SCIENCE

TEXTBOOK FOR CLASS-VII

The Jammu and Kashmir State Board of School Education Jammu/Srinagar

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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 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 student 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 text book of science for Class 7th 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 BOSE gratefully acknowledges the use of material from science textbook of Class 7th published by National Council of Education

Research and Training (NCERT), New Delhi in preparing the text book.

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 **Mr. Malik Gh. Hasan, Director (Academics) JK BOSE, and Dr. Yasir Hamid Sirwal, Academic Officer, JK BOSE** for their laudable contribution in the preparation and processing of this book.

Comments and suggestions for improvement are welcome.

Dr. Sheikh Bashir Ahmad
Chairman
Jammu & Kashmir
State Board of School Education

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 VII**. 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 record that while dedicating this textbook of **Class 7th** to the pupil of State, I acknowledge with gratitude the contribution made by the experts of the subjects, and for expending their whole hearted support. They are :

1. Mr. A.K. Sen, Ex-Director (Academics), J&K State BOSE.
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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.

Malik Gh. Hasan

Director (Academics)

Jammu & Kashmir

State Board of School Education

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1 NUTRITION IN PLANTS

Nutrition is the fundamental life process because all other processes stem from it. Energy gained through nutrition is used to maintain other life processes. In Class VI you have learnt that food is essential for all living organisms. You have also learnt that carbohydrates, proteins, fats, vitamins and minerals are components of food. These components of food are necessary for our body and are called **nutrients**.

All living organisms require food. Plants can make their food themselves but animals including humans cannot. They get it from plants or animals that eat plants. Thus, humans and animals are directly or indirectly dependent on plants.

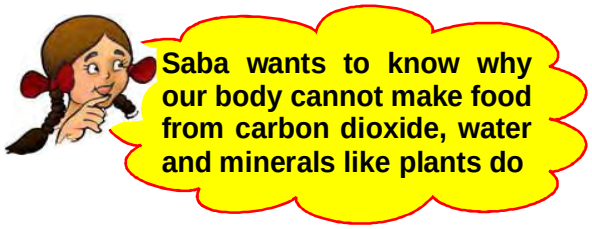
1.1 MODE OF NUTRITION IN PLANTS

Plants are the only organisms that can prepare food for themselves by using water, carbon dioxide and minerals. These raw materials are present in their surroundings.

The nutrients enable living organisms to build their bodies, to grow, to repair damaged parts of their bodies and provide the energy to carry out life processes. **Nutrition** is the mode of taking food by an organism and its utilization by the body. The mode of nutrition in which organisms make food themselves from simple substances is called **autotrophic** (auto = self; trophos = nourishment) nutrition. Therefore, plants are called **autotrophs**. Animals and most other organisms take in ready made food prepared by the plants. They are called **heterotrophs** (heteros = other).

NUTRITION

Autotrophic Nutrition	Heterotrophic Nutrition
e.g., Green Plants [Producers of food]	e.g., all animals including man and non-green plants

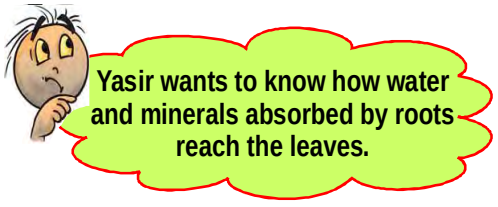


Now where the food factories of

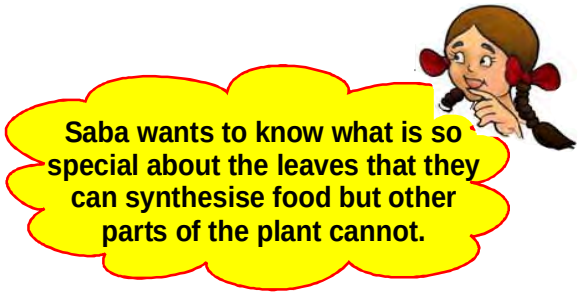
the plants are located: whether food is made in all parts of plants or only in certain parts? How do plants obtain raw materials from their surroundings? How do they transport them to the food factories of the plants?

1.2 PHOTOSYNTHESIS - FOOD MAKING PROCESS IN PLANTS

Leaves are the food factories of plants. The synthesis of food in the plants occurs in leaves. Therefore, all the raw materials must reach there. Water and minerals present in the soil are absorbed by the roots and transported to the leaves. Carbon dioxide from air is taken in through the pores present on the surface of the leaves. These pores are surrounded by 'guard cells'. Such pores are called **stomata [Fig. 1.1 (c)].**



Water and minerals are transported to the leaves by the vessels which run like pipes throughout the roots, the stem, the branches and the leaves. They form a continuous path or passage for the nutrients to reach the leaf.



The leaves have a **green pigment** called **chlorophyll**. It helps leaves to capture the energy of sunlight. This energy is used to synthesise (prepare) food from carbon dioxide and water. Since the synthesis of food occurs in the presence of sunlight, it is called **photosynthesis** (photo : light; synthesis : to combine). So we find that chlorophyll, sunlight, carbon dioxide and water are necessary to carry out the process of photosynthesis. It is a unique process on the earth. The solar energy is captured by the leaves and stored in the plant in the form of food. **Thus, sun is the ultimate source of energy for all living organisms.**

Can you imagine life on earth without photosynthesis !

In the absence of photosynthesis there would not be any food. The survival of almost all living organisms directly or indirectly depends upon the food made by the plants. Besides, oxygen which is essential for the survival of all living

Besides leaves, photosynthesis also takes place in other green parts of the plant - in green stems and green branches. The desert plants have scale or spine-like leaves to reduce loss of water by transpiration. These plants have green stems which carry out photosynthesis. e.g. cactus

organisms is produced during photosynthesis. In the absence of photosynthesis, life will be impossible on the earth.

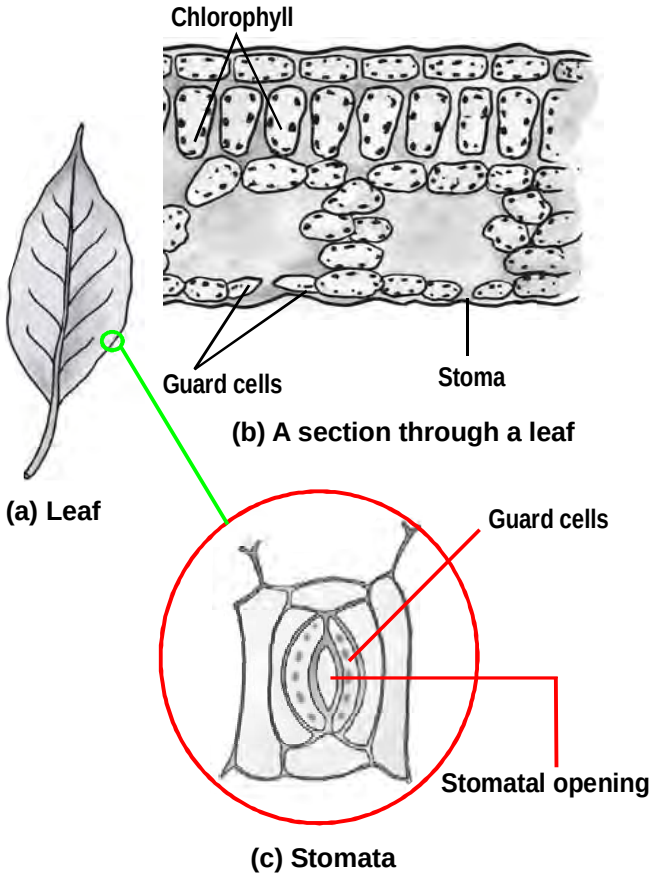


Fig. 1.1

During photosynthesis, chlorophyll containing cells of leaves **(Fig.1.1)**, in the presence of sunlight, use carbon dioxide and water to synthesise carbohydrates **(Fig.1.2)**. The process can be represented by an equation:

$$6CO_2 + 6H_2O \xrightarrow[\text{cholorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6O_2$$

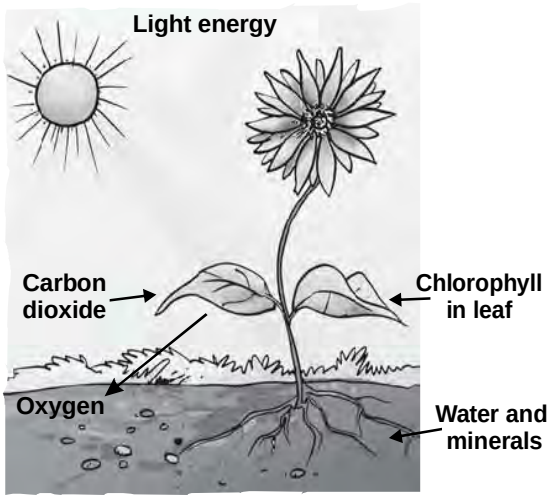


Fig.1.2: Diagram showing photosynthesis

During photosynthesis, oxygen is released. The carbohydrates ultimately get converted into starch. The presence of starch in leaves indicates the occurrence of photosynthesis. The starch is also a carbohydrate.

Activity 1.1

Take two potted plants of the same kind. Keep one in the dark (or in a black

box) for 72 hours and the other in the sunlight. Perform iodine test with leaves of the both plants as you did in Class VI. Record your results. Now leave the pot which was earlier kept in the dark, in the sunlight for 3-4 days and perform the iodine test again on its leaves. Record your observations in your notebook.

The leaves other than green also have chlorophyll. The large amount of red, brown and other pigments mask the green colour **(Fig.1.3)**. Photosynthesis takes place in these leaves also.

Fig.1.3: Leaves of various colours

You often see slimy, green patches in ponds or in other stagnant water bodies. These are generally formed by the growth of organisms called **algae**. Can you guess why is algae green in colour? They contain chlorophyll which gives them the green colour. Algae can also prepare their own food by photosynthesis.

Synthesis of Plant food other than carbohydrates

You have just learnt that plants synthesize carbohydrates through the process of photosynthesis. The carbohydrates are made of carbon, hydrogen and oxygen. These are used to synthesize other components of food such as proteins and fats. But proteins are nitrogenous substances which contain nitrogen. From where do the plants obtain nitrogen?

Recall that nitrogen is present in abundance in gaseous form in the air. However, plants cannot absorb nitrogen in this form. Soil has certain bacteria that convert gaseous nitrogen into a usable form and release it into the soil. These soluble forms are absorbed by the plants along with water. Also, you might have seen farmers adding fertilizers rich in nitrogen to the soil. In this way the plants fulfil their requirements of nitrogen along with the other constituents. Plants can then synthesize components of food other than carbohydrates such as proteins and fats.

1.3 OTHER MODES OF NUTRITION IN PLANTS

There are some plants which do not have chlorophyll. They cannot synthesize their food. How do they

survive and from where do they derive nutrition? Like humans and animals such plants depend on the food produced by the other plants. They use the **heterotrophic mode** of nutrition. Look at **Fig.1.4.** Do you see yellow tubular structures twining around the stem and branches of a tree? This is a plant called *Cuscuta* (Amarbel). It does not contain chlorophyll. It takes ready made food from the plant on which it is climbing.

Fig.1.4: Cuscuta (Amarbel) on host plant

The plant on which they climb is called a **host**. Since it deprives the host of valuable nutrients, it is called a **parasite**. Are we and the other animals also parasites on the plants? You should think about it and discuss with your teacher**.**

Saba wants to know whether mosquitoes, bed bugs, lice and leeches that suck our blood are also parasites.

Have you seen or heard of plants that can eat animals? There are a few plants which can trap insects and digest them. Is it not amazing? Such plants may be green or of some other colour. Look at the plant in **Fig.1.5.** The pitcher-like structure is the modified part of the leaf. The apex of the leaf forms a lid which can open or close the mouth of pitcher**.** Inside the pitcher there are hair which are directed downwards. When an insect lands in the pitcher, the lid closes and the trapped insect is digested by the digestive juices secreted in the pitcher. Such insect-eating plants are called **insectivorous plants.**

It is possible that such plants do not get all the required nutrients from the soil in which they grow?

Yasir is confused. If the pitcher plant is green and carries out photosynthesis, then why does it feed on insects?

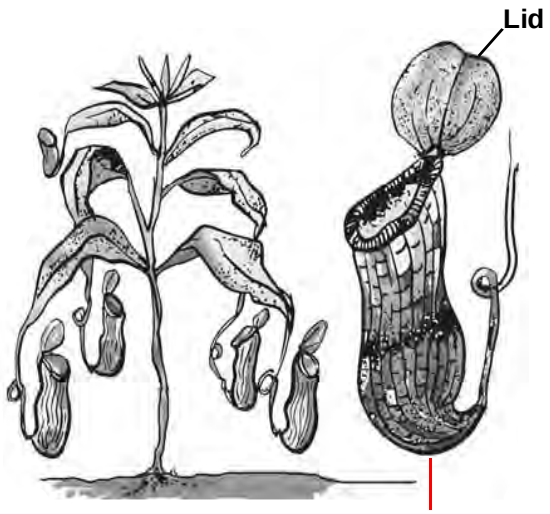


Fig.1.5: Pitcher plant showing lid and pitcher

1.4 SAPROTROPHS

You might have seen packets of mushrooms sold in the vegetable market.

Fig.1.6: Packet of mushrooms, a mushroom growing on decayed material

Yasir wants to know how these organisms acquire nutrients. They do not have mouths like animals do. They are not like green plants as they lack chlorophyll and cannot make food by photosynthesis.

You may have also seen fluffy umbrella-like patches growing on rotting wood during the rainy season **(Fig.1.6)**. Let us find out what type of nutrients they need to survive and from where they get them.

Activity 1.2

Take a piece of bread and moisten it with water. Leave it in a moist warm place for 2-3 days or until fluffy patches appear on it **(Fig.1.7)**. These patches may be white, green, brown or of any other colour. Observe the patches under a microscope or a magnifying glass.

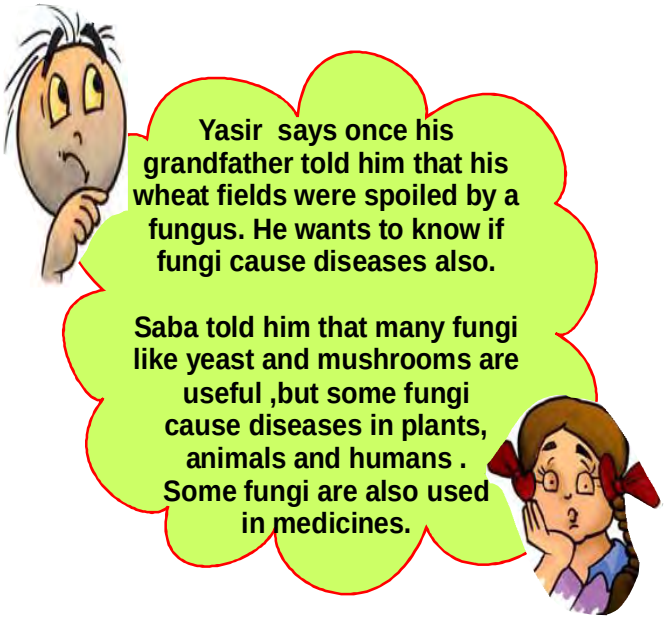
Fig.1.7: Fungi growing on bread

Write down your observation in your notebook. Most probably you will see cotton like thread spread on the piece of bread.

These organisms are called **fungi**. They have a different mode of nutrition. They secrete digestive juice on the dead and decaying matter and convert it into a solution. Then they absorb the nutrients from it. This mode of nutrition in which

organisms take in nutrients in solution form from dead and decaying matter is called **saprotrophic nutrition**. Plants which use saprotrophic mode of nutrition are called **saprotrophs.**

Fungi also grow on pickles, leather, clothes and other articles that are left in hot and humid weather for long time.



During the rainy season they spoil many things. Ask your parents about the menace of fungi in your house.

The fungal spores are generally present in the air. When they land on wet and warm things, they germinate and grow. Now, can you figure out how we can protect our things from getting spoiled?

Some organisms live together and share shelter and nutrients. This is called **symbiotic relationship**. For example, certain fungi live in roots of trees. The tree provides nutrients to the fungus and, in return, receives help from it to take up water and nutrients from the soil. This association is very important for the tree.

In organisms called **lichens**, a chlorophyll-containing partner, which is an alga and a fungus live together. The fungus provides shelter, water and minerals to the alga and in return, the alga provides food which it prepares by photosynthesis.

1.5 HOW NUTRIENTS ARE REPLENISHED IN THE SOIL

Have you seen farmers spreading manure or fertilizers in the field, or gardeners using them in lawns or in pots? Do you know why they are added to the soil?

You learnt that plants absorb mineral nutrients from the soil. So, their amount in the soil keep on declining. Fertilizers and manures contain plant nutrients such as nitrogen, potassium,

phosphorus, etc. These nutrients need to be added from time to time to enrich the soil. We can grow plants and keep them healthy if we fulfil the nutrient requirement of plants.

Usually crops require a lot of nitrogen to make proteins. After the harvest, the soil becomes deficient in nitrogen. You learnt that though nitrogen gas is available in plenty in the air, plants cannot use it in the manner they can use carbon dioxide. They need nitrogen in a soluble form. The bacterium called Rhizobium can take atmospheric nitrogen and convert it into soluble form. But Rhizobium cannot make its own food. So it lives in the roots of grams, peas, moong, beans and other legumes and provides them with nitrogen. Most of the pulses (dals) are obtained from leguminous plants. In return, the plants provide food and shelter to the bacteria. They thus, have a symbiotic relationship. This association is of great significance for the farmers. They do not need to add nitrogen fertilizers to the soil in which leguminous plants are grown.

In this chapter you learnt that most of the plants are autotrophs. Only a few plants adopt other modes of nutrition like parasitic and saprotrophic. They derive nutrition from other organisms. All animals are categorised as heterotrophs since they depend on plants and other animals for food. Can we say that the insectivorous plants are partial **heterotrophs**?

KEYWORDS

Autotrophic	**Insectivorous**	**Photosynthesis**
Chlorophyll	**Nutrient**	**Saprotrophs**
Heterotrophs	**Nutrition**	**Saprotrophic**
Host	**Parasite**	**Stomata**

What you have learnt

- All organisms take food and utilize it to get energy for growth and maintenance of their bodies.
- Green plants synthesise their food themselves by the process of photosynthesis. They are autotrophs.
- Plants use simple chemical substances like carbon dioxide, water and minerals for the synthesis of food.
- Chlorophyll and sunlight are the essential requirements for photosynthesis.
- Complex chemical substances such as carbohydrates are the products of photosynthesis.
- Solar energy is stored in the form of food in the leaves with the help of chlorophyll.
- Oxygen is produced during photosynthesis .
- Oxygen released in photosynthesis is utilized by living organisms for their survival.
- Fungus derive nutrition from dead, decaying matter. They are saprotrophs. Plants like Cuscuta are parasites. They take food from the host plant.
- A few plants and all animals are dependent on others for their nutrition and are called heterotrophs.

EXERCISES

1. Why do organisms need to take food?

2. Distinguish between a parasite and a saprotroph?

3. How would you test the presence of starch in leaves?

4. Give a brief description of the process of synthesis of food in green plants?

5. Show with the help of a sketch that the plants are the ultimate source of food.

6. **Fill in the blanks:**

(a) Green plants are called .....since they synthesis their own food.

(b) The food synthesized by the plants is stored as ..... .

(c) In photosynthesis solar energy is captured by the pigment called ..... .

(d) During photosynthesis, plants take in .....and release..... .

7. **Name the following :**

(I) A parasitic plant with yellow, slender and tubular stem.

(ii) A plant that has both autotrophic and heterotrophic mode of nutrition.

(iii) The pores through which leaves exchange gases.

8. **Tick the correct answer:**

(a) Amarbel is an example of:

(i) Autotroph (ii) Parasite (iii) Saprotroph (iv) Host

(b) The plant which traps and feeds on insects is:

(I) Cuscuta (ii) China rose (iii) Pitcher plant (iv) Rose

9. Match the items in Column I with those in Column II:

Column I	Column II
Chlorophyll	Bacteria
Nitrogen	Heterotrophs
Amarbel	Pitcher plant
Animals	Leaf
Insects	Parasites

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

(i) Carbon dioxide is released during photosynthesis. (T/F)

(ii) Plants which synthesise their food themselves are called saprotrophs. (T/F)

(iii) The product of photosynthesis is not a protein. (T/F)

(iv) Solar energy is converted into chemical energy during photosynthesis. (T/F)

11. Choose the correct option from the following:

Which part of the plant takes in carbon dioxide from the air for photosynthesis?

(i) Root hair (ii) Stomata (iii) Leaf veins (iv) Sepals

12. Choose the correct option from the following:

Plants take carbon dioxide from the atmosphere mainly through their:

(i) Roots (ii) Stem (iii) Flower (iv) Leaves

13. Tick Mark (✓) the Correct Choice :

(i) Which one of the following is an insectivorous plant?

(a) Lichen (b) Venus fly trap (c) Mushrooms (d) Yeast

(ii) Two different organisms living together and both benefitting from each other, are known as

(a) Saprophytic (b) Symbiotic (c) Parasitic (d) Heterotrophs

(iii) Tiny pores on the surface of leaves are

(a) Lamina (b) Stomata (c) Chlorophyll (d) Leaf scale

(iv) Which of the following is the green colour pigment in leaves:

(a) Protoplast (b) Chloroplast (c) Chlorophyll (d) Anthocyanin

Extended Learning - Activities and Projects

1. Project

Take a potted plant with broad leaves. Take two strips of black paper and cut out a small square in their centres. Cover a part of two leaves with these papers and secure them with paper clips **(Fig 1.8)**.Keep the plant in the sunlight for 2-5 days. Observe the difference in the colour of the covered and the uncovered portions on the one leaf. Perform iodine test on this leaf.

Fig.1.8: Experiment to test the occurance of photosynthesis

Did the two parts show any difference in results? Now take second leaf. Remove the strip and expose the covered part to the sunlight for 2-3 days and do the iodine test again. Describe your observations.

2. Visit a green house if there is one near your place. Observe how they raise plants. Find out how they regulate the amount of light, water and carbon dioxide to grow the plants.
3. Try growing a sweet potato just in water. Describe your experiment and observations.

You can read more on the following website:

Www.phschool.com/science/biology_place/biocoach/photosynth/overview.htm

DO YOU KNOW?

Light is so important for plants that their leaves grow in many patterns so as to catch the most sunlight.

2 NUTRITION IN ANIMALS

Nutrition in animals is altogether different from plants as plants can prepare their own food by the process of photosynthesis but animals cannot. Animals get food from plants, either directly by eating plants or indirectly by eating animals that eat plants. Some animals eat both plants and animals. Recall that all organisms including humans require food for growth, repair and functioning of the body. **Animal nutrition includes nutrients requirement, mode of intake of food and its utilization in the body.**

You have studied in class VI that food consists of many components. Try to recall and list them below:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

The components such as carbohydrates are complex substances. These complex substances cannot be utilized as such. So they are broken down into simpler substances. The breakdown of complex components of food into simpler substances is called **digestion**.

2.1 DIFFERENT WAYS OF TAKING FOOD

The mode of taking food into the body varies in different organisms. Bees and humming-birds suck the nectar of plants, infants of human and many other animals feed on mother's milk. Snakes like the python swallow the animals they prey upon. Some aquatic organisms filter tiny food particles floating nearby and feed upon them.

Activity 2.1

What is the type of food and mode of feeding of the following animals? Write down your observations in the given table. You may find the list of modes of feeding given below in the table helpful.

Table 2.1: Various modes of feeding

Name of animal	Kind of food	Mode of feeding
Snail		
Ant		
Eagle		
Humming-bird		
Lice		
Mosquito		
Butterfly		
House fly		

(Scraping, Chewing, Siphoning, Capturing and Swallowing, Sponging, Sucking etc.)

Amazing fact

Starfish feeds on animals covered by hard shells of calcium carbonate. After opening the shell, the starfish pops out its stomach through its mouth to eat the soft animal inside the shell. The stomach then goes back into the body and the food is slowly digested.

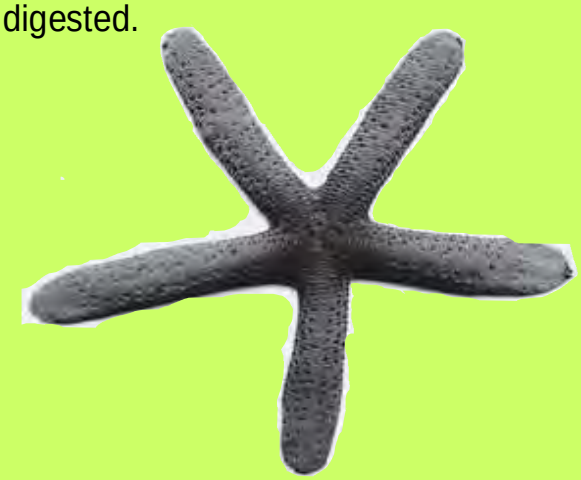


Fig.2.1: Starfish

2.2 DIGESTION IN HUMANS

We take in food through the mouth, digest and utilize it. The unused parts of the food are defecated. Have you ever wondered what happens to the food inside the body? The food passes through a continuous canal called alimentary canal **(Fig. 2.2)** which begins at the buccal cavity and ends at the anus.

The canal can be divided into various compartments: (1) the **mouth** or the **buccal cavity** (2) **food pipe** or **oesophagus** (3) **stomach** (4) **small intestine** (5) **large intestine** ending in the **rectum** and (6) the **anus**. Is it not a very long path ? These parts together form the **alimentary canal (digestive tract)**. The food components gradually get digested as food travels through the compartments of the alimentary canal.

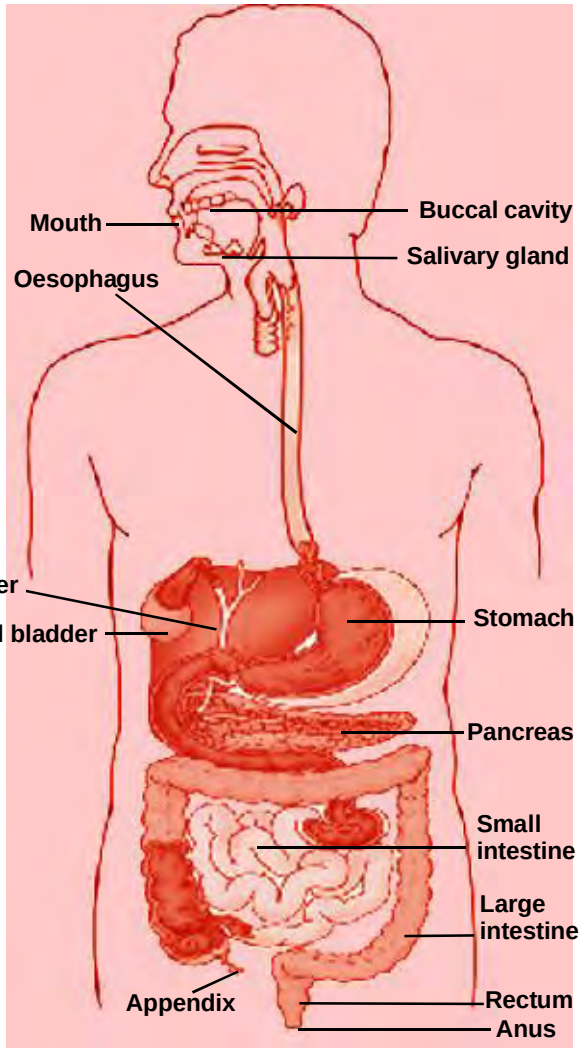


Fig.2.2: Human digestive system

The inner walls of the stomach, the small

Milk teeth and permanent teeth

The milk set contains 20 teeth whereas permanent set consists of 32 teeth. Do you remember about falling of your teeth some years ago? The first set of teeth grows during infancy and they fall off at the age between six to eight years. These are termed as **milk teeth.** The second set that replaces them are the **permanent teeth.** The permanent teeth may last throughout life or fall off during old age or due to some dental disease. The teeth that appear in two sets are described as diphydont.

intestine and the various glands, associated with canal such as **salivary glands**, the **liver** and the **pancreas** secrete digestive juices. The digestive juices convert complex substances of food into simpler ones. The digestive tract and the associated glands together constitute the **digestive system**.

Now, let us know what happens to the food in different parts of the digestive tract.

