SCIENCE

TEXTBOOK FOR CLASS VIII

THE JAMMU & KASHMIR STATE BOARD OF SCHOOL EDUCATION

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FOREWORD

The days have gone when Science and Technology was concerned only with scientists. Now, everyone should understand the implications of Science and Technology and have a say in making its right use. To develop, what we call a scientific culture is the need of the hour. A strong foundation in science is a must to develop this culture. The major contribution of science lies in developing scientific attitude and propensity for the exploration of the truth. The science curriculum is the tool which helps the students to arrive at the desired truth. The National Curriculum Framework - 2005 (NCF-2005), recommends that child's life at school must be linked to its life outside the school so that tremendous advance made in Science and Technological literacy affect the human life qualitatively.

It is in this context that the present textbook of science for class 8th has been developed. I am sure that it will provide the necessary scientific and technology literacy, encouraging students in their innovativeness and creativity thereby enabling them to take decisions and facilitate them to solve the problem in day to day life. As per the guidelines of NCF-2005, Contextualization has been done with special reference to local specific contents in the textbook.

The textbook, it is hoped, will provide our children the basic knowledge of science and develop their scientific temperament in order to understand and appreciate different natural phenomenon.

The Board gratefully acknowledges the use of materials from science textbook of class 8th published by National Council of Education Research and Training (NCERT), New Delhi in preparing the textbook.

While dedicating this book to the students, I thank the participants who developed, reviewed the materials in different workshops.

I also take this opportunity to place on record my profound appreciation to Dr. Sheikh Bashir Ahmad, Secretary, JK BOSE, and Dr. Yasir Hamid Sirwal, Academic Officer for their laudable contribution in the preparation and processing of this book.

Comments and suggestions for improvement are welcome.

Prof. (Dr.) Desh Bandu Gupta
Chairman
J & K State BOSE

ACKNOWLEDGEMENT

At the outset it is indeed laudable to mention the assistance and valuable inputs/contribution offered by the subject experts for framing the present science textbook for class VIII. The contents have been developed in a lucid and exhibitive manner to enable the students to comprehend all the topics unambiguously.

It is opt to racord that while dedicating this textbook of class 8th to the pupil of State, I acknowledge with gratitude the contribution made by the experts of the subject, and for expending their whole hearted support. They are :

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19. Mr. Jameel Ahmad, Central Academics, JK State BOSE
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I am highly thankful to the Academic Division/CDR Wing for their contribution in preparing this book of Science. I also place on record my profound appreciation for the contribution made by **Mr. S.M. Mahajan, Dy. Director, (Academics)-JD and Dr. Yasir Hamid Sirwal, Academic Officer** in preparing and processing this Science textbook and making available local specific materials for the children of the state. The services of Mr. Mukesh Rakwal for composing and designing of this textbook is highly acknowledged.

Every effort has been made to keep this book error free. As there is always scope for improvement, any comment and suggestion will be gratefully acknowledged.

(Dr. Sheikh Bashir Ahmad)
Secretary
J & K State BOSE.

CONTENTS

CHAPTER - 1

MICROORGANISMS : FRIEND AND FOE

You have seen several kinds of plants and animals. However, there are other living organisms around us which we cannot see with eyes alone. These are called **microorganisms** or **microbes**. For example, you might have observed that during rainy season moist bread gets spoilt and its surface gets covered with greyish white patches. Observe these patches through a magnifying glass. You will see tiny, black rounded structures. Do you know what these structures are and where did these come from?

1.1 Microorganisms

Activity 1.1

Collect some moist soil from the field in a beaker and add water to it. After soil particles have settled. Take a drop and spread it on a slide. Observe it under a microscope. What do you see ?

Activity 1.2

Take a few drops of water from a pond. Spread it over a glass slide and observe through a microscope.

Do you find tiny organisms moving around?

These observations show that water and soil are full of tiny organisms, though not all of them fall into the Category of microbes. These microorganisms or microbes are so small in size that they cannot be seen with the unaided eye. Some of these, such as the fungus that grows on bread, can be seen with a magnifying glass. Others cannot be seen without the help of a microscope. That is why these are called microorganisms.

Microorganisms are classified into four major groups. These groups are **bacteria**, **fungi**, **protozoa** and some **algae**. Some of these common microorganisms are shown in **Figs.1.1 -1.4.**

Viruses are also microscopic. They, however, reproduce only inside the cells of the host organism, which may be a bacterium, plant or an animal. Some of the viruses are shown in **Fig. 1.5.** Common ailments like cold, influenza (flu) and most coughs are caused by viruses. Serious diseases like polio and chicken pox are also caused by viruses.

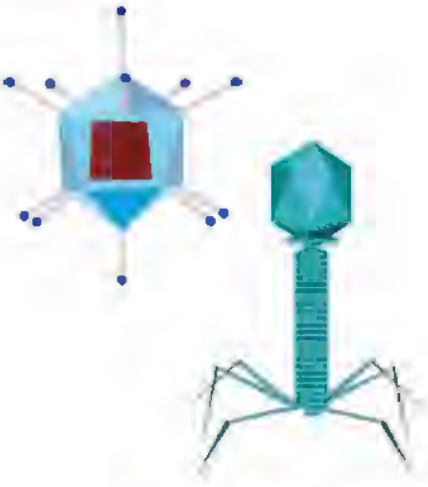
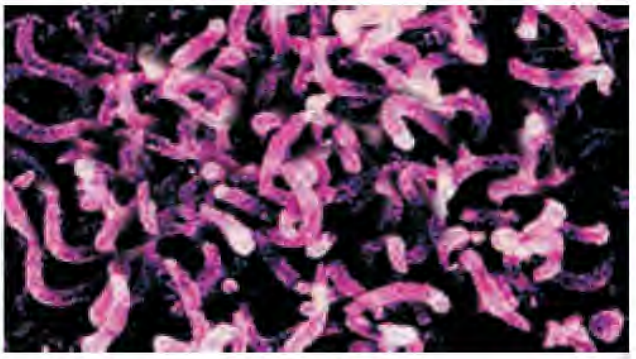


Fig. 1.5 : Viruses

Diseases like dysentery and malaria are caused by protozoans whereas typhoid and tuberculosis (TB) are bacterial diseases.



Spiral Bacteria

Rod Shaped Bacteria

Fig. 1.1: Bacteria

Chlamydomonas

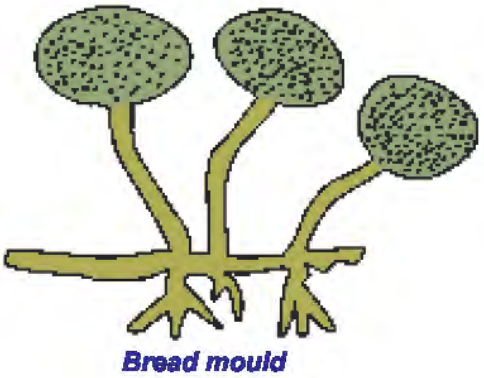
Spirogyra

Fig. 1.2 : Algae

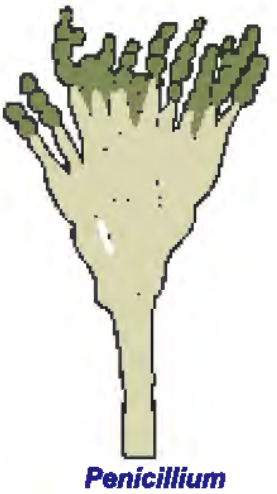
Amoeba

Paramecium

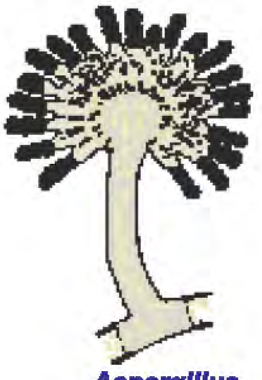
Fig. 1.3 : Protozoa



Bread mould



Penicillium



Aspergillus

Fig. 1.4: Fungi

You might have learnt about some of these microorganisms from your elders.

1.2 Where do Microorganisms Live?

Microorganisms may be single-celled like bacteria, some algae and protozoa, or multicellular, such as algae and fungi. They can survive under all types of environment, ranging from ice cold climate to hot springs and deserts to marshy lands. They are also found inside the bodies of animals including humans. Some microorganisms grow on other organisms while others exist freely. Microorganisms like *amoeba* can live alone, while fungi and bacteria may live in colonies.

1.3 Microorganisms and Man

Microorganisms play an important role in our lives. Some of them are beneficial in many ways whereas some others are harmful and cause diseases. Let us study about them in detail.

Friendly Microorganisms

Microorganisms are used for various purposes. They are used in the preparation of curd, bread and cake.

Microorganisms have been used for the production of alcohol since ages.

They are also used in cleaning up of the environment. For example, the organic wastes (vegetable peels, remains of animals, faeces, etc.) are broken into simple substances by bacteria. Recall that bacteria are also used in the preparation of medicines. In agriculture they are used to increase **soil fertility** by fixing nitrogen.

Making of Curd and Bread

You might have heard that milk is turned into curd by bacteria.

I saw that my mother added a little curd to warm milk to set curd for the next day. I wonder why!

Curd contains several micro-organisms. Of these, the bacterium ***Lactobacillus*** promotes the formation of curd. It multiplies in milk and converts it into curd. Bacteria are also involved in the making of cheese, pickles and many other food items. An important ingredient of rava (suji) idlis and bhaturas is curd. Can you guess why?

Activity 1.3

Take ½ kg flour (*atta* or *maida*), add some sugar and mix with warm water. Add a small amount of yeast powder and knead to make a soft dough. What do you observe after two hours? Did you find the dough rising?

Yeast reproduces rapidly and produces carbon dioxide during respiration. Bubbles of the gas fill the dough and increase its volume **(Fig. 1.6)**. This is the basis of the use of yeast in the baking industry for making breads, pastries and cakes.

Maida with Yeast Powder

Raised Maida

Fig. 1.6

Commercial Use of Microorganisms

Microorganisms are used for the large scale production of alcohol, wine and acetic acid (vinegar). Yeast is used for commercial production of alcohol and wine. For this purpose yeast is grown on natural sugars present in grains like barley, wheat, rice and crushed fruit juices, etc.

Activity 1.4

Take a 500 mL beaker filled upto ¾ with water. Dissolve 2-3 teaspoons of sugar in it. Add half a spoon of yeast powder to the sugar solution. Keep it covered in a warm place for 4-5 hours. Now smell the solution. Could you get a smell?

This is the smell of alcohol as sugar has been converted into alcohol by yeast. This process of conversion of sugar into alcohol is known as **fermentation.**

Louis Pasteur discovered fermentation in 1857.

Medicinal Use of Microorganisms

Whenever you fall ill the doctor may give you some antibiotic tablets, capsules or injections such as of pencillin. The source of such medicines is microorganisms. These medicines kill or stop the growth of the disease-causing microorganisms. Such medicines are called **antibiotics**. These days a number of antibiotics are being produced from bacteria and fungi. Streptomycin, tetracycline and erythromycin are some of them.

In 1929, Alexander Fleming was working on a culture of disease causing bacteria. Suddenly he found the spores of a little green mould in one of his culture plates. He observed that the presence of mould prevented the growth of bacteria. In fact, it also killed many of these bacteria. From this, the mould penicillin was prepared.

Commonly known antibiotics which are made from fungi and bacteria. The antibiotics are manufactured by growing specific microorganisms and are used to cure a variety of diseases.

Antibiotics are even mixed with the feed of livestock and poultry to check microbial infection in animals. They are also used to control many plant diseases.

It is important to remember that antibiotics should be taken only on the advice of a qualified doctor. Also you must finish the course prescribed by the doctor. If you take antibiotics when not needed or in wrong doses, it may make the drug less effective when you might need it in future. Also antibiotics taken unnecessarily may kill the beneficial bacteria in the body. Antibiotics, however, are not effective against cold and flu as these are caused by viruses.

Vaccine

Why are children/ infants given vaccination?

When a disease-carrying microbe enters our body, the body produces **antibodies** to fight the invader. The body also remembers how to fight the microbe if it enters again. So, if dead or weakened microbes are introduced in a healthy body, the body fights and kills them by producing suitable antibodies. The antibodies remain in the

body and we are protected from the disease causing microbes. This is how a vaccine works. Several diseases, including cholera, tuberculosis, smallpox and hepatitis can be prevented by vaccination.

Edward Jenner discovered the vaccine for smallpox in 1798.

In your childhood, you must have been given injections to protect yourself against several diseases. Can you prepare

a list of these diseases? You may take help from your parents.

It is essential to protect all children against these diseases. Necessary vaccines are available in the nearby hospitals. You might have seen the advertisement on T.V. and newspapers regarding protection of children against polio under Pulse Polio Program. Polio drops given to children are actually a vaccine.

A worldwide campaign against smallpox has finally led to its eradication from most parts of the world.

These days vaccines are made on a large scale from microorganisms to protect humans and other animals from several diseases.

Increasing Soil Fertility

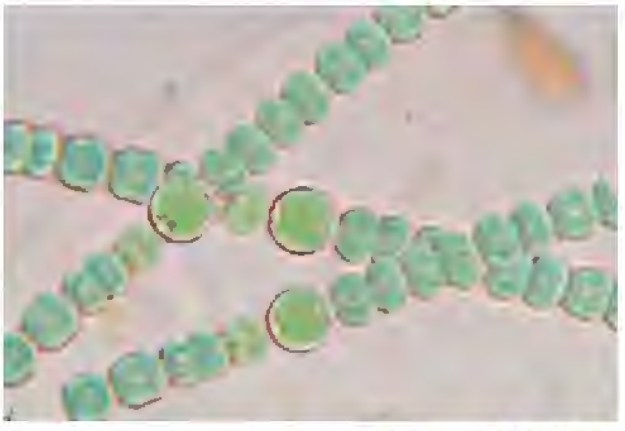
Some bacteria and blue green algae **(Fig. 1.7)** are able to fix nitrogen from the atmosphere to enrich soil with nitrogen and increase its fertility. These microbes are commonly called biological nitrogen fixers.

Cleaning the Environment

Sometimes you might have observed the school gardener making manure. Along with his colleagues, he collected wastes of plants, vegetables and fruits from nearby houses and gardens. He put them in a pit meant for waste disposal. After some time, it decomposed and got converted to manure. Do you want to know how this could happen?

Activity 1.5

Take two pots and fill each pot half With soil. Mark them A and B. Put plant waste in pot A and things like polythene bags, empty glass bottles and broken plastic toys in pot B. Put



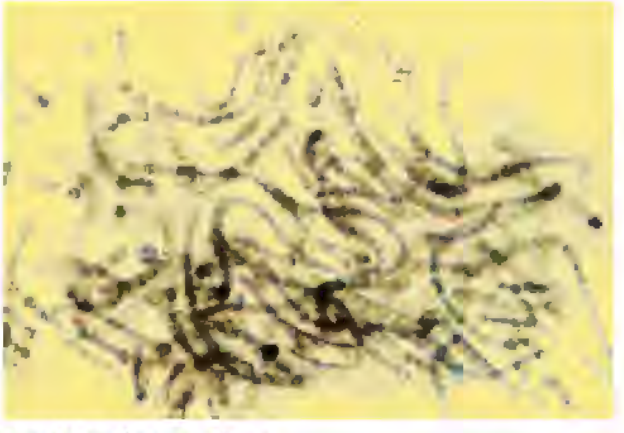


Fig. 1.7 : The Nitrogen Fixing Blue Green Algae

the pots aside. Observe them after 3-4 weeks.

Do you find any difference in the contents of the two pots? If so, what is the difference? You will find that plant waste in pot A, has been decomposed. How could this happen? The plant waste has been converted into manure by the action of microbes. The nutrients released in the process could be used by the plants again.

Did you notice that in pot B, the polythene bags, empty glasses, bottles and broken toy parts did not undergo any such change? The microbes could not 'act' on them and convert them into manure.

You often see large amounts of dead organic matter in the form of decaying plants and sometimes dead animals on the ground. You find that they disappear after some time. This is because the microorganisms decompose dead organic waste of plants and animals converting them into simple substances. These substances are again used by other plants and animals. Thus, microorganisms can be used to degrade the harmful and smelly substances and thereby clean up the environment.

1.4 Harmful Microorganisms

Microorganisms are harmful in many ways. Some of the microorganisms cause diseases in human beings, plants and animals. Such disease-causing microorganisms are called **pathogens.** Some microorganisms spoil food, clothing and leather. Let us study more about their harmful activities.

Disease— causing Microorganisms in Humans

Pathogens enter our body through the air we breathe, the water we drink or the food we eat. They can also get transmitted by direct contact with an infected person or carried through an animal. Microbial diseases that can spread from an infected person to a healthy person through air, water, food or physical contact are called **communicable diseases**. Examples of such diseases include cholera, common cold, chicken pox and tuberculosis.

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

Then how can you prevent the spread of communicable diseases?

We should keep a handkerchief on the nose and mouth while sneezing. It is better to keep a distance from infected persons.

There are some insects and animals which act as **carriers** of disease causing microbes. Housefly is one such carrier. The flies sit on the garbage and animal excreta. Pathogens stick to their bodies. When these flies sit on uncovered food they may transfer the pathogens. Whosoever eats the contaminated food is likely to get sick. So, it is advisable to always keep food covered. Avoid consuming uncovered items of food. Another example of a carrier is the female ***Anopheles*** mosquito **(Fig. 1.8)**, which carries the parasite of malaria. Female

Aedes mosquito acts as carrier of dengue virus. How can we control the spread of malaria or dengue?

Fig. 1.8 : Female Anopheles Mosquito

Why does the teacher keep telling us not to let water collect anywhere in the neighbourhood?

All mosquitoes breed in water. Hence, one should not let water collect anywhere, in coolers, tyres, flower pot Etc. By keeping the surroundings clean and dry we can prevent mosquitoes from breeding. Try to make a list of measures which help to avoid the spread of Malaria.

Some of the common diseases affecting humans, their mode of transmission and few general methods of prevention are given in **Table 1.1.**

Disease— causing Microorganisms in Animals

Several microorganisms not only cause diseases in humans and plants, but also in other animals. For example, anthrax

Table 1.1: Some Common Human Diseases Caused by Microorganisms

Human Disease	Causative Microorganism	Mode of Transmission	Preventive measures (General)
Tuberculosis Measles Chicken Pox Polio	Bacteria Virus Virus Virus	Air Air Air/Contact Air/Water	Keep the patient in complete isolation. Keep the personal belongings of the patient away from those of the others. Vaccination to be given at suitable age.
Cholera Typhoid	Bacteria Bacteria	Water/Food Water	Maintain personal hygiene and good sanitary habits. Consume properly cooked food and boiled drinking water. Vaccination.
Hepatitis B	Virus	Water	Drink boiled drinking water. Vaccination.
Malaria	Protozoa	Mosquito	Use mosquito net and repellents. Spray insecticides and control breeding of mosquitoes by not allowing water to collect in the surroundings.

is a dangerous human and cattle disease caused by a bacterium. Foot and mouth disease of cattle is caused by a virus.

Robert Köch (1876) discovered the bacterium (*Bacillus anthracis*) which causes anthrax disease.

Disease— causing Microorganisms in Plants

Several microorganisms cause diseases in plants like wheat, rice, potato, sugarcane, orange, apple and others. The diseases reduce the yield of crops. See **Table1.2** for some such plant diseases. They can be controlled by the use of certain chemicals which kill the microbes.

Table 1.2: Some Common Plant Diseases Caused by Microorganisms

Plant Diseases	Micro-organism	Figures
Black Rot of Cabbage	Bacteria	
Late Blight of Potato	Fungi	
White Rust of Mustard	Fungi	

Food Poisoning

Yasir was invited by his friend to a party and he ate a variety of foodstuff. On reaching home he started vomiting and had to be taken to a hospital. The doctor said that this condition could be due to food poisoning.

Saba wonders how food can become 'poison'.

Food poisoning could be due to the consumption of food spoilt by some microorganisms. Microorganisms that grow on our food sometimes produce toxic substances. These make the food poisonous causing serious illness and even death. So, it is very important that we preserve food to prevent it from being spoilt.

1.5 Food Preservation

How do we preserve cooked food at home? You know that bread left unused under moist conditions is attacked by fungus. Microorganisms spoil our food. Spoiled food

emits bad smell and has a bad taste and its colour also changes. Is spoiling of food a chemical reaction?

Saba bought some mangoes but she could not eat them for a few days. Later she found that they were spoilt and rotten. But she knows that the mango pickle her grandmother makes does not spoil for a long time. She is confused.

Let us study the common methods to preserve food in our homes. We have to prevent it from the attack of microorganisms.

Chemical Methods

Some preservatives are used to check the growth of microorganisms. We add salt or acid preservatives to pickles to prevent the attack of microbes. Sodium benzoate and sodium metabisulphite are common preservatives. These are also used in the jams and squashes to check their spoilage.

Preservation by Common Salt

Common salt has been used to preserve meat and fish for ages. Meat and fish are covered with dry salt to check the growth of bacteria. Salting is also used to preserve amla, raw mangoes, tamarind, etc.

Preservation by Sugar

Jams, jellies and squashes are preserved by sugar. Sugar reduces the moisture content which inhibits the growth of bacteria which spoil food.

Preservation by Oil and Vinegar

Use of oil and vinegar prevents spoilage of pickles because bacteria cannot live in such an environment. Vegetables, fruits, fish and meat are often preserved by this method.

Heat and Cold Treatments

You must have observed your mother boiling milk before it is stored or used. Boiling kills many microorganisms. Similarly, we keep our food in the refrigerator. Low temperature inhibits the growth of microbes.

Why does the milk that comes in packets not spoil? My mother told me that the milk is 'pasteurized'. What is pasteurization?

Pasteurized milk can be consumed without boiling as it is free from harmful microbes. The milk is heated to about 70°C for 15 to 30 seconds and then suddenly chilled and stored. By doing so, it prevents the growth of microbes. This process was discovered by Louis Pasteur. It is called **pasteurization**.

Storage and Packing

These days dry fruits and even vegetables are sold in sealed air tight packets to prevent the attack of microbes.

1.6 Nitrogen Fixation

You might have learnt about the bacterium

Fig. 1.9 : Roots of a Leguminous Plant with Root Nodules

Rhizobium. It is involved in the fixation of nitrogen in leguminous plants (pulses). Recall that Rhizobium lives in the root nodules of leguminous plants **(Fig. 1.9)**, such as beans and peas, with which it has a symbiotic relationship. Sometimes nitrogen gets fixed through the action of lightning. But you know that the amount of nitrogen in the atmosphere remains constant. You may wonder how? Let us understand this in the next section.

1.7 Nitrogen cycle

Our atmosphere has 78% nitrogen gas. Nitrogen is one of the essential constituents of all living organisms as part of proteins, chlorophyll, nucleic acids and vitamins. The atmospheric nitrogen cannot be taken directly by plants and animals. Certain bacteria and blue green algae present in the soil fix nitrogen from the atmosphere and convert into compounds of nitrogen. Once nitrogen is converted into these usable compounds, it can be utilised by plants from the soil through their root system. Nitrogen is then used for the synthesis of plant proteins and other compounds. Animals feeding on plants get these proteins and other nitrogen compounds **(Fig. 1.10)**.

When plants and animals die, bacteria and fungi present in the soil convert the nitrogenous wastes into nitrogenous compounds to be used by plants again. Certain other bacteria convert some part of them to nitrogen gas which goes back into the atmosphere. As a result, the percentage of nitrogen in the atmosphere remains more or less constant.

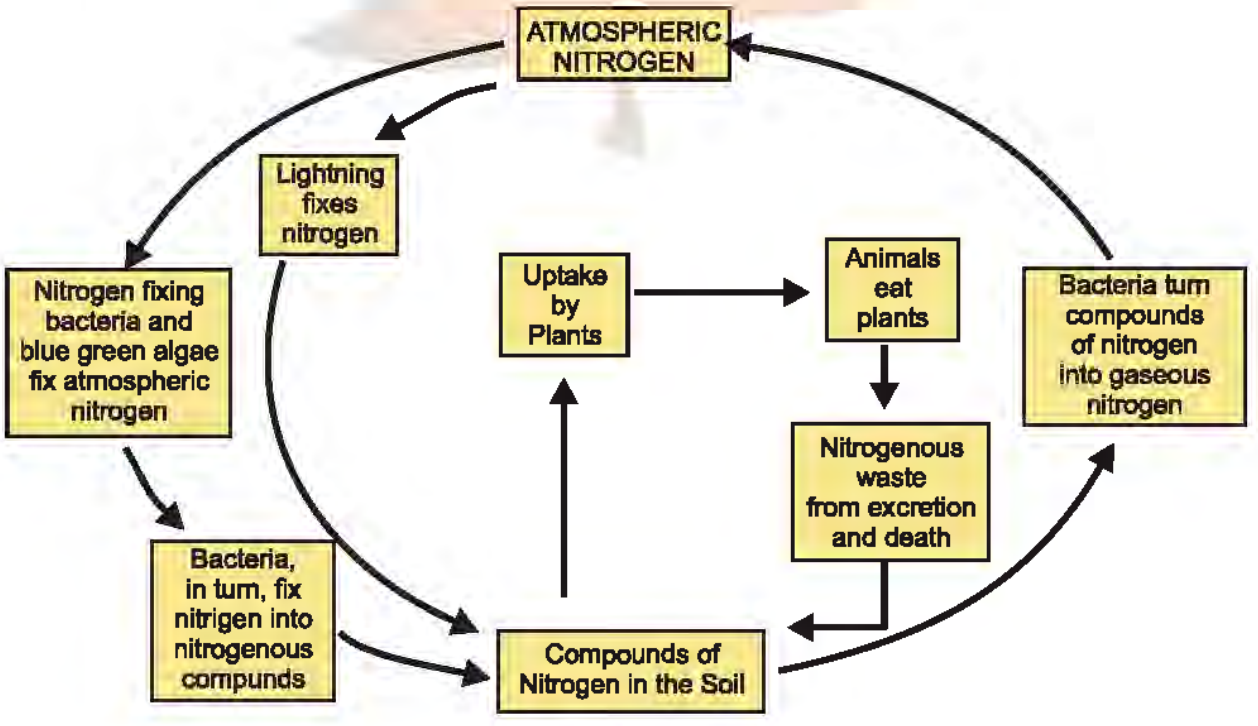


Fig. 1.10

KEYWORDS

ALGAE

ANTIBODIES

BACTERIA

CARRIER

COMMUNICABLE DISEASES

FERMENTATION

FUNGI

LACTOBACILLUS

MICROORGANISM

NITROGEN CYCLE

NITROGEN FIXATION

PASTEURIZATION

PATHOGEN

PRESERVATION

PROTOZOA

RHIZOBIUM

VACCINE

VIRUS

YEAST

WHAT YOU HAVE LEARNT

Microorganisms are too small and are not visible to the unaided eyes.

They can live in all kinds of environment ranging from ice cold climate to hot springs and deserts to marshy lands.

Microorganisms are found in air, water and in the bodies of plants and animals.

They may be unicellular or multicellular.

Microorganisms include bacteria, fungi, protozoa and some algae. Viruses, though different from the above mentioned living organisms, are considered microbes.

Viruses is quite different from other microorganisms. They reproduce only inside the host organism; bacterium, plant or animal cell.

Some microorganisms are useful for commercial production of medicines and alcohol.

Protozoans cause serious diseases like dysentery and malaria.

Some of the microorganisms grow on our food and cause food poisoning.

Some microorganisms reside in the root nodules of leguminous plants. They can fix nitrogen from air into soil and increase the soil fertility.

Some bacteria and blue green algae present in the soil fix nitrogen from the atmosphere and convert into nitrogenous compounds.

Some microorganisms decompose the organic waste and dead plants and animals into simple substances and clean up the environment.

Certain bacteria convert compounds of nitrogen present in the soil into nitrogen gas which is released to the atmosphere.

Exercises

1. Fill in the blanks:

(a) Microorganisms can be seen with the help of a _____.

(b) Blue green algae fix _____ directly from air to enhance fertility of soil.

(c) Alcohol is produced with the help of _____.

(d) Cholera is caused by _____.

2. Tick the correct answer:

(a) Yeast is used in the production of

(i) sugar (ii) alcohol

(iii) hydrochloric acid (iv) oxygen

(b) The following is an antibiotic

(i) Sodium bicarbonate (ii) Streptomycin

(iii) Alcohol (iv) Yeast

(c) Carrier of malaria-causing protozoan is

(i) female *Anopheles* mosquito (ii) cockroach

(iii) housefly (iv) butterfly

(d) The most common carrier of communicable diseases is

(i) ant (ii) housefly

(iii) dragonfly (iv) spider

(e) The bread or *idli* dough rises because of

(i) heat (ii) grinding

(iii) growth of yeast cells (iv) kneading

(f) The process of conversion of sugar into alcohol is called

(i) nitrogen fixation (ii) moulding

(iii) fermentation (iv) infection

3. Match the organisms in Column I with their action in Column II.

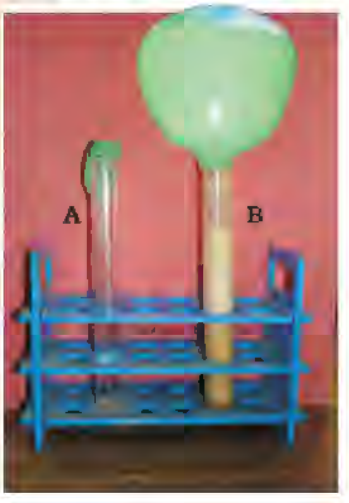
Column I	Column II
(i) Bacteria	(a) Fixing Nitrogen
(ii) Rhizobium	(b) Setting of curd
(iii) Lactobacillu	(c) Baking of bread
(iv) Yeast	(d) Causing Malaria
(v) A protozoan	(e) Causing Cholera
(vi) A Virus	(f) Causing AIDS
	(g) Producing antibodies

4. Can microorganisms be seen with the naked eye? If not, how can they be seen?
5. What are the major groups of microorganisms?
6. Name the microorganisms which can fix atmospheric nitrogen in the soil.
7. Write 10 lines on the usefulness of microorganisms in our lives.
8. Write a short paragraph on the harms caused by microorganisms.
9. What are antibiotics? What precautions must be taken while taking antibiotics?

Extended Learning — Activities and Projects

1. Pull out a gram or bean plant from the field. Observe its roots. You will find round structures called root nodules on the roots. Draw a diagram of the root and show the root nodules.
2. Collect the labels from the bottles of jams and jellies. Write down the list of contents printed on the labels.
3. Visit a doctor. Find out why antibiotics should not be overused. Prepare a short report.
4. Project : Requirements – 2 test tubes, marker pen, sugar, yeast powder, 2 balloons and lime water.

   Take two test tubes and mark them A and B. Clamp these tubes in a stand and fill them with water leaving some space at the top. Put two spoonfuls of sugar in each of the test tubes. Add a spoonful of yeast in test tube B. Inflate the two balloons incompletely. Now tie the balloons on the mouths of each test tube. Keep them in a warm place, away from sunlight. Watch the setup every day for next 3-4 days. Record your observations and think of an explanation.

   Now take another test tube filled 1/4 with lime water. Remove the balloon from test tube B in such a manner that gas inside the balloon does not escape. Fit the balloon on the test tube and shake well. Observe and explain.
5. For more information, visit the following websites:
   www.microorganisms
   www.biology4kids.com/files/micro_main html

Did You Know?

Bacteria have lived on the earth for much longer than human beings. They are such hardy organisms that they can live under extreme conditions. They have been found living in boiling mudpots and extremly cold icy waters. They have been found in lakes of caustic soda and in pools of concentrated sulphuric acid. They can survive at depths of several kilometres. They probably can survive in space, too. A kind of bacterium was recovered from a camera which stood on the moon for two years. There is probably no environment in which bacteria cannot survive.

CHAPTER - 2

COAL AND PETROLEUM

We use various materials for our basic needs. Some of them are found in nature and some have been made by human efforts.

Activity 2.1

Make a list of various materials used by us in daily life and classify them as natural and man-made.

Natural	Man-made

Does this list include air, water, soil and minerals? Since all these are obtained from nature, they are called natural resources.

Can we use all our natural resources forever?

Can air, water and soil be exhausted by human activities? Is water a limitless resource?

In the light of the availability of various resources in nature, natural resources can be broadly classified into two kinds:

Inexhaustible Natural Resources

These resources are present in unlimited Quantity in nature and are not likely to be exhausted by human activities. Examples are: sunlight, air.

Exhaustible Natural Resources

The amount of these resources in nature is limited. They can be exhausted by human activities. Examples of these resources are forests, wildlife, minerals, coal, petroleum, natural gas etc.

Activity 2.2

(It is a group activity)

Take some containers. Fill them with popcorn/peanuts/roasted gram/toffees. Divide students into groups of seven each. Further divide each group into three subgroups containing 1, 2 and 4 students. Label them as first, second and third generation respectively. These sub-groups represent the consumers. As population is growing, second and third generations have larger number of consumers.

Put one full container for each group on a table. Ask consumers of the first generation from each group to consume eatables from the container of their group. Now, ask the second generation consumers from each group to do the same. Ask students to observe carefully the availability of eatables in each container. If some thing is left in the containers, ask third generation from each group to consume it. Now, finally observe whether all the consumers of the third generation got the eatables or not. Also observe if any thing is still left in any of the containers.

Assume that the eatables in the container represent the total availability of an exhausible natural resource like coal,

petroleum or natural gas. Each group may have different consumption pattern. Are the earlier generations of any group too greedy? It may be that the earlier generations in some groups were concerned about the coming generation(s) and left something for them.

In this chapter we will learn about some exhaustible natural resources like coal, petroleum and natural gas. These were formed from the dead remains of living organisms (fossils). So, these are all known as fossil fuels.

2.1 Coal

You may have seen coal, or heard about it **(Fig. 2.1)**. It is as hard as stone and is black in colour.

Fig. 2.1: Coal

Coal is one of the fuels used to cook food. Earlier, it was used in railway engines to produce steam to run the engine. It is also used in thermal power plants to produce electricity. Coal is also used as a fuel in various industries.

Story of Coal

Where do we get coal from and how is it formed?

About 300 million years ago the earth had dense forests in low lying wetland areas. Due to natural processes, like flooding, these forests got buried under the soil. As more soil deposited over them, they were compressed. The temperature also rose as they sank deeper and deeper. Under high pressure and high temperature, dead plants got slowly converted to coal. As coal contains mainly carbon, the slow process of conversion of dead vegetation into coal is called **carbonisation**. Since it was formed from the remains of vegetation, coal is also called a fossil fuel. A coal mine is shown in **Fig. 2.2.**

Fig. 2.2: A Coal Mine

When heated in air, coal burns and produces mainly carbon dioxide gas.

Coal is processed in industry to get some useful products such as coke, coal tar and coal gas.

Mineral Resources (Fuel) in Jammu and Kashmir :

Compared to some of the other states like Bihar, West Bengal, Orissa, Madhya Pradesh or Mysore, the mineral resources of the State of Jammu and Kashmir can only be described as modest. But occurrence of Lignite in Kashmir Province and Coal in Jammu Province, places the state in better position as compared to North-western India, which are totally dependent on long hauls for their fuel requirements. Important mineral resources (Fuel) are (i) Coal (ii) Natural Gas and Petroleum and (iii) Lignite

Coal :

This most important resource is found in Jammu Province. Also known as "Black Diamond", the belt of coal runs from Jangalgali to Jigni, over a distance of 36 miles, important fields like Kalakote, Metka, Mahagala areas are on the western flank. In addition, this coal belt of good quantity and quantity is located on the fringes of Great Limestone formation, east of Kotli where hundred million tonnes of coal is reported to exist. Production of Coal ranged from 9,000 to 10,000 million tonnes per annum which provided work to about a hundred families.

Geological distribution of two groups is given below :

A- Group : Kalakote coal belt
(with western sector)

1. Kalakot area (Sair Block)
2. Tata Pani Block
3. Jigni Block
4. Mahagala

B-Group :Chakkar - Chinkha - Jangalgali
(Central Sector)

1. Chakkar area chokri, Sujjanpur, Kalimiti
2. Sangarmarg - Chinkhar (Panshasa, Paddar and Thakra kot)
3. Jangalgali (Lain, Gouri, Mitti, Thalwal Anji Khad to Salal)
4. Metka.

Petroleum and Natural Gas :

Some resources of natural gas and petroleum exist near Nowshera, Dharmathal and some areas of Ram Nagar Tehsil. Very little quantity of petroleum is discovered near Surinsar area.

Lignite :

The deposits have been found in Handwara, Raithan, oder in Kashmir valleys.

A. Coke

It is a tough, porous and black substance. It is almost pure form of carbon. Coke is used in the manufacture of steel and in the extraction of many metals.

B. Coal tar

It is a black, thick liquid **(Fig. 2.3)** with unpleasant smell. It is a mixture of about 200 substances. Products obtained from coal tar are used as starting materials for

manufacturing various substances used in everyday life and in industry, like synthetic

Fig. 2.3: Coal-tar

dyes, drugs, explosives, perfumes, plastics, paints, photographic materials, roofing materials, etc. Interestingly, naphthalene balls used to repel moths and other insects are also obtained from coal tar.

These days, bitumen, a petroleum product, is used in place of coal-tar for metalling the roads.

C. Coal gas

Coal gas is obtained during the processing of coal to get coke.

Coal gas was used for street lightening for the first time in London in 1810 and in New York around 1820. Now a days, it is used as a source of heat rather than light. It is used as a fuel in many industries situated near the coal processing plants.

2.2 Petroleum

You know that petrol is used as a fuel in light automobiles such as motor cycles/scooters and cers. Heavy motor vehicles like trucks and tractors run on diesel. Petrol and diesel are obtained from a natural resource called **petroleum.**

Do you know how petroleum is formed?

Petroleum was formed from organisms living in the sea. As these organisms died, their bodies settled at the bottom of the sea and got covered with layers of sand and clay. Over millions of years, absence of air, high temperature and high pressure transformed the dead organisms into petroleum and natural gas.

Look at **Fig. 2.4.** It shows the deposits of petroleum and natural gas. You see that the layer containing petroleum oil and gas is above that of water. Why is it so? Recall that oil and gas are lighter than water and do not mix with it.

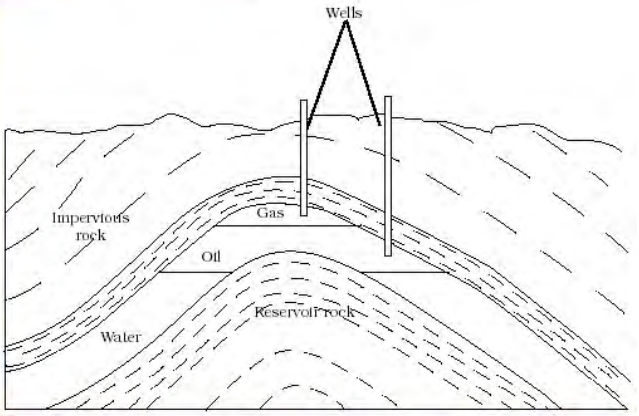


Fig. 2.4 : Petroleum and Natural Gas Deposits

The world's first oil well was drilled in Pennsylvania, USA, in 1859. Eight years later, in 1867, oil was stuck at Makum in Assam. In India, oil is found in Assam, Gujarat, Mumbai High and in the river basins of Godavari and Krishna.

Refining of Petroleum

Petroleum is a dark oily liquid. It has an unpleasant odour. It is a mixture of various constituents such as petroleum gas, petrol, diesel, lubricating oil, paraffin wax, etc. The process of separating the various constituents/fractions of petroleum is known as refining. It is carried out in a **petroleum**

refinery (Fig. 2.5).

Fig. 2.5: A Petroleum Refinery

Various constituents of petroleum and their uses are given in **Table 2.1**.

Many useful substances are obtained from petroleum and natural gas. These are termed as 'Petrochemicals'. These are used in the manufacture of detergents, fibres (polyester, nylon, acrylic etc.), polythene and other man-made plastics. Hydrogen gas obtained from natural gas, is used in the production of fertilisers (urea). Due to its great commercial importance, petroleum is also called 'black gold'.

2.3 Natural Gas

Natural gas is a very important fossil fuel because it is easy to transport through pipes. Natural gas is stored under high pressure as compressed natural gas (CNG). CNG is used for power generation. It is now being used as a fuel for transport vehicles because it is less polluting. It is a cleaner fuel.

The great advantage of CNG is that it can be used directly for burning in homes and factories where it can be supplied through pipes. Such a network of pipelines exists in Vadodara (Gujarat), some parts of Delhi and other places.

Natural gas is also used as a starting

Table 2.1 Various Constituents of Petroleum and their Uses

S.No.	Constituents of petroleum	Uses
1.	Petroleum Gas in Liquid form (LPG)	Fuel for home and industry
2.	Petrol	Motor fuel, aviation fuel, solvent for dry cleaning
3.	Kerosene	Fuel for stoves, lamps and for jet aircrafts
4.	Diesel	Fuel for heavy motor vehicles, electric generators
5.	Lubricating oil	Lubrication
6.	Paraffin wax	Ointments, candles, vaseline etc.
7.	Bitumen	Paints, road surfacing

material for the manufacture of a number of chemicals and fertilisers. India has vast reserves of natural gas. In our country, natural gas has been found in Tripura, Rajasthan, Maharashtra and in the Krishna Godavari delta.

Can coal, petroleum and natural gas be prepared in the laboratory from dead organisms?

No, their formation is a very slow process and conditions for their formation cannot be created in the laboratory.

2.4 Some Natural Resources are Limited

You have studied in the beginning of the chapter that some natural resources are exhaustible like fossil fuels, forests, minerals etc.

You know that coal and petroleum are fossil fuels. It required the dead organisms millions of years to get converted into these fuels. On the other hand, the known reserves of these will last atmost a few hundred years. Moreover, burning of these fuels is a major cause of air pollution. Their use is also linked to global warming. It is therefore necessary that we use these fuels only when absolutely necessary. This will result in better environment, smaller risk of global warming and their availability for a longer period of time.

In India, the Petroleum Conservation Research Association (PCRA) advises people how to save petrol/diesel while driving. Their tips are:

- Drive at a constant and moderate speed as far as possible,
- Switch off the engine at traffic lights or at a place where you have to wait,
- Ensure correct tyre pressure, and
- Ensure regular maintenance of the vehicle.

Do You Know ?

In the industrial map of India, J&K State, is endowed with important industrial minerals and occupies a pre-dominant position. As most of the area comprising mostly of Sub-Himalayas and Lesser Himalayas, is a mountainous area with rugged topography, the exploitation of these deposits could not find much utilization. The important industrial minerals available and their occurrence is as tabulized

Name	***Region where found.***
Borax	Pagga valley (Ladakh)
Cement stone	Wuyam (Kashmir), Reasi and Basohli (Jammu)
China day	Chakhar, Tikri, Salal, Jangalgali (Jammu)
Gypsym	Ramban, Batote, Gool Gulab Garh(Jammu) Lachhipura, Kathia Nullah, Baramullah, Anantnag (Kashmir)
Graphite	Braripora, Uri, Karnah, Malogam, Piran (Kashmir), Kishtwar (Jammu)
Ochire	Nurkhawan, Ratasar, Jhaggi (Kashmir)
Mica	Doda, Ramban, Reasi (Jammu)
Sulphur	Pagga valley (Ladakh), Anantnag, Khrew (Kashmir), Rajouri (Jammu)
Slate	Ramsu, Banihal, Ramban (Jammu), Baramullah (Kashmir)
Asbestos	Kargil
Marble	Drugmulla, Zirhama, Oura, Trehgan (Kashmir), Thatri (Jammu)

KEYWORDS

COAL
COAL GAS
COAL TAR
COKE
FOSSIL FUEL
NATURAL GAS
PETROLEUM
PETROLEUM REFINERY

WHAT YOU HAVE LEARNT

Coal, petroleum and natural gas are fossil fuels.

Fossil fuels were formed from the dead remains of living organisms millions of years ago.

Fossil fuels are exhaustible resources. Coke, coal tar and coal gas are the products of coal.

Petroleum gas, petrol, diesel, kerosene, paraffin wax, lubricating oil are obtained by refining petroleum.

Coal and petroleum resources are limited. We should use them judiciously.

Exercises

1. What are the advantages of using CNG and LPG as fuels?
2. Name the petroleum product used for surfacing of roads.
3. Describe how coal is formed from dead vegetation. What is this process called?
4. **Fill in the blanks :**
   (a) Fossil fuels are ....., ... and .....
   (b) Process of separation of different constituents from petroleum is called .....
   (c) Least polluting fuel for vehicle is .....
5. **Tick True/False against the following statements :**
   (a) Fossil fuels can be made in the laboratory. (T/F)
   (b) CNG is more polluting fuel than petrol. (T/F)
   (c) Coke is almost pure form of carbon. (T/F)
   (d) Coal tar is a mixture of various substances. (T/F)
   (e) Kerosene is not a fossil fuel. (T/F)
6. Explain why fossil fuels are exhaustible natural resources ?
7. Describe characteristics and uses of coke ?
8. Explain the process of formation of petroleum ?
9. The following Table shows the total power shortage in India from 1991– 1997. Show the data

in the form of a graph? Plot shortage percentage for the years on the Y-axis and the year on the X-axis.

S. No.	Year	Shortage (%)
1	1991	7.9
2	1992	7.8
3	1993	8.3
4	1994	7.4
5	1995	7.1
6	1996	9.2
7	1997	11.5

10. What are exhaustible natural resources ? Give examples.
11. What are inexhaustible natural resources ? Give examples.
12. Why is natural gas is called a clean fuel ?
13. What are the uses of coal ?

Note for Teacher : Questions should also be asked from the information given in the various chapters regarding Jammu and Kashmir.

Extended Learning — Activities and Projects

1. Get an outline map of India. Mark the places in the map where coal, petroleum and natural gas are found. Show the places where petroleum refineries are situated.
2. Choose any five families of your neighbourhood. Enquire whether their energy consumption (coal, gas, electricity, petrol, kerosene) has increased or decreased in the last five years. Enquire also about the measures they adopt to conserve energy.
3. Find out the location of major thermal power plants in India. What could be the reasons for their being located at those places?
4. Find out the location of major power projects in J&K ? What could be the reasons for their being located at those places ?

For more information, visit:

www.energyquest.ca.gov/story/chapter08.html

en.wikipedia.org/wiki/Non-renewable_resources

http://lsa.colorado.edu/summarystreet/texts/coal.htm

http://www.eia.doe.gov/kids/energyfacts/sources/nonrenewable/oil.html

CHAPTER - 3

CONSERVATION OF PLANTS AND ANIMALS

Two of the students, Yasir and Arif had visited the forest along with Prof. Ahmad. They were eager to share their experiences with their classmates. Other children in the class were also eager to share their experiences as some of them had visited Bharatpur Sanctuary. Some others had heard about Kaziranga National Park, Lockchao Wildlife Sanctuary, Great Nicobar Biosphere Reserve and Tiger Reserve, etc.

What is the purpose of making national parks, wildlife sanctuaries and biosphere reserves?

3.1 Deforestation and Its Causes

A great variety of plants and animals exists on earth. They are essential for the well being and survival of mankind. Today, a major threat to survival of these organisms is **deforestation**. We know that deforestation means clearing of forests and using that land for other purposes. Trees in the forest are cut for some of the purposes mentioned below:

Procuring land for cultivation.

Building houses and factories.

Making furniture or using wood as fuel.

Some natural causes of deforestation are forest fires and severe droughts.

Do You Know ?

One of the nature's precious gifts is forest. It constitutes most important sector of J & K State economy. Apart from providing valuable raw material for the industries, it promises both direct and indirect opportunities.

According to estimates, total area under forests in J&K is 20,230 sq. Km (excluding the area under the occupation of Pakistan and China i.e 19.95% of the State area.

Latest data available on forests of J&K is as summarized :

Forest cover in Kashmir Division : 50.97%

Forest cover in Jammu Division : 45.89%

Forest cover in Ladakh : 3.14%

Erstwhile District Doda is leading in forest cover while Kargil district is very poor in forest wealth. In Jammu & Kashmir the vegetation is classified as :

1. Dry Savana and Scrubs : It is confined to Jammu plains and Kandi areas Important species are :

(i) Kikar (ii) Phulai (iii) Ber (iv) Shishum (v) Pipal (vi) Banyan (vii) Mango (viii) Palm (ix) Bamboo.

2. Sub-Tropical Forests : These forests are confined to Shiwalik foot hills. Chir (Pinus long folia) is the main tree species in these forests. It is a valuable source of timber. Important locations are Reasi,

Udhampur, Poonch, Rajouri, Billawar, Ramban and Jammu.

3. Temperate Forests : The Kashmir valley and erstwhile Distt. Doda is home of these forests which include Deodar, Kairoo (Pine); Kachil and Burza etc.

4. Alpine Vegetation : It comprises pastures (Margs) where Birch and Junipers are common. eg.; Gulmarg, Yusmarg, Tangmarg, Sonamarg etc.

5. Xerophytic Vegetation : It is very common in Ladakh region which receives scanty rainfall.

Activity 3.1

Add more causes of deforestation to your list and classify them into natural and man-made.

3.2 Consequences of Deforestation

Yasir and Arif recalled the consequences of deforestation. They remembered that deforestation increases the temperature and pollution level on the earth. It increases the level of carbon dioxide in the atmosphere. Ground water level also gets lowered. They know that deforestation disturbs the balance in nature. They were told by Prof. Ahmad that if cutting of trees continues, rainfall and the fertility of the soil will decrease. Moreover, there will be increased chances of natural calamities such as floods and droughts.

How does deforestation reduce rainfall on the one hand and lead to floods on the other?

Recall that plants need carbon dioxide for photosynthesis. Fewer trees would mean that less carbon dioxide will be used up resulting in its increased amount in the atmosphere. This will lead to global warming as carbon dioxide traps the heat rays reflected by the earth. The increase in temperature on the earth disturbs the water cycle and may reduce rainfall. This could cause **droughts**.

Deforestation is a major cause which leads to the change in soil properties. Physical properties of the soil get affected by plantation and vegetation. Your know trees prevent soil erosion. Fewer trees result in more soil erosion. Removal of the top layer of the soil exposes the lower, hard and rocky layers. This soil has less humus and is less fertile. Gradually the fertile land gets converted into deserts. It is called **desertification**.

Deforestation also leads to a decrease in the water holding capacity of the soil. The movement of water from the soil surface into the ground (infiltration rate) is reduced. So, there are floods. The other properties of the soil like nutrient content, texture, etc., also change because of deforestation.

Soil Erosion in Jammu region of J & K State

This is one of the serious constraints in soils of Kandi belt in Jammu (Foothills of Siwalik zone of Jammu district, comprising hilly portion of small dry hillocks with rugged topography and altitude varying from 300-1050 m above mean sea level is called Kandi. The annual rainfall is 1000 mm, bulk

of which is received during monsoon). The top soil has been removed in this layer from the entire area of 4,89,266 ha.

A number of villages located on Mansar to Surinsar road face a drastic erosion problem by nearby nallahs during rainy season. The areas between Balaul and Basantar are badly affected with soil erosion and heavy amount of sand silt and stones deposited after erosion by the flash food continue to take heavy toll of the agricultural lands. About 26% of the total area which is under village forests is now quite eroded.

Besides this, the areas where continuous soil erosions are taking place are, Kaleeth and Chauki Chora of Akhnoor tehsil, Dansal, Jhajjar Kotli, Ram Nagar, Mansar, Suriansar, Jandial and Amb series of Bhalwal block of Jammu.

We get many products from forests. List these products. Will we face the shortage of these products if we continue cutting trees?

Activity 3.2

Animal life is also affected by deforestation. How? List the points and discuss them in your class.

3.3 Conservation of Forest and Wildlife

Having become aware of the effects of deforestation, Yasir and Arif are worried. They go to Prof. Ahmad and ask him how forests and wildlife can be saved.

Biosphere is that part of the earth in which living organisms exist or which supports life. Biological diversity or biodiversity, refers to the variety of organisms existing on the earth, their interrelationships and their relationship with the environment.

Prof. Ahmad organises a visit to a biosphere reserve for Yasir, Arif and their classmates. He selects a place named Pachmarhi Biosphere Reserve. He knows that the plants and animals found here are similar to those of the upper Himalayan peaks and to those belonging to the lower western ghats. Prof. Ahmad believes that the biodiversity found here is unique. He requests Madhavji, a forest employee, to guide the children inside the biosphere reserve. He explains that preserving areas of such biological importance make them a part of our national heritage.

Madhavji explains to the children that apart from our personal efforts and efforts of the society, government agencies also take care of the forests and animals. The government lays down rules, methods and

To protect our flora and fauna and their habitats, **protected areas** called sanctuaries, national parks and biosphere reserves have been earmarked. Plantation, cultivation, grazing, felling trees, hunting and poaching are prohibited there.

Sanctuary : Areas where animals are protected from any disturbance to them and their habitat.

National Park : Areas reserved for wild life where they can freely use the habitats and natural resources.

Biosphere Reserve : Large areas of protacted land for conservation of wild life, plant and animal resources and traditional life of the tribals living in the area.

policies to protect and conserve them. Wildlife sanctuaries, national parks, biosphere reserves, etc., are protected areas for conservation of plants and animals present in that area.

Activity 3.3

Find out the number of national parks, wildlife sanctuaries and biosphere reserves in your district, state and country. Record in **Table 3.1**. Show these areas in an outline map of your state and India.

3.4 Biosphere Reserve

Children along with Prof. Ahmad and Madhavji enter the biosphere reserve area. Madhavji explains that **biosphere reserves** are the areas meant for conservation of biodiversity. As you are aware that biodiversity is the variety of plants, animals and microorganisms generally found in an area. The biosphere reserves help to maintain the biodiversity and culture of that area. A biosphere reserve may also contain other protected areas in it. The Pachmarhi Biosphere Reserve consists of one national park named Satpura and two wildlife sanctuaries named Bori and Pachmarhi **(Fig. 3.1)**.

Activity 3.4

List the factors disturbing the biodiversity of your area. Some of these factors and human activities may disturb the biodiversity

Table 3.1 : Protected Areas for Conservation.

Protected Areas	National Park	Wildlife Sanctuary	Biosphere Reserve
In my district			
In my state			
In my country			

Fig. 3.1 : Pachmarhi Biosphere Reserve

unknowingly. List these human activities. How can these be checked? Discuss in your class and write a brief report in your notebook.

3.5 Flora and Fauna

As the children walk around the biosphere reserve they appreciate the green wealth of the forest. They are very happy to see tall teak trees and animals inside the forest. Suddenly, Yasir finds a rabbit and wants to catch it. He starts running after it. Prof. Ahmad stops him. He explains that animals are comfortable and happy in their own habitat. We should not disturb them. Madhavji explains that some animals and plants typically belong to a particular area. The plants and animals found in a particular area are termed **flora** and **fauna** of that area respectively.

Activity 3.5

Try to identify the flora and fauna of your area and list them.

3.6 Endemic Species

Soon the group quietly enters the deep forest. Children are surprised to see a very big squirrel. This squirrel has a big fluffy tail. They are very curious to know about it. Madhavji tells them that this is known as the giant squirrel and is endemic to this area.

Endemic species are those species

***Sal*, teak, mango, *jamun*, silver ferns, *arjun*, etc are the flora and *chinkara*, blue-bull, barking deer, *cheetal*, leopard, wild dog, wolf, etc. are examples of the fauna of the Pachmarhi Biosphere Reserve(Fig. 3.2).**

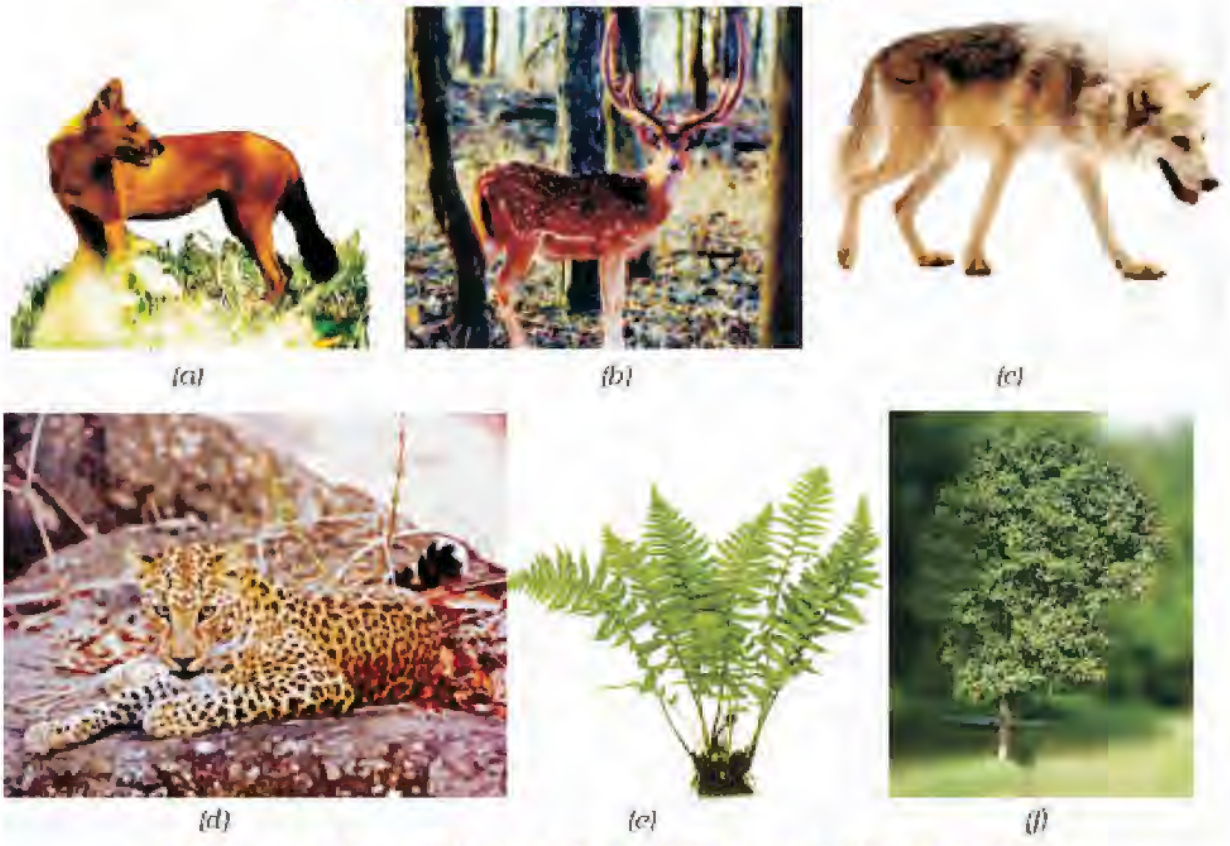


Fig.3.2 : (a) Wild Dog (b) Cheetal (c) Wolf (d) Leopard (e) Fern (f) Jamun

of plants and animals which are found exclusively in a particular area. They are not naturally found anywhere else. A particular type of animal or plant may be endemic to a zone, a state or a country.

Do you know Endemic Species of Animals in J&K State?

The Himalayas harbour a hardy range of animals, which survive in extreme cold. Ladakh's freezing high altitudes are a home to Yak, the shaggy horned wild ox weighing around one tonne, the Tibetan antelope, the bharal (blue sheep), wild sheep and kiang (Tibetan wild ass).

Yak

The 'Hangul' is the most prized wild life animal. The famous Dachigam National Park in Srinagar (in the state of J&K) is abode of Hangul. It is a rare and unique species of deer not found any where in the world.

Hangul

Madhavji shows *sal* and wild mango **[(Fig. 3.3 (a)]** as two examples of the

Fig. 3.3 : (a) Wild Mango

Fig. 3.3 : (b) Giant Squirrel

endemic flora of the Pachmarhi Biosphere Reserve. Bison, Indian giant squirrel **[Fig. 3.3 (b)]** and flying squirrel are endemic fauna of this area. Prof. Ahmad explains that the destruction of their habitat, increasing population and introduction of new species may affect the natural habitat of endemic species and endanger their existence.

