthesis.
- The equlibrium of carbondioxide and oxygen are maintainted through photosynthesis.

New words: photosynthesis, carbohydrate, autotrops.

EXERCISES

Multiple choice questions

1. What type of food is produced through photosynthesis?

   a) carbohydrate b) protein

   c) fat d) Vitamin

2. The factors required for photosynthesis are -

   i. water ii. light iii. oxygen

   Which one is correct?

   a) i and ii b) i and iii

   c) ii and iii d) i, ii and iii

Read the text below and answer questions 3 and 4

Himu went to play football in the afternoon. In the field, he could see a brick laying on the grass. When he lifted the brick, he saw that the grasses under the brick had turned pale. But the grasses beyond the area of the brick were fresh and green.

3. Factor responsible for retaining the green colour of the grasses outside the brick?

   i) water ii) sunlight

   iii) carbon di-oxide

   Which of the following is correct ?

   a) i & ii b) i & iii

   c) ii & iii d) i, ii & iii

4. Impediment to which of the following process caused the grass turn pale?

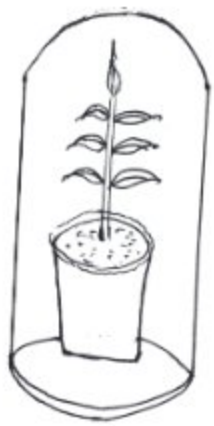
   a) diffusion b) osmosis

   c) respiration d) photosynthesis.

Creative questions

1.

P



Q

a. What is photosynthesis?

b. Why does photosynthesis occur mainly in leaf?

c. Why is the candle in bell jar P burning?

d. Will the plant in bell jar Q survive in the condition shown in the picture? Give reasons supporting your answer.

2. Carbon di-oxide + R $\xrightarrow[chloroplast]{sun\ light}$ S + water + oxygen

a. What in this world is the source of all energy?

b. Why does photosynthesis not take place at night?

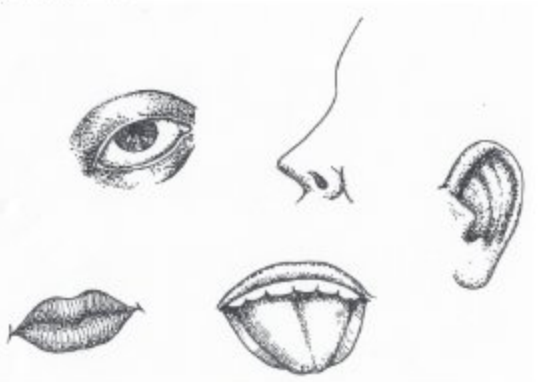
c. How is the compound S produced in the reaction given in the stem. Give explanation.

d. Analyse the importance of the above reaction in the animal world.

CHAPTER SIX

Sensory Organs

Our body is an amazing machine. This machine is so flawlessly designed that we bewildered to think of it. The different parts of our body are delicately assembled with no inconsistency. These parts of the body function instinctively to make the body work without any commands. All the body parts are concerned about their respective roles. Things happen even before we can understand anything. For example, if a fly flies towards your eyes, they will readily blink. You will move your hands involuntarily if you accidentally touch any hot object. The moment a fish bone prick your feet, you will yelp in pain. The whole body will know that something has penetrated your feet. We can feel all these with the help of our five sensory organs. In this chapter, we will discuss the five sensory organs.



By the end of this chapter, you will be able to-

- explain the structure and functions of different sensory organs
- demonstrate the uses of sensory organs through observations and examinations
- explain various ways of taking care of sensory organs
- develop awareness and motivate others to take proper care of sensory organs

LESSONS 1 - 3: SENSORY ORGANS

Anika stood first in the annual examination and was promoted to class six. She has been always good in her studies. Everybody says she is intelligent. Being intelligent is popularly express as "having a good brain". Brain is the chief commander of our body. Co-ordination of our different activities is regulated by the direction of brain. Brain is located within our skull. Residing within the skull how does it regulate all the activities that take place in and outside the body?

We see with our eyes, hear with our ears, smell with our nose, taste food with our tongue, and feel heat or pressure with our skin. We can carry out all these activities due to our sensory organs. Our eyes, ears, nose, tongue and skin send all the information from the outside world to our brain.

With the help of these sensory organs, our brain is informed of everything happening in the world around us. Suppose, you are crossing the road and suddenly a car comes in front of you. Your eyes will instantly let your brain know about it. Your brain will then send message to your muscles to stop walking and not to cross the road; as a result, you will stand still instantly. All these functions are being carried out by the command of our brain.

Eye

We can see everything around us with eyes. How is our eye structured? We have a pair of eyes placed inside the orbit, in front of the skull. The eyes are positioned inside the orbit with the help of six muscles. These muscles help us move the eyeballs. What we call tear is the secretion of water from the eye. Where does this tear come from? The water secreted from the tear glands is known as tear. Tear keeps the eye moist and it cleans the eye by washing away dirt. The eye is in fact a part of skin. The cells of skin turn transparent at the front of the eye and opaque at the back. As a result, human eyes act like a small camera. The functions of different parts of the eye are described below.

1. Eyelids: They are he outer covering of the eye. Eyelids can be opened and closed. They close to keep dirt away from the eyes.

2. Conjunctiva: The thin and transparent membrane covering the visible part of the eye is called conjunctiva. When this screen is infected by bacteria, it is called conjunctivitis.

3. Eyeball: This is a spherical, ball like structure. Eyeballs are placed inside the orbits. They are composed of three layers;

a) Sclera: The white, tough, outer layer of the eyeball is known as sclera. It helps maintain the shape of the eye. No light can pass through it. The shiny layer in front of the sclera is called cornea. It is transparent. It allows light to enter the eye.

b) Choroid: The mid layer of the eyeball is choroid. It is a dense pigmented layer. It contains many blood capillaries.

Irish: The black and round membrane situated at the back of cornea is called iris. It is a part of Choroid It is a round, opaque and pigmented membrane. There is a whole in the middle of iris which is known as pupil. Iris is made of muscles. The contraction and relaxation of these muscles can dilate and contract the pupil. As a result, light rays can enter the retina.

Lens: There is a biconvex lens behind the pupil. The lens is elevated in the middle and narrows at the top. The lens is held with the choroid by ciliary muscles. These muscles contract and relax to change the shape of the lens.

c) Retina: This is the innermost layer of the eyeball. It is a light sensitive layer, which consists of rod and cone cells.

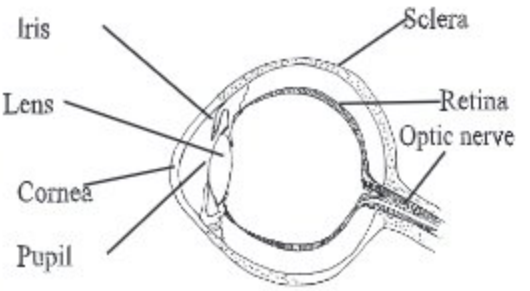


Fig- 6.1: Internal structure of the human eye

The lens divides the eyeball into two chambers. The front chamber is filled with watery fluid and the chamber at the back is filled with jelly like fluid. The fluids help light to enter the eye, supply nutrients and control the shape of the eyeball.

Taking care of the eye

The eye is a sensitive organ and it requires proper care. If proper care is not taken, the eye might be prone to many diseases. You can take care of the eye in the following ways:

- Clean your eyes regularly with clean water.
- Use a piece of clean cloth to wipe your eyes.
- Eat green, leafy vegetables and fruits regularly. These contain vitamin A, which is good for the eye. Regular intake of vitamin A helps prevent night blindness.

Task: With the help of a model or chart identify the different parts of the eye. Now draw a diagram of the eye and label its different parts.

New words: sensory organ, retina, lens, eyeball, pupil, iris, conjunctiva, sclera.

LESSONS 4--5: EAR

How do we hear? The answer is, definitely, with the help of our ears. If we did not have ear, we could not hear; in fact, we could not even speak, because we learn to talk by hearing others.

We have two ears- one on each sides of our head. Other than helping us with hearing, ears also help us maintain the balance of our body. Our ear is divided into three parts-- external ear, middle ear and inner ear.

1. **Outer ear:** Outer ear is composed of pinna, ear hole and eardrum.

a. Pinna: It is a part of the outer ear. It is a flap of skin and cartilage. It's main function is to dispatch sound into the ear hole.

b. Ear hole: Pinna is connected to a tube called ear hole.

c. Ear drum: The ear-hole ends with the eardrum or Tympanic membrane. This is the last part of external ear.

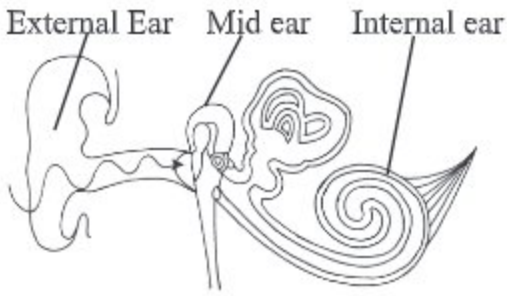


Fig-6.2 Internal structure of the human ear

2. **Middle ear:** This is situated between the external and inner ear. It is a sack filled with air and it contains three small bones Malleus, Incus, Stapes. With the help of these bones, sound reaches the inner ear. Eustachian tube connects the ear with the back of the throat. The function of this tube is to balance the air pressures both in and outside the eardrum.

3. **Inner ear:** It is situated inside the auditory capsule bone. It is divided into two major chambers; utriculus and sacculus.

a. Utriculus: This chamber consists of three semi-circular canals. Among these three canals, two are vertical and one is horizontal. They are covered with hair- like sensory nerves. These canals are filled with fluid. When the fluid is relesed , these sensory nerves are stimulated and then, impulses are sent to the brain. The brain then sends messages to the rest of the body, thus maintaining a balance of the body.

b. Sacculus: This chamber of the inner ear has a coiled shell-like structure. This is known as choclea. The walls of the choclea have auditory sensitive cells. The coiled tube is filled with fluid. This part acts for hearing.

Taking care of ear

Ear is our auditory organ. We can have hearing impairment if we do not take proper care of our ear. To take care of our ear we should take the following steps.

- Cleaning ears regularly.
- Being careful that water does not get into ear while bathing.
- Consulting a doctor if any insect or other alien bodies enter the ear.
- Avoiding listening to music in high volume.

LESSON 6

Task: With the help of a model or a chart identify the different parts of the ear. Now draw a diagram of the ear and label its different parts. Also write down the functions of these different parts.

New words: middle ear, inner ear, semi-circular canal, choclea.

LESSON 7: NOSE

We can identify fragrance and odour with our nose. We breathe and smell with it. We enjoy the fragrances of flower and cover our nose when we smell the odour coming from dirt. Our nose is situated above the buccall cavity. It has two parts; 1.nostrils and, 2. nasal canal.

1. **Nostrils:** The part of the nose through which air enters is called nostrils.

2. **Nasal canal:** It is a cavity that extends from the nostrils to the back of the throat or pharynx. The cavity is triangular in shape and divided into two parts by a thin wall. The front part is covered with hair and the hinder part is lined with a mucus membrane. This membrane is also called smell membrane. It contains blood capillaries and numerous smell receptor cells.

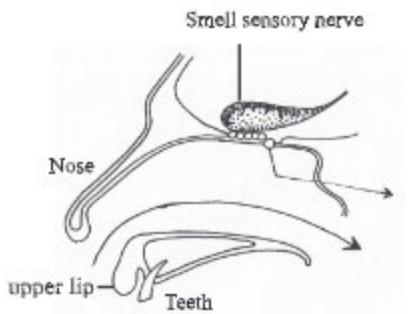


Fig-6.3 Internal strueture of nose

Taking care of the nose

We smell through the nose and also breathe through it. It has a mucus membrane in it. In children, dirt gets trapped in the mucus which should be cleaned regularly.

Tongue: Rakib likes eating sweets. He salivates often at the sight of sweets. We feel the various type of test such as sweet, sour, spicy and bitter with the help of tongue. It is our organ of taste. The long and muscular organ situated in the buccal cavity is called tongue. There is a covering over the tongue containing the taste

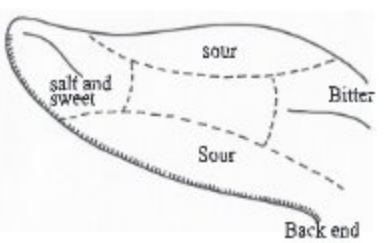


Fig 6.4 Structure of tongue and Taste buds

buds which is used receive various tastes. The front, sides and back of the tongue contain special taste buds. We can feel sweet and salty tastes with the front part of the tongue. With the sides of the tongue we feel sour taste. The taste buds at the back are larger in size and these help us to feel bitter taste. Since there are no taste buds in the middle of the tongue we do not feel tastes in this region.

Functions of Tongue:

The following functions are performed by tongue:

- tasting and swallowing food
- helping chewing of food by moving it nearer to teeth
- helping mixing food with saliva
- assisting in speaking

Taking care of the tongue

The tongue is an essential organ for digestion of food. To take care of our tongue we have to follow few steps. They include brushing teeth and cleaning tongue regularly. A white or yellow coating may form on the tongue due to certain diseases. This may happen during fever. A good result can be obtained by rinsing with salt water. If the tongue of the children are not cleaned, curd like spots may be visible on them. It Occurs due to a fungal infection. Clean the tongue regularly. If you have a sore tongue or buccal cavity, consult a doctor immediately.

New words: taste bud, pharynx, nasal canal.

LESSON 8: SKIN AND SKINCARE

We can feel if an ant walks on our body. We can feel if anything is hot or cold. We can also understand if anybody touches us. Why and how does this happen? We can feel all these through skin or dermis.

Skin : The organs that make up our body are covered with skins to protect them from diseases or external injury. Skin acts as the covering of our body. Skin has two layers-epidermis and endodermis.

Epidermis: This is the outer layer of the skin. The skin of palm and sole is thick and the skin of lip is thin. Hair and nails outgrows from epidermis. Epidermis has hair follicles.

Endodermis: There are blood vessels and nerves in the endodermis. It also contains sweat glands, oil glands, sebaceous glands and hair root. The number of sebaceous glands is in palm and sole is greater.

Functions of skin

Skin performs the following functions:

- Protects the soft part of the body from external injury, hot, sunshine, cold etc.
- Prevents microbes from getting into the body.
- Keeps the body cool and healthy through sweating.
- Expels harmful substances from the body.
- Protects the body from harmful sun rays.

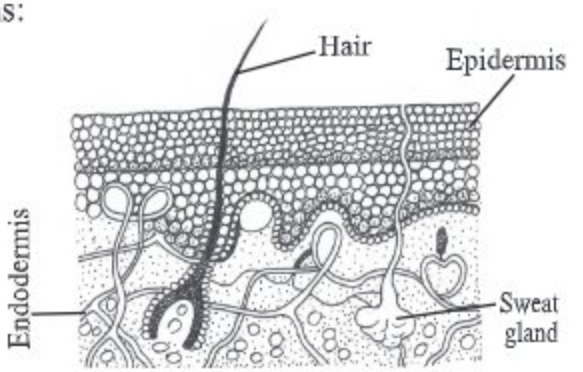


Fig 6.5 Cross section through mammal skin

Taking care of skin

The skin makes the outer covering of our body. Things that we need to do to take care of our skin are:

- Taking bath regularly to avoid infection of skin dandruff, scabies etc.
- Avoiding using other's towels, cleaning ones towels and napkins with hot water and soap after one or two days.
- Consulting a doctor if any skin diseases such as scabies, ring worm etc. occur. Do not use any ointment without consulting a doctor.

Task: With the help of a model or a chart draw the structure of dermis and label different parts of the structure.

Things learnt from this chapter-

- The lens of the eye is biconvex.
- The contraction and relaxation of ciliary muscles help bend, round and flatten the lens.
- The contraction and relaxation of iris expands and dilates the pupil.

EXERCISES

Fill in the blanks

1. Light enters the eye through the _____.
2. There are three bones in the _____.
3. _____ is the last part of the external ear.
4. There are _____ on the tongue.
5. The sensory cells are connected to the _____ by special nerves.

Multiple choice questions

1. Which one is the commander of the body?

   (i) hand (ii) leg

   (iii) eye (iv) brain

2. Where is sweat produced?

   (i) epidermis (ii) endodermis

   (iii) sweat gland (iv) hair root

Read the text and answer the questions 3 and 4

A boy of 12 years does not take bath regularly and does not use a personal towel after shower. Recently dandruff has increased in his head. He is attacked by scabies. He uses an ointment. He has bought it from a street hawker.

3. The boy is suffering from the problem of .....?

   (i) Skin (ii) Hair

   (iii) Gland (iv) Brain

4. To avoid scabies the boy has to --------?

   (a) Take bath regularly (b) Use clean towel

   (C) Use any kind of ointment

   Which one is correct?

   (a) i and ii (b) i and iii

   (c) ii and iii (d) i, ii and iii

Short answer questions

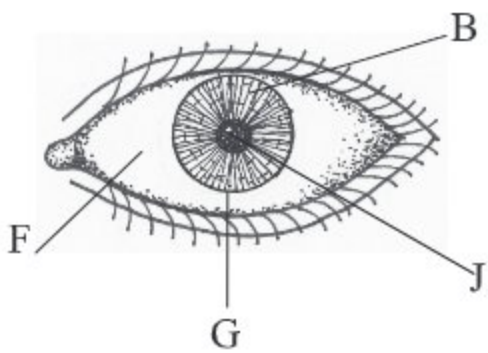
1. Why is the tongue called the organ of taste?
2. How does the middle ear help us hear?
3. What is the function of retina?
4. What happens if the lens of the eye is damaged?
5. What are the functions of skin?

Do it yourself

1. How will you prove that the tongue is the organ of taste?
2. Draw a diagram of an eye, label the lens and retina and write down their functions next to the diagram.

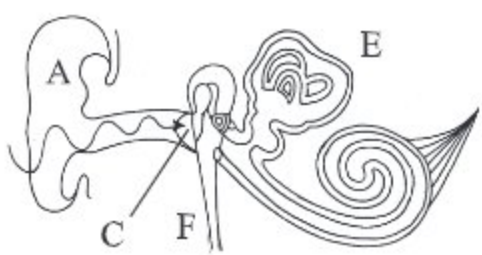
Creative questions

1. With the help of the diagram given below answer the following questions:



   a. What is sclera ?
   b. What happens if (G) is distorted?
   c. Explain the function of (B)
   d. Discuss how (j) helps us see things.

2. With the help of the diagram given below answer the questions:

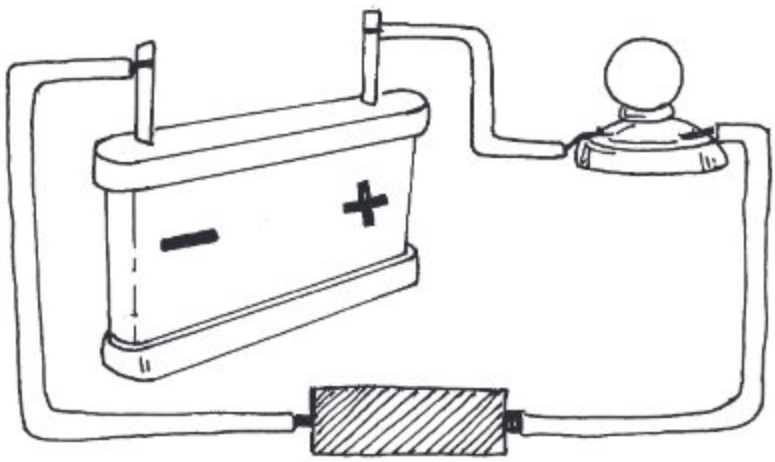


   a. What do you mean by auditory sensory organ?
   b. What would happen in absence of (A)?
   c. What is the function of (E)?
   d. What are the importance of (C) and (F)?

CHAPTER SEVEN

Properties of Matter and External Effect

Thousand types of matters like iron, copper, rubber, wood etc. are related closely to our daily life. As different matters has different properties, any one of them can be brought into use for a certain purpose.



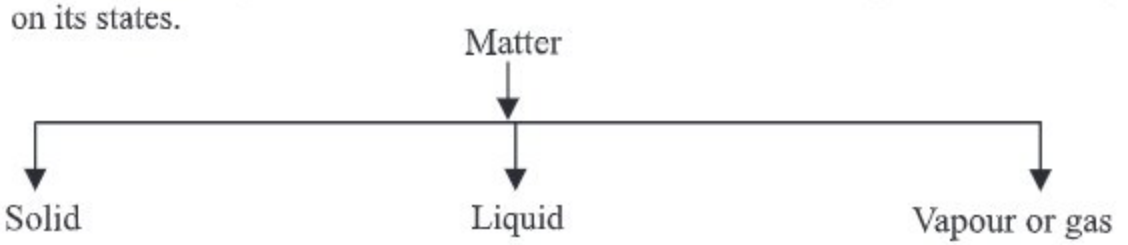
By the end of this chapter we will be able to-

- describe different properties of matters.
- classify matters based on their properties.
- explain conductivity of heat and current.
- understand the usefulness of metals and non-metals and also will be careful about using and preserving of metals.
- determine the thermal and electrical conductivity of metals and non-metals through experiments.
- explain the melting-point and boiling-point of a matter by experiment.
- use stop-watch, thermometer accurately.
- explain cooling.
- explain deformation of metals and non-metals .
- take initiative for applying security measures and precautions during experimental procedures and make others aware of them.

LESSONS 1-3: THE PROPERTY OF MATTER AND THEIR CLASSIFICATION

We are to use various materials in doing different work. We use of thousand of materials, starting with the water to wash our hands and face just after getting up from bed in the morning. We bring to use various type of food, crockery, clothes, toy, stone, cycle, football, marble, book etc. Of these, some are soft, some are hard, some are shiny, some are round and some are flat. But all of those are matter. All of these materials occupy space and have mass. So we can say that things which occupy space and have mass are called matter. However, the volume of some very small particles of matter is negligible.

There are numerous types of matters in the world and they are classified in various ways. Among these, one of the classifications is based on the state of the matter. Let us take an example, when a piece of ice is kept in a pot, what happens? It is converted into water. Again we can convert the water into vapour by heating it up. So, it appears that water can be found in three different states, e.g. ice, water and vapour. When water remains in the form of ice, it is in solid state. When it remains water, it is in liquid state. Again when it becomes vapour or steam, it take gaseous state. So matter is divided in to three groups depending on its states.



Now the question is what characteristics are responsible for making a matter solid, liquid or vapour?

A solid body has a definite shape. The space occupied by a body is its volume. As all solid bodies occupy space, they all have volume. The size and volume of a solid body can't be changed easily. It is highly rigid, that is, it has rigidity. Although some of the solids have less rigidity (For example: mustard seed, boiled rice, banana).

A liquid has no definite shape. It holds the shape of the container where it is kept. Liquid has a definite volume. Because it occupies space like solid. Its volume can be also measured. Does this volume changes? No, although depending on the shape of the container the shape of the liquid changes but

the volume remains the same. As a liquid has no definite shape, its shape is changeable. Therefore, it can be said that the liquid is not rigid like solid e.g. liquid has no rigidity.

Let us take the example of air to understand the property of gas. Like air no definite shape. Is there any definite volume of a gas? Think of two cylinders, one small and another large. Now if you keep the same amount of gas in both the cylinders, the gas will occupy the space whole area of the small cylinder as well as of the in cylinder. Then it can be said that when in the same amount of gas is kept in a small cylinder, its volume is small and it is kept in the large cylinder, its volume is large. That means, the volume of the gas is the volume of the container in which it is kept. So gaseous matter has no definite shape and volume. No rigidity at all.

In addition to that, some other characteristics which can be taken into account for classifying matters are density, rigidity, flexibility, thermal conductivity and electrical conductivity.