Yasir is fascinated by the highly coiled small intestine seen in Fig 2.2 . He wants to known its length. Would you like to make a wild guess? We have given its approximate length on page 17. Just imagine how such a long structure is accommodated in a small space within our body !

The Mouth and Buccal Cavity

Food is taken into body through the mouth. The process of taking of food into the body is called **ingestion.** We chew the food with our teeth and break it down mechanically into small pieces. Each tooth is rooted in the separate socket in the gums**.** Such embedded teeth are called thecodont **(Fig. 2.3)**. Our teeth vary in appearance and perform different function. Accordingly they have different names **(Fig. 2.3)**.

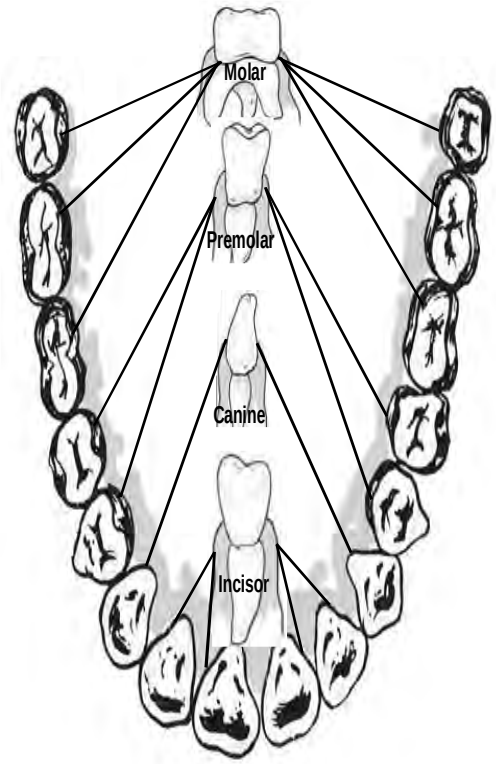


Fig.2.3: Arrangement of teeth and different type of teeth

Activity 2.2

Wash your hands. Look into the mirror and count your teeth . Use your finger to feel the teeth. How many kinds of teeth could you find? Take a piece of an apple or bread and eat it . Which teeth do you use for biting and cutting, and which ones for piercing and tearing? Also find out the ones that are used for chewing and grinding ?

Record your observations in **Table 2.2**

Table2.2

Type of teeth	Number of teeth		Total
	Lower jaw	Upper jaw	
Cutting and biting teeth			
Piercing and tearing teeth			
Chewing and grinding teeth			

Our mouth has the salivary glands which secrete saliva. Do you know the action of saliva on food? Let us find out.

Activity 2.3

Take two test tubes. Label them 'A' and 'B'. In test tube 'A' put one teaspoonful of boiled rice; in test tube 'B' keep one teaspoonful of boiled rice after chewing it for 3-5 minutes. Add 3-4ml of water in both the test tubes **(Fig. 2.4)**. Now pour 2-3 drops of iodine solution in each test tube and observe. Why is there a change in colour in the test tubes? Discuss the result with your classmates and your teacher. The **saliva** breaks down the **starch** into sugars.

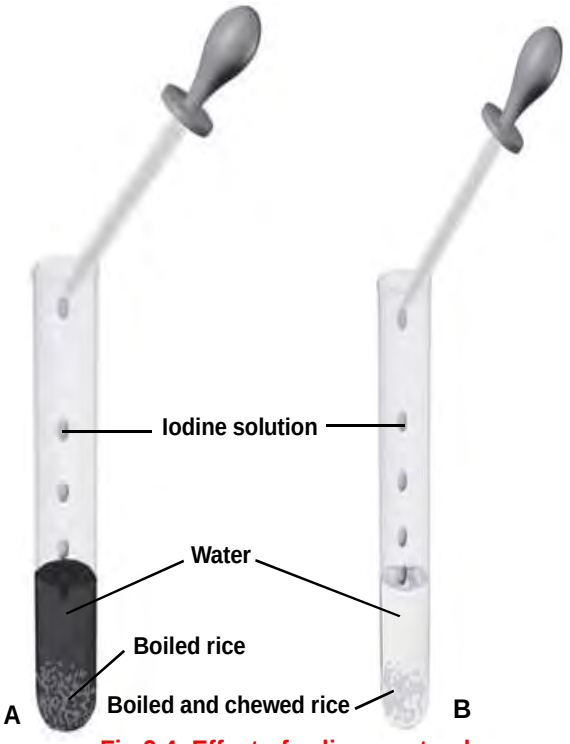


Fig.2.4: Effect of saliva on starch

The tongue is a fleshy muscular organ attached at the back to the floor of buccal cavity. It is free in the front and can be moved in all directions. Do you know the function of the tongue? We use our tongue for talking.

Fig.2.5: Regions of the tongue for different tastes

Sweets and tooth decay

Normally bacteria are present in our mouth but they are not harmful to us. However, if we do not clean our teeth and mouth after eating, many harmful bacteria also begin to live and grow in it. These bacteria break down the sugars present from the leftover food and release acids (see Chapter 5 to know what an acid is). The acids gradually damage the teeth **(Fig. 2.6)**.This is called **tooth decay**. If it is not treated in time, it causes severe toothache and in extreme cases results in tooth loss. Chocolates, sweets, soft drinks and other sugar products are the major culprits of tooth decay.

Therefore, one should clean the teeth with a brush or datun and dental floss (a special strong thread which is moved between two teeth to take out trapped food particles) at least twice a day and rinse the mouth after every meal. Also, one should not put dirty fingers or any unwashed object in the mouth. We should get our teeth checked by a dentist every six months.

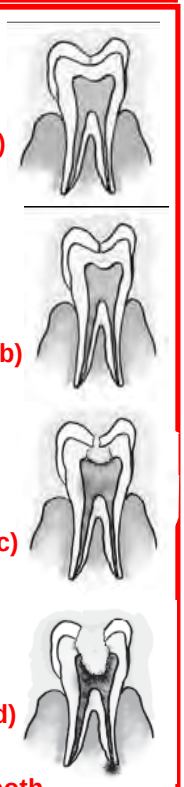


Fig.2.6: Gradual decay of tooth

Sometimes when you eat in a hurry, talk or laugh while eating you may cough, get hiccups or a choking sensation. This happens when food particles enter the windpipe. The windpipe carries air from the nostrils to the lungs. It runs adjacent to the food pipe. But inside the throat, air and food share a common passage. Then how is food prevented from entering the windpipe? During the act of swallowing a flap like valve closes the passage of the windpipe and guides the food into the food pipe. If by chance food particles enter the windpipe, we feel chocked, get hiccups or cough.

Besides, it mixes saliva with the food during chewing and helps in swallowing food. We also taste food with our tongue. It has taste buds that detect different tastes of food. We can find out the position of different taste buds by the following activity.

Activity 2.4

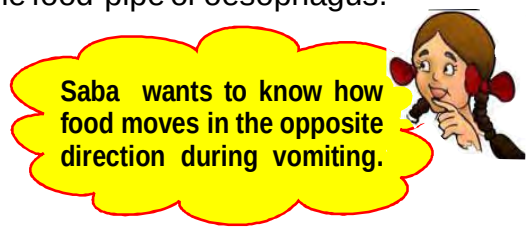
1. Prepare a separate sample each of (i) sugar solution (ii) common salt solution (iii) lemon juice and (iv) juice of crushed neem leaf or bitter gourd.
2. Blindfold one of your classmates and ask her/him to take out the tongue and keep it in straight and flat position.

3. Use a clean toothpick to put the above samples one by one on different areas of the tongue as shown in **Fig. 2.5.** Use a new toothpick for each sample.
4. Ask the classmate which areas of the tongue could detect the sweet, salty, sour and bitter substances.
5. Now write down your observations and label **Fig 2.6.**

   Repeat this activity with other classmates.

The Food Pipe / Oesophagus

The swallowed food passes into the food-pipe or oesophagus.



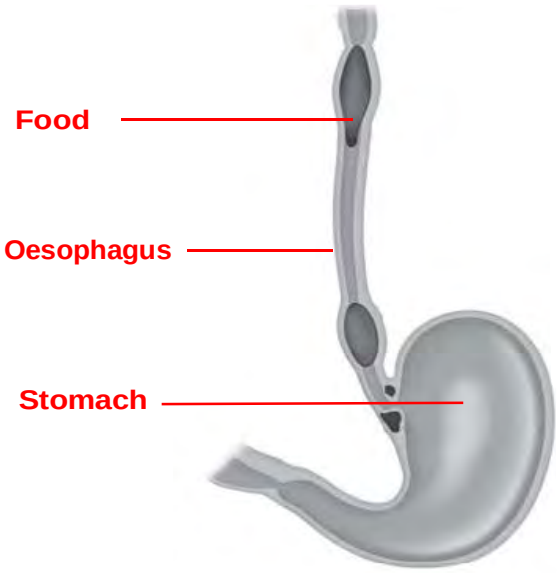


Fig.2.7: Movement of the food in the oesophagus of the alimentary canal

Look at **Fig.2.2.** The food-pipe runs along the neck and the chest. Food is pushed by movement of the walls of the food-pipe. Actually this movement takes place throughout the alimentary canal and pushes the food downwards **(Fig 2.7)**. At times the food is not accepted by our stomach and is vomited out. Recall the instances when you vomited after eating and think of the reason for it. Discuss with your parents and teacher. The passage of food back into buccal is called **regurgitation**.

The Stomach

The stomach is a thick-walled bag. Its shape is like a flattened U and it is the widest part of the alimentary canal. It receives the food-pipe at one end and opens into the small intestine at the other.

The inner lining of the stomach secretes mucous, hydrochloric acid (HCl) and digestive juices. The mucous protects the lining of the stomach. The acid kills many bacteria that enter along with the food and makes the medium in the stomach acidic and helps the digestive juices to act. The digestive juices break down the **proteins** into simpler substances.

The Small Intestine

The small intestine is highly coiled and about 7.5 metres long. It receives

secretions from liver and pancreas. Besides, its wall also secretes juices.

The liver is reddish brown gland situated in the upper part of the abdomen on the right side. It is the largest gland in the body. It secretes **bile juice** that is stored in a sac called **gall bladder (Fig. 2.2).** The bile juice plays an important role in digestion of **fats.**

The pancreas is a large cream coloured gland located just below the stomach **(Fig 2.2).** Pancreatic juice acts on carbohydrates which get broken down into simple sugars as glucose, fats into fatty acids and glycerol, and proteins into amino acids.

Absorption in the small intestine

The digested food can now pass into the blood vessels in the wall of intestine. This process is called **absorption**. The inner walls of the small intestine have thousands of finger-like outgrowths called **villi** (singular villus). Can you guess what the role of villi could be in intestine? The villi increase the surface area for absorption of digested

The working of the stomach was discovered by a strange accident . In 1882, a man named Alexis St. Martin was badly hit by a shot gun. The bullet had seriously damaged the chest wall and made a hole in his stomach. He was brought to an American army doctor William Beaumont. The doctor saved the patient but he could not close the wound properly and left it bandaged **(Fig.2.8)** Beaumont took it as a great opportunity to see the inside of stomach through the hole. He made some wonderful observations.

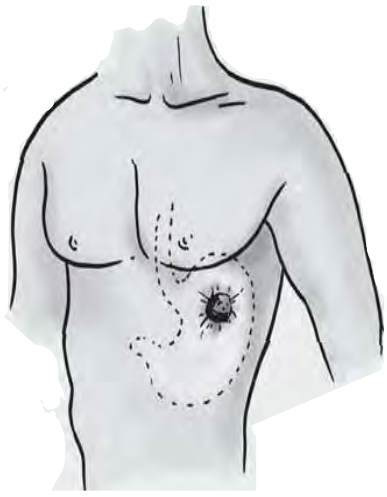


Fig.2.8: Alexis St. Martin's shotgun wound

Beaumont found that the stomach was churning food. Its wall secreted a fluid which could digest the food. He also observed that the end of the stomach opens into the intestine only after the digestion of the food inside the stomach is completed.

food. Each villus has a network of thin and small blood vessels close to its surface. The surface of the villi absorbs the digestive food materials. The absorbed substances are transported via the blood vessels to different organs of the body where they are used to build complex substances such as the proteins required by the body. This is called **assimilation**. In the cells, glucose breaks down with the help of oxygen into carbon dioxide and water, and energy is released. The food that remains undigested and unabsorbed enters into the large intestine.

Large Intestine

The large intestine is wider and shorter than small intestine. It is about 1.5 metre in length. Its function is to absorb water and some salts from the undigested food material. The remaining waste passes into the rectum and remains there as semi-solid faeces. The faecal matter is removed through the anus from time-to-time. This is called **egestion**.

Summary of various steps in the process of digestion.

INGESTION

Taking in of food directly or indirectly from plants (through mouth)

↓

DIGESTION

The breakdown of ingested food (in mouth cavity, stomach and small intestine)

↓

ABSORPTION

Digested food is absorbed through membranes into various organs (in small intestine; large intestine absorbs only water)

↓

ASSIMILATION

Absorbed food is incorporated into cell components

↓

EGESTION for defecation

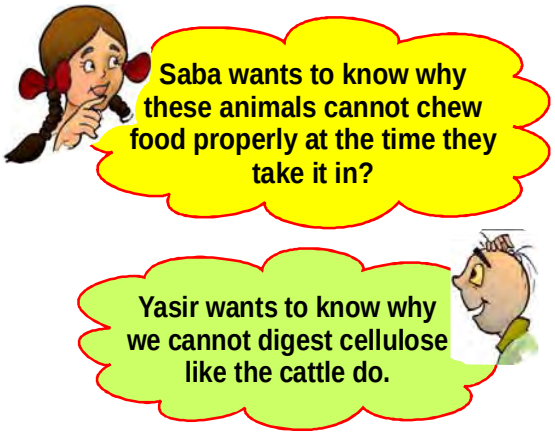
Undigested food is excreted out. (through anus)

2.3 DIGESTION IN GRASS-EATING ANIMALS

Have you observed cows, buffaloes and other grass-eating animals chewing continuously even when they are not eating? Actually, they quickly swallow the grass and store it in a part of the stomach called **rumen (Fig. 2.9)**. Here the food gets partially digested and is called **cud**. But later the cud returns to the mouth in small lumps and the animal chew it. This process is called **rumination** and these animals are called **ruminants**.

Diarrhoea

Sometime you may have experienced the need to pass watery stool frequently. This condition is known as **diarrhoea**. It may be caused by an infection, food poisoning or indigestion. It is very common in India, particularly among children. Under severe conditions it can be fatal. This is because of the excessive loss of water and salts from the body. Diarrhoea should not be neglected. Even before a doctor is consulted the patient should be given plenty of boiled and cooled water with a pinch of salt and sugar dissolved in it. This is called **Oral Rehydration Solution (ORS)**.



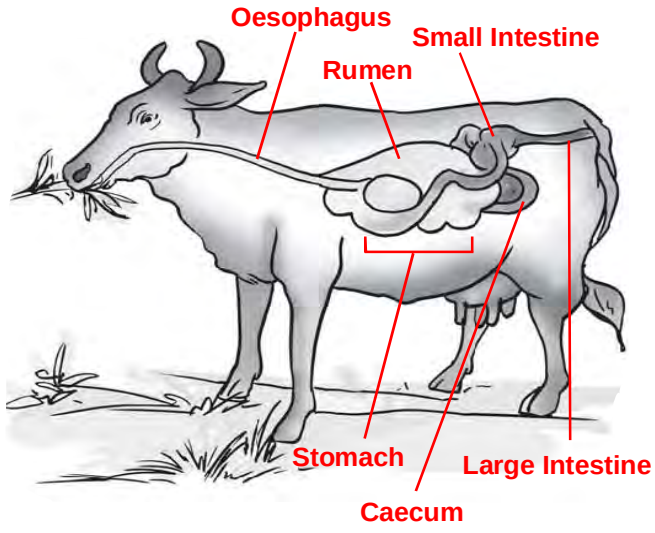


Fig.2.9: Digestive system of ruminant

The grass is rich in **cellulose**, a type of carbohydrate. Many animals, including humans, cannot digest cellulose.

Ruminants have a large sac-like structure called Caecum between the small intestine and large intestine **(Fig. 2.9)**. The cellulose of the food is digested here by the action of certain bacteria which are not present in humans.

So far you have learnt about animals which possess the digestive system. But there are many small organisms which do not have a mouth and a digestive system. Then, how do they acquire and digest food? In the section below you will learn another interesting way of food intake.

2.4 FEEDING AND DIGESTION IN AMOEBA (Unicellular Organism)

Amoeba is a microscopic single-celled organism found in pond water.

Amoeba has a cell membrane, a rounded, dense nucleus and many small bubble-like vacuoles **(Fig. 2.10)** in its cytoplasm. Amoeba constantly changes its shape and position. It pushes out one, or more finger-like projections, called **pseudo podia** or false foot for movement and capture of food.

Amoeba feeds on some microscopic organisms. When it senses food, it pushes out pseudo podia around the food particle and engulfs it. The food becomes trapped in a food vacuole **(Fig. 2.10).**

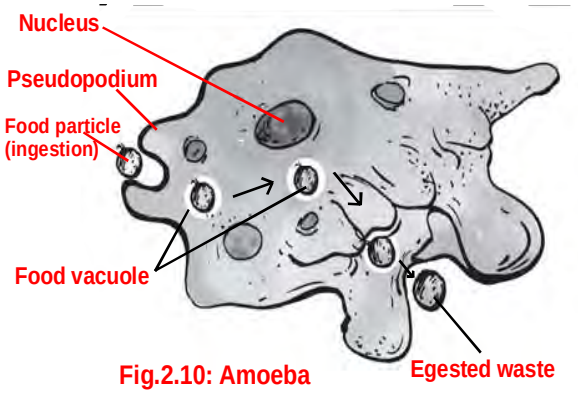


Fig.2.10: Amoeba

Digestive juices are secreted into the food vacuole. They act on the food and break it down into simpler substances. Gradually the digested food is absorbed. The absorbed substances are used for growth, maintenance and multiplication. The undigested residue of the food is expelled outside by the vacuole.

The basic process of digestion of food and release of energy is the same in all animals. In the later chapter you will learn about the transport of food absorbed by the intestine to the various parts of the body.

KEYWORDS

Absorption	**Fatty acid**	**Oesophagus**
Amino acid	**Food vacuole**	**Pancreas**
Amoeba	**Gall bladder**	**Premolar**
Assimilation	**Glycerol**	**Pseudopodia**
Bile	**Incisor**	**Rumen**
Buccal Cavity	**Ingestion**	**Ruminant**
Canine	**Liver**	**Rumination**
Cellulose	**Milk teeth**	**Salivary glands**
Digestion	**Molar**	**Villi**
Egestion	**Permanent teeth**	**Saliva**

What you have learnt

- Animal nutrition includes nutrients requirement, mode of intake of food and its utilization in the body.
- The human digestive system consists of the alimentary canal and secretary glands. Former consists of (i) buccal cavity, (ii) oesophagus, (iii) stomach, (iv) small intestine, (v) large intestine ending in the rectum and (vi) the anus. The main digestive glands which secretes digestive juices are (i) the salivary gland, (ii) the liver and (iii) pancreas. The stomach wall and the small intestine also secrete digestive juices.
- The modes of feeding vary in different organisms.
- Nutrition is a complex process involving: (i) ingestion, (ii) digestion, (iii) absorption, (iv) assimilation and (v) egestion.
- Digestion of carbohydrates, like starch begins in the buccal cavity. The digestion of proteins starts in the stomach. The bile secreted from the liver, the pancreatic juice from the pancreas and the digestive juice from the intestinal wall complete the digestion of all components of food in the small intestine. The digested food is absorbed in the blood vessels from the small intestine.
- The absorbed substances are transported to different parts of the body. Water and some salts are absorbed from the undigested food in the large intestine.
- The undigested and unabsorbed residues are expelled out of the body as faeces through the anus.
- The grazing animals like cows, buffaloes and deer are known as ruminants. They quickly ingest, swallow their leafy food and store it in the rumen. Later, the food returns to the mouth and the animals chew it peacefully.
- Amoeba ingests its food with the help of its false feet or pseudopodia. The food is digested in the food vacuole.

EXERCISES

1. Fill in the blanks:

(a) The main steps of nutrition in humans are _____, _____, _____, _____ and _____.

(b) The largest gland in the human body is _____.

(c) The stomach releases hydrochloric acid and _____ juice which act on food.

(d) The inner wall of the small intestine has many finger-like outgrowths called _____.

(e) Amoeba digests its food in the _____.

2. Mark "T" if the statement is true and "F" if it is false:

(a) Digestion of starch starts in the stomach. (T/F)

(b) The tongue helps in mixing food with saliva. (T/F)

(c) The gall bladder temporarily stores bile. (T/F)

(d). The ruminants bring back swallowed grass into their mouth and chew it for sometime. (T/F)

3. Tick mark (✓) the correct answer in each of the following:

(a) Fats are completely digested in the

(i) Stomach (ii) Mouth (iii) Small intestine (iv) Large intestine

(b) Water from the undigested food is absorbed mainly in the

(i) Stomach (ii) Food pipe (iii) Small intestine (iv) Large intestine

(c) The process of taking food into the body is called

(i) Digestion (ii) Absorption (iii) Ingestion (iv) Assimilation

(d) Which of the following is the largest gland in human body

(i) Pancreas (ii) Liver (iii) Salivary gland (iv) Thyroid

(e) Finger like projections called villi are present in

(i) Small intestine (ii) Stomach (iii) Rectum (iv) Large intestine

(f) Which of the following is a ruminant

(i) Amoeba (ii) Man (iii) Cow (iv) Earthworm

4. Match the items of Column I with those of Column II:

Column I	Column II
Food Components	Product(s) of digestion
Carbohydrates	Fatty acids and glycerol
Proteins	Sugar
Fats	Amino Acids

5. What are villi ? What is their location and function?

6. Where is the bile produced? Which component of the food does it help to digest?

7. Name the type of carbohydrates that can be digested by ruminants but not by humans. Give the reason also.

8. Why do we get instant energy from glucose?

9. Which part of the digestive canal is involved in:

(i). Absorption of food _____

(ii). Chewing of food _____

(iii). Killing of bacteria _____

(iv). Complete digestion of food _____

(v). Formation of faeces _____

10. Write one similarity and one difference between the nutrition in amoeba and human

beings.

11. Match the items of Column I with suitable items of Column II:

Column I	Column II
(a) Salivary gland	i. Bile juice secretion
(b) Stomach	ii. Storage of undigested food
(c) Liver	iii. Saliva secretion
(d) Rectum	iv. Acid release
(e) Small intestine	v. Digestion is completed
(f) Large intestine	vi. Absorption of water

12. Label Fig. 2.11 of the digestive system.

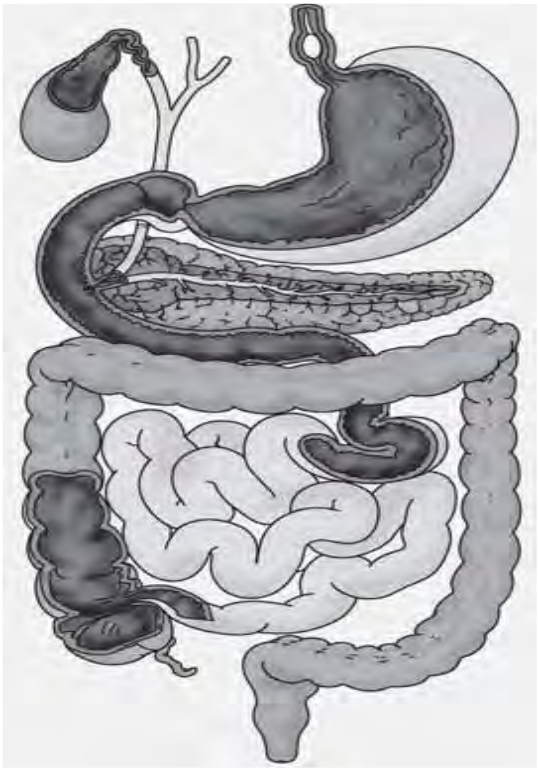


Fig.2.11: A part of human digestive system

13. Can we survive only on raw, leafy vegetables/grass? Discuss?

Extended Learning - Activities and Project

1. Visit a doctor and find out:

i. Under what conditions does a patient need to be on a drip of glucose?

ii. For how long does a patient need to be given glucose?

iii. How does glucose help the patient to recover ?

Write the answers in your notebook.

2. Find out what vitamins are and get the following information.

i. Why are vitamins necessary in our diet?

ii. Which fruit or vegetables should be eaten regularly to get vitamins?

Write a one-page note on the information collected by you.

You may take help of a doctor, a dietician, your teacher or any other person, or from any other source.

S.No	Age at which first tooth fell	Age at which last tooth fell	No. of teeth lost	No. of teeth replaced
1.				
2.				
3.				
4.				
5.				

Find out from at least twenty children, the average age at which children lose their milk teeth. You may take help of your friends.

You can read more on the following website:

www.health,howstuffworks.com/admn-200112.htm

DO YOU KNOW?

Fats in goat's milk are much simpler than those in cow's milk. Therefore, the goat's milk is much easier to digest than the cow's milk.

3 FIBRE TO FABRIC

Besides milk, meat, eggs some fibers are also obtained from animals. Wool is obtained from the **fleece** (hair) of sheep or yak. Silk fibres come from cocoons of the silk moth. Do you know which part of the sheep's body yields fibres? Are you aware how these fibres are converted into the woollen yarn that we buy from the market to knit sweaters? Do you have any idea how silk fibres are made into silk, which is woven into saris?

In this chapter we shall try to find answers to these questions.

Animal Fibres - Wool and Silk

3.1 WOOL

Wool comes from sheep, goat, yak and some other animals. These wool-yielding animals bear hair on their body. Do you know why these animals have a thick coat of hair? Hair trap a lot of air. Air is a poor conductor of heat, as you would learn in Chapter 4. So, hair keeps these animals warm. Wool is derived from these hairy fibres.

Activity 3.1

Feel the hair on your body and arms and those on your head. Do you find any difference? Which one seems coarse and which one is soft?

Like us, the hairy skin of the sheep has two types of fibres that form its fleece: (i) the coarse beard hair, and (ii) the fine soft under-hair close to the skin. The fine hair provide the fibres for making wool. Some breeds of sheep possess only fine under - hair. Their parents are specially chosen to give birth to sheep which have only soft under-hair. This process of selecting parents for obtaining special characters in their offspring, such as soft under - hair in sheep, is termed '**selective breeding**'.

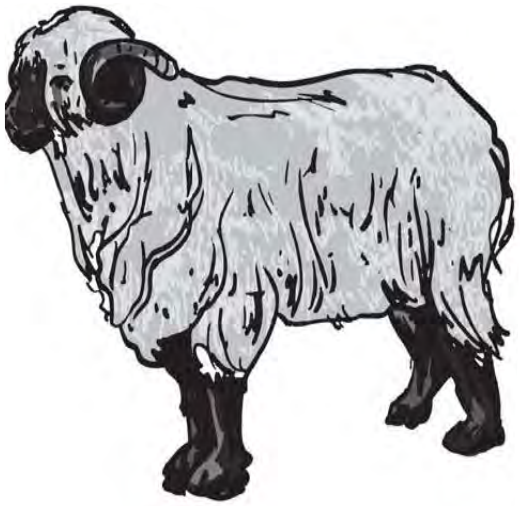


Fig.3.1: Sheep with thick growth of hair

Animals that yield wool

Several breeds of sheep are found in different parts of our country **(Table 3.1)**. However, the fleece of sheep is not the only source of wool, though wool commonly available in the market is sheep wool **(Fig.3.1)**. Yak **(Fig.3.2)** wool is common in Tibet and Ladakh. Angora wool is obtained from Angora goats, **(Fig.3.3)** found in hilly regions such as Jammu and Kashmir.

Famous Goats of J&K State.

1. Pashmina Goat - Found in Ladakh
2. Swiss-Alpine and Jakhrana Goats - Found in Kashmir
3. Bedal Goat - Found in Jammu.

Wool is also obtained from goat hair **(Fig.3.4)**. The under - hair in Kashmiri goat is soft. It is woven into fine shawls called Pashmina shawls.