I have heard that some of the endemic species may vanish. Is it true?

Species is a group of organisms which are capable of interbreeding. This means that the members of a species can reproduce fertile offspring only with the members of their own species and not with members of other species. Members of a species have common characteristics.

Activity 3.6

Find out the endemic plants and animals of the region where you live.

3.7 Wildlife Sanctuary

Soon Yasir sees a board with 'Pachmarhi Wildlife Sanctuary' written on it.

Prof. Ahmad explains that, like reserve forests, **wildlife sanctuaries** provide protection and suitable living conditions to wild animals. Madhavji further explains that sanctuaries are places where killing (poaching) or capturing of animals is strictly prohibited.

Some of the threatened wild animals like black buck, white eyed buck, elephant, golden cat, pink headed duck, *gharial,* marsh crocodile, python, rhinoceros, etc. are protected and preserved in our wild life sanctuaries. Indian sanctuaries have unique landscapes—broad level forests, mountain forests and bush lands in deltas of big rivers.

It is a pity that even protected forests are not safe because people living in the neighbourhood encroach upon them and destroy them.

Children are reminded of their visit to the zoo. They recall that zoos are also places where animals receive protection.

What is the difference between a zoo and a wildlife sanctuary?

Activity 3.7

Visit a nearby zoo. Observe the conditions provided to the animals. Were they suitable for the animals? Can animals live in artificial setting instead of their natural habitat? In your opinion, will the animals be comfortable in a zoo or in their natural habitat?

Do you know the wild life Sancturies and National Park of J&K State

1. Dachigam Wild Life Sanctuary : It is situated 21 km away from Srinagar and is home to the endangered Hangul Species of the Deer in the country. Other animals found in this sanctuary are : black/brown beer, musk deer, leopards and migratory birds.

2. Surinsar- Mansar Wild Life Sanctuary : It is situated at 42 km from Jammu. Goral, wil boar, barking deer and leopards are common here. A number of bird species like black partridge, red jungle fowl, pea fowl, grey partridge, green pigeon etc are also found.

3. Ramnagar Wild Life Sanctuary : Named after Ramnagar ridge, the sanctuary is spread over 12.75 sq. Km on the northern side of Jammu city. The most common animals found here are neel gai, barking deer and rhesus monkey. This sanctuary also supports indian mynah, blue rock pigeon, red jugle fowl, jungle crow and cheeked bulbul.

4. Overa Wild Life Sanctuary : This sanctuary harbours a variety of mammals like hangal, musk deer, serow, langur, leopard etc. A variety of birds are found here viz chakur, koklas, monal and Himalayan snow cocks etc.

5. Kishtwar High altitude National Park : It contains about 15 mammal species including the musk deer and Himalayan black and brown beer, and some species of birds.

Besides there following areas stand declared as wild life sanctuaries :

1. Jasrota Wild Life Sanctuary : The sanctuary is located on the right bank of river Ujh and is spread over 10.4 sq. Km.

2. Nandni Wild Life Sanctuary : It occupies the south western slopes of Nandni along Jammu - Srinagar highway. It is spread over 13.50 sq. Km

3- Trikuta Wild Life Sanctuary : The sanctuary is named after famous Trikuta hills where Shri Mata Vaishno Devi Shrine is located.

3.8 National Park

On the roadside there was another board on which was written 'Satpura National Park'.

Children are now eager to go there. Madhavji tells them that these reserves are large and diverse enough to protect whole sets of ecosystems. They preserve flora, fauna, landscape and historic objects of an area. Satpura National Park is the first Reserve Forest of India. The finest Indian teak is found in this forest.

Rock shelters are also found inside the Satpura National Park. These are the prehistoric evidences of human life in these jungles. They give us an idea of the life of the primitive people.

Rock paintings are found in these shelters. A total of 55 rock shelters have been identified in Pachmarhi Biosphere Reserve.

Figures of animals and men fighting, hunting, dancing, and playing musical instruments are depicted in these paintings. Many tribals still live in the area.

As children move ahead, they see a board with 'Satpura Tiger Reserve' written on it. Madhavji explains that **Project Tiger** was launched by the government to protect the tigers in the country. The objective of this project was to ensure the survival and maintenance of the tiger population in the country.

Are tigers still found in this forest? I hope that I can see a tiger!

Fig. 3.4 : Tiger

Fig. 3.5 : Wild Buffalo

Fig. 3.6 : Barasingha

Tiger **(Fig. 3.4)** is one of the many species which are slowly disappearing from our forests. But, the Satpura Tiger Reserve is unique in the sense that a significant increase in the population of tigers has been seen here. Once upon a time, animals like lions, elephants, wild buffaloes **(Fig. 3.5)** and barasingha **(Fig. 3.6)** were also found in the Satpura National Park. Animals whose numbers are diminishing to a level that they might face extinction are known as the **endangered animals**. Yasir is reminded of the dinosaurs which became extinct a long time ago. Survival of some animals has become difficult because of disturbances in their natural habitat.

Endangered Animals of J & K State

Due to habitat loss, pouching and over exploitation, many animals have become endangered, most notable being pheasants and Deers. Following birds and mammals of J&K state are most endangered at present and need conservation measure on war footing :

1. Monal Pheasant - Neel.
2. Koklas Pheasant - Makk- Makau
3. Western Horned Pheasant - Bindus
4. Indian Panglin
5. Musk Deer
6. Barking Deer
7. Himalayan Brown Beer
8. Himalayan Ibex
9. Kashmir Stag (Hangul)
10. Red Fox
11. Common Leopard and Snow Leopard
12. Indian Wolf.

Are only big animals facing the extinction?

Madhavji tells Yasir that small animals are much more in danger of becoming extinct than the bigger animals. At times, we kill snakes, frogs, lizards, bats and owls ruthlessly without realising their importance in the ecosystem. By killing them we are harming ourselves. They might be small in size but their role in the ecosystem cannot be ignored. They form part of food chains and food webs.

An **ecosystem** is made of all the plants, animals and microorganisms in an area along with non-living components such as climate, soil, river deltes, etc.

I wonder if there is any record of the endangered species!

3.9 Red Data Book

Prof. Ahmad explains about Red Data Book to the children. He tells them that **Red Data Book** is the source book which keeps a record of all the endangered animals and plants. There are different Red Data Books for plants, animals and other species. (For further details about Red Data Book, you can log on to *www.wil.gov.in/envis/primates/page102htm/new/nwdc/plants.htm*)

3.10 Migration

The excursion party then enters deeper into the forest under the guidance of Madhavji. They sit near the Tawa Reservoir to relax for

What would happen if we had no wood? Is there any alternative available for wood? I know that paper is one of the important products we get from forests. I wonder whether there are any alternatives available for paper!

some time. Arif observes some of the birds near the river. Madhavji tells the children that these are the migratory birds. These birds have flown here from other parts of the world.

Migratory birds fly to far away areas every year during a particular time because of climatic changes. They fly for laying eggs as the weather in their natural habitat becomes very cold and inhospitable. Birds who cover long distances to reach another land are known as the migratory birds.

3.11 Recycling of Paper

Prof. Ahmad draws the attention of the children to another cause of deforestation. He tells them that it takes 17 full grown trees to make one tonne of paper. Therefore, we should save paper. Prof. Ahmad also tells that paper can be recycled five to seven times for use. If each student saves at least one sheet of paper in a day, we can save many trees in a year. We should save, reuse used paper and recycle it. By this we not only save trees but also save energy and water needed for manufacturing paper. Moreover, the amount of harmful chemicals used in paper making will also be reduced.

Is there any permanent solution to the problem of deforestation?

3.12 Reforestation

Prof. Ahmad suggests that the answer to deforestation is reforestation. Reforestation is restocking of the destroyed forests by planting new trees. The planted trees should generally be of the same species which were found in that forest. We should plant at least as many trees as we cut. Reforestation can take place naturally also. If the deforested area is left undisturbed, it reestablishes itself. In natural reforestation there is no role of human beings. We have already made a tremendous damage to our forests. If we have to retain our green wealth for generations, plantation of more trees is the only option.

Prof. Ahmad told them that in India we have the Forest (Conservation) Act. This act is aimed at preservation and conservation of natural forests and meeting the basic needs of the people living in or near the forests.

After some rest Madhavji asks children to start moving back because it is not advisable to stay back in the jungle after sunset. On getting back, Prof. Ahmad and the children thank Madhavji for guiding them through this exciting experience.

KEYWORDS

BIODIVERSITY

BIOSPHERE RESERVE

DEFORESTATION

DESERTIFICATION

ECOSYSTEM

ENDANGERED SPECIES

ENDEMIC SPECIES

EXTINCT

FAUNA

FLORA

MIGRATORY BIRDS

NATIONAL PARK

RED DATA BOOK

REFORESTATION

SANCTUARY

WHAT YOU HAVE LEARNT

- Wildlife sanctuary, national park and biosphere reserve are names given to the areas meant for conservation and preservation of forest and wild animals.
- Biodiversity refers to the variety of living organisms in a specific area.
- Plants and animals of a particular area are known as the flora and fauna of that area.
- Endemic species are found only in a particular area.
- Endangered species are those which are facing the danger of extinction.
- Red Data Book contains a record of the endangered species.
- Migration is the phenomenon of movement of a species from its own habitat to some other habitat for a particular time period every year for a specific purpose like breeding.
- We should save, reuse and recycle paper to save trees, energy and water.
- Reforestation is the restocking of destroyed forests by planting new trees.

Exercises

1. Fill in the blanks:

(a) A place where animals are protected in their natural habitat is Called _____.

(b) Species found only in a particular area is known as _____.

(c) Migratory birds fly to far away places because of _____changes.

2. Differentiate between the following:

(a) Wildlife sanctuary and biosphere reserve

(b) Zoo and wildlife sanctuary

(c) Endangered and extinct species

(d) Flora and fauna

3. Discuss the effects of deforestation on the following:

(a) Wild animals

(b) Environment

(c) Villages (Rural areas)

(d) Cities (Urban areas)

(e) Earth

(f) The next generation

4. What will happen if:

(a) we go on cutting trees.

(b) the habitat of an animal is disturbed.

(c) the top layer of soil is exposed.

5. Answer in brief:

(a) Why should we conserve biodiversity?

(b) Protected forests are also not completely safe for wild animals. Why?

(c) Some tribals depend on the jungle. How?

(d) What are the causes and consequences of deforestation?

(e) What is Red Data Book?

(f) What do you understand by the term migration?

6. In order to meet the ever-increasing demand in factories and for shelter, trees are being continually cut. Is it justified to cut trees for such projects? Discuss and prepare a brief report.

7. How can you contribute to the maintenance of green wealth of your locality? Make a list of actions to be taken by you.

8. Explain how deforestation leads to reduced rainfall.

9. Find out the information about the national parks in your state. Identify and show their location on the outline map of India.

10. Why should paper be saved? Prepare a list of ways by which you can save paper.

11. Complete the word puzzle:

Down

1. Species on the verge of extinction.

2. A book carrying information about endangered species.

5. Consequence of deforestation.

Across

1. Species which have vanished.

3. Species found only in a particular habitat.

4. Variety of plants, animals and microorganisms found in an area.

Extended Learning - Activities and Projects

1. Plant at least five different plants in your locality during this academic year and ensure their maintenance till they grow.
2. Promise yourself that this year you will gift at least 5 plants to your friends and relatives on their achievements, or on occasions like birthdays. Ask your friends to take proper care of these gifted plants and encourage them to gift five plants to their friends on such occasions. At the end of the year count the plants that have been gifted through this chain.
3. Is it justifiable to prevent tribals from staying in the core area of the forest? Discuss the matter in your class and note down the points for and against the motion in your notebook.
4. Study the biodiversity of a park nearby. Prepare a detailed report with photographs and sketches of flora and fauna.
5. Make a list of the new information you have gathered from this chapter. Which information did you like the most and why?
6. Make a list of various uses of papers. Observe currency notes carefully. Do you find any difference between a currency paper and paper of yournotebook? Find out where currency paper is made.
7. Karnataka Government had launched 'Project Elephant' to save Asian elephants in the state. Find out about this and other such campaigns launched to protect threatened species.

Did You Know?

1. India has more than half of the world's wild tigers, 65% of the Asian elephants, 85% of the great one-horned rhinoceros and 100% of the Asian lions.
2. India is sixth on a list of 12 mega-biodiversity countries in the world. It contains two of the 13 biodiversity hot spots of the world – North-East India and the Western Ghats. These areas are very rich in biodiversity.
3. One of the most important factors that threatens wildlife today is habitat destruction due to encroachment.
4. India contains 172 species of animals considered globally threatened or 2.9% of the worlds total number of threatened species. This includes 53 species of mammals, 69 of birds, 23 of reptiles and 3 species of amphibians. India contains globally important population of some of Asia's rarest animals such as the *Bengal fox*, *Marbled cat*, Asiatic lion, Indian elephant, Asiatic wild ass, Indian rhinoceros, *gaur*, Wild asiatic water buffalo, etc.

For knowing more, you may contact:

Ministry of Environment and Forests, Govt. of India Environment, Forest and Wildlife Department Paryavaran Bhavan, CGO Complex, Block – B, Lodhi Road, New Delhi – 110003, Website : http:/envfor.nic.in

Project Tiger : www.kidsfortigers.org/raisingtigers/projecttiger.php

Biodiversity Hotspots : www.biodiversityhotspots.org

CHAPTER - 4

REPRODUCTION IN ANIMALS

You might know the processes of digestion, circulation and respiration. These processes are essential for the survival of every individual. You might also know about the process of reproduction in plants. Reproduction is essential for the continuation of a species. Imagine what would have happened if organisms had not reproduced. You will realise that reproduction is very important as it ensures the continuation of similar kinds of individuals, generation after generation.

In this chapter, we shall learn how reproduction takes place in animals.

4.1 Modes of Reproduction

Have you seen the young ones of different animals? Try to name some of the young ones by completing **Table 4.1** as shown in examples at S. No. 1 to 7.

Table 4.1

S. No.	Animal	Young one
1.	Human	Baby
2.	Cat	
3.	Dog	
4.	Butterfly	
5.	Hen Chick	
6.	Cow	
7.	Frog	

You must have also seen the young ones of various animals being born. Can you tell how chicks and caterpillars are born? How are kittens and puppies born? Do you think that these young ones looked the same before they were born ? Let us find out.

Just as in plants, there are two modes by which animals reproduce. These are:

(i) Sexual reproduction, and

(ii) Asexual reproduction.

4.2 Sexual Reproduction

You know that plants that reproduce sexually have male and female reproductive parts. Can you name these parts? In animals also, males and females have different reproductive parts or organs. Like plants, the reproductive parts in animals also produce gametes that fuse to form a zygote. It is the zygote which develops into a new individual.

This type of reproduction beginning from the fusion of male and female gametes is called **sexual reproduction**. Let us find out the reproductive parts in humans and study the process of reproduction in them.

Male Reproductive Organs

The male reproductive organs include a pair of testes (singular, testis), two sperm ducts and a penis **(Fig. 4.1)**. The testes produce the male gametes called **sperms**. Millions of sperms are produced by the testes. Look at **Fig. 4.2** which shows the picture of a sperm.

Though sperms are very small in size, each has a head, a middle piece and a tail. Does it appear to be a single cell? Indeed, each sperm is a single cell with all the usual cell components.

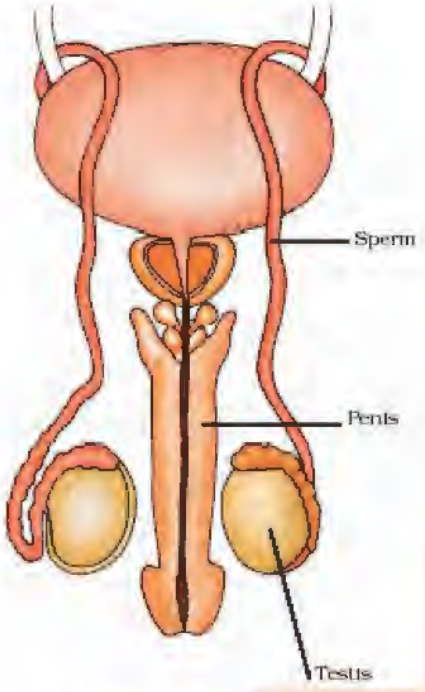


Fig. 4.1: Male Reproductive Organs in Humans

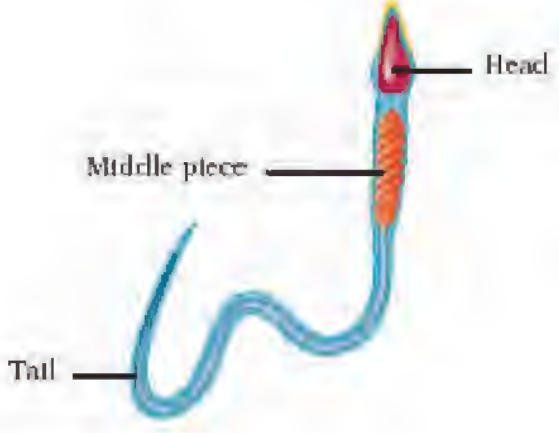


Fig. 4.2 : Human Sperm

What purpose does the tail in a sperm serve?

Female Reproductive Organs

The female reproductive organs are a pair of ovaries, oviducts (fallopian tubes) and the uterus (**Fig. 4.3**). Ovary produces female gametes called **ova** (eggs) **Fig.4.4).**

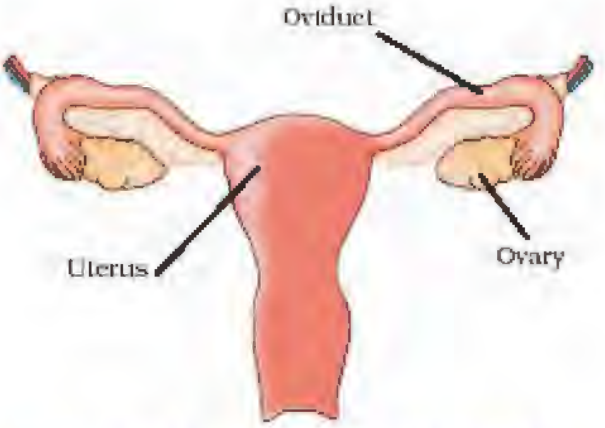


Fig. 4.3 : Female Reproductive Organs in Humans

In human beings, a single matured egg is released into the oviduct by one of the ovaries every month. Uterus is the part where development of the baby takes place. Like the sperm, an egg is also a single cell.

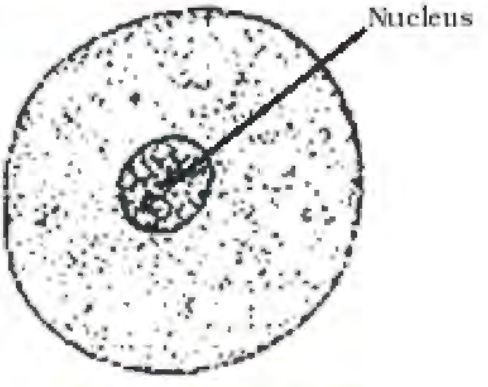


Fig. 4.4 : Human Ovum

Yasir recalls that the size of eggs in animals varies. The egg may be very small as in humans, much larger as in hens. Ostrich egg is the largest!

Fertilization

The first step in the process of reproduction is the fusion of a sperm and an ovum. When sperms come in contact with an egg, **one of the sperms** may fuse with the egg. Such fusion of the egg and the sperm is called

fertilization (Fig. 4.5). During fertilization, the nuclei of the sperm and the egg fuse to form a single nucleus. This results in the formation of a fertilized egg or **zygote (Fig. 4.6)**.

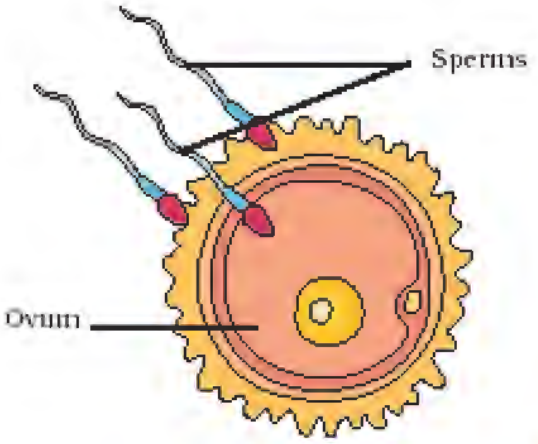


Fig. 4.5 : Fertilization

Did you know that the zygote is the beginning of a new individual?

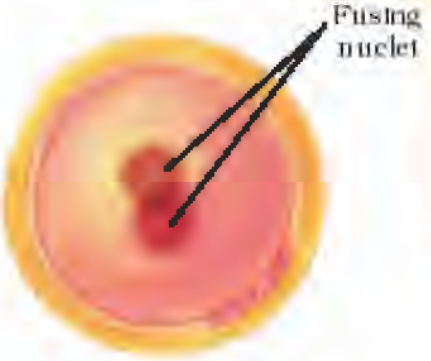


Fig. 4.6 : Zygote

The process of fertilization is the meeting of an egg cell from the mother and a sperm cell from the father. So, the new individual inherits some characteristics from the mother and some from the father. Look at your brother or sister. See if you can recognise some characters in them similar to those of your mother or your father.

Fertilization which takes place inside the female body is called **internal fertilization**. Internal fertilization occurs in many animals including humans, cows, dogs and hens.

Have you heard of test tube babies?

Yasir and Saba's teacher once told them in the class that in some women oviducts are blocked. These women are unable to bear babies because sperms cannot reach the egg for fertilization. In such cases, doctors collect freshly released egg and sperms and keep them together for a few hours for **IVF** or **in vitro fertilization** (fertilization outside the body). In case fertilization occurs, the zygote is allowed to develop for about a week and then it is placed in the mother's uterus. Complete development takes place in the uterus and the baby is born like any other baby. Babies born through this technique are called **test-tube babies**. This term is actually misleading because babies cannot grow in test tubes.

You will be surprised to know that in many animals fertilization takes place outside the body of the female. In these animals, fertilization takes place in water. Let us find out how this happens.

Activity 4.1

Visit some ponds or slow-flowing streams during spring or rainy season. Look out for clusters of frog's eggs floating in water. Write down the colour and size of the eggs.

During spring or rainy season, frogs and toads move to ponds and slow-flowing streams. When the male and female come together in water, the female lays hundreds

of eggs. Unlike hen's egg, frog's egg is not covered by a shell and it is comparatively very delicate. A layer of jelly holds the eggs together and provides protection to the eggs **(Fig. 4.7)**.

Fig. 4.7 : Eggs of Frog

As the eggs are laid, the male deposits sperms over them. Each sperm swims randomly in water with the help of its long tail. The sperms come in contact with the eggs. This results in fertilization. This type of fertilization in which the fusion of a male and a female gamete takes place outside the body of the female is called **external fertilization.** It is very common in aquatic animals such as fish, starfish, etc.

Why do fish and frogs lay eggs in hundreds whereas a hen lays only one egg at a time?

Though these animals lay hundreds of eggs and release millions of sperms, all the eggs do not get fertilized and develop into new individuals.

This is because the eggs and sperms get exposed to water movement, wind and rainfall.

Also, there are other animals in the pond which may feed on eggs. Thus, production of large number of eggs and sperms is necessary to

ensure fertilization of at least a few of them.

How could a single cell become such a big individual?

Development of Embryo

Fertilization results in the formation of zygote which begins to develop into an embryo **[Fig. 4.8(a)]**. The zygote divides repeatedly to give rise to a ball of cells **[Fig. 4.8(b)]**. The cells then begin to form groups that develop into different tissues and organs of the body. This developing structure is termed an **embryo**. The embryo gets embedded in the wall of the uterus for further development **[Fig.4.8(c)]**.

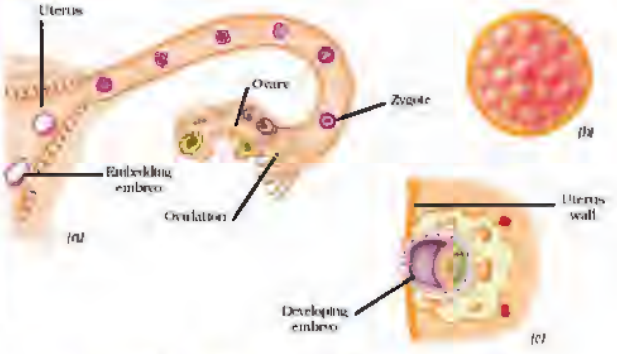


Fig. 4.8 : (a) Zygote Formation and Development of an Embryo from the Zygote; (b) Ball of Cells (Enlarged); (c) Embedding of the Embryo in the Uterus (Enlarged)

The embryo continues to develop in the uterus. It gradually develops the body parts such as hands, legs, head, eyes, ears, etc. The stage of the embryo in which all the body parts can be identified is called a **foetus (Fig. 4.9)**. When the development of the foetus is complete, the mother gives

birth to the baby.

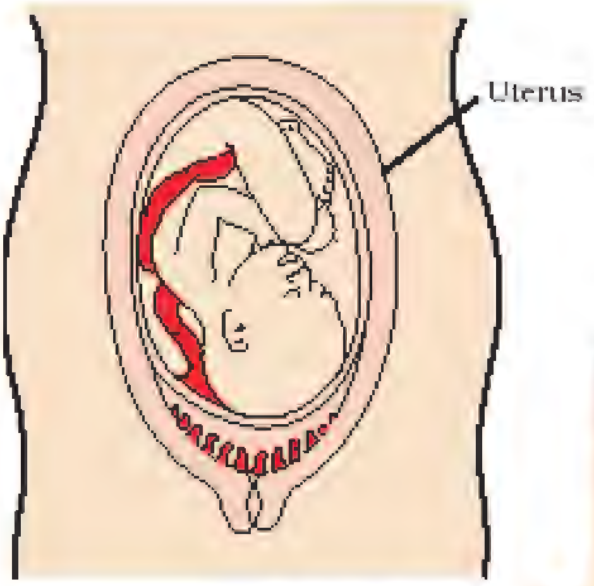


Fig.4.9 : Foetus in the Uterus

Internal fertilization takes place in hens also. But, do hens give birth to babies like human beings and cows? You know that they do not. Then, how are chicks born? Let us find out.

Soon after fertilization, the zygote divides repeatedly and travels down the oviduct. As it travels down, many protective layers are formed around it. The hard shell that you see in a hen's egg is one such protective layer.

After the hard shell is formed around the developing embryo, the hen finally lays the egg. The embryo takes about 3 Weeks to develop into a chick. You must have seen the hen sitting on the eggs to provide sufficient warmth. Did you know that development of the chick takes place inside the egg shell during this period? After the chick is completely developed it bursts open the egg shell.

In animals which undergo external fertilization, development of the embryo takes place outside the female body. The embryos continue to grow within their egg coverings. After the embryos develop, the eggs hatch. You must have seen numerous tadpoles swimming in ponds and streams.

Viviparous and Oviparous Animals

We have learnt that some animals give birth to young ones while some animals lay eggs which later develop into young ones. The animals which give birth to young ones are called **viviparous** animals. Those animals which lay eggs are called **oviparous** animals. The following activity will help you understand better and differentiate between viviparous and oviparous animals.

Activity 4.2

Try to collect eggs of the following organisms – frog, lizard, butterfly or moth, hen and crow or any other bird. Were you able to collect eggs of all of them? Make drawings of the eggs that you have collected.

The eggs of a few animals are easy to collect because their mothers lay them outside their bodies. These animals from which you have collected the eggs are examples of oviparous animals. But you would not be able to collect the eggs of a dog, cow or cat. This is because they do not lay eggs. The mother gives birth to the young ones. These are examples of viviparous animals.

Can you now give some more examples of viviparous and oviparous animals?

Young Ones to Adults

The new individuals which are born or

hatched from the eggs continue to grow till they become adults. In some animals, the young ones may look very different from the adults. Let us consider the life cycle of Frog **(Fig. 4.10)**.

Observe the different stages of frog starting from the egg to the adult stage. We find that there are three distinct stages, that is, egg - tadpole (larva) - adult. Don't the tadpoles look so different from the adults? Can you imagine that these tadpoles would some day become frogs? Similarly, the caterpillar or the pupa of silkworm looks very different from the adult moth. The features that are present in the adult are not found in their young ones. Then what happens to the tadpoles or caterpillars thereafter?

You must have seen a beautiful moth emerging out of the cocoon. In the case of tadpoles, they transform into adults capable of jumping and swimming. The transformation of the larva into an adult through drastic changes is called **metamorphosis**. What about the changes that we observe in our body as we grow? Do you think we too undergo metamorphosis? In human beings, body parts similar to those present in the adults are present from the time of the birth.

4.3 Asexual Reproduction

So far, we have learnt about reproduction in some familiar animals. But what about very small animals like hydra and microscopic organisms like amoeba? Do you know how they reproduce? Let us find out.

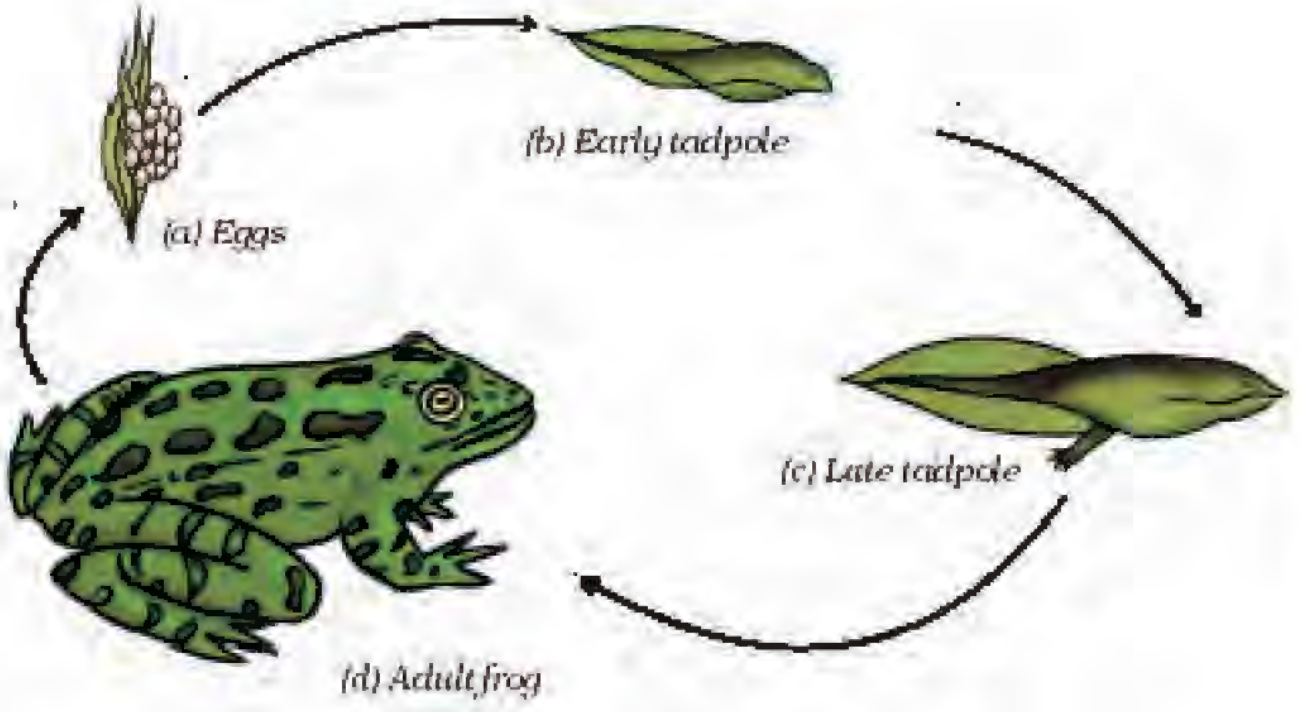


Fig. 4.10 : Life Cycle of Frog

Activity 4.3

Get permanent slides of hydra, Observe them using hand lens or a microscope. Look out for any bulges from the parent body. Count the number of bulges that you see in different slides. Also, note the size of the bulges. Draw the diagram of hydra, as you see it. Compare it with the **Fig. 4.11**.

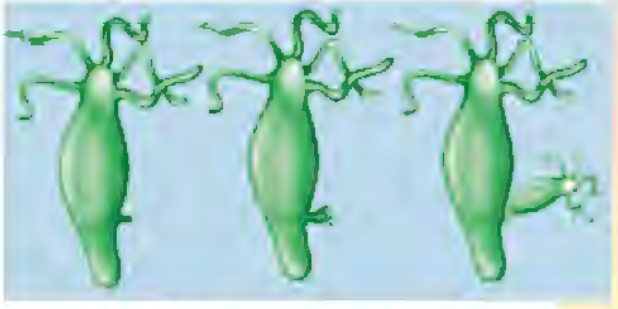


Fig. 4.11 : Budding in Hydra

In each hydra, there may be one or more bulges. These bulges are the developing new individuals and they are called **buds**. Recall the presence of buds in yeast. In hydra too the new individuals develop as outgrowths from a single parent. This type of reproduction in which only a single parent is involved is called **asexual reproduction**. Since new individuals develop from the buds in hydra, this type of asexual reproduction is called **budding**.

Another method of asexual reproduction is observed in the microscopic organism, amoeba. Let us see how this happens.

You have already learnt about the structure of amoeba. You will recall that amoeba is a single-celled organisms **[Fig. 4.12(a)]**. It begins the process of reproduction by the division of its nucleus into two nuclei **[Fig. 4.12(b)]**. This is followed by division of its body into two, each part receiving a nucleus **[Fig.4.12(c)]**. Finally, two amoebae are produced from one parent amoeba **[Fig.4.12(d)]**. This type of asexual reproduction in which an animal reproduces by dividing into two individuals is called **binary fission**.

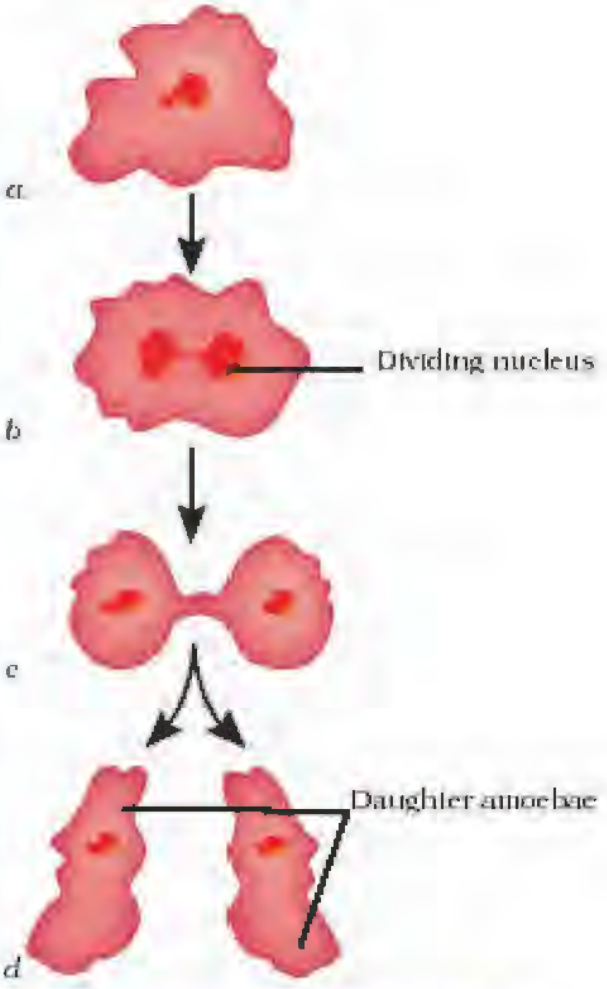


Fig. 4.12 : Binary Fission in Amoeba

Apart from budding and binary fission, there are other methods by which a single parent reproduces the young ones. You will study about these in your higher classes.

Story of Dolly, the Clone

Cloning is the production of an exact copy of a cell, any other living part, or a complete organism. Cloning of an animal was successfully performed for the first time by Ian Wilmut and his colleagues at the Roslin Institute in Edinburgh, Scotland. They cloned successfully a sheep named Dolly **[Fig.4.13 (c)]**. Dolly was born on 5th July 1996 and was the first mammal to be cloned.

(a) Finn Dorsett Sheep *(b) Scottish Blackface Ewe* *(c) Dolly*

Fig. 4.13

During the process of cloning Dolly, a cell was collected from the mammary gland of a female Finn Dorsett Sheep **[Fig. 4.13 (a)]**. Simultaneously, an egg was obtained from a Scottish Blackface Ewe **[Fig.4.13 (b)]**. The nucleus was removed from the egg. Then, the nucleus of the mammary gland cell from the Finn Dorsett ***S***heep was inserted into the egg of the Scottish Blackface Ewe whose nucleus had been removed. The egg thus produced was implanted into the Scottish Blackface Ewe. Development of this egg followed normally and finally Dolly was born. Though Dolly was given birth by the Scottish Blackface Ewe, it was found to be absolutely identical to the Finn Dorsett ***S***heep from which the nucleus was taken. Since the nucleus from the egg of the Scottish Blackface Ewe was removed, Dolly did not show any character of the Scottish Blackface Ewe. Dolly was a healthy clone of the Finn Dorsett ***S***heep and produced several offspring of her own through normal sexual means. Unfortunately, Dolly died on 14th February 2003 due to a certain lung disease.

Since Dolly, several attempts have been made to produce cloned mammals. However, many die before birth or die soon after birth. The cloned animals are many-a-time found to be born with severe abnormalities.

KEYWORDS

ASEXUAL REPRODUCTION
BINARY FISSION
BUDDING
EGGS
EMBRYO
EXTERNAL FERTILIZATION
FERTILIZATION
FOETUS
INTERNAL FERTILIZATION
METAMORPHOSIS
OVIPAROUS ANIMALS
SEXUAL REPRODUCTION
SPERMS
VIVIPAROUS ANIMALS
ZYGOTE

WHAT YOU HAVE LEARNT

- There are two modes by which animals reproduce. These are: (i) Sexual reproduction, and (ii) Asexual reproduction.
- Reproduction resulting from the fusion of male and female gametes is called sexual reproduction.
- The reproductive organs in the female include ovaries, oviducts and uterus.
- The reproductive organs in male include testes, sperm ducts and penis.
- The ovary produces female gametes called ova and the testes produce male gametes called sperms.
- The fusion of ovum and sperm is called fertilization. The fertilized egg is called a zygote.
- Fertilization that takes place inside the female body is called internal fertilization. This is observed in human beings and other animals such as hens, cows and dogs.
- Fertilization that takes place outside the female body is called external fertilization. This is observed in frogs, fish, starfish, etc.
- The zygote divides repeatedly to give rise to an embryo.
- The embryo gets embedded in the wall of the uterus for further development.
- The stage of the embryo in which all the body parts are identifiable is called foetus.
- Animals such as human beings, cows and dogs which give birth to young ones are called viviparous animals.
- Animals such as hen, frog, lizard and butterfly which lay eggs are called oviparous animals.
- The transformation of the larva into adult through drastic changes is called metamorphosis.
- The type of reproduction in which only a single parent is involved is called asexual reproduction.
- In hydra, new individuals develop from buds. This method of asexual reproduction is called budding.
- Amoeba reproduces by dividing itself into two. This type of asexual reproduction is called binary fission.

Exercises

1. Explain the importance of reproduction in organisms.
2. Describe the process of fertilization in human beings.

3. Choose the most appropriate answer:

(a) Internal fertilization occurs

(i) in female body.

(ii) outside female body.

(iii) in male body.

(iv) outside male body.

(b) A tadpole develops into an adult frog by the process of

(i) fertilization. (ii) metamorphosis. (iii) embedding. (iv) budding.

(c) The number of nuclei present in a zygote is

(i) none. (ii) one. (iii) two. (iv) four.

4. Indicate whether the following statements are True (T) or False (F):

(a) Oviparous animals give birth to young ones. ( )

(b) Each sperm is a single cell. ( )

(c) External fertilization takes place in frog. ( )

(d) A new human individual develops from a cell called gamete. ( )

(e) Egg laid after fertilization is made up of a single cell. ( )

(f) Amoeba reproduces by budding. ( )

(g) Fertilization is necessary even in asexual reproduction. ( )

(h) Binary fission is a method of asexual reproduction. ( )

(i) A zygote is formed as a result of fertilization. ( )

(j) An embryo is made up of a single cell. ( )

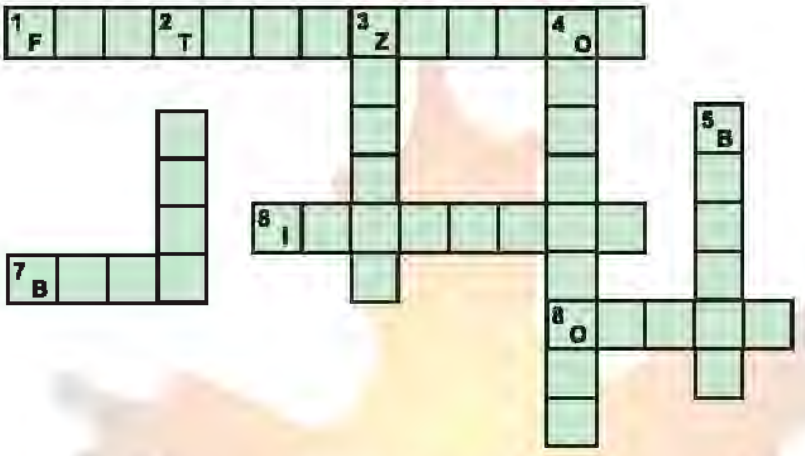
5. Give two difference between a zygote and a foetus.
6. Define asexual reproduction. Describe two methods of asexual reproduction in animals.
7. In which female reproductive organ does the embryo get embedded?
8. What is metamorphosis? Give examples.
9. Differentiate between internal fertilization and external fertilization.
10. Complete the cross-word puzzle using the hints given below Across

1. The process of the fusion of the gametes.
6. The type of fertilization in hen.
7. The term used for bulges observed on the sides of the body of Hydra.
8. Eggs are produced here.

Down

2. Sperms are produced in these male reproductive organs.
3. Another term for the fertilized egg.
4. These animals lay eggs.
5. A type of fission in amoeba.

Extended Learning — Activities and Projects



1. Visit a poultry farm. Talk to the manager of the farm and try to find out the answers to the following:

   (a) What are **layers** and **broilers** in a poultry farm?

   (b) Do hens lay unfertilized eggs?

   (c) How can you obtain fertilized and unfertilized eggs?

   (d) Are the eggs that we get in the stores fertilized or unfertilized?

   (e) Can you consume fertilized eggs?

   (f) Is there any difference in the nutritional value of the fertilized and unfertilized eggs?

2. Observe live hydra yourself and learn how they reproduce by doing the following activity:

   During the summer months collect water weeds from ponds or ditches along with the pond water and put them in a glass jar.

   After a day or so you may see several hydra clinging to the sides of the jar. Hydra is transparent, jelly-like and with tentacles. It clings to the jar with the base of its body. If the jar is shaken, the hydra will contract instantly into a small blob, at the same time drawing its tentacles in.

   Now take out few hydras from the jar and put them on a watch glass. Using a hand lens or a binocular or dissection microscope, observe the changes that are taking place in their body. Note down your observations.

3. The eggs we get from the market are generally the unfertilized ones. In case you wish to observe a developing chick embryo, get a fertilized egg from the poultry or hatchery which has been incubated for 36 hours or more. You may then be able to see a white disc-like structure on the yolk. This is the developing embryo. Sometimes if the heart and blood vessels have developed you may even see a red spot.
4. Talk to a doctor. Find out how twinning occurs. Look for any twins in your neighbourhood, or among your friends. Find out if the twins are identical or non-identical. Also find out why identical twins are always of the same sex? If you know of any story about twins, write it in your own words. You could visit the following website for information on twins:

www.keepkidshealthy.com/twins/expecting_twins.html.
For more information on animal reproduction, you can visit :
www.saburchill.com/chapters/chap0031.html
healthhowstuffworks.com/human-reproduction.htm
www.teenshealth.org/teen/sexual_health

Did You Know?

An interesting organisation is observed in a honey bee hive, a colony of several thousand bees. Only one bee in the colony lays eggs. This bee is called the queen bee. All other female bees are worker bees. Their main job is to build the hive, look after the young and feed the queen bee adequately to keep her healthy so that she could lay eggs. A queen bee lays thousands of eggs. The fertilized eggs hatch into females, while the unfertilized eggs give rise to males, called drones. It is the job of the worker bees to maintain the temperature of the hive around 35°C to incubate the eggs. other organisms while others exist freely. Microorganisms like *amoeba* can live alone, while fungi and bacteria may live in colonies.

CHAPTER - 5

SOUND

How do you come to know that a 'period' is over in your school? You come to know easily that someone is at your door when he knocks or you hear the sound of the doorbell. Most of the time you can make out that someone is approaching you by just hearing the foot steps.

You might have played a game called hide and seek. In this game a person is blind-folded and has to catch the remaining players. How is the blindfolded person able to guess which player is closest to her?

Sound plays an important role in our life. It helps us to communicate with one another. We hear a variety of sounds in our surroundings.

Make a list of sounds you hear in your surroundings.

In the music room of your school you hear the sounds made by musical instruments like flute, tabla, harmonium etc. **(Fig 5.1)**. How is sound produced? How does it travel from one place to another? How do we hear sound? Why are some sounds louder than others? We shall discuss such questions in this chapter.

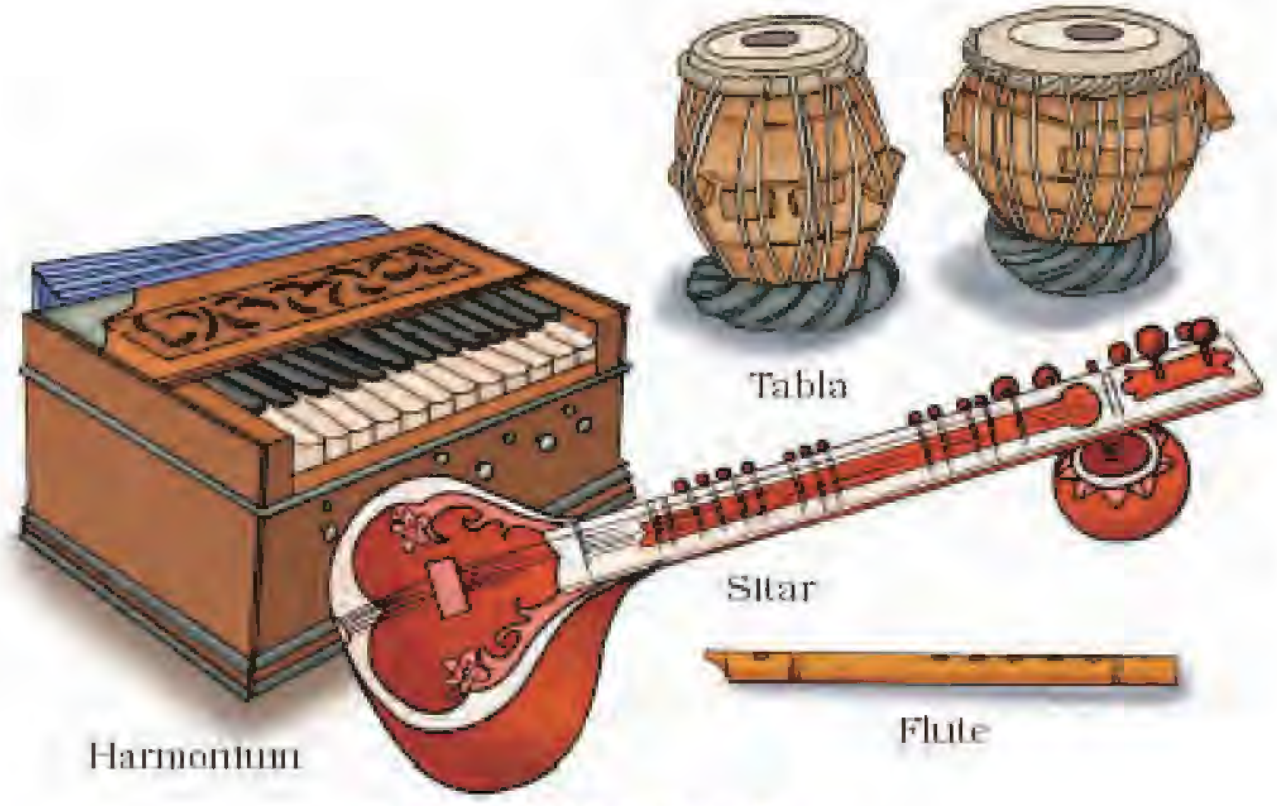


Fig. 5.1 : Some Musical Instruments

5.1 Sound is Produced by a Vibrating Body

Touch the school bell when not in use. What do you feel? Again touch it when producing sound. Can you feel it vibrating?

Activity 5.1

Take a metal plate (or a shallow frying pan). Hang it at a convenient place in such a way that it does not touch any wall. Now strike it with a stick **(Fig.5.2)**. Touch the plate or pan gently with your finger. Do you feel the vibrations?

Fig. 5.2 : Striking a Trying Pan

Again strike the plate with the stick and hold it tightly with your hands immediately after striking. Do you still hear the sound? Touch the plate after it stops producing sound. Can you feel the vibrations now?

Activity 5.2

Take a rubber band. Put it around the longer side of a pencil box **(Fig. 5.3)**. Insert two pencils between the box and the stretched rubber. Now, pluck the rubber band somewhere in the middle. Do you hear any sound? Does the band vibrate?

Fig. 13.3 : Plucking the Rubber Band

As you know, the to and fro or back and forth motion of an object is termed as **vibration.** When a tightly stretched band is plucked, it vibrates and produces sound. When it stops vibrating, it does not produce any sound.

Activity 5.3

Take a metal dish. Pour water in it. Strike it at its edge by a spoon **(Fig.5.4)**. Do you hear a sound? Again strike the plate and then touch it. Can you feel the dish

Fig. 5.4 : Vibrating Plate Produces Waves in Water

vibrating? Strike the dish again. Look at the surface of water. Do you see any waves there? Now hold the dish. What change do you observe on the surface of water? Can you explain the change? Is there a hint to connect sound with the vibrations of a body?

We see that a vibrating object produces sound. In some cases, the vibrations are easily visible to us. But in most cases, their amplitude is so small that we cannot see them. However, we can feel them.

Activity 5.4

Take a hollow coconut shell and make a musical instrument *Ektara*. You can also make it with the help of an earthen pot **(Fig. 5.5)**. Play this instrument and identify its vibrating part.

Fig. 5.5 : Ektara

Make a list of familiar musical instruments and identify their vibrating parts. A few examples are given in **Table 5.1.**

Table 5.1 : Musical Instruments and their Vibrating Parts.

S.No.	Musical Instrument	Vibrating part producing sound
1.	Veena	Stretched string
2.	Tabla	Stretched membrane
3.	Flute	Air-column
4.		
5.		
6.		
7.		

Many of you might have seen the manjira (cymbals), the ghatam **(Fig. 5.6)** and the noot (mudpots) and the kartal. These instruments are commonly used in many parts of our country. These musical instruments are simply beaten or struck. Can you name a few other musical instruments of this type?

You, too can make a musical instrument.

Ghatam

Manjira

Fig. 5.6 : A Few More Musical Instruments

Activity 5.5

Take 6-8 metal bowls or tumblers. Fill them with water up to different levels, increasing gradually from one end to the other. Now take a pencil and strike the bowls gently. Strike all of them in succession. You will hear a pleasant sound. This is your *Jaltrang* **(Fig.5.7).**

Fig. 5.7 : Jaltrang

When we pluck the string of an instrument, like the sitar, the sound that we hear is not only that of the string. The whole instrument is forced to vibrate, and it is the sound of the vibration of the instrument that we hear. Similarly, when we strike the membrane of a mridangam, the sound that we hear is not only that of the membrane but of the whole body of the instrument.

When we speak, does any part of our body vibrate?

5.2 Sound Produced by Humans

Speak loudly for a while or sing a song, or buzz like a bee. Put your hand on your throat as shown in **Fig.5.8**. Do you feel any vibrations?

In humans, the sound is produced by the **voice box** or the **larynx**. Put your fingers on the throat and find a hard bump that seems to move when you swallow. This part of the body is known as the voice box. It is at the upper end of the **windpipe. Two vocal cords,** are stretched across the voice box or larynx in such a way that it leaves a narrow slit between them for the passage of air **(Fig.5.8)**.

Fig.5.8 : Voice Box in Humans

When the lungs force air through the slit, the vocal cords vibrate, producing sound. Muscles attached to the vocal cords can make the cords tight or loose. When the vocal cords are tight and thin, the type or quality of voice is different from that when they are loose and thick. Let us see how the vocal cords function.

Activity 5.6

Take two rubber strips of the same size. Place these two pieces one above the other and stretch them tight. Now blow air through the gap between them **[Fig. 5.9(a)]**. As the air blows through the stretched rubber strips,

a sound is produced. You can also take a piece of paper with a narrow slit and hold it between your fingers as shown in **Fig. 13.9 (b)**. Now blow through the slit and listen to the sound. Our vocal cords produce sound in a similar manner.

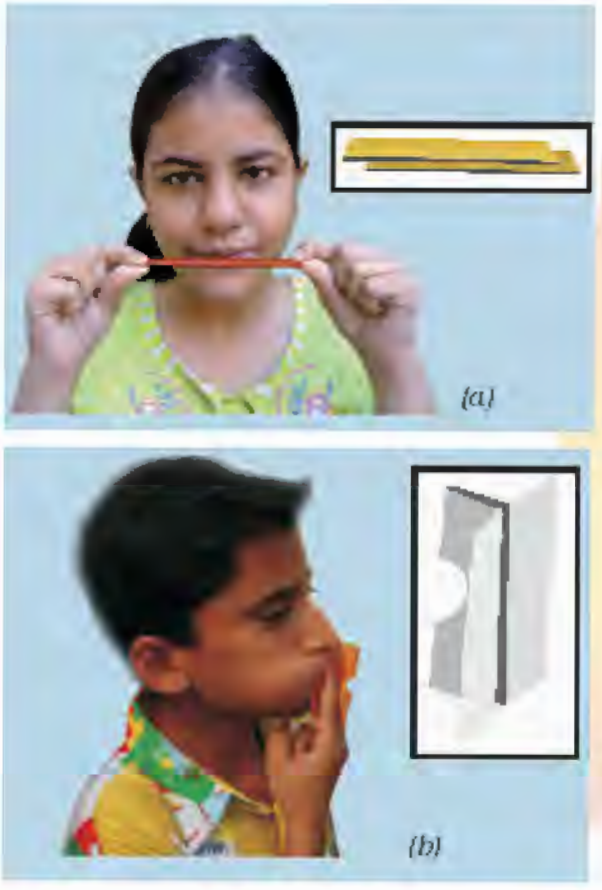


Fig. 5.9 (a), (b) : Working of Vocal Cords

The vocal cords in men are about 20mm long. In women these are about 5mm shorter. Children have very short vocal cords. This is the reason why the voices of men, women and children are different.

5.3 Sound Needs a Medium for Propagation

When you call up your friend who is standing at a distance, your friend is able to hear your voice. How does thesound travel to her?

Activity 5.7

Take a metal glass tumbler. Make sure that it is dry. Place a cell phone in it. (Remember that the cell phone must not be kept in water.) Ask your friend to give a ring on this cell phone from another cell phone. Listen to the ring carefully.

Now, surround the rim of the tumbler with your hands **(Fig. 5.10)**. Put your mouth on the opening between your hands.

Fig. 5.10 : Sound Needs a Medium to Travel

Indicate to your friend to give a ring again. Listen to the ring while sucking air from the tumbler.

Does the sound become fainter as you suck?

Remove the tumbler from your mouth. Does the sound become loud again?

Can you think of an explanation? Is it possible that the decreasing amount of air in the tumbler had something to do with decreasing **loudness** of the ring?

Indeed, if you had been able to suck all the air in the tumbler, the sound would stop completely. Actually, sound needs a medium to travel. When air has been removed completely from a vessel, it is said that there is **vacuum** in the vessel. The sound cannot travel through vacuum.

Does sound travel in liquids? Let us find out.

Activity 5.8

Take a bucket or a bathtub. Fill it with clean water. Take a small bell in one hand. Shake this bell inside the water to produce sound. Make sure that the bell does not touch the body of the bucket or the tub.

Fig. 5.11 : Sound Travelling Through Water

Place your ear gently on the water surface **(Flg.5.11).** (Be careful : water should not enter in your ear). Can you hear the sound of the bell? Does it indicate that sound can travel through liquids?

Oh ! That is how whales and dolphins might be communicating under water.

Let us find out if sound can travel through solids also.

Activity 5.9

Take a metre scale or a long metal rod and hold its one end to your ear. Ask your friend to gently scratch or tap the other end of the scale **(Fig. 5.12).**

Fig.5.12: Sound Travelling Through a Metre Scale

Can you hear the sound of the scratch? Ask your friends around you if they were able to hear the same sound?

You can also perform the above activity by placing your ear at one end of a long wooden or metallic table and asking your friend to gently scratch the other end of the table **(Fig. 5.13).**

Fig. 5.13 : Sound can Travel Through Solids

We find that sound can travel through wood or metal. In fact, sound can travel through any solid. You can perform interesting activities to show that sound can also travel through strings. Recall if you made a toy telephone **(Fig. 5.14).** Can you say that the sound can travel through strings?

Fig.5 .14 : A Toy Telephone

We have learnt so far that vibrating objects produce sound and it is carried in all directions in a medium. How do we hear it?

5.4 How we hear Sound through Ears

The shape of the outer part of the ear is like a funnel. When sound enters in it, it travels down a canal at the end of which a thin membrane is stretched tightly. It is called the **eardrum**. It performs an important function. To understand what the eardrum does, let us build a tin can model of the eardrum.

Activity 5.10

Take a tin can. Cut its ends. Stretch a piece of rubber balloon across one end of the can and fasten it with a rubber band. Put four or five grains of dry cereal on the stretched rubber. Now ask your friend to speak "Hurrey, Hurrey" from the open end **(Fig.5.15)**. Observe what happens to the grain. Why do the grains jump up and down?

Fig. 5.15 : Tin Can Eardrum

The eardrum is like a stretched rubber sheet. Sound vibrations make the eardrum vibrate **(Fig. 5.16)**. The eardrum sends vibrations to the inner ear. From there, the signal goes to the brain. That is how we hear.

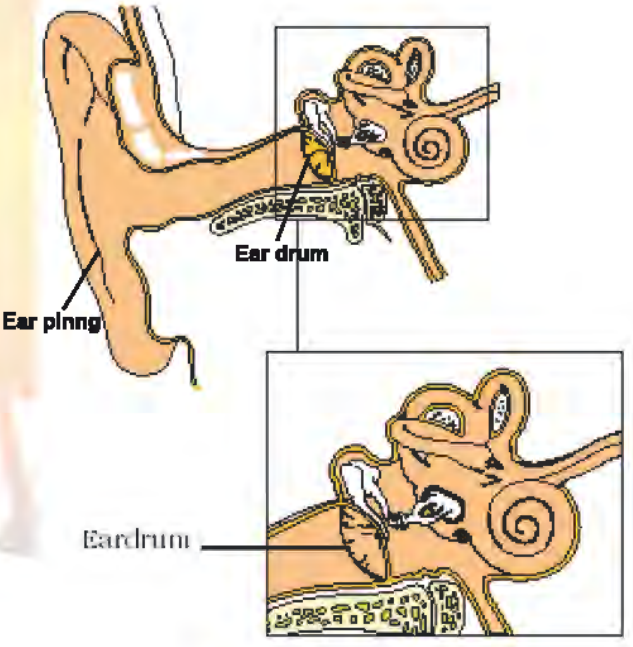


Fig. 5.16 : Human Ear

We must NEVER put a sharp, pointed or hard thing into our ear. It can damage the eardrum. The damaged eardrum can impair hearing.

5.5 Amplitude, Time Period and Frequency of a Vibration

We have learnt that the to and fro motion of an object is known as vibration. This motion is also called **oscillatory motion**. You have

already learnt in earlier classes about the oscillatory motion and its time period.