Task: Collect the following things from home and school.
Chalk, pencil, note book, rubber, duster, hammer, pin, soap, spoke of cycles wheel cricket bat, safety matches, salt, glass, plate of aluminium, school's bell etc. Cassify the matter to which are made of paper, wood, metal and which are not made any of these materials. Also classify them considering which ones glitter and which one does not.

RIGIDITY AND FLEXIBILITY

Some matters are soft, some are hard; some are flexible and some are non- flexible. Do the task below to know about these things.

Task: Take a pot of aluminium, one piece of rubber, one piece of wood, a candle, one piece of stone and a nail. Scratch them with a metal key and observe what is happening. Which one can be scratched easily and which one is not so easily. Take each of them between two fingers and apply pressure. You will see that of them are flexible while some are hard and inflexible. Also find that some of these things have rough surfaces while some are smooth and some other are breakable.

Now make a table like the one shown below.

Name of the substance	hard	soft	flexible	inflexible
1.				
2.				
3.				
4.				
5.				
6.				

Matters can be divided into different types on the basis of density. But it is seen that metals have the highest density among all solids. In the next lessons we will discuss some more properties of matter.

LESSONS 4-6: PROPERTY OF METAL AND NON-METAL

On the basis of various characteristics of density matter is divided into two types- metal and non-metal. Now we will know about some characteristics of metal and non-metal.

Metal: We use various types of aluminium pots, gold jewellery, electric wire made of copper for many purposes. How do these matters look like? They all shine or glitter. This is common characteristic of most metals.

On the other hand we use aluminium pots or iron pans for cooking. Why? Because they transmit the heat from the oven fire to the main in gredients of cooking (rice, fish, etc) and the ingredients get boiled due to that heat. Hence, another characteristic of metals is, they conduct heat very well. So, metals are called good thermal conductors.

Again what is the cause of the use of copper for electric conductivity? To conduct electricity or metals are electric conductor. So, we can say that, metal or metallic matters are shiney, heat and electricity and they conduct.

Non-metal: Can you tell how gases such as nitrogen, oxygen or hydrogen look like? You will not be able to answer this question because, these gases neither glitter like metals nor they have any visible feature to mark. Again, they do not conduct heat or electricity like metals. So non-metals are called non-conductors or insulators.

Task: Take magnesium ribbon, zinc-plate and scales made of plastic, wood and steel scales and keep them in the sun one after another. Observe which of them glitter and which do not. Write down the findings of your observation in the table below.

Table

Name of the matter	Property

Task: To observe the thermal conductivity of metal (copper).

Required Accessories: Thick copper wire (20 cm), two pieces of cork, safety matches, candle or spirit lamp.

Procedure: Insert the copper wire carefully through the cork so that the cork remains in the middle of the wire. Lit the candle. Now, holding one end of the wire, place its other end on the candle-flame. In this way hold the wire until your hand does not feel warm (hot).

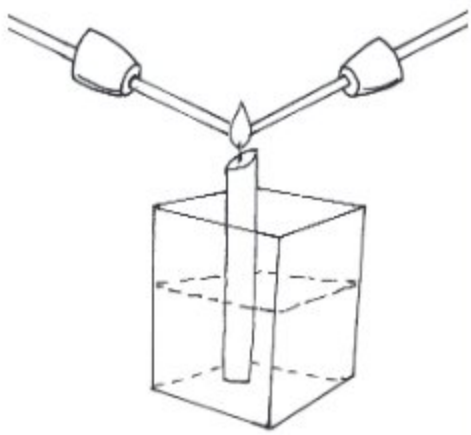


Fig 7.1 : Thermal conductivity of metal

Here what is the reason of using cork? It is used so that the heat from the flame could not reach directly to the hand. Why do you feel the heat at the end of the copper wire that you are holding in your hand? One end of the wire receives the heat from the flame and it travels to other end because copper is a good conductor. If it was not so, you may not have felt the heat. Therefore, it is proved by this experiment that copper is a good thermal conductor. In fact, all metals conduct heat like copper. That is why metals are used where thermal conduction is essential (For example: in refrigerator, air conditioner, solar panel etc.). Therefore, it is our moral duty to ensure proper uses as well as to avoid wastage of metals.

Task: Observing the thermal conductivity of various matters.

Required accessories: 1 glass-spoon, 1 plastic-spoon, 1 aluminium-spoon, 3 one taka coins, 1 beaker of 600 mL, 300 mL water, a spirit lamp, wax, safety matches and stop-watch.

Fig 7.2 : Thermal conductivity of various matter

Procedure: Make the wax soft by heating it moderately. Add a little soft wax on the handle of each spoon. Now place the coins on the wax with pressure so that the coins get stuck on the spoon. Take about 300 mL water in the beaker and put it on the spirit lamp. Now immerse the three spoons in the beaker by holding them with threads in such a way that the coins stay outside the upper portion of the beaker. Light up the sprit lamp and continue to heat the beaker. Carefully observe the coins. Use the stop watch to record the time to determine the time taken by each coin for being separated from the spoon.

From which spoon do the coins get separated at first and from which it happened last of all? Why are the coins separated? Undoubtedly the coin on the aluminium spoon is separated at first because the aluminium is a good conductor. So, heat from the hot water in the beaker reaches the wax of aluminium spoon comparatively faster through conduction. As a result the wax melts down and the coin is separated. On the other hand, as the thermal conductivity of plastic is the least among the three, the heat from the hot end of plastic spoon transmit slowly to the cold end that is towards wax due to conduction. As a result, it takes a longer time to melt the wax and the on it coin become separated last of all. Again, thermal conductivity of wood is less than aluminium but greater than plastic, so heat reaches the wax on wood faster than plastic but slower than aluminium. As a result, the time taken to separate the coin from the wax of wooden spoon is more than aluminium but less than plastic.

LESSONS 7-8: ELECTRICAL CONDUCTIVITY OF METAL AND NON-METAL

You have known earlier that metals are generally electric conductors and non-metals are electric non-conductors or insulators. Now you will see yourself how metals act as electric conductor and non-metals act as electric non-conductor.

Task: Observation of electrical conductivity of metal.

Required Accessories: One electric cell (battery), one electrical bulb, 2 electrical wire, steel spoon, piece of aluminium, rubber, wood, plastic spoon.

Procedure : Take the electric cell and see that there is a positive (+) sign at one end and negative (-) sign at other end. Connect one copper wire at one end of the cell and another copper wire at the other end of the cell (as in the fig). One of you take the electrical bulb. You will see two raised metallic points or thick wire like points at one end of the bulb which end is suppose to go into the socket. Now connect the open end of one wire with one of the connecting points of the bulb and connect the other wire with another connecting point.

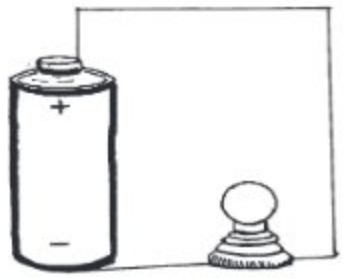


Fig 7.3 : Electrical conductivity

What do you see? The bulb is illuminating. As copper is an electric conductor, it transmits electricity taking from the cell and send it to the bulb. For this reason the bulb lights up. If the copper wire was not an electric conductor, it could not conduct electricity, and the bulb would not illuminate.

Now disconnect the copper wire and give connection between them with iron or aluminium wire. See what happens? Next connect the two wires by a piece of wood, plastic, rubber etc.

Is the electric bulb on now? No it is off. Since rubber, plastic and piece of wood- all these are electric non-conductors, they can not conduct electricity from the cell. That's why the bulb has not illuminated .

LESSONS 9-11: MELTING POINT AND BOILING POINT

Task: To know about melting point of solid.

Required Accessories: 1 beaker, wax, thermometer, test tube, spirit lamp etc.

Procedure : Take some small pieces of wax in the test tube. Taking water in the beaker and keep it on the sprit lamp, immerse the test tube and thermometer in the water of the beaker so that none of them touches the bottom or wall of the beaker with the help of a stand (as shown in the figure). Apply heat to the bottom of the beaker with the help of the spirit lamp. Notice the thermometer reading and the wax in the test tube. Is the temperature of the thermometer increasing? Is there any change of the state of the wax? Observe carefully the condition of the wax when the temperature of the thermometer reaches nearly 57 degree Celsius.

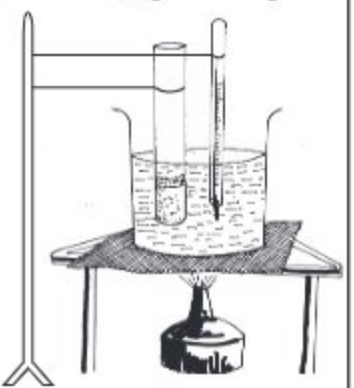


Fig 7.4 : Determination of melting point

Is the wax melting? When the wax starts to melt, notice the temperature in the thermometer. What is the reading of this temperature? Is it 57 degree Celsius? Then 57 degree Celsius is the melting point of wax. So (at standard pressure) the temperature at which a solid begins to melt is known as its melting points. Like wax, Each solid has its melting point. Now, determine the melting point of ice.

Boiling point

When you take some water in a beaker and continue to heat it, what happens? The temperature of water increases and at certain temperature it begins to boil. The temperature at which water begins to vaporise is called the boiling point of water. Like water ach liquid has its specific boiling point. Let us determine the boiling point of water.

Task: To determine the boiling point of water.

Required Accessories: One beaker, water, thermometer, spirit lamp etc.

Procedure: Take a beaker with half of it filled with water. Put the beaker on the spirit lamp. Immerse the thermometer in the water in the beaker as shown in the figure. Now apply heat and observe the temperature in the thermometer. When the temperature of the thermometer raises to 95 degree Celsius, carefully observe the condition of water in the beaker.

Fig 7.5 : Determination of boiling point

When the water begins to boil notice the temperature in the thermometer. This temperature is the boiling point of water. What is the reading of this temperature? It is 100 degree Celsius. You can determine the boiling point of ether or spirit. But as the organic substances are combustible, you can not apply heat directly to them. You need to taking an aluminium pot with water and heat the beaker with ether or spirit in it.

Change of metal and non-metal when it is strucked:

Task: Observation of change of metal and non-metal applying strike.

Required Accessories: Iron plate, copper pot, one hammer.

Procedure: Take iron pot on one hand and strike it with hammer by another hand. What happens? It creates a jingling sound. Will it be broken when struck? No, it will not. Similarly taking the copper pot and strike it with the hammer. What happens? Now take some pieces of sulphur and carbon and strike them with the hammer and observe.

As the iron and copper plates are striken with hammar, they create jingling sound and remain unbroken. Therefore, we can say that metals create jingling sounds and do not break down easily when they are stricken. That means metals are not fragile. On the other hand sulphur and carbon will get broken and will not create jingling sounds.

Precaution: Use security spectacles and hand gloves so that sulphur or pieces of charcoal do not enters the eyes or come to contact with your hands.

Freezing Point

We light candles on birth-day parties or when the electricity goes off. What happens in this case? A portion of wax burns to give light and another portion of wax melts down due to heat and falls along the body of the candle which after some time (loss heat) freezes and converts to solid wax again. The process of changing from liquefied wax to solid wax is known as cooling. This may happen to all other liquids too.

Task: Determination of the freezing temperature
Required Accessories: 1 test tube, 1 beaker, 1 stand, some wax, water, 1 thermometer, spirit lamp, wire-net, tripod and clamp.

Procedure: Take some wax in the test tube. Fill up the three fourth portion of the beaker by water. Keeping the wire-net over the tripod place the beaker upon it. Immerse the test tube in the water of the beaker as shown in the figure. Continue to apply heat on the bottom of the beaker by spirit lamp till the wax completely melts down. Now immerse the thermometer in the test tube so that the lower part of it remains dipped in the melting wax. Remove the test tube with thermometer from the beaker then hold it by the clamp in the stand. Clean the test tube by tissue paper. Observe the temperature of the thermometer. See the temperature at the moment when the wax begins to freeze.

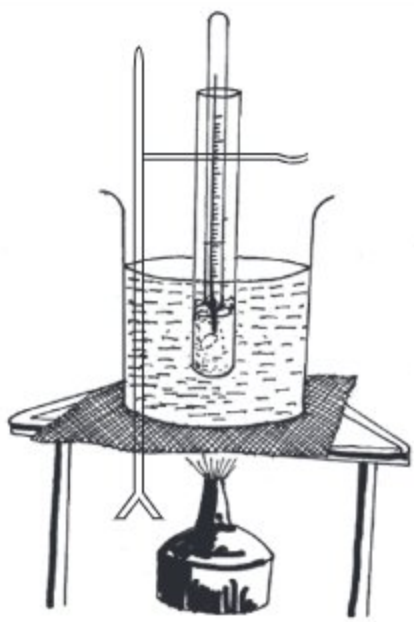


Fig 7.6: Determination of freezing point

At what temperature does wax begins to freeze? Is it 57 degree Celsius? Yes, that is correct. This temperature that is 57 degree Celsius is the freezing point of wax. Earlier you got the melting point of wax as 57 degree Celsius.

That means the melting point and freezing point of a matter is the same.

Now, tell us what the freezing point of water is? Zero degree Celsius? Then the melting point of water (in the form of ice) should also be zero degree Celsius.

If the temperature of a matter remains beyond its freezing point and if it is greater than the surrounding temperature, then if the matter is kept in the surrounding temperature, it losses heat slowly. As a result, its temperature decreases and when the temperature comes to the freezing point, it changes to solid state, as it happened in case of wax. When the wax was in liquid state, its temperature was more than 57 degree Celsius. When the test tube with wax was brought out side it emitted heat slowly. As a result, the temperature decreased. It was decreasing in this way to reach the freezing point e.g. 57 degree Celsius, and then the wax got frozen to become solid.

Things we have learnt in this chapter:

- Objects which have mass and which occupies space are matters. Matter are of three states- solid, liquid and gaseous.
- Solid has a definite shape, volume and rigidity. Although there is a definite volume of a liquid it has no definite size and rigidity.
- Vapour or gas has none of the definite shape, volume (shape) or rigidity.
- Fundamental matters are of two types metals and non-metals. Metals are generally shiny. They conduct heat and electricity and create jingling sound when struck.
- Non-metals do not generally glitters. These do not conduct heat and electricity and do not create jingling sound when struck.
- The temperature at which a solid begins to melt is known as its melting point. the melting point and freezing point of a substance is the same.
- The temperature at which a liquid begins to vaporise is called the boiling point of the liquid.

EXERCISES

1. Match the words in the left column to the words in the right column.

Left	Right
every matter	is not matter
sound	do not conduct heat
solid	has definite size and volume
metals on strike	do not break

Short answer questions

1. What are the characteristics of matter? Explain with examples.
2. Light is one kind of matter- is this statement true or false? Give reasons to defend your answer. What are the main differences among solid, liquid and gaseous substances?
3. Why is copper used in electric wires?
4. Explain melting point and boiling point with examples.

Multiple choice questions

1. Which substance has less rigidity?
   a) brick b) book
   c) banana d) ice
2. Which substance, when kept in a bottle, occupy the entire space of the bottle?
   a) water b) air
   c) milk d) powder

Observe the table below and give answer of question no. 3 and 4.

Mathins mother	cooks in an earthen pitcher.
Mathin's Father	uses a machine made of copper wire
Mathin's grandmother	uses a basket made of bamboo
Mathin	drinks water in a glass made of glass

3. The object used by which person as shown in the table is and electric and heat conductor?
   a) Mathins mother's b) Mathin's Father's
   c) Mathin's grandmother's d) Mathin's

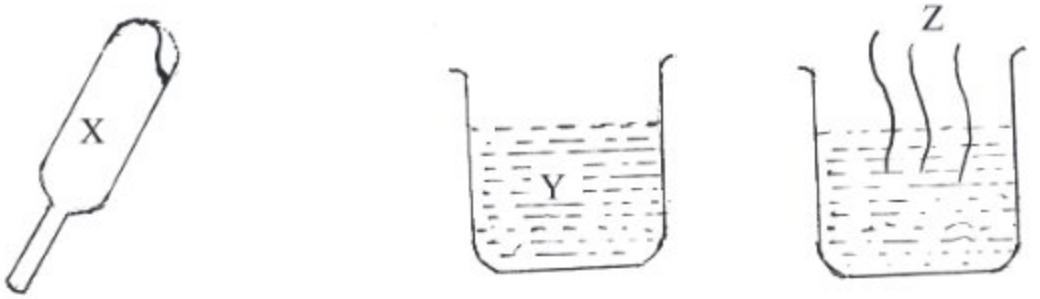
4. In case of thermal conductivity-
   i. Mathin's mother gets more advantage than Mathin's father.
   ii. Mathin gets more advantage than Mathin's father.
   iii. Mathin's grandmother gets less advantage than Mathin's father.

   Which one is correct below?
   a) i and ii b) i and iii
   c) ii and iii d) i, ii and iii

Creative questions

1. Mr. Fazlul Hoq's mother uses an earthen oven and clay pots to cook meals. On the other hand his wife uses a gas oven and cooks in a cooks in an aluminium pan.
   a. What is matter?
   b. What does 'non-metal' mean?
   c. Explain the significance of the elements of the utensils used by Mr. Fazlul Hoq's wife and mother?
   d. Who gets more advantage while cooking meals-- Mr. Fazlul Hoq's mother or wife? Analyse.

2.



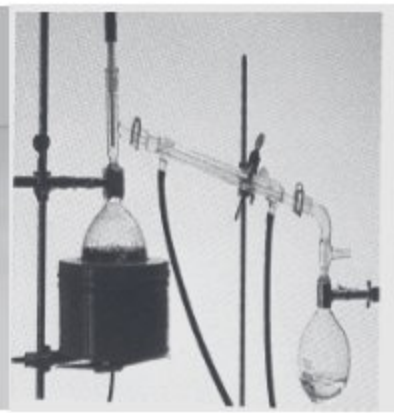
   a. What is boiling point?
   b. What do you mean by thermal conductivity?
   c. How the substance shown in fig. X can be converted into the substance shown in fig. Z? Explain.
   d. Analyse that the materials shown on all the three figures are made of same matter.

CHAPTER EIGHT

Mixture

We use various things in our daily life. Some of them are pure and some are mixture. Again among the mixtures some are solutions, some are suspensions and some of them are colloids.





By the end of this chapter we will be able to-

- explain about mixtures and solutions.
- make differences among different solutions.
- make different solutions of water and solid.
- explain the influence of temperature on the solutions.
- exhibit the use of water as an universal solvent.
- make homogeneous and heterogeneous solutions and separate its components.
- make the crystals of salt and pure water from saline water.
- differentiate solutions, colloids and suspensions.
- explain the role of solutions, colloids and suspensions in our daily life.
- realize the use of solutions and suspensions in our life.
- use the instruments and accessories in experimental works properly.

LESSONS 1-2 : MIXTURE AND SOLUTION

All of us are more or less familiar with sarbet (mixed water) and hot puffed rice mixed. We can prepare sarbet by adding some sugar to some water in a glass or jug and stirring the water with a spoon. Again to make hot puffed rice mixture, we can mix the puffed rice with chick-pea, chopped onion, green chilli, tomato etc in a bowl. In making sugar juice and hot puffed rice mixture, more than one items are mixed together. So, whatever we prepare by mixing more than one different elements or items are called mixture. Although these elements are mixed, their particles exist separately on small scale.

Task: To know about the solution and homogeneous mixture.

Required accessories: 1 glass (made of glass), 1 spoon, some sugar and water.

Procedure: Wash the glass clean. Take drinking water in three-fourth portion of the glass and add one spoon of sugar to it and stir the water with the spoon.

Fig. 8.1 Making solution

Now pour the solution into a numbers of pots. Take one spoon from each pot and taste can you see the sugar seperately?

No, you do not see any sugar, because, the sugar has been dissolved in the water. Is the sweetness of the mixture tasted from each cup the same? Yes, the mixture in each of the cups has the same sweetness because the particles of sugar are equally and uniformly distributed everywhere in the mixture.

The mixtures whose components are distributed evenly and whose components can not be easily separated from one another are called solutions or homogeneous mixtures. That is, solutions are a special type of mixture. Now, you mix salt, glucose, fruit juice with water and see whether the obtained mixtures are homogeneous mixtures or solutions.

Task: To know about the heterogeneous mixture.

Required accessories: 1 bowl, cereal (puffed rice), chick-pea (a salty and spicy crisp snack comprising fried chick-pea, nuts and other things), chopped onion, green chilli, tomato etc.

Procedure: Pepare hot puffed rice mixture by mixing all the elements mentioned above together. Can you separate the ingredients of this mixture easily ? Yes it is possible to separate one element of mixture from the

other quite easily. Are all elements present equally in each portion ? No, they are not. Perhaps in one portion there are more onions, and in another portion there are more puffed rice and may be, in another portion there are more or less amount of chanachur comparing to other portions of the mixture. That is the ingredients are not distributed uniformly. Like Jhalmuri the mixtures whose components are not distributed uniformly in the mixture and the components can be easily separated from one another, are heterogeneous mixtures.

Now, add powdered-milk, soil, flour, dust of chalk, talcum powder with water and see whether the obtained mixture is heterogeneous mixture or not.

LESSONS 3-4: SOLUTE AND SOLVENT

Tell us, which of sugar and water is available in a larger quantity in a mixture of sugar and water. Undoubtedly the amount of water is more and the quantity of sugar is less. Here, water dissolves the sugar and the sugar is dissolved by water. In a solution, usually, the component that remains more in quantity that is the component which dissolves the another component. The component that dissolves the other components is called solvent and the components that are dissolved by the solvent are called solute. Hence we can say-

solution = solute + solvent

In the case of the sugar juice, the solvent is water and the solute is sugar.

Aqueous solution

Like the sugar juice described above, the solutions in which water is used as a solvent are called Aqueous solutions. In case of all solutions, the solvent may not necessarily be water. Besides water, some chemical substances like acetone, spirit, ether, also can be used as solvents.

Concentration of solution: Dilute and concentrated solution.

Solution of different concentrations can be produced by mixing more or less solute and solvent in the solution. The solution is called dilute or concentrated depending upon the concentration level of the solution. Now, let us make solutions of different concentrations.

Task: To make concentrated and dilute solution and differentiate them.

Required accessories: Two glass beakers, a stirrer, measuring flask, spoon, sugar and water.

Procedure: Clean the two beakers by washing. Take 100 milliliters of drinking water in beaker using a measuring flask. Pour 1 spoon of sugar in one beaker and 3 spoons of sugar in the other one and stir them gently. Now test the sweetness of the solution of sugar juice by taking 1 spoon from each beaker. (N.B. The majority of chemical substances are injurious to human-body. So it is not wise to test by drinking or eating any solution or chemical substances without thoroughly knowing about them.)

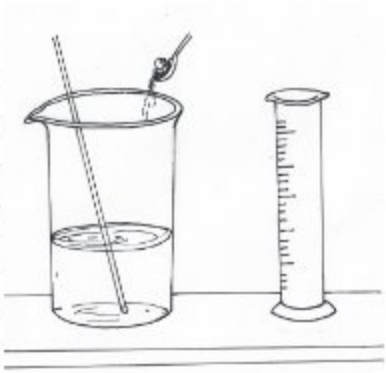


Fig. 8.2 : Making dilute and concentrate solution

The beaker in which 3 spoons of sugar were added has the mixture that tests sweeter. Like sugar juice, out of the two solutions of same volume the solution which one has comparatively more amount of solute is called concentrated solution and the other solution which has comparatively less amount of solute is called dilute solution.

Again if it happens so that keeping the amount of sugar (say 1 spoon) the same in both the beakers the amount of water is increased, the solution in the beaker having less amount of water will be sweeter. In this case too, the solution with less amount of water is concentrated solution. And the beaker in which the amount of water is more will be less sweet and we may call this dilute solution.

It is not possible to say whether a colourless Aqueous solution is dilute or concentrated by taking a look at it. But in case of coloured solutions of different concentration level, it is possible to say which one is dilute and which one is concentrated by looking at them, just like the way we can differentiate concentration and dilute dal (note that, dal is not a solution but a heterogeneous solution). Now we will see how we can differentiate between concentrated and diluted coloured solution.