The fur (hair) on the body of camels is also used as wool **(Fig.3.5)**. Llama and Alpaca, found in South America, also yield wool **(Fig. 3.6)** and **(Fig. 3.7).**

Activity 3.2

Collect pictures of animals whose hair is used as wool. Stick them in your scrap book. If you are unable to get pictures, try and draw them from the ones given in this book. Find out words for sheep, goat, camel, and yak in your local language and also in other languages of

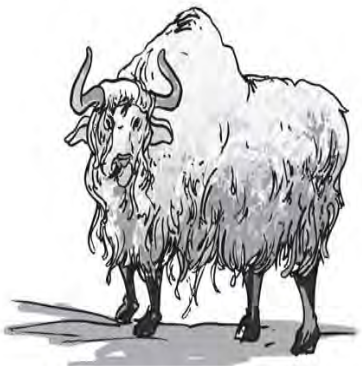


Fig .3.2: Yak

Fig.3.3: Angora goat

Fig.3.4: Goat

Fig.3.6: Llama

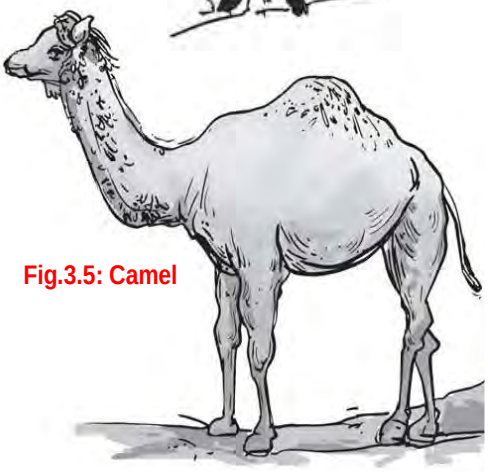


Fig.3.5: Camel

Fig.3.7: Alpaca

our country.

Activity 3.3

Procure outline maps of India and the world. Find out and mark the places on the map where you find animals that provide wool.

Use different colours to denote the location for different wool yielding animals.

From fibres to wool

For obtaining wool, sheep are reared. Their hair is cut and processed into wool. Let us learn about this process.

Rearing and Breeding of sheep: If you travel to the hills in Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Arunachal Pradesh and Sikkim, or the plains of Haryana, Punjab, Rajasthan and Gujarat, you can see shepherds taking their herds of sheep for grazing. Sheep are herbivores and prefer grass and leaves. Apart from grazing sheep, rearers also feed them on a mixture of pulses, corn, jowar, oil cakes (material left after taking out oil from seeds) and minerals. In winter, sheep are kept indoors and fed on leaves, grain and dry fodder.

Breeds of Sheep found in J&K State?

1. Gaddi - Found in Kishtwar, Bhadarwah.
2. Bakarwal - All over State
3. Poonchi - Found in Poonch , Rajouri
4. Karnah - Found in Karnah (Tehsil in North Kashmir)
5. Gurez - Found in Gurez area of Northern Kashmir
6. Changthangi - Found in Changthang region of Ladakh.

Certain breeds of sheep have thick coat of hair on their body which yields good quality wool in large quantities. As mentioned earlier, these sheep are "selectively bred" with one parent being a sheep of good breed.

Once the reared sheep have developed a thick growth of hair, hair is shaved off for getting wool.

Table 3.1: Some Indian breeds of sheep

S.No	Name of breed	Quality of wool	State where found
1.	Lohi	Good quality wool	Rajasthan, Punjab
2.	Rampur bushair	Brown fleece	Uttar Pradesh, Himachal Pradesh
3.	Nali	Carpet Wool	Rajasthan, Haryana, Punjab
4.	Bakarwal	For woollen shawls	Jammu and Kashmir
5.	Marwari	Coarse wool	Gujarat
6.	Patanwadi	For hosiery	Gujarat

Processing fibres into wool

The wool which is used for knitting sweaters or for weaving shawls is the finished product of a long process, which involves the following steps:

Step I: The fleece of the sheep along with a thin layer of skin is removed from its body **[Fig.3.8(a)].** This process is called **shearing**. Machines similar to those used by barbers are used to shave off hair. Usually, hair are removed during the hot weather. This enables sheep to survive without their protective coat of hair. The hair provide woollen fibres. Woollen fibres are then processed to obtain woollen yarn. Shearing does not hurt the sheep just as it does not hurt when you get a hair cut or your father shaves his beard. Do you know why? The uppermost layer of the skin is dead. Also, the hair of sheep grow again just, as your hair does.

Step II : The sheared skin with hair is thoroughly washed in tanks to remove grease, dust and dirt. This is called **scouring**. Nowadays scouring is done by machines **[Fig 3.8 (b) and (c)]**

Step III : After scouring, **sorting** is done. The hairy skin is sent to a factory where hair of different textures are separated or sorted.

Step IV : The small fluffy fibers, called burrs, are picked out from the hair. These are the same burrs which sometimes

Fig.3.8 (a): Shearing

Fig.3.8 (b): Scouring in tanks

Fig.3.8 (c) : Scouring by machines

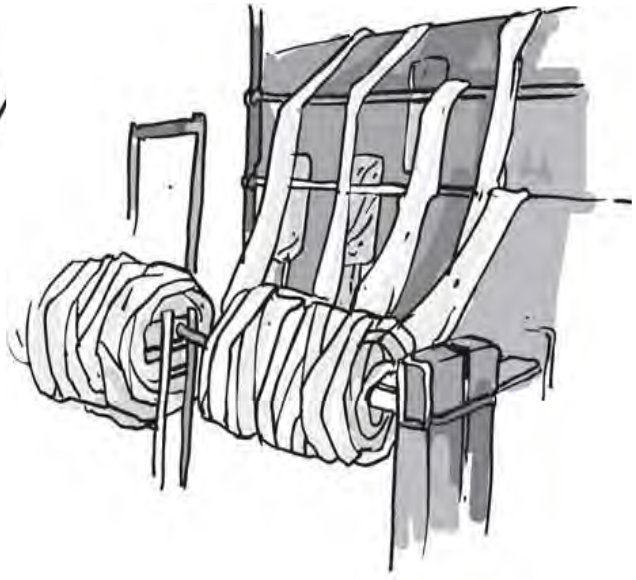


Fig 3.8 (d): Rolling into yarn

appear on your sweaters. The fibres are scoured again and dried. This is the wool ready to be drawn into fibres.

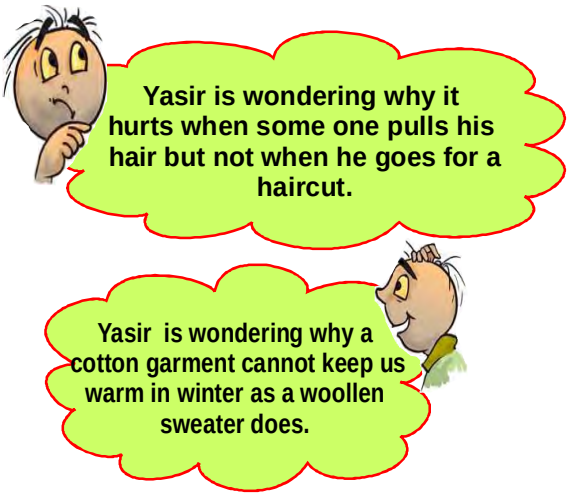
Step V : The fibres can be dyed in various colours, as the natural fleece of sheep and goats is black, brown or white.

Step VI : The fibres are straightened, combed and rolled into yarn **[Fig. 3.8 (d)]**. The longer fibres are made into wool for sweaters and the shorter fibres are spun and woven into woollen cloth.

About 40 tonnes of Pashmina are derived from around 1.6 lakh Pashmina goats found in Ladakh region of J&K State. Pashmina is derived from Changthangi and Chegi goat breeds while Changthangi is found in Ladakh and Chegu breed is found in Himachal Pradesh and Uttarakhand.

Occupational hazard

Wool industry (Grey Revolution) is an important means of livelihood for many people in our country. But sorter's job is risky as sometimes they get infected by a bacterium, anthrax, which causes a fatal blood disease called sorter's disease. Such risks faced by workers in any industry are called occupational hazards.



Activity 3.4

Debate amongst your classmates whether it is fair on the part of humans to rear sheep and then chop off their hair for getting wool.

3.2 SILK

Silk fibres are also animal fibres. Silkworms spin the 'silk fibres'. The rearing of silkworms for obtaining silk is called **sericulture**. Find out from your mother/aunt/grandmother the kind of silk clothes they have. List the kind of silk.

Before we discuss the process of obtaining silk, it is necessary to know the interesting life history of the silk moth.

Life history of silk moth

The female silk moth lays eggs, from which hatch **larvae** which are called **caterpillars** or **silkworms**. They grow in size and when the caterpillar is ready to enter the next stage of its life history called **pupa**, it first weaves a net to hold itself. Then it swings its head from side to side in the form of the figure of eight (8). During these movements of the head, the caterpillar secretes fibre made of **protein** which hardens on exposure to air and becomes silk fibre. Soon the caterpillar completely covers itself by silk fibres and turns into pupa. This covering is known as **cocoon**. The further development of the pupa into moth continues inside the cocoon **(Fig. 3.9)**. Silk fibres are used for weaving silk cloth. Can you imagine that the soft silk yarn is as strong as a comparable thread of steel!

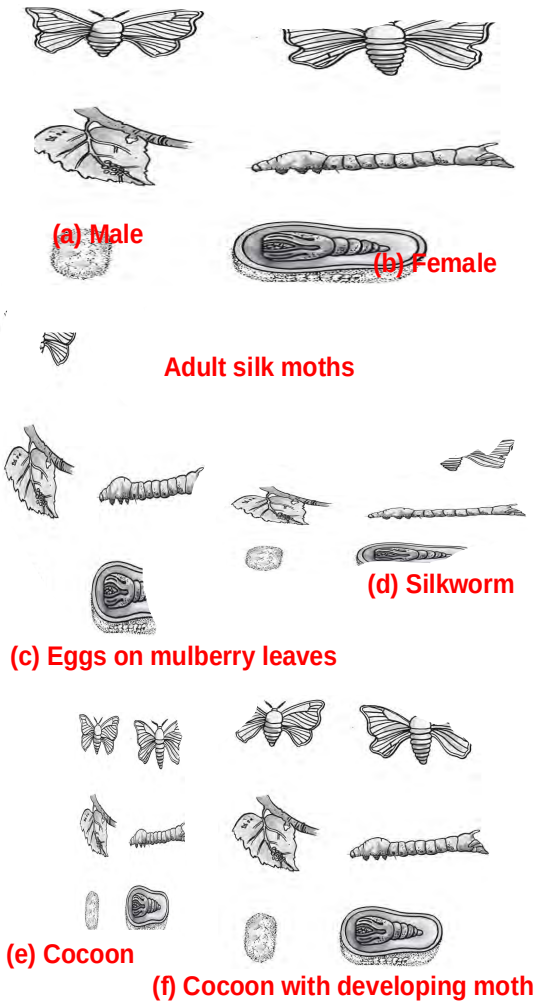


Fig.3.9 (a to f): Life history of silk moth

The silk yarn (thread) is obtained from the cocoon of the silk moth. There is a variety of silk moths which look very different from one another and the silk yarn

In India, women are significantly involved in various kinds of industries related to silk production. These are rearing of silkworms, reeling of silk from cocoons and processing of raw silk into fabrics. By their enterprise, they contribute to the nation's economy. China leads the world in silk production. India also ranks among the leading silk producing countries.

they yield is different in texture (coarse, smooth, shiny, etc.). Thus, tassar silk, mooga silk, kosa silk, etc., are obtained from cocoons spun by different types of moths. The most common silk moth is the **mulberry silk moth**. The silk fibre from the cocoon of this moth is soft, lustrous and elastic and can be dyed in beautiful colours.

Sericulture or culture of silkworms is a very old occupation in India. India produces plenty of silk on a commercial scale & is second largest country in world in producing Natural silk. At present, India produces 16 percent silk of world. Karnataka is the leading producer of silk followed by West Bengal, Bihar, etc.

Activity 3.5

Collect pieces of silk cloth of various types and paste them in your scrap book. You can find them in a tailor's shop among the heap of waste cut pieces.

Take help of your mother, aunt or teacher and identify the types of silk such as mulberry silk, tassar silk, eri silk, mooga silk, etc, Compare the texture of these silks with that of the artificial silk pieces, which contain synthetic fibres. Try and collect pictures of different moths whose caterpillars provide the various types of silk.

Activity 3.6

Take an artificial (synthetic) silk thread and a pure silk thread. Burn these carefully. Did you notice any difference in the smell while burning? Now, burn a woollen fibre carefully. Did it smell like burning of artificial silk or that of pure silk? Can you explain why?

To remember when the cocoon stage is reached in the life history of the silk moth, try the following activity.

Activity 3.7

Photocopy **Fig. 3.9**. Cut out pictures of the stages of the life history of the silk moth, and paste them on pieces of cardboard or chart paper. Jumble them. Now try and arrange the stages in the correct sequence in a cyclic form. Whosoever does it fastest wins.

You may also describe the life history in your own words. Write it down in

your scrap book.

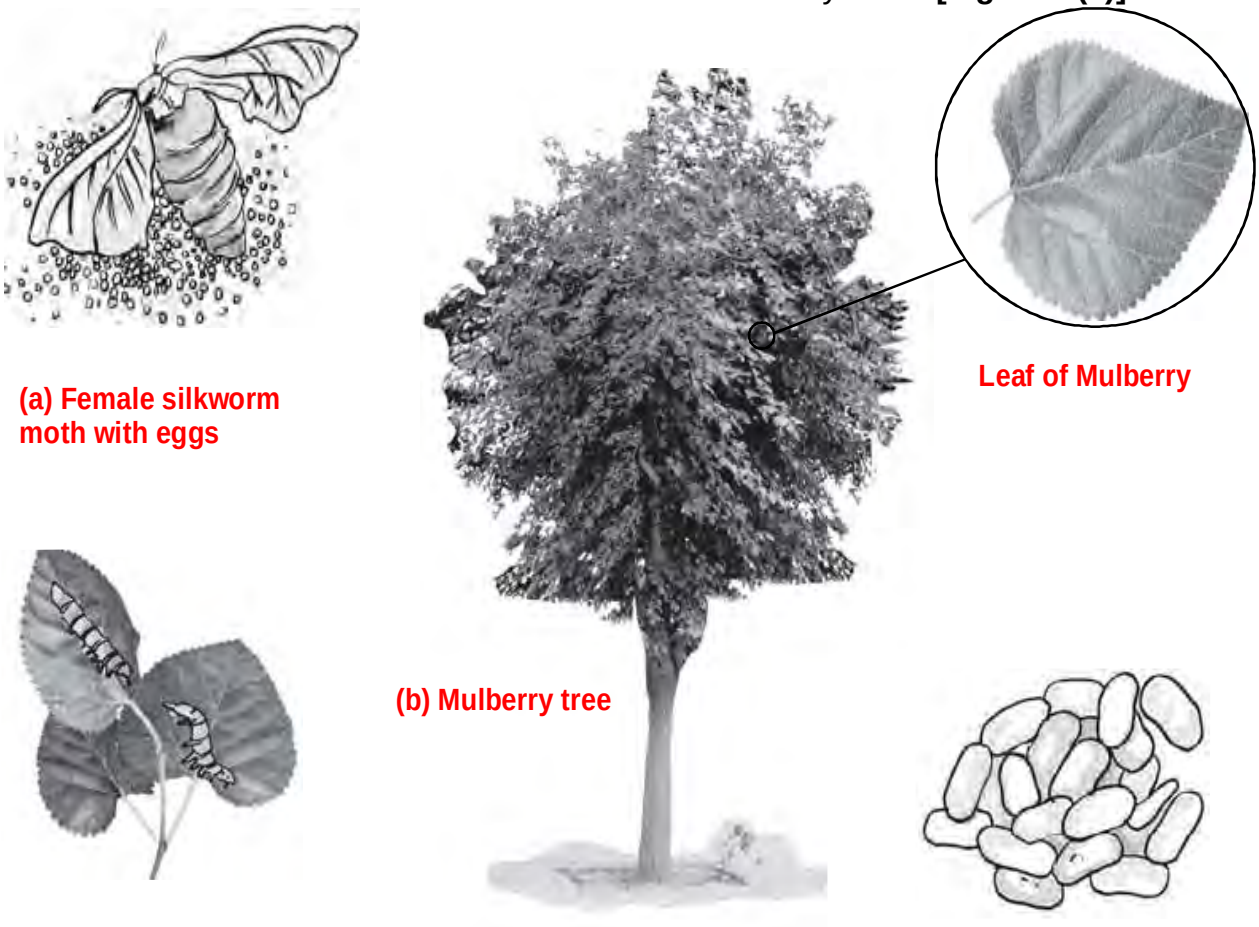
From Cocoon to Silk

For obtaining silk, silk moths are reared and their cocoons are collected to get silk threads.

Rearing Silkworms

A female silk moth lays hundreds of eggs at a time **[Fig. 3.10 (a)]**. The eggs are stored carefully on strips of cloth or paper and sold to silkworm farmers. The farmers keep eggs under hygienic conditions and under suitable conditions of temperature and humidity.

The eggs are warmed to a suitable temperature for the larvae to hatch from eggs. This is done when Mulberry trees **[Fig. 3.10 (b)]** bear a fresh crop of leaves. The larvae, called caterpillars or silkworms, eat day and night and increase enormously in size **[Fig. 3.10 (c)].**



(a) Female silkworm moth with eggs

Leaf of Mulberry

(b) Mulberry tree

(c) Larvae (Caterpillars/ Silkworms feeding on Mulberry leaves

(d) Cocoons

Fig.3.10: Rearing of Silkworm

The annual silk production in J&K is more than 7,000 quintals.

The larvae are kept in clean bamboo trays along with freshly chopped mulberry leaves. After 25 to 30 days, the caterpillars stop eating and move to a tiny chamber of bamboo in the tray to spin cocoons **[Fig. 3.10 (d)]**. Small racks of twigs may be provided in the trays to which cocoons get attached. The caterpillar or silkworm spins the cocoon inside which develops the silk moth.

Processing Silk

A pile of cocoons is used for obtaining silk fibres. The cocoons are kept under the sun or boiled or exposed to steam. The silk fibres separate out. The process of taking out threads from the cocoon for use as silk is called **reeling the silk.** Reeling is done in special machines, which unwind the threads or fibres of silk from the cocoon. Silk fibres are then spun into silk threads, which are woven into silk cloth by weavers.

A Flow Chart Depicting Story from Woollen Fleece to Textiles

Woollen Fleece
↓
Spinning into Yarn

↓	↓
Weaving	**Yarns**
↓	↓
Cloth Formation	**Dyeing of Yarns**
↓	↓
Dyeing of Cloth	**Weaving**
↓	↓
Cloth of Choice	**Woollen Cloth of Choice**

Discovery of Silk

The exact time of discovery of silk is perhaps unknown. According to an old Chinese legend, the empress Si-lung-Chi was asked by the emperor Huang-ti to find the cause of the damaged leaves of Mulberry trees growing in their garden. The empress found white worms eating up Mulberry leaves. She also noticed that they were spinning shiny cocoons around themselves. Accidentally a cocoon dropped into her cup of tea and a tangle of delicate threads separated from the cocoon. Silk industry began in China and was kept a closely guarded secret for hundreds of years. Later on, traders and travellers introduced silk to other countries. The route they travelled is still called the '**Silk route**'.

KEYWORDS

Cocoon	**Scouring**	**Silk moth**
Fleece	**Sericulture**	**Silkworm**
Reeling	**Shearing**	**Sorting**

What you have learnt

- Silk comes from silkworms and wool is obtained from sheep, goat and yak. Hence silk and wool are animal fibres.
- The hairs of camel, llama and alpaca are also processed to yield wool.
- In India, mostly sheep are reared for getting wool.
- Sheep hair is sheared off from the body, scoured, sorted, dried, dyed, spun and woven to yield wool.
- Silkworms are caterpillars of silk moth.
- During their life cycle, the worms spin cocoons of silk fibres.
- Silk fibres are made of protein.
- Silk fibres from cocoons are separated out and reeled into silk threads.
- Weavers weave silk threads into silk cloth.

EXERCISES

1. You must be familiar with the following nursery rhymes:

(i) "Baa baa black sheep, have you any wool".

(ii) "Mary had a little lamb, whose fleece was white as snow".

Answer the following:

(a) Which parts of the black sheep have wool ?

(b) What is meant by the white fleece of the lamb ?

2. The silkworm is (a) a caterpillar, (b) a larva. Choose the correct option.

(i) a (ii) b (iii) both a and b (iv) neither a nor b

3. Which of the following does not yield wool?

(i) Yak (ii) Camel (iii) Goat (iv) Woolly dog

4. What is meant by following terms?

(i) Rearing (ii) Shearing (iii) Sericulture

5. The science of raising silk worms so as to obtain silk cocoons is called:

(a) Apiculture (b) Horticulture

(c) Sericulture (d) Pisciculture

6. The hair on the skin of sheep, yak, etc, from which wool can be obtained.

(a) Wool (b) Fleece

(c) Silk (d) Yarn

7. The proper sequence of life cycle of a silkworm is:

(a) Egg → Pupa → Caterpillar

(b) Pupa → Egg → Caterpillar

(c) Eggs → Caterpillar → Pupa

(d) Caterpillar → Egg → Pupa

8. Which of the following diseases is caused due to wool industry

(a) Typhoid (b) Cholera

(c) Tetanus (d) Anthrax

9. Given below is a sequence of steps in the processing of wool. Which are the missing steps? Add them

Shearing, _____, Sorting, _____, _____, _____

10. Make sketches of the two stages in the life history of the silk moth which are directly related to the production of silk.

11. Out of the following, which are the two terms related to silk production ?

Sericulture, floriculture, moriculture, apiculture and silviculture.

Hints:

(i) Silk production involves cultivation of Mulberry leaves and rearing silkworms.

(ii) Scientific name of Mulberry is **Morus alba.**

12. Match the words of Column I with those given in Column II:

Column I	Column II
1. Scouring	(a) Yields silk fibres
2. Mulberry leaves	(b) Wool yielding animal
3. Yak	(c) Food of silkworm
4. Cocoon	(d) Reeling
	(e) Cleaning sheared skin

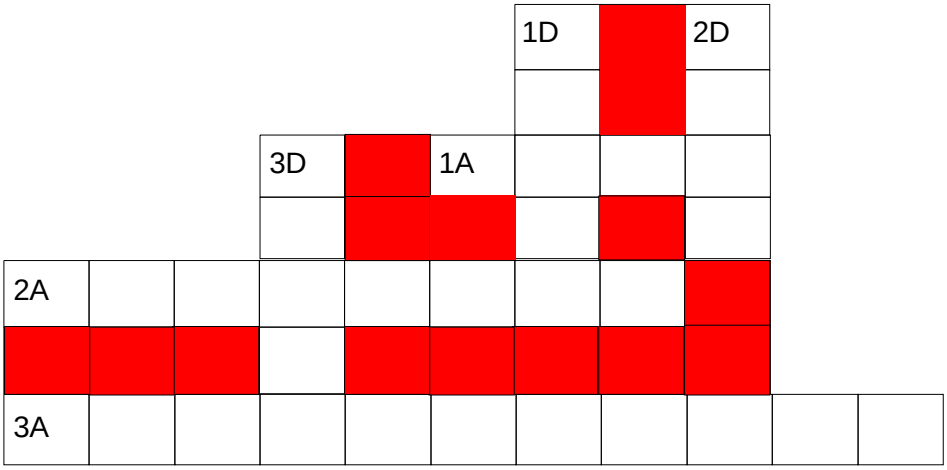
13. Given below is a cross word puzzle based on this lesson. Use hints to fill in the blank spaces with letters that complete the words.

Down

(D) 1. Thorough washing
2. Animal Fibre
3. Long thread like structure

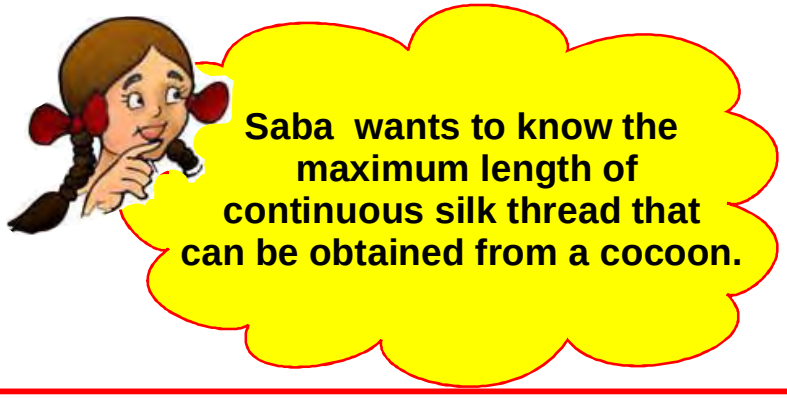
Across

(A) 1. Keeps warm
2. Its leaves are eaten by silkworms
3. Hatches from egg of moth



Extended Learning - Activities and Projects

1.



Find out for her.

2.

Yasir wants to know why caterpillars need to shed their skin when they grow bigger but we humans do not.

Do you have any idea?

3.

Yasir wants to know why caterpillars should not be collected with bare hands.

4. Saba wanted to buy a silk frock and went to the market with her mother. There they found that the artificial (synthetic) silk was much cheaper and wanted to know why. Do you know why? Find out.
5. Someone told Saba that an animal called 'Vicuna' also gives wool. Can you tell her where this animal is found? Look for this in a dictionary or an encyclopedia.
6. When handloom and textile exhibitions are held, certain stalls display real moths of various varieties of silk and their life histories. Try and visit these stalls with elders or teachers and see these moths and stages of their life history.
7. Look for eggs of any moth or butterfly in your garden or park or any other place full of plants. They look like tiny specks (dots) laid in a cluster on the leaves. Pull out the leaves containing eggs and place them in a cardboard box. Take some leaves of the same plant or another plant of the same variety, chop them and put them in the box. Eggs will hatch into caterpillars, which are busy eating day and night. Add leaves everyday for them to feed upon. Sometimes you may be able to collect the caterpillars.

But be careful, Use a paper napkin or a paper to hold a caterpillar.

Observe everyday. Note the (i) number of days taken for eggs to hatch, (ii) number of days taken to reach the cocoon stage, and (iii) number of days to complete life cycle. Record your observations in your notebook.

You can read more on the following website:

www.indiansilk.kar.nic.in

DO YOU KNOW?

In terms of the number of sheep, India ranks third in the world behind China and Australia. However, the New Zealand sheep are known to yield the best wool.

4 HEAT

Heat: - "Heat is a form of energy which produces in us the sensation of warmth". You have learnt that woollen clothes are made from animal fibres. You also know that cotton clothes are made from plant fibres. We wear woollen clothes during winters when it is cold outside. Woollen clothes keep us warm. We prefer to wear light coloured cotton clothes when it is hot. These give us a sensation of coolness. You might have wondered why particular types of clothes are suitable for a particular season.

In winter you feel cold inside the house. If you come out in the sun, you feel warm. In summer, you feel hot even whether an object is hot or cold? How do we find out how hot or cold an object is? In this chapter we shall try to seek answer to some of these questions.

4.1 HOT AND COLD

In our day-to-day life, we come across a number of objects. Some of them are hot and some of them are cold. Tea is hot and ice is cold. List some objects you use commonly in **Table 4.1**. Mark these objects as hot or cold.

Table 4.1: Hot and Cold Objects

Object	Cold/Cool	Warm/Hot
Ice cream		
Spoon in a tea cup		
Fruit juice		
Handle of a frying pan		

Do not touch object which are too hot. Be careful while handling a candle flame or a stove.

We see that some objects are cold while some objects are hotter than others while some are colder than others. How do we decide which object is hotter than the other? We often do it by touching the objects. But is our sense of touch reliable? Let us find out.

Activity 4.1

Take three large mugs. Label them as A, B and C. Put cold water in mug A and hot in mug B. Mix some cold and hot water in mug C. Now dip your left hand in mug A and the right hand in mug B. After keeping the hands in the two mugs for 2-3 minutes, put both the hands simultaneously in mug C **(Fig.4.1)**.

Make sure that water is not so hot that you burn hand

Do both the hands get the same feeling ?