The number of **oscillations** per second is called the frequency of oscillation. Frequency is expressed in **hertz**. Its symbol is Hz. A frequency of 1 Hz is one oscillation per second. If an object oscillates 20 times in one second, what would be its frequency?

You can recognise many familiar sounds without seeing the objects producing them. How is it possible? These sounds must be different to enable you to recognise them. Have you ever thought what factors make them different? **Amplitude** and frequency are two important properties of any sound. Can we differentiate sounds on the basis of their amplitudes and frequencies?

Loudness and Pitch

Activity 5.11

Take a metallic tumbler and a tablespoon. Strike the tablespoon gently at the brim of the tumbler.

Fig. 5.17 : Thermocole Ball Touching the Vibrating Glass Tumbler

Hear the sound produced. Now bang the spoon on the tumbler and hear the sound produced again. Is the sound louder when the tumbler is struck hard?

Now suspend a small thermocole ball touching the rim of the tumbler **(Fig. 5.17)**. Vibrate the tumbler by striking it. See how far the ball is displaced. The displacement of the ball is a measure of the amplitude of vibration of the tumbler.

Now, strike the tumbler gently and then with some force. Compare the amplitudes of vibrations of the tumbler in the two cases. In which case is the amplitude larger?

Loudness of sound is proportional to the square of the amplitude of the vibration producing the sound. For example, if the amplitude becomes twice, the loudness increases by a factor of 4. The loudness is expressed in a unit called decibel (dB). The following table gives some idea of the loudness of sound coming from various sources.

Normal breathing	10 dB
Soft whisper (at 5m)	30 dB
Normal conversation	60 dB
Busy traffic	70 dB
Average factory	80 dB

Above 80 dB the noise becomes physically painful.

The loudness of sound depends on its amplitude. When the amplitude of vibration is large, the sound produced is loud. When the amplitude is small, the sound produced is feeble.

Compare the sound of a baby with that of an adult. Is there any difference? Even if two sounds are equally loud, they differ in some way. Let us see how.

I wonder why my voice is different from that of my teacher.

The frequency determines the **shrillness** or **pitch** of a sound. If the frequency of vibration is higher we say that the sound is shrill and has a higher pitch. If the frequency of vibration is lower, we say that the sound has a lower pitch. For example, a drum vibrates with a low frequency. Therefore, it produces a low-pitched sound.

Fig. 5.18 : Frequency Determines the Pitch of a Sound

On the other hand, a whistle has a high frequency and therefore, produces a sound of higher pitch **(Fig. 5.18)**. A bird makes a high-pitched sound whereas a lion makes a low-pitched roar.

However, the roar of a lion is very loud while the sound of the bird is quite feeble.

Every day you hear the voices of children and adults. Do you find any difference in their voices? Can you say that the frequency of the voice of a child is higher than that of an adult? Usually the voice of a woman has a higher frequency and is shriller than that of a man.

5.6 Audible and Inaudible Sounds

We know that we need a vibrating body for the production of sound. Can we hear the sound of all vibrating bodies?

The fact is that sounds of frequencies less than about 20 vibrations per second (20 Hz) cannot be detected by the human ear. Such sounds are called inaudible. On the higher side, sounds of frequencies higher than about 20,000 vibrations per second (20 kHz) are also not audible to the human ear. Thus, for human ear, the range of audible frequencies is roughly from 20 to 20,000 Hz.

Some animals can hear sounds of frequencies higher than 20,000 Hz. Dogs have this ability. The police use high frequency whistles which dogs can hear but humans cannot.

The ultrasound equipment, familiar to us for investigating and tracking many medical problems, works at frequencies higher than 20,000 Hz.

5.7 Noise and Music

We hear different types of sounds around us. Is the sound always pleasing? Does a sound sometimes cause discomfort to you? Some sounds are pleasant to the ear, whereas some are not.

Suppose construction work is going on in your neighbourhood. Are the sounds coming from the construction site pleasing? Do you enjoy the sounds produced by horns of buses and trucks? Such unpleasant

sounds are called **noise**. In a classroom, if all the students speak together, what would the sound produced be called?

On the other hand you enjoy sounds from musical instruments. **Musical sound** is one which is pleasing to the ear. Sound produced by a harmonium is a musical sound. The string of a sitar also gives out a musical sound. But, if a musical sound becomes too loud, would it remain melodious?

5.8 Noise Pollution

You already know about air pollution. Presence of unwanted gases and particles in air is called air pollution. Similarly, presence of excessive or unwanted sounds in the environment is called noise pollution. Can you list some sources of noise pollution? Major causes of noise pollution are sounds of vehicles, explosions including bursting of crackers, machines, loudspeakers etc. what sources in the home may lead to noise? Television and transistor radio at high volumes, some kitchen appliances, desert coolers, air conditioners, all contribute to noise pollution.

What are the harms of noise pollution?

Do you know that presence of excessive noise in the surroundings may cause many health related problems. Lack of sleep, hypertension (high blood pressure), anxiety and many more health disorders may be caused by noise pollution. A person who is exposed to a loud sound continuously may get temporary or even permanent impairment of hearing.

Measures to Limit Noise Pollution

To control noise, we must control the sources of noise. How can this be achieved? For this, silencing devices must be installed in air craft engines, transport vehicles, industrial machines and home appliances.

How can the noise pollution be controlled in a residential area?

All noisy operations must be conducted away from any residential area. Noise producing industries should be set up away from such areas. Use of automobile horns should be minimised. TV and music systems should be run at low volumes. Trees must be planted along the roads and around buildings to cut down on the sounds reaching the residents, thus reducing the harmful effects of noise pollution.

Hearing Impairment

The total hearing imparment, which is rare, is usually from birth itself. Partial disability is generally the result of a disease, injury or age. Children with impaired hearing need special care. By learning sign language, such children can communicate effectively. Because speech develops as the direct result of hearing, a child with a hearing loss may have defective speech also. Technological devices for the hearing-impared have made it possible for such persons to improve their quality of life. Society can do much to improve the living environment for the hearing-impaired and help them live normal lives.

KEYWORDS

AMPLITUDE

AUDIBLE

EARDRUM

HERTZ (Hz)

LARYNX

LOUDNESS

NOISE

OSCILLATION

PITCH

SHRILLNESS

TIME PERIOD

VIBRATION

VOICE BOX

WIND PIPE

WHAT YOU HAVE LEARNT

- Sound is produced by vibrating objects.
- In human beings, the vibration of the vocal cords produces sound.
- Sound travels through a medium (gas, liquid or solid). It cannot travel in vacuum.
- The eardrum senses the vibrations of sound, It sends the signals to the brain. This process is called hearing.
- The number of oscillations or vibrations per second is called the frequency of oscillation.
- The frequency is expressed in hertz (Hz).
- Larger the amplitude of vibration, louder is the sound.
- Higher the frequency of vibration, the higher is the pitch, and shriller is the sound.
- Unpleasant sounds are called noise.
- Excessive or unwanted sounds lead to noise pollution. Noise pollution may pose health problems for human beings.
- Attempts should be made to minimise noise pollution.
- Plantation on the roadside and elsewhere can reduce noise pollution.

Exercises

Choose the correct answer :

1. Sound can travel through

   (a) gases only (b) solids only

   (c) liquids only (d) solids, liquids and gases.

2. Which of the following voices is likely to have minimum frequency?

   (a) Baby girl (b) Baby boy

   (c) A man (d) A woman

3. In the following statements, tick T against those which are true, and F against those which are false:

(a) Sound cannot travel in vacuum. (T/F)

(b) The number of oscillations per second of a vibrating object is called its time period. (T/F)

(c) If the amplitude of vibration is large, sound is feeble. (T/F)

(d) For human ears, the audible range is 20 Hz to 20,000 Hz. (T/F)

(e) The lower the frequency of vibration, the higher is the pitch. (T/F)

(f) Unwanted or unpleasant sound is termed as music. (T/F)

(g) Noise pollution may cause partial hearing impairment. (T/F)

4. Fill in the blanks with suitable words.

(a) Time taken by an object to complete one oscillation is called ..... .

(b) Loudness is determined by the .....of vibration.

(c) The unit of frequency is.....

(d) Unwanted sound is called ..... .

(e) Shrillness of a sound is determined by the ..... of vibration.

5. A pendulum oscillates 40 times in 4 seconds. Find its time period and frequency.

6. The sound from a mosquito is produced when it vibrates its wings at an average rate of 500 vibrations per second. What is the time period of the vibration?

7. Identify the part which vibrates to produce sound in the following instruments:

   (a) Dholak (b) Sitar (c) Flute

8. What is the difference between noise and music? Can music become noise sometimes?

9. List sources of noise pollution in your surroundings.

10. Explain in what way noise pollution is harmful to humans.

11. Your parents are going to buy a house. They have been offered one on the roadside and another three lanes away from the roadside. Which house would you suggest your parents should buy? Explain your answer.

12. Sketch larynx and explain its function in your own words.
13. Lightning and thunder take place in the sky at the same time and at the same distance from us. Lightning is seen earlier and thunder is heard later. Can you explain?

Extended Learning — Activities and Projects

1. Visit the music room of your school. You may also visit musicians in your locality. Make a list of musical instruments. Note down the parts of these instruments that vibrate to produce sound.
2. If you play a musical instrument, bring it to the class and demonstrate how you play it.
3. Prepare a list of famous Indian musicians and the instruments they play.
4. Take a long thread. Place your hands over your ears and get some one to place this thread round your head and hands. Ask her to make the thread taut and hold its ends in one hand. Now ask her to draw her finger and thumb tightly along the thread **(Fig. 5.19)**. Can you hear a rolling sound like that of a thunder? Now repeat the activity while another friend stands near both of you. Can he hear any sound?

Fig. 5.19

5. Make two toy telephones. Use them as shown in **Fig. 5.20**. Make sure that the two strings are taut and touch each other. Let one of you speak. Can the remaining three persons hear? See how many more friends you can engage in this way. Explain your observations ?

Fig. 5.20

6. Identify the sources of noise pollution in your locality. Discuss with your parents, friends and neighbours. Suggest how to control noise pollution. Prepare a brief report and present it in the class.

You can read more on the related topics on the following websites:

www.physicsclassroom.com/Class/sound/soundtoc.html

health.howstuffworks.com/hearing.htm

www.jaltarang.com for jaltarang

www.tempro/com/articles/hearing.html

www.cartage.org.lb/en/themes/sciencas/physics/mainpage.htm

Golconda Fort

Did You Know

Golconda fort, near Hyderabad, is one of the most magnificient forts in India. It is famous for many engineering and architectural marvels. One of the marvels is the water supply system. But, perhaps, more astonishing is a dome near the entrance to the fort. A hand-clap at a particular point under the dome reverberates and can be heard at the highest point of the fort, about a kilometre away. This was devised as a warning system. If a guard saw a suspicious movement outside the fort, he clapped at the particular point under the dome, and the army inside the fort was alerted to the danger of the approaching enemy.

CHAPTER - 6

FOOD PRODUCTION AND MANAGEMENT

AGRICULTURE

Man depends on plants and their products for his various needs. Since time immemorial he has been engaged in farming. Even today 70% of our population is engaged directly or indirectly in agriculture. Agriculture in the broader sense, is defined as the study of science and art of production of plants and animals useful to man. It includes the preparation of land for growing the crop plants, besides the breeding and management of animals.

The word agriculture is derived from the Latin words; ager = field and cultura = cultivation. Agriculture provides us with food, clothing, shelter and other requirements of our daily life.

Do You Know ?

A huge population of the world depends upon agriculture as the main source of their livelihood, like all agriculture is the mainstay of the people of Jammu and Kashmir which plays a strategic role in the economic development of the State. It is the main source of income and employment for majority of population of the State.

Following is some of the date regarding agriculture in Jammu and Kashmir.

1. Agriculture sustains 80% of State population.
2. Area under cultivation = 24.16 lakh hectares
3. Area on which Rice is sown = 273.10 hec.
4. Area on which Maize is sown = 248.21 hec.
5. Area on which wheat is sown = 298.58 hec.
6. Productivity of food grains (qtls/hect.) = 13.86
7. Total production of food grains=15027000qt.

The Agriculture as we know it today could not have arisen suddenly. Observation indicate that the man started cultivation of plants as he learnt to control fire, developed tool making, began to build houses for shelter and thought of making use of animal skin for clothing. Agriculture originated 7000 to 13000 years ago. The

Table 6.1 Some Crop Plants Grown in India

Type	Some Examples
Cereals of grain crops	Rice, wheat, maize, barley, bajra, jowar, ragi
Fibre crops	Cotton, jute
Pulses	Grams, red gram, black gram, green gram, lentils, peas, beans
Oil seeds	Mustard, groundnut, sunflower, til
Root crops	Sweet potato
Tuber crops	Potato, tapioca
Sugar crops	Sugarcane, beetroot
Plantation crops	Coffee, tea, rubber, coconut

fertility of soil and the availability of plenty of water are the best suited conditions for raising crops.

In order to raise a crop with a good yield, a farmer has to carry out certain basic steps. During cultivation right from sowing seeds to harvesting, improved techniques are employed to produce high yields, better quality and disease resistant varieties.

CROP PLANTS

Many plants are grown on a large scale in vast fields since they are consumed in large amounts. Plants grown in field are known as crop plants or simply crop. There are wide varieties of useful crops grown in India. Rice, wheat and barley are the most common cereal crops that have been used by man. They form the staple food on which mankind has built its civilization. India produces about 150 million tones of rice, wheat and other cereals every year to feed her more than 1000 million people. Some examples of common crop plants grown in India are listed in **Table 6.1**

Main Crops Grown In J&K State

1. **Rice :** Staple food of Kashmiris is Rice which is grown in Kulgam, R.S. Pura, Kathua, Udhampur, Bhaderwah, Reasi and Kishtwar. Coarse to fine varieties of rice are sown in different parts of the State. In Jammu region 15,9000 acres are under rice cultivation whilein Kashmir 37,4000 acres are under cultivation. Yield per area is 13 qtls in Jammu and 15 Qtls in Kashmir. In Kashmir Valley, Kulgam Tehsil is often referred to as "Rice Bowl" of Kashmir".
2. **Wheat :** It is sown in Jammu region extensively for it forms the staple food of local people. Kathua, R.S. Pura, Samba, Reasi are its principle centres. Area under cultivation is 3,31,000 acres in Jammu, 78,000 acres in Kashmir and 7,000 acres in Ladakh.
3. **Maize :** It is cultivated on height elevation where it receives 75 to 125 cm rainfall. Chief areas where it is grown are Kishtwar, Bhaderwah, Batote, Banihal, Basholi, Poonch, Rajouri and Karewas of Kashmir. Area under cultivation is 2091,000 acres in Jammu region, 303,000 acres in Kashmir region. It is not grown in Ladakh.
4. **Barley :** It is grown in Kishtwar, Doda and Udhampur which are principle centres. In Ladakh, a different variety of barley called "Grim" is grown.
5. **Jawar and Bajra :** Grown as fodder for animals. Main areas of cultivation are Kandi, Samba, Kathua and Hiranagar in Jammu region.
6. **Pulses :** Grown in Kathua and Kashmir valley. Rajmash is grown in Kishtwar, Bhaderwah, Doda, Rajouri and Poonch.
7. **Sugar Cane ;** It is sown in Akhnoor, Kathua, R.S. Pura region of Jammu. It does not grow in Kashmir and Ladakh as it requires hot climate.
8. **Oil seeds :** The chief varieties of oil-seeds grown are mustard linseed, cotton seed, rape seed and sesame. They are grown all over the state, chief areas being Anantnag and Srinagar.

In addition to crop plants, vegetables, fruits and flowers are grown on a large scale. Cultivation of these plants come under horticulture, hortus = garden, cultura = cultivation. Thus horticulture means garden cultivation. Some examples of horticultural crops of India are given in **Table 6.2**

Table 6.2 Horticultural Crops

Type	Some examples
Vegetables	Tomato, brinjal, lady's finger, onion, garlic, ginger, cabbage, spinach, cauliflower, methi, bitter gourd.
Fruits	Mango, banana, grape, guave, apple, citrus, plum.
Decorative plants	Croton, cactus, bougainvillea.
Flowers	Rose, Jasmine, Marigold

Walter R. Lawrence has referred to Kashmir as a country of fruits and abundant Saffron. Also there was no other country with such great facilities for horticulture as the indigenous apple, apricot, almond, rasberry wine, pear, peaches, plums, mulberry, walnut, cherry can be grown without difficulty in most parts of valley.

Horticulture In Jammu and Kashmir

The state of J&K is very famous for cultivation of indigenous varieties of fruits and flowers. Fruits : Apples, pears, cherries, plums, vines, pomegranates, mulberries, peaches, apricots, walnuts, almonds are grown in Kashmir. Apples of Kashmir particularly Ambri variety found in Shopian Tehsil (Pulwama district) are famous. Mangoes, guavas, bananas, oranges, black berries are grown in the plains of Jammu region. 10,000 acres of land are under fruit cultivation in Jammu region.

In Ladakh,. Apricot and walnuts are grown over 1000 acres of land.

Fruit is mostly sold outside the state and it brings more than 50 crores of rupees annually. Average exports of fruits (fresh and dry) is 8343 thousand Qts.

"Zaffron" or "Saffron" or "Kong" is sown in Pampore in Kashmir region and Kishtwar and Bhaderwah in Jammu region. In Pampore, 3000 acres are under its cultivation while very small quantity is produced elsewhere. It is a cash crop and is mostly exported. Pulwama district is the leading producer of Saffron in the State.

BASIC PRACTICES OF CROP PRODUCTION

There are certain conditions which are very important for ensuring a good crop yield. Right kind of soil, good quality seeds, required amount of water, protection from weeds and pests and proper implements are necessary to obtain a good quality crop.

RIGHT KIND OF SOIL

To obtain good crop, crop plants are grown in large numbers in the fields and the crop is harvested for their produce. We measure the yield of crop in kilograms and tones per hector of land. A field needs to be managed properly in order to yield good crops. Some of the measures are given below :

- The field should be open so that sunlight and air are abundantly available.
- The field should be protected from stray cattle and others such as trespassers that may destroy crops.

- The soil should be turned before sowing so that the roots of the young plants can penetrate it easily. This helps the plant to hold firmly on to the soil. Also the roots are well ventilated. Roots and tuber crop plants need loosened soil for proper growth and for a good yield of the product.
- The right amount of water should be available.
- The soil should contain sufficient nutrients for the healthy growth of the plants.
- Unwanted plants (weeds) should be removed from the soil, so that the main crop gets enough nutrients.

The soil is, therefore, turned over by a few inches. This is done by ploughing or tilling. For ploughing the soil various types of ploughs are used.

Soils found in Kashmir valley vary from clayey loam to loam. The soils are classfied into eight types on the basis of productivity potential :

(I) Gurtu (Silt) (2) Bahil (Loam) (3) Sekil (Sandy) (4) Sur (Ash) (5) Dazanland (6) Nambel (Peat) (7)Radh (Floating (8) Karewas

In Ladakh region, only glacial and mountain soils are found.

Ploughs used are made of wood and iron and are driven by animals **(Fig. 6.1)**. Now-a-day farmers use tractors to plough their fields. Tractors are motor vehicles used to pull heavy machinery like ploughs and drills. The ploughs are chosen according to the type of soil. If the soil is hard, the plough must have sharp iron to break it. When the soil is dry, it breaks into big chunks. These have to be further broken down by clod crushers. After the soil or land has been ploughed, the soil may get eroded by wind and water. To prevent this the soil is levelled with wooden levelers or plank. By doing this, water distribution is facilitated. Preparation of soil is also helpful for its productivity. Continuous cultivation on a piece of land reduces its fertility. Earthworms are also known to plough the soil.

Fig 6.1. Animals used for Ploughing Soil

SELECTION OF RIGHT SEEDS

After the land has been prepared, seeds are selected for sowing. Seeds to be sown must be free from diseases and also resistant to diseases. The seeds should be viable for germination. The seeds should be obtained from a healthy plant. Seeds of good quality can be had from National Seed Corporation.

SOWING

There are two methods of sowing. The first method is by scattering seeds in the field by hand. This is known as broadcasting. In many developed countries seeds are no longer sown by hand. Even

when it is broadcast, it is sown by a machine called broadcaster which is made up of a long hopper (to hold the seeds) and a series of spinning disc which scatter the seeds as they fall through the bottom of the hopper at a controlled rate.

The second method of sowing is by using seed drills **(Fig. 6.2).** This method is widely used in India. The simplest seed drill consists of a vertical tube with a seed bowl. This arrangement is tied to the plough and the farmer drops the seeds into the bowl as the plough drags on the seed drill. The country plough is often adapted to line sowing. There are a number of modifications in the seed drill. The principle in all is the same.

Fig 6.2 Boradcasted and Seed Drill

RAISING SEEDLINGS IN NURSERY

In the cultivation of paddy and many vegetables, the seeds are first sown in a nursery bed under the great care of the farmer so that they are not damaged and only after a certain stage they are transferred to the main field.

TRANSPLANTING

The practice of taking the seedlings from the nursery to the main field is known as transplanting **(Fig. 6.3).**

Fig 6.3 Transplanting

Transplanting allows better penetration of roots in the soil and better shoot development. Transplanting is a common practice in rice and many vegetables. Before transplanting, the main field is appropriately ploughed and manured. During the transplanting, proper distance is kept between plants and rows to enable the plants to receive sufficient sunlight and water. For paddy, the main field is also flooded with water.

Seeds should be sown at a proper depth in the soil.

ACTIVITY

Take three earthen pots **(Fig. 6.4)** containing the same amounts of soil. Label the pots as A, B and C, sow five bean seeds at a depth of 2 cm in pot A. Sow five bean

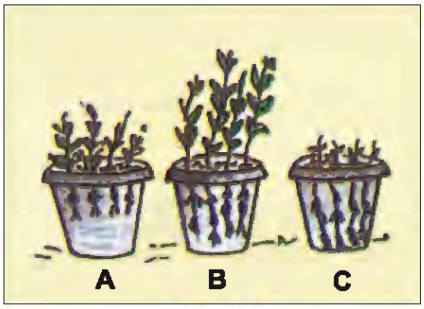


Fig. 6.4

seeds at a depth of 5 cm in pot B, and five seeds at a depth of 10 cm in pot C. Water all the three pots regularly once a day with equal quantity of water for a few days. Observe the saplings in the pots at frequent intervals. What do you observe ?

The plants in pot B show healthy growth in comparison to pot A and pot C. This shows that seeds germinate more easily when they are sown at a proper depth.

MANURING

Plants depend on the soil for their nutrients. Continuous farming on the land exhausts the mineral nutrients in the soil. The soil should be enriched with manure and fertilizers. Manures and fertilizers are major sources of nutrients and hence, used in crop rotation.

Manures are organic materials which supply all the elements a plant needs in small amounts. The manures add organic matter to the soil which increases water-holding capacity in sandy soil and drainage in clayey soil.

The important types of manures are farmyard manure (FYM), green manure, compost, sea manure and poultry manure.

Farmyard manure is the most valuable organic matter commonly applied to the soil. Even the poorest farmer can provide this manure to the soil. This usually consists of remanants of straw, leaves and other materials like the excreta of cattle.

The practice of turning or ploughing of green plants into soil for the purpose of improving physical structure as well as soil fertility is called green manuring. Leguminous crops like cluster beans, cowpea, horsegram, etc. are grown as green manure crops.

Compost consists of all the cattle shed wastes and all the available refuse. All these are properly mixed together and can be used as manure after rottening.

Fertilizers are inorganic materials that are used mainly to increase the essential elements in the soil. For example, nitrogen, phosphate and potash fertilizers. Fertilizers are added to the soil in the form of NPK fertilizers, i.e, nitrogen, phosphate and potash. Other fertilizers are calcium ammonium nitrate (CAN), urea, super phosphate, etc.

The fertilizers may be sprayed on the crops or may be added to the soil. A knowledge of the nature of the soil (pH value) is essential before adding a fertilizer. Fertilizers added in excess can cause great harm.

IRRIGATION

Once the seeds or the seedlings establish themselves in the field, water is again given in the field. This is known as irrigation. Water is required for the plants to meet the needs of evaporation and metabolic activities. This depends upon the weather and moisture already present in the soil and the stage of the crop. Water is also lost through soil seepage(slow escape of liquid deep into soil). A crop should be properly irrigated for its growth. A timely irrigation ensures a high yield of the crop.

A field needs to be irrigated with just the right amount of water, neither too little nor too much. Excess of water can destroy crops. Continuous water logging increases

the amount of salt in the soil and can damage it. Some plants, like paddy (rice), need to be partially submerged in water and are irrigated by the method of individual filed bunds or basin irrigation.

Excess water can be drained off into the streams, rivulets and rivers by providing suitable outlets. Drains are built to help the surplus water reach these streams more quickly.

Do you Know

In J & K State, agricultural land is irrigated through (a) Canals (b) Wells and Tanks (c) Tube Wells (d) Dhingri Wells (e) River Pools

About 70,9795 acres of land is irrigated through canals. The region wise break up is Jammu : 21,9778 acres; Kashmir : 486072 acres, Ladakh : 3945 acres.

Important canals in Jammu are :

(I) Ranvir canal (ii) Partap canal (iii) Kathua canal (iv) Tawi canal (v) Dudhar canal (vi) Pargol canal (vii) Ujh canal (viii) Basantpur canal (ix) Raigarh canal (x) Ravi canal.

Important canals in Kashmir are :

(I) Martand canal (ii) Zainagir canal (iii) Lalkhul (Pohru) (iv) Dadi Khul (lidder) (v) Sumbal Khul (Sukhnag) (vi) Nandi Khul (Vishu) (vii) Awantipora Khul(Lidder) (viii) Zainapora khur (vishu) (ix) Rishipur canal

Important canals in Ladak Region are :

(I) Chuchot Mayur (ii) Thiksay Mayur (iii) Khangral canal (iv) Kharbu Thang (v) Zangla canal (vi) Kaksar canal (vii) Khurbathang canal

WEEDING

Weed are the undesirable plants in crop fields. They compete with the crop plants for nutrients and sunlight and thus, grow at the expense of crop plants. This reduces the yield. The weeds are removed from the field either manually with the help of trowels (khurpi), hoe or harrow or by spraying weedicides (weed killing chemicals) like 2, 4-D (2, 4-dichlorophenoxy acetic acid), and simazine. There are some spraying appliances in use today to apply these chemicals.

CROP PROTECTION

Crop yield is affected if the plants are afflicted with some disease or attacked by pests. The parasitic fungi, insects such as locusts and grasshoppers and rodents such as rats cause extensive damage to crop either as a plant or in storage.

Protection against the pests, weeds and disease is done in various ways. Pesticides are sprayed on the plants to keep off the pests. Insecticides are used to checks the insects, while weedicides check the growth of weeds. Insecticides, like malathion, dimecron and polythion, are common in use. These insecticides kill the pests as well as their larvae but the plants are not affected by them.

The pesticides can be applied either as dusts or sprays. A variety of spraying and dusting equipment is available. The selection of the time of spray of pesticides is also very important. Many of these pesticides are highly poisonous and must be used with great care.

The grains, vegetables and fruits that we buy from the market often have a coating of pesticides. So they should be washed well before use.

In the fields, birds and some mammals also eat away the crop. So they

are to be frieghtened away from the field. For this, farmers generally, make a scarecrow to frighten them away.

HARVESTING

The rabi or Kharif crops are ripe at the end of their season. When the fruits or grains are golden in colour they are ready for harvesting.

Fig 6.5

Harvesting is the process of cutting and collecting the matured crop from the fields. This may be done either by hand or with a sickle or with machines known as combines or harvesters.

In India, there are two main seasons for cultivation and harvesting crops: the Kharif and the rabi. The Kharif crop is sown in June and July and harvested after the monsoon season, i.e., In September and October. Rice is mainly the Kharif crop. The rabi crop is sown in October to December and harvested by March or April. Wheat is mainly the rabi crop. In well irrigated areas rice can also be sown as a rabi crop.

Fig. 6.6 Rice is a Kharif Crop

Fig 6.7 Wheat is a Rabi Crop

HARVEST FESTIVALS

There are some festivals in India, like Pongal, Baisakhi, Holi, Diwali, Nabanya and Bihu that are associated with the harvest time. Farmers enjoy these festivals after seeing their crop flourishing well.

THRESHING

The stems of wheat, paddy or maize plants are cut, make hay and then the grains are separated from the chaff by threshing. This is done manually or with the help of a machine called a thresher or a modernized machine called combine.

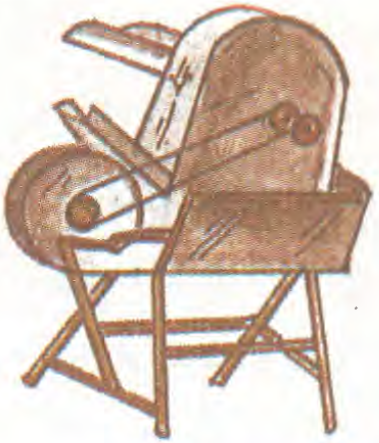


Fig 6.8 A Thresher

WINNOWING

The grains separated by threshing need to be winnowed. Winnowing helps the separation of the seed from the chaff. In winnowing process the seeds being heavier fall straight to the ground while the light chaff is blown a little farther away by the wind.

STORAGE OF GRAINS

Storage means keeping the harvested fruits till they are taken finally to the consumer. Seeds are stored to protect them from birds, insects, rodents and micro-organisms and also for use during periods of food scarcity.

Seeds can be thus stored in caly pots, woven baskets or even holes in the ground. Seeds can also be stored in a barn or granaries in cemented halls called godowns for many years. These godowns should be protected from animal pests. They can be fumigated by pesticides. They are then left for some days and after that the seeds can be stored in them. The seeds are first dried before they are stored.

WORKSHEET : 6.1

1. Name various sources of food ?
2. What are various sources of plant nutrients ?
3. Differentiate between farmyard manure and green manure ?
4. What are the advantages of sea manures?
5. Name two fertilizers supplying nitrogen, phosphate and potash ?
6. Name any two irrigation systems in India?
7. What are weeds ? How do they affect crops ?
8. Name any two insecticides ?
9. Name two harvest festivals ?
10. Name two main crops raised in India. Also mention their time of harvesting ?
11. Name a machine which is used for harvesting ?
12. Name the cereals grown in India ?
13. Differentiate between agriculture and horticulture ?
14. Why is soil ploughed ?
15. Name the methods of sowing ?
16. Why do farmers raise seedlings in nursery ?

IMPROVEMENT OF CROPS

At present, India's population increases by about 20 million every year. Accordingly our food requirements also increase. About 30 years ago, India had a population of 350 million and we produced about 45 million tones of staple food. Our population is over 1000 million people and we grow about 145 million tones of food.

How did this increase of 100 million tones of crop produce come about ? We have of course brought additional land area (about 15 per cent) under the plough over the past few decades. But the main factors responsible for this increase are as follows :

1. PLANT BREEDING

This technique involves cross-breeding (hybridization) between two varieties of plants to obtain a new and better adapted variety. The anthers of one plant are removed by a forceps before they mature and produce pollen grains. This is

known as emasculation. Then the pollen grains of another plant are dusted over to the stigma of this flower to bring about cross-pollination. This plant is now again cross-bred. This process when repeated several times, yields an improved variety called stock. This variety has the desired characters and is resistant to many diseases.

The institutes and universities of Indian Council of Agricultural Research develop new varieties of wheat, rice and various vegetables and fruits. But using the seeds of these varieties, the yield of the crop increases.

2. SOIL IMPROVEMENT

The following three methods are generally used in India for the improvement of soils :

(a) Crop rotation : There are leguminous or pulse crop plants that have the ability to fix atmospheric nitrogen into nitrates which are good fertilizers. This is because these plants have nitrogen-fixing bacteria (Rhizobium sp., Azospirillium sp. and Azotobacter sp.) In their root nodules. So cultivating these crops in between two cereal crops can add to the minerals of the soil. For example, maize and wheat crops are grown alternately with groundnut. The cultivation of groundnut can replenish the minerals of the soil. This method is known as crop rotation.

(b) Mixed cropping : Sometimes, two crops may be grown together to save time and labour. This also helps the products and waste materials of one crop to be utilized by another crop if chosen properly. This method is known as mixed cropping. Groundnut and cotton are usually grown together as mixed crops.

(c) Field fallow : Sometimes, the field may be left as such and crop is not cultivated for one season. During this period humus of the soil may increase and promote the growth of micro-organisms to replenish the nutrients of soil. This is known as field fallow.

All these methods increase the nutrients and humus of the soil and the soil becomes better suited for the growth of new crop.

3. PROTECTION FROM PESTS AND WEEDS

Once the crop is ready, it is to be protected from various diseases and insect pests that damage the crop. Diseases of plants are caused by virus, bacteria, nematodes, fungi etc. To prevent the spread of these diseases, the plants are sprayed with chemicals like pesticides, nematicides, etc. Some of the common pesticides are parathion, malathion, DDT (dichloro-diphenyltrichloroethane) and BHC (bezene hexachloride). These chemicals also protect the crop from insect pests. One of the main drawback in the use of pesticides is that they are not specific. These pesticides not only kill the insects but are harmful to human beings also. So the scientists are now trying to develop certain chemicals which kill specific pests only. These chemicals, are produced by living organisms and are known as biocides.

4. STORAGE

In a developing country like India, there is an acute shortage of food. One of the important reasons for this shortage of

food is the loss of food grains during storage. It is estimated that rats alone eat away about 25 per cent of the total production. This is highly alarming. Not only rats but other animals and insects also destroy the food under storage conditions. The following are some of the important features of a good storage structure for storing grains on a large scale :

It should be easy to clean.

It should be waterproof.

If should protect the grains against variation in temperature and humidity.

It should be located at a convenient place so that transportation becomes easy.

It should be well-protected from rodents, rats, etc.

It should be convenient for regular check up of stored food materials.

It should be convenient for the use of pesticides and also for the control of other microorganisms.

Storage of grains is very important as the yield from the crop is not available all the times. Once the crop is ready, then the grains are to be cleaned for storage so that they can be used later on. Further, much of our agriculture is still based on rain water and monsoon. This annual rainfall varies from year to year and so also the production. When the production is more, grains are stored for adverse conditions. The extra grains stored in a year is known as buffer stock.

WORKSHEET : 6.2

1. What is plant breeding ?
2. How is plant breeding performed ?
3. What is crop rotation ? What are its advantages ?
4. Name two leguminous crops ?
5. What are the advantages of mixed cropping ?
6. Name two crops which are grown together?
7. Define field fallow ?
8. Write the important features of a good storage structure ?

DAIRYING

An establishment where milk and

Fig. 6.9 A Dairy Farm

Cream are kept and butter and cheese are made is known as a **dairy**. The business of dairy is called **dairying.**

Fig. 6.10 Some Dairy Products

Since the beginning of human civilization man has been domesticating animals to use them for his own work and food. But unlike plants, the number of useful animals is not very large. Useful animals play a significant role in the welfare of

mankind. We keep certain animals not only as pets but also serve some specific purposes. For example, hens for eggs and cows for milk, etc. The keeping and breeding of animals for specific uses is known as domestication. Domesticated animals have special qualities of working, for the use of man. These animals have to be looked after and cared for, just as a human being. They have to be provided food, shelter and protection against diseases. All domesticated and useful animals constitute livestock.

Do you know the regions where Livestock is found in J&K State?

1. Cattle	:	Jammu, Kathua
2. Buffaloes	:	Jammu
3. Sheep	:	All over State
4. Goat	:	All over State
5. Horses, Ponie	:	All over State
6. Donkeys, Mules	:	All over State
7. Camels	:	Jammu
6. Yaks	:	Ladakh
9. Poultry	:	All over State

Cows, buffaloes, goats and camels are milk producing animals in out country. The milk from goats is nutritious and sometimes preferred to cow's milk. The milk of buffaloes contains more fats than the cow's milk. Buffaloes are the major source of milk in our country. The well-known breeds of buffaloes are Murrah, Jaffarabadi, Mehsana, Surti, Nili and Nagpuri. Red, Sindhi, Sahwal and Gir are indigenous breeds of dairy cows.

Table 6.3 Indian Breeds of Buffaloes

Name	Breed in	Quantity of milk per day
Murrah	Punjab, Haryana	25-30 litres
Surti	Kerala	9-10 litres
Jaffrabadi	Gujarat	15-20 litres
Nili	Punjab	7 litres
Nagpuri	Madhya Pradesh	6-8 litres
Mehsana	Gujarat (Baroda)	6-8 litres

Feeding : The feed normally given in a dairy farm is a mixture of ordinary grass and a legume with clover.

Some Famous Goats and Sheep of J&K State

1. **Pashmina Goat** : Found in Ladakh (Rupshu, Zanskar and Nubra). Known for finest quality Pasham, which is used for the manufacture of world famous shawls.
2. **Marine Sheep** : Found in Ladakh known for fine quality wool used in shawl industry.
3. **Kangan Goat** : Found in Kangan (Kashmir), Beleived to be finest quality mutton, goat in India.
4. **Beetal Goat** : Found in Jammu. The best milking goat.

Heeding : Heeding means the proper care and management of animals. Care must be taken to maintain the health of the livestock. Some very simple practices are followed by farmers on caring their animals. These are :

Providing the animals food regularly and properly.

Erecting the sheds away from human habitations to maintain sanitary conditions and cleaning the sheds regularly.

Cleaning the animals regularly.

Watching the animals carefully to see if they are normal and healthy.

Taking precautions against infections and diseases.

Performing regular checkups of the animals by Specialist called veterinary doctors.

Working calmly and treating them gently, and not frightening the animals.

POULTRY

Domestication of a group of birds such as chicken, geese, turkey and duck for the purpose of obtaining eggs and meat from them, is known as poultry farming.

An egg-laying bird is called broody hen. Some special breeds of hen are white leghorn, Rhode island red and lack Minorca. Such breeds can lay about 230-240 eggs a year.

Feeding : The common feed of poultry chicken including grains, oil cakes, green food and limestone. Limestone helps in the digestion of food and in the formation of egg shells. For proper egg production, a lot of water is needed by the poultry birds.

Fig. 6.11 A Poultry Farm

SHELTER : The shelter for poultry birds should be comfortable and safe. The birds should be comfortable and safe. The birds should be protected from the cold winds and heavy rains. The house (pens) are generally made of metal or wood because mud houses may be attacked by rats or snakes. Straw is used to cover the floor. Light is essential for the well being of poultry.

Hens start laying eggs at the age of six months. They sit on them to provide the warmth necessary for hatching. Incubators are sometimes used to hatch the eggs.

Protection against disease : Poultry birds suffer from diseases such as fowl cholera, chicken pox, and ranikhet. These diseases can be fatal. Besides these, the birds may get infected with various internal and external parasites. As a preventive measure, vaccination should be given and the infected birds should be separated from the rest.

FISHERIES (PISCICULTURE)

Rearing and management of fish on a large scale production is known as fisheries. The Indian subcontinent is surrounded on three sides by water and the coastal area provides a rich haul of fish. They are a major source of animals protein. Now-a-days, fish are cultivated on an industrial scale in large water reservoirs.

Fishery is a flourishing industry in our country. Prawns, shrimps, lobsters and edible oysters are exported on a large scale. Fish not only provide protein but the oil of the fish can be used for various purposes. Corals are used as decoration pieces. Pearls from oysters are used in jewellery.

Some important fishes are Catla, Labeo, Barbus and Tuna Cod. Marine fishes found in India are Hilsa, sardine and Mackerel etc.

Do you know that :

Fishes are inhabitants of water. Fresh water fishes are common in our rivers and lakes. They are second to insects in the largeness of population and outnumber all other vertebrates in this respect. Familiar colourful fishes of aquariums are mostly marine fishes. A variety of fishes is found in J&K State. There are 35 species of fish found in the Kashmir Valley alone.

The Jammu and Kashmir fisheries department have introduced following Carps and Trouts in the ponds and streams of J&K :

1. Rohu, Labeo rohita
2. Mrigal, Cirhina mrigal
3. Brown Trout
4. Grass Carp
5. Rainbow Trout
6. Scale Carp
7. Mahseer etc.

(a) The number of families engaged in fishing industries in about 5000.

(b) Annual production of fishes is 15,000 qtls.

(c) Number of fisher folk engaged in a single place : 1200 in Wular lake.

Important fish farms in J&K are : Harwan, Acchabal, Laribal, Trikar, Papchan, Marh Block, Kathua, Kishtwar, Bani hill streams and Buddhal.

The pollution of water causes great harm to the fish. This is a very serious problem for the farmers because the fish die when a water body gets polluted. In order to maintain a fish farm, regular monitoring of the level of oxygen and carbon dioxide is essential.

APICULTURE

Apiculture is the practice of keeping beehives and rearing honeybees to get honey and wax. Honey is an essential ingredient of many medicines Wax is also of great value.

A colony of honeybees consists of workers, which are sterile females; drones, which are sterile males; and a queen which is fertile female. The workers build beehives and take care of larvae. They act as foster mothers feeding younger brothers and sisters. They gather pollen and nectar, convert the nectar into honey and store the honey and pollen in chambers called honey combs. The queen bee is responsible for laying eggs, while the drones fertilize the queen bee.

The honey is extracted by a honey extractor. Honey contains 17% water and 78% sugar with minerals and enzymes which help in digestion of food.

The purity of honey can be tested by the presence of pollen. Pure honey when dissolved in water contained in a glass, makes a thread through the depth of glass.

Fig. 6.11 Beehive

WORKSHEET : 6.3

1. What is livestock ?
2. Name any four poultry birds ?
3. What is a broody hen ?
4. Name any two breeds of :
   (a) cows and (b) buffaloes.
5. Why is fishery flourishing in India on a large scale ?
6. Name any four fish ?
7. Give any two uses of honey ?
8. Give any two uses of wax ?
9. Give any four points for care of animals ?

LET'S REVISE

- Agriculture is the study of cultivation of land, breeding and management of plants and animals that are useful to mankind.
- Horticulture deals with the growing of vegetables, fruits and other garden plants.
- Some of the basic agriculture practices followed in India are preparation of the soil, sowing of seeds, irrigation, removal of weeds, use manures and fertilizers, protection of the crops and the use of high-yields varieties.
- Kharif and rabi are the two main crops sown in India. It depends upon the time of sowing and the time of harvesting the crop.
- Soil, air, water and sunlight are essential for the growth of plants.
- Soil needs to be ploughed for free penetration of roots and its ventilation.
- Seeds are sown by broadcasting and seedlings are transplanted into fields.
- Manures and fertilizers provide important nutrients required for plant growth.
- Weeds complete with crops for nutrients in the soil, air, light and water.
- Proper storage of food grains is important to avoid wastage and also for its use later on.
- Dairy farming is the rearing and managing of animals of use to man.
- The proper care and management of animals is known as heeding.

EXERCISE

I. Name the following :

1. Five requirements essential for obtaining good crop production.
2. Two types of fertilizers.
3. Some chemicals used to protect crops from insects pests and weeds.
4. Some animal products.
5. Members of a colony of bees.

II. Fill in the blanks :

1. A _____ is used to remove weeds from the soil.
2. A _____ is used to trowel the soil by breaking the lumps of soil after preliminary ploughing.
3. Kharif crops are sown during the months of _____.
4. _____ seeds are not sown directly into the soil.
5. Rabi crops are harvested during the months of _____.
6. The practice of taking the seedlings from the nursery to the main filed is known as _____ field.
7. Pearls are used in _____.
8. Honey contains _____ water and _____ sugar with minerals.
9. The hen-houses are called _____.
10. Murrah and Jaffarabadi are well-known breeds of _____.

III. Answer the following questions in only one word or in figure :

1. What is the process of turning and loosening the soil called ?
2. Which implement is used for tilling soil ?
3. Which implement is used for breaking up the large lumps of soil ?
4. What is the implement used for sowing called ?
5. What is the top pat of the drill called ?
6. What is an egg-laying bird called ?
7. Name the members of the bee colony?
8. Which material is used to cover the floor of a hen-house ?
9. Which is the common food of poultry chicken ?
10. Which bee is responsible for laying eggs?

IV. Give the scientific reasons for the following :

1. Grains, pulses, vegetables and fruits should be used in our daily life ?
2. The soil should be loosened before seeds are sown ?
3. Seeds should be sown at a proper depth in the soil?

4. Fruits and vegetables should be washed throughly before eating?
5. Grains are dried throughly before they are stored?

V. Answer the following questions :

1. What are the requirements of farming which would lead to high yields of crops ?
2. What is tilling ? How is it done ?
3. Write a short note on the process of sowing ?
4. What are manures ? Discuss their important types.
5. What is a fertilizer ? Explain its importance.
6. What are broadcasting and transplanting?
7. What is the difference between manure and fertilizer ?
8. Why are weeds harmful ? What is used to remove them ?
9. What are insecticides ? Give examples.
10. How do insecticides protect crops ?
11. Which are the two main seasons in India for cultivating crops ?
12. Name some harvest festivals of India.
13. Name four factors responsible for the improvement of a crop.
14. Write short note on the process of harvesting.
15. Why does a farmer rotate crops in the field?
16. What do you understand by mixed cropping ?
17. Why are fields sometimes allowed to remain fallow ?
18. List the importance of fish in our life ?
19. What is nutrient value of honey ?
20. How are domesticated animals useful to us ?

CHAPTER - 7

COMBUSTION AND FLAME

We use different kinds of fuel for various purposes at home, in industry and for running automobiles. Can you name a few fuels used in our homes? Name a few fuels used in trade and industry. What fuels are used for running automobiles? Your list will contain fuels like cowdung, wood, coal, charcoal, petrol, diesel, compressed natural gas (CNG), etc.

You are familiar with the burning of a candle. What is the difference between the burning of a candle and the burning of a fuel like coal? May be you were able to guess right: candle burns with a flame whereas coal does not. Similarly, you will find many other materials burning without a flame. Let us study the chemical process of burning and the types of flame produced during this process.

7.1 What is Combustion?

You might have observed burning of magnesium ribbon. Magnesium burns to form magnesium oxide and produces heat and light **(Fig. 7.1)**.

We can perform a similar activity with a piece of charcoal. Hold the piece with a pair of tongs and bring it near the flame of a candle or a Bunsen burner. What do you observe?

We find that charcoal burns in air. We know that coal, too, burns in air producing carbon dioxide, heat and light.

Fig. 7.1 : Burning of Magnesium

A chemical process in which a substance reacts with oxygen to give off heat is called **combustion**. The substance that undergoes combustion is said to be combustible. It is also called a **fuel**. The fuel may be solid, liquid or gas. Sometimes, light is also given off during combustion, either as a flame or as a glow.

In the reactions mentioned above magnesium and charcoal are combustible substances.

We were told that food is a fuel for our body.

Rightly so. In our body food is broken down by reaction with oxygen and heat is produced.

Activity 7.1

Collect some materials like straw, matchsticks, kerosene oil, paper, iron nails, stone pieces, glass, etc. Under the supervision of your teacher try to burn each of these materials one by one. If combustion takes place mark the material **combustible**, otherwise mark it as **non-combustible (Table 7.1)**.

Table 7.1 Combustible and Non-Combustible Substances

Material	Combustible	Noncombustible
Wood		
Paper		
Iron nails		
Kerosene oil		
Stone piece		
Straw		
Charcoal		
Matchsticks		
Glass		

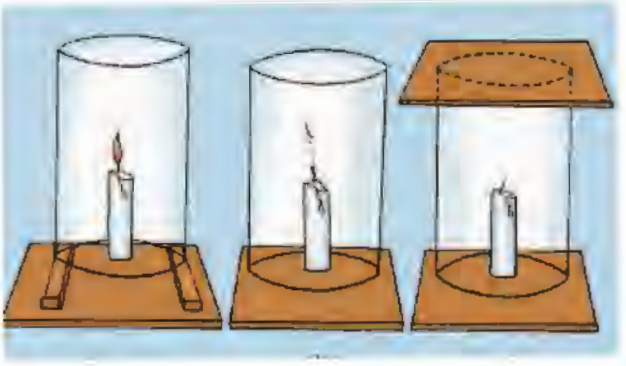
Can you name some more substances which are combustible? You can add those to **Table 7.1**.

Let us investigate conditions under which combustion takes place.

Activity 7.2

Caution : Be careful while handling burning candle.

Fix a lighted candle on a table. Put a glass chimney over the candle and rest it on a few wooden blocks in such a way that air can enter the chimney [Fig 7.2(a)]



(a) (b) (c)

Fig. 7.2: Experiment to Show that Air Is Essential for Burning

Observe what happens to the flame. Now remove the blocks and let the chimney rest on the table **[Fig. 7.2(b)]**. Again observe the flame. Finally, put a glass plate over the chimney **[Fig.7.2(c)]**. Watch the flame again. What happens in the three cases? Does the flame flicker off? Does it flicker and give smoke? Does it burn unaffected? Can you infer anything at all about the role played by air in the process of burning?

We find that for combustion, air is necessary. The candle burns freely in case (a) when air can enter the chimney from below. In case (b), when air does not enter the chimney from below, the flame flickers and produces smoke. In case (c), the flame finally goes off because the air is not available.

We have read that the sun produces its own heat and light. Is it also some kind of combustion?

In the sun, heat and light are produced by nuclear reactions. You will learn about this process in higher classes.

Activity 7.3

Place a piece of burning wood or charcoal on an iron plate or *Tawa*. Cover it with a glass jar or a tumbler, or a transparent plastic jar. Observe what happens. Does

charcoal stop burning after sometime? Can you think of the reason why it stops burning?

You might have heard that when the clothes of a person catch fire, the person is covered with a blanket to extinguish fire **(Fig. 7.3)**. Can you guess why?

Fig. 7.3 : Blanket Wrapped Around a Person Whose Clothes Caught Fire

Now recall some of your experiences.

Does a matchstick burn by itself? How does it burn?

You must have had an experience of burning a piece of paper. Does it burn when a burning matchstick is brought near it?

Can you burn a piece of wood by bringing a lighted matchstick near it?

Why do you have to use paper or kerosene oil to start fire in wood or coal? Have you heard of forest fires?

Do these experiences tell you that different substances catch fire at different temperatures?

The lowest temperature at which a substance catches fire is called its **ignition temperature.**

Can you tell now why a matchstick does not catch fire on its own at room temperature? Why does the matchstick start burning on rubbing it on the side of the matchbox?

The history of the matchstick is very old. More than five thousand years ago small pieces of pinewood dipped in sulphur were used as matches in ancient Egypt. The modern safety match was developed only about two hundred

During extreme heat of summer, at some places dry grasses catch fire. From grasses, it spreads to trees, and very soon the whole forest is on fire (Fig. 7.4). It is very difficult to control such fires.

Fig. 7.4 : Forest Fire

years ago.

A mixture of antimony trisulphide, potassium chlorate and white phosphorus with some glue and starch was applied on the head of a match made of suitable wood. When struck against a rough surface, white phosphorus got ignited due to the heat of friction. This started the combustion of the match. However, white phosphorus proved to be dangerous both for the workers involved in the manufacturing of matches and for the users.

These days the head of the safety match contains only antimony trisulphide and potassium chlorate. The rubbing surface has powdered glass and a little red phosphorus (which is much less dangerous). When the match is struck against the rubbing surface, some red phosphorus gets converted into whita phosphorus. This immediately reacts with potassium chlorate in the matchstick head to produce enough heat to ignita antimony trisulphide and start the combustion.

We find that a combustible substance cannot catch fire or burn as long as its temperature is lower than its ignition temperature. Have you ever seen cooking oil catching fire when a frying pan is kept for long on a burning stove? Kerosene oil and wood do not catch fire on their own at room temperature. But, if kerosene oil is heated a little, it will catches fire. But if wood is heated a little, it would still not catch fire. Does it mean that ignition temperature of kerosene oil is lower than that of wood? Does it mean that we need to take special care in storing kerosene oil? The following activity shows that it is essential for a substance to reach ignition temperature to burn.

Activity 7.4

Caution : Be careful while handling burning candle.

Make two paper cups by folding a sheet of paper. Pour about 50 mL of water in one of the cups. Heat both the cups separately with a candle **(Fig. 7.5)**. What do you observe?

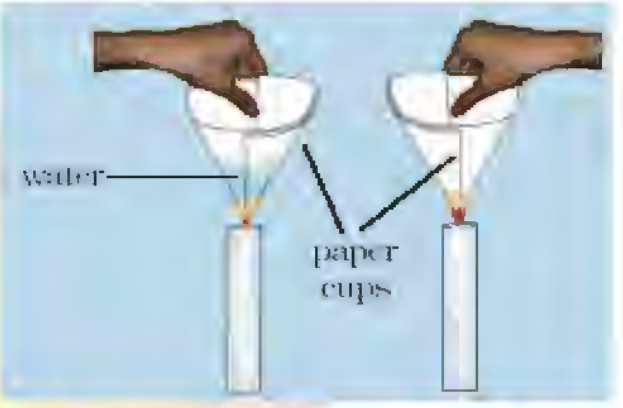


Fig. 7.5 : Heating Water in a Paper Cup

What happens to the empty paper cup? What happens to the paper cup with water? Does water in this cup become hot?

If we continue heating the cup, we can even boil water in the paper cup.

Can you think of an explanation for this phenomenon?

The heat supplied to the paper cup is transferred to water by conduction. So, in the presence of water, the ignition temperature of paper is not reached. Hence, it does not burn.

The substances which have very low ignition temperature and can easily catch fire with a flame are called **inflammable substances**. Examples of inflammable substances are petrol, alcohol, Liquified Petroleum Gas (LPG), etc. Can you list some more inflammable substances?

Fig. 7.6: Firemen Extinguish the Fire by Throwing Water under Pressure

7.2 How do We Control Fire?

You must have seen or heard of fire breaking out in homes, shops and factories. If you have seen such an accident, write a short description in your note book. Also, share the experience with your classmates.

Find out the telephone number of the fire service in your area. If a fire breaks out in your house or in your neighbourhood, the first thing to do is to call the fire service.

It is important that all of us know the telephone numbers of the fire service.

Does your city/town have a fire brigade station?

When a fire brigade arrives, what does it do? It pours water on the fire **(Fig. 7.6)**. Water cools the combustible material so that its temperature is brought below its ignition temperature. This prevents the fire from spreading. Water vapours also surround the combustible material, helping in cutting off the supply of air. So, the fire is extinguished.

You have learnt that there are three essential requirements for producing fire. Can you list these requirements?

These are: fuel, air (to supply oxygen) and heat (to raise the temperature of the fuel beyond the ignition temperature). Fire can be controlled by removing one or more of these requirements. The job of a fire extinguisher is to cut off the supply of air, or to bring down the temperature of the fuel, or both. Notice that the fuel in most cases cannot beeliminated. If, for instance, a building catches fire, the whole building is the fuel.

The most common fire extinguisher is water. But water works only when things like wood and paper are on fire. If electrical equipment is on fire, water may conduct electricity and harm those trying to douse the fire. Water is also not suitable for fires involving oil and petrol. Do you recall that water is heavier than oil? So, it sinks below the oil, and oil keeps burning on top.

Fig. 7.7 : Fire Extinguisher

For fires involving electrical equipment and inflammable materials like petrol, carbon dioxide (CO_2) is the best extinguisher. **(Fig.7.7)** CO_2, being heavier than oxygen, covers the fire like a blanket. Since the contact between the fuel and oxygen is cut off, the fire is controlled. The added advantage of CO_2 is that in most cases it does not harm the electrical equipment.

How do we get the supply of carbon dioxide? It can be stored at high pressure as a

liquid in cylinders. In what form is the LPG stored in cylinders? When released from the cylinder, CO_2 expands enormously in volume and cools down. So, it not only forms a blanket around the fire, it also brings down the temperature of the fuel. That is why it is an excellent fire extinguisher. Another way to get CO_2 is to release a lot of dry powder of chemicals like sodium bicarbonate (baking soda) or potassium bicarbonate. Near the fire, these chemicals give off CO_2.

7.3 Types of Combustion

Bring a burning matchstick or a gas lighter near a gas stove in the kitchen. Turn on the knob of the gas stove. What do you observe?

CAUTION : Do not handle the gas stove yourself. Ask your parents to help.

We find that the gas burns rapidly and produces heat and light. Such combustion is known as **rapid combustion**.

There are substances like phosphorus which burn in air at room temperature.

The type of combustion in which a material suddenly bursts into flames, without the application of any apparent cause is called **spontaneous combustion.** Spontaneous combustion of coal dust has resulted in many disastrous fires in coal mines. Spontaneous forest fires are sometimes due to the heat of the sun or due to lightning strike. However, most forest fires are due to the carelessness of human beings. It is important to remember that the campfires must be completely extinguished before leaving a forest after a picnic, or a visit.

We generally have fireworks on festival days. When a cracker is ignited, a sudden reaction takes place with the evolution of heat, light and sound. A large amount of gas formed in the reaction is liberated. Such a reaction is called **explosion.** Explosion can also take place if pressure is applied on the Cracker.

Q1. What is combustion ? Name some combustible substances.

Q2. What are different type of combustion ? Give examples

Q3. What is Ignition temperature ?

7.4 Flame

Observe an LPG flame. Can you tell the colour of the flame. What is the colour of a candle flame?

Recall your experience of burning a magnesium ribbon. If you do not have experience of burning the remaining items in **Table 7.2** you can do that now.

Table 7.2 Materials Forming Flame on Burning

S. No.	Material	Forms flame	Does not Form flame
1. Candle			
2. Magnesium			
3. Camphor			
4. Kerosene Stove			
5. Charcoal			

Fig. 7.8: Colours of a Candle Flame and the Flame of a Kitchen Stove

Fig. 7.9 : Flames of Kerosene Lamp, Candle and Bunsen Burner

Record your observations and mention whether on burning the material forms a flame or not.

7.5 Structure of a Flame

Activity 7.6

Light a candle (Caution : Be careful). Hold a glass tube with a pair of tongs and introduce its one end in the dark zone of a non-flickering candle flame **[Fig. 7.10 (a)]**. Bring a lighted matchstick near the other end of the glass tube. Do you see a flame? If so, what is it that produces a flame? Notice that the wax near the heated wick melts quickly.

Fig. 7.10 (a)

The substances which vapourise during burning, give flames. For example, kerosene oil and molten wax rise through the wick and are vapourised during burning and form flames. Charcoal, on the other hand, does not vapourise and so does not produce a flame. In Activity 7.6, could the vapours of wax coming out of the glass tube be the cause of the flame produced?

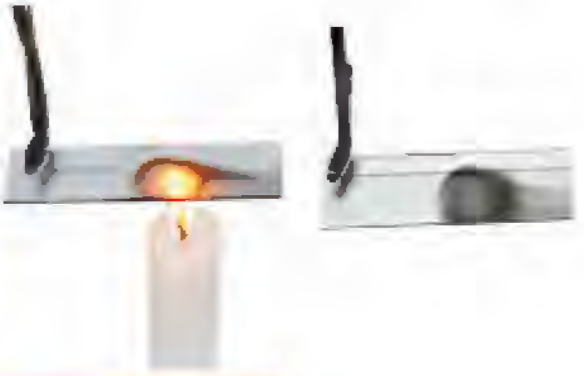


Fig. 7.10 (b)

When the candle flame is steady, introduce a clean glass plate/slide into the luminous zone of the flame **[Flg. 7.10 (b)]**. Hold it there with a pair of tongs for about 10 seconds. Then remove it. What do you observe?

Fig. 7.10 (c)

A circular blackish ring is formed on the glass plate/slide. It indicates the deposition

of unburnt carbon particles present in the luminous zone of the flame.

Hold a thin long copper wire just inside the flame for about 30 seconds **[Fig. 7.10 (c)]**.

Notice that the portion of the copper wire just outside the flame gets red hot. Does it indicate that the non-luminous zone of the flame has a high temperature? In fact, this part of the flame is the hottest part **[Fig. 7.10(d)]**.