Task: To make coloured watery solutions of different concentrations and to differentiate between concentrated and dilute solutions.

Required accessories: Three test tubes, test tube holder, measuring flask, spoon, copper sulphate and water.

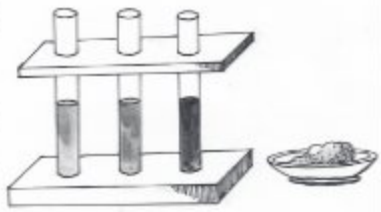


Fig. 8.3 : Making coloured solution

Procedure: Take three clean test tubes. Now place the test tubes in a test tube holder one after another, Take 5 milliliters of water in each tube using a measuring flask. Now add in the first test tube 1 spoon, in the second test tube 2 spoon and in the other 3 spoon of copper sulphate. Then shake the test tubes well till the grains of copper sulphate are completely dissolved. Again set the test tubes in the test tube holder at their own places before.

Do all the solutions look the same blue? No, they do not. The solution looks less blue in which you added less copper sulphate. That means it is less dilute solution. In this way, as you increase the amount of copper sulphate, the colour of the solutions gradually become deeper. That means the solution have become more concentrated from diluted with the increase in the amount of copper sulphate. You can now differentiate between dilute and concentrated solutions by preparing a solution of potassium permanganate and potassium dichromate in the same method.

LESSONS 5-7: SATURATED AND UNSATURATED SOLUTION

Task: To make saturated and unsaturated solutions.

Required accessories: One beaker, measuring flask, stirrer, salt and water.

Procedure: Clean the beaker by it washing well. Use the measuring flask to take 100 milliliters of water in the beaker. Now keep adding salt in little amounts to the water and stir. In this way continue to add salt and stir until the added salt does not dissolve anymore despite rigorous stirring.

In course of adding salt in little chunks, why, at a certain stage, the salt does not dissolve despite constant stirring? The cause is, in the process of adding salt at regular intervals, the solution has become saturated. This is a state when the solvent (water) is unable to dissolve any more solute (salt). So, in a certain temparature if the maximum amount of solute that can be dissolved by a certain amount of solvent is dissolved by the solvent, then the solution obtained is called saturated solution. On the other hand, in a solution if the amount of

solute dissolved is less than the maximum amount of solute the solvent can dissolve, that solution will be unsaturated solution.

In the above events the solution obtained in all the phases before the last chunk of added salt that remained undissolved are examples of unsaturated solution. In a saturated solution a little amount of the solute will not be dissolve in spite of much stirring. On the other hand, in a unsaturated solution, the added solute will continue to dissolve due to stirring till the solution convert into saturated solution.

Solubility

In the above section you have known what saturated solution is. The amount of solute in gm required to make a saturated solution at a particular temperature by any solvent of 100 gram is called the solubility of that solute in that solvent. It is seen by experiment that, 100 gm water can dissolve a maximum 36 gm of salt at 25° Celsius. That means, at this temperature the solubility of salt (solute) is 36 gram. Again the solubility of sugar at 25° Celsius is 211.4 gm. That is, 100 gm water can dissolve maximum 211.4 gm sugar at this temperature.

Liquid-Liquid solution

The solution in which the solvent is liquid and solute is solid is called liquid-solid solution. If the solvent and solute both are liquid then that solution is called liquid-liquid solution. By taking a glass of water if we add one spoon lemon-juice in and stir well, we will get a liquid-liquid solution. Similarly with vinegar or acetic acid and water we can make a liquid-liquid solution.

Liquid Gas solution

Now let us see some solutions, where the solvent is a liquid and the solute is a gaseous substance. Soft drinks such as Cocacola or Seven up is familiar to us. As soon as the bottles of such soft drinks are opened a gaseous substance will be released in the form of bubble and hissing sound. This gaseous substance is carbon dioxide which is dissolved in liquefied state in the soft drink. Therefore, we can say that the soft drinks are examples of liquid -gas solutions.

Do you know from where the animals living (say fish) in water get oxygen which is essential for their respiration? They can not take oxygen directly from air as we do. The creatures living in water takes the oxygen that is dissolved in water. Then the water of large river-stream, canal-channel or other water bodies is a kind of liquid gas solution. It is true that many other substances besides oxygen are

dissolved in the water available in such natural sources. Formalin (which is a much objectionable chemicals used illegally for the preservation of fruits and fishes) is a solution of water and formaldehyde gas.

The effect of temperature on the solution

Task: To observe the effect of temperature on solution.

Required accessories: One beaker, stirrer, tripod stand, wire-net, one balance, salt, water and spirit lamp.

Procedure: Use the balance to take 100 gm water in a clean beaker. Adding salt to in little amounts and continue to stir. Stop adding salt when the added salt is no more dissolving. Now, place the beaker on the wire-net kept over the tripod and apply heat at the bottom of the beaker by the spirit lamp and continue to stir the solution.

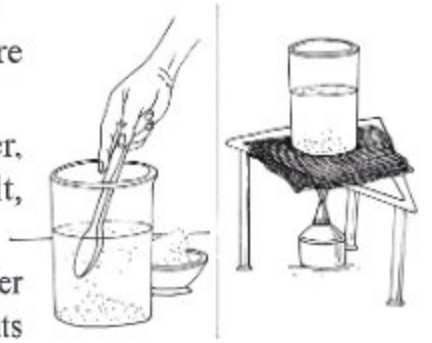


Fig. 8.4 : Observing the effect of temperature on solution

Do you observe any change in the solution after applying heat? Yes, slowly the amount of undissolved salt begins to decrease. In this way, with the heating up of the solution for some time, the entire salt will be dissolved. Then it can be said that, the solubility of salt in water has been increased due to increase of temperature. For this reason the undissolved salt got dissolved after the solution was heated. But in case of some solutions (For example: cerium-sulphate and calcium hydro-oxide in water), solubility of the solute decreases with the increase of temperature.

LESSONS 8-9 : UNIVERSAL SOLVENT

You have known before about the solvent in the solution. What does universal solvent mean? It is such a solvent which is able to dissolve all kind of substances. Is it possible to get such type of solvent in reality? It, perhaps, is not. But the only solvent that can dissolve many kinds of substances is our well known water. That is, water is the only universal solvent found so far. Water can dissolve innumerable inorganic substances (except calcium carbonate, silica etc). It can dissolve many organic substances too. (For example: spirit, acetone, acetic acid) It can also dissolve gaseous substances.

Observe the solubility of various organic and inorganic substances within your reach in water of by conducting practical experiments.

Making homogenous mixture and separating the components

At the beginning of this chapter we have seen some example of homogeneous mixture. Now we will see how these mixtures can be made and their components can be separated.

Task: To make homogeneous mixture.

Required accessories: One beaker, measuring flask, spoon, stirrer, 4 watch glasses, glucose, water, wire-net, tripod stand and spirit lamp.

Procedure: Using a measuring flask take 200 milliliters of (a different amount may be taken) water in the well cleaned beaker. Now add 4-5 spoons of glucose in the beaker and stir gently. Let us see by testing whether the mixture prepared with glucose and water is a homogeneous mixture.

Divide the entire mixture into four portions and keep them in 4 watch glasses. Take weight of each watch glass individually using the balance and write down the weight. Now, place the watch glasses individually on the wire net over the tripod and apply heat with the help of burning spirit lamp to dry up the entire water. Again take weight of each watch glass individually when they cool down. Calculate the mass of the glucose in each glass by subtracting the second weight from the first weight of each watch glass.

Can you see the particles of the glucose anymore? Not really, as the glucose has entirely dissolved in water.

Now, see whether you have found the same amount of glucose in each watch glass. Yes, the obtained glucose in each watch glass is of the same mass. Hence, it can be said that the mixture of water and glucose was a homogeneous mixture. If it was not so, then in some portion glucose could be found more and in some portion it could be found less.

Do you know the name of the process by which the water became quite dry after applying heat? It is vaporization. That is, the process in which heat is applied to a liquid to convert it to vapour state is called vaporization. Do you think that the glucose can be separated from water by any other process except vaporization? No, this is the only way, which is difficult to carry out and it is time-consuming too.

Making heterogeneous mixture and separating

Task: To make heterogeneous mixture of impure salt and water.

Required accessories: One beaker or glass, spoon, stirrer, impure salt, water and measuring flask.

Procedure: Using a measuring flask take 200 milliliters (different amount may be taken) of water in the well cleaned beaker or glass. Now add 1-2 spoons of impure salt in the water of the beaker and stir gently. Leave the mixture for some time.

What do you see? The grains of salt have been dissolved in the water while the heavy dust particles pile up at the bottom of the beaker. On the other hand, the light minute dust particles are floating on the surface of the water. That is the dirts or impurities are not uniformly distributed in the water, so it is sure that the mixture is a heterogeneous mixture of salt, water and impurities.

How it can be proved by experiment that the impurities (the dust particles) are not distributed uniformly? Dividing the remaining impurities into several equal portions and vaporizing the entire water from each portion like as done before and then by measuring the mass of the remaining substances, it will be seen that the different portion have different amount of substances. Now tell, if there is any method to remove eliminate these undissolved impurities.

We can separate these particles from the mixture with the help of a strainer as we separate the tea leafs from the liquor by a tea strainer. Now let us see how pure salt is obtained by separating the impurities i.e dust particles from the saline water by a filter paper.

Task: To make pure salt from impure salt.

Required accessories: The heterogeneous mixture of impure salt, stirrer, tripod stand, wire-net, funnel, filter paper, stand with ring, water.

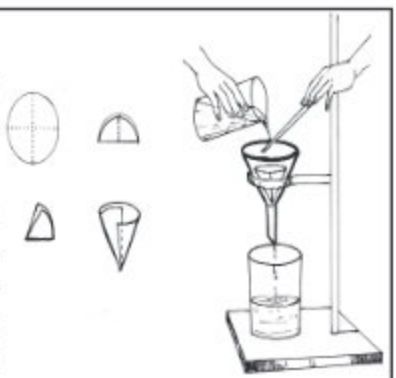


Fig. 8.5 : Filtration

Procedure: At first take a filter paper and fold it into four equal parts. Next set it in the funnel keeping three folds at one side and one fold at the other side as shown in the figure. Soak the filter paper slightly with water so that the filter paper do not get displaced. Place the funnel in the ring attached to the stand as shown in the figure. Keep a beaker under the funnel. Now, pour the heterogeneous mixture of impure salt (taking from the previous experiment) slowly on the filter paper. Wait until all the clean water drains out of the funnel. Now dry up the entire water by placing the beaker of

pure saline water on the wire net over the tripod stand and applying heat at the bottom of the beaker with the help of burning spirit lamp.

What happened after pouring the mixture in the funnel ? The impurity (soil particles) free pure saline water slowly passes through the filter paper and is collected in the beaker under the funnel. The impurities (particles) of soil were detained by the filter paper. This process of separating the particles of soil from the mixture of soil and water by the filter paper is called filtration. Therefore, filtration is such a process by which solid substances can be separated from the heterogeneous mixture of solid and liquid.

After becoming the entire water of the beaker quite dry, what do you obtain? You obtain layers of white, dazzling and clean salt. Because all the impurities of the impure salt taken at the beginning was entirely eliminated by filtration with a filter paper. Remember, if any water- soluble part present in the dirt, that part cannot be separated from the salt using the above method.

LESSONS 10-12: MAKING CRYSTALS OF SALT FROM SALINE WATER

We have seen in the previous article, the process of making pure salt by filtration and vaporization. The salt obtained from that process was not crystalline, but was layer of salt which was basically non-crystalline. Now we will see the technique of making crystals of salt from saline water.

Task: To make crystals of salt from saline water.

Required accessories: 2 beakers, spoon, stirrer, tripod stand, wire-net, funnel, spirit lamp, filter paper, stand with ring, some impure salt and water.

Procedure: Make a mixture by taking 200 mL water and 50 gm impure salt in a beaker. Make a salt-water solution e.g. pure saline water by filtration. Now take saline water in a beaker, keep it on the wire-net over the tripod stand and continue to apply heat with the help of a burning spirit lamp. When the saline water in the beaker reduces to half of its volume due to heat, stop heating it. After this cover the beaker and leave it to cool down.

After the cooling down of the beaker do you see any change? The grains of salt begin to accumulate on the bottom or wall of the beaker. These grain are the crystals of the salt. This process of making the crystals

of the salt is called crystallization. Some time to get crystals from the saline water, a few salt grains are to be added in it from outside. At this, grain granulated salt accumulate quickly surrounding the added salt.

Producing pure water from saline water :

To produce pure water from the saline water or any mixture the easiest way is the distillation process. This process requires a distillation apparat A distillation apparatus is shown in figure 8.6.

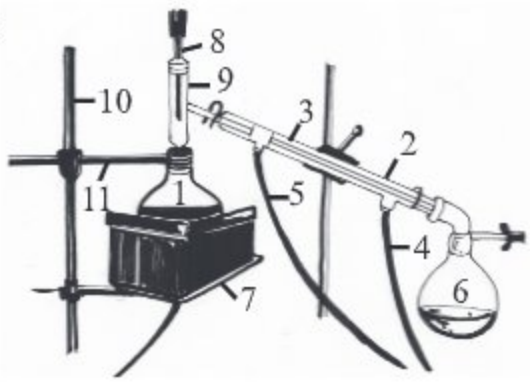


Fig . 8.6 : Distillation apparatus

There is a receiving flask (1) in the left side of the apparatus to keep the saline water required for the experiment. A condenser (2) is connected with it in which a narrow glass tube (3) is placed inside. To flow cold water on all sides of the tube there is an inlet tube (4) and a outlet tube (5). Again, on the right side, there is another spherical flask (round bottomed) (6) to collect the pure water. Moreover to apply heat on the water there is an electric heater (7). There is an glass made adapter (9) on the left side flask to set a thermometer (8) over it in order to measure the temperature and to connect with the condenser. Also to hold both the flask and condenser in correct position there are stands (10) and clamps (11). Now let us see how the distillation apparatus functions.

Task: To produce pure water from saline water.

Required accessories: 1 distillation apparatus, 500 milliliters of saline water.

Procedure: Place the distillation apparatus as in figure 8.6 and take saline water in the receiving flask (round bottomed) (1). Connect the inlet tube (4) of the apparatus with a water tap and open it to flow water. Connect a plastic pipe with the outlet tube (5) and keep it in the basin. Now continue to heat the flask by electric heater. If there is no electric heater system, heat can be applied by a spirit lamp or any other way. Observe the temperature in the thermometer of the apparatus. When the collection of vaporized water through the narrow tube of the condenser (2) in the spherical flask (6) begins, start waiting. When the amount of saline water in the spherical flask is (round bottomed) (1) reduced by three-fourth portion then stop heating.

What happens after applying heat? The temperature of the thermometer increases slowly and at 100° Celsius, the water begins to boil and converts to steam. That steam, when enters into the condenser, then converts into liquid. This process of converting steam (vapour) into liquid is called condensation. The condensed water continues to accumulate in the acceptor flask in drops. This collected water is the pure water.

Hence we see that to make pure water from any mixture of water, we are to apply two processes. One of this is vaporisation and the other one is condensation. Now will you be able to make pure water from the sea water?

Suspension and Colloids

Task: To make suspension.

Required accessories: 1 glass, spoon, mud of soil and water.

Procedure: Take a glass and fill two-third portion of it with water. Add an one spoon full mud of soil to the water of the glass and stir gently. Leave the mixture for some while.

What do you see? At first the entire mixture seems to be opaque. After keeping it for some time, the comparatively heavy particles of the soil are accumulating at the bottom of the glass, although some particles of the soil which are light and minute are still in floating condition as the water and the mixture appears to be less muddy. Leave the mixture undisturbed for some more time. Do you see any change in the mixture? Yes, some more small particles of the soil have gathering at the bottom but the water is does not look completely transparent or clear. Still then some small particle remain in floating condition in the water.

This type of mixture of soil and water from which the components are partially separated is called as suspension. Similarly the mixtures obtained by adding fine chalk-powder or flour with water and stirring gently are also suspensions. The antibiotic or antacid suspensions which we use also becomes partially separated when kept at rest and forms sediment at the bottom of the bottle. That is why those bottles are to be shaken well before use.

Now, can you find the differences among solutions, suspensions and heterogeneous mixtures? The components of heterogeneous mixtures can be identified and separated easily. In case of suspensions although the components can be identified but can not be separated easily and in case of solutions, the components can not be identified and cannot be separated easily.

Now let us come to the story of colloids. In case of suspensions we saw that the small particles of a components remains in floating condition but if it is kept for a long time then the particles gathers as sediments. However, can not it be the case that the particles are so small and light that they will never be able to gather at the bottom of the pot and will always remain in floating or

suspending condition? Yes, surely it can be. Hence that type of mixture where very small particles of a substance remains in floating or suspended condition in the middle of the particles of another substance and even if it is kept at rest it will never gather as sediment that is called colloid.

The existing components of a colloid are not dissolved in to one another but remain scattered. In colloid, the main component or the component which is more in amount is called continuous phase and which remains less in amount is called dispersed phase. Milk is a colloid, which is made of water and fat. The small particles of fat (dispersed phase) remains scattered in water (continuous phase) which is not seen by naked eye but with the help of a microscope. The picture of milk found with the help of a microscope is shown in the figure 8.7.

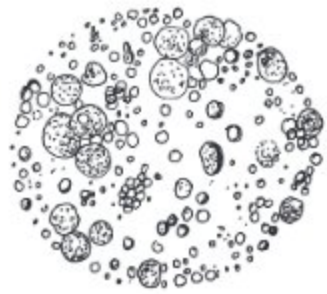


Fig. 8.7: Colloid

Fog is another colloid like milk, where small water particles remain scattered in air. Again our quite known aerosol is one kind of colloid, where liquid particles of insect-killers float in the air. Now the question is, to make a colloid, how much small should the floating small particles be. Usually, the size of the existing floating particle is 1-1000 nanometer. Again if the size of the particle is 1 micrometer or more, the mixture is no colloid but converts into suspension.

Things we have learnt from this chapter:

- Mixing of more than one pure substances makes a mixture.
- Solutions are one special type of mixture where the solute is uniformly distributed in the solvent and one can not be easily separated from another.
- In heterogeneous solutions the components are not uniformly distributed in the mixture and the components can be quite easily separated from one another.
- In a solution the component that remains more in quantity and dissolves another component is called solvent and the component that remains less in quantity and being dissolved by another component is called solute.
- Among the two solutions of same quantity the solution in which the amount of solute is more than the other, the solution is more concentrated.
- In saturated solution a definite amount of solvent which can dissolve the maximum amount of solute is being dissolved by the solvent.
- The amount of solute required to make a saturated solution of that solute at a particular temperature by a solvent of 100 gram is called the solubility of that solute in that solvent.

- By applying heat the solubility of some solutes increases while for some solutes it decreases.
- Filtration is such a process, by which from the heterogeneous mixture of solid and liquid the solid substances can be separated.
- The process by which liquid is converted into vapour by heating is called vaporization.
- The process by which vapour is converted into liquid by cooling is called condensation.
- Suspension is such a mixture, in which the components are partially separated after keeping it at rest.
- Colloid is one type of mixture, in which the small particles of one component remains scattered in another component.

EXERCISES

Fill in the blanks

1. The solution of water and spirit is a _____ solution.
2. _____ is an universal solvent.
3. In a solution the quantity of solute remains _____ and the quality of solvent remains _____.
4. Milk and fog are _____.

Multiple choice questions

1. Which one is liquid-gas solution?
   a. lemon juice b. soft drinks
   c. vinegar d. saline water
2. Which one is a colloid?
   a. chalk powder and water b. flour and water
   c. fat and water d. soil and water

Answer question no 3 and 4 in the light of citation–

At room temperature the solubility of sodium carbonate is 21.6.

3. What amount of sodium carbonate is required to make a saturated solution of sodium carbonate in 200 gm of water?
   a. 2.16 gram b. 4.32 gram
   c. 21.6 gram d. 43.6 gram

4. If the quantity of sodium carbonate is 10 gram less than the solution is-

a. saturated solution b. unsaturated solution
c. suspension d. colloid

Short answer questions

1. What is called a solution? What is the main difference between solution and mixture?
2. What does it mean by solubility?
3. What does 'liquid-gas solution' mean? Explain with examples.
4. What is called suspension?
5. Are the colloid and suspension same? Give reasons in favour of your answer.

Creative questions

1. Priyonti and Ruponti were enjoying when they got down to the sea water at Cox's Bazar. Suddenly the water of sea entered into the mouth of Ruponti and she observed that the water has salinity. The cause of this was asked to Prionti and she answered that it is a solution of water and salt. Salt is made from it. Ruponti was astonished and wanted to know more about the matter. Coming back to their house Priyonti showed Ruponti how to make salt from saline water.

a. What is mixture?
b. Why is water called universal solvent?
c. Show by drawing a schematic diagram the production process of the components showed by Priyonti to Ruponti.
d. Analyse that both the components of the solution is possible to obtain again.

2. When Adil was giving some medicine to his mother to take by mouth he observed that his mother shakes the bottle every time before use. But at the time of drinking milk she does not shake.

a. What is heterogeneous mixture?
b. What does it mean by solubility?
c. Explain, why Adil's mother shakes the bottle of medicine?
d. Are both the mixtures the same? Give reasons.

CHAPTER NINE

Phenomenon of Light

We can not see without light. Without light plants would not grow and animals would not get food. And all the things that provide us with food and clothes would not grow and exist if there were no lights. That is why it is difficult to think of our existence without light. Light is one kind of energy. Light has the capacity to work. That means light is energy. The ability of doing work is called energy. Light travels very fast, with a speed of about 3 lac kilometres per second. Had you been able to travel in this speed, you could have travelled round the earth more than seven times in a second. Scientists believe that, nothing can travel faster than light. Whatever might be the source of light, the sun is the ultimate source of all lights.

By the end of this chapter we will be able to–

- explain propagation of light.
- explain why an object become visible .
- explain reflection and absorption of light.
- explain the reflection of light from smooth and rough surfaces.
- explain formation of image on a mirror.
- explain the reflection of light in terms of various incidents around us.

LESSONS 1-2: HOW LIGHT PROPAGATES

We know that light travels very fast, with a speed of about 3 lac kilometres per second. But how does light travel? Does it travel in a straight direction or takes a curvilinear way? Let us engage in a task now. Form this task you will understand how light travels?

Task: Take three note book covers of the same size. Place one cover after another in way that all the edges of the covers meet together on the same line. Now prick all the three cover with a thick needle or nail. Now set the three boards perpendicularly on the table in a way that the three holes remain horizontally in the same line (you can stand the boards vertically using gum or clay or put the cover between two books. Now lit a candle and place it behind the boards at one end of the table in such a way that the flame reaches the height of the holes (fig:9.1). Array the three boards so that the flame of the candle and the three holes of the board stay horizontally in a straight line. Now look at the candle from the other end of the table, you will be able to see the flame of the candle through the holes. Then, slightly displace one board so that the three holes no more remain in a straight line. Can you see the flame of the candle now? No, you can not see the flame. Light could not enter your eye through the curvy way. What decision you may reach from this? Light do not travel in a zigzag way. It always travels in a straight direction. The straight line traversed by light is known as the ray of light.

Fig. 9.1: Light travels in straight way

LESSON 3 : HOW DO WE SEE ?

Why can't we see anything at night in a dark room? When light reflects or returns from an object to our eye, only then we can see that object. Look at the figure below (fig: 9.3). Here, there is a light bulb and a cricket ball. We can see the bulb as light coming from the bulb falls on our eyes. Our eyes see a light source or an object in the direction from which the light rays directly enter our eyes or are reflected from an object. This is true even if the light rays bend or change direction before entering our eyes. That means, in such cases, our eyes will see the light source or the object in a different location and direction than where it is located. We will explain this further with a few examples later. Objects like the sun, the stars, the firefly, candle, electric bulb, etc have their own light and they can emit light. These are called luminous objects.