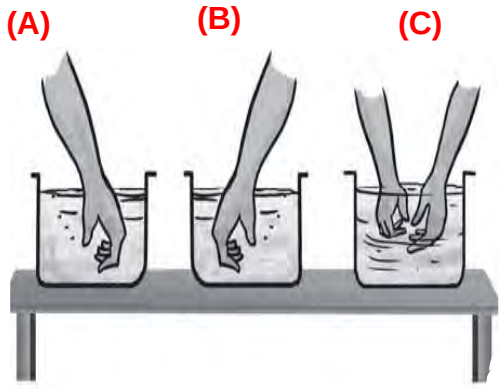
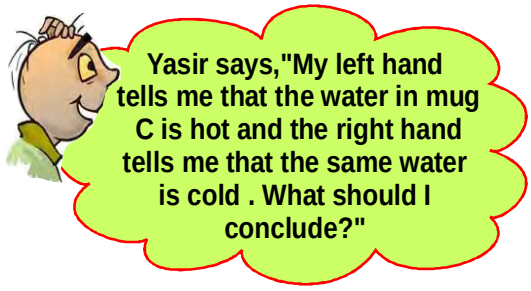


Fig.4.1: Feeling water in three mugs



Yasir's confusion shows that we cannot always rely on our sense of touch to decide whether an object is hot or cold . Sometimes it may deceive us.

Then, how do we find out how hot an object really is? A reliable measure of the hotness of an object is its temperature. Temperature is measured by a device called **thermometer**.

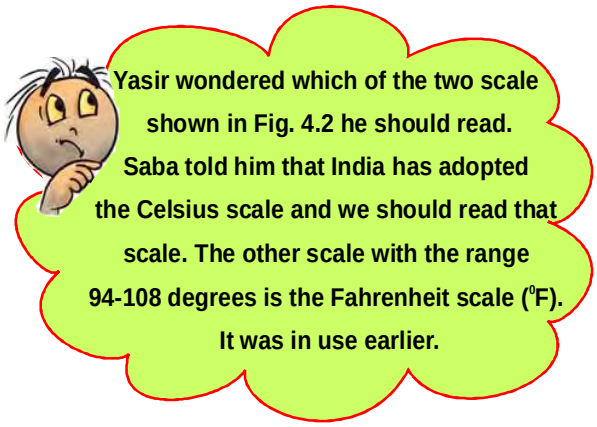
4.2 MEASURING TEMPERATURE

Have you seen a thermometer? Recall that when you or someone else in your family had fever, the temperature was measured by a thermometer. The thermometer that measures our body temperature is called a **clinical thermometer.** Hold the thermometer in your hand and examine it carefully. If you do not have a thermometer, request a friend to share it with you. A clinical thermometer looks like th e one shown in **Fig. 4.2**.

Fig.4.2: A clinical themometer

A clinical thermometer consists of a long, narrow, uniform glass tube . It has a bulb at one end. This bulb contains mercury. Outside the bulb, a small shining thread of mercury can be seen.

If you do not see the mercury thread, rotate the thermometer a bit till you see it. You will also find a scale on the thermometer. The scale we use is the Celsius scale, indicated by ^{0}C.



A clinical thermometer reads temperature from 35^{0}C to 42^{0}C.

Activity 4.2

Reading a thermometer

Let us learn how to read a thermometer. First find out the temperature difference indicated between the two bigger marks. Also note down the number of divisions (shown by smaller marks) between these marks. Suppose the bigger marks read one degree and there are five divisions between them. Then, one small division can read $\frac{1}{5}$ **= 0.2°C.**

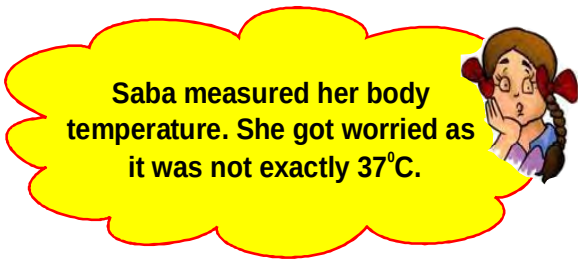
How to use

Wash the thermometer, preferably with an antiseptic solution. Hold it firmly and give it a few jerks. The jerks will bring the level of mercury down. Ensure that it falls below 35°C. Now place the bulb of the thermometer under your tongue. After one minute, take the thermometer out and note the reading. This is your body temperature. The temperature should always be stated with its unit °C.

What did you record as your body temperature?

The normal temperature of human body is 37°C. Note that the temperature is stated with its unit.

Fig.4.3: Correct method of reading a clinical thermometer



Let us try to assure Saba that there is nothing wrong with her.

Precautions to be observed while reading a clinical thermometer

Thermometer should be washed before and after use, preferably with an antiseptic solution. Ensure that before use the mercury level is below 35°C. Read the thermometer keeping the level of mercury along the line of sight. **(See Fig. 4.3)** Handle the thermometer with care. If it hits against some hard object, it can break. Don't hold the thermometer by the bulb while reading it

Activity 4.3

Measure the body temperature of some of your friends (at least 10) with a clinical thermometer. Record your observations as in **Table 4.2.**

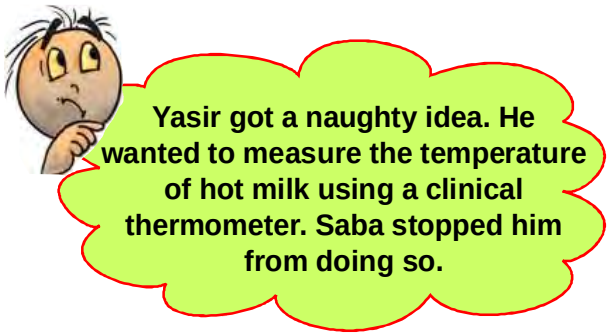
Table 4.2: Body temperature of some persons

Name	Temperature (^{0}C)

Is the body temperature of every person 37^{0}C.

The temperature of every person may not be 37^{0}C. It could be slightly higher or slightly lower. Actually, what we call normal temperature is the average body temperature of a large number of healthy persons.

The clinical thermometer is designed to measure the temperature of human body only. The temperature of human body normally does not go below 35^{0}C or above 42^{0}C. This is the reason that this thermometer has the range 35^{0}C to 42^{0}C



CAUTION

Do not use a clinical thermometer for measuring the temperature of any object other than the human body. Also avoid keeping the thermometer in the sun or near a flame. It may break.

4.3 LABORATORY THERMOMETER

How do we measure the temperature of other objects? For this purpose, there are other thermometers. One such thermometer is known as the laboratory thermometer. The teacher will show you this thermometer. Look at it carefully and note the highest and the lowest temperature it can measure.

Different types of thermometers are used for different purposes. The maximum and minimum temperatures of the previous day, reported in weather reports, are measured by a thermometer called the maximum-minimum thermometer.

The range of a laboratory thermometer is generally from -10^{0}C to 110^{0}C **(Fig. 4.4)**. Also, as you did in the case of the clinical thermometer, find out how much a small division on this thermometer reads. You would need ths information to read the thermometer correctly. Let us now learn how this thermometer is used.

Fig. 4.4 A laboratory thermometer

In addition to the precautions needed while reading a clinical thermometer, the laboratory thermometer

- should be kept upright not tilted **(Fig. 4.5)**.
- bulb should be surrounded from all sides from the substance of which the temperature is to be measured. The bulb should not touch the surface of the container.

Activity 4.4

Take some tap water in a beaker or a mug. Dip the thermometer in water so that the bulb is immersed in water but does not touch the bottom or the sides of the container. Hold the thermometer vertically **(Fig. 4.5)**. Observe the movement of mercury in the thermometer. Wait till the mercury thread becomes steady.

Fig.4.5: Measuring temperature of water with a laboratory thermometer

Note the reading. This is the temperature of water at this time.

Compare the temperature of water recorded by each student in the class. Are there any variations in the readings? Discuss the possible reasons.

Let us try to answer this question.

Activity 4.5

Take some hot water in a beaker or a mug. Dip the thermometer in water. Wait till the mercury thread becomes steady and note the temperature. Now take out the thermometer from the water. Observe carefully what happens now. Do you notice that as soon as you take thermometer out of water, the level of mercury begins to fall. This means that the temperature must be read while the thermometer is in water.

You may recall that while taking your own temperature, you have to take the thermometer out of your mouth to note the reading. Can you then use the laboratory thermometer to measure your body temperature? Obviously, it is not convenient to use the laboratory thermometer for this purpose.

Yasir now understand why clinical thermometer cannot be used to measure high temperatures. But still wonders whether a laboratory thermometer can be used to measure his body temperature.

Yasir wonders why the level of mercury should change at all when the bulb of the thermometer is brought in contact with another object.

Why does the mercury not fall or rise in a clinical thermometer when taken out of the mouth?

Observe a clinical thermometer again. Do you see a kink near the bulb **(Fig. 4.6)**.

What is the use of the kink? It prevents mercury level from falling on its own.

Fig. 4.6: A clinical thermometer has a kink in it.

There is a lot of concern over the use of mercury in thermometers. Mercury is a toxic substance and is very difficult to dispose of if a thermometer breaks. These days, digital thermometers are available which do not use mercury.

4.4 TRANSFER OF HEAT

You might have observed that a frying pan become hot when kept on a flame. It is because the heat passes from the flame to the utensil. When the pan is removed from the fire, it slowly cools down. Why does it cool down? The heat is transferred from the pan to the surroundings. So you can understand that in both cases, the heat flows from a hotter object to a colder object. In fact, in all cases heat flows from a hotter object to a colder object.

How dos heat flow? Let us investigate.

Saba asks: "Does it mean that heat will not be transferred if the temperature of two objects is the same?"

Activity 4.6

Take a rod of flat strip of a metal, say of aluminium or iron. Fix a few small wax pieces on the rod. These pieces should be at nearly equal distances **(Fig. 4.7)**. Clamp the rod to a stand. If you do not find a stand,

you can put one end of the rod in between bricks. Now, heat the other end of the rod and observe.

What happens to the wax pieces? Do these pieces begin to fall? Which piece falls the first? Do you think that heat is transferred from the end nearest to the flame to the other end?

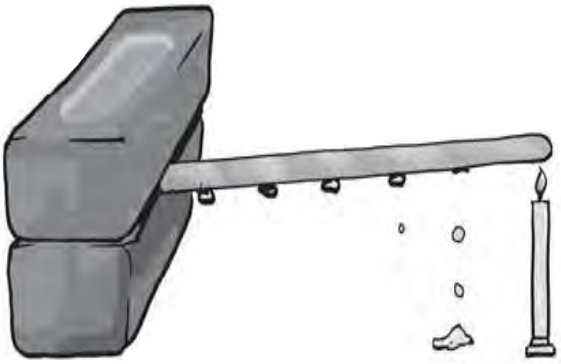


Fig.4.7: Flow of heat through a metal strip

The process by which heat is transferred from the hotter end to the colder end of an object is known as **conduction**. In solids, generally, the heat is transferred by the process of conduction.

Do all substances conduct heat easily? You must have observed that the metallic pan for cooking has a plastic or wooden handle. Can you lift a hot pan by holding it from the handle without getting hurt?

Activity 4.7

Heat some water in a small pan or a beaker. Collect some articles such as a steel spoon, plastic scale, pencil and divider. Dip one end of each of these articles in hot water **(Fig.4.8)**.

Fig.4.8: Conduction of heat by different materials

Wait for a few minutes. Touch the other end. Enter your observation in **Table 4.3**

The materials which allow heat to pass through them easily are **conductors** of heat. For example

Table: 4.3

Article	Material with which the article is made of	Does the other end get hot (Yes / No)
Steel spoon	Metal	Yes

aluminium, iron and copper. The materials which do not allow heat to pass through them easily are poor conductor of heat such as plastic and wood. Poor conductors are known as **insulators**.

The water and air are poor conductors of heat. Then, how does the heat transfer take place in these substances? Let us find out.

Activity 4.8

Take a round bottom flask (if flask is not available, a beaker can be used). Fill it two-thirds with water. Place it on a tripod stand, or make some arrangement to place the flask in such a way that you can heat it by placing a candle below it. Wait till the water in the flask is still. Place a crystal of potassium permanganate at the bottom of the flask gently using a straw. Now, heat the water by placing the candle just below the crystal.

Write your observation in your notebook and also draw a picture of what you observe **(Fig. 4.9)**.

When water is heated, the water near the flame gets hot. Hot water rises up. The cold water from the sides moves down towards the source of heat. This water also gets hot and rises and water from the sides moves down. This process continues till the whole water gets heated. This mode of heat transfer is known as **convection.**

How does the heat travel in air? In which direction does the smoke go?

Fig.4.9: Convection of heat in water

The air near the heat source gets hot and rises. The air from the sides comes in to take its place. In this way the air gets heated. The following activity confirms this idea.

Activity 4.9

Light a candle. Keep one hand above the flame and one hand on the side of the flame **(Fig. 4.10)**. Do your hands feel equally hot? If not which hand feels hotter? and why?

Be careful. Keep your hands at a safe distance from the flame so that they do not get burnt.

Fig.4.10: Transfer of heat by convection in air

Notice that towards the top, the air gets heated by convection. Therefore, the hand above the flame feels hot. On the sides, however, there is no convection and air does not feel as hot as at the top.

The people living in the coastal areas experience an interesting phenomenon. During the day, the land gets heated faster than the water. The air over the land becomes hotter and rises up. The cooler air from the sea rushes in towards the land to take its place. The warm air from the land moves towards the sea to complete the cycle. The air from the sea is called the **sea breeze**. To receive the cooler sea breeze, the windows of the houses in coastal areas are made to face the sea. At night it is exactly the reverse **(Fig. 4.11)**. The water cools down more

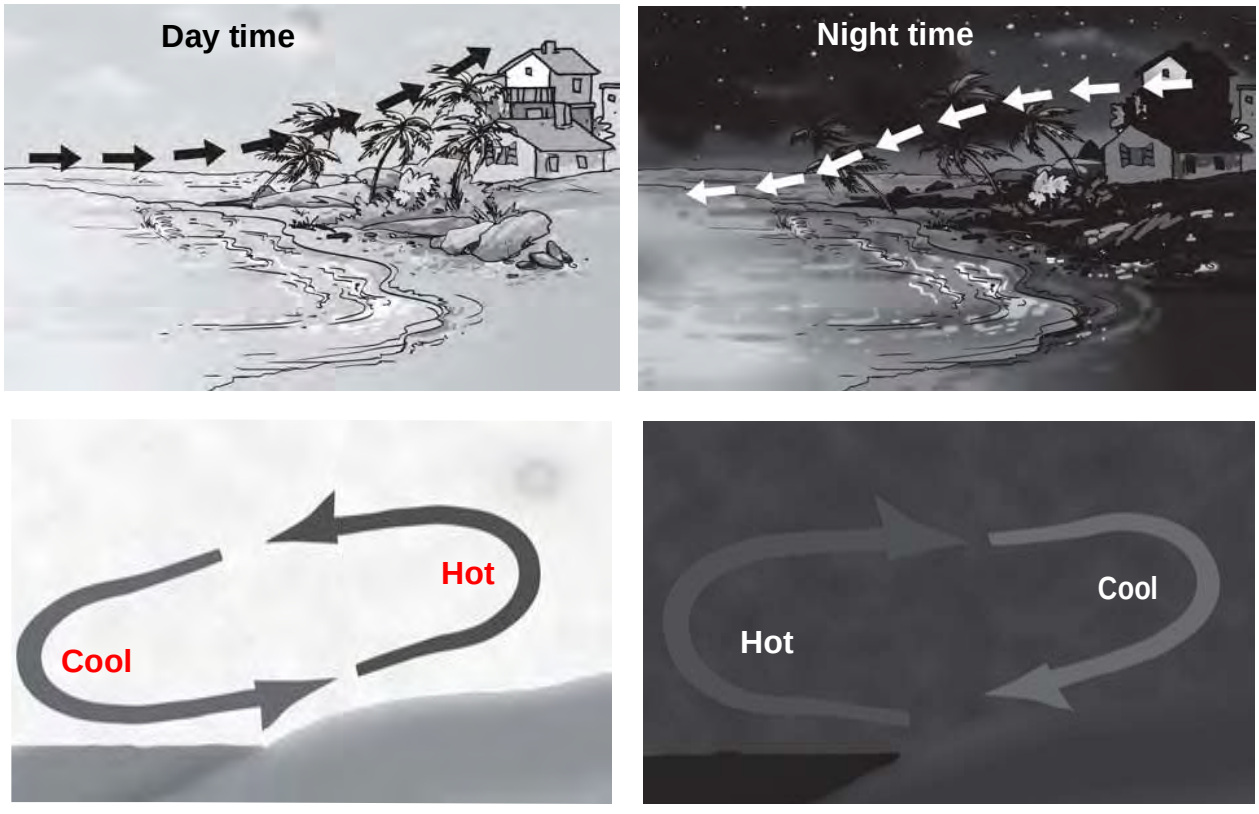


Fig. 4.11

slowly than the land. So, the cool air from the land moves towards the sea. This is called the **land breeze**. **Fig. 4.11** shows this phenomenon.

When we come out in the sun, we feel warm. How does the heat from the sun reach us? It cannot reach us by conduction or convection as there is no medium such as air in most part of the space between the earth and the sun. From the sun the heat comes to us by another process known as **radiation**. The transfer of heat by radiation does not require any medium. It can take place whether a medium is present or not. When we sit in front of a room heater, we get heat by this process. A hot utensil kept away from the flame cools down as it transfer heat to the surroundings by radiation. Our body too, gives heat to the surroundings and receives heat from it by radiation.

All hot bodies radiate heat. When this heat falls on some object, a part of it is reflected, a part is absorbed and a part may be transmitted. The temperature of the object increases due to the absorbed part of the heat. Why are you advised to use an umbrella when you go out in the sun?

4.5 KINDS OF CLOTHES WE WEAR IN SUMMER AND WINTER

You know that in summer we prefer light coloured clothes and in winter we usually wear dark coloured clothes. Why is it so? Let us find out.

Activity 4.10

Take two identical tin cans. Paint the outer surface of one black and of the other white **(Fig. 4.12)**. Pour equal amounts of water in each and leave them in the mid-day sun for about an hour. Measure the temperature of water in both the cans. Do you find any difference in the temperatures? In which can is the water warmer? You can feel the difference even by touching water in the two cans.

Fig.4.12: Containers with black and white surface

Activity 4.11

Fill the two cans used in Activity 4.10 with the same amount of hot water at the same temperature (say, at 60°C). Leave the cans in a room or in a shade. Note the temperature of water after 10-15

minutes. Does the temperature of water in both the cans fall by the same amount?

Do these activities suggest to you the reason why it is more comfortable to wear white or light coloured clothes in the summer ? Dark surfaces absorb more heat and, therefore, we feel comfortable with dark coloured clothes in the winter. Light coloured clothes reflect most of the heat that falls on them and, therefore, we feel comfortable wearing them in the summer.

Woollen clothes keep us warm in winter

In the winter, we use woolen clothes. Wool is a poor conductor of heat. Moreover, there is air trapped in between the wool fibres. This air prevents the flow of heat from our body to the cold surroundings. So, we feel warm.

Suppose you are given the choice in winter of using either one thick blanket or two thin blankets joined together. What would you choose and why. Remember that there would be a layer of air in between the blankets.

KEYWORDS

Celsius Scale	**Insulator**	**Sea breeze**
Conduction	**Land breeze**	**Temperature**
Conductor	**Radiation**	**Thermometer**
Convection		

What you have learnt

- Our sense of touch is not always a reliable guide to the degree of hotness of an object.
- Temperature is a measure of the degree of hotness of an object.
- Thermometer is a device used for measuring temperatures.
- Clinical thermometer is used to measure our body temperature. The range of this thermometer is from 35^{0}C to 42^{0}C. For other purpose, we use the laboratory thermometers. The range of these thermometers is usually from -10^{0}C to 110^{0}C.
- The normal temperature of the human body is 37^{0}C.
- The heat flows from a body at a higher temperature to a body at a lower temperature. There are three ways in which heat can flow from one object to another. These are conduction, convection and radiation.

- ❖ In solids, generally, the heat is transferred by conduction. No medium is required for transfer of heat by radiation.
- ❖ The materials which allow heat to pass through them easily are called insulators.
- ❖ Dark-coloured objects absorb radiation better than the light-coloured objects. That is the reason we feel more comfortable in light-coloured clothes in the summer.
- ❖ Woollen clothes keep us warm during winter. It is so because wool is a poor conductor of heat and it has air trapped in between the fibres.

EXERCISES

1. State similarities and differences between the laboratory thermometer and the clinical thermometer.

2. Give two examples each of conductors and insulators of heat.

3. **Fill in the blanks:**

(a) The hotness of object is determined by its _____.

(b) Temperature of boiling water cannot be measured by a _____ thermometer.

(c) Temperature is measured in degree _____.

(d) No medium is required for transfer of heat by the process of _____.

(e) A cold steel is dipped in a cup of hot milk. It transfers heat to its other end by the process of _____.

(f) Clothes of _____ colours absorb heat better than clothes of light colours.

4. **Match the following**

(i)	Land breeze blows during	**(a)**	Summer
(ii)	Sea breeze blows during	**(b)**	Winter
(iii)	Dark coloured clothes are preferred during	**(c)**	Day
(iv)	Light coloured clothes are preferred during	**(d)**	Night

5. Discuss why wearing more layers of clothing during winter keeps us warmer than wearing just one thick piece of clothing.

6. Look at **Fig. 4.13.** Mark where the heat is being transferred by conduction, by convection and by radiation.

Fig.4.13

7. In places of hot climate it is advised that the outer walls of houses be painted white. Explain.

8. One litre of water at 30°C is mixed with one litre of water at 50°C. The temperature of mixture will be

(a) 80°C (b) more than 50°C but less than 80°C

(c) 20°C (d) between 30°C and 50°C

9. An iron ball at 40°C is dropped in a mug containing water at 40°C. The heat will

(a) flow from iron ball to water.

(b) not flow from iron ball to water or from water to iron ball.

(c) flow from water to iron ball.

(d) increase the temperature of both.

10. A wooden spoon is dipped in a cup of ice cream. Its other end

(a) becomes cold by the process of conduction.

(b) becomes cold by the process of convection.

(c) becomes cold by the process of radiation.

(d) does not become cold.

11. Stainless steel pans are usually provided with copper bottoms. The reason for this could be that

(a) copper bottom makes the pan more durable.

(b) such pans appear colourful.

(c) copper is a better conductor of heat than the stainless steel.

(d) copper is easier to clean than the stainless steel.

Extending Learning -Activities and Projects

1. Go to a doctor or your nearest health centre. Observe the doctor taking temperature of patients, Enquire:

   (a) Why she dips the thermometer in a liquid before use.

   (b) Why the thermometer is kept under the tongue.

   (c) Whether the body temperature can be measured by keeping the thermometer at some place other than the mouth.

   (d) Whether the temperature of different parts of the body is the same or different.

2. Go to a veterinary doctor (a doctor who treats animals). Discuss and find out the normal temperature of domestic animals and birds.

3. Wrap a thin strip tightly around an iron rod. Try to burn the paper with candle while

rotating the iron rod continuously. Does it burn? Explain your observation.

4. Take a sheet of paper. Draw a spiral on it as shown in the **Fig. 4.14**. Cut out the paper along the line . Suspend the paper as shown in **Fig. 4.14** above a lighted

Fig.4.14

candle . Observe what happens. Think of an explanation.

5. Take two similar transparent glass bottles having wide mouths. Put a few crystals of potassium permanganate or pour a few drops of ink in one bottle. Fill this bottle with hot water. Fill the other bottle with cold water. Cover the cold water bottle with a thick piece of paper such as a postcard. Press the postcard firmly with one hand and hold the bottle with the other hand. Invert the bottle and place it on the top of the hot water bottle. Hold both the bottles firmly. Ask some other person to pull the postcard. Observe what happens. Explain.

You can read more on the following website:
www.bbc.uk/schools/gcsebitesize/physics/energy/energytransverse6.html

DO YOU KNOW ?

The Celsius scale was devised by a Swedish Astronomer, Anders Celsius in 1742. Strangely, he fixed temperature of the boiling water as 0^0C and of freezing water as 100^0C . However, this order was reversed very soon.

5 ACIDS, BASES AND SALTS

There are a large number of edible substances which we use in our daily life. Let us try to find the taste of few substances given in **Table 5.1.**

Table 5.1

Substance	Taste (sour/bitter/ salty/sweet, etc.)
Curd	Sour
Grapes	Sour and sweet
Lemon juice	Sour
Orange juice	Sour and sweet
Sugar solution	Sweet
Common salt - solution	Salty
Amla	Bitter
Unripe mangoes	Bitter
Baking Soda - solution	Bitter
Soap solution	Bitter
Tamarind (imli)	Sour
Vinegar	Sour
Plain Soda Water	Sour

Caution

1. *The taste of edible substance should be found by touching a drop of it to the tip of the tongue. Afterwards, the mouth should be rinsed with water.*
2. *Do not taste all substances above. Some of them can be poisonous. Always ask your elders, teachers, before you taste an unknown substance.*

5.2 ACIDS AND BASES

The substances such as curd, grapes, lemon juice, orange juice, tamarind, etc., have sour taste.

The sour substances found in nature or prepared artificially are called **acids.** The chemical nature of acids is called **acidic nature.**

The term acid has been derived from the Latin word ***acidus***, which means ***sour.*** A large number of fruits and some vegetables have sour taste and hence are acidic substances.

The sour taste of lemon is due to citric acid, the sour taste of grapes and tamarind is due to tartaric acid and that of vinegar is due to acetic acid.

The acids which are found in plants and animals are commonly called **natural acids** or **organic acids.** The table given below gives the names of naturally occurring acids and their source.

Table 5.2: Natural or organic acids.

Natural Source	Acid
1. Oranges & lemons	Citric Acid
2. Grapes, tamarind, goose berries	Tartaric acid
3. Tomatoes	Oxalic acid
4. Sour milk	Lactic acid
5. Vinegar	Acetic acid
6. Apples	Malic acid
7. Proteins	Amino acids

In addition to natural or organic acids, there are acids, which can be prepared from non-living things, by chemical means. Such acids are called **mineral acids.**

Definition of mineral acid

An acid which is prepared from the minerals of the earth is called minerals acid.

Examples of Mineral Acids

Name of Acid	Formula
• Sulphuric acid	H_2SO_4
• Nitric acid	HNO_3
• Hydrochloric acid	HCl
• Phosphoric acid	H_3PO_4

Note : Mineral acids are highly corrosive in nature. They can cause severe burns on the skin. They should never be handled with bare hand or tasted.

DO YOU KNOW ?

1. The fats or oils which we consume contain complex compounds called **fattyacids.**
2. All kinds of proteins (animal or plant) are made by **amino acids.** It is the amino acid which helps in growth, development, and repair of our body cells.
3. The nucleus of any living cell contains **deoxyribonucleic acid or DNA.** The DNA has specific genetic information and controls every feature of the living body, such as look, colour of eyes, etc.

Coming back to taste of substances, the substances like baking soda solution, soap solution, etc., have a bitter taste. As these substances do not have sour taste, therefore, they are not acids.

If you rub soap solution or baking soda solution between your fingers. You will feel 'slippery'.

The substances which have a bitter taste and feel slippery (soapy touch) are known as **bases**. The nature of such substances is said to be basic.

Table 5.3 gives the list of common bases and the substance in which they are found in small amounts.

Table 5.3: Common bases

Name of base	Chemical Formula	Found in
Sodium hydroxide	NaOH	Soap
Potassium hydroxide	KOH	Liquid soap
Calcium hydroxide	$Ca(OH)_2$	Limewater
Magnesium hydroxide	$Mg(OH)_2$	Milk of magnesia
Ammonium hydroxide	NH_4OH	Window cleaner solution

We cannot taste all substances to find whether they are acidic or basic in nature. It is because some substances may be corrosive to skin or poisonous.

Now the question arises, if we cannot taste every substance, how do we find its nature. Special type of substances are used to find whether a given substance is acidic or basic in nature. Let us perform the following activity :

ACTIVITY 5.1

Turmeric (haldi) is commonly used as spice in kitchen. It is yellow in colour and stains a white cloth yellow. If the yellow stain is rubbed with soap solution, the colour of the stain changes to brownish red. Why does this happen? The soap solution always contains a small amount of a chemical called sodium hydroxide. It is the sodium hydroxide which changes the colour of turmeric stain from yellow to brownish red. Now, if we rub a freshly cut lemon on the brownish red stain, it again changes to yellow colour. The lemon contains another substance called citric acid, which neutralizes the effect of sodium hydroxide. Thus, the turmeric stain regains its original colour.