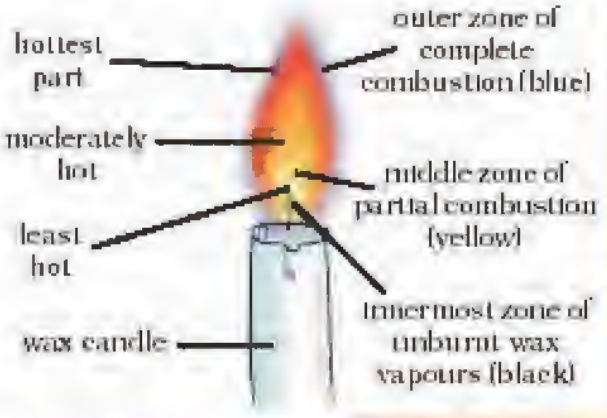


Fig. 7.10 (d): Different Zones of Candle Flame

Goldsmiths blow the outermost zone of a flame with a metallic blow-pipe for melting gold and silver **(Fig. 7.11)**. Why do they use the outermost zone of the flame?

Fig. 6.11 : Goldsmith Blowing Through a Metallic Pipe

Table 7.3 Types of Fuels

S. No.	Solid Fuels	Liquid Fuels	Gaseous Fuels
1.	Coal	Kerosene oil	Natural gas
2.			
3.			

7.6 What is a Fuel?

Recall that the sources of heat energy for domestic and industrial purposes are mainly wood, charcoal, petrol, kerosene, etc. These substances are called **fuels.** A good fuel is one which is readily available. It is cheap. It burns easily in air at a moderate rate. It produces a large amount of heat. It does not leave behind any undersirable substances.

There is probably no fuel that could be considered as an **ideal fuel**. We should look for a fuel which fulfils most of the requirements for a particular use.

Fuels differ in their cost. Some fuels are cheaper than others.

Make a list of fuels familiar to you. Group them as solid, liquid and gaseous fuels as in **Table 7.3**.

7.7 Fuel Efficiency

Suppose you were asked to boil a given quantity of water using cow dung, coal and LPG as fuel. Which fuel would you prefer? Give your reason. You may take the help of your parents. Do these three fuels produce the same amount of heat? The amount of heat energy produced on complete combustion of 1 kg of a fuel is called its

calorific value. The calorific **value** of a fuel is expressed in a unit called **kilojoule per kg** (kJ/kg). Calorific values of some fuels are given in **Table 7.4.**

Table 7.4 : Calorific Values of Different Fuels

Fuel	Calorific Value (kJ/kg)
Cow dung cake	6000-8000
Wood	17000-22000
Coal	25000-33000
Petrol	45000
Kerosene	45000
Diesel	45000
Methane	50000
CNG	50000
LPG	55000
Biogas	35000-40000
Hydrogen	150000

Burning of Fuels Leads to Harmful Products

The increasing fuel consumption has harmful effects on the environment.

1. Carbon fuels like wood, coal, petroleum release unburnt carbon particles.

For centuries, wood was used as domestic and industrial fuel. But now it has been replaced by coal and other fuels like LPG. In many rural parts of our country, people still use wood as a fuel because of its easy availability and low cost. However, burning of wood gives a lot of smoke which is very harmful for human beings. It causes respiratory problem. Also, trees provide us with useful substances which are lost when wood is used as fuel. Moreover cutting of trees leads to **deforestation** which is quite harmful to the environment.

These fine particles are dangerous pollutants causing respiratory diseases, such as asthma.

2. Incomplete combustion of these fuels gives carbon monoxide gas. It is a very poisonous gas. It is dangerous to burn coal in a closed room. The carbon monoxide gas produced can kill persons sleeping in that room.

Oh! So, that is why we are advised never to sleep in a room with burning or smouldering coal fire in it.

3. Combustion of most fuels releases carbon dioxide in the environment. Increased concentration of carbon dioxide in the air is believed to cause **global warming.**

Global warming is the rise in temperature of the atmosphere of the earth. This results, among other things, in the melting of polar glaciers, which leads to a rise in the sea level, causing floods in the coastal areas. Low lying coastal areas may even be permanently submerged under water.

4. Burning of coal and diesel releases sulphur dioxide gas. It is an extremely suffocating and corrosive gas. Moreover, petrol engines give off gaseous oxides of nitrogen. Oxides of sulphur and nitrogen dissolve in rain water and form acids. Such rain is called **acid rain.** It is very harmful for crops, buildings and soil.

The use of diesel and petrol as fuels in automobiles is being replaced by CNG (Compressed Natural Gas), because CNG produces the harmful products in very small amounts. CNG is a cleaner fuel.

KEYWORDS

ACID RAIN
CALORIFIC VALUE
COMBUSTION
DEFORESTATION
EXPLOSION
FLAME
FIRE EXTINGUISHER
FUEL
FUEL EFFICIENCY
GLOBAL WARMING
IDEAL FUEL
IGNITION TEMPERATURE
INFLAMMABLE SUBSTANCES

WHAT YOU HAVE LEARNT

- The substances which burn in air are called combustible.
- Oxygen (in air) is essential for combustion.
- During the process of combustion, heat and light are given out.
- Ignition temperature is the lowest temperature at which a combustible substance catches fire.
- Inflammable substances have very low ignition temperature.
- Fire can be controlled by removing one or more requirements essential for producing fire.
- Water is commonly used to control fires.
- Water cannot be used to control fires involving electrical equipments or oils.
- There are various types of combustions such as rapid combustion, spontaneous combustion, explosion, etc.
- There are three different zones of a flame - dark zone, luminous zone and non-luminous zone.
- An ideal fuel is cheap, readily available, readily combustible and easy to transport. It has high calorific value. It does not produce gases or residues that pollute the environment.
- Fuels differ in their efficiency and cost.
- Fuel efficiency is expressed in terms of its calorific value which is expressed in units of kilojoule per kg.
- Unburnt carbon particles in air are dangerous pollutants causing respiratory problems.
- Incomplete combustion of a fuel gives poisonous carbon monoxide gas.
- Increased percentage of carbon dioxide in air has been linked to global warming.
- Oxides of sulphur and nitrogen produced by the burning of coal, diesel and petrol cause acid rain which is harmful for crops, buildings and soil.

Exercises

1. List conditions under which combustion can take place ?
2. Fill in the blanks:
   (a) Burning of wood and coal causes of air.
   (b) A liquid fuel, used in homes is .
   (c) Fuel must be heated to its before it starts burning.
   (d) Fire produced by oil cannot be controlled by .
3. Explain how the use of CNG in automobiles has reduced pollution in our cities ?
4. Compare LPG and wood as fuels ?
5. Give reasons:

(a) Water is not used to control fires involving electrical equipment.

(b) LPG is a better domestic fuel than wood.

(c) Paper by itself catches fire easily whereas a piece of paper wrapped around an aluminium pipe does not.

6. Make a labelled diagram of a candle flame and name different zones of a flame.
7. Name the unit in which the calorific value of a fuel is expressed.
8. Explain how CO_2 is able to control fires.
9. It is difficult to burn a heap of green leaves but dry leaves catch fire easily. Explain.
10. Which zone of a flame does a goldsmith use for melting gold and silver and why?
11. In an experiment 4.5 kg of a fuel was completely burnt. The heat produced was measured to be 180,000 kJ. Calculate the calorific value of the fuel.
12. Can the process of rusting be called combustion? Discuss.
13. Abida and Ramesh were doing an experiment in which water was to be heated in a beaker. Abida kept the beaker near the wick in the yellow part of the candle flame. Ramesh kept the beaker in the outermost part of the flame. Abida kept the beaker in the middle part of the flame. Whose water will get heated in a shorter time?

Extended Learning — Activities and Projects

1. Survey the availability of various fuels in your locality. Find out their cost per kg and prepare a tabular chart showing how many kJ of various fuels you can get for every rupee.
2. Find out the number, type and location of fire extinguishers available in your school, nearby shops and factories. Write a brief report about the preparedness of these establishments to fight fire.
3. Survey 100 houses in your area. Find the percentage of households using LPG, kerosene, wood and cattledung as fuel.

4. Talk to people who use LPG at home. Find out what precautions they take in using LPG.
5. Make a model of a fire extinguisher. Place a short candle and a slightly taller candle in a small dish filled with baking soda. Place the dish at the bottom of a large bowl. Light both the candles. Then pour vinegar into the dish of baking soda. Take care. Do not pour vinegar on the candles. Observe the following reaction. What happens to the candles? Why? In what order?

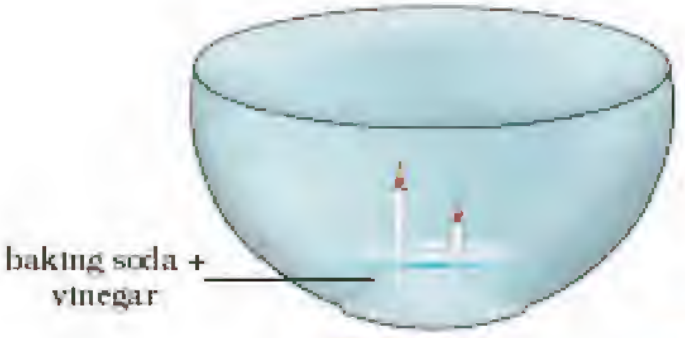


Fig. 7.12

For more information, visit:

www.newton.dep.anl.gov/askasci/chem03/chem03767.htm

http://www.einstrumentsgroup.com/gas_analyzers/combustion/what-is-combustion.php

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CHAPTER - 8

CHEMICAL EFFECTS OF ELECTRIC CURRENT

Your elders might have cautioned you against touching an electrical appliance with wet hands. But do you know why it is dangerous to touch an electrical appliance with wet hands?

We have learnt earlier that the materials, which allow electric current to pass through them, are good conductors of electricity. On the other hand, materials, which do not allow electric current to pass through them easily, are poor conductors of electricity.

We use a tester **(Fig.8.1)** to test whether a particular material allows the electric current to pass through it or not. Do you know how the tester help us in deciding that?

We find that metals such as copper and aluminium conduct electricity whereas materials such as rubber, plastic and wood do not conduct electricity. However, so far we used our tester to test materials which were in solid state. But what about liquids? Do liquids also conduct electricity? Let us find out.

Yasir and Saba want to remind you that one should not experiment with the electric supply from the mains or a generator or an inverter. Use only electric cells for all the activities suggested here.

8.1 Do Liquids Conduct Electricity?

To test whether a liquid allows electric current to pass through it or not, we can use the same tester **(Fig. 8.1)**. However, replace the cell by a battery. Also, before using the tester we should check whether it is working or not.

Activity 8.1

Join the free ends of the tester together for a moment. This completes the circuit of the tester and the bulb should glow. However, if the bulb does not glow, it means that the tester is not working. Can you think of the possible reasons? Is it possible that the

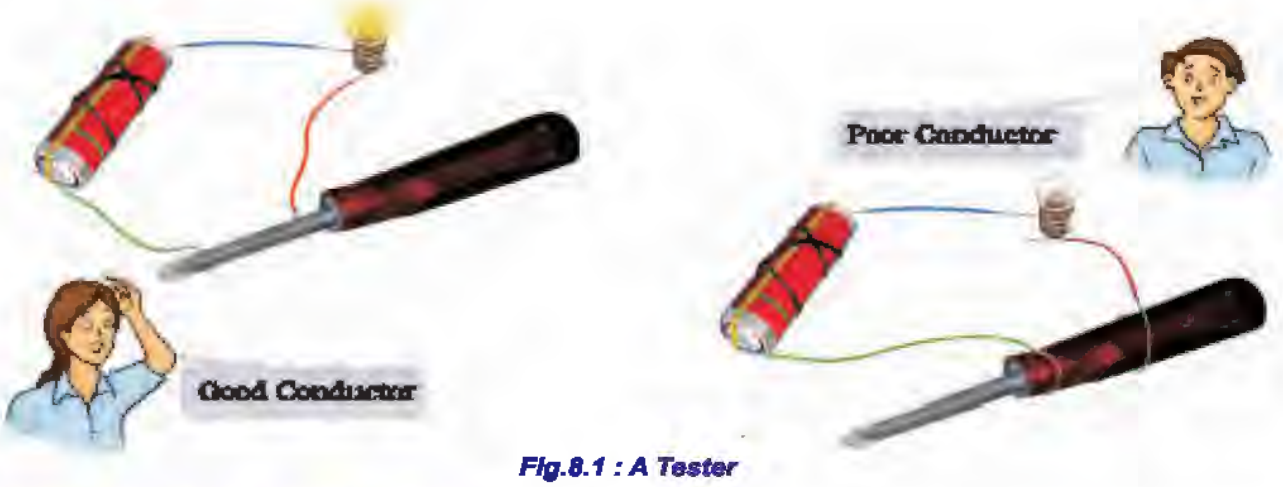


Fig.8.1 : A Tester

connections are loose? Or, the bulb is fused? Or, your cells are used up? Check that all the connections are tight. If they are, then replace the bulb with another bulb. Now test if the tester is working or not. If it is still not working then replace the cells with fresh cells.

Now that our tester is working, let us use it to test the various liquids.

(Caution: While checking your tester, do not join its free ends for more than a few seconds. Otherwise the cells of the battery will drain very quickly.)

Activity 8.2

Collect a few small plastic or rubber caps of discarded bottles and clean them. Pour one teaspoon of lemon juice or vinegar in one cap. Bring your tester over this cap and let the ends of the tester dip into lemon juice or vinegar as shown in **Fig.8.2.**

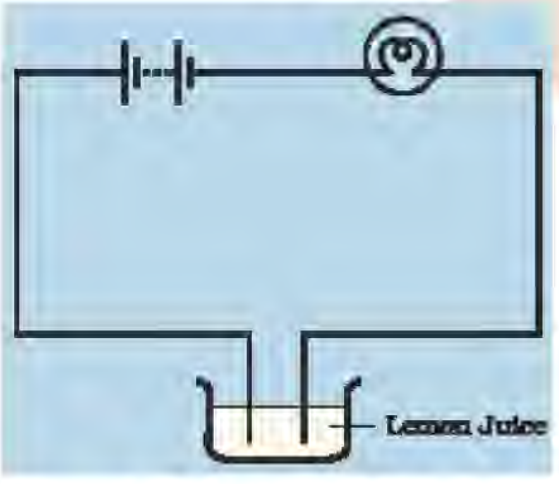


Fig. 8.2 : Testing Conduction of Electricity in Lemon Juice or Vinegar

Take care that the ends are not more than 1 cm apart but at the same time do not touch each other. Does the bulb of the tester glow? Does lemon juice or vinegar conduct electricity? How would you classify lemon juice or vinegar— a good conductor or a poor conductor?

When the liquid between the two ends of the tester allows the electric current to pass, the circuit of the tester becomes complete. The current flows in the circuit and the bulb glows. When the liquid does not allow the electric current to pass, the circuit of the tester is not complete and the bulb does not glow.

In some situations even though the liquid is conducting, the bulb may not glow. It may have happened in Activity 8.2. What can be the reason?

Do you remember why the bulb glows when the electric current passes through it? Due to the heating effect of current, the filament of the bulb gets heated to a high temperature and it starts glowing. However, if the current through a circuit is too weak, the filament does not get heated sufficiently and it does not glow. And why is the current in the circuit weak? Well, though a material may conduct electricity, it may not conduct it as easily as a metal. As a result, the circuit of the tester may be complete and yet the current through it may be too weak to make the bulb glow. Can we make another tester which can detect a weak current?

You may use an LED **(Fig. 8.3)** in place of the electric bulb in the tester of **Fig. 8.2**. LED glows even when a weak electric current flows through it.

There are two wires (called leads) attached to an LED. One lead is slightly longer than the other. Remember that while connecting to a circuit, the longer lead is always connected to the positive terminal of the battery and the shorter lead is

connected to the negative terminal of the battery.

Fig. 8.3 : LEDs

We can use another effect of an electric current to make another kind of tester. Do you recall that electric current produces a magnetic effect? What happens to a compass needle kept nearby when current flows in a wire? Even if the current is small, the deflection of the magnetic needle can be seen. Can we make a tester using the magnetic effect of currents? Let us find out.

Activity 8.3

Take the tray from inside a discarded matchbox. Wrap an electric wire a few times around the tray. Place a small compass needle inside it. Now connect one free end of the wire to the terminal of a battery. Leave the other end free. Take another piece of wire and connect it to the other terminal of the battery **(Fig. 8.4)**.

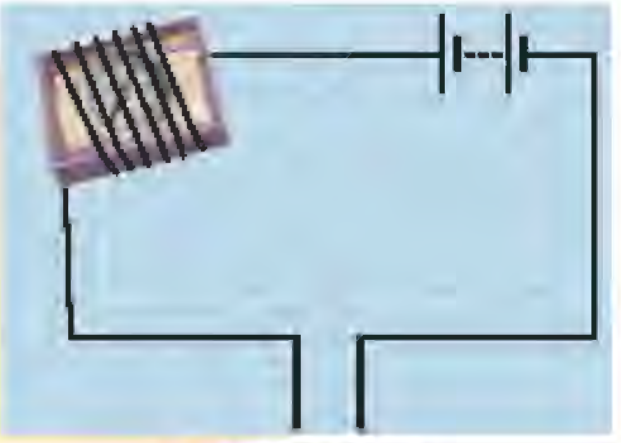


Fig 8.4 : Another Tester

Join the free ends of two wires momentarily. The compass needle should show deflection. Your tester with two free ends of

Table 8.1 : Good/Poor Conducting Liquids

S.No	Material	Compass Needle Shows Deflection (Yes/No)	Good Conductor/ Poor Conductor
1.	Lemon Juice	Yes	Good Conductor
2.	Vinegar		
3.	Tap Water		
4.	Vegetable Oil		
5.	Milk		
6.	Honey		
7.			
8.			
9.			
10.			

the wire is ready.

Now repeat Activity 8.2 using this tester. Do you find a deflection in the compass needle the moment you dip the free ends of the tester in lemon juice?

Take out the ends of the tester from the lemon juice, dip them in water and then wipe them dry. Repeat the activity with other liquids such as tap water, vegetable oil, milk, honey. (Remember to wash and wipe dry the ends of tester after testing each liquid). In each case observe whether the magnetic needle shows deflection or not. Record your observations in **Table 8.1.**

From **Table 8.1**, we find that some liquids are good conductors of electricity and some are poor conductors.

When the free ends of the tester do not touch each other, there is an air gap between them. Saba knows that air is a poor conductor of electricity. But she has also read that during lightening, an electric current passes through air. She wonders if air is indeed a poor conductor under all conditions. This makes Yasir ask whether other materials classified as poor conductors also allow electricity to pass under certain conditions.

Actually, under certain conditions most materials can conduct. That is why it is preferable to classify materials as good conductors and poor conductors instead of classifying as conductors and insulators.

We have tested the conduction of electricity through tap water. Let us now test the conduction of electricity through distilled water.

Activity 8.4

Take about two teaspoonfuls of distilled water in a clean and dry plastic or rubber cap of a bottle. (You may obtain distilled water from your school science lab. You may also get distilled water from a medical store or a doctor or a nurse).

Use the tester to test whether distilled water conducts electricity or not. What do you find? Does distilled water conduct electricity? Now dissolve a pinch of common salt in distilled water. Again test. What do you conclude this time?

When salt is dissolved in distilled water, we obtain salt solution. This is a conductor of electricity.

The water that we get from sources such as taps, hand pumps, wells and ponds is not pure. It may contain several salts sufficiently and it does not glow. And why is the current in the circuit weak ? Well, though a material may conduct electricity, it may not conduct it as easily as a metal. As a result, the circuit of the tester may be complete and yet the current through it may be too weak to make the bulb glow.

Small amounts of mineral salts are naturally present in it. This water is thus a good conductor of electricity. On the other hand, distilled water is free of salts and is a poor conductor.

Small amounts of mineral salts present naturally in water are beneficial for human health. However, these salts make water conducting. So, we should never handle electrical appliances with wet hands or while standing on a wet floor.

We have found that common salt, when dissolved in distilled water, makes it a good conductor. What are the other substances which, when dissolved in distilled water, make it conducting? Let us find out.

Caution: Do the next activity under the supervision of your teacher/parent or some elderly person, because the use of acid is involved in it.

Activity 8.5

Take three clean plastic or rubber caps of bottles. Pour about two teaspoonfuls of distilled water in each of them. Add a few drops of lemon juice or dilute hydrochloric acid to distilled water in one cap. Now in the second cap containing distilled water, add a few drops of a base such as caustic soda or potassium iodide. Add a little sugar to the distilled water in the third cap and dissolve it. Test which solutions conduct electricity and which do not. What results do you obtain?

Most liquids that conduct electricity are solutions of acids, bases and salts.

When an electric current flows through a conducting solution, does it produce an effect on the solution?

8.2 Chemical Effects of Electric Current

You might know some effects of electric current. Can you list these effects? What effect does the current produce when it flows through a conducting solution? Let us find out.

Activity 8.6

Take out carbon rods carefully from two discarded cells. Clean their metal caps with sand paper. Wrap copper wires around the metal caps of the carbon rods and join them to a battery **(Fig. 8.5)**. We call these two rods **electrodes**.

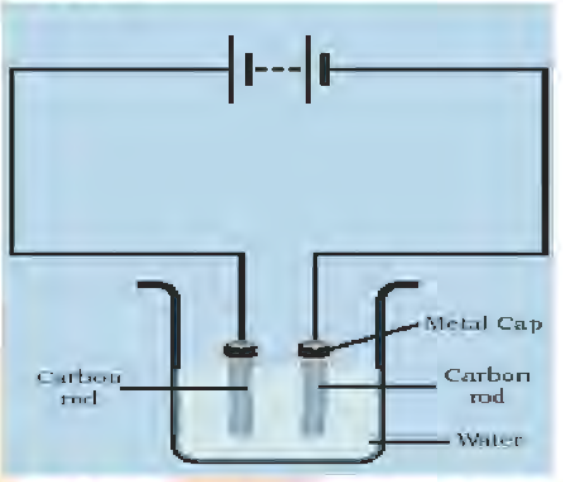


Fig.8.5 : Passing Current Through Water

(Instead of carbon rods, you may take two iron nails about 6 cm long). Pour a cupful of water in a glass/plastic bowl. Add a teaspoonful of salt or a few drops of lemon juice to water to make it more conducting. Now immerse the electrodes in this solution. Make sure that the metal caps of the carbon rods are outside the water. Wait for 3-4 minutes. Observe the electrodes carefully. Do you notice any gas bubbles near the electrodes? Can we call the change taking place in the solution a chemical change? Try to know the definition of a chemical change?

In 1800, a British chemist, William Nicholson (1753–1815), had shown that if electrodes were immersed in water, and a current was passed, bubbles of oxygen and hydrogen were produced. Oxygen bubbles formed on the electrode connected to the positive terminal of the battery and hydrogen bubbles formed on the other electrode.

The passage of an electric current through a conducting solution causes chemical reactions. As a result, bubbles of a gas may be formed on the electrodes. Deposits of metal may be seen on electrodes. Changes of colour of solutions may occur. The reaction would depend on what solution and electrodes are used. These are some of the chemical effects of the electric current.

Once, Yasir decided to test whether some fruits and vegetables also conduct electricity or not. He cut a potato into two halves and inserted

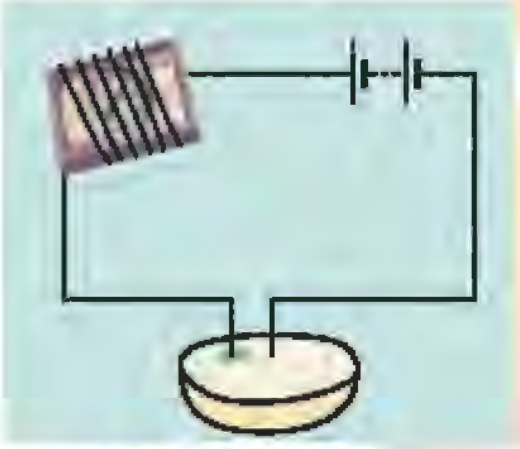


Fig. 8.6 : Testing Potato

the copper wires of a tester into it. Just then his mother called him and he forgot to take out the wires of the tester inserted into the potato. When he came back after half an hour, he noticed that there was a greenish blue spot on the potato around one wire whereas there was no such spot around the other wire.

He was surprised with this Observation and along with Saba repeated this activity many times. They found that it was always the wire connected to the positive tarminal, which had greenish blue spot around it. They felt that this discovery was very useful because it could be used for identifying the positive terminal of a cell or a battery concealed in a box. They decided to report their finding to a children's magazine.

Remember that Yasir set out to test whether potato conducted electricity or not. What he found was that current produced a chemical effect in the potato. To him this was very exciting. In fact, this is how science sometimes works. You are looking for something and you discover something else. Many important discoveries have been made in this manner.

8.3 Electroplating

Recall that a brand new bicycle has shiny handlebar and wheel rims. However, if these are accidentally scratched, the shiny coating comes off revealing a not so shiny surface beneath. You might have also seen women using ornaments, which appear to be made of gold. However, with repeated use, the gold coating wears off, revealing silver or some other metal beneath.

In both these cases, a metal has a coating of another metal. Do you wonder how a layer of one metal can be deposited on top of another? Well, let us try doing it ourselves.

Activity 8.7

We will need copper sulphate and two copper plates of size around 10 cm × 4 cm. Take 250 mL of distilled water in a clean and dry beaker. Dissolve two teaspoonfuls of copper sulphate in it. Add a few drops of dilute sulphuric acid to copper sulphate solution to make it more conducting. Clean copper plates with sand paper. Now rinse them with water and dry them. Connect the copper plates to the terminals of a battery and immerse them in copper sulphate solution **(Fig. 8.7)**.

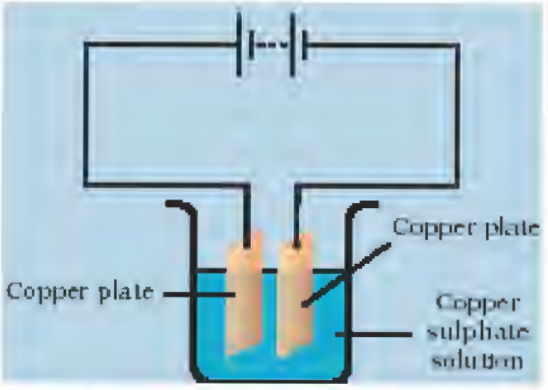


Fig.8.7 : A Simple Circuit Showing Electroplating

Allow the current to pass for about 15 minutes. Now remove the electrodes from the solution and look at them carefully. Do you find any difference in any one of them? Do you find a coating over it? What colour is the coating? Note down the terminal of the battery with which this electrode is connected.

When electric current is passed through the copper sulphate solution, copper sulphate dissociates into copper and sulphate. The free copper gets drawn to the electrode connected to the negative terminal of the battery and gets deposited on it. But what about the loss of copper from the solution? From the other electrode, a copper plate, an equal amount of copper gets dissolved in the solution. Thus, the loss of copper from the solution is restored and the process keeps going. This means that copper gets transferred from one electrode to the other.

Yasir could get only one copper plate. So he performed Activity 8.7 by connecting a carbon rod in place of the copper plate which was connected to the negative terminal of the battery. He succeeded in obtaining a coating of copper on carbon rod.

The process of depositing a layer of any desired metal on another material by means of electricity is called **electroplating**. It is one of the most common applications of chemical effects of electric current.

Electroplating is a very useful process. It is widely used in industry for coating metal objects with a thin layer of a different metal **(Fig.8.8)**. The layer of metal deposited has some desired property, which the metal of the object lacks. For example, chromium plating is done on many objects such as car parts, bath taps, kitchen gas burners, bicycle handlebars, wheel rims and many others. Chromium has a shiny appearance. It does not corrode. It resists scratches. However, chromium is expensive and it may not be economical to make the whole object out of chromium. So the object is made from a cheaper metal and only a coating of chromium over it is deposited. Jewellery makers electroplate silver and

Fig. 8.8 : Some Electroplated Objects

gold on less expensive metals. These ornaments have the appearance of silver or gold but are much less expensive.

Tin cans, used for storing food, are made by electroplating tin onto iron. Tin is less reactive than iron. Thus, food does not come into contact with iron and is protected from getting spoilt.

Iron is used in bridges and automobiles to provide strength. However, iron tends to corrode and rust. So, a coating of zinc is deposited on iron to protect it from corrosion and formation of rust.

In the electroplating factories the disposal of the used conducting solution is a major concern. It is a polluting waste and there are specific disposal guidelines to protect the environment.

KEYWORDS

ELECTRODE

ELECTROPLATING

GOOD CONDUCTOR

LED

POOR CONDUCTOR

WHAT YOU HAVE LEARNT

- Some liquids are good conductors of electricity and some are poor conductors.
- Most liquids that conduct electricity are solutions of acids, bases and salts.
- The passage of an electric current through a conducting liquid causes chemical reactions.
- The resulting effects are called chemical effects of currents.
- The process of depositing a layer of any desired metal on another material, by means of electricity, is called electroplating.

Exercises

1. Fill in the blanks

(a) Most liquids that conduct electricity are solutions of , _____ and _____.

(b) The passage of an electric current through a solution causes _____ effects.

(c) If you pass current through copper sulphate solution, copper gets deposited on the plate connected to the terminal of the battery.

(d) The process of depositing a layer of any desired metal on another material by means of electricity is called .

2. When the free ends of a tester are dipped into a solution, the magnetic needle shows deflection. Can you explain the reason?

3. Name three liquids, which when tested in the manner shown in **Fig.8.9**, may cause the magnetic needle to deflect.

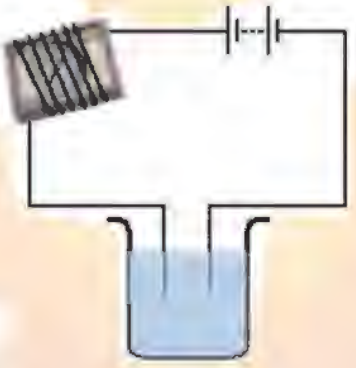


Fig. 8.9

4. The bulb does not glow in the setup shown in **Fig.8.10**. List the possible reasons. Explain your answer.

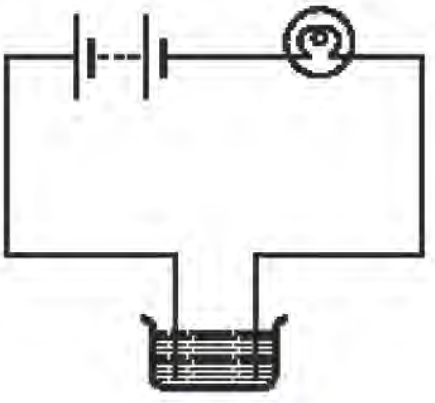


Fig. 8.10

5. A tester is used to check the conduction of electricity through two liquids, labeled A and B. It is found that the bulb of the tester glows brightly for liquid A while it glows very dimly for liquid

B. You would conclude that

(i) liquid A is a better conductor than liquid B.

(ii) liquid B is a better conductor than liquid A.

(iii) both liquids are equally conducting.

(iv) conducting properties of liquid cannot be compared in this manner.

6. Does pure water conduct electricity? If not, what can we do to make it conducting?
7. In case of a fire, before the firemen use the water hoses, they shut off the main electrical supply for the area. Explain why they do this.
8. A child staying in a coastal region tests the drinking water and also the seawater with his tester. He finds that the compass needle deflects more in the case of seawater. Can you explain the reason?
9. Is it safe for the electrician to carry out electrical repairs outdoors during heavy downpour? Explain.
10. Paheli had heard that rainwater is as good as distilled water. So she collected some rainwater in a clean glass tumbler and tested it using a tester. To her surprise she found that the compass needle showed deflection. What could be the reasons?
11. Prepare a list of objects around you that are electroplated.
12. The process that you saw in Activity 8.7 is used for purification of copper. A thin plate of pure copper and a thick rod of impure copper are used as electrodes. Copper from impure rod is sought to be transfered to the thin copper plate. Which electrode should be attached to the positive terminal of battery and why?

Extended Learning — Activities and Projects

1. Test the conduction of electricity through various fruits and vegetables. Display your result in a tabular form.
2. Repeat the Activity 8.7 with a zinc plate in place of the copper plate connected to the negative terminal of the battery. Now replace zinc plate with some other metallic object and again repeat the activity. Which metal gets deposited over which other metal? Discuss your findings with your friends.
3. Find out if there is a commercial electroplating unit in your town. What objects are electroplated there and for what purpose? (The process of electroplating in a commercial unit is much more complex than what we did in Activity 8.7). Find out how they dispose off the chemicals they discard.
4. Imagine that you are an 'entrepreneur' and have been provided a loan by a bank to set up a small electroplating unit. What object you would like to electroplate and for what purpose? (Look up the meaning of 'entrepreneur' in a dictionary).

5. Find out the health concerns associated with chromium electroplating. How are people trying to resolve them?
6. You can make a fun pen for yourself. Take a conducting metal plate and spread a moist paste of Potassium Iodide and starch. Connect the plate to a battery as shown in **Fig. 8.11**. Now using the free end of the wire, write a few letters on the paste. What do you see?

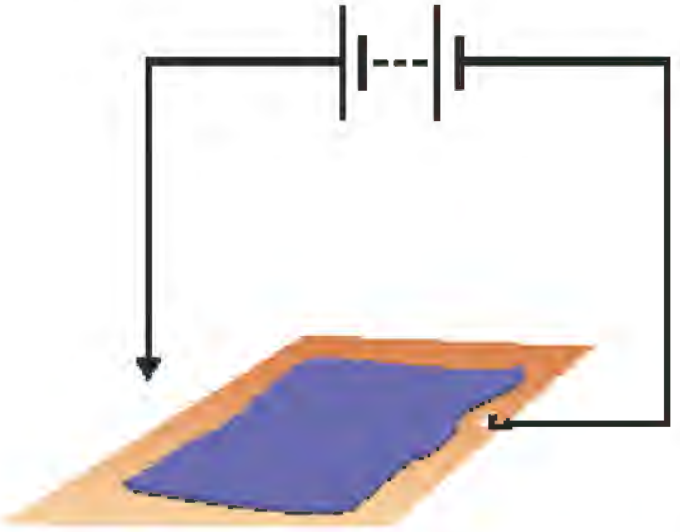


Fig. 8.11

Did You Know?

LEDs (Light Emitting Diodes) are available in many colours such as red, green, yellow, blue, white and are increasingly being used for many applications, for example in traffic signal lights. LEDs are increasingly being used for lighting. A cluster of white LEDs grouped together forms a LED light source. LED light sources consume less electricity and have longer lifetime than light bulbs and fluorescent tubes. But LED light sources are expensive, so CFLs are currently the best choice. However, CFLs contain mercury which is toxic. Therefore, used or broken CFLs need to be disposed off safely. Once the technological advances reduce the cost of LEDs, they will become the preferred lighting source.

For more information on this topic visit:

Www.tutorvista.com/content/physics/physics-iv/thermalchemical-currents/chemical-effects-current.php

www.physchem.co.za/Redox/Electrolysis.htm

electronics.howstuffworks.com/led.htm

CHAPTER - 9

FORCE AND PRESSURE

You might know how objects move. Do you know how we can decide whether an object is moving faster than the other? What does the distance moved by an object in unit time indicate? You also know that a moving object like a ball rolling on the ground slows down. Sometimes it may change its direction of motion. It is also possible that the ball may slow down and also change its direction. Did you ever wonder what makes an object to slow down or go faster, or change its direction of motion?

Let us recall some of our everyday experiences. What do you do to make a football move? What do you do to make a moving ball move faster? How does a goalkeeper stop a ball? How do fielders stop a ball hit by a batsman? A hockey player changes the direction of the moving ball with a flick of the stick **(Fig. 9.1)**. In all these situations the ball is either made to move faster or slower or its direction of motion is changed.

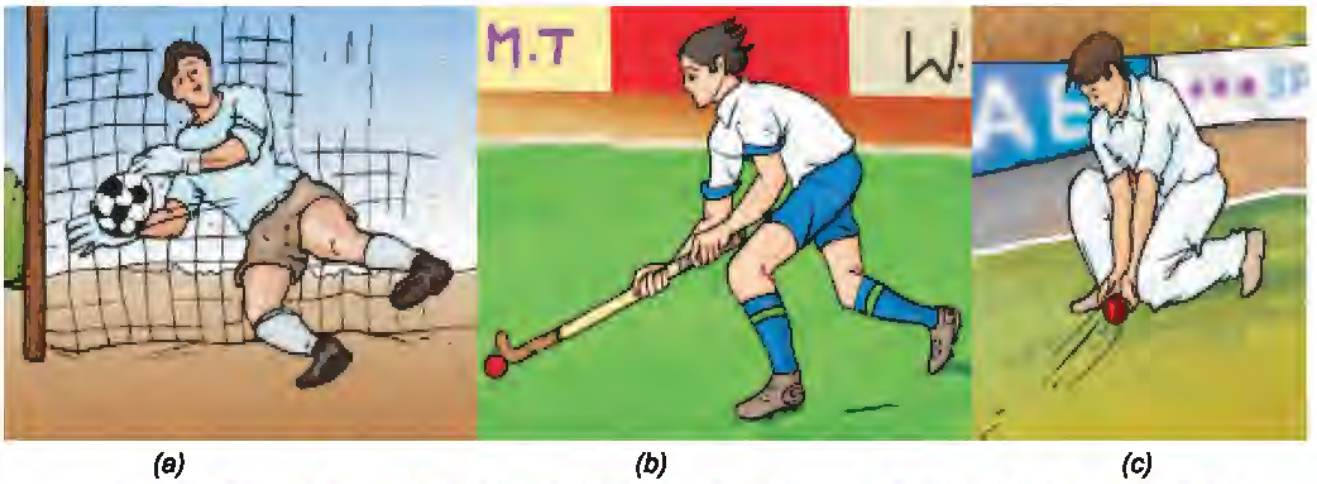
We often say that a force has been applied on a ball when it is kicked, pushed, thrown or flicked. What is a force? What can it do to bodies on which it is applied? We shall seek answers to such questions in this chapter.

9.1 Force – A Push or a Pull

Actions like picking, opening, shutting, kicking, hitting, lifting, flicking, pushing, pulling are often used to describe certain tasks. Each of these actions usually results in some kind of change in the motion of an object. Can these terms be replaced with one or more terms? Let us find out.

Activity 9.1

Table 9.1 gives some examples of familiar situations involving motion of objects. You can add more such situations or replace those given here. Try to identify action involved in each case as a push and/or a pull and record your observations. One example has been given to help you.



(a) (b) (c)

Fig. 9.1 : (a) A Goal Keeper Saving a Goal (b) A Hockey Player Flicking a Ball (c) A Fielder Stopping a Ball

Table 9.1 : Identifying Actions as Push or Pull

S .No	Description of the situation	Action : (pushing/ pulling/picking/ hitting/lifting/ lowering/flying/ kicking/ throwing/shutting/flicking)				Action can be grouped as a	
						Push	Pull
1.	Moving a book placed on a table	Pushing	Pulling	Lifting	—	Yes	Yes
2.	Opening or shutting a door						
3.	Drawing a bucket of water from a well						
4.	A football player taking a penalty kick						
5.	A cricket ball hit by a batsman						
6.	Moving a loaded cart						
7.	Opening a drawer						

Do you notice that each of the actions can be grouped as a pull or a push or both? Can we infer from this, that to move an object, it has to be pushed or pulled?

In science, a push or a pull on an object is called a **force**. Thus, we can say that the motion imparted to objects was due to the action of a force. When does a force come into play? Let us find out.

We know that a magnet attracts a piece of iron towards it. Is attraction also a pull? What about repulsion between similar poles of two magnets? Is it a pull or a push?

9.2 Forces are due to an Interaction

Suppose a man is standing behind a stationary car **(Fig.9.2)**. Will the car move due to his presence? Suppose the man now

Fig. 9.2 : A Man Standing Behind a Stationary Car

begins to push the car, that is, he applies a

force on it. The car may begin to move in the direction of the applied force.

Fig. 9.2 : A Car Being Pushed by a Man

Note that the man has to push the car to make it move.

Fig. 9.3 (a) : Who is Pushing Whom?

Fig. 9.3 shows three situations that may be familiar to you. Can you decide who is pulling and who is pushing in these cases? In **Fig. 9.3 (a)**, both the girls appear to push each other while the pair of girls in **Fig. 9.3 (b)** are trying to pull each other.

Fig 9.3 (b) : Who is Pulling Whom ?

Similarly, the cow and the man in **Fig. 9. 3(c)** appear to pull each other.

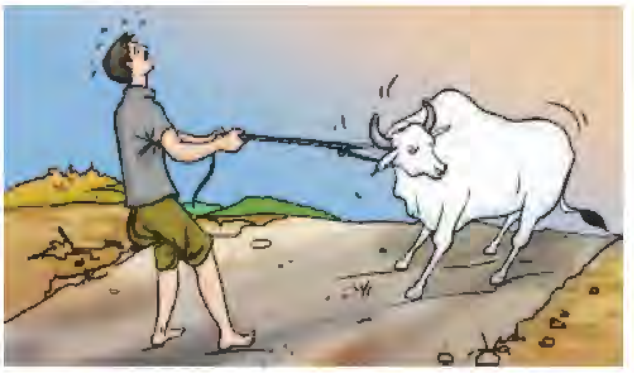


Fig 9.3 (c) : Who is Pulling Whom?

The girls in the two situations shown here are applying force on each other. Is it also true for the man and the cow?

From these examples, we can infer that at least two objects must interact for a force to come into play. Thus, an interaction of one object with another object results in a force between the two objects.

9.3 Exploring Forces

Let us try to learn more about forces.

Activity 9.2

Choose a heavy object like a table or a box, which you can move only by pushing hard. Try to push it all by yourself. Can you move it? Now ask one of your friends to help you in pushing it in the same direction **[Fig.9.4(a)]**. Is it easier to move it now? Can you explain why?

Next push the same object, but ask your friend to push it from the opposite side **[Fig.9.4 (b)]**. Does the object move? If it does, note the direction in which it moves. Can you guess which one of you is applying a larger force?

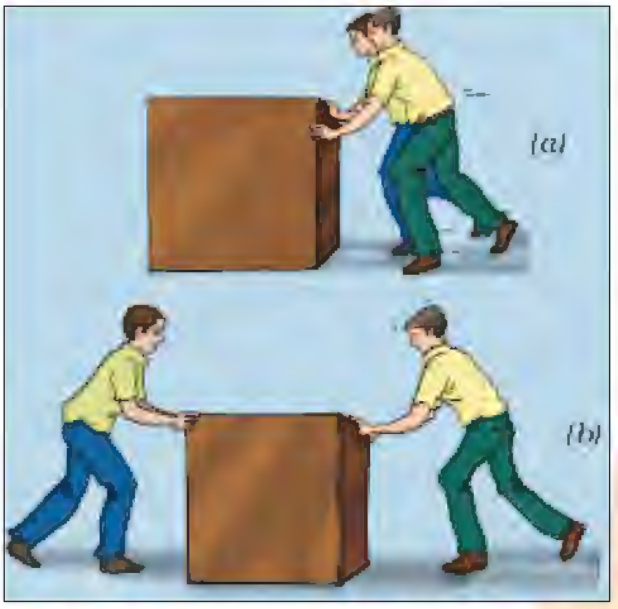


Fig. 9.4 : Two Friends Pushing a Heavy Load (a) in the Same Direction, (b) in Opposite Direction

Have you ever seen a game of tug-of war? In this game two teams pull at a rope in opposite directions **(Fig. 9.5)**. Members of both the teams try to pull the rope in their direction. Sometimes the rope simply does not move. Is it not similar to the situation shown in **Fig. 9.3 (b)**? The team that pulls harder, that is, applies a larger force, finally wins the game

Fig. 9.5 : The Rope may not Move if the Two Teams Pull at it with Equal Force

What do these examples suggest about the nature of force?

Forces applied on an object **in the same direction add** to one another. Now recall what happened when you and your friend pushed the heavy box in the same direction in Activity 9.2(a)

If the two forces act in the opposite directions on an object, the net force acting on it is the **difference between the two forces**. What did you observe in Activity 9.2(b) when both of you were pushing the heavy box from opposite directions?

Recall that in the tug-of-war when two teams pull equally hard, the rope does not move in any direction.

So, we learn that a force could be larger or smaller than the other. The strength of a force is usually expressed by its **magnitude**. We have also to specify the direction in which a force acts. Also, if the direction or the magnitude of the applied force changes, its effect also changes.

Does it mean that the net force on an object is zero if the two forces acting on it in opposite directions are equal?

In general, more than one force may be acting on an object. However, the effect on the object is due to the net force acting on it.

9.4 A Force can Change the State of Motion

Let us now find out what happens when a force acts on an object.

Activity 9.3

Take a rubber ball and place it on a levelled surface such as a table top or a concrete floor. Now, gently push the ball along the level surface **(Fig. 9.6)**. Does the ball begin to move? Push the ball again while it is still moving. Is there any change in its speed?

Does it increase or decrease?

Next, place your palm in front of the moving ball. Remove your palm as soon as the moving ball touches it. Does your palm apply a force on the ball? What happens to the speed of the ball now? Does it increase or decrease? What would happen if you let your palm hold the moving ball?

Fig. 9.6 : A Ball at Rest Begins to Move When a Force is Applied on it

You might recall similar situations. For example, while taking a penalty kick in football, the player applies a force on the ball. Before being hit, the ball was at rest and so its speed was zero. The applied force makes the ball move towards the goal. Suppose, the goalkeeper dives or jumps up to save the goal. By his action the goalkeeper tries to apply a force on the moving ball. The force applied by him can stop or deflect the ball, saving a goal being scored. If the goalkeeper succeeds in stopping the ball, its speed decreases to zero.

These observations suggest that a force applied on an object may change its speed. If the force applied on the object is in the direction of its motion, the speed of the object increases. If the force is applied in the direction opposite to the direction of motion, then it results in a decrease in the speed of the object.

We have seen children competing with one another in moving a rubber tyre or a ring by pushing it **(Fig. 9.7)**. I now understand why the speed of the tyre increases whenever it is pushed.

Fig. 9.7 : To Move a Tyre Faster it has to be Pushed Repeatedly

Now you are curious to know whether application of a force can only change the speed of an object. Let us find out.

Activity 9.4

Take a ball and place it on a level surface as you did in Activity 9.3. Make the ball move by giving it a push. Now place the ruler from your geometry box in its path as shown in **Fig. 9.8**. In doing so, you would apply a force on the moving ball. Does the ball continue to move in the same direction after it strikes the ruler? Repeat the activity and try to obstruct the moving ball by placing the ruler such that it makes different angles to its path. In each

case note your observations about the direction of motion of the ball after it strikes the ruler.

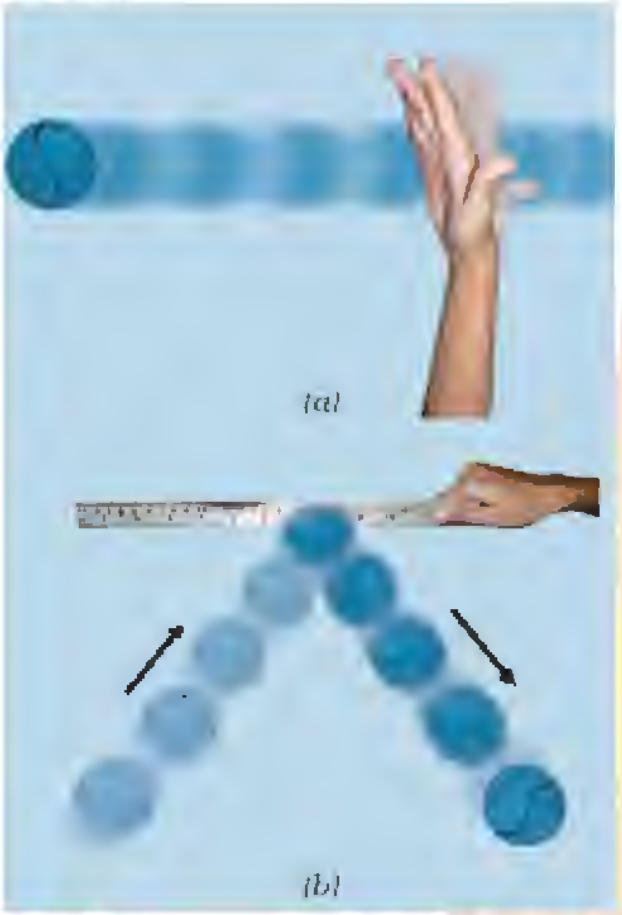


Fig. 9.8 : (a) A Ball Set in Motion by Pushing it Along a Level Surface and (b) the Direction of Motion of the Ball after it Strikes the Ruler Placed in its Path

Let us consider some more examples. In a game of volleyball, players often push the moving ball to their teammates to make a winning move. Sometimes the ball is returned to the other side of the court by pushing or smashing it. In cricket, a batsman plays his or her shot by applying a force on the ball with the bat. Is there any change in the direction of motion of the ball in these cases? In all these examples the speed and the direction of the moving ball change due to the application of a force. Can you give a few more examples of this kind?

A change in either the speed of an object, or its direction of motion, or both, is described as a **change in its state of motion**. Thus, a force may bring a **change in the state of motion of an object.**

State of Motion

The state of motion of an object is described by its speed and the direction of motion. The state of rest is considered to be the state of zero speed. An object may be at rest or in motion; both are its states of motion.

Does it mean that the application of a force would always result in a change in the state of motion of the object? Let us find out.

It is common experience that many a time application of force does not result in a change in the state of motion. For example, a heavy box may not move at all even if you apply the maximum force that you can exert. Again, no effect of force is observed when you try to push a wall.

9.5 Force can Change the Shape of an Object

Activity 9.5

Some situations have been given in Column 1 of **Table 9.2** in which objects are not free to move. Column 2 of the Table suggests the manner in which a force can be applied on each object while Column 3 shows a diagram of the action. Try to observe the effect of force in as many situations as possible. You can also add similar situations using available material from your environment. Note your observations in Columns 4 and 5 of the Table.

Table 9.2 : Studying the Effect of Force on Objects

Description of Situation	How to Apply Force	Diagram	Action of force			
			Change in state of Motion		Change in Shape	
			Yes	No	Yes	No
A lump of dough on a plate	Pressing it down with your hands					
Spring fixed to the seat of a bicycle	By sitting on the sat.					
A rubber band Suspended from a hook/nail fixed on a wall	By hanging a weight or by pulling its free end.					
A plastic or metal scale placed between two bricks	By putting a weight at the centre of the scale.					

What do you conclude from the observations noted in **Table 9.2** What happens when you apply a force on an inflated balloon by pressing it between your palms? What happens to the shape of a ball of dough when it is rolled to make a *chapati*? What happens when you press a rubber ball placed on a table? In all these examples you saw that the application of **force on an object may change its shape.**

Having performed all the above activities, you would have realised that a force

- may make an object move from rest.
- may change the speed of an object if it is moving.
- may change the direction of motion of an object.
- may bring about a change in the shape of an object.
- may cause some or all of these effects.

While a force may cause one or more of these effects, it is important to remember that none of these actions can take place without the action of a force. Thus, an object cannot move by itself, it cannot change speed by itself, it cannot change direction by itself and its shape cannot change by itself.

9.6 Contact Forces

Muscular Force

Can you push or lift a book lying on a table without touching it? Can you lift a bucket of water without holding it? Generally, to apply a force on an object, your body has to be in contact with the object. The contact may also be with the help of a stick or a piece of rope. When we push an object like a school bag or lift a bucket of water, where does the force come from? This force is caused by the action of muscles in our body. The force resulting due to the action of muscles is known as the **muscular force**.

It is the muscular force that enables us to perform all activities involving movement or bending of our body. We know that in the process of digestion, the food gets pushed through the alimentary canal. Could it be a muscular force that does it? You also know that lungs expand and contract while we inhale and exhale air during breathing. Where are these muscles located which make breathing possible? Can you list a few more examples of the force exerted by the muscles in our body?

Animals also make use of muscular force to carry out their physical activities and other tasks. Animals like bullocks, horses, donkeys and camels are used to perform various tasks for us. In performing these tasks they use muscular force **(Fig. 9.9)**.

Fig.9.9 : Muscular Force of Animals is used to Carry out Many Difficult tasks

Since muscular force can be applied only when it is in contact with an object, it is also called a **contact force**. Are there other types of contact forces? Let us find out.

Friction

Recall some of your experiences. A ball rolling along the ground gradually slows down and finally comes to rest. When we stop pedalling a bicycle, it gradually slows down and finally comes to a stop. A car or a scooter also comes to rest once its engine is switched off. Similarly, a boat comes to rest if we stop rowing it. Can you add some more such experiences?

In all these situations no force appears to be acting on the objects, yet their speed gradually decreases and they come to rest after some time. What causes a change in their state of motion? Could some force be acting on them! Can you guess the direction in which the force must be acting in each case?

The force responsible for changing the state of motion of objects in all these examples is the force of **friction**. It is the

force of friction between the surface of the ball and the ground that brings the moving ball to rest. Similarly, friction between water and the boat brings it to a stop once you stop rowing.

The force of friction always acts on all the moving objects and its direction is always opposite to the direction of motion. Since the force of friction arises due to contact between surfaces, it is also an example of a contact force.

9.7 Non-contact Forces

Magnetic Force

Activity 9.6

Take a pair of bar magnets. Place the longer side of one of the magnets over three round shaped pencils or wooden rollers as shown in **Fig.9.10.** Now bring one end of the other magnet near the end of the magnet placed on the rollers. Make sure that the two magnets do not touch each other. Observe what happens. Next, bring the other end of

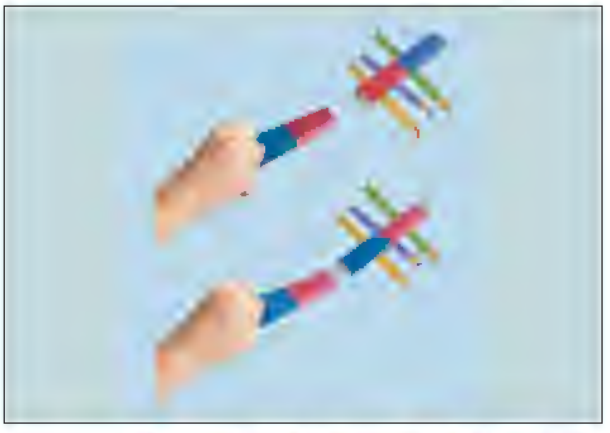


Fig.9.10 : Observing Attraction and Repulsion between Two Magnets

the magnet near the same end of the magnet placed on the rollers **(Fig.9.10)**. Note what happens to the magnet placed on the rollers every time another magnet is brought near it.

Does the magnet on the rollers begin to move when the other magnet is brought near it? Does it always move in the direction of the approaching magnet? What do these observations suggest? Does it mean that some force must be acting between the two magnets?

You know that like poles of two magnets repel each other and unlike poles attract each other. Attraction or repulsion between objects can also be seen as another form of pull or push. Do you have to bring the magnets in contact for observing the force between them? A magnet can exert a force on another magnet without being in contact with it. The force exerted by a magnet is an example of a **non-contact force.**

Similarly, the force exerted by a magnet on a piece of iron is also a noncontact force.

Electrostatic Force

Activity 9.7

Take a plastic straw and cut it into nearly two equal pieces. Suspend one of the pieces from the edge of a table with the help of a piece of thread **(Fig.9.11).** Now hold the other piece of straw in your hand and rub its free end with a sheet of paper. Bring the rubbed end of the straw near the suspended straw. Make sure that the two pieces do not touch each other. What do you observe?

Next, rub the free end of the suspended piece of straw with a Sheet of paper. Again, bring the piece of straw that was rubbed

earlier with paper near the free end of the suspended straw. What do you observe now?

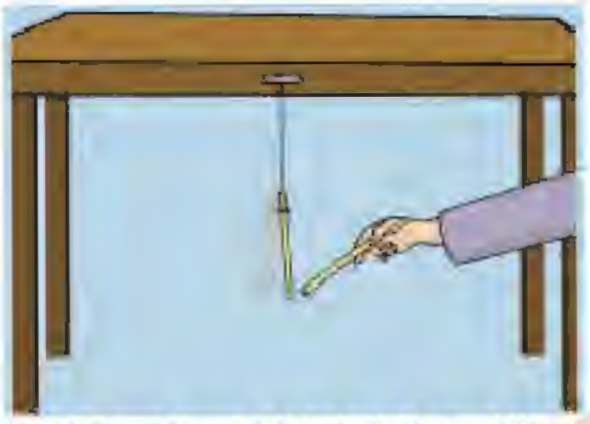


Fig.9.11 : A Straw Rubbed with Paper Attracts Another Straw but Repels If it has also been Rubbed with a Sheet of Paper

A straw is said to have acquired electrostatic charge after it has been rubbed with a sheet of paper. Such a straw is an example of a charged body.

The force exerted by a charged body on another charged or uncharged body is known as **electrostatic force.** This force comes into play even when the bodies are not in contact. The **electrostatic force**, therefore, is another example of a **non-contact force.**

C. Gravitational Force

You know that a coin or a pen falls to the ground when it slips off your hand. The leaves or fruits also fall to the ground when they get detached from the plant. Have you ever wondered why is it so?

When the coin is held in your hand it is at rest. As soon as it is released, it begins to move downwards. It is clear that the state of motion of the coin undergoes a change. Can this happen without a force acting on it? Which is this force?

Objects or things fall towards the earth because it pulls them. This force is called the **force of gravity**, or just **gravity**. This is an attractive force. The force of gravity acts on all objects. The force of gravity acts on all of us all the time without our being aware of it. Water begins to flow towards the ground as soon as we open a tap. Water in rivers flows downward due to the force of gravity.

Gravity is not a property of the earth alone. In fact, every object in the universe, whether small or large, exerts a force on every other object. This force is known as the **gravitational force.**

9.8 Pressure

You might have observed that strong winds during a storm or a cyclone can blow away even the roof-tops. You also learnt that winds and cyclones are caused by the differences in air pressure. Is there any relation between pressure and force? Let us find out.

Try to push a nail into a wooden plank by its head. Did you succeed? Try now to push the nail by the pointed end **(Fig. 9.12)**. Could you do it this time?

Fig. 9.12 : Pushing a Nail into a Wooden Plank also been Rubbed with a Sheet of Paper.

Try cutting vegetables with a blunt and a

sharp knife. Which is easier?

Do you get the feeling that the area over which the force is applied (for example, the pointed end of the nail) plays a role in making these tasks easier?

The force acting on a unit area of a surface is called **pressure.**

pressure = force / area on which it acts

At this stage we consider only those forces which act perpendicular to the surface on which the pressure is to be computed.

You can now understand why porters place on their heads a round piece of cloth, when they have to carry heavy loads **(Fig. 9.13)**. By this they increase the area of contact of the load with their head. So, the pressure on their head is reduced and they find it easier to carry the load.

Fig. 9.13 : A Porter Carrying a Heavy Load

Note that the area is in the denominator in the above expression. So, the smaller the area, larger the pressure on a surface for the same force. The area of the pointed end of the nail is much smaller than that of its head. The same force, therefore, produces a pressure sufficient to push the pointed end of the nail into the wooden plank.

Can you explain now why shoulder bags are provided with broad straps and not thin strap? And, why the tools meant for cutting and piercing always have sharp edges?

Do liquids and gases also exert pressure? Does it also depend on the area on which the force acts? Let us find out.

9.9 Pressure exerted by Liquids and Gases

Activity 9.8

Take a transparent glass tube or a plastic pipe. The length of the pipe/ tube should be about 15 cm and its diameter should be 5-7.5 cm. Also take a piece of thin sheet of a good quality rubber, say, a rubber balloon. Stretch the rubber sheet tightly over one end of the pipe. Hold the pipe at the middle, keeping it in a vertical position **(Fig.9.14)**. Ask one of your friends to pour some water in the pipe. Does the rubber sheet bulge out? Note also the height of the water column in the pipe. Pour some more water. Observe again the bulge in the rubber sheet and the height of the water column in the pipe. Repeat this process a few more times. Can you see any relation between the amount of the bulge in the rubber sheet and the height of the water column in the pipe?