Most objects do not have their own lights but they reflect lights of other sources. They are called non-luminous objects. Some objects do not reflect the light falling on them. They rather absorb all the light. Such objects look black.

We see an object not because of the fact that light from our eyes fall on that object. Rather, light is reflected from that object and falls on our eyes which make us see the object.

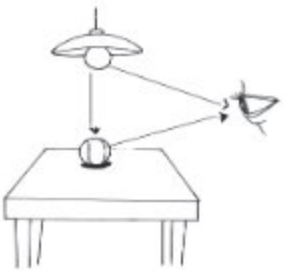


Fig 9.2: How do we see things

Task : To know how we see with the help of light.

Required accessories: One shoe box, stone chip and some black paper.

Procedure: Take a shoe box with the cover. Wrap the inner side of the box with black paper. Make a small hole on the cover of the box and a big hole on its wall of one side of the box. Keep the stone chip just below the hole of the cover. Place the cover. Close the big hole of the side wall by a thick black paper or tape. Try to see the stone chip through the small hole of the cover. Can you see the stone chip? No, it is not visible. Remove the black paper or tape from the hole on the side wall of the box. Light enters inside the box through this hole. This you try to see the stone through the hole on the cover. Is the stone visible now? Yes, it is.

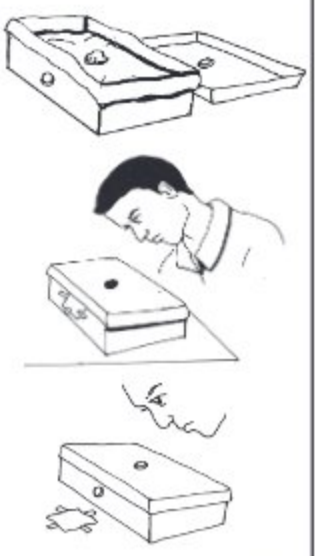


Fig. 9.3 : How do we see by light

What can be decided from this? We can decide that, nothing can be seen without light. When light falls on an object and if it is reflected back to our eyes, then we can see the object. Why the blind people can not see? When light coming from an object and falls on normal eyes only then the object is seen. Eyes of the blinds are not normal so they can not receive the light coming from the object. As a result they can not see.

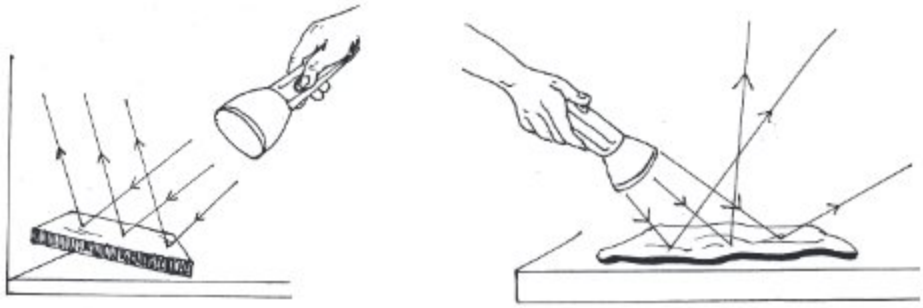
How can we see the letters printed on this page? Any black object or any black colour absorbs light coming from any source. But our eyes receive the light reflected from the white paper. As a result, we can see the printed black lettters from the white paper. Bright colours absorb more light than the light colour. The object that absorbs all the light looks black.

LESSONS 4-5 : REFLECTION AND ABSORPTION OF LIGHT

When light falls on an object, obstructed and returns back, it is called reflection of light. When light falls on an object and do not comes back then it is called absorption of light.

Observe these two pictures below; the first picture is of smooth a surface (mirror or steel plate). The second one is of rough surface (steel plate used for a long time or a page of paper). What are the two pictures about?

In the first picture, the reflection from the mirror is seen. Here the light falls on the surface at an angle and returns back creating exactly the same angle. This fall of light on a surface is called incidence and obstruction of light by the surface and its returning back is called the reflection. The incident rays are parallel to each other as well as the reflected rays are parallel to each other. In the second picture incident rays are parallel to each other but the reflected rays are not parallel to each other. This type of reflection is called irregular or scattered or diffused reflection.



A B

Fig 9.4: Reflection of light

Task : The differences in reflection of light on different objects or surfaces.

Required accessories: A reflector or mirror, a piece of wood, one page of paper, one steel plate, one plastic plate and one torch light.

Procedure: At first hold a mirror vertically opposite to a white wall. Now throw light on the mirror from the torch light. The reflected light from the mirror will fall on the wall. Observe whether the light falls on the wall is bright or faded. Now throw the light on the page of paper, piece of wood, steel plate, plastic plate from the torch light in the similar way and see the reflection of light on the wall each time. What do you see? Which reflected ray is brighter? You will see that the reflection of light from the mirror and steel plate is maximum and brighter. The reflection of light from the pieces of wood, paper and plastic plate is the least and the reflected light is less bright or faded.

Therefore the surfaces which are smoothers or shinier reflect more light. On the contrary, the surfaces which are rougher or less glittering reflect less light. The reflection of light on rough or less glittering surfaces leads to some other observations which you will learn in higher classes.

LESSIONS 6-7: THE LAW OF REFLECTION OF LIGHT BY THE MIRROR

The reflection of light by the mirror is similar to when a ball is thrown on the wall and it bounces back from the wall. If you throw any ball straight way on the wall, then it will come back straight from the wall. The same phenomenon is applicable in case of falling light on the mirror. Now do the task below.

Task: Observation of the change of direction of a ball thrown on the wall.

Required accessories: One tennis ball.

Procedure: Take one tennis ball. Throw it straight way to the wall. How does the ball return back being bounced on the wall? Does return in a vertically way or any other way? Now, throw the ball on the wall at an angle. How does the ball return back now? Straight way nor making an angle? Throw the ball on the wall making from different angles and see how it returns back.

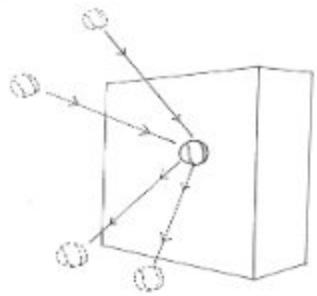


Fig. 9.6: The change of direction of the ball.

Observations from the above task

1. When the ball was thrown straight way it returns back straight way.
2. When the ball was thrown at an angle it returns back making an angle.
3. The angle in which the ball is thrown, it returns back making that angle.

Same things happens when the light incidents on the mirror and reflects from it. It will be easy to understand this if the following task is done.

Task: Reflection of light by mirror.

Required accessories: A plane mirror and a torch-light.

Procedure: Keep the mirror on the floor of the room in such a way that its face or the smooth surface remains upward. Throw light from the torch in a straight way on the mirror. This light will be reflected back from the mirror and fall straight to the

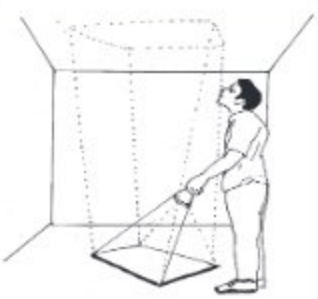


Fig. 9.7 : Reflection of light

roof. Now move the torch to throw the light on the mirror at an angle. You will see that when the angles are changing then the lights returning after falling on the mirror are also changing their directions.

The angle created by the light falling on a mirror with the normal is called the angle of incidence and the angle created by the light reflecting back from the mirror with the normal is called angle of reflection. It was found from the experiment that the angle of incidence is equal to the angle of reflection. That is,

Angle of incidence = Angle of reflection.

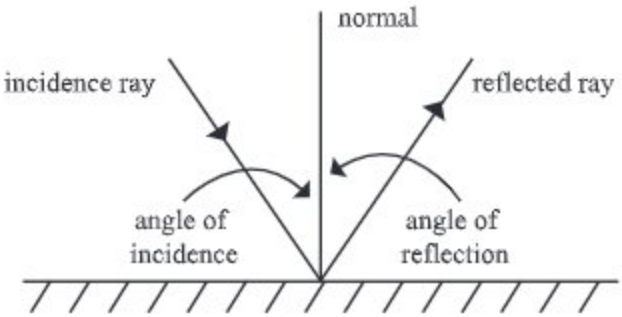


Fig: 9.7 Incidance and reflection angle

LESSON 8: FORMATION OF IMAGE BY MIRROR

We know that, when light reflects back from an object and falls on our eyes, we can see the object. But if the light reflected from the object falls on a smooth or glittering surface, an image of the object is formed on that surface. The known example is the mirror or reflector and stagnant water. If we stand in front of a mirror, we can see our image.

Stand in front of a large mirror (it might be the mirror of a dressing table). You will see your image. Now tell-

Is the image formed on the mirror equal to, greater than or smaller than your size?

- Is the distance of the image which is formed behind the mirror is equal to, greater than or smaller than the distance of your image.
- Go one step forward to the mirror. Does the image come forward the equal distance toward you or goes back? Or, is it standing still at the same spot?

- Now you move your right hand. Is the hand of the image also moving? If it moves, which hand is moving -right hand or left hand?
- The answer to these questions will help you know about some important properties of the images formed on the mirror.

Task: The distance of image formed on a plane mirror.

Required accessories: One large transparent glass and two candles.

Procedure: Place the glass sheet vertically on the table firmly so that it does not move. Light a candle and keep it in front of the glass on the table. You will see an image of the illuminating candle behind the glass. Place the second candle behind the glass in such a position that it coincides with the flame of the image. It appears that the second candle is illuminating. Now measure the distances of the first candles and the second candle from the glass. See whether both the distance is equal. The interesting matter is, if you place your finger at the position of the second candle, it appears that your finger is burning.

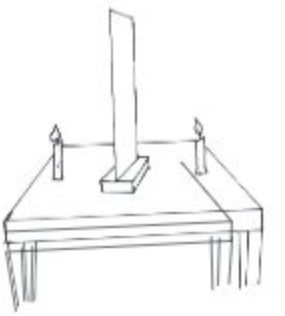


Fig. 9.8: Formation of image

The answers to the questions raised in this lesson are-

a The image of you formed by the plane mirror is equal to your actual size. It is true for all objects.

b The distance of the image from the plane mirror is equal to the distance of you from the mirror.

c The image is laterally inverted, that is right and left side exchanges their positions.

If you move your right hand, it appears that the image is moving the left hand.

Lesson 9-10: Some Popular Optical Phenomena

When an object is placed in front of a plane mirror MM` from a point O, two reflections are formed in our eye. One is formed at the actual position of the reflection point, the other is formed at I position behind the mirror. Let us see how this second image is formed. Among many rays reflected from O, two rays OA and OB (in the figure) are shown. After reflection according to the law of reflection in a mirror, they proceed

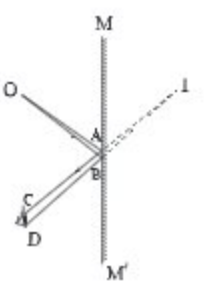


Fig. 9.9: Optical Phenomena

along the path AC and BD and enter the eye. That is, the eye sees two rays AC and BD, which appear to come from point I. So the eye sees an image of O at point I.

Reflection in Periscope: Periscope is made of a long tube and two small plane mirrors. Mirrors at both ends of the tube are placed at an angle of 45° to the tube wall at both ends, as shown in the figure. The mirrors are parallel to each other.

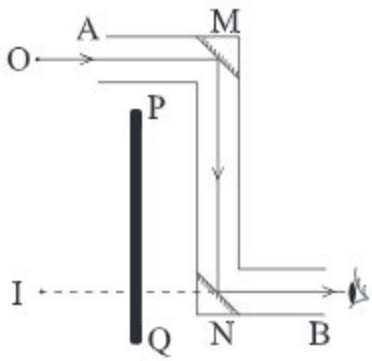


Fig. 9.10: Optical Phenomena

As shown in the figure, A ray of light from point O of an object enters through the end A of the periscope and is incident on the first mirror M. Then the incident ray is reflected there is incident on the second mirror N according to the law of reflection. The second mirror re-reflects the ray and exits through the end B of the periscope. If this ray is incident on our eye there, the eye sees the light coming along NB, so an image of point O is seen by the eye along this line at point I.

If there is an obstacle in front of the eye (PQ in the picture), a periscope is often used to see objects or events on the other side of the obstacle. Periscope can be used to watch the game among the crowd in the stadium. It is also widely used to see what is on the surface of the sea from submarines.

New words

mirror, plane mirror, reflection, absorption, regular reflection, scattered reflection, dispersion, image, prism, angle of incidence, angle of reflection.

Things we have learned in this chapter:

- Nothing can be seen without light. When light falling on an object reflects or return back from it to our eyes, only then we can see that object.
- Light travels in straight lines.
- If the light falls on an object it is obstructed and returns back and it is called reflection.
- If the light falls on an object and does not return back but absorbed, it is called absorption.
- The angle of incidence is equal to the angle of reflection.

- Light is generally reflected from all surfaces.
- Regular reflection of light occurs from smooth or polished surfaces.
- The size of the image formed by a plane mirror is equal to the size of the object.
- An image is laterally inverted on a plane mirror.
- The distance of the object from the mirror is equal to the distance of the image from the mirror.

EXERCISES

Fill in the blanks

1. In the plane mirror the angle of incidence and the angle of reflection is _____.
2. If a person stands at a distance of 1 meter from a plane mirror, his distance from the image is _____ meter.
3. If you touch your right ear standing in front of a plane mirror, its image will touch _____.
4. The periscope is made by applying the reflection of light _____.

Multiple choice questions

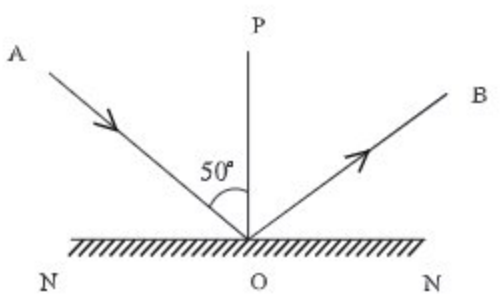
1. When light falling on an object does not return back, what do we call it?

   a) absorption b) reflection
   c) refraction d) analysis

2. We can see an object when-

   a) it absorbs light b) it reflects light
   c) light is refracted by the object d) light from the eyes falls on the object

Answer the question no. 3 and 4 on the basis of the figure below:



3. What is the value of ∠BON in the figure?

   a) 10° b) 40°
   c) 50° d) 90°

4. If the incident ray falls along the line PO, what will be the value of the angle of reflection?

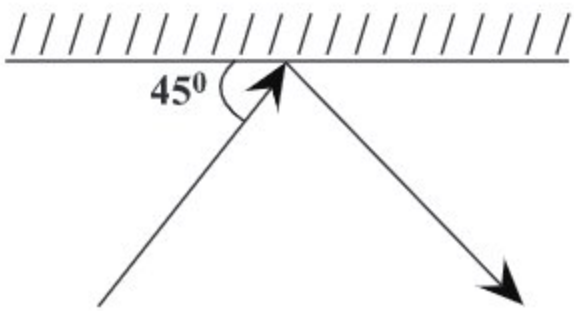
a) 0° b) 40°
c) 50° d) 90°

Short answer questions

1. Suppose you are in a dark-room. Will you be able to see the things inside the room around you? Will you be able to see the things those are outside the room? Explain, why/why not.
2. What is the difference between regular and diffused (irregular) reflections?
3. Describe the construction of a periscope.
4. Which of the following substances cause regular reflection and irregular reflection?

a. floor of marble b. scattered flour
c. shoe box d. plane mirror
e. polished door e. new steel plate

5. Look at the diagram below and find out the value of the angle.



Creative questions

1. Shamin got a periscope in his school practical class and looked outside through it. He could see the flowers of the garden outside the class. After the class, he went to the plane mirror fixed above the basin to wash hands. He observed that the closer he approached to the mirror, the closer his image behind the mirror was approaching towards him. Again, when he was going away from the mirror, his image behind the mirror was also going further. On his return home, he designed one periscope placing the mirrors at an angle of 30° using all the required accessories.

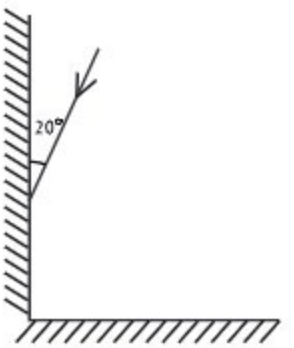
a What is called reflection of light?

b What is image?

c Explain the cause of changing the position of Shamin's image in the mirror?

d Will it be possible to see the sceneries outside as in the school by the periscope designed by Shamin at home? Give reasons in favour your answer.

2. Two mirrors are combined at right angle. A light ray is falling at first mirror making an angle of 20° with it.



a. What is called reflection?
b. Write down the principles of reflection.
c. Draw the reflecting ray from the second mirror.
d. If the two mirrors are kept parallel to each other, what type of reflection will occur and explain why it will occur.

Do it yourself

1. Make a periscope with all the required accessories.

2. Make your mirror by yourself. Take a glass sheet. Clean it properly. Place the glass sheet on a white paper and try to see your face in the glass. How clear does it look? After that, place the glass on black paper sheet and again try to see your face in the glass. Now are you seeing your face much better and clear? why?

CHAPTER TEN
Motion

We experience rest and motion in our every day life. In this world some things are at rest and some are on the move. We see various examples of rest and motion daily around us. House and buildings, the lamp posts and trees on the roadside, etc. are always standing still - these are at rest. On the other hand running buses, cars, rickshaws and trains and walking people are the examples of motion. In this chapter we will discuss rest and motion.

By the end of this chapter we will be able to-

- make difference between rest and motion.
- explain that all motions are relative.
- describe the characteristics of different kinds of motions.
- calculate the mathematical relations among motion related quantities.
- measure the quantities related to motion.
- determine distance and acceleration.
- use stop-watch accurately in determining speed.
- explain how life-risks come from high speed.
- explain the security measures for making journey.
- be conscious about taking security measures during journey and raise this consciousness among others.

LESSON 1: REST AND MOTION

There are many substances around us. Some of them are at rest, for example: house and buildings, the lamp posts and trees on the roadside, etc. These things stand at rest in a fixed place.

Fig 10.1 : State of rest

Again there are many other things which are moving. These have motion. For example: running train, moving bus and car, running cycle and rickshaw, walking people, etc.

Fig. 10.2 : State of motion

Now, let us come to the point. What do we understand by rest and motion?

Suppose, Anusheh is standing beside the road at a bus stand. He is telling that the tree beside the road, houses, lamp post at the roadside and the bus-stop all are in a state of rest. Can you tell why he is telling this?

Anusheh is telling this, because these bodies are not changing their position with time that is relative to him. So when an object does not change its position that is relative to an observer, the object is at considered at rest and this state of the object is called rest.

Task : Hold a pen by your hand. Compare, if the position of the pen is changing relative to everything around it?

The pen held by you is surrounded by many things, for example : your chair, table, your book, khata and everything within the room. The pen has a specific distance and direction from these things. The position of the pen is fixed relative to the surrounding things. The position of the pen is not changing with time. We say the pen is at rest relative to the surroundings. The phenomenon of being at rest is called state of rest.

Hence, when an object does not change its position with time, relative to an observer then the object is at rest.

Now, let us mention another event. Arian is waiting for train standing at a railway station. A train passed the station as he was standing. Seeing that he told that the train is in motion because the train was changing its position in every instant relative to him. That is, the train was changing its position every moment relative to Arian.

Task : Keep the pen held by you moving to and fro. Compare, if the position of the pen is changing relative to everything around it?

The distance and direction of the pen is continuously changing from everything around. Moreover, position of the pen is changing with time. We may say the pen is in motion relative to its surroundings.

Hence, When an object changes its position with time relative to an observer, then the object is said to be in motion and the object is in a state of motion.

The examples of motion found around us are, moving bus, a running person, a flying bird, a rolling football, a fruit falling off the tree, etc.. You can also give many examples of such motion. Tell us about a number of objects which have such a motion?

LESSON 2: REST AND MOTION ARE RELATIVE

Although an object might at rest relative to an observer, at the same time, it can be in motion relative to another observer. Let us consider an event, Arian

was standing on the road and a passenger sitting in a bus passed him with the motion of the bus. The bus and the passenger of the bus both are in motion relative to Arian. But the tree standing near the bus stop is at rest relative to him. But it seems to the passenger of the bus that the tree is moving backward relative to him. That is, the tree near the bus-stop is in motion relative to the passenger of the bus. If Arian were the passenger of that bus then would will see that the passenger at rest relative to him but the tree of the bus-stop in motion, going backwards from the bus.

The same tree is at rest relative to Arian when he was standing but is in motion relative to the passenger. From this we may come to the decision that no object can be in absolute rest or absolute motion in this universe. The two words rest or motion is entirely relative and depend the observer's perspective. Though any object is in motion relative to an observer it may be at rest relative to another observer. Hence, before determining rest (position) or motion (speed) we are to specify the relative factors which might be taken in to account for determining them.

Task: You three friends go to the field with a bi-cycle. Tell one friend to stand in a position at rest. You ride on the back-sit of the cycle and tell another friend to paddle the cycle in a straight direction. You and your friend riding on the cycle are changing position every moment relative to the friend at rest

Are you in motion relative to you friend at rest ? yes. You are in motion relative to the friend at rest. But is the friend who is paddling the cycle is in motion relative to you? Certainly not. Hence, all motions are relative.

Reference frame

The observer relative to whom motion or rest is determined is called reference frame. Hence the reference frame is such a specified object or point, relative to which the rest or motion of an object is determined. The reference frame may be a person, an object or a place. But in all cases it must be specified. If you want to measure the motion of a rickshaw in resference of your house, in this case your house is a reference frame. To know the distance of the sun from the earth then earth will be the reference frame.

We know the whole universe is in motion. Suppose you are lying on the bed. You will surely say that, you are at rest relative to the ground. But the earth itself moves round its own axis.

Hence, you are also in motion or moving with the earth.

LESSON 3 -4: DIFFERENT KINDS OF MOTION

Motion may be classifi into different kinds. They are-

a.Translational motion, b. Rotational or circular motion, c. Complex motion, d. Peroidic motion, e. Vibratory or Oscillatory motion.

Translational Motion

Suppose, a box Ac is being pushed on the floor to take it somewhere. The box has been shifted from A to B and the point C of the lower portion of the box has been moved to point D.

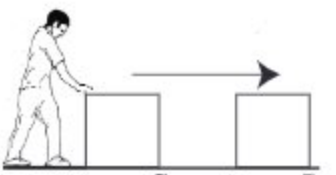


Fig. 10.3: Translational motion

All the points of the box have been displaced in the same direction travelling the same distance CD. This is an example of translational motion.

Hence, translational motion is the motion, when an object moves in such a way that all the particles or points of the object traverse the same distance in the same direction taking the same time. Therefore, you are in motion along with the word, that means you are moving.

Task : Collect one brick. Keep the brick at a definite point A on the table in your class-room. Mark the point of the front and back edge of the brick by drawing line on the table with a chalk. Now, push the object in a forward direction and take it to a definite distance. Measure the distance between the point of front edge marked on the table to the new position of the point of front edge and also the distance between marked point and the new position of back edge point.

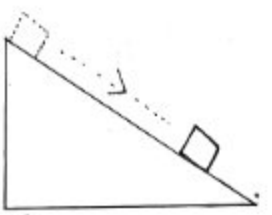


Fig. 10.4: Rectilinear motion

You will find both the distances are the same. Similarly, if you measure the distance of the middle point to the new middle point, you will find the same distance.

The motion of the drawer of a table, the motion of a box sliding along an inclined plane and the motion of the hand while writing- all of these are translational motions. Translational motion may be divided into two kinds (1) Rectilinear motion and (2) Curvilinear motion. When we write, our hand travels in a straight line for some times and again through different curve lines in other times. When an object travels in a straight line, it is called rectilinear motion. Again when an objects travels through curved line, the motion is called curvilinear.