From this discussion, we can say that there are certain substances which change their colour on coming in contact with other substances. Such substances are called **indicators.**

5.3 INDICATORS

The complex, naturally occurring substances, which change their colour on coming in contact with acidic or basic substances are called indicators.

In the above discussion, turmeric is an indicator. Other common indicators are *litmus solution, phenolphthalein solution and china rose petals (Gudhal).*

Sometimes we soak thin rectangular strips of filter paper in the solution of above mentioned substances and then dry them. These dried strips are

called litmus paper, methyl orange paper, phenolphthalein paper, China rose paper, etc.

On the basis of effect on indicators, we can classify substances as acidic, basic or neutral substances.

By neutral substances *we mean such substances which are neither acid, nor basic and do not effect indicators. For example, distilled water, alcohol, common salt solutions are neutral substances.*

5.4 NATURAL INDICATORS AROUND US

(a) Litmus: A Natural Dye

Litmus in the form of solution or in the form of dried paper strips is the most commonly used indicator.

The dye (litmus) is extracted from lichen plants found in Tundra region **[Fig.5.1(a)].**The solution of litmus in distilled water is mauve (purple) in colour. This solution is called neutral litmus solution.

The neutral litmus solution turns red when added to some acidic solution. Conversely, the neutral litmus solution turns blue, when added to some basic solution.

If thin strips of paper are soaked in red litmus solution or blue litmus solution and then dried, and then these strips are commonly called red litmus paper **[Fig.5.1(b)]** or blue Litmus Paper **[Fig.5.1(c)].** These strips are bound in the form of a tiny booklets and supplied to chemical laboratories.

Fig.5.1 (a) : Lichen plant

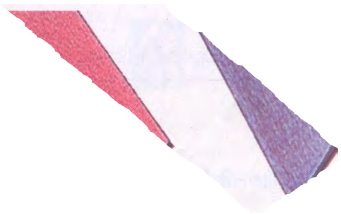


Fig.5.1 (b) : Red litmus paper

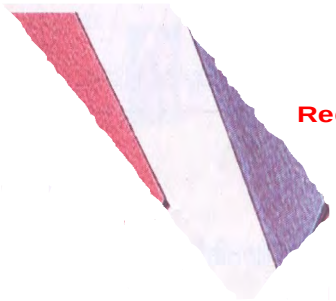


Fig.5.1(c): Blue litmus paper

(B) Turmeric

Turmeric is another natural indicator.

(C) China Rose

China rose is a flower which has pink petals. The coloured solution

ACTIVITY 5.2

To find the effect on (a) red litmus paper (b) blue litmus paper of different solutions.

Mix a few drops of vinegar in a cup half filled with distilled water. Take a dropper and fill it with solution of vinegar. Pour a drop of this solution on (i) blue litmus paper (ii) red litmus paper.

You will observe that blue litmus paper turns red, but there is no effect on red litmus paper. Thus, vinegar solution is acidic in nature.

Repeat the above procedure with the following:

(I) Soap solution
(ii) Aerated water (soda water)
(Iii) Common salt solution
(iv) Shampoo solution
(V) Baking soda solution
(vi) Lemon juice solution
(Vii) Hydrochloric acid solution
(viii) Nitric acid solution
(ix) Washing soda solution
(x) Lime Water

Table 5.4: Shows the expected results.

S. no	Test solution	Effect on red litmus paper	Effect on blue litmus paper	Inference
1.	Soap solution	Changes to blue colour	No Change	Solution is basic
2.	Aerated water	No Change	Change to red colour	Solution is acidic
3.	Common salt solution	No Change	No Change	Solution is neutral
4.	Shampoo solution	Changes to blue colour	No Change	Solution is basic
5.	Baking soda solution	Changes to blue colour	No Change	Solution is basic
6.	Lemon juice solution	No Change	Change to red colour	Solution is acidic
7.	Hydrochloric acid solution	No Change	Change to red colour	Solution is acidic
8.	Nitric acid solution	No Change	Change to red Colour	Solution is acidic
9.	Washing soda solution	Changes to blue colour	No Change	Solution is basic
10	Limewater	Changes to blue colour	Change	

extracted from it is light pink colour. When used as an indicator, its colour changes to green in **basic solution** and dark pink colour (magenta) in **acidic solutions.** In neutral solution, its colour does not change.

ACTIVITY 5.3

To find the effect of acidic /basic solutions on turmeric as an indicator.

- Add a spoonful of turmeric powder in a cup containing warm water. Stir the contents well and allow it to stand so that undissolved turmeric settles down.
- Pour the clear solution over a blotting paper or a filter paper. Allow the paper to dry and cut strips 5cm long and 1cm wide.
- Dip a strip each in the solutions of substances mentioned in Activity 5.2.
- You will notice the yellow colour of the strip changes to brown or reddish brown in the solutions of soap, shampoo, baking soda, washing soda and limewater. These solutions are basic in nature.
- The yellow colour of the strip will not change in case of aerated water, common salt solution, lemon juice, hydrochloric acid and nitric acid. These solutions may be neutral or acidic.

Note: Turmeric as an indicator identifies basic solutions only. Its colour does not change in acidic or neutral solutions.

(D) Phenolphthalein

Phenolphthalein is an organic dye prepared by dissolving it in alcohol. Its solution is **colourless.**

When a few drops of phenolphthalein are added to basic solution, such as soap solution, shampoo solution, washing soda solution, etc., it changes to **deep pink colour.**

However, it remains **colourless,** in acidic or neutral solutions.

ACTIVITY 5.4

To find the effect of acidic /basic solutions on the china rose solution as an indicator.

- Take a fistful of china rose petals in a bowl. Soak the petals in the boiling water for half an hour. On cooling, crush the petals with hand and then filter the mixture. You will get pink coloured clear solution, which can be used as an indicator.
- Take 1cc of china rose solution in a test tube and to it add few drops of soap solution. Shake the contents. You will notice that colour of the solution changes to

green.

- Similarly, repeat the activity with solutions mentioned in Activity 5.2.
- You will notice that pink colour of china rose solution changes to green colour in case of solutions of soap, shampoo, baking soda, washing soda and limewater. These solutions are basic in nature.
- You will notice that pink colour of china rosé solution changes to deep pink colour in case of aerated water, lemon juice, hydrochloric acid and nitric acid. These solutions are acidic in character.
- You will notice that pink colour of china rose solution does not change in case of common salt solution. This solution is neutral in nature.

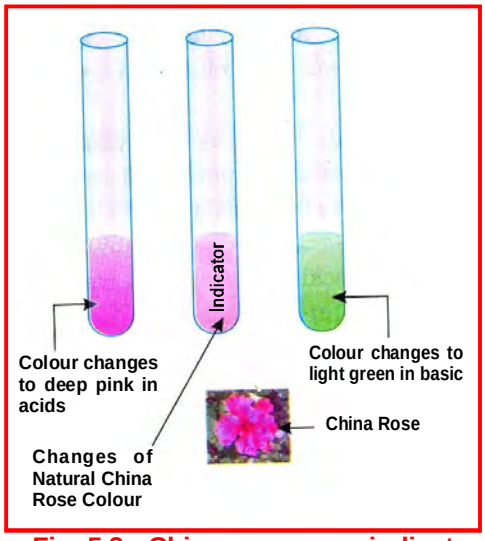


Fig. 5.2 : China rose as an indicator

5.5 GENERAL PHYSICAL PROPERTIES OF ACIDS

1. They have a sour taste.
2. They turn blue litmus solution red, but do not affect red litmus solution.
3. They do not affect turmeric solution.
4. They do not affect phenolphthalein solution.
5. They turn China rose solution to deep pink colour.
6. Mineral acids, such as sulphuric acid, hydrochloric acid and nitric acid are highly corrosive. They cause painful blisters on the skin.
7. Most of the acids are soluble in water
8. All acid solutions in water are good conductors of electricity.

DO YOU KNOW?

1. You must have seen people getting their copper or brass cooking vessels coated with tin metal (kalai). Why do they do so?

When we cook food in these vessels without the coating of kalai, the organic acids present in the food materials react with copper and corrode it. Further-more, the copper salts formed by the acids are poisonous in nature.

The kalai protects the vessel from the action of acids for a while, and hence,

prevents food poisoning.

However, these days, quite a number of people use stainless steel cooking vessels, because they are not affected by the acids present in food materials.

2. **Acid Rain :** Rain containing traces of mineral acid, such as hydrochloric acid, nitric acid is called acid rain. These acids are formed when the air is highly polluted with gases like sulphur dioxide and nitrogen dioxide, due to excessive burning of coal and petroleum products. The above mentioned gases dissolve in rain droplets and cause acid rain.

The acid rain can cause extensive damage to the forests and crops as they die. Furthermore, the acids in acid rain react chemically with the building materials of houses and historical monuments. Thus, the buildings gradually decay.

5.6 GENERAL PHYSICAL PROPERTIES OF BASES

1. They have a bitter taste.
2. They turn red litmus solution blue, but do not affect blue litmus solution.
3. They turn yellow turmeric solution reddish brown.
4. They turn phenolphthalein solution pink.
5. They turn china rose solution green.
6. Base like sodium hydroxide, potassium hydroxide and calcium hydroxide cause painful blisters on skin and are highly corrosive in nature.
7. Most of the bases are insoluble in water.
8. All bases have slippery touch like that of soap.

5.7 NEUTRALISATION

We have learnt that bases turn phenolphthalein solution pink. The pink colour changes to colourless, if an acid is added to it. Let us perform the following activity :

5.8 NEUTRALISATION IN EVERY DAY LIFE

(a) Indigestion

Our stomach walls produce gastric juice which contains hydrochloric acid. The gastric juice helps in the digestion of food. However, when we eat very spicy foods or have worries or tension, the stomach wall produces a large amount of hydrochloric acid which leads to the acidity of stomach. One has a burning feeling in the stomach and sour taste in the mouth. This condition is commonly called “acidity of stomach or indigestion”. If not controlled, it can

ACTIVITY 5.5

To show that acids react with alkalis and a neutralization reaction takes place.

Materials required:

- dilute sodium hydroxide solution
- dilute hydrochloric acid or lemon juice
- phenolphthalein solution
- beaker
- a dropper.

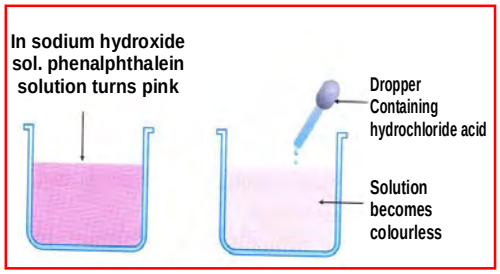


Fig. 5.3 (a) **Fig. 5.3 (b)**

Method : Pour about 20cc of sodium hydroxide solution in the beaker. To this solution, add phenolphthalein solution. You will notice that the solution turns deep pink.

Fill the dropper with dilute hydrochloric acid. Allow the acid to fall in the beaker drop by drop. Go on stirring the beaker.

You will notice that at some stage, by the addition of one drop of acid the solution suddenly become colourlees.

It is because at this stage the sodium hydroxide solution has completely reacted with hydrochloric acid to form salt and water. Thus, the last drop of hydrochloric acid makes the acid in excess, and hence, the colour of phenolphthalein changes from pink to colourless.

Touch the beaker immediately after the solution become colourless. You will notice that beaker is warm. Thus, we can say heat is evolved when an acid reacts with base.

Acid + Base → Salt + Water + Heat

HCl + NaOH → NaCl + H_2O + Heat

Hydrochloric acid — Sodium hydroxide — Sodium chloride — Water

The process due to which an acid completely reacts with a base with the evolution of heat to form salt and water as the only products is called **neutralization.**

damage the walls of the stomach and can cause stomach ulcers.

To relieve indigestion, doctor's prescribe antacid tablets or syrup. It contains milk of magnesia (magnesium hydroxide) and aluminium hydroxide. These hydroxides neutralise excess hydrochloric acid, and hence, help in controlling acidity of stomach.

(b) Soil Treatment

Plants grow well only in the neutral soil. However, sometimes a neutral soil gets acidic due to the excessive use of artificial fertilizers. The soil also gets acidic, if the roots of harvested crop are allowed to decay in it. This in turn reduces the fertility of the soil. In order to convert acidic soils into neutral soils farmers spray it with calcium oxide (quick lime) or calcium hydroxide (slaked lime). These chemicals neutralize soil acids and hence soil becomes neutral.

Some soils are naturally basic in nature. In order to make these soils neutral, a large amount of organic manure is added. The acids present in the organic manure neutralize the basic chemicals in the soil and make it neutral.

(C) Factory Wastes

The wastes of many factories contain acids. If these wastes are directly discharged in a river or a lake, they kill the fish and other living organisms. Thus to prevent such a situation, the wastes are treated with lime which neutralises acids.

(d) Stings of Ants and Bees

The stings of ants and bees contain formic acid when these insects sting, they inject formic acid in our body which causes a painful irritation and swelling. To reduce the effect of formic acid, the area around the sting is rubbed with soap or baking soda solution or calamine, which contains zinc carbonate. These substances neutralise the effect of formic acid to some extent and hence help in relieving pain.

(e) Preserving Milk for a Short Period

Milk is brought to the cities from the villages by the milk vendors. In hot climate the natural bacteria present in the milk produces a large amount of lactic acid, which curdles the milk, thereby causing a loss to milk vendors. To prevent the ill effect of lactic acid the milk vendor adds a small amount of baking soda to the milk. This in turn neutralizes lactic acid and the milk does not curdle.

KEYWORDS

Acid	**Acidic**	**Base**
Basic	**Indicator**	**Neutral**
Neutralization	**Salt**	

What you have learnt

- Acids are sour in taste. They turn blue litmus red, china rose solution deep pink, but do not affect turmeric solution and phenolphthalein solution.
- Bases are bitter in taste and have a soapy touch. They turn red litmus blue, china rose solution green, turmeric solution reddish brown and phenolphthalein solution pink.
- The substances which change their colour on coming in contact with acid or base are called indicators.
- When an acid neutralizes a base, the products of reaction are salt and water. It always proceeds with the evolution of heat.
- A neutral solution is neither acidic nor basic and the indicators do not show any change in colour in it.

EXERCISES

(I). Fill in the blank spaces by choosing correct words from the list given below:

List: bitter, ants, corrosive, citric, soapy, slaked lime.

1. The acid found in lemons is _____acid.
2. The bases have a _____taste and _____touch.
3. The sting of the _____contains formic acid.
4. Sulphuric acid is highly _____acid.
5. Acidic soils are neutralized with _____.

(II) Statements given below are incorrect. Write the correct statements.

1. Sulphuric acid is an example of an organic acid.
2. Blue litmus paper turns red in a basic solution.
3. China rose solution turns green in citric acid solution.
4. Formic acid is found in the sting of a grasshopper.
5. During neutralization, an acid reacts with a salt to from water and a base, as

products.

(III) Write true or false in front of the following statements:

Statement	True \False
1. Tooth decay is caused by the presence of basic substance in mouth.	_____
2. The substance which shows different colours in acids and bases are called indicators.	_____
3. Milk of magnesia and slaked lime are the examples of neutral substances.	_____
4. Acid rain is caused by the excess of carbon dioxide in air.	_____
5. Potassium hydroxide turns blue litmus red.	_____
6. Most of the fruits contain organic acids.	_____

Answer the following questions :

1. Name three organic and three inorganic acids.
2. What are indicators ? Name any three indicators and state the colour change which takes place in (i) acids (ii) bases.
3. What are neutral substances ? Give examples of two neutral substances.
4. You are given three unlabelled bottles A , B and C, containing colourless solutions, such that one of them is acid, the other being basic and neutral. How will you distinguish between them by using china rose as an indicator.
5. What do you understand by the term neutralisation ? Describe an activity in which neutralisation of hydrochloric acid takes place with sodium hydroxide, using phenolphthalein as an indicator.
6. **Explain Why :**
   (a) Farmers add slaked lime to acidic soils.
   (b) Soap solution or baking soda paste is applied on the part of body stung by a bee.
   (c) Factory wastes and city sewerage is neutralised before discharging in rivers.
   (d) Antacids are used for relieving stomach activity.
7. Give four differences between the acids and the alkalis.
8. Write an equation when hydrochloric acid neutralises sodium hydroxide.

MCQS : Choose the correct answer.

1. Name the acid which is present in the sting of ants

(a) Acetic acid (b) Formic acid (c) Oxalic acid (d) Tartaric acid

2. Blue litmus turns red in which solution:

(a) Acidic solution (b) Basic solution (c) Both acidic and basic solutions

(d) Neutral solution

3. Which of the following is not a mineral acid ?

(a) Hydrochloric acid (b) Sulphuric acid (c) Citric acid (d) Nitric acid

4. When few drops of china rose solution is added to shampoo taken in test tube the colour of the solution becomes:

(a) Blue (b) Red (c) Green (d) Deep Pink

Extended Learning - Activities and Projects

1. Make a concentrated solution of baking soda in about 10 ml of water. With the help of a cotton bud write a message on a white sheet of paper using baking soda solution as an ink. Allow the paper to dry in the sun.
   Cut a piece of fresh beet root and rub it over the invisible message written on the white paper. Using your knowledge of acids/bases/indicators, explain your observations.
2. Collect a sample of soil from your garden and make its suspension in water. Filter the suspension and obtain the clear filtrate. Test the filtrate with litmus solution and find out whether the filtrate and hence the garden soil is acidic / basic / neutral.
3. Take a white paper and soak it in the turmeric solution. Take out the paper and dry it in the sun. Take some soap solution in a small bowl. With the help of cotton bud make any drawing of your choice on the dried turmeric paper, using soap solution as ink. Record your observations and discuss them with your friends.

6 PHYSICAL AND CHEMICAL CHANGES

Every day you come across many changes in your surroundings. These changes may involve one or more substances. For example, your mother may ask you to dissolve sugar in water to make a cold drink. Making a sugar solution is a change. Similarly, setting curd from milk is a change. Sometimes milk becomes sour. Souring of milk is a change. Stretched rubber band also represents a change. Make a list of ten changes you have noticed around you.

In this chapter we shall perform some activities and study the nature of these changes. These changes are of two kinds, **physical** and **chemical.**

Fig.6.1 Paper pieces

6.1 PHYSICAL CHANGES

Activity 6.1

Cut a piece of paper in four square pieces. Cut each square piece further into four square pieces. Lay these pieces on the floor or a table so that the pieces acquire the shape of the original piece of paper **(Fig.6.1)**.

Obviously, you cannot join the pieces back to make the original piece, but is there a change in the property of the paper?

Activity 6.2

Collect the chalk dust lying on the floor near the blackboard in your classroom. Or, crush a small piece of chalk into dust. Add a little water to the dust to make a paste. Roll it into the shape of a piece of chalk. Let it dry.

Did you recover chalk from the dust?

Activity 6.3

Take some ice in a glass or plastic tumbler. Melt a some portion of ice by placing the tumbler in the sun. You have now a mixture of ice and water. Now place the tumbler in a freezing mixture (ice plus

common salt).

Does the water become solid ice once again?

Activity 6.4

Boil some water in a container. Do you see the steam rising from the surface of water? Hold an inverted pan by its handle over the steam at some distance from the boiling water. Observe the inner surface of the pan.

Do you see any droplet of water there?

Activity 6.5

CAUTION

Be careful while handling a flame.

Hold a used hack-saw blade with a pair of tongs. Keep the tip of the free end on the flame of a gas stove. Wait for a few minutes.

Does the colour of the tip of the blade change?

Remove the blade from the flame. Observe the tip once again after some time.

Does it get back its original colour?

In **Activities 6.1** and **6.2** above, you saw that paper and a piece of chalk underwent changes in size. In **Activities 6.3** and **6.4**, water changes its state (from solid to liquid or from gas to liquid). In **Activity 6.5**, the hack-saw blade changed colour on heating.

Properties such as shape, size, colour and state of a substance are called its **physical properties**. A change in which a substance undergoes a change in its physical properties is called a **physical change**. A physical change is generally reversible. **In such a change no new substance is formed.**

Let us consider the other kind of change.

Fig.6.2: Rusting of iron

6.2 CHEMICAL CHANGE

A change with which you are quiet familiar is the rusting of iron. If you keep a piece of iron in the open for some time; it acquires a film of brownish substance. This substance is called **rust** and the process is called **rusting (Fig. 6.2)**. Iron gates of parks or farmlands, iron benches kept in lawns and gardens, and almost every article of iron, kept in the open gets rusted. At home you must have seen shovels and spades getting rusted when exposed to the atmosphere for some time. In the kitchen, a wet iron pan (tawa) often gets rusted if left in that state for sometime. Rust is not iron. It is different from iron on which it gets deposited.

Let us consider a few more changes where new substances are formed.

Activity 6.6

(To be demonstrated by the teacher)

CAUTION

It is dangerous to look for long at the burning magnesium ribbon. The teachers should advise children not to stare at the burning ribbon.

Get a small piece of thin strip or ribbon of magnesium. Clean its tip with sandpaper. Bring the tip near a candle flame. It burns with a brilliant white light **(Fig. 6.3)**. When it is completely burnt it leaves behind a powdery ash.

Does the ash look like the magnesium ribbon?

Fig.6.3: Magnesium ribbon burning

The change can be represented by the following equation:

Magnesium (Mg) + Oxygen (O_2)→ Magnesium oxide (MgO)

The equations here are different from those in mathematics. In equations of this kind, the arrow implies 'becomes'. No attempt should be made to balance chemical equations at this stage.

Collect the ash and mix it with a small amount of water. Stir the mixture

(aqueous solution) well. Test the mixture with blue and red litmus papers.

Does the mixture turn red litmus blue?

Does the mixture turn blue litmus red?

On the basis of this test, how do you classify the aqueous solution - acidic or basic?

On dissolving the ash in water it forms a new substance. This change can be written in the from of the following equation:

Magnesium oxide (MgO) + water (H_2O) → Magnesium hydroxide [$Mg(OH)_2$].

As you have already learnt in Chapter 5, magnesium hydroxide is a base. So, magnesium oxide is a new substance formed on burning of magnesium. Magnesium hydroxide is another new substance formed by mixing magnesium oxide with water.

Activity 6.7

(To be demonstrated by the teacher)

Dissolve about a teaspoonful of copper sulphate (blue vitriol or neela thotha) in about half a cup of water in a glass tumbler or a beaker. Add a few drops of dilute sulphuric acid to the solution. The solution becomes blue in colour. Save a small sample of the solution in a test tube or a small glass bottle. Drop a nail or a used shaving blade into the remaining solution. Wait for half an hour or so. Observe the colour of the solution. Compare it with the colour of the sample solution saved separately **(Fig. 6.4).**

Do you see any change in the colour of the solution?

Take out the nail or the blade.

The changes that you notice are due to a reaction between copper sulphate and iron. The change of colour of the solution

Fig.6.4: Change in colour of the copper sulphate solution due to reaction with iron

from blue to green is due to the formation of iron sulphate, a new substance. The brown deposit on the iron nail is copper, another new substance. We can write the reaction as:

Copper sulphate solution (blue) + Iron →Iron sulphate solution (green) + copper (brown deposit)

Activity 6.8

Take about a teaspoonful of vinegar in a test tube. Add a pinch of baking soda to it. You would hear a hissing sound and see bubbles of a gas coming out. Pass this gas through freshly prepared lime water as shown in **Fig. 6.5.**

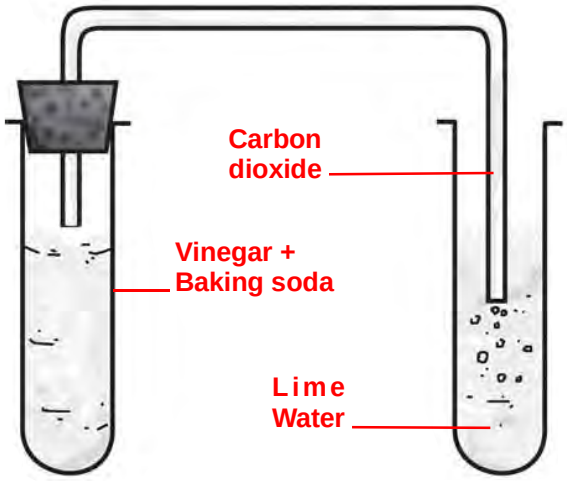


Fig.6.5: Set up to pass gas through lime water

What happens to the lime water?

The change in the test tube is as follows:

Vinegar (Acetic acid)+Baking soda (Sodium hydrogen carbonate) → Carbon dioxide + other substances

The reaction between carbon dioxide and lime water is as follows:

Carbon dioxide (CO_2) + Lime water [$Ca(OH)_2$] → Calcium carbonate ($CaCO_3$) + water (H_2O)

When carbon dioxide is passed through lime water, Calcium carbonate is formed, which makes lime water milky. The turning of lime water into milky appearance is a standard test of carbon dioxide. You will use it in Chapter 10 to show that the air we breathe out is rich in carbon dioxide.

In **Activities 6.6 - 6.8**, you saw that in each change, one or more new substances were formed. In **Activity 6.6**, the ash was the new substance formed when magnesium was burnt. In **Activity 6.7**, the reaction of copper sulphate with iron produced iron sulphate and copper. Both of these are new substances. Copper was deposited on the shaving blade of iron. In **Activity 6.8**, vinegar and baking soda together produced carbon dioxide, which turned lime water milky. Can you name the new substance formed in this reaction?

A change in which one or more new substances are formed is called a chemical change. A chemical change is also called a **chemical reaction**.

Chemical changes are very

important in our lives. All new substances are formed as a result of chemical changes. For example, if a metal is to be extracted from an ore, such as iron from iron ore, we need to carry out a series of chemical changes. A medicine is the end product of a chain of chemical reactions. Useful new materials, such as plastics and detergents, are produced by the chemical reactions. Indeed, every new material is discovered by studying chemical changes.

We have seen that one or more new substances are produced in chemical changes. In addition to new products, the following may accompany a chemical change:

- Heat, light or any other radiation (ultra-violet, for example) may be given off or absorbed.
- Sound may be produced.
- A change in smell may take place or a new smell may be given off.
- A colour change may take place.
- A gas may be formed.

Let us look at some examples.

You saw that burning of magnesium ribbon is a chemical change. Burning of coal, wood or leaves is also a chemical change. In fact, burning of any substance is a chemical change. Burning is always accompanied by production of heat.

Explosion of fire-work is a chemical change. You know that such an explosion produces heat, light, sound and unpleasant gases that pollute the atmosphere. That is way you are advised not to play with fireworks.

When food gets spoiled, it produces a foul smell. Shall we call this change a chemical change?

You must have noticed that a slice of an apple acquires a brown colour if it is not consumed immediately. If you have not seen this change in colour, cut a fresh slice of apple and keep it away for some time. Repeat the same activity with a slice of potato and brinjal. The change of colour in these cases is due to the formation of new substances. Are not these changes chemical changes?

In Chapter 5, you neutralized an acid with a base. Is neutralization a chemical change?

You must have heard of the ozone layer in our atmosphere. It protects us from the harmful ultraviolet radiations which come from the sun. Ozone absorbs this radiation and breaks down to oxygen. Oxygen is different from ozone. Can we call the breakdown of ozone a chemical change?

If ultraviolet radiation were not absorbed by ozone, it would reach the earth's surface and causes harm to us and other life forms. Ozone acts as a natural shield against this radiation.

6.3 RUSTING OF IRON

Let us get back to rusting. This is one change that affects iron articles and slowly destroys them. Since iron is used in making bridges, ships, cars, truck bodies and many other articles, the monetary loss due to rusting is huge.

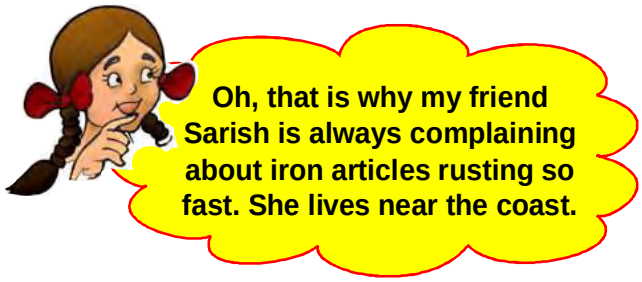
The process of rusting can be represented by the following equation:

Iron (Fe) + Oxygen (O_2, from the air) + water (H_2O) → rust (Iron oxide Fe_2O_3)

For rusting, the presence of both oxygen and water (or water vapour) is essential.