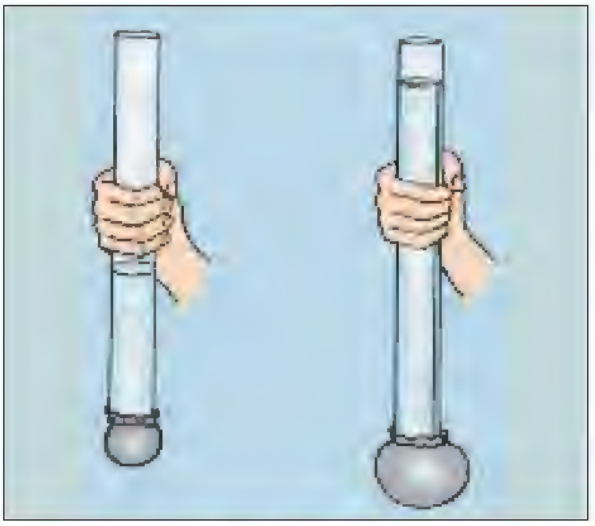


Fig.9.14 : Pressure Exerted by Water at the Bottom of the Container Depends on the Height of its Column

Activity 9.9

Take a plastic bottle. You can take a discarded water or soft drink bottle. Fix a cylindrical glass tube, a few cm long near its bottom as shown in **Fig. 9.15**. You can do so by slightly heating one end of the glass tube and then quickly inserting it near the bottom of the bottle. Make sure that the water does not leak from the joint. If there is any leakage, seal it with molten wax. Cover the mouth of the glass tube with a thin rubber sheet as you did in Activity 9.8. Now fill the bottle upto half with water. What do you observe? Why does the rubber sheet fixed to the glass tube bulge this time? Pour some more water in the bottle. Is there any change in the bulge of the rubber sheet?

Fig.9.15 : A Liquid Exerts Pressure on the Walls of the Container

Note that the rubber sheet has been fixed on the side of the container and not at the bottom. Does the bulging of the rubber sheet in this case indicate that water exerts pressure on the sides of the container as well? Let us investigate further.

Activity 9.10

Take an empty plastic bottle or a cylindrical container. You can take a used tin of talcum powder or a plastic bottle. Drill four holes all around near the bottom of the bottle. Make sure that the holes are at the same height from the bottom **(Fig. 9.16)**. Now fill the bottle with water. What do you observe?

Does the water coming out of the holes falls at the same distance from the bottle? What does this indicate?

Fig. 9.16 : Liquids Exert Equal Pressure at the Same Depth

Can you now say that **liquids exert pressure on the walls of the container?**

Do gases also exert pressure? Do they also exert pressure on the walls of their containers? Let us find out.

Have you ever seen fountains of water coming out of the leaking joints or holes in pipes supplying water. Is it not due to the pressure exerted by water on the walls of the pipes?

When you inflate a balloon, why do you have to close its mouth? What happens when you open the mouth of an inflated balloon? Suppose you have a balloon which has holes. Would you be able to inflate it? If not, why? Can we say that air exerts pressure in all directions?

Do you recall what happens to the air in the bicycle tube when it has a puncture? Do these observations suggest that air exerts pressure on the inner walls of an inflated balloon or a tube? So, we find that **gases, too, exert pressure on the walls of their container.**

9.10 Atmospheric Pressure

You know that there is air all around us. This envelop of air is known as the **atmosphere**. The atmospheric air extends up to many kilometres above the surface of the earth. The pressure exerted by this air is known as **atmospheric pressure**. We know that pressure is force per unit area. If we imagine a unit area and a very long cylinder standing on it filled with air, then the weight of the air in this cylinder is the atmospheric pressure **(Fig. 9.17)**.

Fig. 9.17 : Atmospheric Pressure is the Weight of Air in a Column of Unit Area

But, how large or small is the atmospheric pressure? Let us get an idea about its magnitude.

Activity 9.11

Take a good quality rubber sucker. It looks like a small rubber cup **(Fig.9.18)**. Press it hard on a smooth plane surface. Does it stick to the surface? Now try to pull it off the surface. Can you do it?

Fig.9.18 : A Rubber Sucker Pressed on a Surface.

When you press the sucker, most of the air between its cup and the surface escapes out. The sucker sticks to the surface because the pressure of atmosphere acts on it. To pull the sucker off the surface, the applied force should be large enough to overcome the atmospheric pressure. This activity might give you an idea about the magnitude of atmospheric pressure. In fact, it would not be possible for any human being to pull the sucker off the surface if there were no air at all between the sucker and the surface. Does it give you an idea how large the atmospheric pressure is?

If the area of my head were 10 cm × 10 cm, how much weight of air would I be carrying on my head?

The weight of air in a column of the height of the atmosphere and area 10 cm × 10 cm **(Fig. 9.19)** is as large as 1000 kg.

Fig. 9.19 : Pressure of Atmosphere on Your Head

The reason we are not crushed under this weight is that the pressure inside our bodies is also equal to the atmospheric pressure and cancels the pressure from outside.

Did you know?

Otto von Guericke, a German scientist of 17th century, invented a pump to extract air out of the vessel. With the help of this pump, he demonstrated dramatically the force of the air pressure. He joined two metallic hemispheres of 51 cm diameter each and pumped air out of them. Then he employed eight horses on each hemisphere to pull them apart **(Fig. 9.20)**. So great is the force of air pressure that the hemispheres could not be pulled apart.

Fig. 9.20 : Horses Pulling the Hemispheres

KEYWORDS

ATMOSPHERIC PRESSURE
CONTACT FORCE
ELECTROSTATIC FORCE
FORCE
FRICTION
GRAVITATIONAL FORCE
GRAVITY
MAGNETIC FORCE
MUSCULAR FORCE
NON-CONTACT FORCE
PRESSURE
PULL
PUSH

WHAT YOU HAVE LEARNT

- Force could be a push or a pull.
- A force arises due to the interaction between two objects.
- Force has magnitude as well as direction.
- A change in the speed of an object or the direction of its motion or both implies a change in its state of motion.
- Force acting on an object may cause a change in its state of motion or a change in its shape.
- A force can act on an object with or without being in contact with it.
- Force per unit area is called pressure.
- Liquids and gases exert pressure on the walls of their containers.
- The pressure exerted by air around us is known as atmospheric pressure.

Exercises

1. Give two examples each of situations in which you push or pull to change The state of motion of objects ?
2. Give two examples of situations in which applied force causes a change in the shape of an object ?
3. **Fill in the blanks in the following statements:**
   (a) To draw water from a well we have to ——— at the rope.
   (b) A charged body ——— an uncharged body towards it.
   (c) To move a loaded trolley we have to ——— it.
   (d) The north pole of a magnet ——— the north pole of another magnet.
4. An archer stretches her bow while taking aim at the target. She then releases the arrow, which begins to move towards the target. Based on this information fill up the gaps in the

following statements using the following terms:

muscular, contact, non-contact, gravity, friction, shape, attraction

(a) To stretch the bow, the archer applies a force that causes a change in its ——.

(b) The force applied by the archer to stretch the bow is an example of ——— force.

(c) The type of force responsible for a change in the state of motion of the arrow is an example of a ———— force.

(d) While the arrow moves towards its target, the forces acting on it are due to ———— and that due to ———— of air.

5. In the following situations identify the agent exerting the force and the object on which it acts. State the effect of the force in each case.

(a) Squeezing a piece of lemon between the fingers to extract its juice.

(b) Taking out paste from a toothpaste tube.

(c) A load suspended from a spring while its other end is on a hook fixed to a wall.

(d) An athlete making a high jump to clear the bar at a certain height.

6. A blacksmith hammers a hot piece of iron while making a tool. How does the force due to hammering affect the piece of iron?

7. An inflated balloon was pressed against a wall after it has been rubbed with a piece of synthetic cloth. It was found that the balloon sticks to the wall. What force might be responsible for the attraction between the balloon and the wall?

8. Name the forces acting on a plastic bucket containing water held above ground level in your hand. Discuss why the forces acting on the bucket do not bring a change in its state of motion.

9. A rocket has been fired upwards to launch a satellite in its orbit. Name the two forces acting on the rocket immediately after leaving the launching pad.

10. When we press the bulb of a dropper with its nozzle kept in water, air in the dropper is seen to escape in the form of bubbles. Once we release the pressure on the bulb, water gets filled in the dropper. The rise of water in the dropper is due to

(a) pressure of water

(b) gravity of the earth

(c) shape of rubber bulb

(d) atmospheric pressure

Extended Learning — Activities and Projects

1. Make a 50 cm × 50 cm bed of dry sand about 10 cm in thickness. Make sure that its top surface is levelled. Take a wooden or a plastic stool. Cut two strips of graph paper each with a width of 1 cm. Paste them vertically on any leg of the stool - one at the bottom and the other from the top. Now gently put the stool on the sand bed with its legs resting on the sand. Increase the size of sand bed if required. Now put a load, say a school bag full of books, on the seat of the stool. Mark the level of sand on the graph strip. This would give you the depth, if any, to which the legs of stool sink in sand. Next, turn the stool upside down so that now it rests on its seat on the sand bed. Note the depth to which the stool sinks now. Next, put the same load on the stool and note the depth to which it sinks in the sand. Compare the pressure exerted by the stool in the two situations.
2. Take a tumbler and fill it with water. Cover the mouth of the tumbler with a thick card similar to that of a postcard. Hold the tumbler with one hand while keeping the card pressed to its mouth with your other hand. Turn the tumbler upside down while keeping the card pressed to its mouth. Make sure that the tumbler is held vertical. Gently remove the hand pressing the card. What do you observe? Does the card get detached allowing the water to spill? With a little practice you will find that the card continues to hold water in the tumbler even after it is not supported by your hand. Also try this activity by using a piece of cloth to hold the tumbler in an upside down position **(Fig. 9.21)**.

Fig. 9.21

3. Take 4-5 plastic bottles of different shapes and sizes. Join them together with small pieces of glass or rubber tube as shown in **Fig. 9.22**. Keep this arrangement on a level surface. Now pour water in any one of the bottles. Note whether the bottle in which water is poured gets filled first or all the bottles get filled up simultaneously. Note the level of water in all the bottles from time to time. Try to explain your observations.

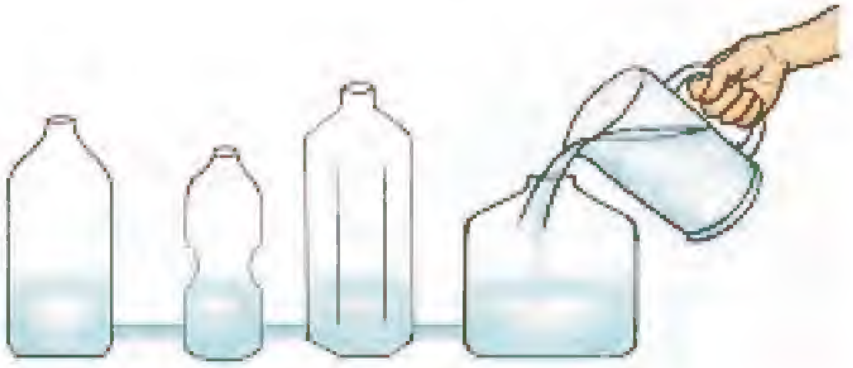


Fig. 9.22

For more information on force and pressure visit:

www.glenbrook.k12.il.us/gbssci/phys/class/newtlauws/ u2l2a.html

www.hatesville.k12.in.us/physics/phyNet/Mechanics/Newton2/Pressure.html

Kids.earth.nasa.gov/archive/air_pressure/

CHAPTER - 10

REACHING THE AGE OF ADOLESCENCE

In the previous chapter 4, you have learnt how animals reproduce. It is only after 'growing up' to a certain age that human beings and many other animals can reproduce. Why can humans reproduce only after a certain age?

In this chapter, you will learn about changes that take place in the human body after which a person becomes capable of reproduction.

In Chapter 4, you have learnt about human reproductive organs. Here, we shall discuss the role that hormones play in bringing about changes that make a child grow into an adult.

10.1 Adolescence and Puberty

Yasir was celebrating his 12th birthday. After his friends left, Yasir and Saba began chatting with their parents. Saba studies in an all-girls school. She started laughing. She remarked that many of Yasir's school friends, whom she met after a year, had suddenly shot up in height. Some of them were looking very funny with a hairy line above their lips. Her mother explained that the boys had grown up.

Growth begins from the day one is born. But upon crossing the age of 10 or 11, there is a sudden spurt in growth which becomes noticeable. The changes taking place in the body are a part of growing up. They indicate that you are no longer a child but are on the way to becoming an adult.

I wonder how long this period marked by changes in the body will last!

It is a strange period of life when you are neither a child nor an adult. I wonder whether this period between childhood and adulthood had a special name!

Growing up is a natural process. The period of life, when the body undergoes changes, leading to reproductive maturity, is called **adolescence.** Adolescence begins around the age of 11 and lasts upto 18 or 19 years of age. Since this period covers the 'teens' (13 to 18 or 19 years of age), adolescents are also called 'teenagers'. In girls, adolescence may begin a year or two earlier than in boys. Also, the period of adolescence varies from person to person.

The human body undergoes several changes during adolescence. These changes mark the onset of **puberty**. The most important change which marks puberty is that boys and girls become capable of reproduction. Puberty ends when an adolescent reaches reproductive maturity.

Yasir and Saba realised that sudden increase in height and hairy line above the lips in boys were signs of adolescence. They wanted to know more about other changes at puberty.

10.2 Changes at Puberty

Increase in Height

The most conspicuous change during puberty is the sudden increase in height. At this time the long bones, that is, the bones of

the arms and the legs elongate and make a person tall.

Activity 10.1

The following chart gives the average rate of growth in height of boys and girls with age. The figures in columns 2 and 3, give the percentage of the height a person has reached at the age given in column 1. For example, by the age 11, a boy has reached 81% of his probable full height, while a girl has reached 88% of her full height. These figures are only representative and there may be individual variations.

Use the Table for your friends and work out how tall they are likely to be. Find out who is likely to be the tallest and who might be the shortest in your class.

Age in Years	% of full height	
	Boys	Girls
8	72%	77%
9	75%	81%
10	78%	84%
11	81%	88%
12	84%	91%
13	88%	95%
14	92%	98%
15	95%	99%
16	98%	99.5%
17	99%	100%
18	100%	100%

Calculation for full height (cm)

$$\frac{\textit{Present height cm}}{\textit{\% of full height at this age}} \times 100$$

(as given in the chart)

Example:

A boy is 9 years old and 120 cm tall. At the end of the growth period he is likely to be

$$\frac{120}{75} \times 100 \text{ cm} = 160 \text{ cm tall}$$

Activity 10.2

Use the data given in Activity 10.1 to draw a graph. Take age on the X-axis and per cent growth in height on the Y-axis. Highlight the point representing your age on the graph. Find out the percentage of height you have already reached. Calculate the height you might eventually reach. Tally your graph with the one given here **(Fig. 10.1)**.

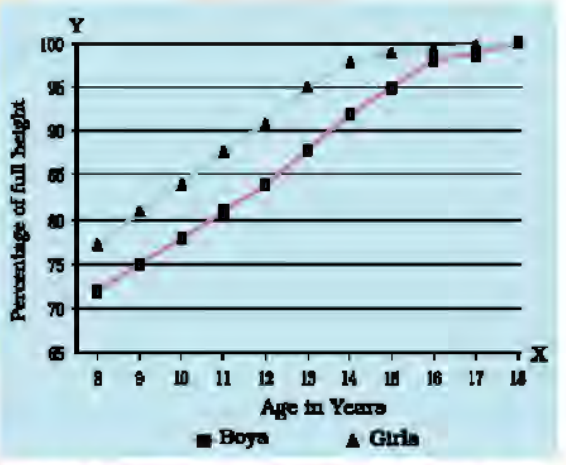


Fig. 10.1 : Graph Showing Percentage of Height with Age

Initially, girls grow faster than boys but by about 18 years of age, both reach their maximum height. The rate of growth in height varies in different individuals. Some may grow suddenly at puberty and then slow down, while others may grow gradually.

I am worried. Though I have become taller, my face looks much smaller compared to my body.

There is no need for Saba to worry.

All parts of the body do not grow at the same rate. Sometimes the arms and legs or hands and feet of adolescents look oversized and out of proportion with the body. But soon the other parts catch up and result in a proportionate body.

You must have noticed that height of an individual is more or less similar to that of some family member. This is because height depends on the genes inherited from parents. It is, however, very important to eat the right kind of food during these growing years. This helps the bones, muscles and other parts of the body get adequate nourishment for growth. You will find nutritional needs of adolescents discussed later in the lesson.

Change in Body Shape

Have you noticed that boys in your class have broader shoulders and wider chests than boys in junior classes? This is because they have entered the age of puberty when shoulders generally broaden as a result of growth. In girls, the region below the waist becomes wider.

In boys, the muscles of the body grow more prominently than in the girls. Thus, changes occurring in adolescent boys and girls are different.

Voice Change

Did you notice that sometimes the voice of some of the boys in your class cracks? At puberty, the **voice box** or the **larynx** begins to grow. Boys develop larger voice boxes. The growing voice box in boys can be seen as a protruding part of the throat called **Adam's apple (Fig.10.2)**. In girls, the larynx is hardly visible from the outside because of its small size. Generally, girls have a high pitched voice, whereas boys have a deep voice. In adolescent boys, sometimes, the muscles of the growing voice box go out of control and the voice becomes hoarse. This state may remain for a few days or weeks after which the voice becomes normal.

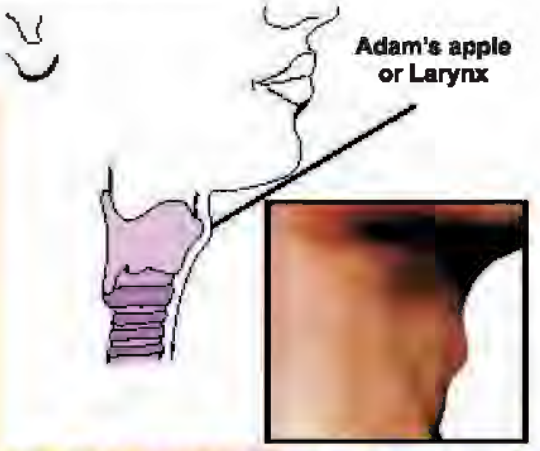


Fig. 10.2 : Adam's Apple in a Grown up Boy

Many of my classmates have a hoarse voice. Now I know why?

Increased Activity of Sweat and Sebaceous Glands

During puberty the secretion of sweat glands and sebaceous glands (oil glands) increases. Many young people get acne and pimples on the face at this time because of the increased activity of these glands in the skin.

A few glands such as sweat glands, oil glands and salivary glands release their secretions through ducts. Endocrine glands release hormones directly into the bloodstream. So, they are also termed ductless glands.

Development of Sex Organs

Look up Fig. 4.1 and 4.3 of chapter 4 which shows sex organs of humans. At puberty,

male sex organs like the testes and penis develop completely. The testes also begin to produce sperms. In girls, the ovaries enlarge and eggs begin to mature. Also ovaries start releasing mature eggs.

Reaching Mental, Intellectual and Emotional Maturity

Adolescence is also a period of change in a person's way of thinking. Adolescents are more independent than before and are also self conscious. Intellectual development takes place and they tend to spend considerable time thinking. In fact, it is often the time in one's life when the brain has the greatest capacity for learning. Sometimes, however, an adolescent may feel insecure while trying to adjust to the changes in the body and mind. But as adolescent learners, you should know that there is no reason to feel insecure. These changes are a natural part of growing up.

10.3 Secondary Sexual Characters

Testes and ovaries are the reproductive organs and they produce the gametes, that is, sperms and ova. In girls, breasts begin to develop at puberty and boys begin to grow facial hair, that is, moustaches and beard. As these features help to distinguish the male from the female they are called **secondary sexual characters**. Boys also develop hair on their chest. In both, boys and girls, hair grows under the arms and in the region above the thighs or the pubic region.

Both Yasir and Saba wish to know what initiates changes at puberty.

The changes which occur at adolescence are controlled by **hormones.** Hormones are the chemical substances. These are the secretions from **endocrine glands**, or endocrine system. The **male hormone** or **testosterone** begins to be released by the testes at the onset of puberty. This causes changes in boys about which you have just learnt, for example, the growth of facial hair. Once puberty is reached in girls, ovaries begin to produce the **female hormone** or **estrogen** which makes the breasts develop. Milk secreting glands or mammary glands develop inside the breasts. The production of these hormones is under the control of another hormone secreted from an endocrine gland called **pituitary gland.**

10.4 Role of Hormones in Initiating Reproductive Function

Endocrine glands release hormones into the bloodstream to reach a particular body part called **target site**. The target site responds to the hormone. There are many endocrine glands or ductless glands in the body.

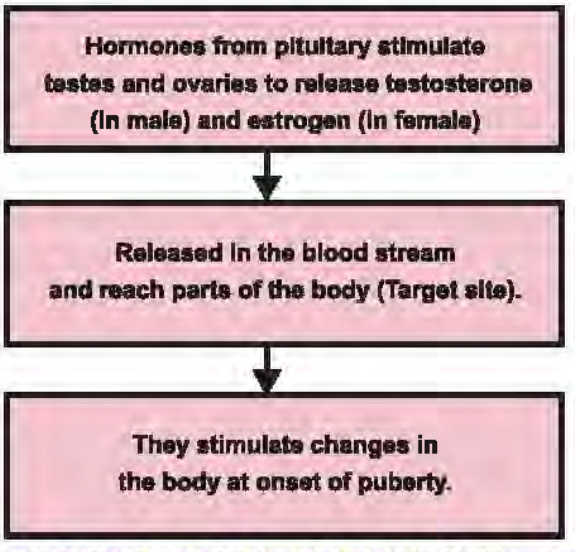


Fig. 10.3 : The Onset of Puberty is Controlled by Hormones

The testes and ovaries secrete sex hormones. You have just learnt that these hormones are responsible for the male and female secondary sexual characters. Further, the sex hormones are under the control of hormones from the pituitary gland **(Fig.10.3).** The pituitary secretes many hormones, one of which makes ova mature in the ovaries and sperms form in the testes.

Yasir and Saba have now understood that puberty marks the beginning of the reproductive period when one becomes capable of reproduction. But they want to know if reproductive life, once begun, continues, or it ends after some time.

10.5 Reproductive Phase of Life in Humans

Adolescents become capable of reproduction when their testes and ovaries begin to produce gametes. The capacity for maturation and production of gametes lasts for a much longer time in males than in females.

In females, the reproductive phase of life begins at puberty (10 to 12 years of age) and generally lasts till the age of approximately 45 to 50 years. The ova begin to mature with the onset of puberty. One ovum matures and is released by one of the ovaries once in about 28 to 30 days. During this period, the wall of the uterus becomes thick so as to receive the egg, in case it is fertilised and begins to develop. This results in pregnancy. If fertilisation does not occur, the released egg, and the thickened lining of the uterus along with its blood vessels are shed off. This causes bleeding in women which is called **menstruation**. Menstruation occurs once in about 28 to 30 days. The first menstrual flow begins at puberty and is termed **menarche**. At 45 to 50 years of age, the menstrual cycle stops. Stoppage of menstruation is termed **menopause.** Initially, menstrual cycle may be irregular. It take some time to become regular.

Saba says that the reproductive life of a woman lasts from menarche to menopause. Is she right?

Menstrual cycle is controlled by hormones. The cycle includes the maturation of the egg, its release, thickening of uterine wall and its breakdown if pregnancy does not occur. In case the egg is fertilised it begins to divide and then gets embedded in the uterus for further development.

10.6 How Is the Sex of the Baby Determined?

I heard my mother and my aunt talking about my cousin who is going to have a baby. They were discussing whether she would give birth to a boy or a girl. I wonder what makes the fertilised egg develop either into a boy or a girl!

Boy or Girl?

Inside the fertilised egg or zygote is the instruction for determining the sex of the baby. This instruction is present in the thread-like structures, called **chromosomes** in the fertilised egg. Chromosomes are present inside the nucleus of every cell. All human beings have

23 pairs of chromosomes in the nuclei of their cells. Two chromosomes out of these are the **sex chromosomes,** named X and Y. A female has two X chromosomes, while a male has one X and one Y chromosome. The gametes (egg and sperm) have only one set of chromosomes. The unfertilised egg always has one X chromosome. But sperms are of two kinds. One kind has an X chromosome, and the other kind has a Y chromosome.

See **Fig. 10.4**. When a sperm containing X chromosome fertilises the egg, the zygote

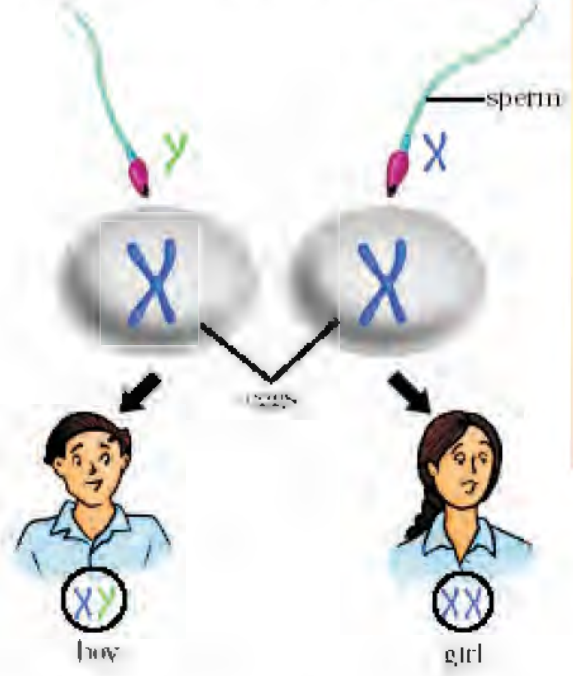


Fig. 10.4 : Sex Determination in Humans

Would have two X chromosomes and develop into a female child. If the sperm contributes a Y chromosome to the egg (ovum) at fertilisation, the zygote would develop into a male child.

Now you know that the sex chromosomes of the father determine the sex of an unborn baby. The belief that the mother is responsible for the sex of her baby is completely wrong and to blame her for this is totally unjustified.

10.7 Hormones other than Sex Hormones

Look at **Fig.10.3** again. The hormones secreted by the pituitary stimulate testes and ovaries to produce their hormones.You have already learnt that the pituitary gland is an endocrine gland. It is attached to the brain.

Apart from the pituitary, the testes and the ovaries, there are other Endocrine glands in the body such as thyroid, pancreas and adrenals **(Fig. 10.5).**

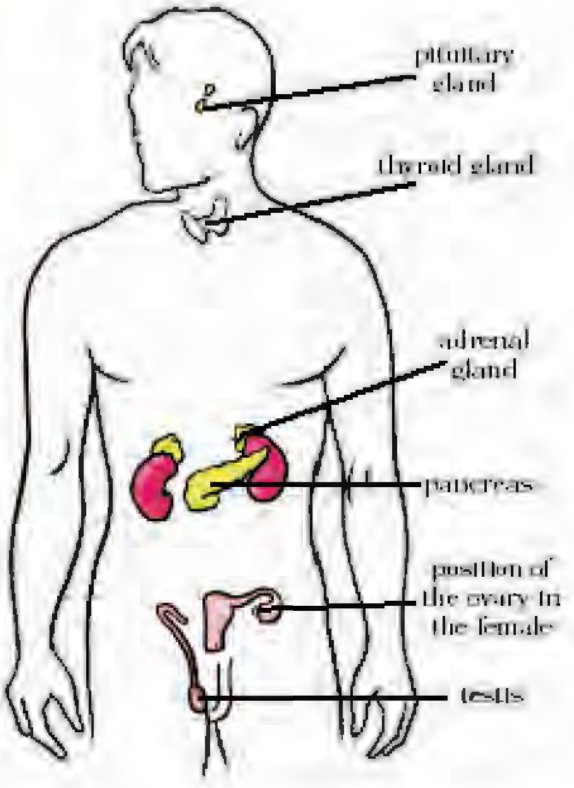


Fig. 10.5: Position of Endocrine Glands in the Human Body

Yasir and Saba had once visited their aunt who was a doctor and remembered that a boy named Kaka had a very big and bulging throat. Their aunt had

told them that Kaka was suffering from 'goitre', a disease of the **thyroid gland**. Kaka's thyroid gland was not producing the hormone **thyroxine**.

Their aunt also told them that their uncle was suffering from 'diabetes' because his pancreas was not producing the hormone **insulin** in sufficient quantities. Yasir and Saba then asked their aunt about the adrenal glands, which are also shown in the chart hung on the wall of her clinic. The aunt told them that adrenal glands secrete hormones which maintain the correct salt balance in the blood. Adrenals also produce the hormone **adrenalin.** It helps the body to adjust to stress when one is very angry, embarrassed or worried.

Thyroid and adrenals secrete their hormones when they receive orders from the pituitary through its hormones. Pituitary also secretes **growth hormone** which is necessary for the normal growth of a person.

Are there hormones in other animals also? Have they any role to play in reproduction?

10.8 Role of Hormones in completing the Life History of Insects and Frogs

You might know about the life history of the silk moth and the frog. The caterpillar has to pass through various stages to become an adult moth. Similarly, the tadpole passes through certain stages to become a frog.

This change from larva to adult is called **metamorphosis**. Metamorphosis in insects is controlled by **insect hormones.** In a frog, it is controlled by **thyroxine,** the hormone produced by **thyroid.** Thyroxine production requires the presence of iodine in water. If the water in which the tadpoles are growing does not contain sufficient iodine, the tadpoles cannot become adults.

If people do not have enough iodine in their diet, will they get goitre caused by lack of thyroxine?

Activity 10.3

Collect information from magazines or from doctors and prepare a note on the importance of consuming iodised salt. You can also look for this information on the internet.

10.9 Reproductive Health

The physical and mental well being of an individual is regarded as an individual's health. To keep the body healthy, every human being, at any age, needs to have a balanced diet. The person must also observe personal hygiene and undertake adequate physical exercise.

During adolescence, however, these become even more essential as the body is growing.

Nutritional Needs of the Adolescents -

Adolescence is a stage of rapid growth and development. Hence the diet for an adolescent has to be carefully planned. You have already learnt what a **balanced diet** is. Recall that a balanced diet means that the meals include proteins, carbohydrates, fats and vitamins in requisite proportions. Our Indian meal of ***roti***/rice, ***dal*** (pulses) and vegetables is a balanced meal. Milk is a balanced food in itself. Fruits also provide

nourishment. For infants, mother's milk provides all the nourishment that they need.

Iron builds blood and iron-rich food such as leafy vegetables, jaggery, meat, citrus, Indian gooseberry ***(amla)*** are good for adolescents.

Check items for lunch and dinner in your meal. Is the meal balanced and nutritious? Does it include cereals which give energy and milk, meat, nuts and pulses which provide proteins for growth? Also, does it include fats and sugar that give energy? What about fruits and vegetables which are protective foods? **Chips and packed or tinned snacks, though very tasty should never replace regular meals as they do not have adequate nutritional value.**

Activity 10.4

Make a group with your friends. Write down the items of food in your breakfast, lunch and dinner you had on the previous day. Identify the items responsible for proper growth. Also identified the junk food that you consumed the previous day.

Activity 10.5

Get ideas from the pictures given in **Fig.10.6**. Prepare charts or posters and paste them in the class so that you are aware of the diet for adolescents. You may use your creative ideas and present it like an advertisement. You may even organise a competition on this topic.

Personal Hygiene

Everyone should have a bath at least once everyday. It is more necessary for

Fig. 10.6 : Nutritious Items of Food

teenagers because the increased activity of sweat glands sometimes makes the body smelly. All parts of the body should be washed and cleaned everyday. If cleanliness is not maintained there are chances of catching **bacterial** infection. Girls should take special care of cleanliness during the time of menstrual flow. They should keep track of their menstrual cycle clean and be prepared for the onset of menstruation.

Physical Exercise

Walking and playing in fresh air keeps the body fit and healthy. All young boys and girls should take walks, exercise and play outdoor games.

Myths, Taboos, Do's and Dont's

You have learnt the scientific facts related to human reproduction. There are many wrong notions which you should now be able to discard as informed adolescents. For example, there are myths and taboos regarding bodily changes that adolescents experience. Some of these are given below and you can now argue why these are myths and not facts.

1. A girl becomes pregnant if she looks at boys during menstruation.
2. The mother is responsible for the sex of her child.
3. A girl should not be allowed to work in the kitchen during menstruation.

You may come across many other myths and taboos. Discard them.

Activity 10.6

Collect data on the number of children in your class who exercise regularly and who do not exercise regularly. Did you notice any difference in their fitness and health? Prepare a report on the benefits of regular exercise.

Say "NO" to Drugs

Adolescence is a period of much activity in the body and mind which is a normal part of growing up. So do not feel confused or insecure. If anybody suggests that you will get relief if you take some drugs, just say 'No' unless prescribed by the doctor. Drugs are addictive. If you take them once, you feel like taking them again and again. They harm the body in the long run. They ruin health and happiness.

You must have heard about AIDS which is caused by a dangerous virus, HIV. This virus can pass on to a normal person from an infected person by sharing the syringes used for injecting drugs. It can also be transmitted to an infant from the infected mother through her milk. The virus can also be transmitted through sexual contact with a person infected with HIV.

Adolescent Pregnancy

You might be knowing that in our country, the legal age for marriage is 18 years for girls and 21 years for boys. This is because teenage mothers are not prepared mentally or physically for motherhood. Early marriage and motherhood cause health problems in the mother and the child. It also curtails employment opportunities for the young woman and may cause mental agony as she is not ready for responsibilities of motherhood.

KEYWORDS

ADAM'S APPLE

ADOLESCENCE

ADRENALIN

BALANCED DIET

ENDOCRINE GLANDS

ESTROGEN

HORMONES

INSULIN

PITUITARY GLAND

PUBERTY

REPRODUCTIVE HEALTH

SECONDARY SEXUAL-CHARACTERS

SEX CHROMOSOMES

TARGET SITE

TESTOSTERONE

THYROXINE

VOICE BOX

WHAT YOU HAVE LEARNT

- Humans become capable of reproduction after puberty sets in. Between the ages of 11 years and 19 years children are called adolescents.
- The onset of puberty brings about growth of the reproductive organs. Hair grow at various places on the body. Breasts develop in girls and facial hair (moustache and beard) appear in boys. Voice of boys becomes hoarse as voice box enlarges during adolescence.
- Children gain height during adolescence.
- The onset of puberty and maturity of reproductive parts are controlled by hormones.
- Hormones are secretions of endocrine glands which pour them directly into the blood stream.
- Pituitary gland secretes hormones which include growth hormone and hormones that make other glands such as the testes, ovaries, thyroids and adrenals, secrete hormones. Pancreas secretes insulin, thyroid produces thyroxine and adrenals produce adrenalin.
- Testosterone is the male hormone and estrogen, the female hormone. The uterine wall in females prepares itself to receive the developing fertilised egg. In case there is no fertilisation, the thickened lining of the uterine wall breaks down and goes out of the body along with blood. This is called menstruation.
- Sex of the unborn child depends on whether the zygote has XX or XY chromosomes.
- It is important to eat balanced food and maintain personal hygiene during adolescence.

Exercises

1. What is the term used for secretions of endocrine glands responsible for changes taking place in the body?
2. Define adolescence ?
3. What is menstruation? Explain.
4. List changes in the body that take place at puberty ?
5. Prepare a Table having two columns depicting names of endocrine glands and hormones secreted by them.
6. What are sex hormones? Why are they named so? State their function.
7. ***Choose the correct option.***

(a) Adolescents should be careful about what they eat, because

(i) proper diet develops their brains.

(ii) proper diet is needed for the rapid growth taking place in their body.

(iii) adolescents feel hungry all the time.

(iv) taste buds are well developed in teenagers.

(b) Reproductive age in women starts when their

(i) menstruation starts.

(ii) breasts start developing.

(iii) body weight increases.

(iv) height increases.

(c) The right meal for adolescents consists of

(i) chips, noodles, coke.

(ii) chapati, dal, vegetables.

(iii) rice, noodles and burger.

(iv) vegetable cutlets, chips and lemon drink.

8. Write notes on—

(a) Adam's apple.

(b) Secondary sexual characters.

(c) Sex determination in the unborn baby.

9. Word game : Use the clues to work out the words.

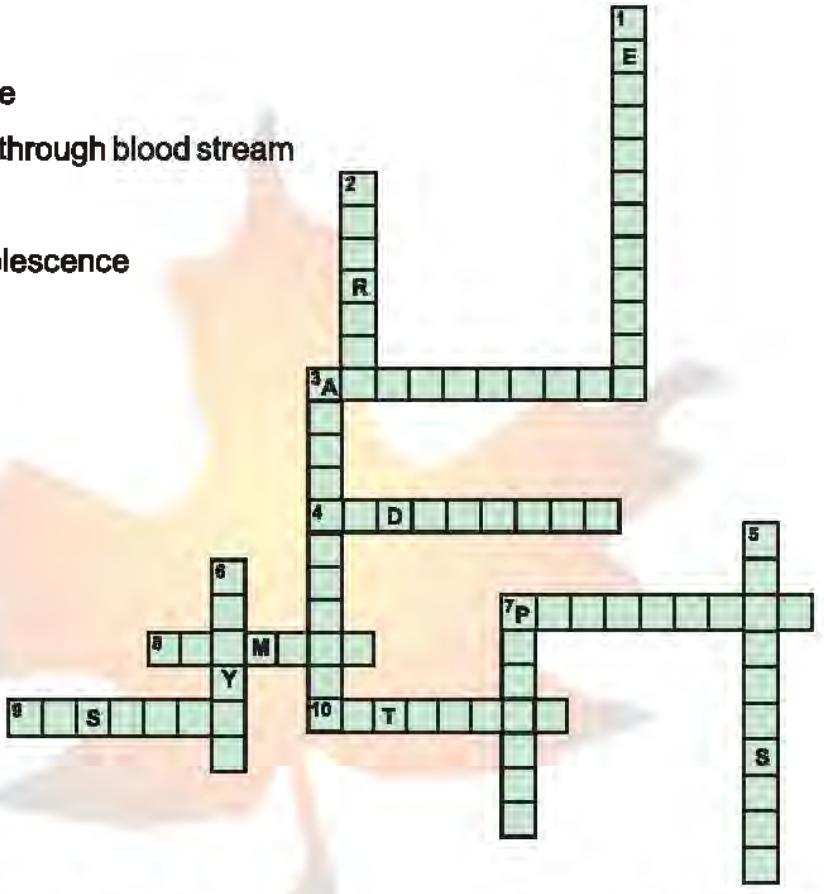
Across

3. Protruding voice box in boys
4. Glands without ducts

7. Endocrine gland attached to brain
8. Secretion of endocrine glands
9. Pancreatic hormone
10. Female hormone

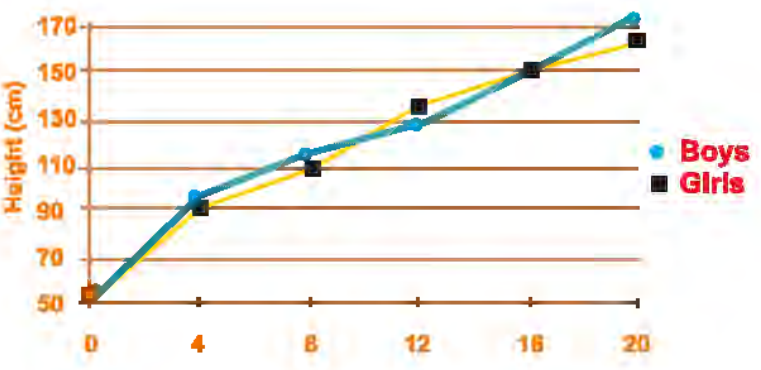
Down

1. Male hormone
2. Secretes thyroxine
3. Another term for teenage
5. Hormone reaches here through blood stream
6. Voice box
7. Term for changes at adolescence



10. The table below shows the data on likely heights of boys and girls as they grow in age. Draw graphs showing height and age for both boys and girls on the same graph paper. What conclusions can be drawn from these graphs?

Age (Years)	Height (cm)	
	Boys	Girls
0	53	53
4	96	92
8	114	110
12	129	133
16	150	150
20	173	165



Extended Learning — Activities and Projects

1. Find out from your elder relatives about their awareness of the legal status of early marriage. You yourself may get information on it from your teacher, parents, a doctor or the internet. Write a two minute speech explaining why early marriage is not good for the couple.
2. Collect newspaper cuttings and information in magazines about HIV/AIDS. Write a one page article of 15 to 20 sentences on HIV/AIDS.
3. In our country, according to a census, there are 882 adolescent females for every 1000 males. Find out:

(a) the concerns of the community regarding this low ratio. Remember that the chance of having a boy or a girl is equal.

(b) what amniocentesis is and how useful this technique is. Why is its use for identification of sex of the unborn child banned in India?

4. Put your ideas together and write a short note on the importance of knowing facts about reproduction.

For more information, visit :

www.teenshealth.org/teen/sexual_health/

www.ama_assn.org/ama/pub/category/1947.html

www.adolescenthealth.com

CHAPTER - 11

MATERIALS : METALS AND NON-METALS

You are familiar with a number of materials like iron, aluminium, copper, etc. Some materials have been given in **Table 11.1**.

Table 11.1 : Appearance and Hardness of Materials

Object/ Material	Appearance (Shiny/Dull)	Hardness (Very hard/ Not very hard)
Iron		
Coal		
Sulphur		
Aluminium		
Copper		

Can you name the materials which are metals? The rest of the materials in **Table 11.1** are non-metals. Metals can be distinguished from non-metals on the basis of their physical and chemical properties. Recall that lustre and hardness are physical properties.

11.1 Physical Properties of Metals and Non-metals

Have you ever seen a blacksmith beating an iron piece or an article made up of iron, like a spade, a shovel, an axe? Do you find a change in the shape of these articles on beating? Would you expect a similar change if we try to beat a wood log ? Let us find out.

Activity 11.1

Take a small iron nail, a coal piece, a piece of thick aluminium wire and a pencil lead. Beat the iron nail with a hammer **(Fig. 11.1)**. (But take care that you don't hurt yourself in the process). Try to hit hard. Hit hard

Fig. 11.1 : Beating an Iron Nail with Hammer

also the aluminium wire. Then repeat the same kind of treatment on the coal piece and pencil lead. Record your observations in **Table 11.2.**

Table 11.2 Malleability of Materials

Object/ Material	Change In Shape (Flattens/Breaks into pieces)
Iron nail	
Coal piece	
Aluminium wire	
Pencil lead	

You saw that the shape of the iron nail and the aluminium wire changed on beating. If they were beaten harder these could be changed into sheets. You might be familiar with silver foil used for decorating

sweets. You must also be familiar with the aluminium foil used for wrapping food. The property of metals by which they can be beaten into thin sheets is called **malleability**. This is a characteristic property of metals. As you must have noticed, materials like coal and pencil lead do not show this property. Can we call these as metals?

Can you hold a hot metallic pan which is without a plastic or a wooden handle and not get hurt? Perhaps not! Why? Try to list some other experiences in which a wooden or plastic handle protects you from being hurt while handling hot things. On the basis of these experiences what can you say about the conduction of heat on wood and plastic?

You must have seen an electrician using his screw driver. What kind of handle does it have? Why?

Let us find out.

Activity 11.2

Recall how to make an electric circuit to test whether electricity can pass through an object or not for example **(Fig. 11.2)**. You might have

Fig. 11.2 : Electric Tester

performed the activity with various objects. Now, repeat the activity with the materials mentioned in **Table 11.3.** Observe and group these materials into good conductors and poor conductors.

Table 11.3: Electrical Conductivity of Materials

S.No.	Materials	Good Conductor / Poor Conductor
1.	Iron rod/nail	
2.	Sulphur	
3.	Coal piece	
4.	Copper wire	

You observe that iron rod, nail and copper wire are good conductors while rolled sulphur piece and coal piece are poor conductors.

Oh! The meaning of recalling our experiences and then of this activity was to show that metals are good conductors of heat and electricity.

Where do you find the use of aluminium and copper wires? Have you seen wires of coal? Definitely not!

The property of metal by which it can be drawn into wires is called **ductility**.

Have you ever noticed the difference in sound on dropping an iron sheet/ plate, a metal coin, and a piece of coal on the floor? If not, you can try it now.

Do you note any difference in the sound produced?

Have you seen wooden bells in temples? Can you give reason?

The things made of metals produce ringing sound when struck hard. Suppose

you have two boxes similar in appearance, one made of wood and the other of metal. Can you tell which box is made of metal by striking both the boxes?

Since metals produce ringing sounds, they are said to be **sonorous**. The materials other than metals are not sonorous.

After performing the above activities, we can say that some materials are **hard, lustrous, malleable, ductile, sonorous and good conductors of heat and electricity.** The materials which generally possess these properties are called metals. The examples of metals are iron, copper, aluminium, calcium, magnesium, etc. In contrast, materials like coal and sulphur are soft and dull in appearance. They break down into powdery mass on tapping with hammer. They are not sonorous and are poor conductors of heat and electricity. These materials are called **non-metals.** The examples of non-metals are sulphur, carbon, oxygen, phosphorus, etc.

Metals like sodium and potassium are soft and can be cut with a knife. Mercury is the only metal which is found in liquid state at room temperature. These are exceptions.

Underground Wealth in J&K State

Endowed with rich forest wealth and perennial water resources, J&K is blessed by nature with huge mineral deposits of high industrial and medicinal value. Unfortunately, desired attention to explore underground wealth of State has not been paid. Whatever little has been done so far is below the expectations and needs review.

Some of the places in J &K where diff. minerals/metals are found :

1. Chromite (Chromium)	Drass (Ladakh)
2. Copper	Jangalgali, Reasi, Doda, Kishtwar (Jammu)
	Aishmuqam, Lastil, Handwara, Sumbal, Kangan, Lolah (Kashmir)
3. Gold	Kargil (Ladakh),
	Sonamarg (Kashmir)
4. Galena (Lead)	Zanskar (Ladakh),
	Reasi, Kishtwar (Jammu)
5.Limestone (Calcium)	Anantnag, Acchabal Doru,Verinag,
	Beeru, Wuyan, Khrew (Kashmir)
	Salal, Basholi, Banjalgala (Jammu)
6. Iron	Rajouri, Salal, Pauni, Chakhar (Jammu)
	Sharda, Khrew, Haral, Uri, Gurez, Lolab (Kashmir)
7. Manganese	Kargil, Leh (Ladakh),
	Kishtwar (Jammu)
8. Bauxite	Chakkar, Salal, Jaugalgati (Jammu)
9. Nickel	Ramsu, Khelani (Jammu) Baniyar (Kashmir)
10. Lead	Reasi, Ramban (Jammu)
	Uri (Kashmir)
11. Uranium	Ladakh
12. Zinc	Reasi, Angota, Ramsu (Jammu) Uri, Buniyar (Kashmir)

11.2 Chemical Properties of Metals and Non-metals

A. Reaction with Oxygen

You are familiar with the phenomenon of rusting of iron. Recall the reaction by which rust is formed. You also know about burning a magnesium ribbon in air. In both the processes oxide formation takes place.

Complete the following reactions of iron and magnesium with oxygen.

Iron (Fe) + Oxygen (O_2) + Water (H_2O) → ?

Magnesium (Mg) + Oxygen (O_2) → ?

Activity 11.3

Let us check the nature of rust formed as a result of the reaction between iron, oxygen and water. Collect a spoonful of rust and dissolve it in a very little amount of water. You will find that the rust remains suspended in water. Shake the suspension well. Test the solution with red and blue litmus papers **(Fig. 11.3)**. What do you observe? Is the solution acidic or basic?

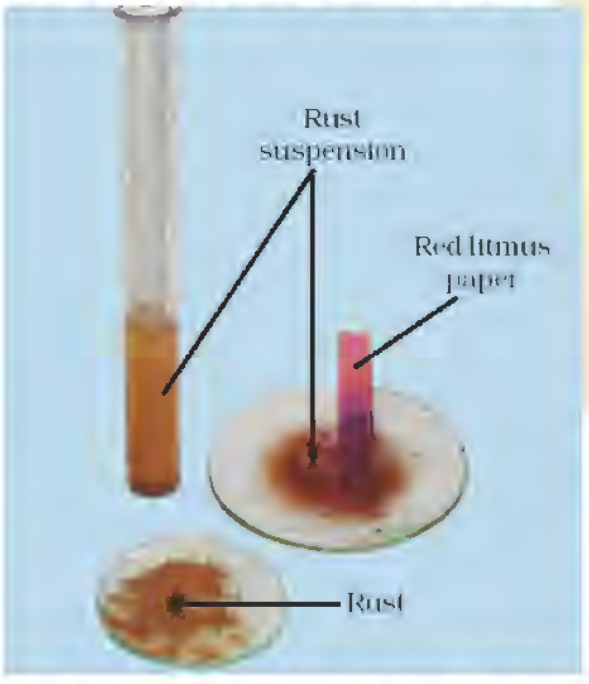


Fig. 11.3 : Testing the Nature of Rust

Does copper also get rusted? I have seen a greenish deposit on the surface of copper vessels.

When a copper vessel is exposed to moist air for long, it acquires a dull green coating. The green material is a mixture of copper hydroxide ($Cu(OH)_2$) and copper carbonate ($CuCO_3$). The following is the reaction $2Cu+H_2O+CO_2+O_2 \rightarrow Cu(OH)_2+CuCO_3$

Now recall the activity of burning magnesium ribbon. The ash obtained on burning magnesium ribbon is dissolved in water and tested for its acidic / basic nature.

Is the solution acidic or basic? How do you ascertain this?

You must have observed that the red litmus turns blue. So, oxide of magnesium is also basic in nature. In general, metallic oxides are basic in nature.

Let us now observe the reaction of non-metals with oxygen.

Activity 11.4

(To be demonstrated by the teacher in the class)

Take a small amount of powdered sulphur in a deflagrating spoon and heat it. If deflagrating spoon is not available, you may take a metallic cap of any bottle and wrap a metallic wire around it and give it the shape shown in **Fig. 11.4 (a).**

Fig. 11.4 (a) : Burning of Sulphur Powder

As soon as sulphur starts burning, introduce the spoon into a gas jar/glass

tumbler **[Fig. 11.4 (a)]**. Cover the tumbler with a lid to ensure that the gas produced does not escape. Remove the spoon after some time. Add a small quantity of water into the tumbler and quickly replace the lid. Shake the tumbler well. Check the solution with red and blue litmus papers **[Fig. 11.4 (b)]**.

Fig. 11.4 (b) : Testing of Solution with Litmus

Table 11.4 : Metals and Non-Metals in Acids and Bases

S. No.	Name of the base	Metal	Name of the Acid	Non Metal
1.	Calcium hydroxide	Calcium	Sulphuric acid	Sulphur
2.				
3.				
4.				
5.				

The name of the product formed in the reaction of sulphur and oxygen is sulphur dioxide gas. When sulphur dioxide is dissolved in water sulphurous acid is formed. The reaction can be given as follows:

Sulphur dioxide (SO_2) + Water (H_2O)

Sulphurous acid (H_2SO_3)

The sulphurous acid turns blue litmus paper red. Generally, oxides of non-metals are acidic in nature.

Recall the name of some of the laboratory acids and bases you have been in touch in Class. Note down their names in **Table 11.4.** Identify the metal or nonmetal present in them which forms oxides with oxygen.

B. Reaction with Water

Let us see how metals and non-metals react with water.

Sodium metal is very reactive. It reacts vigorously with oxygen and water. A lot of heat is generated in the reaction. It is, therefore, stored in kerosene.

Questions based on above concept

1. Why sodium metal is stored in kerosene?
2. Oxides of metals are basic in nature
3. Oxides of _____ are acidic in nature
4. An acid is a substance which turns blue litmus _____.
5. A base is a substance which turns red litmus _____.

Activity 11.5

To be demonstrated by the teacher. During demonstration special care should be taken that the size of the sodium metal piece is roughly the size of a wheat grain. It should be held with a pair of tongs.)

Take a 250 mL beaker/glass tumbler. Fill half of it with water. Now carefully cut a small piece of sodium metal. Dry it using filter paper and wrap it in a small piece of cotton. Put the sodium piece wrapped in cotton into the beaker. Observe carefully. During observation keep away from the beaker.

Fig.11.5 : Reaction of Sodium with Water

When reaction stops touch the beaker. What do you feel? Has the beaker become hot? Test the solution with red and blue litmus papers. Is the solution acidic or basic?

You observed that sodium reacts vigorously with water. Some other metals do not do so. For example, iron reacts with water slowly.

Generally, non-metals do not react with water though they may be very reactive in air. Such non-metals are stored in water. For example, phosphorus is a very reactive non-metal. It catches fire if exposed to air. To prevent the contact of phosphorus with atmospheric oxygen, it is stored in water.

Non-Metallic Minerals in J&K State

1. Precious Stones :

(a) Sapphire : Paddar in Kishtwar (Jammu)

(b) Aquamarine : Drass, Askardu (Ladakh)

(c) Beril : Drass, Askardu (Ladakh)

(d) Serpentine : Ladakh Mountains.

(e) Felspar : Paddar (Kishtwar)

(f) Quartz : Paddar (Kishtwar), Sonamarg (Kashmir)

(g) Ruby Gems : Mountain slopes of Kishtwar.

2. Gypsum : Ramban, Batote, Gool Gulab Garh (Jammu) Lachhipura, Baramulla, Anantnag (Kashmir)

3. Sulphur : Pagga Valley (Ladakh), Anantnag, Khraw (Kashmir), Rajouri (Jammu)

4. Graphite (Black Lead) : Sumjan in erstwhile Distrcit Doda (Jammu), Baramulla (Kashmir)

C. Reactions with Acids

Let us see how metals and non-metals behave with acids.

Table 11.5 : Reaction of Metals and Non-Metals with Acids

Test tube Label	Metal/ Non-Metal	Reaction with dilute Hydrochloric acid		Reaction with dilute Sulphuric acid	
		Room temperature	Warm	Room temperature	Warm
A	Magnesium (ribbon)				
B	Aluminium (foil)				
C	Iron (filings)				
D	Copper (peeled flexible wira)				
E	Charcoal (powder)				
F	Sulphur (powder)				

Activity 11.6

Warning : Keep the mouth of the test tube away from your face. Use test tube holder to hold the test tube.

Take samples of metals and nonmetals listed in **Table 11.5** in separate test tubes and label them as A, B, C, D, E, and F. With the help of a dropper add 5 ml of dilute hydrochloric acid to each test tube one by one. Observe the reactions carefully. If no reaction occurs in a cold solution, warm the test tube gently. Bring a burning matchstick near the mouth of each test tube. Repeat the same activity using dilute sulphuric acid instead of the dilute hydrocholoric acid. Record your observations in **Table 11.5.**

Is there a difference in the way metals and non-metals react with acids? What could the 'pop' sound in some cases be due to when a burning match stick is brought near the mouth of the test tubes?

You must have found that nonmetals generally do not react with acids but metals react with acids and produce hydrogen gas that burns with a 'pop' sound. You must have noticed that copper does not react with dilute hydrochloric acid even on heating but it reacts with sulphuric acid.

D. Reactions with Bases

Activity 11.7

To be demonstrated by the teacher. **During the preparation of sodium hydroxide solution, care should be taken that pellets of sodium hydroxide are handled with a plastic spatula.**

Prepare a fresh solution of sodium hydroxide in a test tube by dissolving 3-4 pellets of it in 5 ml of water. Drop a piece of aluminium foil into it. Bring a burning match stick near the mouth of the test tube. Observe carefully.

What does the 'pop' sound indicate? As before, the 'pop' sound indicates the presence of hydrogen gas.

Metals react with sodium hydroxide to produce hydrogen gas.

Reactions of non-metals with bases are complex.

E. Displacement Reactions

Let us observe some reactions by doing activity to explain displacement reactions.

Activity 11.8

Take five 100 mL beakers and label them A, B, C, D and E. Take about 50 mL of water in each beaker. Dissolve in each beaker a teaspoonful of each substance as indicated in **Fig. 11.6 (a)**.

Keep the beakers undisturbed for some time.

Record your observations in your note book.

What changes do you observe in the various beakers? You have read that one metal displaces another metal from its compound in aqueous solution. In beaker 'A' zinc (Zn) replaces copper (Cu) from copper sulphate ($CuSO_4$). That is why the blue colour of copper sulphate disappears and a powdery red mass of copper is deposited at the bottom of the beaker. The reaction can be represented as follows:

Copper Sulphate ($CuSO_4$) + Zinc (Zn)

Beaker A : Copper sulphate ($CuSO_4$) + Zinc granule (Zn),

Beaker B : Copper sulphate ($CuSO_4$) + Iron nail (Fe)

Beaker C : Zinc sulphate ($ZnSO_4$) + Copper turnings (Cu),

Beaker D : Iron sulphate ($FeSO_4$) + Copper turnings (Cu)

Beaker E : Zinc sulphate ($ZnSO_4$) + Iron nail (Fe)

Fig. 11.6 (a) and (b) : Displacement Reactions

(Blue)

--> Zinc Sulphate ($ZnSO_4$) + Copper (Cu)

(Colourless) (Red)

You can write down the reaction taking place in beaker 'B' in a similar manner.

There could have been displacement of zinc by copper in beaker 'C' and by iron in beaker 'E'. Similarly iron could be displaced by copper in beaker 'D'.

Since we do not see any change in beaker C, we can infer that copper is not able to replace zinc from zinc sulphate. But why? When zinc can replace copper in beaker 'A' why cannot copper replace zinc in beaker 'C'? Remember that science is not arbitrary. It follows definite rules based on facts. And the rule here is that zinc is more reactive than copper and iron. A more reactive metal can replace a less reactive metal, but a less reactive one cannot replace a more reactive metal. Now you can understand why there are no displacement reactions in beakers D and E. Can you guess the sequence of metals from more reactive to less reactive among zinc, iron and copper?

11.3 Uses of Metals and Non-metals

You should be able to guess why metals are used in making machinery, automobiles, aeroplanes, trains, satellites, industrial gadgets, cooking utensils, water boilers, etc. You are also familiar with the uses of some non-metals. Here are some interesting ones. We are sure that you will guess them right:

- Non-metal essential for our life which all living beings inhale during breathing,
- Non-metals used in fertilisers to enhance the growth of plants,
- Non-metal used in water purification process,

- Non-metal used in the purple coloured solution which is applied on wounds as an antiseptic,
- Non-metals used in crackers.

You may add some more uses of metals and non-metals from your experiences. I have understood the reactions taking place in beakers 'A' and 'B'. But I am still confused why there is no change in beakers 'C', 'D' and 'E'?

I heard that magnesium is found in plants. In what form is it found in them?

Doctor reported iron deficiency in my body. Where is iron in my body?

In a chemical reaction, new substances are formed. These substances are different from those which underwent the reaction. Now, if a substance cannot be broken down further by chemical reactions, by cooling, heating, or by electrolysis, it is called 'element'. Sulphur is an element. So is iron. Carbon, too, is an element. The smallest unit of an element is atom. A sample of an element contains only one kind of atoms. The atom of an element remains unaffected by physical changes in the element. For example, an atom of liquid sulphur would be exactly the same as the atom of solid or vapour sulphur.

Although we have an infinite variety of substances in the universe, the number of elements forming these substances is limited. There are no more than 92 naturally occurring elements. An important classification of elements is in terms of metals and non-metals. Most of the elements are metals. Less than 20 are non-metals. A few are metalloids which possess characters of both metals and non-metals.

Q:- Write three uses of metals and three uses of non-metals ?

Q:- Name the metals present in Chlorphyll and Haemoglobin ?

KEYWORDS

ATOM
CONDUCTOR
DISPLACEMENT- REACTION
DUCTILITY
ELEMENTS
HARDNESS
MALLEABILITY
METALS
METALLOIDS
NON-METALS
SONOROUS

WHAT YOU HAVE LEARNT

- Metals are lustrous whereas non-metals have no lustre.
- Generally, metals are malleable and ductile. Non-metals do not have these properties.
- Generally, metals are good conductors of heat and electricity but non-metals are poor conductors.
- On burning, metals react with oxygen to produce metal oxides which are basic in nature. Non-metals react with oxygen to produce non- metallic oxides which are acidic in nature.
- Some metals react with water to produce metal hydroxides and hydrogen gas. Generally, nonmetals do not react with water.
- Metals react with acids and produce metal salts and hydrogen gas. Generally, non-metals do not react with acids.
- Some metals react with bases to produce hydrogen gas.
- More reactive metals displace less reactive metals from their compounds in aqueous solutions.
- Metals and non-metals are used widely in every day life.