Fig. 10.5: Curvilinear motion

Task: Tell one of your friends to walk straight from one end to the other end of your class-room. This is rectilinear motion. Tell another friend to walk from one end to another point of your class-room in a zigzag way. This is curvilinear motion.

LESSON 5: ROTATIONAL MOTION

Observe the motion of the ceiling fan of your class. See the picture, here for the rotation of the blades of the rotating electric fan displace point A to the point A′, point B to the point B′ and point C to the point C′. All points of the fan revolves round the centre of the fan in a circular path making the same angle with different radius. This motion of the fan is rotational motion. Observe the rotational motion by moving a fan.

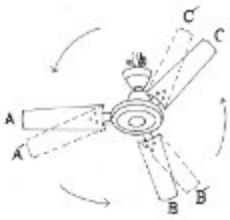


Fig 10.6: Rotational motion

Task: Go to the field of your school. Strongly bore a pole of bamboo in the ground. Holding the pole lightly by one hand continue to rotate around the pole. This motion is the example of rotational motion.

Fig. 10.7: Rotational motion

LESSON 6: TRANSLA-ROTATORY MOTION OR COMPLEX MOTION

You must have noticed the motion of your by-cycle's wheel. The wheel of the cycle proceeds or traverse a path by continuous rotation. This type of motion has rotational as well as translational motion. This motion is called transla-rotatory or complex motion. The motion of the rolling ball and drill machine are the examples of transla-rotatory motion.

Task: Tell one of your friends to ride a bi-cycle in your school-field. During movement of the cycle observe the motion of the wheel.

What the two wheels are doing. The wheels are rotating. What are the wheels rotating round? Is any distance traversed by the wheels? The two wheels are rotating round their centre points and every time they are traversing some distances. Here, both rotational and translational motions are working together. This is an example of transla-rotatory motion.

LESSON 7: PERIODIC MOTION

Observe the motion of the hand of a clock. The hand of second rotates round its centre once in a minute. The hand is rotating at a certain mantion continuously in one direction and its motion is repeated. This kind of motion is periodic motion.

Remember the four round race of your school's annual athletic competition. Suppose you remain standing at one corner of the field. One sprinter of four round race will cross you four times from the same direction (after certain definite intervals of time). It is also periodic motion. The motion of clock hands, round race, electric fan, etc. are examples of periodic motion. Hence,

If an object travels a certain distance of its path from the same direction after certain definite intervals of time repeatedly, the motion is called a periodic motion.

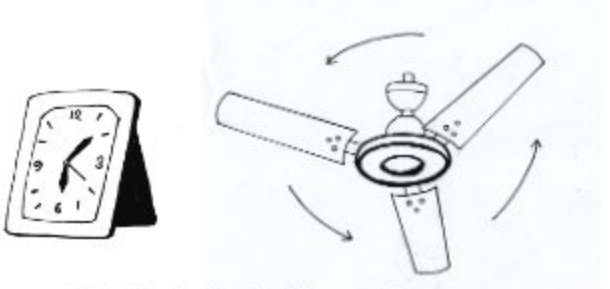


Fig 10.8: Periodic motion

Task: First, take a well-inflated football and throw it straight downwards towards the floor vertically. When the ball bounces back up after hitting the floor, push it down again. Keep doing this repeatedly. In this case, the motion of the ball is periodic motion because part of its motion keeps repeating. When you repeatedly push the ball down with your hand, your hand's motion is also periodic.

Now, give examples of such periodic motion from your day to day experiences.

LESSON 8: OSCILLATORY OR VIBRATORY MOTION

Task: Taking a long plastic scale keep it on one side of a table in such a way that some (about half) portion of the scale remains hanging outside the table. Now hold the portion of the scale lying on the table tightly by one of your hand, so that it does not move and remains at rest in a fixed place. Pull the outside portion of the scale slightly downward and release it.

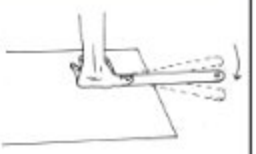


Fig. 10.9 : Vibratory motion

What do you see? The outside portion of the scale is moving up and down (figure). This to and fro periodic motion is called oscillatory or vibratory motion.

Task: Tie a stone at one end of a thread and hang it from one side of a table as shown in the figure. Pull the stone to a short distance from any side and release it gently. The stone will first go back to the initial position, from there, it will move to the opposite direction. After going to a short distance it will again return to the initial position and will go to the direction in which it was pulled. In this way the stone will move in both the directions from its initial position. This vibration is the to and fro periodic motion of the initial position (Fig.) This motion of the stone is called oscillatory or vibratory motion.

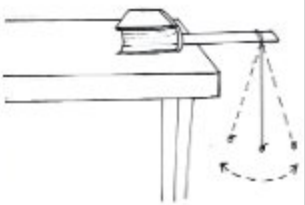


Fig. 10.10 : Oscillatory motion

Hence, vibratory or oscillatory motion is the motion, when an object moves equally to and fro from its mean position. The motion of wall-clock's pendulum is oscillatory motion.

LESSON-9: DISTANCE AND DISPLACEMENT

Supose, Anila moves 10 meters toward south from a fixed point. Then, she turns round and walks up to 4 meters toward north. Here, Anila traversed a distance of (10+4) meters or 14 meters. But Anila's displacemer from north to south is (10-4) meters = 6 meters.

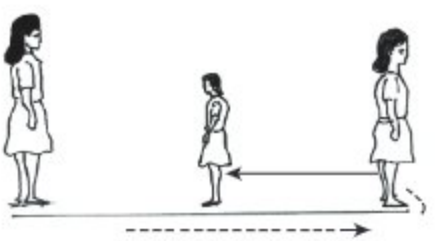


Fig. 10.11 : Displacement and distance

Can you say why? Because, distance is the total length travelled by an object in any direction from a fixed point. Here, the distant is 14 meter.

Again, displacement is the direct minimum distance between initial and final position of an object in a particular direction. Which is (10-4) meter = 6 meter.

Hence, the distance is the total length travelled by an object in any direction and displacement is the linear distance covered in a particular direction. Displacement is the linear distance and direction from initial position towards the final position.

Example

Mrs. Rashida walked 7 kilometers in forward direction. Then turns back and walked 5 kilometer in backward direction. How many kilometres of distance has she travelled and how many kilometres is her displacement?

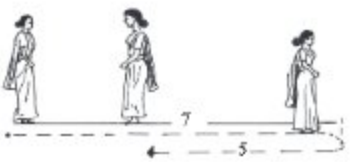


Fig. 10.12 : Displacement and distance

The distance traversed by Mrs. Rashida = Total distance traversed = 7 km + 5km = 12 km.

Displacement of Mrs. Rashida = linear distance in a particular direction from initial to final position = 7 kilometer-5 kilometer = 2 kilometer.

Solve the problem-1

Mr. Rashed travelled 4 kilometers toward north on a bicycle in the morning. After returning back he travelled 7 kilometers towards south. What distance did he travel and how many kilometers was his displacement?

LESSON 10: SPEED AND VELOCITY

Suppose, Anila and Nowshin went to the Novo-theatre after school. Both started at 5'o clock in the afternoon. Anila reached the Novo-theatre at 5:30 pm and Nowshin reached at 5:10 pm. Who went with more speed? Certainly Nowshin, because Nowshin traversed the same distance 20 minutes earlier than Anila.

Robin and Sahin Started for school from their houses. Robin reached the school in 20 minutes, Sahin reached in 40 minutes. The distance of the school from Robin's house is 1600 meters and the distance of the school from Sahin's house is 2000 meters. Who went with more speed? Here, Robin travelled a shorter distance and Sahin travelled a longer distance. To find out who went with more speed we are to find out their distance travelled in a fixed time interval. Let us suppose, this fixed time interval is 1 minute.

For 1 minute the distance traversed by Robin= 1600/20= 80 meter

For 1 minute the distance traversed by Robin= 2000/40= 50 meter

Hence, Robin went to school with more speed. Because, he traversed more distance in one minute. Hence, the speed of an object in motion is the distance travelled by it in unit time. It may be mentioned in this way,

Speed = Distance/ required time to cross the listance.

Distance is measured in meter in short it is m. Time is measured in second in short it is s.

Example : A car travelled a distance of 60 meters in 3 seconds. What is its speed?

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{60\,\text{m}}{3\,\text{s}} = 20\ \frac{\text{m}}{\text{s}} = 20\ \text{ms}^{-1}$$

Solve the problem-2

Nahian traversed 5000 meters in 25 minutes in a four-round race at the annual athletic competition of his college. What is his speed?

Velocity

Speed in a particular direction is called velocity.

Suppose Lubaba travels 15 meters in 10 seconds towards north. What will be her velocity?

$$\text{velocity} = \frac{\text{displacement}}{\text{time}} = \frac{\text{distance in a particular direction}}{\text{time}}$$

$$= \frac{15\,\text{meter (towards - north)}}{10\,\text{second}}$$

$$= 1.5\ \frac{\text{m}}{\text{s}}\ \text{(towards north)} = 1.5\ \text{ms}^{-1}\ \text{(towards north)}$$

Direction of velocity should be mentioned with the magnitude of velocity. Because velocity has both magnitude and direction. But the speed has only magnitude.

The example of speed in the round-race of athletic competition where the distance travelled per second is the speed. It has no particular direction but has only magnitude. The distance travelled per second in a particular direction in the 100 meter sprint is the example of velocity

Remember

- The displacement of an object from a fixed point is equal to the distance in a particular direction from that fixed point.
- The rate of change of displacement of an object with time is called its velocity.

LESSON 11: ACCELERATION

Suppose a motor-cycle was running with a velocity of 20 meter/second. As a result of pressing on the accelerator by the driver the motor-cycle was going with more velocity. Suppose the velocity of the motor-cycle was increasing at the rate of 5 meter/second.

The primary or initial velocity of the motor-cycle was 20 meter/second.
After 1 second the velocity increased to 25 meter/second.
After 2 second the velocity increased to 30 meter/second.
After 3 second the velocity increased to 35 meter/second.
After 4 second the velocity increased to 40 meter/second.
After 5 second the velocity increased to 45 meter/second.

The amount of velocity increasing per second is the acceleration. Here the velocity increasing per second is 5 meter/second. Hence, acceleration per second is 5 meter/second, which can be written as 5 meter/second^2 .
If the total increase of velocity and total time are known, the acceleration can be easily found out.

Here, the initial velocity was 20 meter/second and final velocity was 45 meter/second. Here, the initial velocity was 20 meter/second and final velocity was 45 meter/second. Hence, total increase in velocity is, (final velocity)–(initial velocity) = (45 –20) meter/second = 25 meter/second. Total time taken is 5 seconds.

$$\text{Hence, acceleration} = \frac{\text{total increase in velocity}}{\text{total time}} = \frac{25\,\text{m/s}}{5\text{s}} = 5\,\text{m/s}^2$$

Hence, acceleration is the rate of increasing in velocity with unit time or increase in velocity per second.

Retardation

In the above example the velocity of the motor-cycle was increasing 5 m/s per second. If the driver pressed on the brake instead of accelerator then the motion of the motor-cycle becomes slower. Its velocity may decrease to 5 m/s per second. The rate of decrease in velocity of the motor-cycle per unit time is called negative acceleration or retardation. Hence, retardation is negative acceleration or deceleration.

LESSON 12: EXCESSIVE MOTION (HIGHT SPEED) AND RISK OF LIFE

Task : Make several groups by taking 5/6 friends. Discuss in each group about the causes of road accidents. After discussion write the causes in your note-book. Present it by one of you from each group. After presentation from all groups summarise or make a gist of the discussion.

In our country many forms of road accidents are taking place daily. One of the causes of these accidents is driving the vehicles with high-speed.When drivers drive vehicles with a high speed, they don't have any control over their vehicles. Hence, the drivers of bus, truck or car who drives with high-speed fall victims of road accident. As a result, many people loss their lives, many people are injured and some of them become handicapped for the rest of their lives.. So it is better not to drive bus, truck, lorry and car in high speed. If any one drives fast they are to be restricted from doing so. The chance of accident is more in narrow roads, at the turning of roads and on the bridges. If the vehicles move fast in these spots, accident are more likely to occur. There is specified speed limits in many parts of roads. Vehicles should be driven following the speed-limit that is shown on the road signs. When you will grow-up, do not drive vehicles with high speed and discourage others to do so. New words: rest, motion, translational motion. rotational motion, transla- rotatory motion, periodic motion, oscillatory motion, displacement, velocity and acceleration.

New words: rest, motion, translational motion. rotational motion, transla-rotatory motion, periodic motion, oscillatory motion, displacement, velocity and acceleration.

Things we have learnt from this chapter

- When an object changes its position with time relative to an observer, the object is said to be in motion and this state of the object is called motion.
- All the states of motion and rest are relative.
- Motion may be classified into different kinds. These are-

  a) Translational motion b) Rotational motion c) Complex or transla-rotatory motion

  d) Periodic motion e) Vibratory or oscillatory motion
- When an object moves in such a way that all the particles or points of the object traverse the same distance in the same direction taking the same time, it is called translational motion.
- If all points of an object do no follow the same path but every point of the object revolves round the centre in a circular path making the same angle with different radius, this motion is called rotational motion.
- The motion which has both translational and rotational motion is called transla-rotatory motion.
- If an object passes certain point of its path from the same direction after certain definite intervals of time repeatedly, then the motion is called a periodic motion.
- Vibratory or oscillatory motion is that motion, when an object is in to and fro periodic motion in a position.
- Distance is the total length travelled by an object in any direction and displacement is the linear minimum distance between initial and final position of an object in a particular direction.

- The distance travelled by an object in unit time is called its speed.
- Speed in a particular direction is called velocity.
- Acceleration is the rate of increase in velocity with time or increase in velocity per second.
- Retardation is negative acceleration.
- One of the main cause of road accident is the high speed of vehicles.

EXERCISES

Fill in the blanks

1. The motion of an object sliding over an inclined plane is called___ motion.
2. The motion of a rolling marble is_____motion.
3. The rate of change of____ of an object with time is called its acceleration.
4. _____have both magnitude and direction.

Write the kinds of motions in each of the following cases -

1. The motion of the wheel of a running bus.
2. The motion of the cradle.
3. The motion of the pedal of bi-cycle.
4. The motion of earth about its own axis.
5. The motion of car in zigzag road.

Multiple choice questions (There may have more corect ansawer)

1. What is called, the rate of change of displacement with time?
   a) speed b) velocity
   c) distance d) acceleration
2. What kind of motion is that of the clock's second hand?
   a) translational motion b) rotational motion
   c) oscillatory motion d) periodic motion

Read the paragraph below and give answer of question no. 3 and 4.

Rimi travelled a linear distance of 8 meters in a particular direction from a fixed position. From there she came back 6 meters along the same way.

3. What distance was traversed by Rimi?
   a) 2 meters b) 10 meters
   c) 8 meters d) 48 meters
4. What was Rimi's displacement?
   a) 2 meter b) 6 meter
   c) 8 meter d) 14 meter

Short answer questions

1. What is periodic motion? Give two examples.
2. What is the difference between rotational motion and transla-rotatory motion?
3. Explain displacement drawing a diagram.
4. What is the difference between speed and velocity.
5. What is the difference between acceleration and retardation.

Creative questions

1. Khusbu, Hridita and Sawdichsa starts for school from their houses. The time taken to reach the school by Khusbu was 15 minute, by Hridita was 20 minute and by Sawdichsa was 30 minute. The distance of the school from the house of Khusbu is 1500 meter, of Hridita is 1800 meter and that of Sawdichsa is 2100 meter.

   a. What is periodic motion?
   b. What kind of motion is the motion of wall clock's pendulum.
   c. Determine the speed of Khusbu.
   d. Whose speed is faster between Hridita and Sawdichsa? Give your comment by mathematical analysis.

2.

One particle is going from point A to the point C.

   a. What is rest
   b. What do you mean by reference frame.
   c. What is the average velocity of the particle when moving from point A to point C, determine by calculation.
   d. Whether the time will be more or less if the particle reaches the point C from the point B by moving with uniform acceleration? Give argument in favour of your answer.

Do it yourself

1. 4 or 5 friends go to the field. Take a stop-watch with you. Tell all to run up to certain known distance. Find out with the help of stop-watch who has taken how much time to traverse this distance, (if there is no stop-watch you can use hand- watch). From the time and distance find out the speed of each runner.
2. Conduct an investigation to find out the causes of road accidents in your area.

CHAPTER ELEVEN

Force and Simple Machines

To change the state of motion of an object, the influence exerted is called force. Applying force can make a stationary object move, change the speed of a moving object, or make a moving object stop. Force has various forms and applications. By applying force through different techniques, tasks can be accomplished in various situations, making work easier. Devices that simplify work through the application of force are called machines. In this chapter, you will learn about force as well as some simple machines.

By the end of this chapter we will be able to-

- explain what force is.
- analyse the affects of different kinds of force on an object.
- explain the uses of different types of simple machine.
- compare the efficiency of different types of simple machines.
- compare the functions of simple machines with different organs of human body.
- appraise the contribution of simple machines and the affect of force on our day to day life.
- use simple machines in our practical life.

LESSONS 1-2: WHAT IS FORCE?

Do you know that we apply force knowingly or unknowingly in various ways in our day to day life? You might be thinking what is this thing called force! Our application of force on different objects in various ways starts from the very morning. We need to apply force in order to open the tap or press the tube well handle while getting fresh after getting up from bed. Even we have to apply force in pulling the study chair to sit on. Again, suppose,your geometry box is inside the drawer of your reading table; you are to pull and push the drawer respectively to bring it open and close it. You must have switched on light in your room. You have applied force in this instance too. Have you seen anyone to opening a coke-can? This also requires application of force. To kick a football or to strike the cricket ball with bat- are examples of applying force. Analysing the events mentioned above it will be seen that two things are related with each of them--push and pull. These push and pull are the forces.

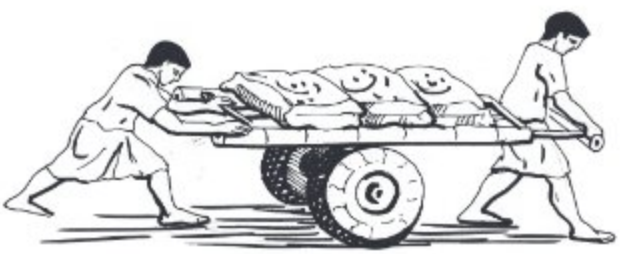


Fig. 11.1: Force is push or pull

Impacl of different types of forces on an object.

You must have got an eraser. Have you seen what changes occur in its shape when it is ever when it is bended, twisted, pressed or pulled? The efforts taken to bend, twist, press, and stretch involves the application of various forms of force on a certain object. Will you be able to draw the diagrams illustrating these?

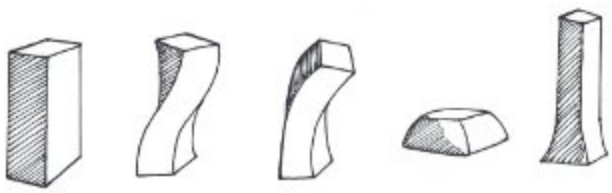


Fig. 11.2: Affect of force on an object

Observe another interesting event. Have you ever played with marble? At first the marbles are kept scattered in front of you. Then target one of the marble from the scattered ones to strike it by another marble from a short distance. When you throw the marble off your hand to the target, what do you see when the marble strikes the target? You will see that the marble changes its state of rest to the state of motion after receiving the strike. You might also see this marble striking another marble at rest. or continue the movivg in the same mrotion. This process will continue till any other force is not applied on the marble in motion. In addition to that, it is observed that the frictional force of ground stops the marble at a certain time.

Let us give another example. It may happen that a microbus got out of order on the road. Then it may be required to push the microbus to run. It may not move if only one person pushes it. When 4/5 persons push it together, it may start to moved, even run. Here, force has been applied, as a result, the body at rest changes or tries to change the state of rest.

Now will you be able to tell, what are the events that have happened here? Different changes in motion have happened due to application of force on the marble. Similarly, general force can be applied to change a body at rest to a state of motion, to increase or decrease the motion of a body in motion and to stop a moving body completely.

From the above examples we come to the conclusion mentioned below.

When force is applied on a body, -

- a body changes its state from rest to motion and motion to rest.
- the speed of a body in motion can be increased or deercased.
- the direction of the motion of a body is changed.
- the size, shape or volume of a body are changed.

Accordingly we can say that force is the thing that when applied on a body at rest changes or tries to change the state of rest to motion or when applied on a body in motion changes or tries to change its state of motion to rest, of changes the shape and size of that. The uses of force is seen in numerous

activities such as- putting an electric switch 'off' or 'on', opening a coke-can, crushing spices, lifting weights, throwing stones, rowing boats, wondering, click the mouse of computer, etc. The application of force is seen even in using things starting from motor-car, train, aeroplane, push cart to rickshaw-paddles.

LESSON 3: SIMPLE MACHINE

You must have seen the process of lifting or shifting a heavy body by applying force at one end of a long iron or wooden pole leaning against a piece of stone or brick on the other end. Yes, it becomes easier to a great extent to move away a heavy body by using the iron or wooden rod in this special method.

Easily you can experience doing this in your class-room. In this event of doing a work using iron or wooden rod leaning against a stone, the set up has acted like a simple machine. Basically it has made it possible to do more work by applying less force.

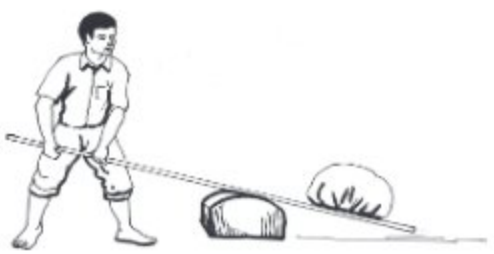


Fig. 11.3: Simple machine

In this way, we use different simple machines to make jobs easier in our daily life. Examples of such simple machines include scissors, forceps, hammer, crowbar, pulley, lever, etc. The common characteristic of these machines is, a special technique is applied on them to make work easier. The simple machines mentioned above can make works easier in one or more than one way mentioned below. It can be done by-

- multiplying the applied force by many times (multiplication).
- performing a work applying less force.
- applying force in one advantageous direction.
- performing work in a particular way, which would be difficult to do otherwise.
- increases motion and speed.

Here one thing is to be noted that in doing work by all the machines, an external impressed force is required. Now you will be familiar with various simple machines separately and will be able to to explain how mechanical efficiency is obtained from them.

LESSON 4: LEVER

Lever is a simple machine in which a strong bar can freely move upward and downward or rotate on a supporter. Similar to the pole and stone or brick system in the event descnbed in Lasson-3. The simple example of lever is the act of lifting a heavy body by a crowbar which dependsn on a brick or stone to take support.Similar to the pole and store or boick system in event descnibed in Lesson-3. Here, the heavy body is the weight and the force required to lift it is the force. The point at which the supporting body resists the strong bar to freely ascent and decent or to rotate is the pivot (fulcrum) of the lever. Lever helps raise or move a heavy body (load) with minimum application of force. Here the mechanical efficiency is-

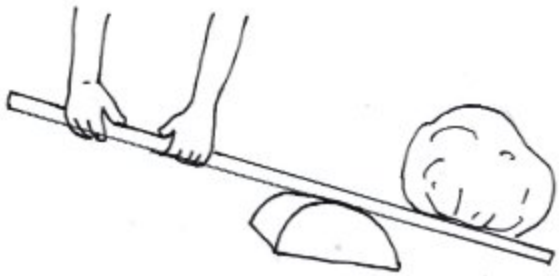


Fig. 11.4: Lever

$$\text{mechanical efficiency} = \frac{\text{weight}}{\text{applied force}}$$

Now you have understand how you can avail mechanical anvantage by using a lever. The principle of leaver is as follows:

Applied force x the length of force-arm = weight x the length of load-arm

Here the length of force-arm is the distance between the point of applied force and the pivot. Similarly the distance from the pivot to the centre of load is the length of the load-arm.