In fact, if the content of moisture in air is high, which means if it is more humid, rusting becomes faster.

So, how do we prevent rusting? Prevent iron articles from coming in contact with oxygen, or water, or both. One simple way is to apply a coat of paint or grease. In fact, these coats should be applied regularly to prevent rusting. Another way is to deposit a layer of a metal like chromium or zinc on iron.



This process of depositing a layer of zinc on iron is called **galvanization.** The iron pipes we use in our homes to carry water are galvanized to prevent rusting.

You know that ships are made of iron and a part of them remains under water. On the part above water also ,water drops keep clinging to the ship's outer surface. Moreover, the water of the sea contains many salts. The salt water makes the process of rust formation faster.

Therefore, ships suffer a lot of damage from rusting in spite of being painted. So much so, that a fraction of ship's iron has to be replaced every year. Can you imagine the monetary loss to the world?

Stainless steel is made by mixing iron with carbon and metal like chromium, nickel, and manganese. It does not rust.

6.4 CRYSTALLISATION

You know that salt can be obtained by the evaporation of sea water. The salt obtained in this manner is not pure and its crystals are small. The shape of the crystals cannot be seen clearly. However, large crystals of pure substances can be formed from their solutions. The process is called **crystallization.** It is an example

of a physical change.

Activity 6.9

(To be performed in the presence of the teacher)

CAUTION

Use only dilute sulphuric acid. Be careful while boiling water.

Take a cupful of water in a beaker and add a few drops of dilute sulphuric acid. Heat the water. When it starts boiling add copper sulphate powder till no more powder can be dissolved. Filter the solution. Allow it to cool. Do not disturb the solution when it is cooling. Look at the solution after some time. Can you see the crystals of copper sulphate? If not, wait for some more time. You have learnt about physical and chemical changes. Try to identify changes that you observe around you as physical or chemical changes.

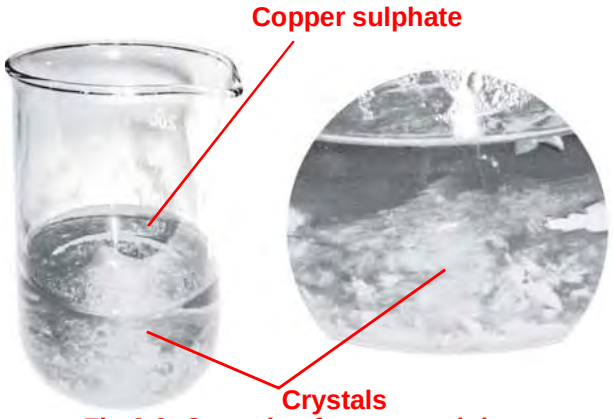


Fig.6.6: Crystals of copper sulphate

KEYWORDS

Chemical change	**Crystallization**	**Physical change**
Chemical reaction	**Galvanization**	**Rusting**

What you have learnt

- Changes can be of two types, physical and chemical.
- Physical changes are changes in the physical properties of substances.
- No new substances are formed in these changes. These changes may be reversible.
- In chemical changes new substances are produced.
- Some substances can be obtained in pure state from their solutions by crystallization.

EXERCISES

1. **Classify the changes involved in the following processes as physical or chemical changes**
   - **(a)** Photosynthesis
   - **(b)** Dissolving sugar in water
   - **(c)** Burning of coal
   - **(d)** Melting of wax
   - **(e)** Beating aluminum to make aluminum foil
   - **(f)** Digestion of food
2. **State whether the following statements are true or false. In case a statement is false, write the corrected statement in your notebook.**
   - **(a)** Cutting a log of wood into pieces is a chemical change. (True /False)
   - **(b)** Formation of manure from leaves is a physical change. (True/False)
   - **(c)** Iron pipes coated with zinc do not get rusted easily. (True/False)
   - **(d)** Iron and rust are the same substances. (True/False)
   - **(e)** Condensation of steam is not a chemical change. (True/False)
3. **Fill in the blanks in the following statements:**
   - **(a)** When carbon dioxide is passed through lime water, it turns milky due to the formation of _____ .
   - **(b)** The chemical name of baking soda is _____.
   - **(c)** Two methods by which rusting of iron can be prevented are _____and_____.
   - **(d)** Changes in which only _____properties of a substance change are called physical changes.
4. When baking soda is mixed with lemon juice, bubbles are formed with evolution of a gas. What type of change is it? Explain.
5. When a candle burns, both physical and chemical changes take place. Identify these changes. Give another example of a familiar process in which both the chemical and the physical changes take place.
6. How would you show that setting of curd is a chemical change?
7. Explain why burning of wood and cutting it into small pieces are considered as

two different types of changes.

8. Describe how crystals of copper sulphate are prepared ?

9. Explain how painting of an iron gate prevents it form rusting ?

10. Explain why rusting of iron objects is faster in coastal areas than in deserts ?

11. The gas we use in the kitchen is called liquified petroleum gas (LPG). In the cylinder it exists as a liquid .When it comes out from the cylinder it becomes a gas (change-A) then it burns (change-B) .The following statements pertain to these changes. Choose the correct one.

(i) Process - A is a chemical change.

(ii) Process - B is a chemical change.

(iii) Both processes A and B are chemical changes.

(iv) None of these processes is a chemical change.

12. Anaerobic bacteria digest animal waste and produce bio gas (change-A).The bio gas is then burnt as fuel (change B). The following statements pertain to these changes.

Choose the correct one.

(i) Process - A is a chemical change.

(ii) Process - B is a chemical change.

(iii) Both processes A and B are chemical changes.

Choose the correct one

13. Rust is

(a) Carbon dioxide (b) Iron

(c) Oxygen (d) Iron oxide.

14. Which of the following is not a physical change?

(a) Rusting of iron (b) Melting of ice

(c) Freezing of water (d) Dissolving sugar in water.

Extended Learning - Activities and Projects

1. Describe two changes that are harmful. Explain why you consider them harmful. How can you prevent them?
2. Take three glass bottles with wide mouths. Label them A, B and C. Fill about

half of bottle A with ordinary tap water. Fill bottle B with water which has been boiled for several minutes, to the same level as in A. In bottle C, take the same boiled water and of the same amount as in other bottles. In each bottle put a few similar iron nails so that they are completely under water. Add a teaspoon ful of cooking oil to the water in bottle C so that it forms a film on its surface. Put the bottles away for a few days. Take out nails from each bottle and observe them. Explain.

3. Prepare crystals of alum.
4. Collect information about the types of fuels used for cooking in your area. Discuss with your teachers / parents / others which fuels are less polluting and why?

DO YOU KNOW?

Near the Qutub Minar in Delhi stands an iron pillar **(Fig. 6.7)** which is more than 7 metres high. It weighs more than 6000kg. It was built more than 1600 years ago. After such a long period it has not rusted. For its quality of rust resistance it has been examined by scientists from all parts of the world. It tells something about the advances India had made in metal technology as back as 1600 years ago.

Fig.6.7 Iron pillar

7 WEATHER, CLIMATE AND ADAPTATIONS OF ANIMALS TO CLIMATE

Do you remember the things that you were asked to pack when you were heading for a hill station? When the sky is cloudy, your parents insist that you carry an umbrella. Have you heard elders in your family discuss the weather before planning a family function? You must have also heard the experts discussing the weather before the start of a game.

Have you ever wondered why? The weather may have a profound effect on the game. It has a profound effect on our lives. Many of our daily activities are planned based on the weather predicted for that day. There are daily reports of the weather on the television and radio and in the newspapers. But do you know what this weather really is?

In this chapter, we will study about the weather and climate. We will also see how different forms of life are adapted to the climate of their habitat.

7.1 WEATHER

In **Fig. 7.1,** a sample of weather report from a newspaper is given.

We find the daily weather report carries information about the temperature, humidity and rainfall during the past 24 hours. It also predicts the weather for the day. Humidity, as you might know, is a measure of the moisture in air.

WEATHER

Max 16.1°C /Min 2.6°C
Sunset: Tuesday - 5.41 pm
Sunrise: Wednesday -7.15 am
Moonset: Wednesday - 11.13 am
Moonrise: Tuesday - 11.05 pm
Mist/Fog in the morning. Partly cloudy sky. Min temp will be around **4°C.** Max humidity on Monday **83%** and Min **37%**

Fig.7.1: A sample of a weather report from a newspaper

The weather reports are prepared by the Meteorological Department of the Government. This department collects data on temperature, wind, etc., and makes the weather prediction.

Activity 7.1

Cut out the weather reports of the last week from any newspaper. If you do not get a newspaper at home, borrow from your neighbours or friends and copy these reports in your notebook. You can also collect weather reports from a library. Paste all the cut-outs on a white sheet or on a chart paper.

Now record the information from the weather reports collected by you in **Table 7.1.** The first row is just a sample. Fill all the columns according to the data in the chart that you have prepared.

Rainfall is measured by an instrument called the rain gauge. It is basically a measuring cylinder with a funnel on top to collect rainwater.

Do all the seven days have the same maximum and minimum temperatures, humidity and rainfall? The maximum and minimum temperatures recorded may be the same for some of the days. However, all the parameters are not the same on any two days. Over a week there may be considerable variation. **The day-to-day condition of the atmosphere at a place with respect to the temperature, humidity, rainfall, wind speed, etc., is called the weather at that place.** The temperature, humidity, and other factors are called the elements of the weather. The weather of a place changes day after day and week after week. That is why we often say. “today's weather is too humid", or “the weather was warm last week”.

Table 7.1

Weather data of a week

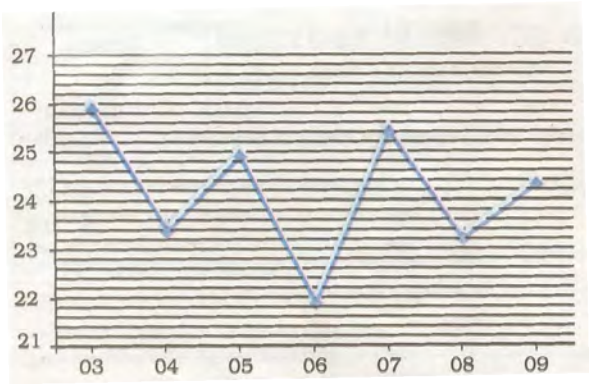
Date	Max. temp.(^{0}C)	Min. temp.(^{0}C)	Min. humidity (%)	Max. humidity(%)	Rainfall* (mm)
23-08-06	36.2	27.8	54	82	

*(Rainfall may not be recorded for all the days since it may not rain every day. Leave the space for rainfall blank if the data is not available.)

The weather is such a complex phenomenon that it can vary over very short periods of time. It can happen sometimes that it is sunny in the morning, but suddenly clouds appear from nowhere and it starts raining heavily. Or, a heavy rain may vanish in a matter of minutes and give way to bright sunshine. You must have had several such experiences. Try to recall any such experience and share it with your friends. Since weather is such a complex phenomenon, it is not easy to predict.

Look at the graph below which shows the maximum temperature recorded during 03 August 2006 to 09 August, 2006 at Shillong, Meghalaya **(Fig.7.2)**.

As it is clear from any weather report, the maximum and minimum temperatures are recorded everyday. Do you know how these temperatures are recorded. In chapter 4 you have learnt that there are special thermometers for this purpose, called **maximum and minimum thermometers.** Can you

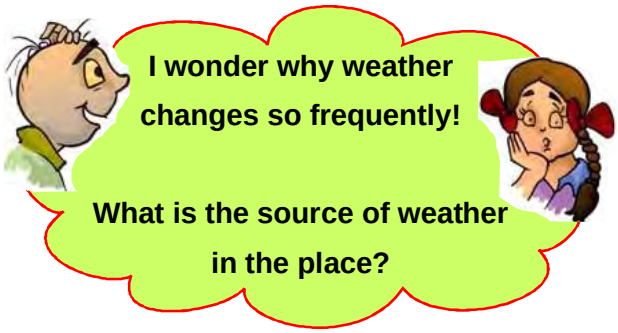


Date	Maximum temperature
03.08.06	26.0°C
04.08.06	23.5°C
05.08.06	25.0°C
06.08.06	22.0°C
07.08.06	25.5°C
08.08.06	23.3°C
09.08.06	24.4°C

Fig.7.2: Graph showing the variation of maximum temperature during 03 to 09 August, 2006

All changes in the weather are caused by the **sun.** The sun is a huge sphere of hot gases at a very high temperature. The distance of the sun from us is very large. Even then the energy sent out by the sun is so huge that it is the source of all heat and light on the earth. So, the sun is the primary source of energy that causes changes in the weather. Energy absorbed and reflected by the earth's surface, oceans and the atmosphere play important roles in determining the weather at any place. If you live near the sea, you would have realized that the weather at your place is different from that of a place in a desert, or near a mountain

guess when during the day we have the maximum temperature and when the minimum?



The maximum temperature of the day occurs generally in the afternoon while the minimum temperature occurs generally in the early morning. Can you now understand why in summers we feel so miserable in the afternoon and comfortable early in the morning?

What about the times of sunrise and sunset? You know that in winters it becomes dark early and you do not get much time to play. Are the days shorter in winter than summer? Try to find it out yourself by completing the project given at the end of the chapter.

7.2 CLIMATE

Meteorologists record the weather everyday. The records of the weather have been preserved for the past several decades. These help us to determine the weather pattern at a place. **The average weather pattern taken over a long time, say 25 years, is called the climate of the place.** If we find that the temperature at a place is high most of the time, then we say that the climate of that place is hot. If there is also heavy rainfall on most of the days in the same place, then we can say that the climate of that place is hot and wet.

In **Table 7.2 and 7.3** we have given the climate condition at two places in India. The mean temperature for a given month is found in two steps. First we find the average of the temperatures recorded during the month. Second, we calculate the average of such average temperatures over many years. That gives the mean temperature. The two places are: Srinagar in Jammu and Kashmir, and Thiruvananthapuram in Kerala.

By looking at **Tables 7.2 and 7.3** we can easily see the difference in the climate of Jammu and Kashmir and Kerala. We can see that Kerala is very hot and wet in comparison to Jammu and Kashmir, which has a moderately hot and wet climate for a part of the year.

Similar data for the western region of India, for example Rajasthan, will show the temperature is high during most part of the year. But during winter, which lasts only for a few months, the

Table 7.2: Srinagar (Jammu & Kashmir) Information about climate

Month	Mean Temperature °C		Mean total rainfall (mm)
	Daily minimum	Daily maximum	
Jan	-2.3	4.7	57
Feb	-0.6	7.8	65
Mar	3.8	13.6	99
Apr	7.7	19.4	88
May	10.7	23.8	72
Jun	14.7	29.2	37
July	8.2	30.0	49
Aug	17.5	29.7	70
Sep	12.9	27.8	33
Oct	6.1	21.9	36
Nov	0.9	14.7	27
Dec	-1.6	8.2	43

Table 7.3: Thiruvananthapuram (Kerala) Information about Climate

Month	Mean Temperature °C		Mean total rainfall (mm)
	Daily minimum	Daily maximum	
Jan	22.2	31.5	23
Feb	22.8	31.9	24
Mar	24.1	32.6	40
Apr	24.9	32.6	117
May	24.7	31.6	230
Jun	23.5	29.7	321
July	23.1	29.2	227
Aug	23.2	29.4	138
Sep	23.3	30.0	175
Oct	23.3	29.9	282
Nov	23.1	30.3	185
Dec	22.6	31.0	66

(Note: The numbers for the mean total rainfall have been rounded off)

temperature is quite low. This region receives very little rainfall. This is the typical desert climate. It is **hot and dry.** The northeastern India receives rain for a major part of the year. Therefore, we can say that the climate of the north-east is **wet.** In our state climatic conditions are different at different places. In Jammu region temperature at times shoot upto 46 °C. On the contrary in Ladakh temperature falls as low as -23 °C.

7.3 CLIMATE AND ADAPTATION

Climate has a profound effect on living organisms.

Animals are adapted to survive in the conditions in which they live. Animals living in very cold and hot climate must possess special features to protect themselves against the extreme cold or heat. Recall from your class VI science book the definition of adaptation. Features and habits that help animals to adapt to their surroundings are a result of the process of evolution.

In chapter 9 you will learn about the effect of weather and climate on soil. Here we will study the effect of climate on animals only. In class VI, you have read about adaptations of animals to certain habitats. As examples of adaptation of animals to climatic conditions, we discuss

only animals living in Polar Regions and tropical rainforests.

Some animals that have adapted to the Himalayan climate include the mountain goat, which has a thick wat for warmth and strong hooves for running up the rocky slopes.

The wild Yak is a bulky species with high capacity and a thick coat which are adaptations to the high altitude environment of Tibet.

As the name suggests, the Polar Regions are situated near the poles, i.e., north pole and south pole.

Some well-known countries that belong to the polar regions are Canada, Greenland, Iceland, Norway, Sweden, Finland, and Alaska in U.S.A. and Siberian region of Russia.

Examples of some countries where the tropical rainforests are found are India, Malaysia, Indonesia, Brazil, Republic of Congo, Kenya, Uganda, and Nigeria.

Activity 7.2

Take an outline map of the world. Mark the polar regions in blue. Similarly, mark the tropical regions in red.

(i) The Polar Regions

The polar regions present an extreme climate. These regions are covered with snow and it is very cold for most part of the year. For six months the sun does not set at the poles while for the other six months the sun does not rise. In winters, the temperatures can be as low as-37^{o}C. Animals living there have adapted to these severe conditions. Let us see how they are adapted by considering the examples of polar bears and penguins.

Polar bears have white fur so that they are not easily visible in the snowy white background. It protects them from their predators. It also helps them in catching their prey. To protect them from extreme cold, they have two thick layers of fur. They also have a layer of fat under their skin. In fact, they are so well-insulated that they have to move slowly and rest often to avoid getting overheated.

Physical activities on warm days necessitate cooling. So, the polar bear goes for swimming. It is a good swimmer. Its paws are wide and large, which help it not only to swim well but also walk with ease in the snow. While swimming under water, it can close its nostrils and can remain under water for long durations. It has a strong sense of smell so that it can catch its prey for food. We can understand the adaptations of polar bears with the

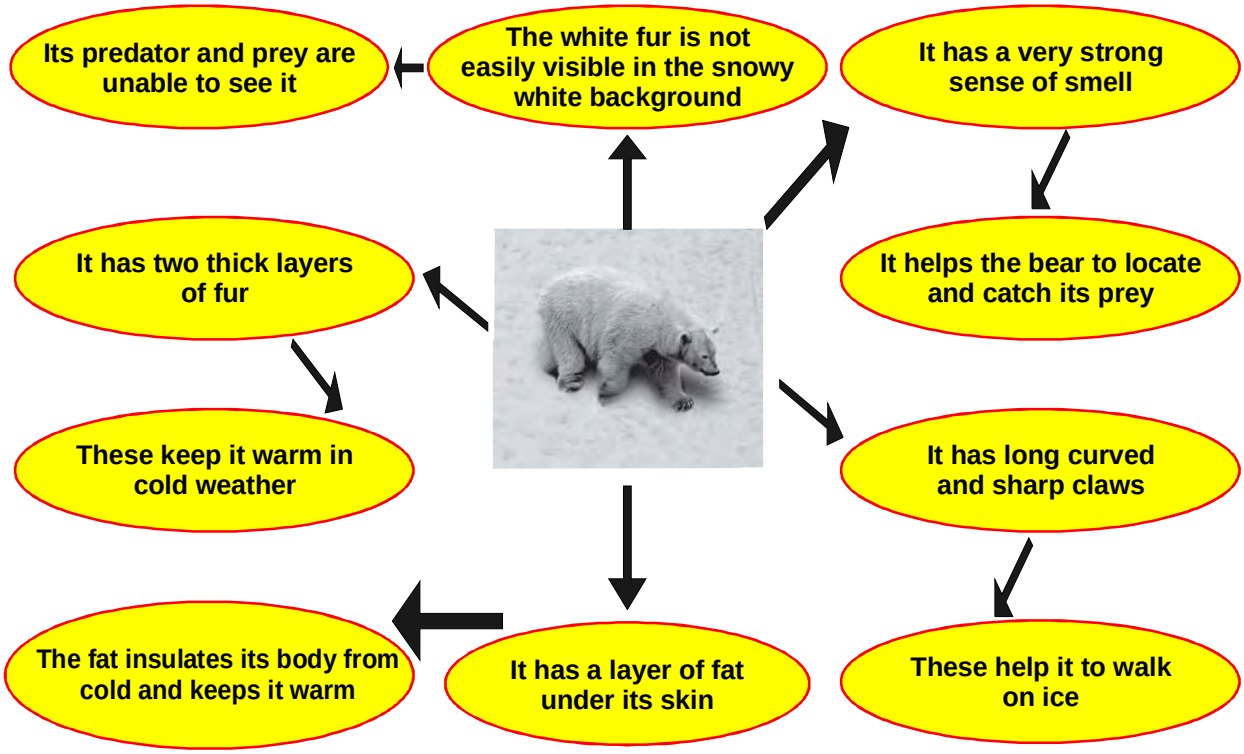


Fig. 7.3: Adaptations of polar bear

Fig. 7.4: Penguins huddled together

Fig. 7.5: Feet of Penguin

help of the flow chart shown in **Fig 7.3.**

Another well-known animal living in the polar regions is the penguin **(Fig. 7.4).** It is also white and merges well with the white background. It also has a thick skin and a lot of fat to protect it from cold.

You may have seen pictures of penguins huddled together. This they do to keep warm. Recall how warm you feel when you are in a hall full of people.

Like polar bears, penguins are also good swimmer. Their bodies are

streamlined and their feet have webs, making them good swimmers **(Fig. 7.5)**.

Other animals living in the polar regions are many types of fishes, musk oxen, reindeers, foxes, seals, whales, and birds. It is to be noted that while fish can remain under cold water for long, birds must remain warm to survive. They migrate to warmer regions when winter sets in. They come back after the winter is over. You know probably that India is one of the destinations of many of these birds. You must have seen or heard about the Siberian crane that comes from Siberia to places like Bharatpur in Rajasthan and Sultanpur in Haryana, Gharana netland in Jammu and some wetlands of north east and some other parts of India **(Fig.7.6).**

Fig.7.6: Migratory birds in their habitat/ Migratory birds in flight.

The ladakh region is home to many rare Himalayan birds including Tibetan Snowcocks, griffon vultures and bearded vultures which have a 3 m long wingspan. Many migratory birds are seen in Ladakh including the graceful Black-necked crane, which can be seen flying in distinctive V-shaped formation across the clear Himalayan sky.

There is an estimated 1.3 million migratory birds in various wetlands of the valley this year. The birds migrate from Central Asia and China, Siberia and Eastern Europe.

Avian visitors migrate to three famous wetlands in valley viz; Haygam, Hokersar and Shalibag. The other prominent destination for the migratory birds in the valley is at Mirgund.

Kashmir's Largest Wetland Reserve is **Shallabagh Wetland Reserve**.

In the 29 wetlands surveyed in J&K, 106 species of birds were observed, of which 25 species were land birds, occassionally visiting the wetlands, especially the drier parts. The highest number of species (43) was in Tokhar Tso in Ladakh region. Two threatened species, namely the Blacknecked Crane (at 3 sites in Ladakh) and Sarus Crane (at Gharana, R.S. Pura) and nearly two threatened species, viz. white-eyed Pochard (at 7 wetlands in state) and White ibis (at 2 wetlands in Jammu) were observed.

There is a blanket ban on bird shooting in the state. Most of the bird poaching reports during the winter came from north Kashmir, Baramulla district where poachers reportedly shot many birds in the Wullar Lake under the cover of darkness using guns loaded on their boats.

Infact the migratory birds could be purchased at many places in North Kashmir confirming (Poal Specific) that poaching had not completely stopped.

(ii) The Tropical Rainforests:

The tropical region has generally a hot climate because of its location around the equator. Even in the coldest month the temperature is generally higher than about 15^0C. During hot summers, the temperatures may cross 40^0C. Days and nights are almost equal in length throughout the year. These regions get plenty of rainfall. An important feature of this region is the tropical rainforest. Tropical rainforests are found in Western Ghats and Assam in India. Southeast Asia, Central America and Central Africa. Because of continuous warmth and rain, this region supports wide variety of plants and animals. The major types of animals living in the rainforests are monkeys, apes, gorillas, lions, tigers, elephants, leopards, lizards, snakes, birds and insects.

Let us read about the adaptations of these animals to a hot, humid climate.

The climatic conditions in rainforests are highly suitable for supporting an enormous number and variety of animals. Since the numbers are large, there is intense competition for food and shelter. Many animals are adapted to living on the trees. Red- eyed frog **(Fig. 7.7)** has developed sticky pads on its feet to help it climb trees on which it lives. To help them live on the trees, monkeys **(Fig. 7.8)** have long tails for grasping branches. Their hands and feet are such that they can easily hold on to the branches.

Fig.7.7: Red-eyed frog

Fig.7.8: A new world monkey

As there is competition for food, some animals are adapted to get food not easily reachable. A striking example is that of the bird Toucan **(Fig. 7.9)**, which possesses a long, large beak. This helps a Toucan to reach the fruits on branches which are otherwise too weak to support its weight.

Fig.7.9: Toucan

Many tropical animals have sensitive hearing, sharp eyesight, thick skin and a skin colour which helps them to camouflage by blending with the surrounding. This is to protect them from predators. For example, big cats (lions and tigers) have thick skins and sensitive hearing.

The lion- tailed macaque (also called Beard ape) lives in the rainforest of Western Ghats **(Fig.7.10)**. Its most outstanding feature is the silver- white mane, which surrounds the head from the cheeks down to its chin. It is a good climber and spends a major part of its life on the tree. It feeds mainly on fruits. It also eats seeds, young leaves, stems, flowers

and buds. This bearded ape also searches for insects under the bark of the trees. Since it is able to get sufficient food on the trees, it rarely comes down on the ground.

Fig.7.10: Lion-tailed macaque

Another well- known animal of Indian tropical rainforest is the elephant **(Fig.7.11)**. It has adapted to the conditions of rainforests in many remarkable ways. Look at its trunk. It uses it as a nose because of which it has a strong sense of smell. The trunk is also used by it for picking up food. Moreover, its tusks are modified teeth. These can tear the bark of trees that elephant loves to eat. So, the elephant is able to handle the competition for food rather well. Large ears of the elephant help it to hear even very soft sounds.

Fig.7.11: An Indian elephant

They also help the elephant to keep cool in the hot and humid climate of the rainforest.

KEYWORDS

Adaptation	Maximum Temperature	Tropical rainforest
Climate	Migration	Tropical region
Elements of weather	Minimum temperature	Weather
Humidity	Polar region	

What you have learnt

- The day- to- day condition of the atmosphere at a place with respect to the temperature, humidity, rainfall, wind- speed, etc., is called the weather at that place.
- The weather is generally not the same on any two days and week after week.
- The maximum temperature of the day occurs generally in the afternoon while the minimum temperature occurs in the early morning.
- The times of sunrise and sunset also change during the year.
- All the changes in the weather are driven by the sun.
- The average weather pattern taken over a long time, say 25 years is called the climate of the place.
- The tropical and the polar regions are the two regions of the earth, which have severe climatic conditions.
- Animals are adapted to the conditions in which they live.
- The polar regions are very cold throughout the year. The sun does not set for six months in a year and in the other six months it does not rise.
- Animals in the polar region are adapted to the extremely cold climate by having some special characteristics such as white fur, strong sense of smell, a layer of fat under the skin, wide and large paws for swimming and walking, etc.
- Migration is another means to escape the harsh, cold conditions.
- Because of the hospitable climatic conditions, huge populations of plants and animals are found in the tropical rainforests.
- Animals in the tropical rainforests are adapted such that they eat different kind of food to overcome the competitions for food and shelter.

- Some adaptations of animals living in the tropical rainforests include living on the trees, development of strong tails, long and large beaks, bright colours, sharp patterns, loud voice, diet of fruits, sensitive hearing, sharp eyesight, thick skin, ability to camouflage in order to protect themselves from predators, etc.