Exercises

1. Which of the following can be beaten into thin sheets?

(a) Zinc (b) Phosphorus (c) Sulphur (d) Oxygen

2. Which of the following statements is correct?

(a) All metals are ductile.

(b) All non-metals are ductile.

(c) Generally, metals are ductile.

(d) Some non-metals are ductile.

3. Fill in the blanks :

(a) Phosphorus is very _____non-metal.

(b) Metals are conductors of heat and _____.

(c) Iron is _____reactive than copper

(d) Metals react with acids to produce _____gas.

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

(a) Generally, non-metals react with acids. ( )

(b) Sodium is a very reactive metal. ( )

(c) Copper displaces zinc from zinc sulphate solution. ( )

(d) Coal can be drawn into wires. ( )

5. Some properties are listed in the following Table. Distinguish between metals and non-metals on the basis of these properties.

Properties	Metals	Non-metals
1. Appearance		
2. Hardness		
3. Malleability		
4. Ductility		
5. Heat Conduction		
6. Conduction of Electricity		

6. Give reasons for the following :

(a) Aluminium foils are used to wrap food items.

(b) Immersion rods for heating liquids are made up of metallic substances.

(c) Copper cannot displace zinc from its salt solution.

(d) Sodium and potassium are stored in kerosene.

7. Can you store lemon pickle in an aluminium utensil? Explain.

8. In the following Table some substances are given in Column I. In Column II some uses are given. Match the items in column I with those in Column II.

Column I	Column II
(i) Gold	(a) Thermometers
(ii) Iron	(b) Electric wire
(iii) Aluminium	(c) Wrapping food
(iv) Carbon	(d) Jewellery
(v) Copper	(e) Machinary
(vi) Mercury	(f) Fuel

9. What happens when

(a) Dilute sulphuric acid is poured on a copper plate?

(b) Iron nails are placed in copper sulphate solution?

Write word equations of the reactions involved.

10. Sarish took a piece of burning charcoal and collected the gas evolved in a test tube.

(a) How will she find the nature of the gas ?

(b) Write down word equations of all the reactions taking place in this process.

11. One day Reeta went to a jeweller's shop with her mother. Her mother gave old gold jewellery to the goldsmith to polish. Next day when they brought the jewellery back, they found that there was a slight loss in its weight. Can you suggest a reason for the loss in weight?

12. Why phosphorous is stored in water ?

Extended Learning — Activities and Projects

1. Prepare Index Cards for any four metals and four non-metals. The card should have information like name of metal/non-metal; its physical properties, chemical properties and its uses.

2. Visit a blacksmith and observe how metals are moulded.

3. Suggest an experiment to compare the conductivity of electricity by iron, copper, aluminium and zinc. Perform the experiment and prepare a short report on the results.

4. Find out the locations of the deposits of iron, aluminium and zinc in India. Mark these in an outline map of India. In which form are the deposits found? Discuss in the class.

5. Discuss with your parents/neighbours/goldsmiths why gold is preferred for making jewellery.

6. Visit the following websites and enjoy the quiz on metals and nonmetals:

chemistry.about.com/library/weekly/bl050303a.htm

chemistry.about.com/od/testsquizzes/Chemistry_Tests Quizzes.htm

www.syvum.com/cgi/online/mult.cgi/squizzes/science/metals.tdf?0

www.gcsescience.com/q/qusemet.html

www.corrosionsource.com/handbook/periodic/metals.htm

CHAPTER - 12

LIGHT

The world is largely known through the senses. The sense of sight is one of the most important senses. Through it we see mountains, rivers, trees, plants, chairs, people and so many other things around us. We also see clouds, rainbows and birds flying in the sky. At night we see the moon and the stars. You are able to see the words and sentences printed on this page. How is seeing made possible?

12.1 What makes Things Visible

Have you ever thought how we see the various objects? You may say that eyes see the objects. But, can you see an object in the dark? It means that eyes alone cannot see any object. It is only when light from an object enters our eyes that we see the object. The light may have been emitted by the object, or may have been reflected by it.

You know that a polished or a shiny surface can act as a mirror. A mirror changes the direction of light that falls on it. Can you tell in which direction the light falling on a surface will be reflected? Let us find out.

12.1 Laws of Reflection

Activity 12.1

Fix a white sheet of paper on a drawing board or a table. Take a comb and close all its openings except one in the middle. You can use a strip of black paper for this purpose. Hold the comb perpendicular to the sheet of paper. Throw light from a torch through the opening of the comb from one side **(Fig. 12.1)**. With slight adjustment of the torch and the comb you will see a ray of light along the paper on the other side of the comb. Keep the comb and the torch steady. Place a strip of plane mirror in the path of the light ray **(Fig. 12.1)**. What do you observe?

Fig. 12.1 : Arrangement for Showing Reflection

After striking the mirror, the ray of light is reflected in another direction. The light ray, which strikes any surface, is called the **incident ray**. The ray that comes back from the surface after reflection is known as the **reflected ray**.

A ray of light is an idealization. In reality, we have a narrow beam of light which is made up of several rays. For simplicity, we use the term ray for a narrow beam of light.

Draw lines showing the position of the plane mirror, the incident ray and the reflected ray on the paper with the help of your friends. Remove the mirror and the comb. Draw a line making an angle of 90° to the line representing the mirror at the point where the incident ray strikes the mirror. This line is

known as the **normal** to the reflecting surface at that point **(Fig. 12.2).** The angle between the normal and incident ray is called the **angle of incidence** ($\angle i$). The

Fig. 12.2 : Drawing the Normal

angle between the normal and the reflected ray is known as the **angle of reflection** ($\angle r$) **(Fig. 12.3).** Measure the angle of incidence and the angle of reflection. Repeat the activity several times by changing the angle of incidence. Enter the data in Table 16.1.

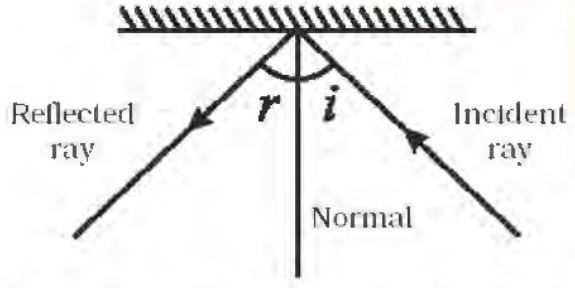


Fig. 12.3 : Angle of Incidence and Angle of Reflection

Table 12.1 : Angles of Incidence and Reflection

S. No.	Angle of incidence ($\angle i$)	Angle of reflection ($\angle r$)
1.		
2.		
3.		
4.		
5.		

Do you see any relation between the angle of incidence and the angle of reflection. Are they approximately equal? If the experiment is carried out carefully, it is seen that the **angle of incidence is always equal to the angle of reflection**. This is known as the **law of reflection**. Let us perform another activity on reflection.

What would happen if I threw the light on the mirror along the normal.

Activity 12.2

Perform Activity 12.1 again. This time use a sheet of stiff paper or a chart paper. Let the sheet project a little beyond the edge of the table **(Fig. 12.4).** Cut the projecting portion of the sheet in the middle. Look at the reflected ray. Make sure that the reflected ray extends to the projected portion of the paper. Bend that part of the projected portion on which the reflected ray falls. Can you still see the reflected ray? Bring the paper back to the original position. Can you see the reflected ray again? What do you infer?

(a)

(b)

Fig. 12.4 (a), (b) : Incident Ray, Reflected Ray and the Normal at the Point of Incidence lie in the Same Plane

When the whole sheets of paper is spread on the table, it represents one plane. The incident ray, the normal at the point of incidence and the reflected ray are all in this plane. When you bend the paper you create a plane different from the plane in which the incident ray and the normal lie. Then you do not see the reflected ray. What does it indicate? It indicates that **the incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane**. This is another **law of reflection.**

Yasir and Saba performed the above activities outside the classroom with the sun as the source of light instead of a torch. You, too, can use the sun as the source of light.

Yasir remembered that he had studied some features of the image of an object formed by a plane mirror. Saba asked him to recall those features:

(I) Was the image erect or upside down?

(ii) Was it of the same size as the object?

(iii) Did the image appear at the same distance behind the mirror as the object was in front of it?

(iv) Could it be obtained on a screen?

Let us understand a little more about the formation of image by a plane mirror in the following way:

Activity 12.3

A source of light O is placed in front of a plane mirror PQ. Two rays OA and OC are incident on it **(Fig. 12.5).** Can you find out the direction of the reflected rays?

Draw normals to the surface of the mirror PQ, at the points A and C. Then draw the reflected rays at the points A and C. How would you draw these rays? Call the

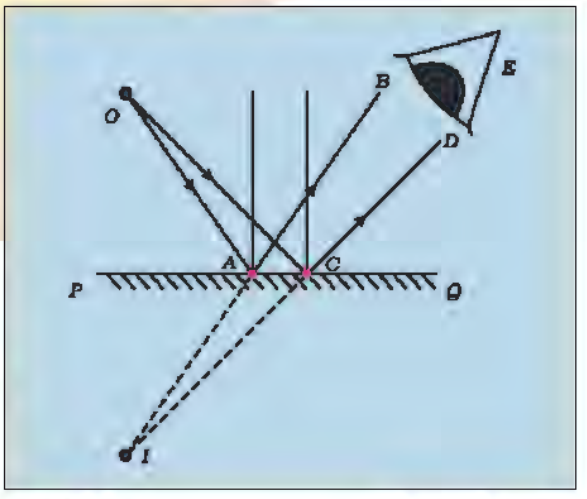


Fig. 12.5 : Image Formation in a Plane Mirror

reflected rays AB and CD, respectively. Extend them further. Do they meet? Extend them backwards. Do they meet now? If they meet, mark this point as I. For a viewer's eye at E **(Fig. 12.5),** do the reflected rays appear to come from the point I. Since the reflected rays do not actually meet at I, but only appear to do so, we say that a virtual image of the point O is formed at I. As a matter of

fact such an image cannot be obtained on a screen.

You may recall that in an image formed by a mirror the left of the object appears on the right and the right appears on the left. This is known as **lateral inversion**.

Regular and Diffused Reflection

Activity 12.4

Imagine that parallel rays are incident on an irregular surface as shown in **Fig. 12.6.** Remember that the laws of reflection are valid at each point of the surface. Use these laws to construct reflected rays at various points. Are they parallel to one another? You will find that these rays are reflected in different directions. **(Fig. 12.7)**

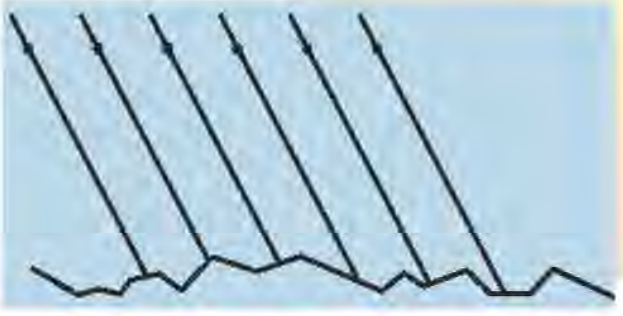


Fig. 12.6 : Parallel Rays Incident on an Irregular Surface

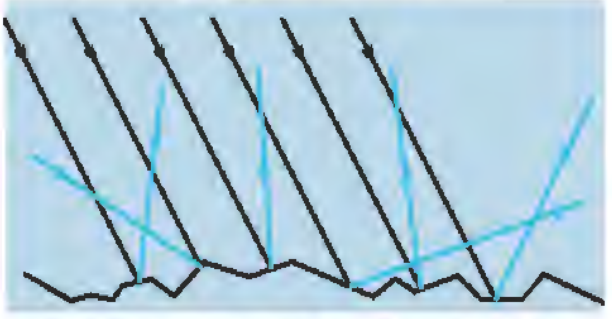


Fig. 12.7 : Rays Reflected from Irregular Surface

Do We See all Objects due to Reflected Light?

Nearly everything you see around is seen due to reflected light. Moon, for example, receives light from the sun and reflects it. That's how we see the moon. The objects which shine in the light of other objects are called illuminated objects. Can you name some other such objects?

When all the parallel rays reflected from a plane surface are not parallel, the reflection is known as **diffused** or **Irregular** reflection. Remember that the diffused reflection is not due to the failure of the laws of reflection. It is caused by the irregularities in the reflecting surface, like that of a cardboard.

On the other hand reflection from a smooth surface like that of a mirror is called **regular reflection (Fig. 12.8)**. Images are formed by regular reflection.

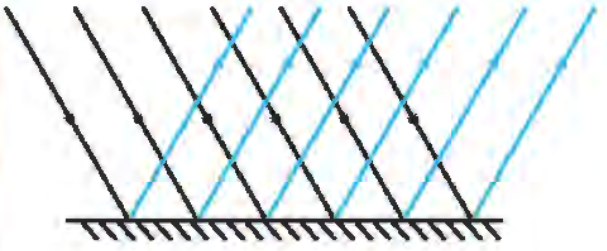


Fig. 12.8 : Regular Reflection

There are other objects, which give their own light, such as the sun, fire, flame of a candle and an electric lamp. Their light falls on our eyes. That is how we see them. The objects which emit their own light are known as luminous objects.

I have a question. Can the reflected rays be further reflected if incident on another mirror?

Let us find out.

12.4 Reflected Light Can be Reflected Again

Recall the last time you visited a hair dresser. She/he makes you sit in front of a mirror. After your hair cut is complete, she/he places a mirror at your back to show you how the hair has been cut **(Fig. 12.9)**. Can you think how you could see the hair at the back of your head?

Fig. 12.9 : Mirror at the Hair Dresser Shop

Do you know ?

Periscopes are used in submarines, tanks and also by soldiers in bunkers to see things outside. The periscope makes use of two plane mirrors. Can you explain how reflection from the two mirrors enables you to see objects which are not visible directly?

12.5 Multiple Images

You are aware that a plane mirror forms only a single image of an object. What happens if two plane mirrors in combination are used? Let us see.

Activity 12.5

Take two plane mirrors. Set them at right angles to each other with their edges touching **(Fig. 12.10)**. To hinge them you can use adhesive tape. Place a coin in between the mirrors. How many images of the coin do you see **(Fig. 12.10)**

Fig. 12.10 : Images In Plane Mirror at Right Angle to Each Other

Now hinge the mirrors using the adhesive tape at different angles, say 45°, 60°, 120°, 180° etc. Place some object (say a candle) in between them. Note down the number of images of the object in each case.

Finally, set the two mirrors parallel to each other. Find out how many images of a candle placed between them are formed **(Fig.12.11)**.

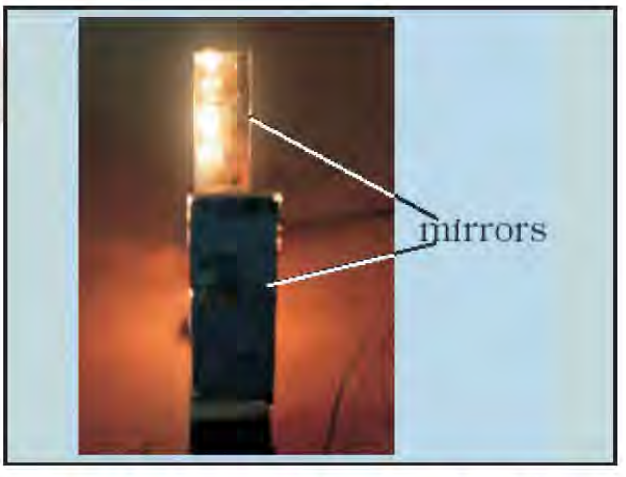


Fig. 12.11 : Image in Plane Mirror Parallel to Each Other

Can you now explain how you can see the back of your head at the hair dresser's shop?

This idea of number of images formed by mirrors placed at an angle to one another is used in a kaleidoscope to make numerous beautiful patterns. You can also make a kaleidoscope yourself.

Kaleidoscope

Activity 12.6

To make a kaleidoscope, get three rectangular mirror strips about 15 cm long and 4 cm wide each. Join them together to form a prism as shown in **Fig. 12.12(a)**. Fix them in a circular cardboard tube or tube of a thick chart paper. Make sure that the tube is slightly longer than the mirror strips. Close one end of the tube by a cardboard disc having a hole in the centre, through which you can see **[Fig.12.12(b)]**. To make the disc durable, paste a piece of transparent plastic sheet under the cardboard disc.

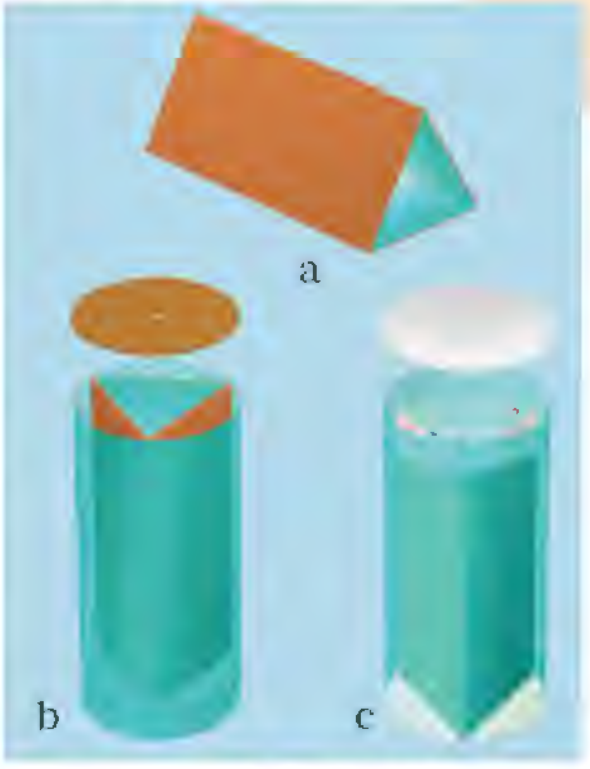


Fig. 12.12 : Making a Kaleidoscope

At the other end, touching the mirrors, fix a circular plane glass plate **[Fig. 12.12(c)]**. Place on this glass plate several small pieces of coloured glass (broken pieces of coloured bangles). Close this end of the tube by a ground glass plate. Allow enough space for the colour pieces to move around.

Your kaleidoscope is ready. When you peep through the hole, you will be able to see a variety of patterns in the tube. Interesting feature of a kaleidoscope is that you will never see the same pattern again. Designers of wallpapers and fabrics and artists use kaleidoscopes to get ideas for new patterns. To make your toy attractive, you can wrap the kaleidoscope in a coloured paper.

12.6 Sunlight — White or Coloured

You know that the sunlight is referred to as white light. You also know that it consists of seven colours. Here is one activity (Activity 12.7) showing that sunlight consists of several colours.

12.7 What is Inside Our Eyes?

We see things only when light coming from them enters our eyes. Eye is one of our most important sense organs. It is, therefore, important to understand its structure and working.

The eye has a roughly spherical shape. Outer coat of the eye is white. It is tough so that it can protect the interior of the eye from accidents. Its transparent front part is called **cornea** **(Fig 12.13)**. Behind the cornea, we find a dark muscular structure called **iris**. In the iris, there is a small opening called the **pupil**. The size of the

pupil is controlled by the iris. The iris is that part of eye which gives it its distinctive colour. When we say that a person has green eyes, we actually refer to the colour of the iris. The iris controls the amount of light entering into the eye. Let us see how.

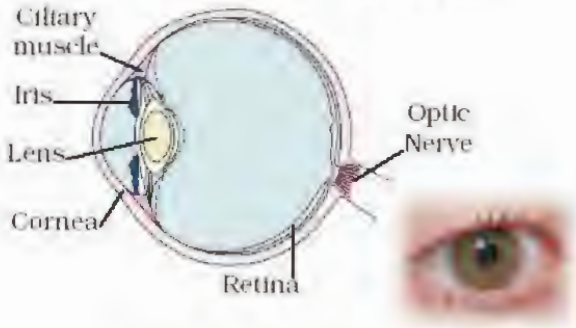


Fig. 12.13 : Human Eye

Caution : For this activity, never use a laser torch.

Activity 12.7

Get a plane mirror of suitable size. Place it in a bowl (Katori) as shown in **Fig. 12.14**. Fill the bowl with water. Put this arrangement near a window such that direct sunlight falls on the mirror. Adjust the position of the bowl such that the reflected light from the mirror falls on a wall. If the wall is not white, fix a sheet of white paper on it. Reflected light will be seen to have many colours. How can you explain this? The mirror and water form a prism. This breaks up the light into its colours. Splitting of light into its colours is known as **dispersion** of light. Rainbow is a natural phenomenon showing dispersion.

Fig. 12.14 : Dispersion of Light

Activity 12.8

Look into your friend's eye. Observe the size of the pupil. Throw light on her eye with a torch. Observe the pupil now. Switch off the torch, and observe her pupil once again. Do you notice any change in the size of the pupil? In which case was the pupil larger? Why do you think it was so?

In which case do you need to allow more light in the eye, when the light is dim or bright?

Behind the pupil of the eye is a lens which is thicker in the centre. What kind of lens is thicker at the centre? The lens focuses light on the back of the eye, on a layer called **retina (Fig.12.13)**. Retina contains several nerve cells. Sensations felt by the nerve cells are then transmitted to the brain through the optic nerve.

There are two kinds of cells

(i) cones, which are sensitive to bright light and

(ii) rods, which are sensitive to dim light. Besides, cones sense colour. At the junction of the optic nerve and the retina, there are no sensory cells, so no vision is possible at that spot. This is called the **blind spot**. Its existence can be demonstrated as follows:

Activity 12.9

Make a round mark and a cross on a sheet of paper with the spot to the right of the cross **(Fig. 12.15)**. The distance between two

marks may be 6-8 cm. Hold the sheet of paper at arms length from the eye. Close your left eye. Look continuously at the cross. Move the sheet slowly towards you, keeping your eye on the cross. What do you find? Does the round mark disappear at some point? Now close your right eye. Look at the round mark now and repeat the activity. Does the cross disappear? The disappearance of the cross or the round mark shows that there is a point on the retina which cannot send messages to the brain when light falls on it.

Fig. 12.15 : Demonstration of Blind Spot

The impression of an image does not vanish immediately from the retina. It persists there for about 1/16th of a second. So, if still images of a moving object are flashed on the eye at a rate faster than 16 per second, then the eye perceives this object as moving.

Activity 12.10

Get a square piece of cardboard of side 6-8 cm. Make two holes as shown in **Fig. 12.16.** Thread a string through the two holes. Draw/paste a cage on one side of the cardboard and a bird on the other side. Twist the string and make the card twirl rapidly. Do you see the bird in the cage?

The movies that we see are actually a number of separate pictures in proper sequence. They are made to move across the eye usually at the rate of 24 pictures per second (faster than 16 per second). So, we see a moving picture.

Fig. 12.16 : Bird in Cage

Nature has provided eyes with eyelids to protect from any object entering the eye. Eyelids also shut out light when not required.

Eye is such a wonderful organ that it (normal) can see distant objects as well near objects clearly. The minimum distance at which the eye can see objects distinctly varies with age. The most comfortable distance at which one can read with a normal eye is about 25 cm.

Some persons can see near objects clearly but cannot see distant objects so clearly. On the other hand, some persons cannot see near objects clearly but they can see distant objects quite well. With suitable corrective lenses, these defects of the eye can be corrected.

Sometimes, particularly in old age, eyesight becomes foggy. It is due to the eye lens becoming cloudy. When it happens, persons are said to have cataract. There is a

loss of vision, sometimes extremely severe. It is possible to treat this defect. The opaque lens is removed and a new artificial lens is inserted. Modern technology has made this procedure simpler and safer.

12.8 Care of Eyes

It is necessary that you take proper care of your eyes. If there is any problem you should go to an eye specialist. Have a regular checkup.

- If advised, use suitable spectacles.
- Too little or too much light is bad for eyes. Insufficient light causes eyestrain and headaches. Too much light, like that of the sun, a powerful lamp or a laser torch can injure the retina.
- Do not look at the sun or a powerful light directly.
- Never rub your eyes. If particles of dust go into your eyes, wash your eyes with clean water. If there is no improvement go to a doctor.
- Wash your eyes frequently with clean water.
- Always read at the normal distance for vision. Do not read by bringing your book too close to your eyes or keeping it too far.

You might are aware about balanced diet. If food is deficient in some components, eye may also suffer. Lack of vitamin A in foodstuff is responsible for many eye troubles. Most common amongst them is night blindness.

One should, therefore, include in the diet components which have vitamin A.

Raw carrots, broccoli and green vegetables (such as spinach) and cod liver oil are rich in vitamin A. Eggs, milk, curd, cheese, butter and fruits such as papaya and mango are

Did you know?

Animals have eyes shaped in different ways. Eyes of a crab are quite small but they enable the crab to look all around. So, the crab can sense even if the enemy approaches from behind. Butterfly has large eyes that seem to be made up of thousands of little eyes **(Fig.12.17).** It can see not only in the front and the sides but the back as well.

A night bird (owl) can see very well in the night but not during the day. On the other hand, day light birds (kite, eagle) can see well during the day but not in the night. The Owl has a large cornea and a large pupil to allow more light in its eye. Also, it has on its retina a large number of rods and only a few cones. The day birds on the other hand, have more cones and fewer rods.

Fig. 12.17 : Eyes of Butterfly

also rich in vitamin A.

12.9 Visually Challenged Persons Can Read and Write

Some persons, including children, can be visually handicapped. They have very limited vision to see things. Some persons cannot see at all since birth. Some persons may lose their eyesight because of a disease. Such persons try to identify things by touching and listening to voices more carefully. They develop their other senses more sharply. However, additional resources can enable them to develop their capabilities further.

12.10 What is a Braille System?

The most popular resource for visually challenged persons is known as **Braille**.

Louis Braille

Louis Braille, himself a visually challenged person, developed a system for visually challenged persons and published it in 1821.

The present system was adopted in 1932. There is Braille code for common languages, mathematics and scientific notation. Many Indian languages can be read using the Braille system.

Braille system has 63 dot patterns or characters. Each character represents a letter, a combination of letters, a common word or a grammatical sign. Dots are arranged in cells of two vertical rows of three dots each.

Patterns of dots to represent some English

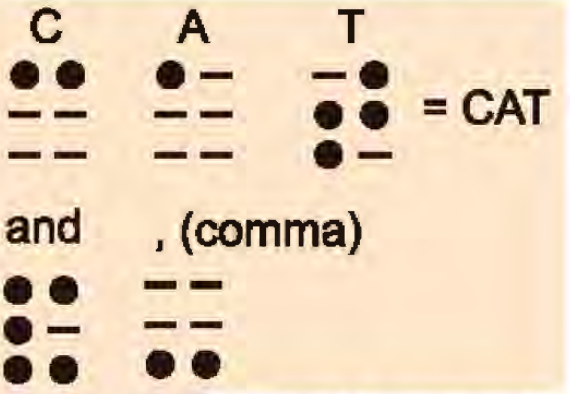


Fig. 12.18 : Example of Dot Patterns used in Braille System

Resources can be of two types : Non-optical aids and optical aids.

Non-optical aids include visual aids, tactual aids (using the sense of touch), auditory aids (using the sense of hearing) and electronic aids. Visual aids, can magnify words, can provide suitable intensity of light and material at proper distances. Tactual aids, including Braille writer slate and stylus, help the visually challenged persons in taking notes, reading and writing. Auditory aids include cassettes, tape recorders, talking books and other such devices. Electronic aids, such as talking calculators, are also available for performing many computational tasks. Closed circuit television, also an electronic aid, enlarges printed material with suitable contrast and illumination. Nowadays, use of audio CDs and voice boxes with computers are also very helpful for listening to and writing the desired text.

Optical aids include bi-focal lenses, contact lenses, tinted lenses, magnifiers and telescopic aids. While the lens combinations are used to rectify visual limitations, telescopic aids are available to view chalkboard and class demonstrations.

alphabets and some common words are shown below.

These patterns when embossed on Braille sheets help visually challenged to recognise words by touching. To make them easier to touch, the dots are raised slightly.

Visually challenged people learn the Braille system by beginning with letters, then special characters and letter combinations. Methods depend upon recognition by touching. Each character has to be memorised. Braille texts can be produced by hand or by machine. Type writer - like devices and printing machines have now been developed.

Helen A Keller

Some visually challenged Indians have great achievements to their credit. Diwakar, a child prodigy has given amazing performances as a singer.

Mr. Ravindra Jain, born completely visually challenged, obtained his Sangeet Prabhakar degree from Allahabad. He has shown his excellence as a lyricist, singer and music composer.

Mr. Lal Advani, himself visually challenged, established an Association for special education and rehabilitation of disabled in India. Besides, he represented India on Braille problems to UNESCO.

Helen A Keller, an American author and lecturer, is perhaps the most well known and inspiring visually challenged person. She lost her sight when she was only 18 months old. But because of her resolve and courage she could complete her graduation from a university. She wrote a number of books including *The Story of my Life* (1903).

KEYWORDS

ANGLE OF INCIDENCE
ANGLE OF REFLECTION
BLIND SPOT
BRAILLE
CONES
CORNEA
DIFFUSED / IRREGULAR-REFLECTION
DISPERSION
INCIDENT RAYS
IRIS
KALEIDOSCOPE
LATERAL INVERSION
LAWS OF REFLECTION
PUPIL
REFLECTED RAYS
REFLECTION
REGULAR REFLECTION
RETINA
RODS

WHAT YOU HAVE LEARNT

- Light is reflected from all surfaces.
- Regular reflection takes place when light is incident on smooth, polished and regular surfaces.
- Diffused/irregular reflection takes place from rough surfaces.
- Two laws of reflection are

  (i) The angle of incidence is equal to the angle of reflection.

  (ii) Incident ray, reflected ray and the normal drawn at the point of incidence to the reflecting surface, lie in the same plane.
- Image formed in a plane mirror undergoes lateral inversion.
- Two mirrors inclined to each other give multiple images.
- Beautiful patterns are formed in a kaleidoscope because of multiple reflections.
- Sunlight, called white light, consists of seven colours.
- Splitting of light into its constituent colours is known as dispersion.
- Important parts of the eye are cornea, iris, pupil, lens, retina and optic nerve.
- A normal eye can see nearby and distant objects clearly.
- Visually challenged persons can read and write using Braille system.
- Visually challenged persons develop their other senses more sharply to improve their interaction with their environment.

Exercises

1. Suppose you are in a dark room. Can you see objects in the room? Can you see objects outside the room. Explain.
2. Differentiate between regular and diffused reflection. Does diffused reflection mean the failure of the laws of reflection?
3. Mention against each of the following whether regular or diffused reflection will take place when a beam of light strikes. Justify your answer in each case.

   (a) Polished wooden table (b) Chalk powder

   (c) Cardboard surface (d) Marble floor with water spread over it

   (e) Mirror (f) Piece of paper
4. State the laws of reflection ?
5. Describe an activity to show that the incident ray, the reflected ray and the normal at the point of incidence lie in the same plane?

6. Fill in the blanks in the following :

(a) A person 1 m in front of a plane mirror seems to be _____ m from his image.

(b) If you touch your _____ ear with right hand in front of a plane mirror it will be seen in the mirror that your right ear is touched with _____

(c) The size of the pupil becomes _____ when you see in dim light.

(d) Night birds have _____ cones than rods in their eyes..

Choose the correct option in Questions 7 – 8

7. Angle of incidence is equal to the angle of reflection

   (a) Always (b) Sometimes

   (c) Under special conditions (d) Never
8. Image formed by a plane mirror is

   (a) virtual, behind the mirror and enlarged

   (b) virtual, behind the mirror and of the same size as the object

   (c) real at the surface of the mirror and enlarged

   (d) real, behind the mirror and of the same size as the object.
9. Describe the construction of a kaleidoscope ?
10. Draw a labeled sketch of the human eye ?
11. Gurmit wanted to perform Activity 16.8 using a laser torch. Her teacher advised her not to do so. Can you explain the basis of the teachers advise?
12. Explain how you can take care of your eyes ?

13. What is the angle of incidence of a ray if the reflected ray is at an angle of 90° to the incident ray?
14. How many images of a candle will be formed if it is placed between two parallel plane mirrors separated by 40 cm?
15. Two mirrors meet at right angles. A ray of light is incident on one at an angle of 30° as shown in **Fig. 12.19**. Draw the reflected ray from the second mirror.

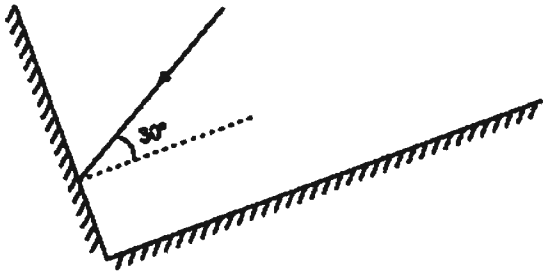


Fig. 12.19

16. Yasir stands at A just on the side of a plane mirror as shown in **Fig. 12.20**. Can he see himself in the mirror? Also can he see the image of objects situated at P, Q and R?

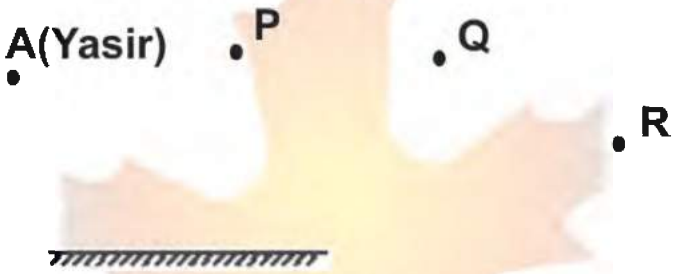


Fig. 12.20

17. (a) Find out the position of the image of an object situated at A in the plane mirror **(Fig. 12.21)**.

(b) Can Saba at B see this image?

(c) Can Yasir at C see this image?

(d) When Saba moves from B to C, where does the image of A move?

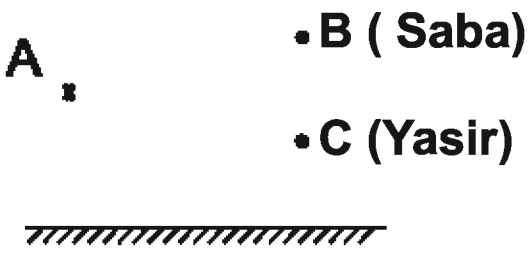


Fig. 12.21

Extended Learning — Activities and Project

1. Make your own mirror. Take a glass strip or glass slab. Clean it and put it on a white sheet of paper. See yourself in the glass. Next put the glass slab on a black sheet of paper. Again look into the glass. In which case you see yourself better and why?
2. Make friends with some visually challenged students. Enquire from them how they read and write. Also find out how they are able to recognise objects, hurdles and currency notes.
3. Meet an eye specialist. Get your eye sight checked and discuss how to take care of your eyes.
4. Survey your neighbourhood. Find out how many children below the age of 12 years use spectacles. Find out from their parents what, in their view, could be the reason for the weak eyesight of their children.

You can read more on this topic on the following websites:
www. glenbrook.k12.il.us/gbssci/phys/mmedia/optics/ifpm.html.
www.glenbrook.k12.il.us/gbssci/phys/class/refln/u1311b.html.

Did You Know?

Eyes can be donated by any person as an invaluable gift to visually challenged persons suffering from corneal blindness, The person may be:

(a) male or female (b) of any age

(c) of any social status (d) using spectacles

(e) suffering from any normal disease but not AIDS, Hepatitis B or C, Rabies, Leukemia, Tetanus, Cholera, Encephalitis.

The eyes have to be donated within 4-6 hours after death at any place, home or hospital.

A person who wants to donate the eyes has to pledge eyes during his/her lifetime to any registered eye bank. He/she should also inform his/her relatives about this pledge so that they can take necessary action after his/her death.

You can also donate a Braille kit. Contact :

Give India, National Association for the Blind. [The cost of a Braille kit is Rs. 750/-]

CHAPTER - 13

POLLUTION OF AIR AND WATER

We all were very excited to hear the news that Taj Mahal in Agra is now one of the seven wonders of the world. But we are disappointed to hear that the beauty of this monument in white marble is being threatened by air pollution in the area surrounding the Taj. We are eager to know if something can be done to fight the air and water pollution.

We are all aware that our environment is not what it used to be. Our elders talk about the blue sky, clean water and fresh air that was available in their times. Now the media regularly reports on the falling quality of the environment. We ourselves feel the impact of the falling quality of air and water in our lives. For example the number of people suffering from diseases of the respiratory system is steadily rising.

We dread to imagine a time when clean air and water may no longer be available! You have learnt about the importance of air and water in your previous classes. In this chapter, we will study about the harmful changes taking place in our surroundings and their effects on our lives. We can survive for some time without food, but we cannot survive even for a few minutes without air. This simple fact tells us how important clean air is to us. You already know that air consists of a mixture of gases. By volume, about 78% of this mixture is nitrogen and about 21% is oxygen. Carbon dioxide (CO_2), argon(Ar), methane (CH_4), ozone (CO_3) and water vapour are also present in very small quantities.

Q. Name the various constitutents of air ?

13.1 Air Pollution

Activity 13.1

You may have covered your nose while passing a brick kiln emitting smoke or started coughing while walking on a busy road **(Fig. 13.1).**

On the basis of your experience, compare the quality of air at theplaces given below:

- A park and a busy road.
- A residential area and an industrial area.
- A busy traffic intersection at different times of the day e.g. early morning, afternoon and evening.
- A village and a town.

Fig. 13.1 : A Congested Road in a City

One of your observations in the above activity could be the differences in the amount of smoke in the atmosphere. Do you know where the smoke could have come from? Addition of such substances e.g dust,

smoke etc., to the atmosphere modifies it. When air is contaminated by unwanted substances which have a harmful effect on both the living and the non-living things, it is referred to as **air pollution**.

13.2 How does Air Get Polluted?

The substances which contaminate the air are called **air pollutants**. Sometimes, such substances may come from natural sources like smoke and dust arising from forest fires or volcanic eruptions. Pollutants are also added to the atmosphere by human activities. The sources of air pollutants are factories **(Fig.13.2)**, power plants, automobile exhausts and burning of firewood and dung cakes.

Fig. 13.2 : Smoke from a Factory

You might have read in the newspapers that respiratory problems amongst children are rising day by day. Conduct a survey of households in your neighbourhood and among friends to find out how many children are suffering from respiratory problems.

Many respiratory problems are caused by air pollution. Let us now try to find out the substances or pollutants which are present in the polluted air.

Have you noticed how rapidly the number of vehicles is increasing in our cities?

Vehicles produce high levels of pollutants like carbon monoxide, carbon dioxide, nitrogen oxides and smoke **(Fig. 13.3)**. Carbon monoxide is produced from incomplete burning of fuels such as petrol and diesel. It is a poisonous gas. It reduces the oxygen-carrying capacity of the blood.

Fig. 13.3 : Air Pollution due to Automobiles

Do you know?

If the vehicles registered in Delhi are lined up one after the other, the total length would be nearly equal to the combined lengths of the two longest rivers in the world, Nile and Amazon!

Yasir remembers seeing a thick fog-like layer in the atmosphere, especially during winters. This is **smog** which is made up of smoke and fog. Smoke may contain oxides of nitrogen which combine with other air pollutants and fog to form smog. The smog causes breathing difficulties such as asthma, cough and wheezing in children.

Many industries are also responsible for causing air pollution. Petroleum refineries are a major source of gaseous pollutants like sulphur dioxide and nitrogen dioxide. Sulphur dioxide is produced by combustion of fuels like coal in power plants. It can cause respiratory problems, including permanent lung damage.

Other kinds of pollutants are **chlorofluorocarbons** (CFCs) which are used in refrigerators, air conditioners and aerosol sprays. CFCs damage the ozone layer of the atmosphere. Recall that the ozone layer protects us from harmful ultraviolet rays of the sun. Have you heard of the ozone hole? Try to find out about it. Thankfully, less harmful chemicals are now being used in place of CFCs.

In addition to the above mentioned gases, automobiles which burn diesel and petrol, also produce tiny particles which remain suspended in air for long periods **(Fig. 13.3)**. They reduce visibility. When inhaled, they cause diseases. Such particles are also produced during industrial processes like steel making and mining. Power plants give out tiny ash particles which also pollute the atmosphere.

Q1. Define Air pollution ?

Q2. What are pollutants and name them ?

Q3. Name the various sources of air pollutants ?

Q4. Define smog and what are its ill-effects?

Activity 13.3

Prepare a table using the pollutants mentioned above. You may even add more data to the following Table.

Table 13.1

Air Pollutants	Sources	Effects

13.3 Case Study : The Taj Mahal

Over the past 2 decades, India's most famous tourist attraction, Taj Mahal located in Agra **(Fig. 13.4)**, has become a matter of concern. Experts have warned that pollutants in air are discolouring its white marble. So, it is not only living organisms that get affected by polluted air but non-living things like buildings, monuments and statues also get affected. The industries located in and around Agra like rubber processing, automobile, chemicals and especially the Mathura oil refinery, have been responsible for producing pollutants like sulphur dioxide and nitrogen dioxide. These gases react with the water vapour present in the atmosphere to form sulphuric acid (H_2SO_4) and nitric acid (HNO_3). The acids drop down with rain, making the rain acidic. This is called **acid rain**. Acid rain corrodes the marble of the monument. The phenomenon is also called "Marble cancer". Suspended particulate matter, such as the soot particles emitted by Mathura oil refinery, has contributed towards yellowing of the marble.

The Supreme Court has taken several steps to save the Taj. It has ordered the industries

Fig. 13.4 : Taj Mahal

to switch to cleaner fuels like CNG (Compressed Natural Gas) and LPG (Liquefied Petroleum Gas). Moreover, the automobiles should switch over to unleaded petrol in the Taj zone.

Discuss with your elders and see what they have to say about the condition of the Taj, 20 or 30 years ago!

Try to procure a picture of the Taj Mahal for your scrap book.

I am reminded of the chapter on crops. I wonder whether acid rain affects the soil and plants also.

13.4 Greenhouse Effect

You know that the sun's rays warm the earth's surface. A part of the radiation that falls on the earth is absorbed by it and a part is reflected back into space. A part of the reflected radiation is trapped by the atmosphere. The trapped radiations further warm the earth. If you have seen a greenhouse in a nursery or elsewhere, recall that the sun's heat is allowed to get in but is not allowed to go out. The trapped heat warms the green house. The trapping of radiations by the earth's atmosphere is similar. That is why it is called the **greenhouse effect**. Without this process, life would not have been possible on the earth. But now it threatens life. CO_2 is one of the gases responsible for this effect.

You know that CO_2 is one of the components of air. But how does CO_2 content rise in the atmosphere and become excessive? But if there is excess of CO_2 in the air, it acts as a pollutant.

CO_2 is continuously being released because of human activities. On the other hand, area under forests is decreasing. Plants utilise CO_2 from the atmosphere for photosynthesis, thereby decreasing the

amount of CO_2 in the air. Deforestation leads to an increase in the amount of CO_2 in the air because the number of trees which consume CO_2 is reduced. Human activities, thus, contribute to the accumulation of CO_2 in the atmosphere. CO_2 traps heat and does not allow it to escape into space. As a result, the average temperature of the earth's atmosphere is gradually increasing. This is called **global warming.**

Other gases like methane, nitrous oxide and water vapour also contribute towards this effect. Like CO_2, they are also called **greenhouse gases.**

Global Warming
A Serious Threat!

Global warming can cause sea levels to rise dramatically. In many places, coastal areas have already been flooded. Global warming could result in wide ranging effects on rainfall patterns, agriculture, forests, plants and animals. Majority of people living in regions which are threatened by global warming are in Asia. A recent climate change report gives us only a limited time to keep the greenhouse gases at the present level. Otherwise, the temperature may rise by more than 2 degrees Celsius by the end of the century, a level considered dangerous.

Global warming has become a major concern for governments worldwide. Many countries have reached an agreement to reduce the emission of greenhouse gases. The Kyoto Protocol is one such agreement.

It is surprised to hear that an increase in the earth's temperature by even as little as 0.5 °C can have such a serious effect! You might have read in the newspapers recently that the Gangotri glacier in the Himalayas has started melting because of global warming.

Q1. What do you understand by Green House Effect?

Q2. Define Global warming and name the various gases which lead to Global warming?

Q3. What are the ill-effects of global warming?

The State of Jammu and Kashmir has been showing a steady progress in small scale industrial sector. Satwari (Jammu Distt.) Zainakote (Srinagar Distt.) represent Industrial estates.

In Jammu Province Industrial areas are in Bari Brahamna, Gangyal, Udhampur, Doda, Rajouri and Kathua and in Kashmir valley Rangreth, Khonmuh, Doagbarh, Letipora, Shelteng, Kupwara and Kondabal are the major industrial areas.

13.5 What can be Done?

What can we do to reduce air pollution?

There are many success stories in our fight against air pollution. For example, a

Fig. 13.5 : A Public Transport Bus Powered by CNG

few years ago, Delhi was one of the most polluted cities in the world. It was being choked by fumes released from automobiles running on diesel and petrol. A decision was taken to switch to fuels like CNG **(Fig. 13.5)** and unleaded petrol. These measures have Resulted in cleaner air for the city. You might know of some other examples from your area regarding reduction of air pollution. Share these with your friends.

Do you know about the Say "no to crackers" campaign which was organised by children from many schools? This made a big difference to the air pollution levels around Diwali.

The quality of air at various locations is monitored regularly by government and other agencies. We can use this data to generate awareness about air pollution among friends and neighbours.

There is a need to switch over to alternative fuels instead of the fossil fuels for our energy requirements. These could be solar energy, hydropower and wind energy.

Q. Name the alternative fuels which we can use instead of fossils fuels ?

Activity 13.4

You have various options of commuting to your school such as walking, going by bicycle, travelling by bus or other public transport, using a car individually, travelling by car pool. Discuss in your class the impact of each of these options on the quality of air.

Small contributions on our part can make a huge difference in the state of the environment. We can plant trees and nurture the ones already present in the neighbourhood. Do you know about *Van Mahotsav*, when lakhs of trees are planted

Fig. 13.6 : Children Planting Saplings

in July every year **(Fig. 13.6)**?

Whenever we go to an area where some people are burning dry leaves, we start coughing because the entire area is full of smoke. It would be a better option to put them in a compost pit rather than burning. What do you think?

13.6 Water Pollution

You know that water is a precious resource. Think and list the various activities in which we need water. We saw that water is becoming scarce due to increase in population, industries and agricultural activities. You have also studied how water becomes "dirty" after we use it for washing clothes, bathing, etc. This means that we are adding some materials to the water, which spoil its quality and change its smell and colour.

Whenever harmful substances such as sewage, toxic chemicals, silt, etc., get mixed with water, the water becomes polluted. The substances that pollute water are called **water pollutanta**.

Activity 13.5

Try to collect samples of water from a tap, pond, river, well and lake. Pour each into separate glass containers. Compare these for smell, acidity and colour. Complete the following Table.

Table 13.2

	Smell	Acidity	Colour
Tap Water			
Pond Water			
River Water			
Well Water			
Lake Water			

13.7 How does Water Get Polluted?

Case Study

Ganga is one of the most famous rivers of India **(Fig. 13.7)**. It sustains most of the northern, central and eastern Indian population. Millions of people depend on it

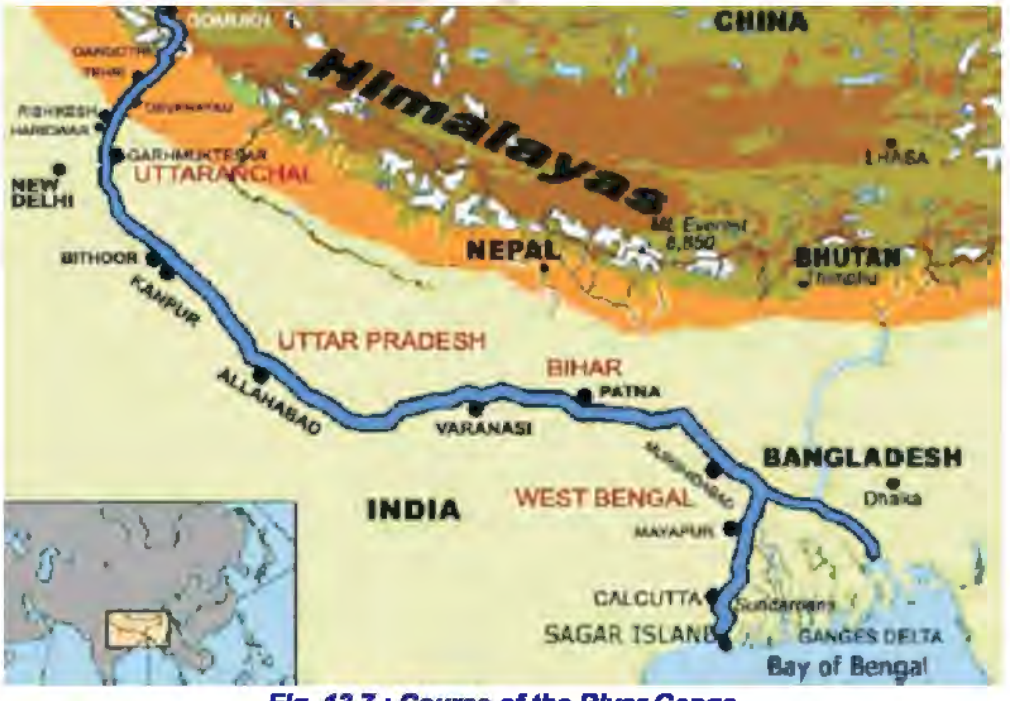


Fig. 13.7 : Course of the River Ganga

for their daily needs and livelihood. However, recently a study by the World Wide Fund for Nature (WWF) found that Ganga is one of the ten most endangered rivers in the world. The pollution levels have been rising for many years. We have reached this stage because the towns and cities, through which the river flows, throw large quantities of garbage, untreated sewage, dead bodies, and many other harmful things, directly into the river. In fact the river is "dead" at many places where the pollution levels are so high that aquatic life cannot survive.

An ambitious plan to save the river, called the **Ganga Action Plan** was launched in 1985. It aimed to reduce the pollution levels in the river. However, the increasing population and industrialisation have already damaged this mighty river beyond repair.

Let us take a specific example to understand the situation. The Ganga at Kanpur in Uttar Pradesh (U.P.), has one of the most polluted stretches of the river **(Fig. 13.8)**. Kanpur is one of the most populated towns in U.P. People can be seen bathing,

Fig.13.8 : A Polluted Stretch of the River Ganga

washing clothes and defecating in the river. They also throw garbage, flowers, idols of gods and goddesses and non-biodegradable polythene bags into the river.

At Kanpur the amount of water is comparatively small and the flow of the river is very slow. In addition, Kanpur has more than 5000 industries. These include fertiliser, detergent, leather and paint industries. These industrial units discharge toxic chemical wastes into the river.

Do you Know ?

The Dal Lake (in Srinagar city of J &K State) is the star attraction for the tourists. The lake is situated at the foot of Zabarwan hills with Shankar Acharya hill (Takhti - Sulaiman) in its south and Hariparbat hill on its west. On the northern side of the lake is the world famous Hazratbal Shrine. The famous Mughal Gardens, Cheshma Shahi, Nishat and Shalimar lie on the eastern periphery of the lakes.

This once pure lake is slowly turning into a polluted water body. Soil erosion, caused by deforestation in the catchment areas and pollution because of discharge of untreated effluents mostly organic wastes are threatening the very existance of this lake. As a result the lake is overburdened and its ability to sustain life. The size has decreased plus its water has become dirty, foul smelling and a breeding ground for infections. We need to make concerted efforts to save the Dal Lake.

Based on the above information, think of the answers to the following questions :

Q1. What are the factors responsible for pollution of the river ?

Q2. What steps can be taken to restore the river Ganga to its past glory ?

Q3. How would the disposal of garbage, etc., affect the living organisms in the river ?

Many industries discharge harmful chemicals into rivers and streams, causing the pollution of water **(Fig. 13.9)**. Examples are oil refineries, paper factories, textile and sugar mills and chemical factories. These

Fig. 13.9 : Industrial Waste Discharged into a River

industries cause chemical contamination of water. The chemicals released include arsenic, lead and fluorides which lead to toxicity in plants and animals. There are regulations to prevent this. Industries are supposed to treat the waste produced before discharging it into waters, but quite often the rules are not followed. The soil is also affected by impure water, causing changes in acidity, growth of worms, etc.

We all know the importance of pesticides and weedicides for the protection of crops. However, all these chemicals dissolve in water and are washed into water bodies from the fields. They also seep into the ground to pollute ground water.

Have you seen ponds which look green from a distance because they have a lot of algae growing in them? This is caused by excessive quantities of chemicals which get washed from the fields. These act as nutrients for algae to flourish. Once these algae die, they serve as food for decomposers like bacteria. A lot of oxygen in the water body gets used up. This results in a decrease in the oxygen level which may kill aquatic organisms.

Do you know how the sewage is collected from your home and where it go thereafter.

Sometimes untreated sewage is thrown directly into rivers. It contains food wastes, detergents, microorganisms, etc. Can ground water get polluted by sewage? How? Water contaminated with sewage may contain bacteria, viruses, fungi and parasites which cause diseases like cholera, typhoid and jaundice.

The bacteria present in the faeces of mammals are the indicators of the quality of water. If water has these bacteria, it means that it has been contaminated by faecal matter. If such water is used by us, it can cause various infections.

Do you know?

Hot water can also be a pollutant ! This is usually water from power plants and industries. It is released into the rivers. It raises the temperature of the waterbody, adversely affecting the animals and plants living in it.

13.8 What is Potable Water and How is Water Purified ?

Activity 13.6

Let us construct a water filter with simple, everyday materials.

Take a plastic bottle and cut it into 2 halves at the centre. Use the upper half as a funnel by putting it upside down in the lower half. Make layers in it with paper napkin or a fine cloth followed by cotton, sand and then gravel. Now pour dirty water through the filter and observe the filtered water.

Discuss the following questions amongst yourselves and with your teacher:

Q1. Why do we need to filter water before drinking ?

Q2. Where do you get your drinking water from?

Q3. What will happen if we drink polluted water?

Sometimes you drink water which looked clear and was without any smell, but still you fell sick !

Doctor explains that water which looks clean may still have disease carrying micro organisms and dissolved impurities. So, it is essential to purify water before drinking, for example, by boiling.

Water which is suitable for drinking is called **potable water.** You have seen how various physical and chemical processes in the sewage treatment plants help to clean water before discharging it into water bodies. Similarly, municipal bodies treat the water before supplying it to households.

Fig. 13.10 : Water Treatment Plant

Do you know?

25% of the world's population is without safe drinking water!

Let us see how water can be made safe for drinking:

You have already seen how water is filtered. This is a physical method of removing impurities. A popular household filter is a candle type filter.

Many households use boiling as a method for obtaining safe drinking water. Boiling kills the germs present in the water.

Chlorination is a commonly used chemical method for purifying water. It is done by adding chlorine tablets or bleaching powder to the water. **We must be cautious. We should not use more chlorine tablets than specified.**

13.9 What can be Done?

Activity 13.7

Investigate the level of awareness about water pollution in your area. Collect data on the sources of drinking water and the methods of sewage disposal.

What are the common water-borne diseases in the community? You can consult your local doctor/health worker for this.

Which are the governmental and non-governmental organisations working in this field? What are the measures being taken by them for generating awareness?

Laws for industrial units should be strictly implemented so that polluted water is not disposed off directly into rivers and lakes. Water treatment plants should be installed in all industrial areas **(Fig. 13.10)**. At our individual levels we should consciously save water and not waste it. **Reduce**, **reuse** and **recycle** should be our mantra!

Think of your daily routine – How can you save water?

We can think of creative ideas like reusing water used for washing and for other household tasks. For example, water used for washing vegetables may be used to water plants in the garden.

Pollution is no longer a distant phenomenon. It is affecting the quality of our daily lives. Unless we all realise our responsibility and start using environment-friendly processes, the very survival of our planet is in danger.

Do you know?

While brushing your teeth, leaving the tap running may waste several litres of water. A tap that drips once every second wastes a few thousand litres of water every year. Think about it!

Q1. Name some methods used for purification of water

Q2. What are the common water borne diseases?

Q3. How can you save water?

KEYWORDS

ACID RAIN
AIR POLLUTION
CHEMICAL CONTAMINATION
GLOBAL WARMING
GREEN HOUSE EFFECT
POLLUTANTS
POTABLE WATER
WATER POLLUTION

WHAT YOU HAVE LEARNT

- Air pollution is the contamination of air by impurities which may have a harmful impact on the living organisms and the non-living components.
- Pollutants are the substances which contaminate air and water.
- Carbon monoxide, nitrogen oxides, carbon dioxide, methane and sulphur dioxide are the major pollutants of air.
- Increasing levels of green house gases like CO_2 are leading to global warming.
- Water pollution is the contamination of water by substances harmful to life.
- Sewage, agricultural chemicals and industrial waste are some of the major contaminants of water.
- Water which is purified and fit for drinking is known as potable water.
- Water is a precious natural resource. We must learn to conserve it.

Exercises

1. What are the different ways in which water gets contaminated ?
2. At an individual level, how can you help reduce air pollution?
3. Clear, transparent water is always fit for drinking. Comment.
4. You are a member of the municipal body of your town.

Make a list of measures that would help your town to ensure the supply of clean water to all its residents.

5. Explain the differences between pure air and polluted air?
6. Explain circumstances leading to acid rain. How does acid rain affect us?

7. Which of the following is not a greenhouse gas?

(a) Carbon dioxide

(b) Sulphur dioxide

(c) Methane

(d Nitrogen

8. Describe the 'Green House Effect' in your own words ?

9. Prepare a brief speech on global warming that you have to make in your class.

10. Describe the threat to the beauty of the Taj Mahal ?

11. Why does the increased level of nutrients in the water affect the survival of aquatic organisms?

Extended Learning — Activities and Projects

1. In some cities, a pollution check has been made compulsory for vehicles. Visit a petrol pump in order to learn about the process of conducting a pollution check. You may systematically record your findings in the following areas:

Average number of vehicles checked per month.

Time taken to check each vehicle.

Pollutants checked for.

The process of testing.

Permissible levels of emission of various gases.

Measures taken if the emitted gases are above the permissible limits.

How frequently is a pollution check required ?

2. Conduct a survey in your school to investigate various environment related activities that have been undertaken. The class can divide itself into two groups, with each group looking at a different area.

For example, one group can find out whether there is an environment club in the school. What are its objectives ? What is its calendar of events ? How can you become a member ? If your school does not have such a club, you can even think of starting one along with a few of your friends.

3. Organise a field visit to a river in or around your town with the help of your teachers.

Observations followed by discussion could focus on :

The history of the river.

Cultural traditions.

Role of the river in meeting the town's water needs.

Pollution concerns.

Sources of pollution.

Effects of pollution on the people living by the riverside as well as those living far away.

4. Find out with the help of your teachers and the internet (if possible), Whether there are any international agreements to control global warming. Which are the gases covered under these agreements?

www.edugreen.teri.res.in/explore/air/air.htm
www.edugreen.teri.res.in/explore/water/pollu.htm
www.cpcb.nic.in/citizen's%Charter/default_citizen's.html
coe.mse.ac.in/kidswater.asp
coe.mse.ac.in/kidsair.asp

CHAPTER - 14

FRICTION

14.1 INTRODUCTION

Consider a block of wood placed on a wooden table, such that the weight of the block (W) acting vertically downward is equal to the reaction of the Table (R) acting vertically upward as shown in **Fig. 10.1**. Now , if this block is attached to a spring balance is pulled towards the right gently ,it is observed that the block initially does not move. However, when the applied force is gradually increased, a stage comes when the block just starts sliding .The question arises why does not the block move with a gentle force?