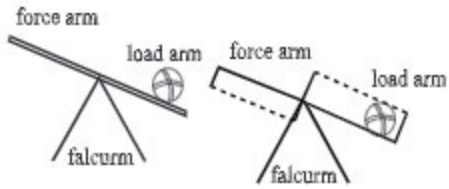


Fig. 11.5: Lever

Then the above principle is expressed by this equation,

$$\frac{\text{load (weight)}}{\text{applied force}} = \frac{\text{the length of force/arm}}{\text{the length of load/arm}}$$

Here we shall show by performing tasks how we can avail mechanical efficiency in raising or moving a particular load using a particular force.

Task: Make a lever by binding a pencil with a scale by a rubber band. Here the pencil will act as pivot. At first make the scale parallel to the ground by moving it forward and backward. Now keep five 50 paisa coins on each end of the scale in such a way so that the scale remains again parallel to the ground. Now, again keep 5 TK coins on the right side. What happens? Surely the right hand leans toward the ground. Now again moving the scale forward and backward make it parallel to the ground by keeping 5 coins on the left side and 10 coins on the right side of the scale. What happens now? The length of the load-arm decreases and the length of the force-arm increases. We can tell that mechanical efficiency has been obtained. That is by the application of less force more weight has been lifted. Again, by putting 5 more coins we may see what happens?

LESSONS 5-6: CLASSIFICATION OF LEVER

The levers can be classified into three types on the basis of applied force, load and pivot.

Class I lever: In this case the position of the pivot is in the middle of applied force and the load. For example: scissors, forceps, balance, handle of tube-well, watering-can, husking pedal, etc.

Class II lever: In this case the load remains in the middle and the position of the applied force and the pivot are on the two edges. For example, nut-cracker, one wheeled push cart, bottle openers, etc.

Class III lever: In this case, the applied force is effective in the middle. The load and pivot remain on the two edges. For example: pincers.

Now we will see how we can do work easily with scissors, nut-cracker and pincer.

Firstly: At the time of cutting something (says cloth) by scissors it will be much easier to cut the thing placing closer to the pivot. Basically, in this case the mechanical efficiency is increased by trying to decrease the length of the load-arm.

Fig 11.6 : Scissors

Secondly : In case of nut-cracker, the closer the pivot is to the load (for example : betel nut) the less force will be required to apply. In this case, we get mechanical advantage also by decreasing the length of the load-arm, that means, by increasing the length of the force-arm.

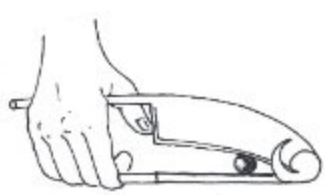


Fig. 11.7 : Nut cracker

Thirdly: In case of griping a substance by pincers the closer the pressure of the finger to the substance, the easier will it be to grab the substance. Here also basically increasing the length of the force-arm, that is by decreasing the length of the load-arm the work is made rather easy.

Fig. 11.8 : Pincers

LESSON 7: HAMMER

There are generally two ends of a hammer. By one end drive a nail into wood and by another end it plucks nail out of wood. When nails are plucked by hammar force is applied by holding the hammar's handle by the hand. Agains a nail is plucked by pressing the hammar against the area sorrounding the nail, which functions as fulcrum. In this ease the resistance against pulling out of the nail functions as weight . Here as the fulcrum works in the middle, it functions as a class I lever.

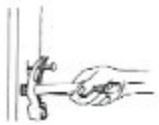


Fig. 11.9 : Hammer

Forceps

Forceps also act as a lever. The end where the hand holds the forceps is the force end and the end where the substance is grasped acts as the weight or load. Here, the pivot remains at the middle; so forceps is included in class-I lever. In it the length of the load-arm is unchangeable, so the mechanical advantage is availed only by changing the length of the force-arm.

Fig. 11.10 : Forceps

LESSONS 8-9 : INCLINED PLANE AND PULLEY

Inclined Plane

Inclined plane is a simple machine, with the help of it a heavy body can be lifted by sliding it rather than raising the body vertically. The work can be done quite easily by using an inclined plane, so to ascend a high bridge the road is made slanting and to reach the top floor of a building the staircases are made inclined instead of making them vertical. To raise a body by sliding over an inclined plane, although the distance traversed by the body is more but it requires a small amount of force. To understand this we are to know mechanical efficiency. The mechanical efficiency of an inclined plane is:

$$\text{mechanical efficiency} = \frac{\text{load (weight)}}{\text{force}} = \frac{\text{length of the inclined plane}}{\text{height of the inclined plane}}$$

From this equation it can be understood that to raise a body over the same height the more the length of the inclined plane increases, the more mechanical efficiency is availed.

Have any one of you seen how the wheel of a car is changed? At first, one end of the car is raised off the ground with the help of a simple machine or jack-screw. It is done to remove and replace the wheel easily.

Jack-screw follows the principle of lever and inclined plane at the same time. The height of the portion of the twisted screw is the height of the inclined plane and the distance travelled through the twisted path is the length of the inclined plane. Mechanical advantage can be availed by increasing the length of the inclined plane. On the other hand, the direction in which the force is applied on the handle the load acts in the opposite direction. So by increasing the force as well as changing the direction of force jack-screw makes a work easier.

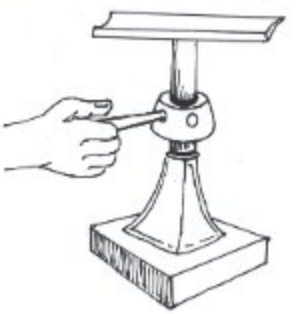


Fig. 11.11: Jack-screw

Pulley

Pulley is one kind of simple machine. There is grooved small wheel (dish) from which a rope is hanged from two sides. The pulley rotates round an axis-rod which is connected to a fixed block. Pulley is generally used to lift heavy bodies or to collect water from the well.

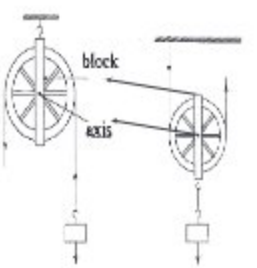


Fig. 11.12: Pulley

Pulley may be static or dynamic. In a static pulley the block remains at rest and only the disc rotates. On the other hand in a dynamic pulley the block is not at rest, it rotates with the rotation of the pulley.

Usually for hoisting flags we use static pulley. In this case only the pulley rotates as soon as the rope is pulled. In this case, the flag will be hoisted as high as much the rope is pulled down. As a result, although mechanical efficiency is not available but the direction of force is changed.

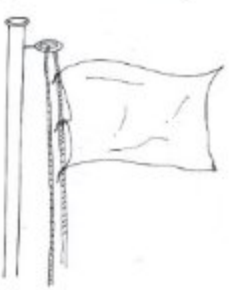


Fig. 11.13: Pulley to hoist flag

LESSONS 10-11: WHEEL-ROD AXIS

Wheel-rod axis is one type of simple machine. It is originally different form of lever. Here, wheel acts as the force-arm and rod-axis act as the load-arm. The load is fastened by one end of a rope and the rope is rolled-up by rotating the rod-axis. Its mechanical advantage depends on the ratio of the radius of the wheel to the radius of the rod axis. That means, if the radius of the wheel is 6 times greater than the radius of the rod-axis, 6 kilogram-weight load can be lifted by applying 1 kilogram-weight force. So, one thing is clear that to increase the mechanical efficiency of wheel rod-axis, the radius of its wheels need to be much greater. The wheel of motor car, screw driver, etc. work like wheel rod-axis.

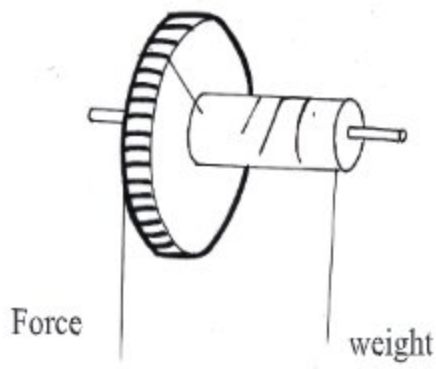


Fig. 11.14: Wheel and axle

Task: To determine the mechanical efficiency of screw driver.

Required accessories: Two screw drivers of different size, two screw of the same length, soft wood.

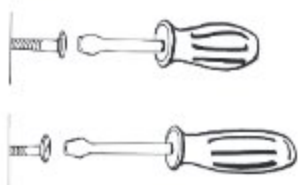


Fig 11.15 : Screw driver

Procedure: At first one of the student drive a screw with a narow-handle screw driver. In this case he will rotate the handle for five complete cycles. Similarly see by rotating the relatively big. handled screw driver for five cycles. Have any differences been noticed? These differences will tell you what type of screw driver you should use to avail the mechanical efficiency of a screw driver.

LESSON 12: HUMAN BODY AND SIMPLE MACHINE

Human body is a complex machine. Some of its organs work like a simple machine. You will be acquainted with three such organs below.

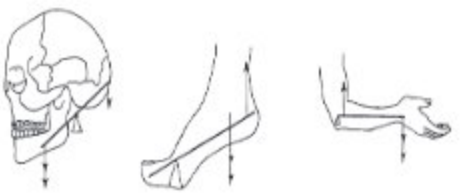


Fig. 11.16: Organs of human body and simple machine

It is understandable from the figure that the jaw of mouth, the lower part of leg and the hand of human body work like simple machines. Now think how these organs can be used to perform a work easily. Can you tell, at the time of chewing food, why we chew the food by molar tooth instead of the front tooth?

Task: Place a stone (of about 1 kg) at different places of your body starting from the tip of your finger to the elbow and tell how you feel. You will know from this exercise how to use your hand to obtain mechanical efficiency.

New words: The body at rest, the body in motion, mechanical efficiency, pivot (fulcrum), wheel, rod-axis, pulley

Things learnt in this chapter:

- The position, size, shape or motion of a body change or tend to change due to the application of force.
- A technique may be applied in a special way to all the simple machines by which mechanical efficiency can be obtained from the machine.
- In the case of lever, mechanical efficiency can be realized by increasing or decreasing the length of force-arm or load-arm.
- To raise a body over the same height more the length of inclined plane, more the mechanical efficiency.
- Some of the organs of human body work following the principle of lever.

EXERCISES

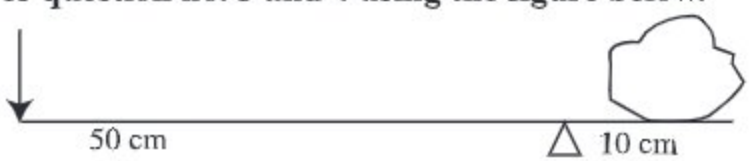
Fill up the blanks

1. When force is applied on an object, it changes or tries to change an object at rest to _____ and an object in motion to
2. Applying _____ force_____ work can be done by a simple machine.
3. The position of_____ in a class-I lever is in the middle of applied force and load
4. Jack screw follows the principle of_____ and _____ at the same time.

Multiple choice questions

1. Which one is a lever of class-II.
   a. scissors b) forceps
   c. pincers d. nut-cracker
2. How is the mechanical efficiency availed from inclined plane?
   a. increasing length b. decreasing length
   c. increasing height d. decreasing height

Answer question no. 3 and 4 using the figure below.



Fig

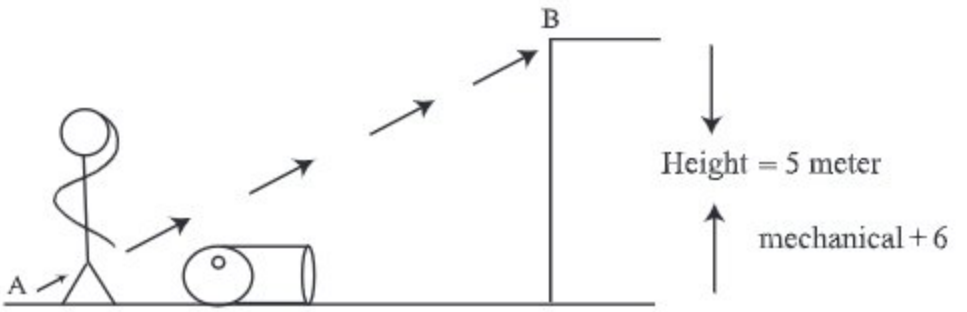
3. What is the mechanical efficiency of the machine shown in the figure?
   a. 5 b. 40
   c. 60 d. 500
4. If the length of the load-arm is increased by 15 cm, the mechanical efficiency-
   a. will decrease b. will increase
   c. will remain the same d. depend on the quantity of weight.

Short answer question

a. What types of changes occur due to application of force on a body?
b. How is mechanical efficiency realized from the scissors?
c. How a jack screw makes works easier?
d. What type of handle of a screw driver is more advantageous?

Creative questions

1.



The man, showed in the figure, is having difficult to lift the oil drum. In this circumstances, alone he has to raise up the drum by any means. There is only the inclined plane.

a. What is pivot (fulcrum)?
b. How a simple machine makes a piece of work easy to do?
c. Determine the length from A to B.
d. Discuss the advantages of the technique applying by the man to lift the drum.

2. Moni and Shilpi were stapling some papers using a stapler. Moni was working by applying pressure on the front portion of the stapler. On the other hand, Shilpi was working by pressing on the middle of the stapler.

a. What is lever?
b. How can the mechanical efficiency of class-III lever be increased?
c. Explain the fundamental principle of the machine used by Moni and Shilpi.
d. Who should change the way of working in order to make the work much easier- Moni or Shilpi. Analyse and answer.

CHAPTER TWELVE
Origin and Formation of The Earth

For thousands of years man has been searching the answer to the question, "How were the earth and the univers created". There are many conventional theories and stories in different cultures and societies regarding the creation of the earth. But on the basis of evidences found so far, majority of the scientists have accepted this theory now. According to this theory, ths universe was created following a vigorous explosion. One astronomical body of the universe is the earth. We can see the outer side of the earth but the internal formation of the earth is not easy to understand. The internal formation of the earth can be presumed from the happenings of earth-quake and volcanic eruption.

By the end of this chapter, you will be able to:

- describe the incident of the origin of the earth.
- explain the formation of the earth.
- explain the uniqueness of the earth, the sun and the moon.
- explain the causes of earth-quake·

LESSONS 1-2: ORIGIN OF THE UNIVERSE AND THE EARTH

You all know that we live on the surface of the earth. What can we see as we look upward? We can see the sun at day time and at night we can see the moon, stars and the planets. Have you ever wonder thinking how was this earth created? Or, did you ever ponder about origin of the sun, the moon and the stars?
There are many conventional theories and stories in different societies about the origin of the earth and the universe. For example: in the fairy tales of ancient China it is told that at first, a monster was born from a gigantic egg. Everything in this universe is born out of different limbs and appendages of the monster's body. Scientists has given an idea about the origin of the earth and the universe using many evidences. Scientists believe that about 13.7 billion years ago, the universe was concentrated at a point of infinite density and extreme heat, which exploded and began to spread in all directions. This explosion is called the Big Bang.

Fig. 12.1: Vigorous explosion

After the Big Bang, tiny particles were created and gradually formed into small clusters. These small clusters then cooled down and coalesced to form celestial bodies. In this way, the Sun and other stars were created. While small clusters were forming celestial bodies, the universe continued to expand.

Fig. 12.2 Baloon model of Expantion of universe

The energy, matters, space everything of the universe is created from this Big Bang. It is assumed that when the sun was created then its remaining portion of small particles was floating in the space like dust particles. After that, these dust particles came together and the earth was created about four billion years ago.

Evidence in favour of vigorous explosion

There are many theoretical evidences in favour of the creation of the universe by a Big Bang. One of the evidences is the universe is expanding till now. The galaxy and the stars in space are moving away from one another. Hence, perhaps once they were centralized in a small place and they were separated by explosion.

LESSONS 3-4: THE IDENTITY OF THE SUN, THE EARTH AND THE MOON

You have known that the Solar system, whese we live, is a past of the Milky-Way Galaxy. Our sun is one of the stars of the Milky Way galaxy. Sun is a star because it has its own light. Actually sun is a lump of gases. Hydrogen gas and other gases held together in it due to gravitational forces. Hydrogen gas at the time of mutual interactions with each other produces huge amount of heat and light. Then that heat and light is scattered in all directions.

The sun produces a huge amount of heat and light. Some amount of heat and light anchor reach our earth. Some astronomical bodies orbit around the sun keeping it in the centre. Our solar system consists of the sun, the astronomical bodies that orbit round it and the vacuum. The major portion of the spaces of the solar system is vacuum. The planets, satellites, comets etc. astronomical bodies orbit round the sun keeping it in the centre.

Eight planets orbit round the sun keeping it in the centre. The earth is one of these planets. The shape of the earth is like a sphere. There are various gaseous substances in the earth. But the earth can not produce heat and light like sun. That's why the earth depends on the sun for light and heat. The trees produce food using sun light. The existence of animals too depend on the production of food by the plants. The earth is not going to be very cool as the heat is coming from the sun. In this way the heat and light of the sun save the life on the earth.

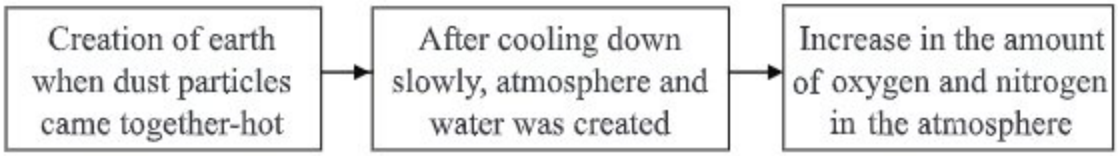
Our earth orbits round the sun keeping it in centre. Similarly the moon orbits round the earth keeping it in the centre. The moon itself can not produce heat and light. Then why does the moon appear to be luminous? Originally the light from the sun fall on the moon and it is reflected and that is why we see the moon to be luminous.

It takes the moon 27 days 8 hours to orbit the earth once. The volume of moon is one-fiftieth of the earth. The sun is thirteen lac times greater than the earth. The sun and the moon look equal as we see them in the sky, don't they? Why do they appear to be of the same size? The sun is too far away from us, so it looks much smaller than its actual size. Assume, if the size of the sun is like a that of a football , what will be the size of the earth like? Then the earth will be equal to a sand particle. Radius of the sun is 109 times greather than that of the earth.

Fig. 12.3: Comparison of size of the sun and the earth

We know that the earth is a suitable place for men and other animals. Do the animals reside in any other planets, stars or satellites besides the earth? They could be small, big or any type of animal. Scientists are searching, whether there is existence of life in any other planets. But till now the existence of life was not found in any place except the earth. Why then there is life only on earth? What speciality is there on earth for which the creature can live here?

It is assumed that, when the sun was created then its remaining portion was floating in the space like gas dust particles. After millions of years of that these dust particles came together and created the earth -At the beginning the earth was too hot -so much hot that the earth surface would boil with bubbles. There was no liquid water which is essential for life. There was no oxygen in the atmosphere. Should the earth remain in that state, the appearance of life would not be possible.



Flow-chart: The appearance of suitable environment for creature in the earth

Gradually heat was released and the earth cooled down. At the time of cooling the heavy particles went towards the centre. And the light particles remained near the surface of the earth. Gaseous substances such as carbon dioxide, water vapour, methane, carbon- monoxide etc. formed the atmosphere. After that the earth cooled down more and the water vapour converted to liquid water which created the sea. The amount of oxygen and nitrogen increased in the atmosphere. These elements are essential for life. Following the production of these elements on the earth life is created at last, and the creature started to exist on earth.

LESSON 5: THE FORMATION OF OUR HOMEL AND: THE EARTH

You have known that at the time of creation of the earth it was too hot. Then, in course of time the earth cooled down slowly. At that time the earth was formed with three portions. Light substances, that is, gaseous substances formed the extreme outer portion. We call this portion atmosphere. After that a beat heavy material formed on the surface of the earth and more heavier materials combined together to form the interior portion of the earth.

Atmosphere: The segment which surrounds and covers the surface of the earth is the atmosphere. You know that, the atmosphere is mainly formed by nitrogen and oxygen. In addition to that, there are water-vapour, dust particles, argon, carbon- dioxide and some more gases in the atmosphere. Earth attracts everything towards it. For that attraction gases of the atmosphere remains close to the earth surface. So the atmosphere near to the earth surface is denser. If you go above the earth's surface, the higher you go, the lighter and thinner will be the atmosphere. So if you want to climb up the top of a hill you will have to take oxygen with you for respiration.

The atmosphere up to twelve kilometers from the earth-surface is called troposphere. The major portion of this layer of atmosphere has gas and cloud. You have known that cloud is mainly formed by water vapour. Just above the troposphere begins the stratosphere. This layer is above the troposphere and extended up to fifty kilometers from the earth- surface. In this layer there is a gas named ozone. This gas protects us from the injurious Ultra-violet rays of the sun. There is a very small amount of gases in this layer and the layers beyond.

LESSON 6: EARTH SURFACE

We stay on the surface of the earth. Above the earth's surface is the atmosphere and below the surface lies its interior portion. How do the earth-surface appear to our eyes? Some parts of the earth-surface is covered with of soft soil, some are covered with hard rocks and again, some parts of it are covered water. The three-fourth portion of the earth-surface is water and only of it is one-forth land. If you see a world map, you will understand the matter. Most parts of the earth's surface are occupied by vast wide seas and oceans. Moreover, there are lakes, rivers, canals, swamps etc.

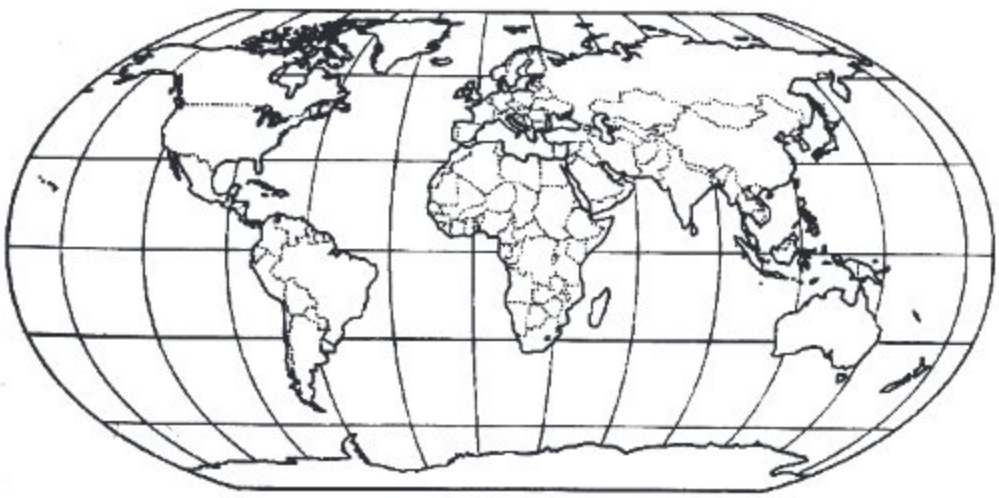


Fig. 12.4 World Map

The Bay of Bengal is located to the south of Bangladesh. It is a part of Indian Ocean. The other oceans are the Pacific, the Atlantic, the North and South Oceans. There live plenty of fishes along with various living creatures in the sea water. Loaded ships travel across the sea water. You know that the water from rain and melted ice flow through the rivers and fall on the seas. How are the rivers created? Actually, ice melted water and rain water flows down creating rivers. The Himalayan range of mountains is situated to the north of our country. A huge amount of ice accumulates on the top of this mountain-range. When this ice melt, water comes down alongside the mountain and a narrow river is created. The river becomes wider when more rain water is added to this. There is excessive rain fall in Nepal, India, Bhutan and Bangladesh. The rivers created in the Himalayan range are responsible for bringing this rain water. So the rivers such as the Padma, the Jamuna and the Meghna are very large and wide.