EXERCISES

1. Name the elements that determine the weather of a place.

2. When are the maximum and minimum temperatures likely to occur during the day?

3. **Fill in the blanks:**

(i) The average weather taken over a long time is called _____

(ii) A place receives very little rainfall and the temperature is high throughout the year, the climate of that place will be_____and _____

(iii) The two regions of the earth with extreme climatic conditions are _____ and _____

4. **Indicate the type of climate of the following areas:**

(a) Jammu and Kashmir: _____

(b) Kerala: _____

(c) Rajasthan: _____

(d) North-east India: _____

5. Which of the two changes frequently, weather or climate?

6. Following are some of the characteristics of animals:

(i) Diets heavy on fruits **(ii)** White fur

(iii) Need to migrate **(iv)** Loud voice

(v) Sticky pads on feet **(vi)** Layer of fat under skin

(vii) Wide and large paws **(viii)** Bright colours

(ix) Strong tails **(x)** Long and large beak

For each characteristic, indicate whether it is adaptation for tropical rainforests or polar regions. Do you think that some of these characteristics can be adapted for both regions?

7. The tropical rainforest has a large population of animals. Explain why it is so?

8. Explain, With examples, why we find animals of certain kind living in particular climatic conditions?

9. How do elephant living in the tropical rainforest adapt itself.

Choose the correct option which answers the following questions:

10. A carnivore with stripes on its body moves very fast while catching its prey. It is likely to be found in

(i) polar regions **(ii)** deserts

(iii) oceans **(iv)** tropical rainforests

11. Which features adapted polar bears to live in extremely cold climate?

(i) A white fur, fat below skin, keen sense of smell.

(ii) Thin skin, large eyes, a white fur.

(iii) A long tail, strong claws, white large paws.

(iv) White body, paws for swimming, gills for respiration.

12. Which option best describes a tropical region?

(i) Hot and humid

(ii) Moderate temperature, heavy rainfall

(iii) Cold and humid

(iv) Hot and dry

Extending Learning - Activities and Projects

1. Collect weather reports of seven successive days in the winter months (preferably December). Collect similar reports for the summer months (preferably June). Now prepare a table for sunrise and sunset times as shown:

Table

June			December		
Date	Sunrise	Sunset	Date	Sunrise	Sunset

Try to answer the following questions:

(i) Is there any difference in the time of sunrise during summer and winter?

(ii) When do you find that the sun rises earlier?

(iii) Do you also find any difference in the time of sunset during the month of June and December?

(iv) When are the days longer?

(v) When are the nights longer?

(vi) Why are the days sometimes longer and sometimes shorter?

(vii) Plot the length of the day against the days chosen in June and December.

2. Collect information about the Indian Meteorological Department. If possible visit its website: http// www.imd.gov.in.
Write a brief report about the things this department does.

DO YOU KNOW?

Rainforests cover about 6% of the earth's surface, but they have more than half of the animal life and about two thirds of the flowering plants of the planet. However, much of this life is still unknown to us.

8 WINDS, STORMS AND CYCLONES

Orrisa was hit by a cyclone with wind Speed of 200 km/hr on 18 October, 1999. The cyclone smashed 45,000 houses making 7,00,000 people homeless. On 29 October the same year, a second cyclone with a speed of 260 km/hr hits Orrisa again. It was accompanied by water waves about 9m high. Thousands of people lost their lives. Property worth crores of rupees was destroyed. The cyclone affected agriculture, transport, communication, and electricity supply.

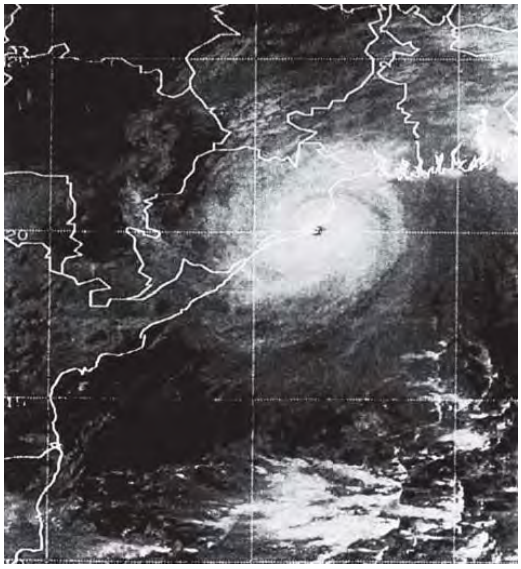


Fig. 8.1: Image taken by a satellite of a cyclone approaching the coast of Orissa

Courtesy : India Meteorological Department, New Delhi

But what are cyclones? How are they formed? Why are they so destructive? In this chapter we shall seek answers to some of these questions.

We begin with some activities involving air. These activities will clarify some basic features concerning a cyclone. Before we begin, remember that the moving air is called the **wind.**

8.1 AIR EXERTS PRESSURE

Activity 8.1

Whenever an activity involves heating, be careful. It is advised that such activities are performed in the presence of an elderly person from your family. Or, carry out these activities in the presence of your teacher.

You need to boil water in the following activity.

Take a tin can with a lid. Fill it approximately half with water. Heat the can on a candle flame till the water boils. Let the water boil for a few minutes. Blow out the candle. Immediately put the lid tightly on the can. Put the can carefully in

a shallow metallic vessel or a washbasin. Pour fresh water over the can. What happens to the shape of the can?

Fig. 8.2 : Can with hot water being cooled

Can you guess why the shape of the can got distorted?

If you cannot get a tin can, take a soft plastic bottle. Fill it with hot water. Empty the bottle and immediately cap it tightly. Place the bottle under running water.

Recall some of your experiences. When you fly a kite, does the wind blow from behind you?

Do you find it difficult to ride a bicycle against the direction of the wind.

You know that we have to fill air into the bicycle, tube overfilled with air must burst. What is the air doing inside the tube?

Discuss with your friends how the air in the bicycle tube keeps it in shape.

All these experiences show that the air exerts pressure. It is due to this pressure that the leaves of trees, banners, or flags flutter when the wind is blowing. You can list some more experiences which shows that the air has pressure.

Let us now try to explain why the can (or the bottle) gets distorted. As water is poured over the can, some steam in the can condenses into water, reducing the amount of the air inside. The pressure of air inside the can decreases the pressure exerted by the air from outside the can. As a result the can gets compressed.

This activity again confirms that air exerts pressure.

8.2 HIGH SPEED WINDS ARE ACCOMPANIED BY REDUCED AIR PRESSURE

ACTIVITY 8.2

Crumble a small piece of the paper into a ball of size smaller than the mouth of an empty bottle. Hold the empty bottle on its side and place the paper ball just inside its mouth. Now try to blow on the ball to force it into the bottle. Try the activity with bottle of different size. Challenge your friends if they can force the paper ball in by blowing into the bottle.

Saba and Yasir are thinking about the following question:

Why is it difficult to force the paper ball into the bottle?

Fig. 8.3 : Blowing into the bottle

ACTIVITY 8.3
Blow the balloons

Take two balloons of approximately equal size. Put a little water into the balloons.

Fig. 8.4 : Blowing between the balloons

Blow up the balloons and tie each one to a string. Hang the balloons 8-10 cm apart on a cycle spoke or a stick. Blow in the space between the balloons.

What did you expect? What happens?

Try different ways of blowing on the balloons to see what happens.

ACTIVITY 8.4
Can you blow and lift ?

Hold a strip of paper, 20cm long and 3cm wide, between your thumb and forefinger as shown in **Fig.8.5**. Now blow over the paper.

Saba thinks that strip will be lifted up. Yasir thinks that the strip will bend down.

Fig. 8.5 : Blowing over a strip of paper

What do you think will happen to the paper?

Let us try to understand the observations in **Activity 8.2, 8.3 and 8.4**.

Were the observations along the lines you thought? Do you get the feeling that the increased wind speed is accompanied by a reduced air pressure?

When we blow into the mouth of the bottle, the air near the mouth has higher speed. This decreases the pressure there. The air pressure inside the bottle is higher than near the mouth. The air inside the bottle pushes the ball out.

In **Activity 8.3** you saw that when you blew between the balloons, they moved towards each other. How could this happen? This could happen if the pressure of air between the balloons were somehow reduced. The pressure outside the balloons would then push them towards each other.

In **Activity 8.4** you saw that when you blew over the paper strip, it went upwards. Again, this could happen if blowing over the paper reduced the air pressure above the strip.

We see that the **increased wind speed is, indeed, accompanied by a reduced air pressure.**

Can you imagine what would happen if high-speed winds blew over the roofs of buildings? If the roofs were weak, they could be lifted and blown away. If you have any such experience, share it with your friends.

Let us try to understand how winds are produced, how they bring rain and how they can be destructive sometimes.

You already know that when air moves, it is called wind. **Air moves from the region where the air pressure is high to the region where the pressure is low.** The greater the difference in pressure, the faster the air moves. But how are the pressure differences created in nature? Is the difference in temperature involved? The following activities will help you to understand this.

Fig. 8.6 : The shape of the balloon depicting hot and cold water

8.3 AIR EXPANDS ON HEATING

Activity 8.5

Take a boiling tube. Stretch a balloon tightly over the neck of the tube. You can use a tape to make it tight. Pour

some hot water in a beaker. Insert the boiling tube with the balloon in the hot water. Observe for 2-3 minutes for any change in the shape of the balloon. Take the tube out, let it cool down to the room temperature. Take some ice cold water in another beaker and place tube with the balloon in cold water for 2-3 minutes. Observe the change in the shape of the balloon.

Think and try to answer :

What makes the balloon deflated when the boiling tube is placed in hot water?

Can we infer from the first observation that air expands on heating? Can you now state what happens to the air in the boiling tube when it cools down?

The next activity is very interesting. This will make you understand more about hot air.

ACTIVITY 8.6

CAUTION
Handle the burning candle carefully.

Take two paper bags or empty paper cups of the same size. Hang the two bags in the inverted position on the two ends of a metal or wooden stick.

Tie a piece of thread in the middle of the stick. Hold the stick by the thread **(Fig. 8.7)** as in a balance. Put a burning candle below one of the bags as shown in the figure. Observe what happens. Why is the balance of the bags disturbed?

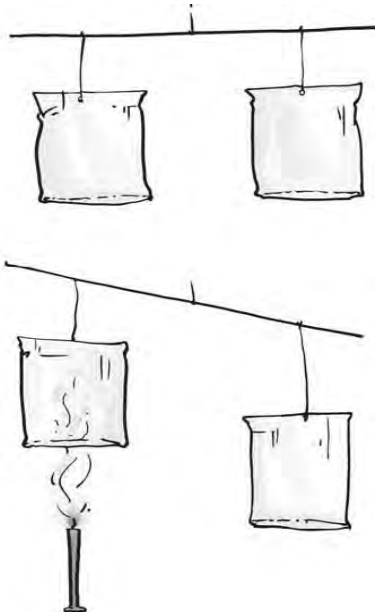


Fig. 8.7 : Hot air rising up

Does this activity indicate that warm air rises up? As the warm air rises up, it pushes the bag above the candle. Does the disturbance of the balance suggest that the warm air is lighter than the cold air?

Can you now explain why smoke always rises up?

Also, it is important that on heating the air expands and occupies more space. When the same thing occupies more space, it becomes lighter. **The warm air is,** therefore, **lighter than the cold air.** That is the reason why smoke goes up.

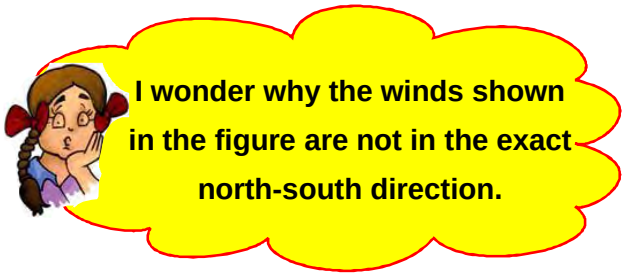
8.4 WIND CURRENTS ARE GENERATED DUE TO UNEVEN HEATING ON THE EARTH

These situations are:

(A) Uneven heating between the equator and the poles

You might have learnt in Geography that region close to the equator get maximum heat from the sun. The air in these regions gets warm. The warm air rises up, and the cooler air from the regions in the 0-30 degrees latitude belt on either side of the equator moves in. These winds blow from the north and the south towards the equator. At the poles, the air is colder than that at latitudes about 60 degrees. The warm air at these latitudes rises up and the cold wind from the polar regions rushes in, to take its place. In this way, wind circulation is set up from the poles to the warmer latitudes, as shown in **Fig. 8.8.**

Fig. 8.8 : The wind flow pattern because of uneven heating on the earth.



The winds would have flown in the north-south direction from north to south, or from south to north. A change in directions is however, caused by the rotation of the earth.

(B) Uneven heating of land and water

You have read about the sea breeze in Chapter 4.

In summer, near the equator the land warms up faster and most of the time the temperature of the land is higher than that of the water in oceans. The air over the land gets heated and rises. This causes the winds to flow from oceans towards the land. These are monsoon winds **(Fig. 8.9).**

The word monsoon is derived from the Arabic word 'mausam' which means 'season'.

In winter, the direction of the wind flow gets reversed; it flows from the land to ocean **(Fig. 8.10).**

I want to know what these winds do for us.

The winds from the ocean carry water and bring rain. It is a part of the water cycle.

The monsoon winds carry water and it rains.

Clouds bring rain and give happiness. Farmers in our country depend mainly on rains for their harvests. There are many folk songs associated with clouds and rain. Sing and enjoy with your friends, if you know such a song. Here is one for you.

Roaring clouds across the sky
Tell us that monsoon's here
Dark and floating clouds then pour
Raindrops every where.
Clouds make lightning flash overhead.
And irrigate fields with rain.
Clouds make earth, its fragrance spreads
When wet with drops of rain,
Rising from the ocean vast
Clouds fill up with rain.
Rain to ocean, back at last
To mingle with ocean again!

However, it is not always a happy ending. Rains often create problems.

Can you list some of the problems?

You can discuss the causes and solution of the problem with your teacher and parents.

In nature itself there are certain situations that can sometimes create disaster and pose threat to humans, animals and plant life.

Let's study two such situations - **thunderstorm** and **cyclones**.

Fig. 8.9 : Uneven heating of land especially the Rajasthan desert generates monsoon winds from **Southwest** direction in **summer**. These winds carry lots of water from the Indian Ocean.

Fig. 8.10 : Uneven heating of land and water in **winter** generates winds from the **northwest** colder land. These colder winds carry little water, hence small amount of rain in winter.

DO YOU KNOW?

The energy possessed by Wind is called 'Wind Energy'. Denmark is called the country of 'Winds'. More than 25% of their electricity needs are generated through windmills. Germany ranks first whereas India ranks fifth in harnessing wind energy. About 45,000 MW power can be generated if India's wind potential is fully exploited.

Largest Wind energy farm in India is near Kanyakumari in Tamil Nadu and it generates 380 MW of electricity.

8.5 THUNDERSTORMS AND CYCLONES

Thunderstorms develop in hot, humid tropical areas like India very frequently. The rising temperatures produce strong upward rising winds. These winds carry water droplets upwards, where they freeze, and fall down again. The swift movement of the falling water droplets along with the rising air creates lightning and sound. It is this event that we call a **thunderstorm.** You will read about lightning in higher classes

If a storm is accompanied by lightning, we must take the following precautions:

- Do not take shelter under an isolated tree. If you are in a forest take shelter under a small tree. Do not lie on the ground.
- Do not take shelter under an umbrella with a Metallic end.
- Do not sit near a window. Open garages, storage sheds, metal sheds are not safe places to take shelter.
- A car or a bus is a safe place to take shelter.
- If you are in water, get out and go inside a building.

How a thunderstorm becomes a cyclone

You know that water requires heat when it changes from liquid to vapour state. Does the water give back heat when vapour condenses into liquid? Can you recall any experience to support this?

Structure of a Cyclone

The centre of a cyclone is calm area. It is called the **eye** of the storm. A large cyclone is a violently rotating mass of air in the atmosphere, 10 to 15 km high. The diameter of the eye varies from 10 to 30 km **(Fig. 8.11)**. It is a region free of clouds and has light winds. Around this calm and clear eye **(Fig. 8.12)**, there is a cloud region of about 150 km in size. In this region there are high-speed winds (150-250 km/h) and thick clouds with heavy rain. Away from this region the wind gradually decreases. The formation of a cyclone is a very complex process. A model is shown in **Fig. 8.11.**

Before cloud formation, water takes up heat from the atmosphere to change into vapour. When water vapour changes back to liquid form as raindrops, this heat is released in the atmosphere. The heat released in the atmosphere warms the air around. This air tends to rise and causes a drop in pressure. More air rushes to the centre of the storm. This cycle is repeated. The chain of events ends with the formation of a very low-pressure system with very high-speed winds revolving around it. It is this weather condition that we call a **cyclone.** Factors like wind speed, wind direction, temperature and humidity contribute to the development of cyclones.

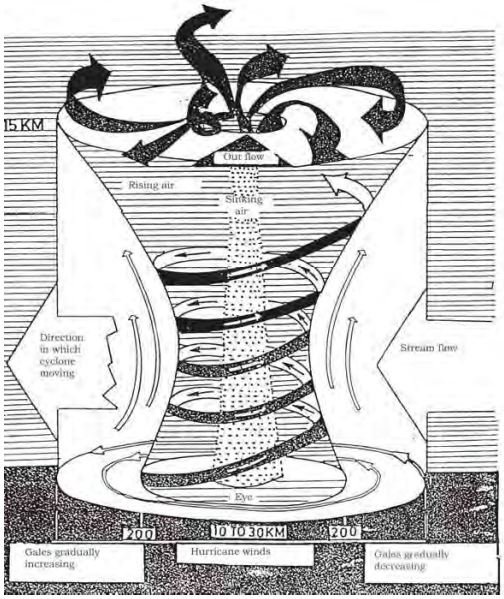


Fig. 8.11 : Formation of a cyclone

8.6 DESTRUCTION CAUSED BY CYCLONES

Cyclone can be very destructive. Strong winds push water towards the shore even if the storm is hundreds of kilometers away. These are the first indications of an approaching cyclone.

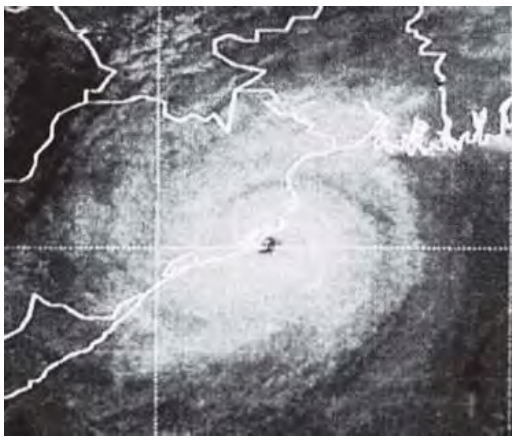


Fig. 8.12 : The image of the 'eye' of a cyclone

Fig. 8.13 : Rising water caused by a cyclone.
Courtesy : India Meteorological Department, New Delhi

The water produced by the wind are so powerful that a person cannot overcome them.

The low pressure in the eye lifts water surface in the centre. The rising water may be high as 3-12 meters **(Fig. 8.13).** It appears like a water-wall moving towards the shore. As a result, the seawater enters the low-laying coastal areas, causing severe loss of life and property. It also reduces the fertility of the soil.

Continuous heavy rainfall may further worsen the flood situation.

High-speed winds accompanying a cyclone can damage houses, telephones and other communication systems, trees, etc., causing tremendous loss of life and property.

A cyclone is known by different names in different parts of the world. It is called a **'hurricane'** in the American continent. In Philippines and Japan it is called a **'typhoon' (Fig. 8.14).**

The diameter of a tornado can be as small as a metre and as large as a km, or even wider. The funnel of a tornado sucks dust, debris and everything near it at the base (due to low pressure) and throws them out near the top. Here are a few accounts of the survivors of tornados - (from Discovery Channel's "Young Discovery Series") .

"I saw the cloud coming and tried to take shelter inside. But as soon

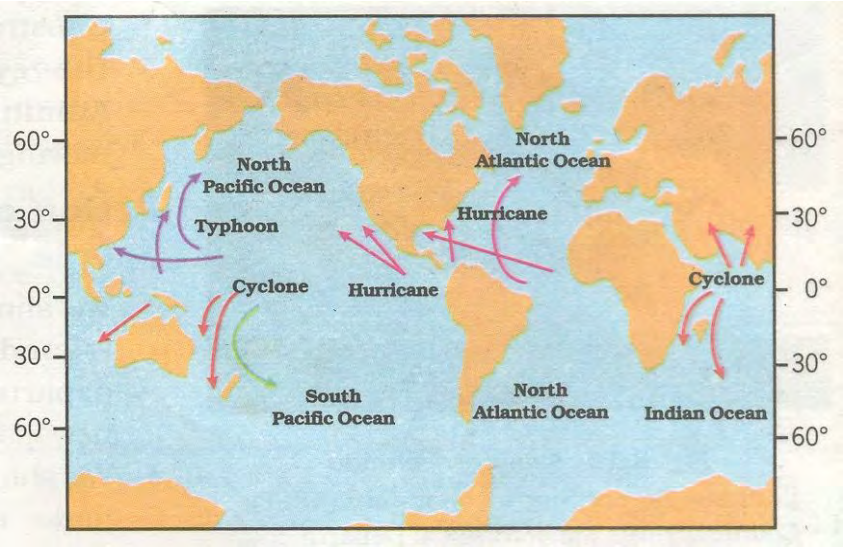


Fig. 8.14 :Regions near the equator where cyclones exist.

as I reached for the doorknob, the house took off into the sky. I was not hurt at all."

Fig. 8.15 : Protecting from a tornado

"After the storm we had to clean the debris from the wheat fields. We picked up splintered boards and tree branches as well as dead chickens with their feathers blown off and rabbits looked like they had been skinned."

A tornado shelter is a room situated deep inside or underground having no windows. Or otherwise it is better to shut windows and take shelter under a table, workbench, where debris cannot reach. One has to bow down on knees protecting head and neck using arms **(Fig. 8.15).**

Tornadoes: In our country they are not very frequent. A tornado is a dark funnel shaped cloud that reaches from the sky to the ground **(Fig. 8.16).** Most of the tornadoes are weak. A violent tornado can travel at speeds of about 300 km/h. Tornadoes may form within cyclones.

The whole coastline of India is vulnerable to cyclones, particularly the east. The west coast of India is less vulnerable to cyclonic storms both in terms of intensity and frequency of the cyclones.

Fig. 8.16 : Image of a tornado
[National Server Storm Laboratory (NSSL)]
Courtesy : India Meteorological Department, New Delhi

We have learnt that all storms are low-pressure systems. Wind speed plays an important role in the formation of storms. It is, therefore, important to measure the wind speed. The instrument that measures the wind speed is called an anemometer.

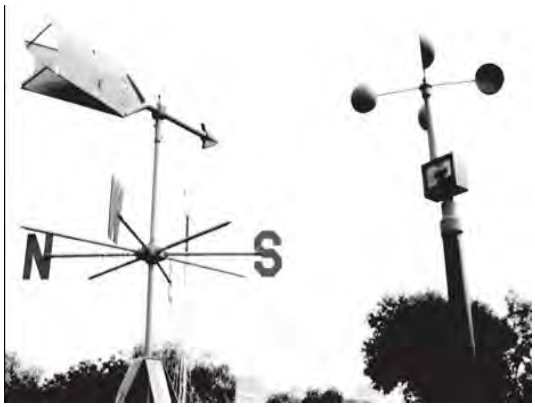


Fig. 8.17 : An anemometer for measuring the speed of wind
Courtesy : India Meteorological Department, New Delhi

8.7 EFFECTIVE SAFETY MEASURES

- A cyclone forecast and warming service.
- Rapid communication of warning to the Government agencies, the ports, fishermen, ships and to general public.
- Construction of cyclone shelters in the cyclone prone areas, and Administrative arrangements for moving people fast to safer places.

Action on the part of the people

- We should not ignore the warnings issued by the meteorological department through T.V, radio, or newspaper.
- We should make necessary arrangements to shift the essential household goods, domestic animals and vehicles, etc, to safer places; avoid driving on road; and keep ready the phone number of all emergency services like police, fire brigade, and medical centres.

Some other precautions, if you are staying in a cyclone hit area -

- Do not drink water that could be contaminated. Always store drinking water for emergencies.

- Do not touch wet switches and fallen power lines.
- Do not go out just for the sake of fun.
- Do not pressurize the rescue force by making undue demands.
- Cooperate and help your neighbors and friends.

8.8 ADVANCED TECHNOLOGY HAS HELPED

These days we are better protected. In the early part of the last century, coastal residence may have had less than a day to prepare or evacuate their homes from an oncoming cyclone. The world today is very different. Thanks to satellites and radars, a **Cyclone alert** or **Cyclone watch** is issued 48 hours in advanced of any expected storm and a **cyclone warning** is issued 24 hrs in advance. The message is broadcast every hour when a cyclone is nearer the coast. Several national and international organizations cooperate to monitor the cyclone -related disasters.

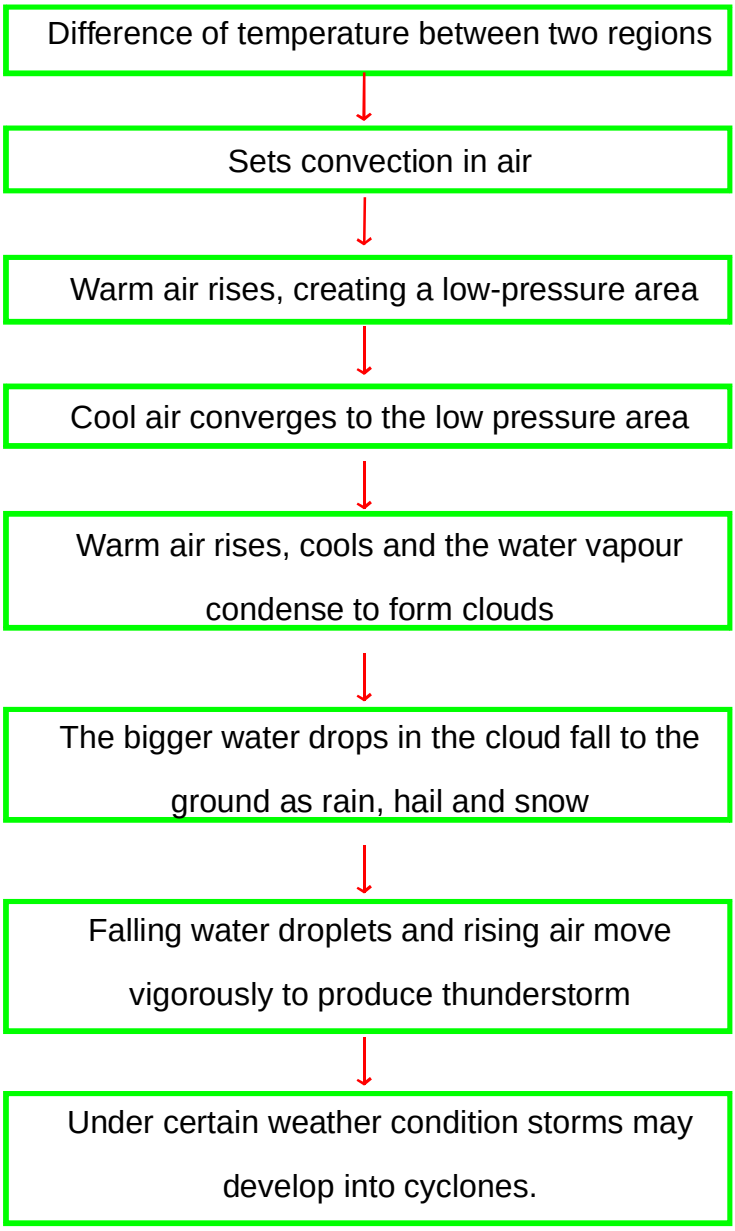
KEYWORDS

Anemometer	**Low pressure**	**Tornado**
Cyclone	**Monsoon winds**	**Typhoon**
Hurricane	**Pressure**	**Wind flow pattern**
Lightning	**Thunderstorms**	

What you have learnt

- Air around us exerts pressure.
- Air expands on heating and contracts on cooling.
- Warm air rises up, whereas comparatively cooler air tends to sink towards the earth's surface.
- As warm air rises, air pressure at that place is reduced and the cooler air moves to that place.
- The moving air is called wind.
- Uneven heating on the earth is the main cause of wind movements.