The answer to the above question is that an equal and opposite force is applied on the surface of the table. This force which resists motion, is called **the force of friction.**

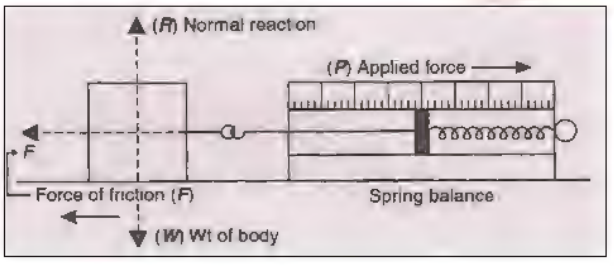


Fig.14.1

Definition

An opposing force called into play, when two surface in contact with each other try to move relative to one another, is called **friction**

14.2 HOW IS FRICTION CAUSED?

However smooth the two surfaces may be, on observing them under a Macroscope, you will see that they have irregularities on their surfaces.

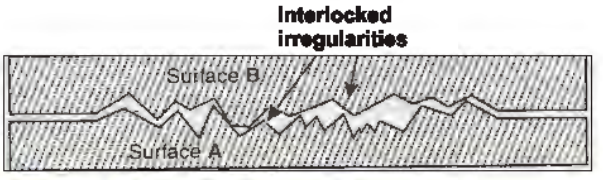


Fig. 14.2 Enlarged View of Smooth Surfaces In Contact

It means that at some points, the surface will be raised and at some other points, the surface will be depressed.

Thus, when two bodies are placed upon one another, the irregularities of the surface of two bodies inter lock as shown in **Fig.14.2**. When a force is applied on one body to slide it upon another body, its interlocked irregularities oppose the applied force, which appears to us in the form of friction. It is for the same reason that a sufficient amount of force has to be applied; before one body starts sliding upon another body. Thus, to sum up, more the irregularities on the two surfaces in contact, i.e., the rougher are the surfaces in contact, more is the force of friction.

ACTIVITY 14.1

To understand the meaning of static friction, limiting friction and dynamic friction.

Material Required: A wooden block provided with a hook, a sensitive spring balance

Method: Place the wooden block on a smooth table top. To its hook attach the spring balance and gently pull it outward right side. You will notice that gentle pull does not move the wooden block. However, the spring balance records the force applied on the wooden block. This force registered by the spring balance is equal and opposite to the force of friction offered by the surface of wooden block in contact with table top. Now, increase the force on the spring balance a little more. You will notice that wooden block does not move, but the spring balance records higher magnitude of applied force. From this observation it can be concluded that, when the wooden block does not move (remains static), then applied force is equal and opposite to the force of friction offered by the surface of wooden block in contact with table top. In a way the force of friction in static (stationary) situation is self-adjusting.

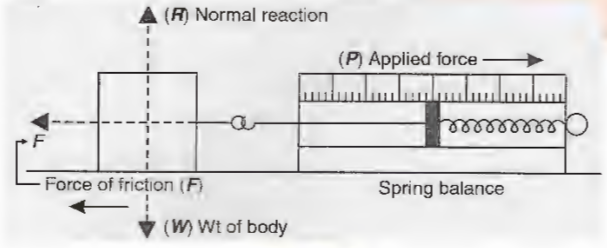


Fig. 14.3

Such a force of friction is called static friction and only as much is called into play as is necessary to prevent the motion of the wooden block.

Now go on increasing the pull on this wooden block, till it starts sliding. At this moment, the spring balance will register maximum applied force which is equal and opposite to the force of friction. This maximum force required to make one body just slide over another body is the limit of static friction. It is commonly called limiting friction.

It is further noticed that, if we apply the pull on the wooden block in such a way that it gently sides over table top, then the spring balance records lesser force than the limiting force. This lesser force registered by the spring balance which keeps the wooden block just sliding on the table top is called **dynamic friction** or **sliding friction.**

Definitions

1. Static Friction : The force of friction called into play, which does not allow two bodies to slide upon one another is called static friction.

It is a self-adjusting force, that is only as much as is necessary to prevent the motion.

2. Limiting Friction : The maximum static force of friction comes into play, when one body just slides upon another body is called limiting friction.

3. Dynamic Friction or Sliding Friction : The force of friction acting between the two bodies, when they are sliding upon one another with a uniform speed is called dynamic friction or sliding friction.

Why is dynamic friction slightly less than the limiting friction ?

You know that friction is caused due to the interlocking of the irregularities on the surface of two bodies in contact with each other. Now, more force is required to unlock the irregularities between the surfaces of two stationary bodies as compared to the

force required to keep the irregularities unlocked between the surfaces of two sliding bodies. Thus, the limiting friction is always slightly more than the dynamic friction or dynamic friction is slightly less than the limiting friction.

Fig. 14.4 shows a graph between the applied force on the spring balance and the force of friction. The region AB in the graph shows static friction, which is self adjusting. BC shows the magnitude of limiting friction. DE shows the magnitude of dynamic friction.

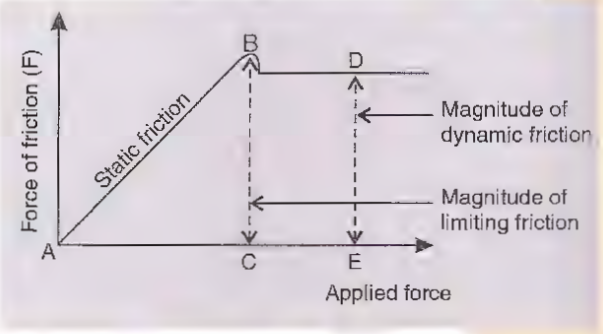


Fig. 14.4

14.3 Laws of Limiting Friction

1. Limiting friction always opposes the motion of a body and acts in the direction opposite to the direction of applied force.
2. Limiting friction depends upon the nature of surfaces in contact with each other.
3. Limiting friction increases with the increase in the weight of the body and vice versa.
4. Limiting friction is independent of area of contact between two surfaces; provided the weight of the body and the nature of surface does not change.

Let us perform the following activities to verify the above laws.

Activity 14.2

To prove that limiting friction depends upon the nature of surface in contact with each other

Material Required : A wooden block provided with a hook, a spring balance, a sand paper, talcum powder.

Method : Place the wooden block on the smooth table top. To the hook of wooden block attach the spring balance (refer to **Fig 14.1**). Put the spring balance gently towards the right. Go on increasing the pull on the spring balance, till it just starts sliding. Read and record the force shown by the spring balance. This force is equal and opposite to the limiting friction between the surface of the wooden block and the table top.

Now, place a sand paper flat on the table top and over it place the wooden block. Repeat the activity as above and again record the force of limiting.

Now, sprinkle some talcum power on the table to and over it place the wooden block. Repeat and again record the force of limiting friction.

You will observe that the force of limiting friction is least in case of talcum powder, of middle order in case of smooth table top and maximum in case of sand paper.

The activity clearly proves that limiting friction depends upon the nature of surfaces in contact with each other.

Activity 14.3

Prove that limiting frictions increases with the weight of body.

Material Required: A wooden block provided with a hook, a spring balance, brass weight of 50 gm and 100 gm.

Method: Place the wooden block on the smooth table top. To the hook of wooden block attach the spring balance (refer to **Fig. 14.1**). Pull the spring balance gently towards the right. Go on increasing the pull on the spring balance, till it just starts sliding. Read and record the force shown by the spring balance. This force is equal and opposite to the limiting friction between the surface of wooden block and the table top.

Now place 50 gm weight on the wooden block and repeat the activity. Read and record the force of limiting friction. Repeat the activity with 100 gm weight and 150 gm weight.

You will notice that as the weight of block is increased the magnitude of limiting friction also increases. The activity clearly proves that limiting friction increases. With the increase in the weight of a body.

Activity 14.4

To prove that limiting friction is independent of area of cross-section in contact with other body.

Material Required : A wooden block with hook having different length, width and height, such as its all surfaces are similar, a spring balance.

Method : Place the wooden block on the smooth table top such that its largest face is in contact with the top. To the hook of wooden block attach a spring balance (refer to **Fig. 14.1**). Pull the spring balance gently towards the right. Go on increasing the pull on the spring balance, till it just starts sliding. Read and record the force when shown by the spring balance. This force is equal and opposite to the limiting friction between the surface of wooden block and the table top.

Repeat the activity by placing wooden block in such a way on the table top that its smallest face is in contact with table top. You will notice that the force of limiting friction required to slide the block remains same.

The activity clearly proves that limiting friction is independent of area of cross-section in contact with other body.

14.4 Rolling Friction Before we discuss rolling friction, let us perform the following activity.

Activity 14.5

To prove that rolling friction is far less than limiting friction

Material Required : A wooden block provided with hook, a spring balance, four pencils with round surface.

Method : Proceed as in Activity 14.2, and thus, find the limiting friction for the wooden block when placed over a table top.

Now place four pencils parallel to one another, such that they are at a distance of about 2 cm from each other. Over the pencils place the wooden block in such a way that when force is applied on it the pencils under it roll in the direction of applied force.

Attach the hook of the spring balance to the wooden block and gently apply force towards right, till the wooden block just starts sliding over the pencils. You will notice that

force required is far less than the limiting friction. This force of friction is called rolling friction.

Definition : The friction experience by a body, when it is made to move over bodies like roller or a wheel is called rolling friction.

How is rolling friction caused ?

1. The roller or the wheel deforms (change the shape) the surface on which it is rolling temporarily, thereby causing a depression, on account of its weight.

2. In this process the roller or the wheel itself gets deformed temporarily at the point of contact of the surface of the body. Because of the above deformations a kind of inclined plane is formed in the direction of motion of the roller or the wheel. Thus, a force is required to over come this temporary, but continuously forward moving inclined plane. This force applied against the continuously forward moving inclined plane is the equivalent of rolling friction.

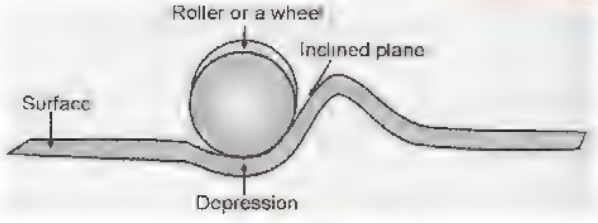


Fig 14.5

From the above discussion it is clear that the smaller the depression formed at the point of contact of wheel or roller with a given surface, the lesser is the force of rolling and vice versa.

Furthermore, rolling friction is far less than the sliding friction. This is why, wherever possible, sliding friction is replaced by rolling friction. This is achieved using wheels, ball bearings, roller bearings, etc.

Examples of Rolling Friction

1. When a car or bus or bicycle, etc., moves on the road, a part of its wheels and the surface of the road get continuously deformed. Thus, force has to be applied to overcome this deformation and is equivalent to the rolling friction.

It is for the same reason that more force is required when the tyres do not have sufficient air pressure because deformation produced is very large. Conversely, if the tyres are heavily inflated, the deformation produced is very small and hence the rolling friction decreases. However, the ride becomes very bumpy. Furthermore, it become difficult to apply brakes as the vehicle does not stay on its path during the application of brakes.

2. The wheels of the train are made of steel and so are the railway tracks. Thus, the deformation produced in them is very small and hence, they have very small rolling friction. It is because of this small rolling friction that the trains run very fast.

3. These days luggage, such as suitcases, are provided with tiny wheels. These wheels offer very small amount of rolling friction and are easy to move.

4. Roller skates have tiny wheels. These wheels have very small rolling friction and help in fast motion of the skater.

Test yourself

1. What do you understand by the term friction ? Explain how it is caused.

2. Distinguish between the static friction and dynamic friction ?
3. What is limiting friction ? State the laws of limiting friction ?
4. How is rolling friction caused ?
5. Under what conditions the rolling friction increases ?

14.5 Friction Due to Liquids and Gases

We have learnt that solids experience friction when their surfaces move relative to one another. It has been found that when a solid moves in a liquid or a gas, the surface of the solid experiences friction. However, it is found that liquids exert less force of friction as :

1. In nature the body of fishes is streamlined, such that they experience least amount of friction in water.
2. When a swimmer swims in water he tries to streamline his body as far as possible, so that he experience least friction due to water.
3. The boatman moves his oars in the reverse direction on approaching close to shore. This in turn decreases the speed of boat and it safely reaches the shore. It is because water offers very small amount of friction and hence it is very difficult to stop the boat.

It is for the reason that big ships fire their engines in reverse direction, in order to slow down or compared to the solids. Similarly, the gases exert least force of friction as compared to the solids or liquids. As the commonest liquid is water and commonest gas is air, therefore, we will discuss friction due to water and friction due to air.

Friction Due to Water

Before, we discuss the friction due to water, let us know about the "streamlined shape". The special shape of a body or an object around which a fluid (air or water) can flow easily, offering minimum amount of friction, is called streamlined shape.

Examples.

1. The body of ships and boats is streamlined so that they experience minimum amount of friction while moving through water.
2. In nature the body of fishes is streamlined, such that they experience least amount of friction in water.
3. When a swimmer swims in water he tries to streamline his body as far as possible, so that he experiences least friction due to water.
4. The boatman moves his oars in the reverse direction on approaching close to shore. This in turn decreases the speed of boat and it safely reaches the shore. It is because water offers very small amount of friction and hence it is very difficult to stop the boat.

It is for the same reason that big ships fire their engines in reverse direction, in order to slow down or stop, as the water offers very small friction.

Friction Due to Air

Friction due to air is so small that we hardly feel it. However, following activity will show the friction of air.

Take a full sheet of paper and allow it

to fall down from the level of your hand. Record the time in which the sheet of paper reaches the ground level. Now crumple the sheet in form of a ball and allow it to fall down from the level of your head. You will notice the crumple ball quickly reaches the ground level. Why?

It is because when the sheet is flat, it has a large surface area, which experiences a large force of friction due to air and hence shows down. However, when the sheet is crumpled in the form of ball, it has very small surface area. The small surface area experiences less force of friction due to air and hence, reaches the ground level quickly.

Examples :

1. Nature has shaped the body of birds in such a way, that air offers least resistance and hence, they can fly with a lot of speed.

2. The body of aero planes is streamlined so that the air offers least possible friction.

3. The body of automobiles (cars, buses, motorcycles, etc.) Is streamlined so that air offers least possible friction.

4. The meteors (shooting stars) enter the atmosphere of the earth at a very, very high speed. At such speeds the friction due to air extremely high. Due to this high friction the temperature of meteor rises to such a high degree that they catch fire.

5. The spaceships are provided with hat shield at their head. It is because, when the spaceships enter the atmosphere, then due to friction of air they can catch fire, much like the meteors. Thus, to prevent their burn out a shield is provided.

Fig14.6 Burning Meteor

14.6 BENEFITS OF THE FORCE OF FRICTION

Friction is desirable in many cases as explained below.

1. We will be unable to walk if there is not friction between soles of our shoes and the ground. It is because when we push the ground backward, the ground reacts back only on account of friction. If there is not friction, then there will be no reaction from the ground in forward direction, with the result that we will not be able to move forward, and hence slip and fall down.

2. There must be a friction between the tyres of an automobile and the road. It is for the same reason that special kinds of grooves are made in tyres so that they offer the required amount of friction. It is for the same reason that the wornout tyres (the tyres from which grooves have disappeared due to constant use) are discarded, as they slip on the roads and can cause serious accidents.

3. The surface of the belts used for turning pulleys and wheels in factories are made rough so that they could provide the necessary reaction, and the wheels could turn about their axels.

4. The brake leathers used in the braking system of the cars and other vehicles are

provided with rough surfaces, so that they provide maximum friction when brakes are applied.

5. It is the force of friction, which holds the screws and nails in the wood.

6. The lighting of a match stick is due to the force of friction. The force of friction raises the temperature of match head to such an extent, that the chemicals in it catch fire to produce flame.

7. Spikes are provided in the shoes of athletes to increase the friction and prevent slipping.,

14.6.1 Disadvantages of Friction

1. Friction increases the energy required to operate the machines. This energy is wasted in the form of heat energy.

2. Friction causes wear and tear in the machines and renders them inoperable.

3. Friction reduces the speed of moving vehicles to a great extent.

14.6.2. Friction as a Necessary Evil

With friction we cannot set the bodies in motion or stop the moving bodies. Thus, friction is absolutely necessary for carrying out day to day activities. On the other hand, friction wastes energy, brings about wear and tear and slows down motion.

Thus, we can say that friction is a necessary evil as without it, we cannot do our day to day activities and with it we lose energy, speed, etc.

14.6.3 Ways of Reducing Friction

Basically, friction is caused because of the interlocking irregularities of two surfaces. Thus, if irregularities are minimized, the friction will get reduced. Following are the methods employed for reducing friction.

1. By the use of lubricants

A lubricant is a substance which, when applied between two surfaces in contact, reduces the force of friction between them. The lubricant separates the two surfaces in such a way that the interlocking of irregularities are greatly reduced as the spaces between them are filled with the lubricant.

For light machines, less viscous oils are used as lubricants, whereas for heavy machines, more viscous oils or grease are used.

2. By using soap solutions

Soap solutions are slippery in nature. They are used in reducing friction in high speed cutting and grinding machines, so that not only friction is reduced, but the heat produced during cutting or grinding is rapidly taken away by water present in the soap solution.

3. By using fine powders

Graphite is a very soft solid which can be ground to a very fine state. It is then used as a lubricant in those parts of machinery, where oil cannot be applied. It fills up irregularities between the surfaces and hence, reduces friction. Similarly, finely powdered talcum is used as a lubricant. For example, we spread it on the carromboard, so as to reduce friction between the carromboard and the coils.

4. By polishing

When the surface are highly polished, the irregularities are knocked out. This in turn reduces friction.

5. By streamlining

The air or water offers a large friction to the bodies moving in them. However, the surface of such bodies is so designed that friction due to air or water is reduced to a large extent. Giving a shape to the bodies, such that they offer the least resistance to the air or water is called streamlining. Modern aircrafts, boats and ships are streamlined so as to reduce friction as far as possible.

6. By converting sliding friction into rolling friction

It has been found that rolling friction is about 10 times less as compared to sliding friction between the two surfaces.

It is for the same reason, many heavy objects, such as suitcases are provided with small wheels, commonly called rollers. The rollers reduces friction and hence, suitcase can be moved easily from one place to another.

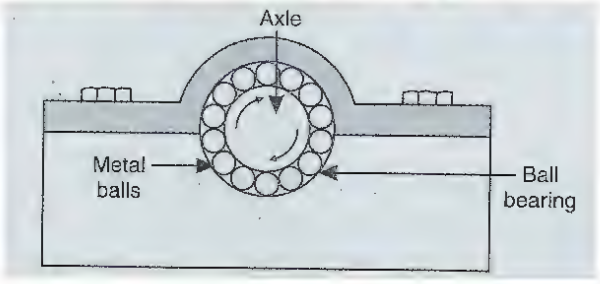


Fig 14.7 Use a Ball Bearings to Reduce Friction

In moving bigger machines, such as wheels of automobiles, ball bearings are used. Ball bearings are small steel balls, which are introduced between the sliding surface of the axel and the cup. When the axle rotates, then the metal ball rotate along with it. This reduces the friction to large extent. You might have seen these tiny steel balls (ball bearing) fitted around the axle and the cup of the front and rear wheel of bicycle as shown in **Fig 14.7**.

TEST YOURSELF

1. State one way of increasing the friction between two surfaces ?
2. Name four ways by which friction can be reduced between two surfaces in contact?
3. State two advantages of friction ?
4. State two disadvantages of friction ?
5. Why is friction called a necessary evil ?
6. (a) What is a lubricant ?

   (b) How does a lubricant reduce friction ?

   (c) What kind of lubricant is used in (i) a sewing machine, (ii) the axle of a tractor ?
7. Name two solid lubricants and state where they are used ?
8. What do you understand by the term streamlining ? Name a few machines which use streamlining to reduce friction?
9. Why is friction called a perverse force ?

Key Words	
Friction :	The opposing force comes into play when two surfaces in contact move relative to one another.
Irregularities :	Uneven projection on the surface of a body.
Static Friction :	The force of friction comes into play, which does not allow two surfaces to slide upon one another.
Limiting Friction :	The maximum force of static friction comes into play, when the surfaces of one body just slides over the surface of another body.
Dynamic Friction :	The force of friction acting between the surface of two bodies sliding upon one another at a constant speed.
Rolling Friction :	Friction experienced by a body when made to move over roller/wheels.
Streamlining :	Giving a special shape to a body/object such that a fluid (air/water) flowing past it offers a minimum amount of friction.
Lubricant :	A material which, when applied between two surfaces in contact, reduces the force of friction.
Ball-bearing :	A device used for reducing rolling friction, by making an axle to move over metal balls placed around it radially.

EXERCISES

1. Answer the following questions :

(i) Why are the worn out tyres discarded ?

(ii) Why do carom coins move faster on carom board when dusted with talcum powder ?

(iii) Why is the surface of conveyor belt made rough ?

(iv) Why is the sewing machine often oiled ?

(v) Why do new automobile tyres have deep grooves ?

(vi) Why does a ball rolling on the ground slow down ?

(vii) Why are the boats and aeroplane given special shape ?

(viii) Why do meteors burn on entering into the atmosphere ?

(ix) Why do painters use sand papers in polishing doors ?

(x) Why is it easier to tie a knot with cotton string as compared to silk string ?

2. Fill in the blank spaces by choosing words from the list given below :

List : movement, sliding, streamlined, static, opposite

(i) Friction always acts in the direction _____ to the direction of applied force.

(ii) _____ friction is a self-adjusting force.

(iii) Friction is very useful as it helps in the _____ of the bodies.

(iv) The _____ friction is 10 times the rolling friction.

(v) The boats and aero planes are _____ so as to reduce fluid friction.

3. Statements given below are incorrect. Write the correct statements.

(i) Sliding friction is slightly more than the limiting friction.

(ii) The conveyor belts are made rough, in order to decrease friction.

(iii) The friction between two surfaces decreases with the increase in the weight of a body.

(iv) The friction offered by the wheels is called sliding friction.

(v) The friction increase with the increase in the area of contact at the two surfaces.

CHAPTER - 15

STARS AND THE SOLAR SYSTEM

15.1 Introduction

The earth is the third planet which revolves around the sun. There are eight more planets which revolve around the sun. You will learn more about the sun, the planets and other heavenly bodies in this chapter.

15.2 What are Heavenly Bodies or Celestial Bodies ?

We, the human beings, live on the surface of the earth. What we look up, what do we see ? Obviously, we see the sky. The sky appears blue on a clear day, but is dark at night. Why is it so ? This is because during the day, it is the sunlight which makes it appear blue. But what is really the sky ? Well, the vast empty space can be called sky.

During the day-time, we see a bright ball of fire in the sky which appears to move from the east to the west. We call it the sun. At night, we see thousands of stars in the sky. If we watch the sky through a telescope we may see millions of stars, some of which are brightly coloured. We see certain groups of stars which appear to be in clusters. They are called **constellants.** There is the moon whose size changes every day. The moon is a natural satellite of the earth. It completes one revolution around the earth in 27⅓ days. Furthermore, we see an occasional comet. It appears as a ball of fire, having a tail. Then, there are shooting starts or meteors. They appear to fall from the sky. In addition to it, there are planets like the morning stars.

Bodies such as the earth, moon, planets, sun, stars, meteors, comets, etc., are called **heavenly bodies** or **celestial bodies.**

15.3 What is Universe ?

The vast unimaginable space which encompasses most distant stars, planets and anything else, which exists is called universe.

15.4 What is Astronomy ?

The branch of science which deals with the study of universe is called astronomy. The study of astronomy involves the methods and instruments used for the study of the universe. We know a lot about the universe from the information already gathered by the astronomers.

15.5 The Night Sky

After sunset, the night sky is dotted with bright stars. On a clear night (when there is no dust or clouds in the sky) one can see about 3000 stars with the unaided eye. However, if the sky is viewed through a good telescope, many more stars are visible. Most of the stars are yellow in colour, but some stars are white or red in colour. Another property of the stars is that they appear to twinkle. The twinkling stars takes place due to the atmosphere of the earth. However, if the stars are viewed from above the atmosphere, as in the case of a spaceship, they do not twinkle, but appear to shine more brightly.

Another prominent object visible at night is moon, whose size changes every night. In addition to it, there are star-like objects, which do not appear to twinkle. These are planets. They revolve around the sun in the same way as our earth. Then there are shooting stars (meteors), they appear to fall from the sky with a long, bright streak of light.

15.5.1 Why are Stars not Visible during Day Time ?

During day-time, the light from the sun is so strong that it suppresses the light coming from the stars, and hence, they are not visible to us.

15.5.2 How do the Stars Emit Light ?

All stars are giant balls of hydrogen gas and this includes our sun which is a medium star. At the core (centre) of this giant hydrogen cloud, the temperature is from 2 million to 5 million degree celsius. At such a high temperature, the hydrogen gas fuses (joins or melts) to form a heavier gas called helium, with the liberation of a huge amount of heat and light energy. Thus, it is the fusion of hydrogen gas within the core of the star which emits light energy.

15.5.3 The Sun

The sun is the nearest star from the earth. Our sun is a medium order star in terms of its mass and brightness. You may wonder as to why the sun does not appear like the other stars or why does it appear bigger and hotter than other stars in the sky?

This is because the sun is very close to the earth as compared to other stars. For example, the distance of the sun from the earth is 150 million kilometers. Whereas the distance of the nearest star (after sun) from the earth (Alpha Centauri) is 40678000 million kilometers. It is on account of these enormous distance that stars appear very small and appear to have much less heat and light as compared to the sun.

15.5.3.1 How big is the sun as compared to earth ?

The diameter of the sun is 1,400,000 km (approx). This diameter is 109 times the diameter of the earth. Thus sun is approximately 300,000 times heavier than the earth.

15.5.4 What are Units of Measuring the Distance of Stars from the Earth ?

Most of the stars are so far away from the earth, that even the light which travel at a speed of 3×10^5 km/s (300,000 km/s) takes million of years to reach on the earth. Thus, the distances of the stars are measured in light years.

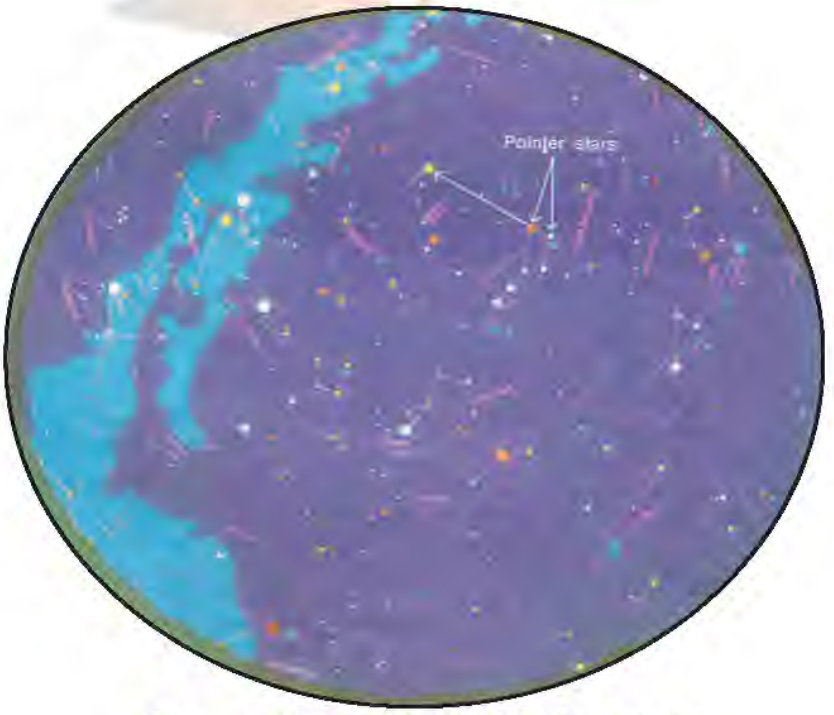


Fig. 15.1 : Stars in Northern Sky in Summer

What is a Light Year ?

The distance travelled by the light at a speed of 300,000 km/s in one year (365 days) is called light year.

1 light year = speed of light x 365 days

= 300,000 km/s x 365 x 24 x 60 x 60s

= 9,460,000,000,000 km

= 9.46×10^{12}km

What is a Light Minute ?

The distance travelled by the light at a speed of 300,000 km/s in one minute (60 seconds) is called a light minute.

1 light minute = 300,000 km/s x 1 minute

= 300,000 km/s x 60s

= 18,000,000 km = 18×10^{6} km

15.5.4.2 How far Is the nearest star Alpha Centauri, from the earth in kilometers ?

Alpha Centauri is at a distance of 4.3 light years.

Therefore, Distance in kilometer = Distance travelled in one light year x Number of light years

= 9.46×10^{12} km/light year x 4.3 light years

= 40.678×10^{12}km.

15.5.4.3 Why do the stars appear to us like point objects ?

The stars, much like our sun are celestial bodies, which continuously emit heat and light. Our sun is a medium sized star. It appears bigger to us, because it is nearest to the earth. The stars appear to us like points, because they are very far away from the earth. Most of the stars are so much far away, that the light from them takes million of years to reach the earth.

15.5.4.4 Appeared to be changed the distance between any two stars not change when viewed from the earth ?

Stars are moving away from each other at a very high speed. However, when viewed from the earth, the distance between them does not seem to change, because they are very far away from us. Hence, any change in the distance between them does not become perceptible in few hundreds of years.

15.5.4.5 Why do the stars appear to move from east to west ?

It is because the earth rotates about its north-south axis from west to east . Thus due to relative motion, all heavenly bodies (stars, planets, moon), etc., appear to move from east to west.

15.5.4.6 Why does the pole star (Polaris or Dhruva Tara) not change its position in the sky ?

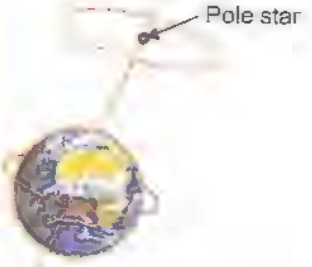


Fig. 15.2 The Pole Star lies on the Axis of Rotation of the Earth

The pole star is situated in the direction, which is directly above the geographic north-pole of the earth's axis. Thus, its position relative to the earth does change and hence, it appears stationary.

15.6 Constellations

A group of stars which forms a recognisable pattern or shape is called a constellation.

Astronomers have divided the whole sky into 88 constellations. Each constellation is assigned a name of the object to which it closely resembles. In ancient Indian astronomy, the constellations

were known as **Nakashatras.** A few of the prominent constellations are discussed below.

(I) Ursa Major or Big Dipper or Vrihat Saptarishi

This constellation consists of 7 bright stars arranged in a pattern somewhat resembling the shape of a big bear. The stars marked 1, 2, 3 and 4 represent the body and the stars marked 5, 6, and 7 represent the tail of the big bear. The head and paws of the big bear are formed by some faint stars, not shown in diagram.

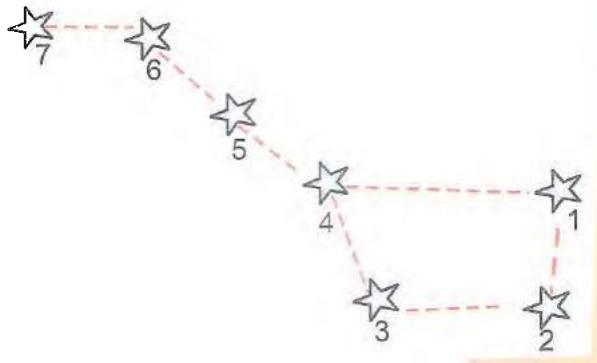


Fig. 16.3 Ursa Major

The Ursa Major constellation can be linked to the following objects :

(i) It looks like an oversized ladle in which stars marked 1, 2, 3, and 4 form the cup of the ladle and stars marked 5,6 and 7 form the handle.

The stars 1 and 2 at the end of the cup of the ladle are called pointer stars, as they point in the direction of the pole star.

(ii) It looks like a question mark suspended across the sky, where the stars 1, 2, 3 and 4 form the curved path and the stars 5,6, and 7 straight line part of the question mark.

(iii) It resembles a kite having a long tail.

The Ursa Major is visible clearly in the northern part of the sky in the summer months, between April to September.

(2) Ursa Minor or Laghu Saptarishi or Dhruva Matsaya

Ursa Minor constellation is also a group of seven stars, similar to that of Ursa Major. However, the stars in Ursa Minor are closer and dimmer as compared to the stars of Ursa Major. They form an outline of a ladle or a kite. At the tail of Ursa Minor is a star of average brightness. It is called **pole star** or **polaris**. In Indian astronomy, the pole star is called Dhruva Tara. Ursa Minor is clearly seen in northern sky in July in summer.

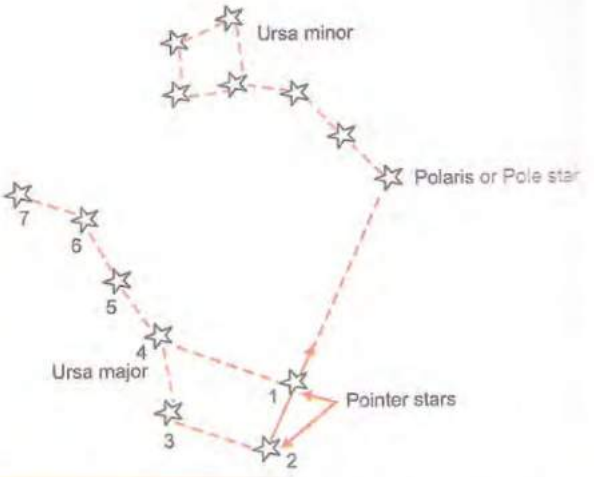


Fig. 15.4 Relative Positions of Ursa Major and Ursa Minor.

How to locate the pole star ?

Look straight in the direction of the stars situated at the far end of the ladle in Ursa Major (stars 1 and 2). The star of medium brightness in the direction of the above stars is the pole star **(Fig. 15.4)**. The stars 1 and 2 in Ursa Major which point in the direction of the pole star are called pointer stars.

(3) Orion or Hunter or Mriga or Vyadha

Orion is another constellation of 7 stars and is one of the most magnificent constellations in the winter sky. Its name in Indian astronomy is Vyadha or Mriga. It looks like a hunter with his shield and club upraised **(Fig. 15.5)**. The seven major stars in it form the body of the hunter. The head and limbs are formed by faint stars, not shown in **Fig. 15.5**.

In the orion, four stars form a kind of rectangle. In the one corner of this rectangle is situated the largest star called Betelgeuse, whereas another bright star called Rigel, is situated on the opposite corner. There are three prominent stars which are situated in the middle of the constellation forming a straight line.

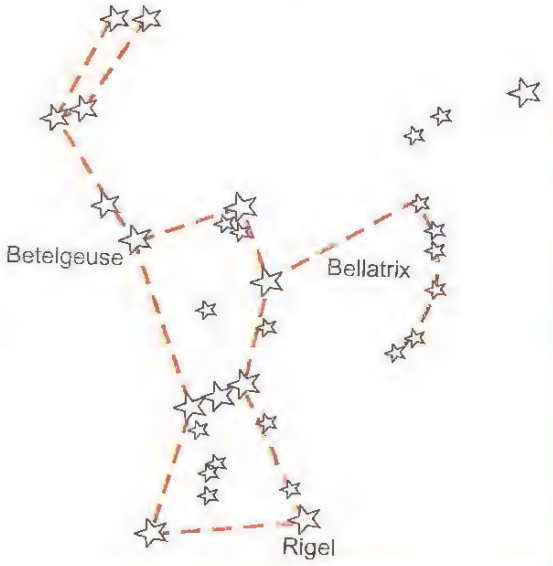


Fig. 15.5 Orion or Mriga

15.7 The Moon

The moon is the only natural satellite of the earth and is our nearest neighbour in space. It is the brightest object in the sky, next to the Sun.

The surface of the moon is rugged. It is made of very large craters (deep depressions or holes) and very high mountains. It has no atmosphere, and hence, no life on it. Its gravitational pull is one sixth that the earth.

The moon always presents its same face towards the earth. On the day side of the moon, the temperature could be as high as 110°C. On the contrary, the temperature on the night side of the moon could be as low as - 150°C.

15.7.1 Phases of the Moon

The moon is a non-luminous body. It has no light of its own. It only reflects the light of the sun falling on its surface. When this reflected light reaches the earth, we see the moon. Only that part of the moon is visible, which reflects the sunlight towards the earth.

On the New Moon day, the moon is between the sun and the earth. Thus, the reflected light from the moon does not reach the earth and hence it is not visible,

In a way, the dark side of the moon is facing us on New Moon day.

The night, just after the new moon day, we see the crescent Moon. It is because only the reflected light from the crescent part reaches the earth. The rest of the moon is only faintly visible, because the sunlight reflected from the earth also falls on the moon's disc.

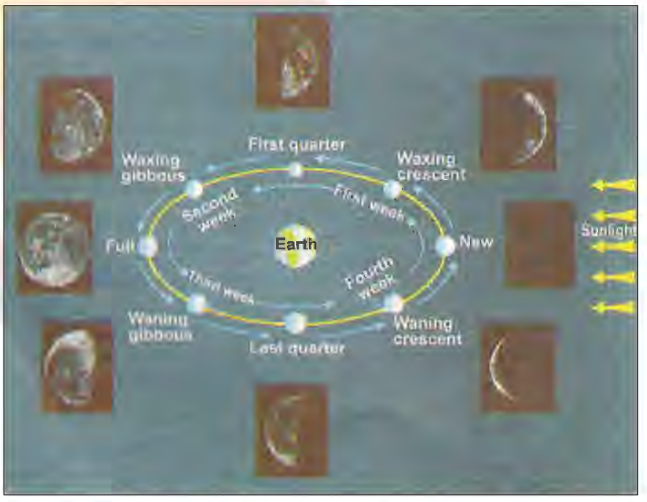


Fig. 15.6 Phases of the Moon

The crescent goes on increasing every day, till on the fifteenth day (from the New Moon day), the full bright face of the moon is visible. On this day the earth is between the sun and the moon, such that the night side of the earth is facing the day side of the moon. This is called Full Moon day. This gradual increase in the bright disc of the moon is called waxing of the moon.

After the Full Moon, the bright face of the moon goes on decreasing every night. This decrease in the bright disc of the moon is called waning of the moon. By another fifteen days, New Moon is formed.

This waxing and waning of the disc of the moon, as the moon revolves around the earth is called phases of the moon.

The moon revolves around the earth. As the earth moves around the sun, in the same way the moon revolves around the sun, along with the earth. The moon completes one revolution around the earth in $27\frac{1}{3}$ days. It takes exactly the same time to spin once about the axis. Due to the same time for rotation on its axis and revolution around the earth, it always presents the same face towards the earth.

However, as the moon revolves around the earth, the earth moves ahead in its own orbit around the sun. Thus, from the earth the moon appears to complete one revolution between one New Moon to next Moon in 291 ½ days. Lunar calendars commonly used by astrologers are based on the fact that the Moon completes one revolution around the Earth in 29½ days.

Test Yourself

1. What are celestial bodies ? Name any three celestial bodies.
2. Why do you classify the sun as a star ?
3. Why do the stars appear like point objects ?
4. What is a constellation ? How does the constellation differ from a star ?
5. Name a star which appears stationary from the earth. In which constellation is it situated ?
6. What is "a light minute?" How many light minutes is the earth from the sun? Express this distance in kilometers?
7. How much time is involved from one new moon to another new moon as seen from the surface of the earth ?
8. In how much time does the moon complete one rotation about its own axis ?

15.7 Planets

A solid heavenly body which revolves around the sun in a well defined orbit is called planet.

If you carefully look at the clear night sky, you will find some objects which (i) appear bigger and brighter than the stars (ii) they do not twinkle (iii) they change their position with respect to the other stars. These bright objects are planets, which means wanderers, as they change their position in the night sky.

There are nine planets in all, including the earth. They have no light of their own, but appear to shine as the sunlight from their surface is reflected. All planets (except Venus) rotate from the west to the east. Due to their different speeds, the position of the planets with respect to the earth changes every day. In Indian astronomy, the planets are called Graha. **Fig. 15.7** shows all planets revolving around the sun.

The list of all the planets in the order of increasing distance from the sun is given below, along with their Hindi names

Name of Planet (in English)	Name of Planet (in Hindi)
1. Mercury	Budha
2. Venus	Shukra
3. Earth	Prithvi
4. Mars	Mangal
5. Jupiter	Brihaspati
6. Saturn	Shani
7. Uranus	Indra or Arun
8. Neptune	Varun
9. Pluto	Yama

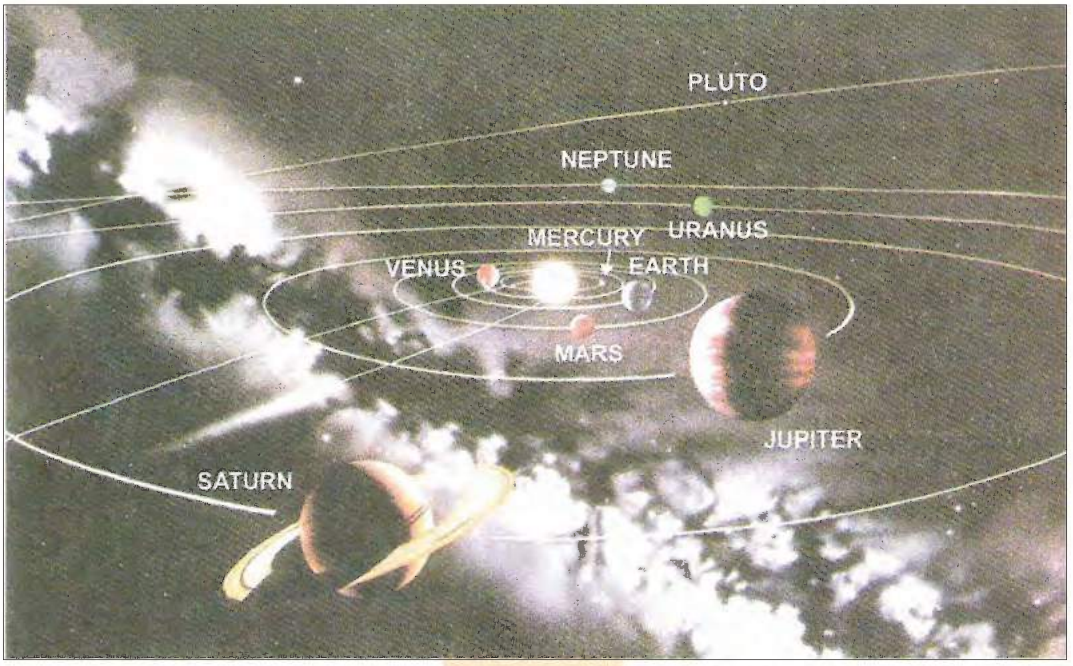


Fig15.7 All Planets Revolve Around the Sun in Elliptical Orbits.
(Note that at some points, the orbit of Pluto fall inside that of Neptune).

Let us study more about the individual planets.

1. Mercury (Budha)

It is the first planet in the solar system and is closest to the sun. Because of its closeness to the sun, it is one of the hottest planets in the solar system.

The surface features of mercury are similar to that of the moon. It has neither water nor atmosphere. Because of its extremely high temperature, lack of water and atmosphere, life is not possible.

As mercury is closest to the sun, it is hidden most of the time in the glare of the sun. However, it is visible just before sunset or just before sunrise. It appears like a bright star in the sky and is commonly called Morning Star or Evening Star. It is visible for 8 weeks just before sunset in the western sky, and then for another 8 week in the eastern sky just before sunrise.

Note: Mercury is a planet and not a star. However, as it the first, which appears in the morning or evening in the sky, it has become customary to call it a star.

2. Venus (Shukra)

It is the second planet from the sun. Except the sun and the moon, it outshines all heavenly bodies and hence, is the brightest and hottest planet. It appears as an evening star just above the western horizon for 292 days. After this, it appears as a morning star for another 292 days in the eastern horizon.

In spite of the fact that venus is second in distance from the sun as compared to mercury, it is brightest, because of cloudy atmosphere of carbon dioxide. This cover reflects more than 3/4th of the sunlight falling on its surface.

Fig. 15.8 Venus is a planet covered by thick clouds

The mass of Venus is 0.8 times the mass of the earth. However, its size is almost similar to that of the earth. It revolves around the sun in 225 days and rotates around its own axis in 243 days. Thus, in this way, Venus keeps its same face towards the sun. On account of its rotation and revolution, the temperature on its day side rises above 150°C and the temperature of its night side is below 170°C.

The most interesting feature of venus is that it rotates from east to west about its axis, whereas all other planets rotate from west to east about their axis.

It has a thick atmosphere of carbon dioxide, which contributes to its excessive day side temperature. It has no water on its surface. No life is possible on venus on account of the following reasons:

(i) Its day side temperature is too high and night side temperature is too low.

(ii) It has no water to sustain life.

(iii) It has no oxygen in its atmosphere to sustain life.

3. Earth (Prithvi)

Fig. 15.9 A Photograph of the Earth from Space

Earth is the third planet from the sun. It has one natural satellite, the moon. The earth is the only planet in the solar system on which life exists, on account of correct distance from the sun, correct temperature and the presence of air, water and soil.

Size of the Earth

The earth is not a perfect sphere. It is somewhat flattened at the poles and bulging at the equator. The average diameter of the earth is 12,800 km. The circumference of the earth at the equator is 40,000 km approximately. The mass of the earth is estimated to be around 5.98×10^{24} kg. It is surrounded by an atmosphere of 20.9% oxygen, nitrogen 78.03% and other gases 1%. The atmosphere extended to a height of 200 km from the surface of the earth.

The motion of the earth around the sun is called revolution. It revolves around the sun at a distance of 150,000,000 km (approx) in a nearly circular orbit. It takes 365.25 days to complete one revolution around the sun.

The earth spins about its own imaginary axis like a top, from west to east. This motion of earth about its own axis is called motion of rotation. The earth completes one rotation about its own axis in 24 hours.

Formation of day and night on the earth

The sun gives heat and light all the time. This heat and light energy is received by all the planets revolving around it. However, at any time, only half of the earth faces the sun, whereas the other half is opposite to the sun. The half of the earth which receive light has day, whereas the half opposite to the sun has night. However, as the earth steadily moves about its own axis, gradually the day part of the earth moves away from the sun, i.e. towards the night side and vice versa. Thus, days and nights are formed.

Change of Season :

Change of season on the earth takes place due to the following reasons:

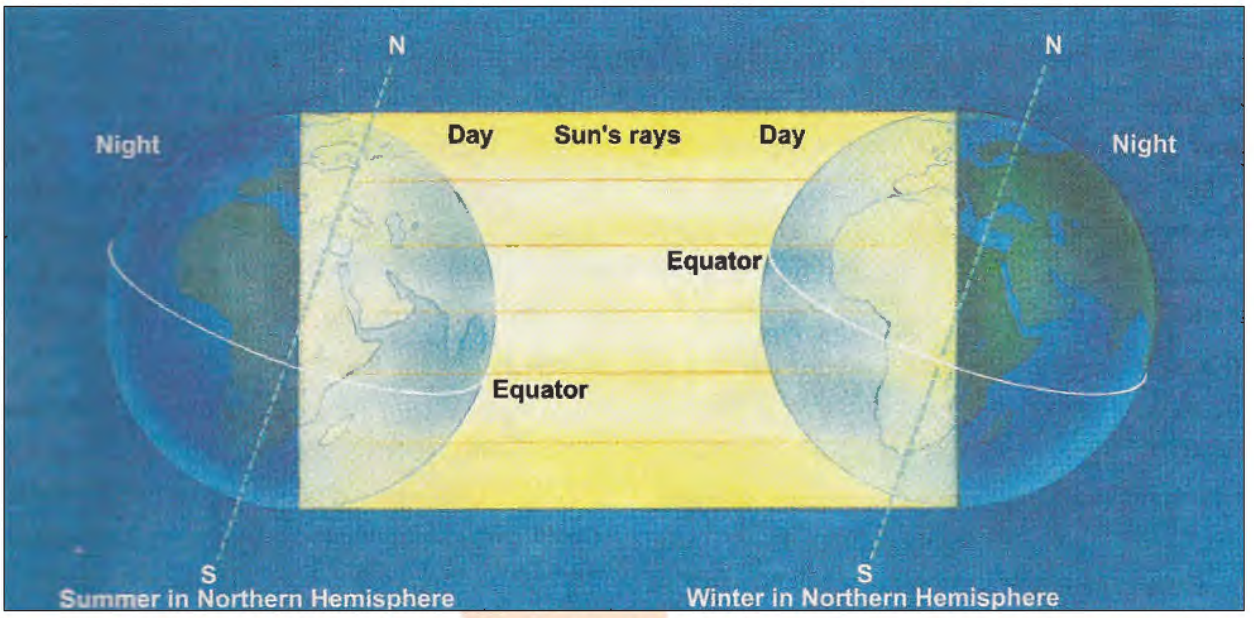


Fig. 15.10 : Earth Tilted About its Axis

(i) The axis of rotation of the earth is tilted at an angle of 23½° with vertical.

(ii) The earth is not always at the same distance from the sun, on account of its slightly elliptical orbit around the sun.

Note in the **Figure 15.10** and **15.11** that the tilted axis rotation of the earth is always in the same direction. Due to this tilt in the axis of rotation, the position of the northern and southern hemispheres of the earth toward the sun, keeps on changing throughout the year.

When the northern hemisphere is tilted towards the sun, we experience summer, whereas the people in the southern hemisphere experience winter. Similarly, autumn and spring occur when the earth is between these two extreme positions in its orbit.

On June 21, the earth is farthest from the sun in the southern hemisphere, but nearest in the northern hemisphere. Thus, on June 21, the northern hemisphere has the longest day, whereas the southern hemisphere has the shortest day. On

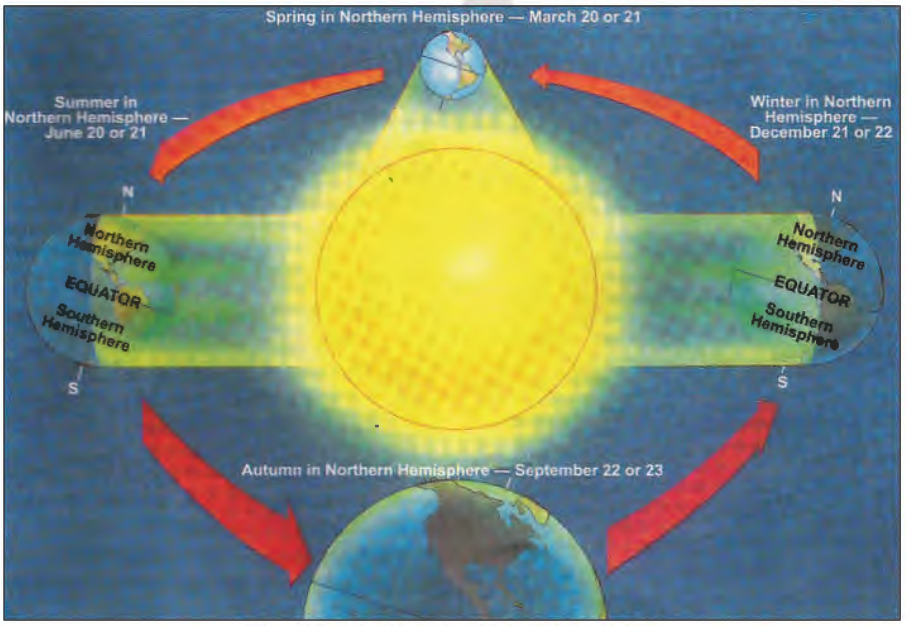


Fig. 15.11 : Formation of Seasons

December 22, the reverse happens, i.e. The northern hemisphere has the shorter day and the sourthern hemisphere has longest day.

On March 21 and September 23, the duration of day and night are equal in both hemispheres. Due to this change in the length of days the mount of heat and light received by the earth changes every day. This in turn gives rise to seasons, such as winter, spring, summer and autumn.

4. Mars (Mangal)

It is the fourth known planet in the order of increasing distance from the sun. To an unaided eye, it appears like a red star and hence it is sometimes called the red planet. The distance of Mars from the sun is 228×10^6 km. It has a diameter of 6794 km. Its mass is $1/9^{th}$ the mass of the earth. It has very thin layer of atmosphere. It rotates about its axis in 1.026 days and revolves around the sun in 687 days (about 2 years). There are two moons revolving around it, namely Photos and Deimos. Both these moons are very close to surface of the Mars and are less than 20 km in diameter.

Fig. 15.12 : View of Mars

It is believed that mars have a large amount of water in the form of ice, near its polar caps. Scientists believe that in the beginning, mars had an atmosphere just like earth. However, owing to its low gravitational pull, gases in its atmosphere escaped, leaving behind a very thin atmosphere. Life on mars could not originate or survive due to the following reasons:

Mars is too cold and the temperature is not right for life to evolve or survive.

It does not have sufficient amount of water and oxygen, so vital for life to survive.

5. Jupiter (Brihaspati or Guru)

It is the fifth planet in the order of increasing distance from the sun. It is the largest planet in the solar system, its mass being more than al the other planets taken together. Its distance from the sun is 778.6×10^6 km i.e. Approximately five times the distance of the sun from the earth. Thus, it receives much less energy from the sun as compared to the first four planets. In spite of the fact that it receives much less solar energy, it happens to be the brightest of the planets in the sky, except for venus and some times mars. It is because, it has a thick atmosphere of hydrogen which reflects most of the sunlight falling on it.

Fig. 15.13 : A Photograph of Jupiter from Space. (Notice the position of the great red spot)

Jupiter rotate about its axis in 0.41 days and revolves around the sun in 11.86 years. The atmosphere as well as the core of this planet mainly consists of hydrogen and helium in gaseous form. Its like regions in the outer atmosphere consists of (i) ammonia gas in crystalline form (ii) methane in gaseous

form. One special feature of this planet is a great red spot which is 30,000 km long and 13,000 km wide. In addition to moons, it has a faint ring around its equatorial plane. Life is not possible on this planet on account of very low temperature and very high gravitational pull.

6. Saturn (Shanl)

It is the sixth planet in the order of distance from the sun, i.e., at a distance of 143.5×10^6 km which is roughly double the distance of jupiter from the sun. It is similar in compensation to the jupiter.

Saturn rotates about its axis in 0.44 days and revolves around the sun in 29.5 years. It is surrounded by three flat rings **(Fig. 15.14)** which consists of rocks whose size may vary from a speck to a few kilometers in diameter. Amongst the rings A, B and C, the ring B is the brightest. It has 30 known moons, the largest being Titan. In fact, Titan is the largest moon in the entire solar system. Life is not possible on Saturn, because of extremely low temperature.

Fig. 15.14 Saturn

7. Uranus (India or Arun)

It is the seventh planet in the order of distance from the sun and the third largest planet in the solar system. It was discovered by an English astronomer, William Herschel, in 1781, with the help of a telescope.

Its distance from the sun is 2872.5×10^6 km, i.e. about twice the distance of saturn from the sun. Its diameter is less than half of that of earth. It rotates about its axis in 0.71 days (17 hr 49 minutes) and revolves around the sun in 84 years. Its atmosphere is found to contain hydrogen and methane. So far 21 satellites or moons have been discovered around it. No life is possible on this planet on account of extremely low temperature.

Fig : 15.15 Uranus - Photograph taken by Voyager Space Craft from a Distance

8. Neptune (Varun)

It is the eighth planet in the order of distance from the sun. It was discovered by Urbain Jean Joseph Leverrier, a French astronomer in 1846, when he observed some disturbance in the orbit of Uranus by some other heavenly body. He was able to calculate the position of this disturber (Neptune), theortically. However, it was first observed by a German astronomer Johann Gottfried Galle in Berlin through a very powerful telescope.

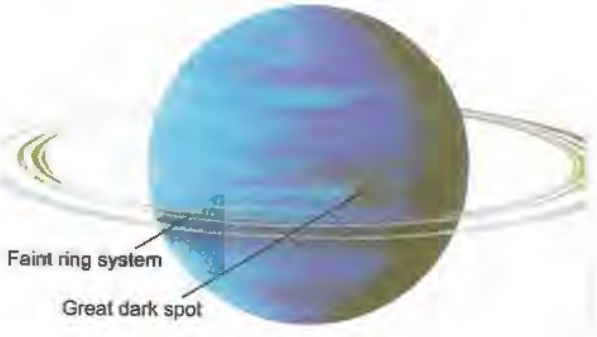


Fig 15.16 : Neptune

Its distance from the sun is 2872.5 x 10^6 km, i.e., about twice the distance of saturn from the sun. Its diameter is less than half of that of earth. It rotates about its axis in 0.71 days (17 hr 49 minutes) and revolves around the sun in 84 days. Its atmosphere is found to contain hydrogen and methane. So far 21 satellites or moons have been discovered around it. No life is possible on this planet, because of extremely low temperature.

9. Pluto (Yama)

It is the outermost and the smallest planet of the solar system around which revolves a single satellite or the moon.

It was discovered in 1930 by C.W. Tombaugh and was originally thought to be a satellite of Neptune. Later observations proved it as an independent planet.

Its orbit around the sun is not aligned to the orbit of other planets. The most noticeable feature of pluto is that its orbit cuts the orbit of planet neptune.

Its distance from the sun is 5870.0 x 10^6 km, such that sunlight takes over 32 hours to reach this planet. It rotates about its axis in 6.9 days and completes one revolutin around the sun in 248.7 years

SPOTLIGHT

The planets from mercury to neptune have well defined near circular orbits, and revolve around the Sun in the same plane. However, pluto (discovered in 1930) does not revolve around the Sun in same plane as the other 8 planets. In fact its orbit is highly tilted and intersects with the orbit of the

Planet	Distance from Sun	Diameter in Kilometers	Time taken to rotate about its axis	Time taken to revolve around the Sun	Number of Moons
Mercury	57.9 million km	4879 km	59 hours	88 days	Nil
Venus	108.2 million km	12,104 km	243 hours	225 days	Nil
Earth	149.6 million km	12,800 km	24 hours	1 year	1
Mars	228 million km	6794 km	24 hours - 37 minutes	2 year (app.)	2
Jupiter	778.6 million km	1,42,984 km	9 hours - 54 minutes	12 years (app.)	28*
Saturn	1433.5 million km	1,20,500 km	10 hours - 14 minutes	29½ years	30*
Uranus	2872.5 million km	51,118 km	17 hours-49 minutes	84 years	21*
Neptune	4495.1 million km	49,528 km	16 hours-40 minutes	165 years (app)	8*
Pluto	570 million km	3,000 km	6.9 days	248 years (app.)	1

nepture. Nevertheless, pluto was called ninth planet.

This continued till 1992, when astronomers discovered several other objects (some bigger than the pluto) moving around the sun in highly titled orbits, and hence, qualified to be called planets.

Thus, there was a reason to reclassify the pluto and other objects which were found beyond pluto.

In 2006, International Astronomical Union (IAU) empanelled a committee to define : (i) What is a planet ? and (ii) what is the status of pluto and observatory in June 2006 and reached a unanimous agreement. The decision of committee was discussed in Prague at IAU General Assembly of Astronomers of the World.

Following were the decisions of the General Assembly of IAU on 23rd August 2006.

1. A planet is a body in near circular orbit around a star (in our case sun), which is big enough for the force of gravity to make it round and should not take more than 2 centuries to revolve around the Sun.
2. Pluto takes 248 years to revolve around the Sun, so it is disqualified as a planet.
3. Now the Pluto and objects beyond it are called 'plutons', new members of solar family. The order of plutons is (i) pluto (ii) charon, (iii) 2003 UB_{313}.

From August 2006 onward :

(i) There are eight planets revolving around the Sun.

(ii) There are three plutons revolving around the Sun, beyond neptune, in highly tilted orbits.

(iii) Mercury is the nearest planet from the Sun.

(iv) Neptune is the farthest planet from the Sun.

(v) Pluto is the first member of plutons.

(vi) Next to pluto is charon and finally 2003 UB_{313}.