LESSON 7: THE INTERNAL FORMATION OF THE EARTH

The interior of the earth, is divided into three layers. Below the earth's surface lies the solid layer covering the interior portion of the earth known as lithosphere. The lithosphere may spreads up to seventy kilometers below the earth's surface. Below the lithosphere is mantle zone and at last surrounding the centre of the earth is the portion called centrosphere or core (Fig. 12.5) It is assumed that, after creation of the earth heat let off gradually from its exterior portion (e,g. the crust) and the earth crust became cool. But from the heat in the central portion could not be emitted. As a result the centrospheres and the mantle zone remain very hot.

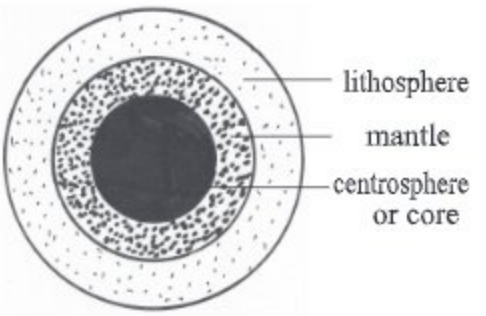


Fig. 12.5: Three main layers of interior earth

The spherical layer of about 2900 kilometers radius from the centre of the earth is the centrosphere. There are heated nickel, iron, lead etc. metals in centrosphere. They are in solid state in the outer side and in melted state in the inner side of the centrospheres. In the middle of centrospheres and lithosphere there is mantle layer. Major portion of mantle is solid. But some portion of it is in semi-liquid or half-melted state. Scientists assume that melted lava springs out by volcanic eruption from this portion.

It is not possible to go too far below from the surface of the earth. But the scientists came to know about the interior of the earth through various forms of investigations. When you will be in higher classes, you will know more about centrosphere and mantle layer. In this class you will know something about the lithosphere.

LESSON 8: PLATE TECTONIC, VOLCANIC ERUPTION AND EARTH QUAKE.

Men always wanted to know the reasons behind earth-quakes. The perplexing question was, "Why does the volcanic eruption occur?" That means men wanted to know why dreadfully hot liquids and gaseous substances expelled from some places of the earth's surface. Many scientists, different religions have tried to explain the matter. But no explanation was acceptable widely. At last scientists introduced a theory named plate tectonic theory. The earth-quake and volcanic

eruption can be explained by this theory and this theory was accepted by all to a great extent.

Plate Tectonic Theory: The basic conception of this theory is based on the finding that the lithosphere below the earth is separated into many portions or parts. These are called plates. These plates are in floating condition over a region of mantle zone. These plates are displaced by few centimetres per year toward any direction. Sometime, these plates moves away from one another. Again sometimes they come close to one another. Even some time plates moves up or down by few millimetres per a year. Where one plate comes in contact with another plate, that area becomes more prone to earth-quake and volcanic eruption.

If there are high hill or mountain in the areas where these plates are connected, occurrences of earth-quakes and volcanic eruptions are more likely to happen in those places.

It is assumed that, when these plates smack or strike one another, immense heat is produced and the substances inside the earth get melted due to this excessive heat. This melt substance gashes out from below the earth's surface due to the pressure. This split, melted and hot liquids are known as magma.

Fig. 12.6 : Magma

Similarly, when these plates have a collision with one another, The earth is shaken mightily. This is called earth-quake. Recently earth-quake is also occuring in Bangladesh.

LESSONS 9-10: EARTH CRUST AND SOIL

The upper portion of lithosphere is known as earth-crust. Earth-crust is covered by either water or soil. Most of the earth-crust is covered by water. The rest portion is covered by dust particles or stone chips. If it is made by organic substances and is soft state, it is called soil. Earth-crust is an important part for the human being. We live on this part of the earth. We produce our essential foods on the soil. Besides, there are minerals in the soil which we use for different purposes.

Soil formation process: Generally soil is formed by stone, stone chips, dust particles, sands, mud etc. Remains of plants and animals are also mixed with them. The earth- crust is formed by the solids the generally known as rocks. Generally the soft soils are formed from the hard rocks in two phases:

1. **First phase:** For a extended period of time hard rocks and minerals are convert to minute particles due to heat, rain, cyclone, earth-quake, etc. Moreover these small rock particles are concentrated at one place from another due to the flow of wind, ice and water and volcanic eruptions.
2. **Second phase:** With the minute particles of rocks and minerals water, air, small living creatures like bacteria, and remains of plants and animals get mixed up to form soil.

Soils of different places have been formed in different processes. So it appears that soils in different places are different in terms of formation. But some layers are seen in general when investigating the soil from its upper level to the lower level. As it seen in the figure, in the top layer of soil remains of trees and animals are mixed up. The black or non-bright elements formed due to the mixing of plant and animal remains are called humus. Humus is found more in the upper layers of the soil. Plants get their essential nutrient from this humus.

In the second layer humus decreases, for this it is less black and looks brighter to some extent. The third layer is originally formed by minute rock-particles. At last the lowest layer is formed by bed-rock alone.

There is flood in the places close to the rivers in Bangladesh. The flood water carries alluvial soil. The upper portion of the soil is formed by alluvial soil in the coastal regions. Hence, the upper layer of the soil in those places does not grow that sterile. This soil is suitable for cultivation.

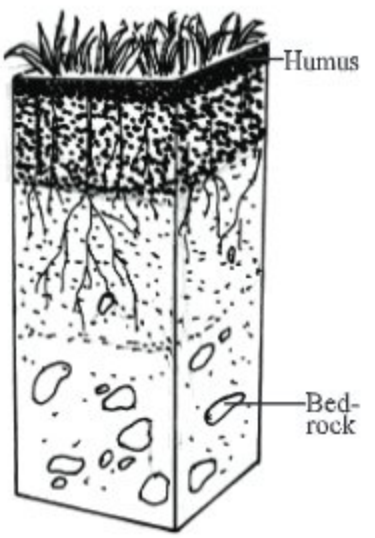


Fig. 12.7: Soil formation

Minerals

It is told before that, the earth-crust is formed by various substances. Some portion of this is formed by organic substances. Moreover, there are also inorganic substances. Sometime there are more than one stuff remain mixed with the inorganic substances. Sometime an inorganic substance does not remain in mixed condition but stay separated. This types of inorganic substances are called minerals. Another characteristic of minerals is, these are not made by the humans, it is produced by nature. Limestone is a mineral, which is actually a substance called calcium-carbonate. Limestone is

available at Joipurhat and Sylhet districts in Bangladesh. Limestone is used as a raw material for manufacturing cement. Usually, minerals are available more in the lower portion of the soil. Sometime they remain mixed with the soil in the upper portion. Many essential minerals are available in nature. The rods used to construct buildings are made from iron. Cars, buses, launches, all of these are made of iron. Tube-wells, plough share, nails, machineries, etc. are also made of iron. Iron is found in the soil as minerals. Some cooking pots and spoons are made from aluminium. Aluminium is also found in the soil as a mineral like iron.

Copper, silver, gold and zinc - all these essential and costly substances are also available in the soil as minerals. However, these minerals are not abound in Bangladesh. Although coal, petroleum or natural gases are found underground, they are not called minerals. Because they are produced from animal body and they are not inorganic. Big trees lying under pressure beneath the earth for a long time have converted to coal, petroleum and natural gases. They are produced from the fossilized remains of a living beings and used as fuel dug out of the earth later. So they are called fossil fuels. In many places of our country natural gas and coal is available under the earth's surface. Petroleum is available in many countries of the world. Natural gas, coal and petroleum are useful forms of fuel. The heat produced by burning these fuels is used to run mills and factories, public transports, and to produces electricity. Cooking is done with these fuels. Many necessary things can also be produced from these. For example, urea fertilizer is produced from natural gase and polythin is produced from petroleum.

Things we learnt from this chapter

- Millions of years ago, the earth and the universe was created from a Big Bang.
- The sun is a star. The earth and other seven (now it is nine) planets orbit round the sun keeping it in the centre. Moon is the only satellite of the earth.
- At the time of creation the earth was too hot. It got cooled down gradually to become suitable for the creatures to live. When there where water and various gases in the earth, life came into existence.
- There are three portions of the earth—atmosphere, earth surface and interior layers. There are various gases in the atmosphere. The earth's surface is covered by water, soil and rocks.
- The rivers were created by the flowing down of water that came from rain and the melting of ice.

- The interior of the earth is again divided in to three layers - centrospheres towards the centre of the earth, mantle layer in the middle and in lithosphere and earth-crust in the upper side.
- The lithosphere is divided in to many separate plates. For the movement of these plates earth-quakes and volcanic eruptions occurs.
- Minute particles of rocks and minerals mixed with water, air, bacteria, residue of plants and animals produce soil.
- There are many essential materials in underground. Among them the inorganic materials are called minerals. Moreover there are petroleum, coal and natural gases etc. fossil fuel.

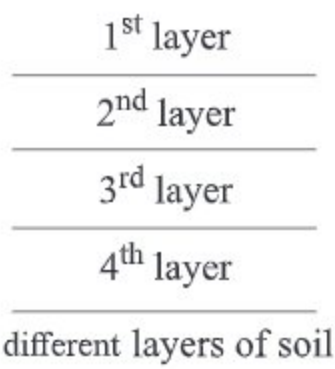
EXERCISES

Multiple choice questions

1. Where in Bangladesh is lime stone found?
   a. in Dhaka b. in Sylhet
   c. in Barisal d. in Khulna
2. Coal and petroleum are called fossil fuels because these are-
   a. organic substance
   b. inorganic substance
   c. living creatures (animal's) body

   Which one is correct?
   a. i and ii b. i and iii
   c. ii and iii d. i, ii and iii

Answer question no. 3 and 4 from the picture below:



3. Which layer of the soil is less black and brighter?

   a. 1st layer b. 2nd layer
   c. 3rd layer d. 4th layer

4. The 1st layer is formed by-

   i. minute rock particle
   ii. humus
   iii. residue of plants and animal

   Which one is correct?

   a. i and ii b . i and iii
   c. ii and iii d. i,ii and iii

Creative questions

1.

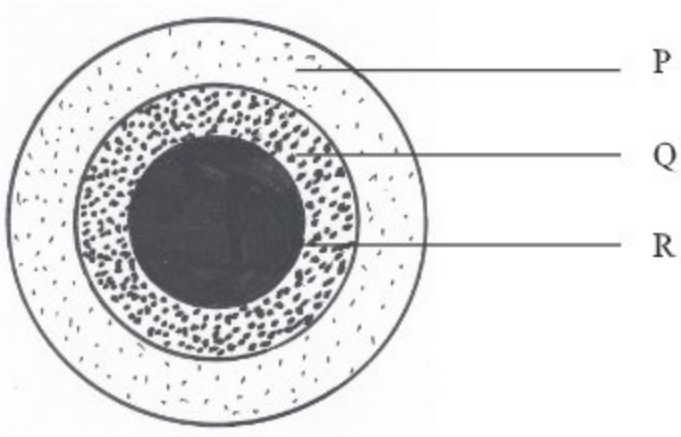
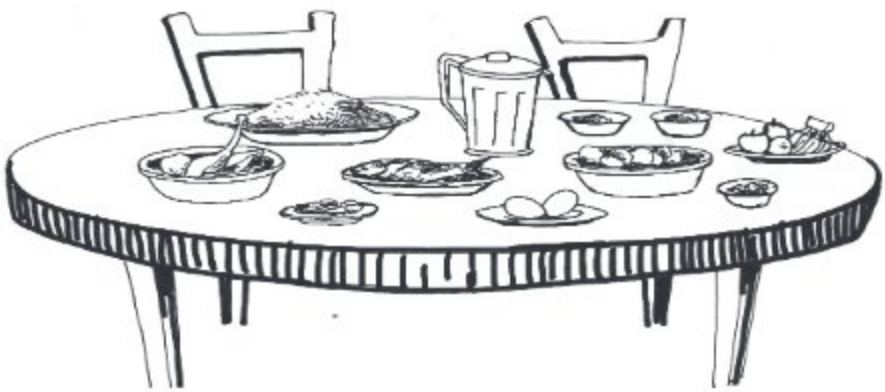


Fig: Three layers of interior earth

a. What is earth-crust?
b. What does volcanic eruption mean?
c. Describe the formation of layer R.
d. Analyse that the layers P and Q form soil.

CHAPTER THIRTEEN
Food and Nutrition

We see different types of foods around us. They can be divided into two groups e.g. Inorganic and Organic substances. We get Carbohydrates, Protein, Fat and Oils from the living things. These are all known as Organic substances. We eat these substances as food. Food and nutrition are closely inter-related. Nutrition is as a daily process which breaks the compound food substances into simple substances for the body to absorb. In this chapter we will learn about food and nutrition in details.



By the end of this chapter we will be able to-

- explain the necessity of food and nutrition.
- describe the functions of various food ingredients.
- make a list of balanced food.

LESSON 1: FOOD AND NUTRITION

What is food? How do we feel after walking, gardening, fetching water from well, cutting wood, catching fish, swimming, playing football etc? We feel tired and we get hungry. What we do then? We eat food. How do we feel after eating food? We get our energy back. Food supplies us with energy that we need to work. We need food for growth and development of our body. It protects us from diseases and repairs the decay and loss. Food also helps us keep our body fit and provides us with the energy to work. Therefore, food is those substances which regulate the body properly and keep it healthy and fit to perform well.

Food provides us with energy, repairs decay and loss and helps our bodies grow and develop. We eat food for survival.

What is nutrition?

Every day we consume rice, lentils, flour, fish, meat, eggs, milk, vegetables, and fresh fruits according to our needs. These foods cannot be directly absorbed by our body. These complex nutrient-rich foods undergo digestion in our digestive system and are transformed into simple, absorbable nutrients. These simple nutrients are then absorbed by the blood and taken up by the body's cells. The absorbed nutrients stored in the body cells help in growth, repair, energy production, and enhancing immunity. This entire process is called nutrition. Food satisfies our hunger and provides the energy needed to perform tasks. In our body, food has various functions, such as generating heat, repairing the body, maintaining bodily functions, and acquiring disease resistance.

New words: nutrition, food ingredients.

LESSON 2: TYPES OF FOOD

Moutushi likes to eat Hog plum (Amra), guava and star fruit; Robin likes fish, meat and sweets and Tuli likes to eats bread, biscuit and chips. These foods differ in terms of taste and nutritional value. Depending on taste and nutritional value, food can be divided into three types. These are: carbohydrate, protein and fat. All these three types of food are useful for growth, development and repair of the body and providing energy to it. In addition to these, minerals, vitamins and water are three important ingredients of food. These ingredients are necessary to maintain a healthy and fit body.

Carbohydrate

The foods which mostly contain the constituent of sugar or glucose are called carbohydrates. For example: rice, wheat, flower, maize, corn, sugar, molasses etc. Plants are the only source of carbohydrates. In our daily life, we mostly eat these types of food. To test the presence of carbohydrates in food we carry out Iodine test.Iodine solution changes its colour with the presence of carbohydrates·

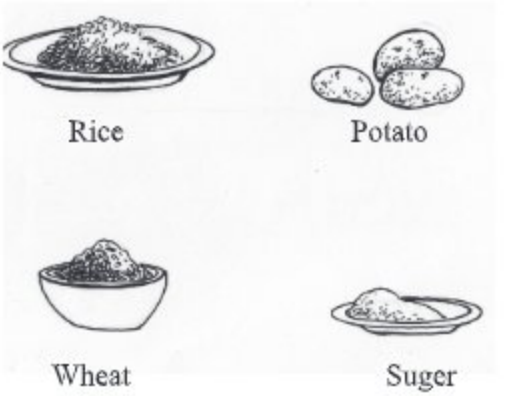


Fig. 13.1: Carbohydrates

Functions:

1. Carbohydrates can be easily digested and provide heat and energy.
2. The cellulose present in carbohydrates eases constipations.

Task: To identify carbohydrate mix a little amount of flour with water in a test tube. Carefully hold the test tube over a spirit lamp. When the mixture is hot, add two drops of iodine solution to it.

Observe what happens. Do you notice any change in the mixture? The mixture has turned deep purple. Therefore, we can infer that flour is a carbohydrate. Since flour contains carbohydrates the mixture has changed its colour.

New words: cellulose, constipation, protein.

LESSON 3: PROTEIN

Goutam, Mr. Sen's elder son, likes having fish and eggs, whereas his younger son, Sukumar likes to have meat and milk and dairy products. What type of food are these? According to its sources, protein can be divided into animal protein and plant protein. Fish, meat, eggs, milk and all other dairy products are derived from animals and are known as animal protein. On the other hand, pulses, nuts, kidney, beans etc. are derived from plants and are called plant protein.

Functions of protein

1. The main function of protein is to develop cells. For example, muscles, bones and blood cells of our body are mainly composed of protein. Protein produces heat in our body.

2. Proteins are involved in the production of antibodies which protect us from different diseases.
3. Lack of protein causes kwashiorkor among children. Due to this disease, the normal growth of the body is hindered. If the growth of children is slowed down, they are likely to suffer from malnutrition.

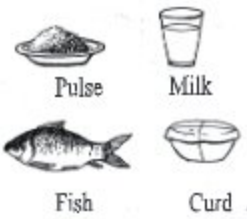


Fig. 13.2: Protein

Task: Take a small amount of water. Mix a little amount of the white portion of egg and water in a test tube. Carefully hold the test tube over a spirit lamp.

Do you notice any change in the mixture? Observe that the solution has turned into solid. Liquid protein becomes hard due to heat.

New words: blood cells, plant protein, animal protein.

LESSON 4-5: FATS OR OIL AND CALORIE

Foods that are mostly constituents of fats and oils are called fats and oils. Like protein, fats and oils are also divided into two groups. Fish oil, fat from beef, ghee, butter etc. can be found from animals and are known as animal fats. Soya bean, nuts, mustards, sesame, olive etc. are derived from plants and are called plant fats. Fat from beef and mutton, ghee and butter are examples of solid fat. Oils from soya bean, mustard, sesame, olive and almond are example of liquid fat.

Functions

Fat produces heat and the energy to work. Layers of fat under the skin helps trap the body heat.

Fat prevents the wastage of protein.

Fat facilitates vitamin A, D, E and K in body.

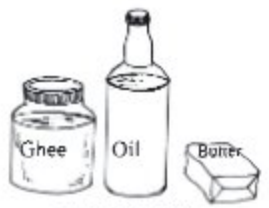


Fig. 13.3: Fats

Task: To identify fat, pour and rub a few drops of soya bean oil on a piece of paper. Now hold the paper against the light. Can you see that the part of the paper which had been oiled has become transparent?

Little light passes through the transparent area of the paper. This is the easiest way to identify fat/oil.

What is Calorie?

The heat that is required to increase the temperature of 1 gm water by 1° celsius is 1 calori. 1000 calories = 1 kilo calori.

Heat is produced from foods containing carbohydrates, protein and fat/oil. The heat helps digestion, metabolism, respiration, blood circulation etc. in our body. Energy is also used up in physical labour. Energy is stored in food. We get energy from food.

The heat produced from energy in food is expressed in calories. The measuring unit of heat energy in food is expressed in kilocalories.

Food which contains carbohydrates, protein and fats are also rich in calories. Food containing large amount of water and cellulose contains fewer calories. The most amounts of calories can be found in food that is enriched in fat or oil.

Look at the table below. A list of some high and low calorific food is shown here:

High Calorific Food	**Low Calorific Food**
Edible oil	Chal kumra (a kind of Pumkin)
Ghee	Cabbage
Butter	Ridge gourd (Jhinga)
Fish oil	Turnip
Concentrated coconut milk	Tomato
Skimmed powder milk	Amarnath (Data)
Roasted peanuts	Bottle gourd
Sugar	Spinach
Honey	Kalmni Data or Bind weed
Molasses	Radish
Gram pulse	*Oalcopi*
Soya bean	*Dhundol*
Kidney beans	Palwal (Patal)

The daily calorie requirement of a person depends on his/her age, weight, height and physical activities. The daily calorie requirement also may change depending on one's occupation and gender.

Task: Make a list of locally available high and low calorific food.

New words: calorie, animal fat, plant fat.

LESSON 6: VITAMINS

Food contains a small dose of organic element which is necessary for good health. This type of organic element is called vitamins. Vitamin is stored in

food that we eat daily (such as; rice, atta, nuts, pulses, green vegetables and fruits). Vitamin is not considered as a separate type of food. Depending on solubility, vitamin can be divided into two types:

Water soluble vitamins, for example, vitamin B-complex and vitamin C

Fat soluble vitamins, for example, vitamin A, vitamin D, vitamin E and vitamin K If vitamin deficiency prolongs, symptoms of different diseases show up. Eating vitamin- enriched food regularly can protect us from a lot of diseases. Though taken in small dose, it is inevitable for our health.

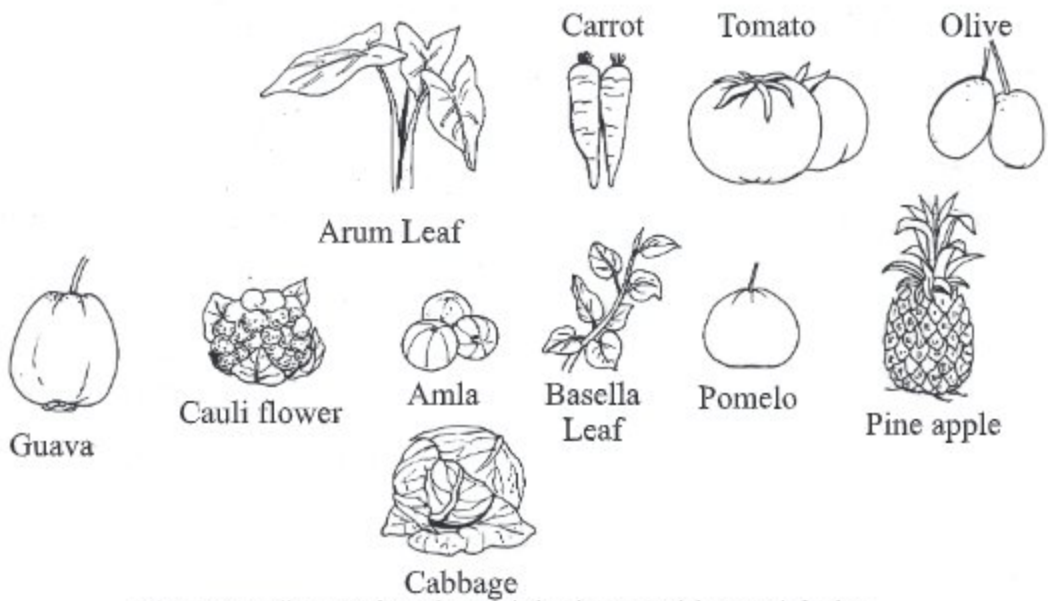


Fig. 13.4: Some vitamin enriched vegetables and fruits

Listed below are some of the vitamins essential for humans. Their names, sources, functions and the diseases that may cause due to their deficiency are also given below.

Vitamin	Sources	Functions
Vitamin A (stored in body)	Liver, eggs, butter, cheese, fish, green vegetables, carrot, mango, jackfruit, ripe papaya	• Growth and development of body, • Maintains good eye sight, • Fights against diseases

Vitamin B-complex (composed of different vitamins together; not stored in body)	Egg, liver, kidney, meat, milk, wheat, red rice, cheese, kidney beans and nuts	• Growth of body • Healthy maintenance of heart, nerve and digestive system • Keeping skin healthy
Vitamin C (destroyed if cooked or stored)	Lemon, orange, amla, guava, pomela, tomato, arum leaf, shak/shag, kalmni shak/shag, green leafy vegetables	• Development and maintenance of bones and teeth • Maintenance of healthy gum • Healing wounds
Vitamin D (stored in body)	Milk, butter, egg, fish oil, (our skin can produce vitamin D in the presence of sunlight)	• Facilitates the functioning of calcium and phosphorus • Development and maintenance of healthy teeth and bones

New words : vitamins, vitamin B-complex.