(vii) Plutons have highly tilted orbit and take more than 200 years to revolve around the Sun.

TEST YOURSELF

1. What is a planet ? How many planets revolve around the Sun ?
2. Name the planet which (i) is nearest to the sun (ii) is farthest from the Sun (iii) supports life ?
3. Name the planet which (i) revolves around the sun from east to west (ii) intersects the orbit of another planet ?
4. Name one planet that was predicted before its discovery ?
5. Name the planet having (i) largest number of moons (ii) a system of number of rings ?
6. What is the solar system? Name all the planets of solar system in the increasing order of distance from the sun ?

15.8 The Solar System

Sun is the nearest star for us on the earth. It is believed that the sun was born 5 billion years (500 crore years) ago. It has been emitting a huge amount of heat and light and is expected to do the same for another 5 billion years.

The sun along with the nine planets and their moons constitutes the solar system (refer to **Figure 15.7**). In addition to the planets and their moons, other heavenly bodies have been found to revolve around the sun. They are asteroids, comets and meteors. Let us study more about them.

15.9.1 Asteroids

The small piece of rocks or metal which revolve around the sun, in between the orbits of the mars and jupiter are called asteroids (meaning star like or minor planets).

Asteroids are not visible to the unaided eye, but can be easily seen through a powerful telescope. They are of varying sizes, the largest being Ceres, which is 633 km in diameter. It is estimated that there are around 100,000 asteroids. Each asteroid has its own orbit. In fact the orbits of asteroids are spread over a large distance forming a band.

There are two schools of thought in formation of asteroids.

1. According to one school, these are original rocks and the metal chunks, which failed to form a planet, when other planets were formed in the solar system.
2. According to the second school of thought, they are the debris of a planet which collided with a moon of the Jupiter.

15.9.2 Comets

The bright "star-like", objects with a long tail, approaching the sun in a highly elliptical orbit are called comets.

Fig. 15.17

The bright star-like objects is commonly called the "head of the comet". It consists of frozen water, along with the sun, the ice and the gases along with dust change to form gaseous matter, which appear in the form of long tail. The tail of a comet always points away from the sun, because of the pressure of solar radiations (solar wind).

The tail of the comets could be as long as 800 million kilometers.

The time period of revolution of the comets around the sun is very long. There are some comets which appear after fixed interval of time. Such comets are called periodic comets.

Halley's Comet is one such periodic comet which is visible once in 76 years. It was sighted in 1910 and then in 1986. It is expected to visit us in the year 2062.

Unlike planets, the comets do not last for ever in the solar system. It is because as they approach the sun, they lost a good amount of their mass in the form of gases and small chunks of rocks. Thus, they become smaller and smaller and finally disappear.

15.9.3 Meteors

The bright star-like objects which appear suddenly in the sky and then for a few moments glow with a brilliant white flash of light falling towards the earth and finally disappear are called meteors.

It is believed that meteors are the debris of comets floating in the sky. When a chunk of this debris enters the gravitational field of the earth, it starts falling towards the earth. When it passes through the atmosphere, it becomes white hot on account of friction of the atmosphere. Thus, it catches fire and appears like a brilliant flash of light. Meteors are commonly known as shooting stars, though they are not stars.

15.9.4 Meteorites

If a meteor is too big and fails to burn completely in the atmosphere, then a part of it reaches the surface of the earth.

The unburnt piece of a meteor, which reaches the surface of the earth is called meteorite.

Fig. 15.18 Meteor in Night Sky

Meteorite which reaches the surface of the earth can be of the size of small pebbles to several tones of rock or metal. By studying the composition of meteorites, we have vital information regarding the nature of matter in the space.

The earth receives far less meteorites as compare to the moon. It is because a majority of the meteors burn in the atmosphere of the earth.

However, the moon has no atmosphere. Thus, the meteors directly reach its surface and form meteorites.

DIFFERENCE BETWEEN A STAR AND A PLANET	
Star	**Planet**
1. Stars have their own light	1. Planets do not have their own light.
2. Stars produce their own energy due to the fusion of hydrogen.	2. Planets do not produce their own energy. They have to depend upon the energy of stars (Sun)
3. Stars appear to twinkle at night.	3. Planets do not twinkle at night
4. Stars have enormous mass.	4. Planets have insignificant mass, compared to the stars.
5. Stars do not change their relative position in the sky every day	5. `Planets change their position in the sky on a daily basis.
6. Stars appear to move from east to west in the sky.	6. Planets appear to rotate from the west to east (except venus) in the sky.
DIFFERENCE BETWEEN A STAR AND A SHOOTING STAR (METEOR)	
Star	**Shooting Star (Meteor)**
1. The material of the stars mostly consists of hydrogen and helium	1. The material of a shooting star is mostly made of rocks, metals and dust.
2. Stars produce heat energy and light energy due to the fusion of hydrogen.	2. The shooting stars produce heat energy and light energy due to the friction of the earth's atmosphere
3. Stars are extremely big.	3. The shooting stars are very small pieces of rocks.
4. Stars last for billion of years.	4. The shooting stars last for a few seconds.

KEY Words	
Asteroids :	The small pieces of rocks or metals which revolve around the sun, in between the orbits of mars and jupiter.
Celestial Bodies :	Bodies such as the earth, the moon, the planets, the sun, the stars, the comets, etc.
Comets :	The bright "star-like" object with a long tail approaching the sun in a highly elliptical orbit.
Light year :	The distance travelled by light in one year.
Meteorities :	The unburnt pieces of meteor, which reach the surface of the earth.
Meteor :	A bright "Star-like" object which suddenly appears in the sky and then for a few moments streaks in the form of a brilliant flashes towards the earth.
Natural Satellite :	The celestial body/bodies revolving around the planets.
Orbit :	The path along which celestial bodies revolve around the sun or other celestial bodies.
Phases of Moon :	The waxing and waning of the disc of the moon as it revolves around the earth.
Planets :	The celestial bodies which revolve around the sun in well defined orbits.
Pole Star :	A star in line with north pole of the earth, whose position does not change.
Shooting Stars :	Same as meteor.
Stars :	Giant balls of fusing hydrogen or helium which emit huge amount of heat and light.

Exercises

1. Fill in the blanks by choosing correct words from the following list :

List: meteorite, pluto, moon, planets, universe, core, comet, constellation.

(i) The branch of science which deals with the study of _____ is called astronomy.

(ii) The unburnt part of a meteor which reaches the earth is called _____.

(iii) The heavenly bodies which revolve around the sun are called _____.

(iv) The heavenly bodies which revolve around the planets are called _____.

(v) The orbit of _____ is not in the same plane as that of the other planets.

(vi) A heavenly body with along tail, moving around the sun in an elliptical path is called _____.

(vii) In the _____ of the sun, hydrogen gas fuses with the liberation of the energy.

(viii) A group of stars which resembles an animal or some other known object is called _____.

2. Statements given below are incorrect. Write correct statements.

(i) Halley's comet visits our solar system after 26 years.

(ii) Helium gas constitutes most of the atmosphere of the sun and the stars.

(iii) Pole star is nearest to our solar system.

(Iv) Astronomers have divided the sky into 68 constellations.

(v) Meteors on burning leave behind gold dust and light.

(vi) The orbit of neptune is different from the orbits of the other planets in the solar system.

(vii) Mars is the second planet nearest to the sun.

(viii) Moon revolves around the earth in 21½ days.

3. Answer the following questions :

(i) What is universe ? Name six different kinds of heavenly bodies found in the universe ?

(ii) With the reference to the average distance from the sun, state : (a) the serial number of the planet earth (b) the average distance of the earth from the sun (c) the time in which the sunlight reaches the earth ?

(iii) (a) Name the natural satellite of the earth ?

(b) In how many days does this satellite complete one revolution around the earth ?

(c) In how many days does this satellite rotate around its own axis ?

(d) How does the gravity of this satellite compare with the earth ?

(e) State the maximum temperature on the day side and minimum temperature on the night side of this satellite ?

(iv) What do you understand by the following terms (a) New Moon (b) Full Moon ?

(v) (a) Define solar system ?

(b) Name all the planets in the solar system in the order of their distance from the sun ?

(vi) (a) How many moons mars have ?

(b) Write the name of these moons ?

(vii) What is comet ? Why does a comet develop a tail while approaching the sun ?

(viii) What is star ? What makes the star give about vast amount of energy ?

(ix) (a) How are meteors different from stars ?

(b) How are meteors different from meteorites ?

CHAPTER - 16

THE CELL

16.1 Introduction

We all know that all living things are made up of tiny living parts called **cells**. Can we see these cells from external examination of a living being ? From external examination of a plant, we can see only its different parts, namely the root, the stem, the leaves and the flowers. In case of humans, we can see the head, face, arms, legs and chest. How do we then see cells ? We can see cells by studying the internal structure of different parts of the living being. This is done by making thin, fine sections of the various parts we want to study, and then observe them with the help of some instruments.

Can you name one such instrument? While studying the parts of a flower, you are suggested to use a hand lens. Hand lens is one such instrument **(Fig. 16.1)**. The other instrument is microscope. The microscope is used to study microscopic organism as well as the internal structure of living things.

16.2 Instruments used to Magnify Objects

Hand lens :

A hand lens is a glass which is convex on both sides. It is, therefore called a **biconvex lens.** Generally a hand lends is held in a frame and has a handle.

Fig. 16.1 : Hand Lens

How to use the hand lens ?

Perform Activity 16.1 to use a hand lens

Activity 16.1

Bring the lens closer to the printed page of your book. Look at this page through the lens and adjust its distance till it becomes clear.

What do you find after looking through the lens ? The letters on the page appear much bigger. In other words, the object has been magnified.

In the above activity, you used a hand lens which can magnify objects to some extent. A microscope **(Fig. 16.2)** has more than one lens. It is an instrument which is used to enlarge objects which can not be seen with the naked eye or with the help of hand lens.

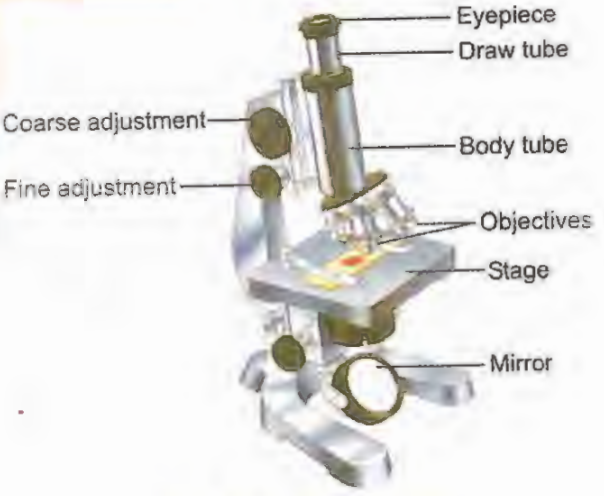


Fig. 16.2 : Microscope

Look at **Fig. 16.2.** This is the figure of a commonly used microscope. It has an upper tubular part called the body tube. It has magnifying lenses at both of its ends. The upper part has a magnifying lens called eyepiece. The lower part has a place where 2 or 3 magnifying lense are attached. These

are called the objectives. The objective lenses are of different powers of magnification (5X, 10X, 40X, etc.)

The object to be examined is placed on the stage under the objective. Light on the object is focused through the mirror. By raising or lowering the body tube with the help of coarse adjustment, we can see the object through eyepiece.

Activity 16.2

Study a microscope from your biology laboratory in the school. Make a sketch of it and label its parts.

16.3 How to Make a Microscopic Slide ?

1. Take a clean glass slide.
2. With a dropper put a drop of water in the middle of the slide.
3. Gently put the objects to be observed in the drop of water on the slide with the help of a brush. (Objects, if transparent, are first stained with a proper chemical and then observe. This is done to obtain suitable contrast to facilitate easy viewing).

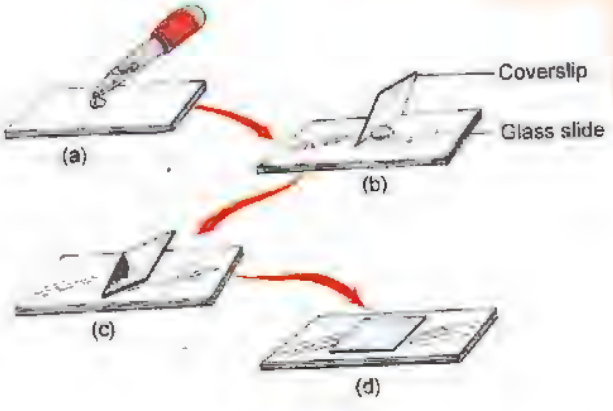


Fig.16.3.

4. Hold the coverslip over the object in such a manner than it touches the edge of the drop of water. Gently lower the coverslip onto the water.
5. Dry the extra water that may come out from under the coverslip with the help of a blotting paper. Take care that the slide thus prepared is clean and dry.

16.4 Cell Structure

See the vast variety of organisms which is present around you. These organisms, whether plants or animals, differ in shape, size and appearance. But all these organisms carry out a number of functions which are same like nutrition, respiration, growth and reproduction.

The body of some living things, like the bacteria and amoeba, have only one cell (unicellular organims). Large plants and animals contain billions of cells (multicellular organisms).

A cell is the basic unit of living things

Cells, in living organisms, have often been compared with bricks in a building. Just as bricks in a building are the basic structural units, cells are the basic structural units in living organisms. Further, just as buildings are different from one another, organisms are also different from one another.

Cells, have been in existence since origin of life which took place millions of years ago. The cells could not be seen before the 17th century because of their small size.

Majority of the cells are too small to be seen with the unaided eye. Cells were, therefore, seen only after magnifying lenses and microscopes. These days, objects as small as one thousandth of a millimeter (10^{-6}m) can be seen with a microscope.

Discovery of the cell

Discovery of the cell was made by an English scientist, Robert Hooke in 1665. He observed thin slices of cork under his crube microscope. Cork could not be seen as such, as it is a solid structure. He found that the cork was made of box-like compartments, forming a honeycomb structure (Fig 16.4). He named these compartments as cells. He demonstrated his work to scientist at Royal Society of

London.

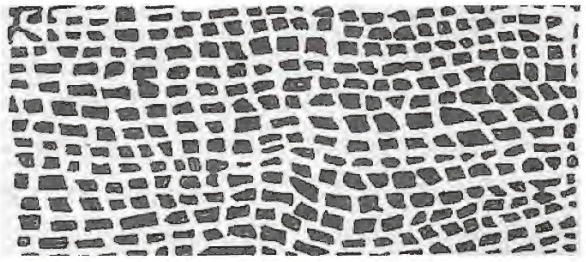


Fig. 16.4 : Cork as Observed by Robert Hooke

Let us now examine cells, both from plants and animals, by performing Activities 16.3, 16.4 and 16.5.

Activity 16.3

To study cell structure in plant using onion peel

Take an onion and prepare a peel with the help of your class teacher. Place a piece of this peel in a drop of water on a glass slide. Put a drop of iodine or safranine on the peel and cover it with a cover slip as shown in Fig. 16.3. Observe it under the microscope. Draw the structures you see.

Activity 16.4

To study cell structure in plants using hydrilla leaf

Take a few thin green leaves of Hydrilla (an aquatic plant). Prepare a slide as describe in section 16.3. Observe it under the microscope. Draw the structure you see.

You will observe structure as shown in Fig. 16.5 and 16.6.

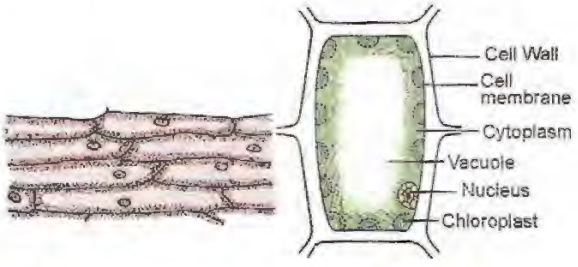


Fig. 16.5 *Fig. 16.6.*

Can you note any difference in the cell structure between an onion peel and a Hydrilla leaf.

Activity 16.5

To study cell structure in animals using human cheek.

Take a slide and put a drop of water on it. Now open your mouth and lightly scrape the inner part of your cheek with a clean cotton bud. Put the scrapping on the slide in the drop of water. Place a coverslip on it and observe it under a microscope. What do you observe ? Make a drawing.

Activity 16.5 will show the cheek cells as shown in **Fig. 16.7**

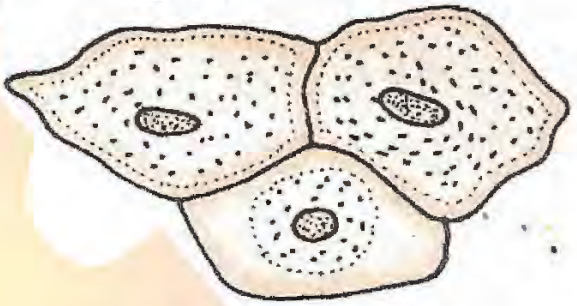


Fig. 16.7 : Cheek Cells

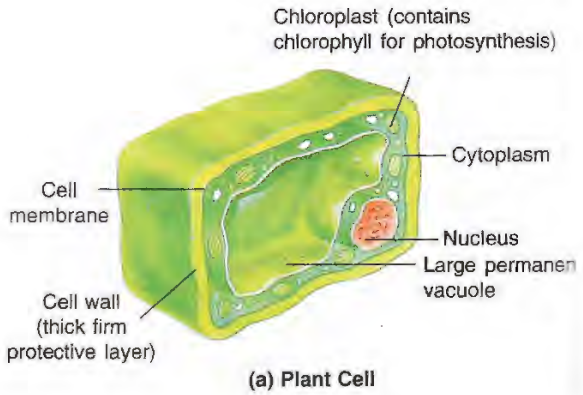
Now, compare the Fig. 16.5, 16.6 and 16.7. In what respects is an animal cell similar to the plant cell ?

In what way are the cells in three cases different ?

To find answer to these questions, let us study section 16.5.

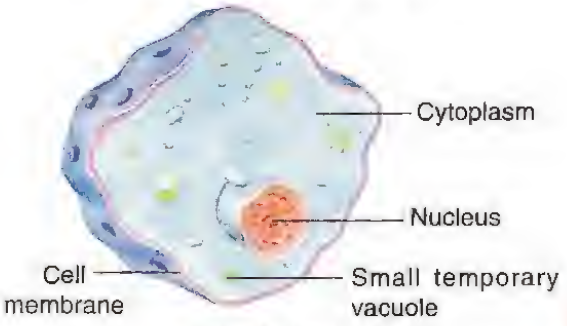
16.5 Parts of a Cell

All the life functions take place in every cell. A cell itself is made of certain parts. Plant and animal cells are not exactly alike.



(a) Plant Cell

All plant and animal cells have three cell parts - the cell membrane, the cytoplasm and the nucleus **(Fig. 16.8).**



(b) : Animal cell

Fig. 16.8 : Cell Structure

The cytoplasm surrounded by the cell membrane and enclosing the nucleus together constituting the protoplasm (proto = first; plasma = liquid). Protoplasm, in other words, includes the cell membrane, the cytoplasm and the nucleus.

Ninety nine percent of protoplasm by weight is made up of four elements namely carbon, hydrogen, nitrogen and oxygen. Other element like phosphorus, sulphur and calcium are also present. These elements combine to form compounds like water, proteins, carbohydrates, fats and nucleic acids. The living nature of protoplasm is provided to it by these compounds.

Cell membrane/ Plasma membrane : It is a very thin skin covering the cell. The plasma membrane performs following functions:

1. It protects the cell.
2. It provides shape to the cell
3. It allows materials to enter and leave the cell through the tiny holes.

Cytoplasm (kytos = hollow; plasma = liquid) : The cytoplasm is a jelly-like substance occupying most of the space inside the cell. It occupies the space between the cell membrane and the nucleus. All the life functions take place in the cytoplasm. The cytoplasm contains many important tiny structures called the **organelles** which perform the various life functions.

Nucleus (plural nuclei; nucleus = kernel): The nucleus is present inside the cell, surrounded by the cytoplasm. The nucleus is the boss of the cell, just like your school principal. As the principal controls everything taking place in the school, the nucleus also controls everything that happens in the cells. Most cells have only one nucleus. Cells like the muscle cells have more than one nucleus.

Did you know ?

Red mature blood cells do not have a nucleus.

Nucleus is a spherical body consisting of four parts;

(i) Nuclear membrane

(ii) Nuclear sap or nucleoplasm

(iii) Nucleolus (plural nucleoli)

(iv) Chromosomes

The outermost covering layer of the nucleus is called the nuclear membrane. It separates the nucleus from the cytoplasm. Nuclear membrane, like the cell membrane, has tiny holes in it which allow exchange of substances between the nucleoplasm and the cytoplasm.

The jelly-like fluid inside the nucleus is called the nucleoplasm. Chromosomes and nucleoli are present in the nucleoplasm.

Chromosomes are thread-like structures which play an important role in the inheritance of characters from one generation to another, that is, from the parents to the children.

Functions of the nucleus :

(i) Transmission of characters from one generation to another.

Table 16.1 : Functions of Organelles

Organelle	Function(s)
1. Mitochondria (singular mitochondrion) 'Power houses of the cell'	Perform the functions of respiration, provide the cell with energy.
2. Chloroplasts (present only in plant cells)	Contain a green pigment called chlorophyll Help in food manufacture (photosynthesis)
3. Endoplasmic reticulum	Being a network of membranes, it provides a large surface area for life functions to take place.
4. Golgi complex	It collects and distributes the substances made in the cell (for example, proteins), synthesis and secretion of many materials.
5. Lysosomes (suicide bags)	Contain enzymes which help in breaking down or destroying the various materials (usually toxic or unwanted)

(ii) Controls all the life functions taking place inside the cell.

Organelles : A number of organelles occur in the cytoplasm. These are :

(1) Mitochondria (rod or spherical in shape)

(2) Chloroplasts (present only in plant cells)

(3) Endoplasmic reticulum

(4) Golgi complex

(5) Lysosomes

(6) Ribosomes

Cell Wall : The cell wall is an extra covering that surrounds the cell membrane of a plant cell. It is made of a stiff, non-living material called cellulose. Cell wall is lacking in animal cells.

Functions :

(i) It provides rigidity to the cell.

(ii) It provides protection to the cell.

Have you ever thought why a plant cell has a wall and chloroplasts ?

Imagine standing erect without bones or muscles. Also, can your body make its own food ? But a green plant stands erect without having any bones and prepares its own food.

A plant cell has special parts that make these things possible. It has a cell wall and chloroplasts. The cell wall stiffens the plant. The chloroplasts help it to make food.

Vacuoles : As a result of various life functions taking place inside a cell, a number of chemical products accumulate within the cell. These are generally stored inside clear areas or space present in the cytoplasm. These clear spaces which are surrounded by a membrane are called vacuoles. Vacuoles are generally absent from animal cells, and if present they are smaller in size and lesser in number. In case of plant cells, vacuoles are larger in size and

more in number. In Amoeba, the vacuoles contain food particles and are called food vacuoles.

Cilia and flagella (singular cilium and flagellum) : In some organisms, cells have projections on their outside surface which help in movement of the cells or the organisms. While cilia are short in length, flagella are the longer projections.

Cilia are found in paramecium.

Flagella are common in Euglena and Chlamydomanas.

Features shared by plant cell and animal cell.

1. Plasma membrane present in both.
2. Nucleus present in both
3. Mitochondria present in both
4. Endoplasmic reticulum, golgi complex, lysosomes and ribosomes present in both.

16.6 Differences between Animal Cell and Plant Cell

Table 16.2 Major differences between animal cell and plant cell

Animal Cell	Plant cell
1. Cell wall is lacking	1. A rigid cell wall is present
2. Chloroplasts are absent	2. Chloroplasts are present
3. Vacuoles are absent; if present they are smaller in size.	3. Vacuoles are larger in size.

16.7 Diversity in Cells

So far we have considered the basic features of cells in general. But this does not mean that all cells are identical. Structures like nucleus, mitochondria, cytoplasm are common to all cells, but the shape, size and contents of individual cells show a lot of variation. These features are closely linked to the functions which the cells perform. In a unicellular organism, all the functions of the body, like nutrition, respiration, excretions, growth and reproduction are carried by the single cell. In multicellular organisms, however, these tasks or functions are divided among groups of cells. All the cells do not do all the jobs. This feature of multicellular organisms is known as division of labour.

A group of cells show variability in their shape, size and other features depending upon the function being performed by them.

Cell Number : Unicellular organisms are formed of single cells. Multicellular organisms are formed of many cells. Which in turn may be of many types.

Even in multicellular organisms, the number of cells may vary a lot. It may be just a few (as in some algae), a few hundred (as in some algae) or several million (as in most plants and animals).

Do you know that a new-born baby has at least 2,000 million cells (i.e. 2,000,000,0000 cells).

Cell Size (Fig. 16.9) : Some plant and animal cells are visible to the naked eye. Most cells, however, are visible only with a microscope. For example, an ostrich egg is

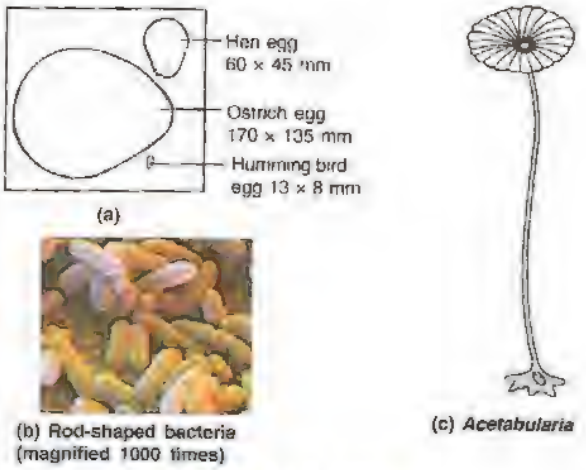


Fig. 16.9 : Cell Size

the largest animal cell. It is as big as 170 x 135 mm. Smallest known cell is that of a

bacterium, Mycoplasma. This bacterium measures about 0.1 micron (ten thousandth part of a millimeter) in size.

In plants, some algae have very big cells. For example, an algae, Acetabularia (a unicellular organism), consists of a single cell which is about ten centimeter in length. Fibres in plants like jute and hemp are a few centimeters long.

In our body, nerve cells are the largest, measuring about 90 micrometers in length. Some nerve cells are longer than a meter. Some blood cells are the smallest. A living red blood cell measures about 9μ. Most other cells (as that of kidney, liver, intestine, etc) are between 20 to 30 microns (micrometers) in diameter.

What about the hen's egg ?

In the egg, there is a central yellow part called yolk which is surrounded by the white albumen. The yellow yolk represents a single cell.

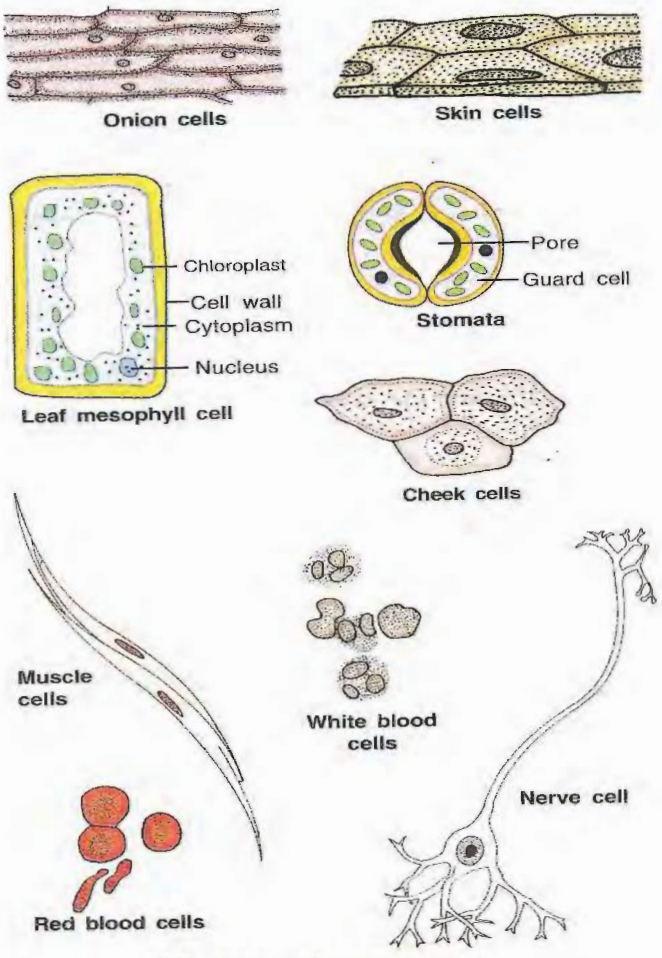


Fig. 16.10 : Cell Shapes

Cell shape : Cells are of diverse shapes **(Fig. 16.10)**. Some cells like those of amoeba and white blood cells of our body continuously change their shapes. Most cells, however, maintain a constant shape all through their existence.

The shape of cell is related to its function. A nerve cell clearly exhibits this relationship. It is long, branched and has thread-like projections, as it has to convey message to different parts of the body.

Basic Facts of Cell Structure and Functions

On the basis of the above study, following general points which are shared by all cells emerge :

1. Cells are the basic structural units of all organisms.
2. Cells are the functional units of all organisms, as cells carry out all body functions of an organism.
3. All cells contain cell organelles.
4. Functioning of cells is responsible for the functioning of organisms.

Round up

- Living things are made up of one or more cells. In unicellular organisms, like the bacteria and amoeba, all life functions are performed by the single cell. In multicellular organisms, the cells are specialized to perform certain functions (division of labour).
- Cells have three parts. The outer covering, **Cell membrane** which encloses a jellylike **cytoplasm**. Within the cytoplasm is present the controlling centre of the cell, the **nucleus.**
- In addition to nucleus, cell organelles such as the chloroplast, mitochondria, endoplasmic reticulum, golgi bodies and vacuoles are present in the cytoplasm.
- Plant cells differ from animal cells in some respects. Cell wall and chlorplasts are present in plant cells, and absent in animal cells.
- Cells show great variation in their sizes and shapes.
- The smallest cell observed is of a bacterium (Mycoplasma). The largest cell is that of an Ostrich egg.

Exercises

1. Define a cell ?
2. Who discovered the cell ?
3. Give three examples of unicellular organisms ?
4. **Answer the following questions :**
   - (i) Why cells could not be observed before 17th century ?
   - (ii) Why cork could not be observed as such by Hook ?
   - (iii) Where did Hook demonstrate his observations on cork slice ?
   - (iv) Name the outermost layer of an animal cell ?
   - (v) Name the layer which is present outside the plasma membrane in plant cell ?
   - (vi) Where are chromosomes present in a cell ?
   - (vii) Name the cell part that has tiny holes ?
   - (viii) Name the cell organelles which are found in the plant cell ?
   - (ix) Name the cells having branched structure ?
   - (x) Which cell can be observed with the unaided eye ?
5. Mention the functions of the following ;
   (a) Cell membrane (b) Chromosomes.
6. Why are the following important to a plant cell ?
   (i) Cell wall (ii) Chloroplast (iii) Mitochondria (iv) Nucleus.
7. Draw an outline diagram of an animal cell. Label the different parts ?
8. Mention three differences between plant cell and animal cell ?
9. What features are possessed by both plant cells and animal cells?
10. Why are nerve cells long ? Why do these cells have projections ?
11. Why are mitochondria known as the 'power house of the cell' ?

12. Which four basic elements constitute more than 90% of protoplasm ?
13. Write in brief about the variation in shape and size of cells?
14. Name the different cell organelles and the functions of these organelles?
15. What is meant by protoplasm ? How does it differ from cytoplasm ?

16. Fill in the blanks, using the words given below :

(mycoplasma, microscope, nucleus, ostrich egg, cytoplasm, lysosome, mitochondria, Robert Hook, plant, cell membrane)

(i) The _____ is also called as suicide bags.
(ii) The term 'cell' was given by _____.
(iii) The instrument used to see tiny objects is called a _____.
(iv) Smallest cell is that of a _____.
(v) An _____ is a cell that can be seen without a microscope.
(vi) The _____, _____, and _____ are parts of a cell.
(vii) Energy is produced in _____.
(viii) Cell wall is present in _____ cells.

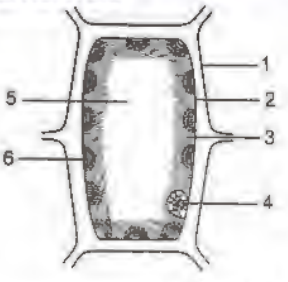
17. Write 'True' or 'False' in front of the statement given below :

Statement	True or False
(i) Most of a cell is the nucleus.	[ ]
(ii) Only the nucleus of a cell represents the protoplasm.	[ ]
(iii) Most cells are microscopic.	[ ]
(iv) All living organisms are made of cells.	[ ]
(v) Every cell has cytoplasm.	[ ]
(vi) All cells in a multicellular organism can live independently	[ ]
(vii) The outermost covering in an animal cell is called cell wall	[ ]

18. Match the statements in Column A with those in Column B. [ ]

Column A	Column B
1. Cell	a. Outermost covering in plant cells.
2. Nucleus	b. Tiny structures inside cells
3. Cell wall	c. Unit of living body
4. Chloroplast	d. Boss of the cell
5. Cytoplasm	e. Photosynthetic units
6. Organelles	f. Jelly-like substance between cell membrane and nucleus.

19. Label the different parts numbered 1 to 6 of the cell indicated by guidelines in the figure shown below :



CHAPTER - 17

SOME NATURAL PHENOMENA

You might have read about winds, storms and cyclones. Cyclones can cause a lot of damage to human life and property. We can protect ourselves from these destructive phenomena to some extent. In this chapter we shall discuss two other destructive natural phenomena. These are lightning and earthquakes. We shall also discuss what steps we can take to minimize destruction caused by these phenomena.

17.1 Lightning

You might have seen sparks on a electric pole when wires become loose. This phenomenon is quite common when a wind is blowing and shacking the wires. You might also have seen sparks when a plug is loose in its socket. Lightning is also an electric spark, but on a huge scale.

In ancient times people did not understand the cause of these sparks. They were, therefore, afraid of lightning and thought that the wrath of gods was visiting them. Now, of course, we understand that lightning is caused by the accumulation of charges in the clouds. We need not be afraid of lightning, but we have to take precautions to protect ourselves from the deadly sparks.

The Sparks that the Greeks Knew About

The ancient Greeks knew as early as 600 B.C. that when amber (amber is a kind of resin) was rubbed with fur, it attracted light objects such as hair. You might have seen that when you take off woollen or polyester clothes, your hair stands on ends. If you take off these clothes in the dark, you see even a spark and hear crackling sound. In 1752 Benjamin Franklin, an American scientist, showed that lightning and the spark from your clothes are essentially the same phenomena. However, this realisation took 2000 years.

I wonder why they took so many years to realise the similarity.

Scientific discoveries are a result of hard work by many people. It can sometime takes a long time.

We shall now study some properties of electric charges. We shall also see how they are related to the lightning in the sky.

Let us perform some activities to understand the nature of electric charges. But recall first what you might have played as a game. When you rub a plastic scale on your dry hair, the scale can attract very small pieces of paper.

17.2 Charging by Rubbing

Activity 17.1

Take a used ballpen refill and rub it vigorously with a piece of polythene. Bring it close to small pieces of paper. Take care not to touch the rubbed end of the refill with your hand or with a metallic object. Repeat the activity with small pieces of dry leaf, husk and mustard seeds. Record your observations.

When a plastic refill is rubbed with polythene, it acquires a small electric charge. Similarly, when a plastic comb is rubbed with dry hair, it acquires a small charge. These objects are called **charged objects**. In the process of charging the refill and the plastic comb, polythene and hair also get charged.

Let's try to charge some other objects that are familiar to you.

Table 17.1

Objects rubbed	Materials used for rubbing	Attracts/does not attract pieces of paper	Charged /not charged
Refill	Polythene, woollen cloth		
Balloon	Polythene, woollen cloth, dry hair		
Eraser	Wool		
Steel spoon	Polythene, woollen cloth		

Activity 17.2

Collect the objects and the materials listed in **Table 17.1**. Try to charge each by rubbing with the materials mentioned in the Table. Record your findings.

You can add more items to the Table.

17.3 Types of Charges and their Interaction

We will select some objects from **Table 17.1** for the next activity.

Activity 17.3

a) Inflate two balloons. Hang them in such a way that they do not touch each other **(Fig. 17.1)**. Rub both the balloons with a woollen cloth and release them. What do you observe?

Fig. 17.1 : Like Charges Repel Each Other

Now let us repeat this activity with the used pen refills. Rub one refill with polythene. Place it carefully in a glass tumbler using the tumbler as a stand **(Fig. 17.2)**.

Fig. 17.2 : Interaction between Like Charges

Rub the other refill also with polythene. Bring it close to the charged refill. Be careful not to touch the charged end with your hand. Is there any effect on the refill in the tumbler? Do the two attract each other, or repel each other?

In this activity we have brought close together the charged objects that were made of the same material. What happens if

two charged objects made of different materials are brought close to each other? Let's find out.

b) Rub a refill and place it gently in a glass tumbler as before **(Fig. 17.3)**. Bring an inflated charged balloon near the refill, what do you observe ?

Fig. 17.3 : Unlike Charges Attract Each Other

Let's summarise the observations:

A charged balloon repelled a charged balloon.

A charged refill repelled a charged refill.

But a charged balloon attracted a charged refill.

Does it indicate that the charge on the balloon is of a different kind from the charge on the refill? Can we say then, that there are two kinds of charges? Can we also say that the charges of the same kind repel each other, while charges of different kind attract each other?

It is a convention to call the charge acquired by a glass rod when it is rubbed with silk as positive. The other kind of charge is said to be negative.

It is observed that when a charged glass rod is brought near a charged plastic straw rubbed with polythene there is attraction between the two.

What do you think would be the kind of charge on the plastic straw? Your guess, that the plastic straw would carry a negative charge is correct.

The electrical charges generated by rubbing are static. They do not move by themselves. When charges move, they constitute an electric current. The current in a circuit which makes a bulb glow, or the current that makes a wire hot, is nothing but a motion of charges.

17.4 Transfer of Charge

Activity 17.4

Take an empty jam bottle. Take a piece of cardboard slightly bigger in size than the mouth of the bottle. Pierce a hole in it so that a metal paper clip could be inserted. Open out paper clip as shown in **Fig. 17.4**. Cut two strips of aluminium foil about 4 cm × 1 cm each. Hang them on the paper clip as shown. Insert the paper clip in the cardboard lid so that it is perpendicular to it **(Fig.17.4)**. Charge a refill and touch it with the end of the paper clip. Observe what happens. Is there any effect on the foil strips? Do they repel each other or attract each other? Touch now, other charged bodies with the end of the paper clip. Do foil strips behave in the same way in all cases?

Fig 17.4 : A Simple Electroscope

Can this apparatus be used to detect whether a body is charged or not? Can you explain why the foil strips repel each other?

The aluminium foil strips receive the same charge from the charged refill through the paper clip (remember that metals are good conductors of electricity). The strips carrying similar charges repel each other and they become wide open. Such a device can be used to test whether an object is carrying charge or not. This device is known as **electroscope.**

Thus, we find that electrical charge can be transferred from a charged object to another through a metal conductor.

Touch the end of the paper clip gently with hand and you will find a change in the foil strips. They come back to their original state. Repeat charging of foil strips and touching the paper clip. Every time you will find that the foil strips collapse as soon as you touch the paperclip with hand. Why does it happen? The reason is that the foil strips lose charge to the earth through your body. We say that the foil strips are **discharged**. The process of transfering of charge from a charged object to the earth is called **earthing**.

Earthing is provided in buildings to protect us from electrical shocks due to any leakage of electrical current.

17.5 The Story of Lightning

It is now possible to explain lightning in terms of the charges produced by rubbing. During the development of a thunderstorm, the air currents move upward while the water droplets move downward. These vigorous movements cause separation of charges. By a process, not yet completely understood, the positive charges collect near the upper edges of the clouds and the negative charges accumulate near the lower edges. There is accumulation of charges.

Fig 17.5 : Accumulation of Charges Leading to Lightning.

The process of electric discharge can occur between two or more clouds, or between clouds and the earth. Today we need not get frightened by lightning like the ancient people did. Now we understand the basic phenomenon. Scientists are trying hard to improve our understanding. However, lightning strike could destroy life and property. It is, therefore, necessary to take measures to protect ourselves.

17.6 Lightning Safety

During lightning and thunderstorm no open place is safe.

- Hearing thunder is an alert to rush to a safer place.
- After hearing the last thunder, wait for some time before coming out of the safe place.

Finding a safe place

A house or a building is a safe place. If you are travelling by car or by bus, you are safe inside with windows and doors of the vehicle shut.

Do's and Don'ts during a Thunderstorm :

Outside the house

Open vehicles, like motorbikes, tractors, construction machinery, open cars are not safe. Open fields, tall trees, shelters positive charges near the ground are not safe also. When the magnitude of the accumulated charges becomes very large,

the air which is normally a poor conductor of electricity, is no longer able to resist their flow. Negative and positive charges meet, producing streaks of bright light and sound. We see streaks as lightning **(Fig. 17.5)**. The process is called an electric discharge.

Carrying umbrella is not a good idea at all during thunderstorms.

If in a forest, take shelter under shorter trees.

If no shelter is available and you are in an open field, stay far away from all trees. Stay away from poles or other metal objects. Do not lie on the ground. Instead, squat low on the ground. Place your hands on your knees with your head between the hands **(Fig. 17.6)**. This position will make you the smallest target to be struck.

Fig. 17.6 : Safe Position During Lightning

Inside the house

Lightning can strike telephone cords, electrical wires and metal pipes (Do you remember, lightning is an electrical discharge?). During a thunderstorm contact with these should be avoided. It is safer to use mobile phones and cordless phones. However, it is not wise to call up a person who is receiving your phone through a wired phone.

Bathing should be avoided during thunderstorms to avoid contact with running water.

Electrical appliances like computers, TVs, etc., should be unplugged. Electrical lights can remain on. They do not cause any harm.

Lightning Conductors

Lightning Conductor is a device used to protect buildings from the effect of lightning. A metallic rod, taller than the building, is installed in the walls of the building during its construction. One end of the rod is kept out in the air and the other is buried deep in the ground **(Fig. 17.7)**. The rod provides easy route for the transfer of electric charge to the ground.

The metal columns used during construction, electrical wires and water pipes in the buildings also protect us to an extent. But do not touch them during a thunderstorm.

17.7 Earthquakes

You just learnt about thunderstorm and lightning. These natural phenomena can cause large scale destruction of human life and property. Fortunately, these phenomena can be predicted to some extent. The weather department can warn about a thunderstorm developing in some area. If a thunderstorm occurs there is always a possibility of lightning and cyclones accompanying it. So, we get time

to take measures to protect ourselves from the damage caused by these phenomena.

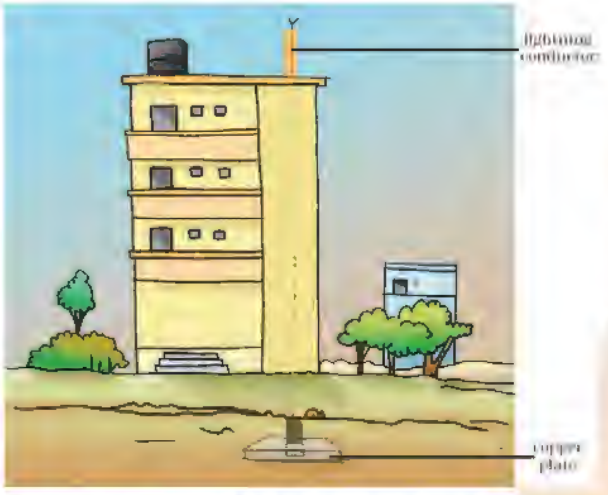


Fig. 17.7 : Lightning Conductor

There is, however, one natural phenomenon which we are not yet able to predict. It is an earthquake. It can cause damage to human life and property on a huge scale.

A major earthquake occurred in India on 8 October 2005 in Uri and Tangdhar towns of North Kashmir **(Fig.17.8)**. Before that a major earthquake occurred on 26 January 2001 in Bhuj District of Gujarat.

Activity 17.5

Ask your parents about the huge damages to life and property caused by these earthquakes. Collect a few pictures showing the damage caused by these earthquakes from newspapers and magazines of those days. Prepare a short report on the suffering of the people during the earthquakes.

What is an earthquake? What happens when it occurs? What can we do to minimise its effects? These are some of the questions which we shall discuss below.

What Is an Earthquake?

An earthquake is a sudden shaking or trembling of the earth lasting for a very short time. It is caused by a disturbance deep inside the earth's crust. Earthquakes occur all the time, all over the earth. They are not even noticed. Major earthquakes are much less frequent. They can cause immense

Fig. 17.8 : Kashmir Earthquake

damage to buildings, bridges, dams and people. There can be a great loss to life and property. The earthquakes can cause floods, landslides and tsunamis. A major tsunami occurred in the Indian Ocean on 26th December 2004. All the coastal areas around the ocean suffered huge losses.

Activity 17.6

Take an outline map of the world. Locate the eastern coast and Andaman and Nicobar Islands in India. Mark other countries around the Indian Ocean which could have suffered damage. Collect accounts of the devastation caused by the tsunami in India from your parents, or other elders in the family or in the neighbourhood.

What Causes an Earthquake?

A myth is very famous that the earth is balanced on the horn of a bull and when the bull shifts it to the other horn, an earthquake takes place.

How could it be true?

In ancient times, people did not know the true cause of earthquakes. Their ideas were, therefore, expressed in mythical stories. Similar myths were prevalent in other parts of the world.

What could cause a disturbance inside the earth?

Now we know that the tremors are caused by the disturbance deep down inside the uppermost layer of the earth called the crust **(Fig. 17.9)**.

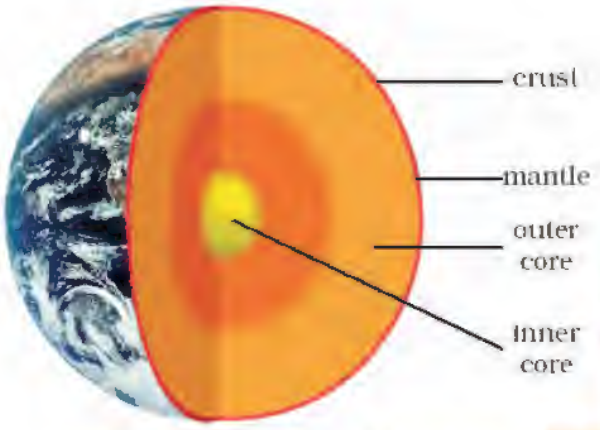


Fig. 17.9 : Structure of the Earth

The outermost layer of the earth is not in one piece. It is fragmented. Each fragment is called a plate **(Fig. 17.10)**.

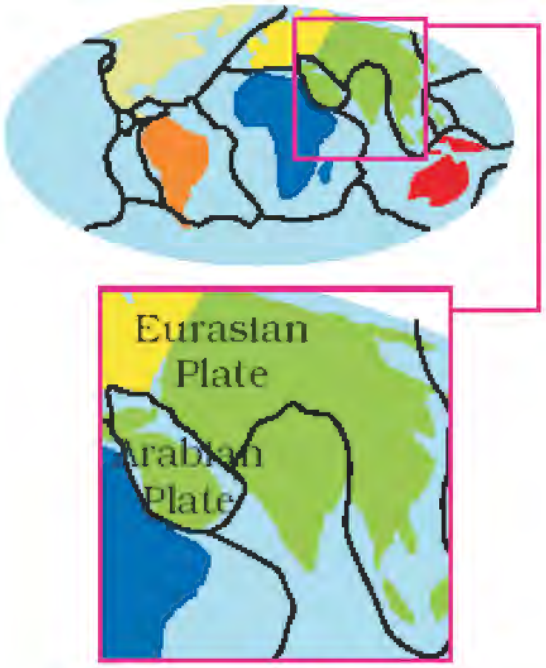


Fig. 17.10 : Earth Plates

These plates are in continual motion. When they brush past one another, or a plate goes under another due to collision **(Fig. 17.11)**, they cause disturbance in the earth's crust. It is this disturbance that shows up as an earthquake on the surface of the earth.

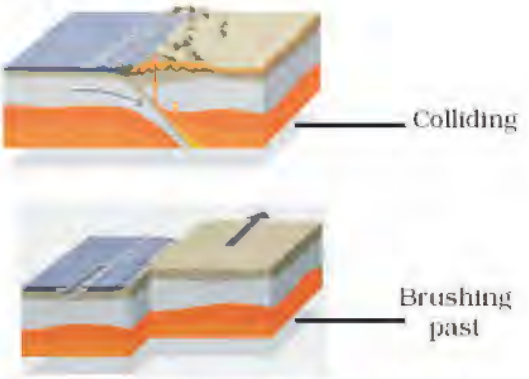


Fig. 17.11 : Movements of Earth's Plates

If scientists know so much about earthquakes, can they also predict when and where the next one will strike?

Although, we know for sure what causes an earthquake, it is not yet possible to predict when and where the next earthquake might occur.

I read somewhere that underground explosions could also cause tremors.

Tremors on the earth can also be caused when a volcano erupts, or a meteor hits the earth, or an underground nuclear explosion is carried out. However, most earthquakes are caused by the movement of earth's plates.

Fig. 17.12 : Movements of Indian Earth's Plate

Since earthquakes are caused by the movement of plates, the boundaries of the plates are the weak zones where earthquakes are more likely to occur. The weak zones are also known as **seismic** or **fault zones**. In India, the areas most threatened are Jammu and Kashmir, Western and Central Himalayas, the whole of North-East, Rann of Kutch, Rajasthan and the Indo – Gangetic Plane. Some areas of South India also fall in the danger zone **(Fig. 17.12)**.

The power of an earthquake is expressed in terms of a magnitude on a scale called **Richter scale**. Really destructive earthquakes have magnitudes higher than 7 on the Richter scale. Both Bhuj and Kashmir earthquakes had magnitudes greater than 7.5.

The tremors produce waves on the surface of the earth. These are called seismic waves. The waves are recorded by an instrument called the **seismograph (Fig. 17.13)**. The instrument is simply a vibrating rod, or a pendulum, which starts vibrating when tremors occur. A pen is attached to the vibrating system. The pen records the seismic waves on a paper which moves under it. By studying these waves, scientists can construct a complete map of the earthquake, as shown in **Fig. 17.14**. They can also estimate its power to cause destruction.

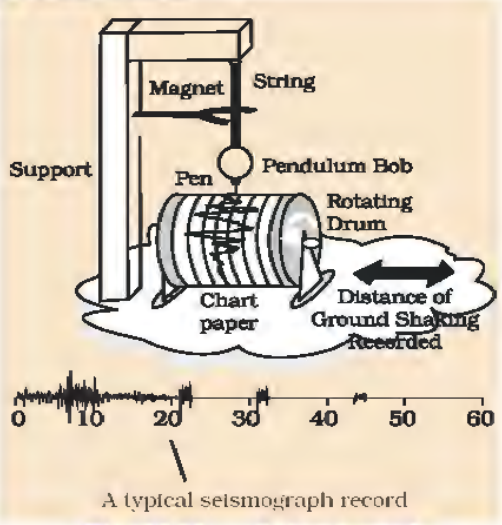


Fig. 17.13 : A Seismograph

Like many other scales in science (decibel is another example), Richter scale is not linear. This means that an earthquake of magnitude 6 does not have one and half times the destructive energy of an earthquake of magnitude 4. In fact, an increase of 2 in magnitude means 1000 times more destructive energy. For example, an earthquake of magnitude 6 has thousand times more destructive energy than an earthquake of magnitude 4.

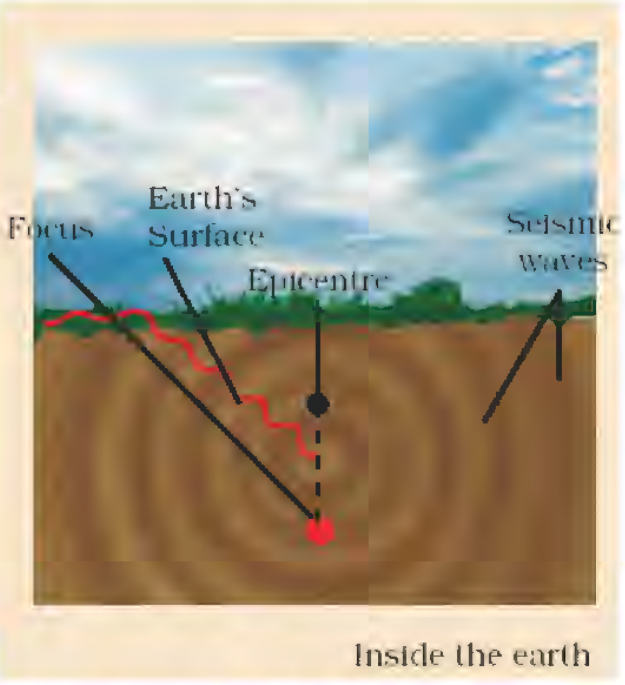


Fig. 17.14 : Map of the Earthquake

Protection against Earthquakes

We know from the earlier pages that earthquakes cannot be predicted. We have also seen that they can be highly destructive. It is, therefore, important that we take necessary precautions to protect ourselves all the time. People living in seismic zones, where the earthquakes are more likely to occur, have to be specially prepared. First of all, the buildings in these zones should be designed so that they can withstand major tremors.

Modern building technology can make it possible.

It is advisable to make the structure simple so that it is 'Quake Safe'.

● Consult qualified architects and structural engineers.

● In highly seismic areas, the use of mud or timber is better than the heavy construction material. Keep roofs as light as possible. In case the structure falls, the damage will not be heavy.

● It is better if the cupboards and shelves are fixed to the walls, so that they do not fall easily.

● Be careful where you hang wall clocks, photo-frames, water heaters etc., so that in the event of an earthquake, they do not fall on people.

● Since some buildings may catch fire due to an earthquake, it is necessary that all buildings, especially tall buildings, have fire fighting equipment in working order.

The Central Building Research Institute, Roorkee, has developed a technique as how to make quake proof houses.

In the event that an earthquake does strike, take the following steps to protect yourself:

1. If you are at home:

● Take shelter under a table and stay there till shaking stops.

● Stay away from tall and heavy objects that may fall on you.

If you are in bed, do not get up. Protect your head with a pillow.

2. If you are outdoors:

● Find a clear spot, away from buildings, trees and overhead power lines. Drop to the ground.

● If you are in a car or a bus, do not come out. Ask the driver to drive slowly to a clear spot. Do not come out till the tremors stop.

KEYWORDS

CRUST
DISCHARGE
EARTH'S PLATES
EARTHQUAKE
ELECTROSCOPE
LIGHTNING
LIGHTNING CONDUCTOR
NEGATIVE CHARGE
POSITIVE CHARGE
RICHTER SCALE
SEISMOGRAPH
THUNDER
THUNDERSTORM
TRANSFER OF CHARGE
TSUNAMI
TREMOR

WHAT YOU HAVE LEARNT

- Some objects can be charged by rubbing with other objects.
- There are two kinds of charges — positive charge and negative charge
- Like charges repel and unlike charges attract each other.
- The electrical charges produced by rubbing are called static charges.
- When charges move, they constitute an electric current.
- An electroscope may be used to detect whether a body is charged or not.
- The process of transfer of charge from a charged object to the earth is called earthing.
- The process of electric discharge between clouds and the earth or between different clouds causes lightning.
- Lightning strike could destroy life and property.
- Lightning conductors can protect buildings from the effects of lightning.
- An earthquake is a sudden shaking or trembling of the earth.
- Earthquake is caused by a disturbance deep inside the earth's crust.
- It is not possible to predict the occurrence of an earthquake.
- Earthquakes tend to occur at the boundaries of earth's plates. These boundaries are known as fault zones.
- Destructive energy of an earthquake is measured on the Richter scale. The earthquake measuring 7 or more on Richter scale can cause severe damage to life and property.
- We should take necessary precautions to protect ourselves from earthquakes.

Exercises

Select the correct option in Questions 1 and 2.

1. Which of the following cannot be charged easily by friction?
   (a) A plastic scale
   (b) A copper rod
   (c) An inflated balloon
   (d) A woollen cloth.
2. When a glass rod is rubbed with a piece of silk cloth the rod
   (a) and the cloth both acquire positive charge.
   (b) becomes positively charged while the cloth has a negative charge.
   (c) and the cloth both acquire negative charge.
   (d) becomes negatively charged while the cloth has a positive charge.

3. Write T against true and F against false in the following statements:

   (a) Like charges attract each other. (T/F)
   (b) A charged glass rod attract a charged plastic straw. (T/F)
   (c) Lightning conductor cannot protect a building from lightning. (T/F)
   (d) Earthquakes can be predicted in advance. (T/F)

4. Sometime, a crackling sound is heard while taking off sweater during winters. Explain.
5. Explain why a charged body loses its charge if we touch it with our hand?
6. Name the scale on which the destructive energy of an earthquake is measured. An earthquake measures 3 on this scale. Would it be recorded by a seismograph? Is it likely to cause much damage?
7. Suggest three measures to protect ourselves from lightning.
8. Explain why a charged balloon is repelled by another charged balloon whereas an uncharged balloon is attracted by another charged balloon?
9. Describe with the help of a diagram an instrument which can be used to detect a charged body?
10. List three states in India where earthquakes are more likely to strike.
11. Suppose you are outside your home and an earthquake strikes. What precaution would you take to protect yourself?
12. The weather department has predicted that a thunderstorm is likely to occur on a certain day. Suppose you have to go out on that day. Would you carry an umbrella? Explain.

Extended Learning — Activities and Projects

1. Open a water tap. Adjust the flow so that it forms a thin stream. Charge a refill. Bring it near the water stream. Observe what happens. Write a short report on the activity.
2. Make your own charge detector. Take a paper strip roughly 10 cm × 3 cm. Give it a shape as shown in Fig. 15.15. Balance it on a needle. Bring a charged body near it. Observe what happens. Write a brief report, explaining its working.

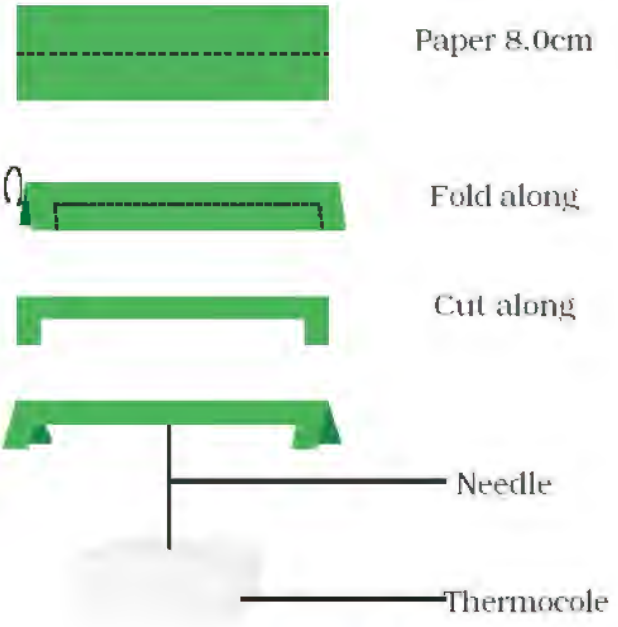


Fig. 17.15

3. This activity should be performed at night. Go to a room where there is a fluorescent tube light. Charge a balloon. Switch off the tube light so that the room is completely dark. Bring the charged balloon near the tubelight. You should see a faint glow. Move the balloon along the length of the tube and observe how glow changes.

Caution : Do not touch the metal parts of the tube or the wires connecting the tube with the mains.

4. Find out if there is an organisation in your area which provides relief to those suffering from natural disaster. Enquire about the type of help they render to the victims of earthquakes. Prepare a brief report on the problems of the earthquake victims.

For more information on these topics, visit: science.howstuffworks.com/lightning.htm
science.howstuffworks.com/earthquake.htm
www.enchantedlearning.com/subjects/astronomy/planets/earth/continents.shtml

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