LESSON 7: MINERAL SALT AND WATER

Rahiman is suffering from goiter and Shahida is from anemic. Can you tell why they pare suffering from these diseases? Deficiency of mineral salt caused them these diseases. Besides the salt that we intake with rice and vegetables, we need a few more salts for our body. Mineral salts are essential for body cells and body fluids (such as; blood, enzymes and hormones). Mineral salts help regulate the internal functions of the body (such as; contraction and relaxation of muscles, nerve stimulation). It is vital for the development of bones, enzymes and hormones.

Plants cannot absorb minerals directly from the soil. The green leafy vegetables and fruits that we eat everyday are a good source of mineral salts. One (1) percent of our body weight is mineral salts. The elements of mineral salts are – phosphorus, potassium, calcium, sulphur, sodium, chlorine and magnesium. Besides these, we also need iron, iodine, zinc, copper etc. in a very small amount. Deficiency of these salts can lead to serious health hazards. For example, iodine deficiency causes goiter. Iodine is mixed with table salt to produce iodide salt. Regular intake of iodide salt can prevent goiter.

The names, sources and functions of some important mineral salts are given below.

Mineral Salts	Sources	Function
Calcium	Milk, meat, green vegetables	Maintenance of healthy bones, teeth and nervous system, helps in blood clotting
Phosphorus	Milk, meat, egg, pulses, green vegetables	Maintenance of healthy bones and teeth
Iron	Meat, green vegetables, fruits	Helps in developing red blood cells protects from anemia
Iodine	Sea-weeds, sea fish and fish oil	Helps in proper functioning of thyroid gland, keeps free from goiter
Sodium	Table salt, salted hilsha, cheese salted biscuits	Lack of sodium in body cells and fluids can cause lethargy
Magnesium	Green vegetables	Facilitates enzymic reactions,helps to build the hard outer cover of teeth
Chlorine	Table salt	Maintenance of healthy teeth, production of hydrochloric acid (HCl)
Potassium	Fish, milk, pulses, molasses, green vegetables	Play a role in Contraction of muscles

Water

Water is a vital element of food. Water is ranked next to oxygen according to their importance in our survival. We can survive a few weeks without food but we cannot survive even a few days without water. Water constitutes one-thirds (1/3) of our body weight.

Water helps the development of our body and regulates its internal functioning (such as; swallowing, digestion and absorption of food). Water acts as a solvent. Many minerals, salts and food elements are present in our body in soluble form. Water makes our blood liquid and thus facilitates blood circulation. It also keeps our internal body temperature constant. Another important task of water is to take out the waste products along with urine and feces. Deficiency of water can cause constipation. It can hamper blood circulation and metabolic functions. It is of immense importance that we drink sufficient and safe water regularly.

Roughage: The fibres of grains, fruits and green leafy vegetables that are not digested are called roughage. The roughage of fruits and vegetables consists of nothing but the cell walls made of cellulose. Roughage is not digested. It remains unchanged after digestion. This unchanged part of fibres helps produce feces in humans.

New words: roughage, enzymes

LESSON 8: BALANCED AND UNBALANCED FOOD

Joya and Jitu are two friends. They both study in class six. Joya is skinny and thin, feeble and inattentive to her studies. She always looks sad and upset. She often misses classes due to illness. One day, Jitu went to her house. He learnt from her mother that Joya does not take her meals properly. Whatever small amount of food she eats contains only a small proportion of rice, fish, or meat. She does not eat milk, egg or any green vegetables, even after her mother's insistence. Her mother is really worried about her. Do you think Joya's daily diet is right for her? She eats a small amount of carbohydrate and protein. Since she does not eat all types of foods, she has deficiency of vitamin, mineral salts and other elements. Thus her diet is not balanced. A list of diet which does not contain all types of food is unbalanced.

What do we understand by balanced diet? A balanced diet contains all types of food in a right proportion. It means a balanced diet contains the right amount of carbohydrate, protein, fat or oil, vitamin, mineral salts and water depending on the desired needs of the body. If anyone wants to have balanced diet, it is essential that the list of diet should contain carbohydrate, protein, fat or oil, vitamin and mineral salts.

Joya is not growing up in a right pace. She does not have energy because her diet is not balanced. She feels tired and has little power to resist diseases. Therefore, balanced diet is essential for the maintenance of growth, production of energy and keeping the body free from diseases.

Unbalanced Diet

A list of diet that contains little amount of all or some of the six food elements is called unbalanced diet. Most people of our country have unbalanced diet. These people mostly eat carbohydrates. The body lacks proper nutrition if the diet does not contain sufficient amount of proteins, carbohydrates, mineral salts and vitamins. The deficiency of proper nutrition in the body is known as malnutrition.

In order to have a healthy and balance diet, it is important to keep the following in the mind-

- Carbohydrates should be eaten in large amounts.
- Sufficient amount of green leafy vegetables should be eaten.
- A lot of fish should be eaten.
- Excess intake of sugar, oil and fat should be avoided.
- Salt should be eaten in right proportion.

Task: Students will form a group and collect different types of locally available foods. They will show the collected food ingredients in the classroom. They will next prepare a report on the importance of each of these food elements.

Things we have learnt

- Foods are of three types.
- There are six types of food elements.
- Vitamin and mineral salts are not extra food. These can be found in green leafy vegetables and fruits.
- Excess intake of carbohydrates and protein should be avoided.
- We need balanced diets to keep our body fit.
- The measuring unit of heat energy in food is Kilocalorie. The daily calorie requirement of a person depends on his/her age, weight, height and physical activities.

EXERCISES

1. Fill in the blanks

a. We get _____ and _____ from green leafy vegetables and fruits.

b. Deficiency of vitamin A causes _____.

c. The measuring unit of heat energy in food is _____.

d. _____ are made up of protein.

e. _____ prevents the decay and loss of protein in body.

2. Draw lines to match the foods on the right side with their appropriate groups shown on the left side

Carbohydrate	Meat
Potato	Nut
Fat or oil	Fish
	Protein
	Milk
	Egg
	Butter
	Ghee
	Soya bean

Multiple choice questions

1. Which one is soluble in water

a) Vitamin A b) V itamin B

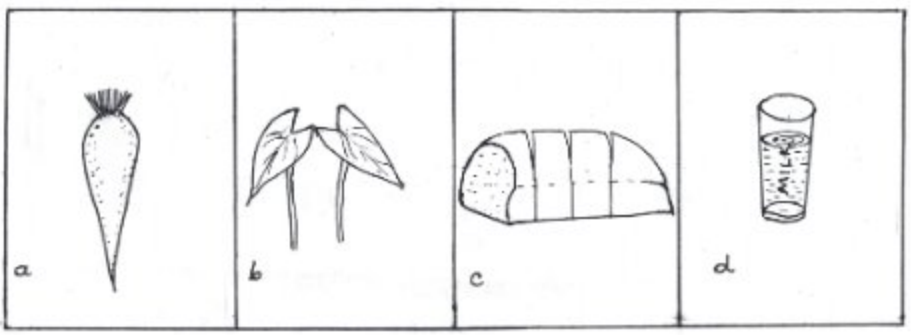
c) Vitamin D d) Vitamin E

2. Which one is animal protein?

a) Pulse b) Milk

c) Nuts d) Ghee

Observe the diagrams and answer the questions 3 and 4.



3. Which food contains comparatively excess fat?

A) a B) b

C) c D) d

4. Which one plays a role in cleaning alimentary canal -

(i) a (ii) b

(iii) c

Which one is correct?

a) i and ii b) i and iii

c) ii and iii d) i, ii and iii

Short answer questions

1. What is the function of iron in the diet?
2. Why do we eat?
3. Why people cannot survive only by eating rice?
4. Describe the diseases caused due to the deficiency of Iodine?

5. What happens when our daily diet lacks sufficient amount of vitamins?

Do it yourself

1. Mix two spoonful of mastered oil in a glass of water. Describe what happens.
2. How you will examine that water soaked bread and rice contains starch?

Creative questions

1. Observe the diagrams below and answer the questions.


A.


B.


C.


D.

a. What is food?

b. Explain the functions of the food marked with 'A'.

c. How does the 'D' marked food increase body weight?

d. Analyse whether the foods shown in the diagram are suitable for balance diet.

2. Mahi is a student of class V. She does not take vegetables at all. She is suffering from cough and cold for some days. She can not see clearly at night. Her parents have become very worried. Her mother took her to the physician. The physician wanted to know about her food habit. The physian explained the cause of her illness to her mother and suggested Marium to take colorful vegetables and fruits.

a. What is malnutrition?

b. What disease is Mahi suffering from?

c. Why has the physician suggested her to take colorful vegetables and fruits?

d. What should Mahi do? Describe why do you think so.

CHAPTER FOURTEEN

Environmental Balance and Our Life

You know the surroundings around us is our environment. In a particular area, the living organisms and the non-living things- all constitute that particular area's environment. You will find different types of environments in different regions of the world. Due to diversity of environment the organisms of different regions are different. You know organisms are consist of plants and animals. Plants and animals of a particular region will depend upon the different components of that environment. Different components of the environment influence all other organisms including human.

By the end of this chapter we will be able to-

- explain the natural environment.
- explain the component of environment.
- explain the interrelationship between the components of environment to keep
- the environmental balance.
- explain the techniques of preservation of environmental components.

LESSON 1: NATURAL ENVIRONMENT

Observe the surroundings all around us. You will find some of the things are man- made while some are naturally created. That is to say, man can not create the thing which are called natural environment? Natural environment is composed of naturally created matters. Natural environment consists of non-living and living organisms that man can not create.

Man builds houses, bus-tracks, boats, roads, bridges, schools, colleges and hospitals.These are known as man made environment. You have noticed, there are so many substances around the surroundings that man can not create as the moon, stars, rivers, sea, hills, forests, men, beast and birds etc. These are the components of natural environment.

Task: While going to school, observe your surroundings. Identify the man made and naturally created things and write them in your note book. Discuss them in the class.

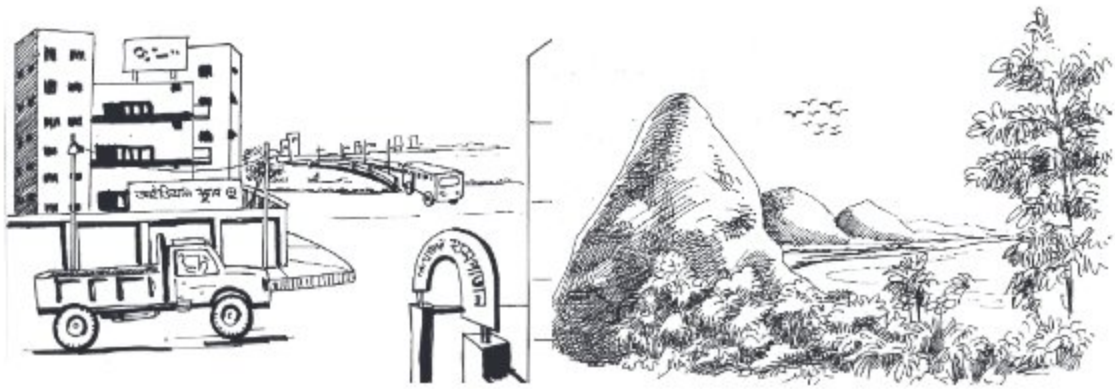


Fig. 14.1: Man made environment and natural environment

There are different types of natural environment such as environment of forest, Hills, rivers etc. Is there any more natural environment known to you!.

LESSON 2: COMPONENTS OF ENVIRONMENT

Environment ecology is divided into two components. One is biotic componental that is known as components of organisms. Except these components the rest of the components consists another environment. That is known as abiotic or non living component.

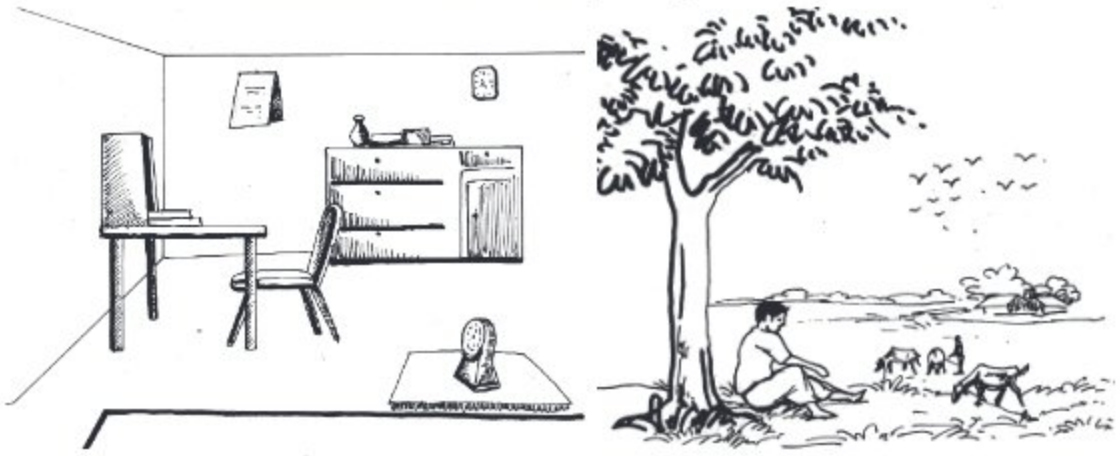


Fig. 14.2: Non Living and Living Environment.

Task: Make groups with the help of your teacher. Go to the school ground. Observe the environment. Identify the living and non living components and list them in your note book. Discuss in the group. Make a table on a poster paper. Write the names of biotic and abiotic component in that table. Display the poster it in your classroom.

Biotic components include plants and animals. Non living elements includes non living components. These are known as non living or abiotic component. Soil, water and air- these are the three main components of non living environment. Without these components organisms can't survive.

LESSONS 3-4: ABIOTIC AND BIOTIC COMPONENT OF ENVIRONMENT

Task: Draw the list in your note book fill in the table. How do different components influence plants and animal life. Participate in discussion.

Components of environment	How does plant use	How does animal use
Soil		
Water		
Air		

Soil, water, air, light, temperature, humidit, climate etc. physical factor influences the nature and its expansion. Availability of such factors to survive in the environment depends on what type of organism exists in a particular region. Here the animals and plants of a particular region will depend on nature. So you can understand how important abiotic and biotic components are for living of any organism.

Task: Observe the Biotic elements surrounding your school you have identified the plants and animals. Now observe / notice their habitat. Make difference between the habitat of plants and animals. Draw the table in poster paper or at the back page of a old calendar. Fill in the table given below.

Name of the organisms	Habitat
Plant	
Animal	

Observe the plants and animals in your nearest environment. What is your idea about their habitat?

Plants and animals in environment

Each community consists of plants and animal. Have you ever thought how plants and animals live in different environment?

Work: Form groups with the help of your teacher. Write down the name of two different environments (e.g. forest and desert) on a poster paper. Draw the different animals that live in these two environments on another poster paper with their names. Cut the animals out and paste them on the poster paper. Discuss the poster paper in class and have discussion on it.

Some basic components are necessary for plants and animals to live. Plants need water, air, food and sunlight. They need protection from their enemies.

You must have noticed that the plants and animals are not the same in all environments. Plants and animals live in all regions of the world. Starting from plain lands to hills or mountains, forests, under the earth, ponds canals, rivers, seas, deserts etc. different plants grow and animals live in all places. Only because of the differences of climate, soil, water, light and other factors, the plant and animal diversities have been so rich.

LESSON 5 – 6: BALANCE OF ENVIRONMENT

No organism can live alone in a particular environment. Living organisms are dependent on their surrounding environments in different ways for their existence. We also depend on different components of environment in order to live our life. Can you imagine what will happen if the sources from which we get our necessaries are destroyed!

You have heard of the Dinosaurs. They existed on this earth millions of years ago. Do you know why the Dinosaurs have become extinct?

Causes of the extinction of Dinosaurs

According to some scientists, when Dinosaurs lived on earth, then the world was too hot. But suddenly the earth became cold. The Dinosaurs could not tolerate that cold and all of them died.

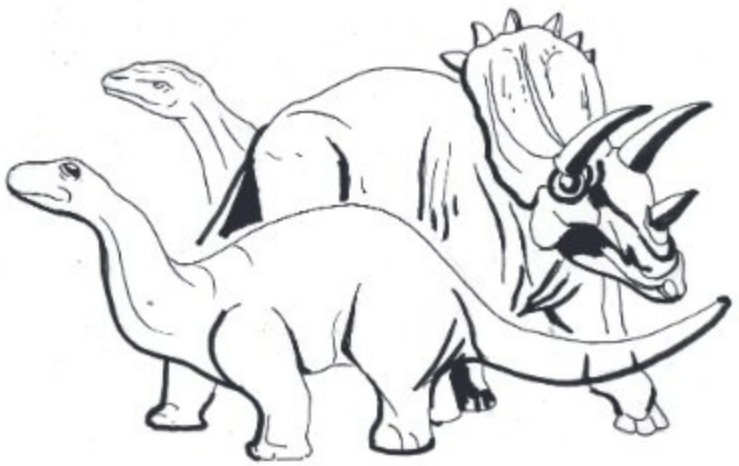


Fig. 14.3: Different Dinosaurs

According to the views of some other scientists, when some other animals appeared on this earth, they started to eat the eggs of Dinosaurs as food. So gradually they become extinct.

Again, yet another group of scientists believe, the environment changed in such a way that Dinosaurs failed to adapt themselves with the environment and became extinct.

Surely you can understand that due to the changes in natural environment by human activities or natural process, the environmental balance is spoilt. Due of the destruction of environmental balance biotic environment is also affected in different ways. What are the causes of destruction of environmental balance? Try to find out the answer by solving the work given below.

Task: Observe the environment around your school (it can be a plain land, a pond or forest). Observe any changes that may have occurred in the environment and note them down. What damages are done to humans or other animals due to these changes? If any damage is done write it down in your note book. Have discussions on environmental change it in class.

At present population of the world is increasing day by day. To meet the various requirements of the increasing population, houses schools, colleges, roads, hospital etc. are being built by destroying the valuable forest. As a result, natural environment is going to be at stake. Moreover

men are polluting the soil, water and air in many different ways. As a result, plants and animals are losing their habitat. In this way environmental balance is being destroyed. In order to enjoy a healthy life, we should protect the environment instead of destroying it.

LESSONS 7-8: INTER RELATION OF THE ENVIRONMENTAL COMPONENTS AND THEIR INTER DEPENDENCE

The relation and interactions between living and non living objects are continuously going on. Even in plants and animals this interaction is happening within the environment. They are dependent on each other for survival. The relationship of dependency between living and non-living component in a particular region is called and ecosystem.

You know, whale is the biggest animal of the world and the smallest Y: 3.45 in one is bacteria. All the organisms, from the biggest to the smallest ones, are interrelated in different ways.

There is a relationship between plants and animals. Again these have relation with air, soil, water which is running following a certain process. Among the processes some are very simple and some are very complex.

> **Task:** Observe the different organisms in your environment and notice how they are dependent on one another. Also, notice how plants and animals are dependent on different non-living organisms. Write it down in your note book. Draw a flowchart of interdependency of living and non-living organisms on a poster paper and display it in the class.

Organisms are dependent on non-living things. Again, one organism in dependent on another organism. Through observation of the environment you must have understood this. As for example, Plants use sunlight to prepare food, which is known as photosynthesis. Photosynthesis (Plant) and respiration (plants and animals) are two main ways of developing inter relationship between living and non-living organisms.

By the photosynthesis: Plant prepares carbohydrate by using carbon di-oxide and water in presence of sun light. The oxygen produced through photosynthesis is used animals for respiration which is used for production of energy. The Carbon di-oxide produced by animal respiration is used by plants for photosynthesis. In this way, by photosynthesis and respiration inter-relationship between plants and animals has been established within the living world.

You know, plants and animal are the main components of living environment. Depending on their characteristics, they are different from each other. But they are dependent on each other for survival.

Fig. 14.4: Plants and animals dependence

Some plants reproduce with the help of insects. Bees move from flower to flower, then pollination occurs with the help of birds and animals. Again, there are many plants those act as shelter for other few other. Few other plants and animals you can also site this as example of inter relationship of environment. You can come up some more examples of inter relationship.

LESSON: 9 – 10 WAYS OF PRESERVING DIFFERENT COMPONENTS OF ENVIRONMENT

You have already learnt about the different components of environment such as soil, water, air, plants, animals etc. You have also learnt that plants and animals are dependent on one another for their survival. They are also dependent on non- living organisms. All organisms are dependent on different components of the environment for survival. If any change occurs in the components of environment then the normal life of organisms is hampered. Can you say how the environment is polluted?

Work: Form groups with the help of your teacher and visit a polluted area (for example: polluted pond, river, land filled with garbage etc.). Identify the causes of pollution. Explain what can be done to prevent pollution. Prepare reports on what steps can be takes to protect the environment and present them in class.

Fig: 14.5 – A non-polluted environment and a polluted environment

To live a healthy life and to protect plants and animals from extinction, the environment must be kept free of pollution. We have to keep the environment clean. We have to prevent the pollution of different components of environment: land, water, air etc. We have to stop the killing of birds and animals. We have to use the natural resources in such a way that the balance between animals and natural resources is unharmed.

Things we have learnt from this chapter

- Natural environment consists of non-living and living organisms that man can not create.
- Environment consists of biotic and abiotic factors. All living elements are biotic factors and all non-living elements are abiotic factors.
- All living and non-living organisms are constantly interacting with one another.
- All organisms are dependent on one another for survival.
- To lead a healthy life different components of the environment have to be protected from pollution.

EXERCISES

Fill in the blanks

1. Different components including man influence all _____.
2. Non-living environment consists of _____ components.
3. Balance of environment is destroyed _____ damages occur in different ways.
4. _____ of some plants occurs by insects.
5. Organisms are dependent on _____ components of environment.

Multiple choice questions

1. Which one is the abiotic factor?

a) amoeba b) water

c) rose d) snail

2. For preserving the environment, we --------- .

i) build roads

ii) keep the environment pollution free

iii) protect animals and plants.

Which one is correct?

a) i and ii b) i and iii

c) ii and iii d) i, ii and iii

Observe the figure / picture below and answer question number 3 and 4.

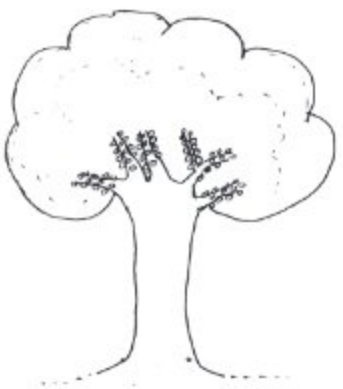


Fig: x

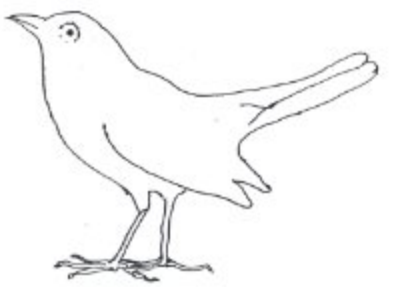


Fig: y

3. How does y, depend on x?

a) photosynthesis b) food taking

c) pollination d) transpriation

4. x and y depends directly and indirectly -------

i) upon water

ii) upon air

iii) upon light

which one is correct?

a) i and ii b) i and iii

c) ii and iii d) i, ii and iii

Creative questions

1.

X	Y	Z
Soil	Paddy plant	man
Water		
Air		
Light		

a. What is environment?

b. What do you mean by pollution?

c. How does the organisms of y column depend on the components of column x.

d. The organisms of column Z depends on x and y column.

2. P is a herbivorous animal. It lives by using the different components around its surroundings. The due to the environmental changes caused by men the number of animal P is decreasing day by day.

a. What is non-living environment?

b. What do you mean by extinction of animals?

c. On what organisms animal P is more dependent ? Describe it.

d. What steps should be taken to keep the number of animal P constant ? give your opinion.

The End

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