- Winds carrying water vapours bring rain.
- High-speed winds and air pressure difference can cause cyclones.
- It has become easier to monitor cyclones with the help of advance technology like satellites and radars.
- Self-help is the best help. Therefore it is better to plan in advance and be ready with defence against any approaching cyclone.
- The following flow chart will help you to understand the phenomena that leads to the formation of clouds and falling of rain and creation of storms and cyclones:



EXERCISES

1. **Fill the missing words in the blank spaces in the following statements:**

(a) Wind is _____air.

(b) Winds are generated due to _____heating on the earth.

(c) Near the earth's surface _____ air rises up whereas _____air comes down.

(d) Air moves from a region of _____ pressure to a region of _____pressure.

2. Suggest two methods to find out wind direction at a given place.

3. State two experiences that made you think that air exerts pressure (other than those given in the text).

4. You want to buy a house. Would you like to buy a house having windows but no ventilators? Explain your answer.

5. Explain why holes are made in hanging banners and hoarding ?

6. How will you help your neighbors in case a cyclone approaches your village/town?

7. What planning is required in advance to deal with the situation created by a cyclone?

8. **Which one of the following place is unlikely to be affected by a cyclone.**

(i) Chennai **(ii)** Mangaluru (Mangalore)

(iii) Amritsar **(iv)** Puri

9. **Which of the statements given below is correct?**

(i) In winter the winds flow from the land to the ocean.

(ii) In summer the winds flow from the land towards the ocean.

(iii) A cyclone is formed by a very high-pressure system with very high speed winds revolving around it.

(iv) The coastline of India is not vulnerable to cyclones.

Extended Learning - Activities and Projects

1. You can perform the Activity 8.5 given in the chapter slight differently at home. Use two plastic bottles of the same size. Stretch one balloon on the neck of each bottle. Keep one bottle in the sun and the other in the shade. Record your observations. Compare these observations and the result with those of Activity 8.5.
2. You can make your own anemometer.
   Collect the following items:

4 small paper cups (used ice cream cups), 2 strips of cardboard (20cm long and 2cm wide), gum, stapler, a sketch pen and a sharpened pencil with eraser at one end.

Take a scale; draw crosses on the cardboard strips as shown in the **Fig. 8.18**. This will give the centre of the strips.

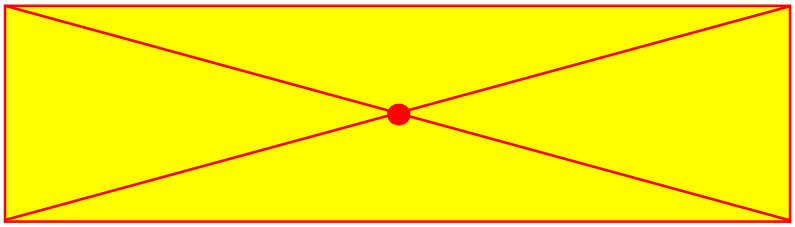


Fig. 8.18 : Finding centre of the strips

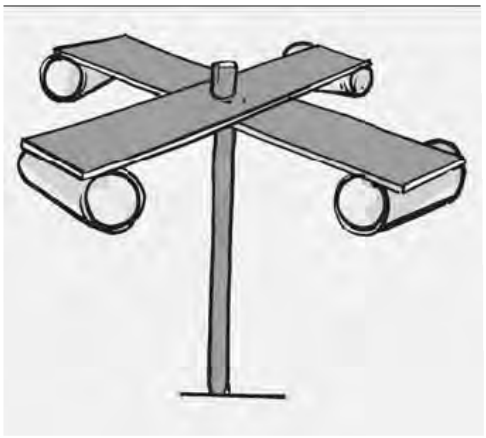


Fig. 8.19 : A model of an anemometer

Fix the strips at the centre, putting one over other so that they make a plus (+) sign. Now fix the cups at the end of the strips. Colour the outer surface of one cup with a marker or a sketch pen. All the 4 cups should face same direction.

Push a pin through the centre of the strips and attach the strips and the cups to the eraser of the pencil. Check that the strips rotate freely when you blow on the cups. Your anemometer is ready. Counting the number of the rotation per minute will give you an estimate of the speed, use it at different places and different times of the day.

If you do not have a pencil with attached eraser you can use the tip of the ball pen.

The only condition is that the strips should rotate freely.

Remember that this anemometer will indicate only speed changes. It will not give you the actual wind speed.

3. Collect articles and photographs from newspapers and magazines about storms and cyclones. Make a story on the basis of what you have learnt in this chapter and the matter collected by you.
4. Suppose you are a member of a committee, which is responsible for creating development plan of a coastal state. Prepare a short speech indicating the measures to be taken to reduce the suffering of the people caused by cyclones.
5. Interview eyewitnesses to collect the actual experience of people affected by a cyclone.
6. Take an aluminum tube about 1 to 1.5cm in diameter. Cut slice of a medium sized potato about 2cm thick. Insert the tube into the slice, press it, and rotate it 2-3 time. Remove the tube. You will find a piece of potato fixed in the tube like a piston head. Repeat the same process with the other end of the tube. Now you have the tube with both ends closed with potato pieces with an air column in between. Take a pencil with one end unsharpened. Place this end at one of the pieces of potato. Press it suddenly to push the potato piece in the tube. Observe what happens. The activity shows rather dramatically how increased air pressure can push things.

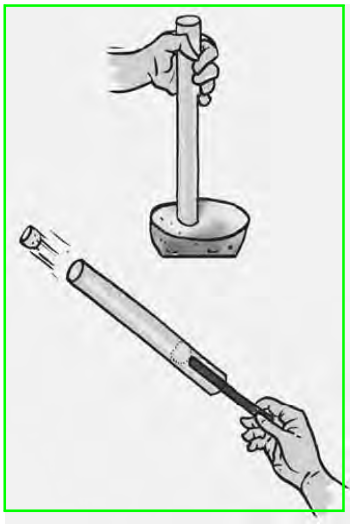


Fig. 8.20

CAUTION: When you perform this activity no body should be standing in front of the tube .

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

http: // www. imd. gov. in/
http: // library. thinkquest. org / 10136 /
www. bom. gov.au / students_ teachers / shtml
www. chunder. com / ski/ lightanim. html

DO YOU KNOW ?

A bolt of lightning travels at a speed of more than 400,000 km/hr. It can heat the air around it to a temperature which is more than 4 times the temperature of the surface of the sun. That is what makes lightning so dangerous.

9 SOIL

All living organisms depend directly or indirectly on soil. Plants prepare food for whole biots but the plants derive all vital nutrients from soil to grow and thrive.

Soil is one of the most important natural resources. It supports the growth of plants by holding the roots firmly and supplying water and nutrients. It is the home for many organisms. Soil is essential for agriculture. Agriculture provides food, clothing and shelter for all. Soil is thus an inseparable part of our life.

Fig.9.1 : Children playing with soil

The earthy fragrance of soil after the first rain is always refreshing.

The scientific study of the characteristics, development and distribution of soils is called **pedology** and the process of soil formation is known as **pedogenesis**.

9.1 SOIL TEEMING WITH LIFE

One day during the rainy season Saba and Yasir observed an earthworm coming out of the soil. Saba wondered whether there were other organisms also in the soil. Let us find out.

Activity 9.1

Collect some soil sample and observe them carefully. You can use a hand lens. Examine each sample carefully and fill in **Table 9.1.**

- Discuss your observations with your friends.
- Are the soil samples collected by

Table 9.1

S.No	Soil Source	Plants	Animals	Any other observation
1.	Garden soil	Grass,…	Ant,…….	
2.	Soil from the roadside	……	…….	
3.	Soil from the area where construction is going on	…….	……...	
4.		.....		
5.		.....		

your friends similar to the ones collected by you?

Yasir and Saba have used soil in many ways. They enjoy playing with it. It is a great fun indeed.

Make a list of the uses of soil.

I wonder why I found some pieces of plastic articles and polythene bags in the soil sample collected from the roadside and the garden.

Polythene bags and plastics pollute the soil. They also kill the organisms living in the soil. That is way there is a demand to ban the polythene bags and plastics. Other substances which pollute the soil are a number of waste products, chemicals and pesticides. Waste products and chemicals should be treated before they are released into the soil. The use of pesticides should be minimized.

I want to know whether the soil from a field can be used to make toys.

9.2 SOIL PROFILE

Soil is composed of distinct layers. Perform the following activity to find out how these layers are arranged.

Activity 9.2

Take a little soil. Break the clumps with your hand to powder it. Now take a glass tumbler, three quarters be filled with water, and then add a handful of soil to it. Stir it well with a stick to dissolve the soil. Now let it stand undisturbed for some time **(Fig.9.2).** Afterwards, observe it and answer the following questions:

✍ Do you see layers of particles of different sizes in the glass tumbler?

✍ Draw a diagram showing these layers.

✍ Are there some dead rotting leaves or animal remain floating on water?

The rotting dead matter in the soil is called **humus.** You probably know that the soil is formed by the breaking down of rocks by the action of wind, water and climate. This process is called **weathering.** The nature of any soil depends upon the rocks from which it has been formed and the type of vegetation that grows in it.

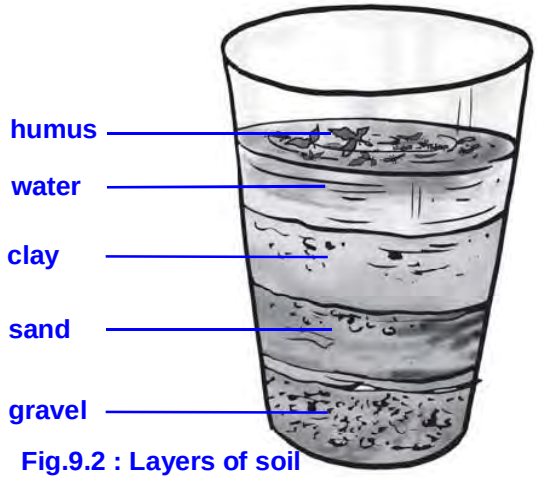


Fig.9.2 : Layers of soil

A vertical section through different layers of the soil is called the **soil profile.** Each layer differs in feel (texture), color, depth and chemical composition. These layers are referred to as **horizons (Fig.9.3).**

The soil profile revels the surface and the sub-surface qualities of the soil which directly affect plant growth.

We usually see the top surface of the soil, not the layers below it. If we look at the sides of a recently dug ditch, we can see the inner layers of the soil, too. Such a view enables us to observe the soil profile at that place. Soil profile can also be seen while digging a well or laying the foundation of a building. It can also be seen at the sides of a road on a hill or at a steep river bank.

The uppermost horizon is generally dark in color as it is rich in humus and minerals. The humus makes the soil fertile and provides nutrients to growing plants. This layer is generally soft, porous and can retain more water. It is called the

Fig.9.3 : Soil profile

topsoil or the **A-horizon**.

This provides shelter for many living organisms such as worms, rodents, moles and beetles. The roots of small plants are embedded entirely in the topsoil.

The next layer has a lesser amount of humus but more of minerals. This layer is generally harder and more compact and is called the **B-horizon** or the middle layer.

The third layer is the **C-horizon,** which is made up of small lumps of rocks with cracks and crevices. Below this layer is the **bedrock,** which is hard and difficult to dig with a spade.

9.3 SOIL TYPES

As you know, weathering of rocks produces small particles of various materials. These include sand and clay. The relative amount of sand and clay depends upon the rock from which the particles were formed, that is the parent rock. **The mixture of rock particles and humus is called the soil.** Living organisms, such as bacteria, plant roots and earthworm are also important parts of any soil.

The soil is classified on the basis of proportion of particles of various sizes. If soil contains greater proportion of big particles, it is called **sandy soil.** If the proportion of fine particles is relatively higher, then it is called **clayey soil.** If the amount of large and fine particles is about the same, then the soil is called **loamy.** Thus, the soil can be classified as sandy, clayey and loamy.

Soil types in Jammu and Kashmir:

1. Gurti or Clay Soil
2. Sekil or Sandy Soil
3. Bahil or Loam Soil
4. Nambal or Peats Soil
5. Surzamin
6. Karewa

The size of the particles in a soil have a very important influence on its properties. Sand particles are quite large. They cannot fit closely together, so there are large spaces between them.

About 35% of the volume of a typical soil consists of air filled pores.

These spaces are filled with air. We say that the sand is well aerated. Water can drain quickly through the spaces between the sand particles. So, sandy soils tend to be light, well aerated and rather dry. Clay particles, being much smaller, pack tightly together, leaving little space for air. Unlike sandy soil, water can be held in the tiny gaps between the particles of clay. So clay soils have little air. But they are heavy as they hold more

water than the sandy soils.

The air trapped in the pores present in the soil has been found to contain excess of carbon dioxide, but a deficiency of oxygen and nitrogen.

The best topsoil for growing plants is loam. **Loamy soil** is a mixture of sand, clay and another type of soil particle known as silt. Silt occurs as a deposit in river beds. The size of the silt particles is between those of sand and clay. The loamy soil also has humus in it. It has the right water holding capacity for the growth of plants.

I want to know: what kind of soil should be used for making matkas and surahis.

Activity 9.3

Collect samples of clayey, loamy and sandy soils. Take a fistful of soil from one of the samples. Remove any pebbles, rocks or grass blades from it. Now add water drop by drop and knead the soil (**Fig 9.4(a)).** Add just enough water so that a ball **(Fig 9.4 (b))** can be made from it, but at the same time it should not be sticky. Try to make a ball **(Fig.9.4 (c))** from the soil. On a flat surface, roll this ball into the cylinder **(Fig.9.4 (d)).** Try to make a ring from this cylinder **(Fig.9.4(e)).** Repeat this activity with other samples also. Does the extent to which a soil can be shaped indicate its type?

Can you suggest which type of soil would be the best for making pots, toys and statues?

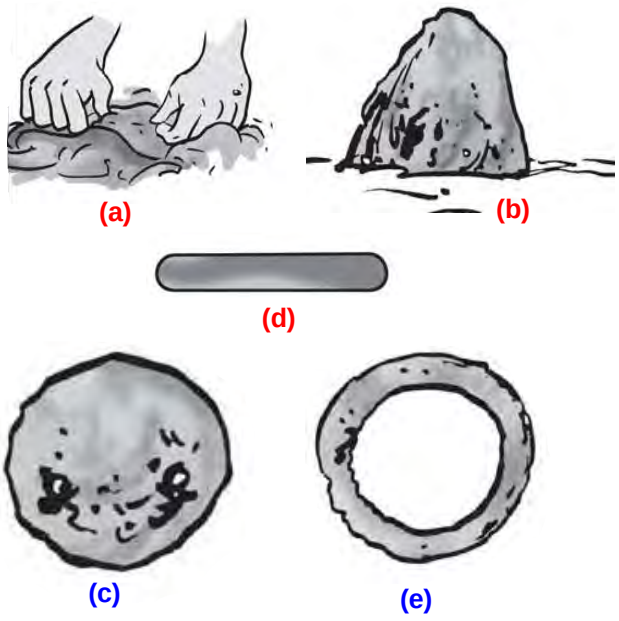


Fig.9.4 : Working with the soil

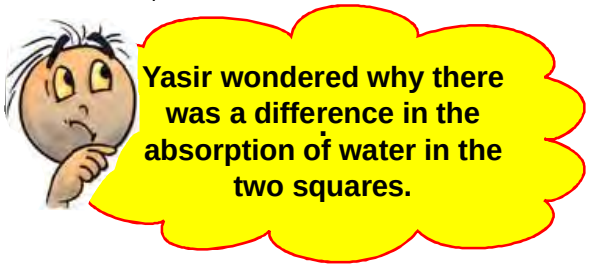
9.4 PROPERTIES OF SOIL

You have listed some uses of soil. Let us perform some activities to find the characteristics of the soil.

Percolation rate of water in soil

Yasir and Saba marked two different squares of 50 cm x 50 cm each, one on the floor of their house and the other on the Kutcha (unpaved) road. They filled two bottles, of the same size with water. They emptied the water from the bottles,

one each, at the same time in the two squares. They observed that the water on the floor flowed down and was not absorbed. On the Kutcha road, on the other hand, the water was absorbed.



Now let us perform an activity to understand this.

Activity 9.4

For this activity divide yourself into three teams A, B and C. You will be finding out how fast the water passes down the soil. You will need a hollow cylinder or a pipe. Ensure that each team uses pipes of the same diameter. Some suggestions for obtaining such a pipe are given below:

1. If possible, get a small tin can and cut off its bottom.
2. If PVC pipe (approx. diameter 5 cm) is available, cut it into 20 cm long pieces and use them.

At the place where you collect the soil, place the pipe about 2 cm deep in the ground. Pour 200 mL water in the pipe slowly. For measuring 200 mL water you can use any empty 200 mL bottle. Note the time when you start pouring water. When all the water has percolated leaving

Fig.9.5 : Measuring rate of percolation

the pipe empty, note the time again. Be careful not to let the water spill over or run down on the outside of the pipe while pouring. Calculate the rate of percolation by using the following formula:

$$\text{percolation rate (mL./min)} = \frac{\text{amount of water (mL.)}}{\text{percolation time (min)}}$$

For example, suppose that for a certain sample, it took 20 minutes for 200 mL to percolate. So,

$$\text{rate of percolation} = \frac{200\ \text{mL}}{20\text{min}} = 10\text{mL/min}$$

Calculate the rate of percolation in your soil sample. Compare your findings with other and arrange the soil samples in the increasing order of the rate of percolation.

9.5 MOISTURE IN SOIL

Have you ever passed through a farmland during a hot summer day? Perhaps you noticed that the air above the land is shimmering. Why is it so? Try out this activity and find the answer.

Activity 9.5

Take a boiling tube. Put two spoonful of a soil sample in it. Heat it on a flame

(Fig.9.6) and observe it. Let us find out what happens upon heating.

Do you see water drops any where? If yes, where did you find them?

On heating, water in the soil evaporates, moves up and condenses on the cooler inner walls of the upper part of the boiling tube.

On a hot summer day, the vapour coming out of the soil reflects the sunlight and the air above the soil seems to shimmer.

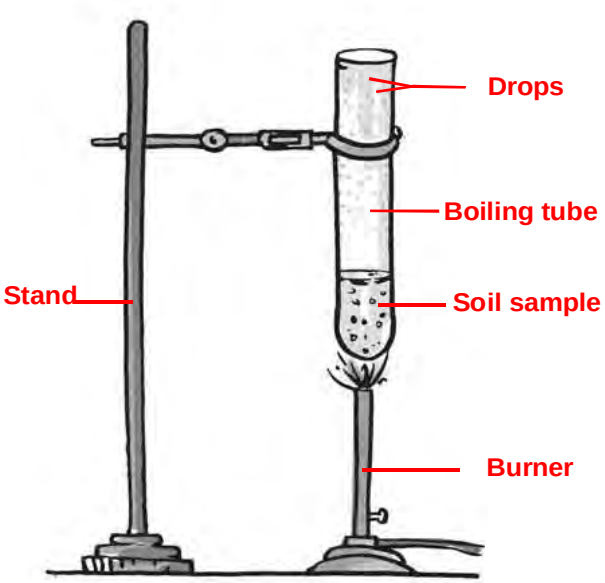


Fig.9.6 : Removing moisture from the soil

After heating the soil, take it out of the tube. Compare it with the soil which has not been heated. Note the difference between the two.

9.6 ABSORPTION OF WATER BY SOIL

Do all the soils absorb water to the same extent? Let us find out.

Activity 9.6

Take a plastic funnel. Take a filter paper (or a piece of newspaper sheet), fold and place it as shown in the figure. Weigh 50 gm of dry, powdered soil and pour it into the funnel. Measure a certain amount of water in a measuring cylinder and pour it drop by drop on the soil. You can use a dropper for this purpose. Do not let all the water fall at one spot.

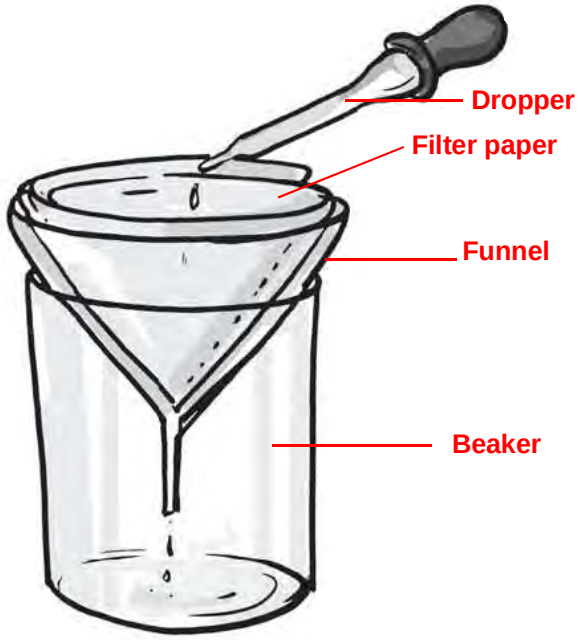


Fig.9.7 : Absorption of water in the soil

Pour water all over the soil. Keep pouring water till it starts dripping. Subtract the amount of water left in the measuring cylinder from the amount you started with. This is the amount of water retained by the soil. Record your results in your notebook in the following manner:

Weight of soil = 50 g

Initial volume of water in the

measuring cylinder = U mL

Final volume of water in the measuring cylinder = V mL

Volume of water absorbed by the soil = (U-V) mL

Weight of water absorbed by the soil = (U-V) g

(1 mL of water has weight equal to 1g)

Percentage of water absorbed

$= \frac{(U-V)}{50} \times 100$

Repeat this activity with different soil samples. Would you get same results for all the samples? Discuss the results with your friends and answer the following questions:

- Which soil would have the highest percolation rate?
- Which soil would have the lowest percolation rate?
- Yasir heard from his neighbourer that 8-10 days after the rain, the level of water in a pond or well rises. Which type of soil will allow water to reach a well faster and in greater amount?
- Which type of soil retains the highest amount of water and which retains the least?
- Can you suggest any method to let more rain water percolate and reach the water underground?

9.7 SOIL AND CROPS

Different types of soils are found in different parts of India. In some parts there is clayey soil, in some parts there is loamy soil while in some other parts there is sandy soil.

In the regions of J&K, the soils are loamy and there is little clay content in them, poor in lime and phosphorus content but with a high content of magnesia.

Soil is affected by wind, rainfall, temperature, light and humidity. These are some climatic factors which affect the soil profile and bring changes in the soil structure. The climatic factors, as well as the components of soil, determine the various types of vegetation and crops that might grow in any region.

A typical productive soil consists of approximately 5% organic matter and 95% inorganic matter.

Clayey and loamy soils are both suitable for growing cereals like wheat and gram. Such soils are good at retaining water. For paddy, soils rich in clay, organic matter and having a good capacity to retain water are ideal. For lentils (masoor) and other pulses, loamy soils, which drain water easily, are required. For cotton, sandy-loam or loam, which drain water easily and can hold plenty of air, are more suitable.

A CASE STUDY

John, Rashida and Radha went to Leeladhar Dada and Santosh Malviya of Sohagpur in Madhya Pradesh. Leeladhar Dada was preparing the soil to make items like Surahi, Matki, Kalla (earthen frying pan) etc. The following is the conversation they all had with Leeladhar Dada :

- Where was the soil obtained from ?

Dada: We brought the black soil from a piece of barren land.

- How is the soil prepared ?

Dada: Dry soil will be placed in a large tank and would be cleared of pebbles etc. After removing these things the soil will be soaked for around 8 hours. This soil would be kneaded after mixing horse dung. The kneaded soil would be placed on the wheel and given appropriate shape. The final shape is given with hands. The items are coloured after three days of drying. All the items are baked at high temperature after drying in the air.

- Why is the horse dung mixed on soil ?

Dada: Burnt horse dung helps open up the pores in the soil. So that water could percolate out of the Matkas and Surahis which evaporates and cools the water inside. You know Sohagpuri surahis and matkas are famous in far off places like Jabalpur, Nagpur, Allahabad etc.

Fig.9.8 : Making pots

Major Crops grown in J&K State

S.No	Area	Crops grown
1.	Jammu and Kathua districts	Rice, Wheat, Sugarcane
2.	Kandi belt (Jammu, Kathua, Udhampur and Rajouri districts)	Maize, Wheat, Jawar and Bajra
3.	Kashmir	Rice, Wheat, Maize, Pulses, Oilseeds
4.	Ladakh	Wheat Barley

Crops such as wheat are grown in the fine clayey soils, because they are rich in humus and are very fertile. Find from your teachers, parents and farmers the type of soil and crops grown in your area. Enter the data in the following **Table 9.2.**

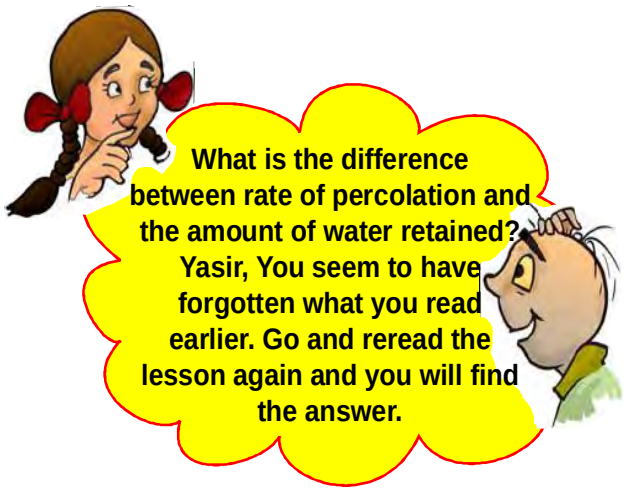
Which kind of soil would be most suitable for planting rice? Soil with a higher or lower rate of percolation?

Table 9.2

S.No.	Type of soil	Crop grown
1.	Clayey	Wheat….....
2.		
3.		

Soil Erosion

The removal of land surface by water, wind or ice is known as erosion. Plant roots firmly bind the soil. In the absence of plants, soil becomes loose. So it can be moved by wind and flowing water. Erosion of soil is more severe in areas of little or no surface vegetation, such as desert or barren lands. So, cutting of trees and deforestation should be prevented and effort should be made to increase the green areas.



Soil Erosion in J&K

Erosion results from energy transmitted from rainfall and wind. In Jammu and Kashmir, the soils of Kandi belt have severely suffered from erosion. About 26 percent of the total area which is under village forests is now quite eroded. Other affected areas in J&K due to erosion are Kaleeth and Chauki Chora of Akhnoor tehsil, Dansal, Jhajjar Kotli, Ramnagar, Mansar, Surinsar, Jandial and Amb series of Bhalwal block of Jammu, areas between Balaul and Basantar.

KEYWORDS

Clayey	Moisture	Humus
Sandy	Loamy	Water retention
Percolation		

What you have Learnt

- Soil is important for life on earth
- Soil profile is a section through different layers of the soil, various layers are called horizons.
- Soil is of different types: Clayey, loamy and sandy.
- Percolation rate of water is different in different types of soil. It is highest in the sandy soil and least in the clayey soil.
- Different types of soils are used to cultivate different types of crops. Clay and loam are suitable for growing wheat, gram and paddy. Cotton is grown in sandy loam soil.
- Soil holds water in it, which is called soil moisture. The capacity of a soil to hold water is important for various crops.
- Clayey soil is used to make pots, toys and statues.

EXERCISES

Tick the most suitable answer in questions 1 and 2.

1. In addition to the rocks particles, the soil contains

(i) Air and water

(ii) Water and plants

(iii) Minerals, organic matter, air and water

(iv) Water, air and plants

2. The water holding capacity is highest in

(i) Sandy soil (ii) Clayey soil

(iii) Loamy soil (iv) Mixture of sand and loam

3. The process of soil formation is called

(i) Conservation (ii) Weathering

(iii) Erosion (iv) Pedogenesis

4. Soil profile consist of

(i) Two layers (ii) Three layers

(iii) Four layers (iv) Five layers

5. Humus is present in

(i) A-Horizon (ii) B-horizon

(iii) C-Horizon (iv) Bed rock

6. **Match the items in Column I with those in Column II:**

	Column I		Column II
(i)	A home for living organisms	(a)	Large particles
(ii)	Upper layer of soil	(b)	All kinds of soil
(iii)	Sandy soil	(c)	Dark in colour
(iv)	Middle layer of the soil	(d)	Small particles and packed tight
(v)	Clayey soil	(e)	Lesser amount of humus

7. Explain how soil is formed.

8. How is clayey soil useful for crops?

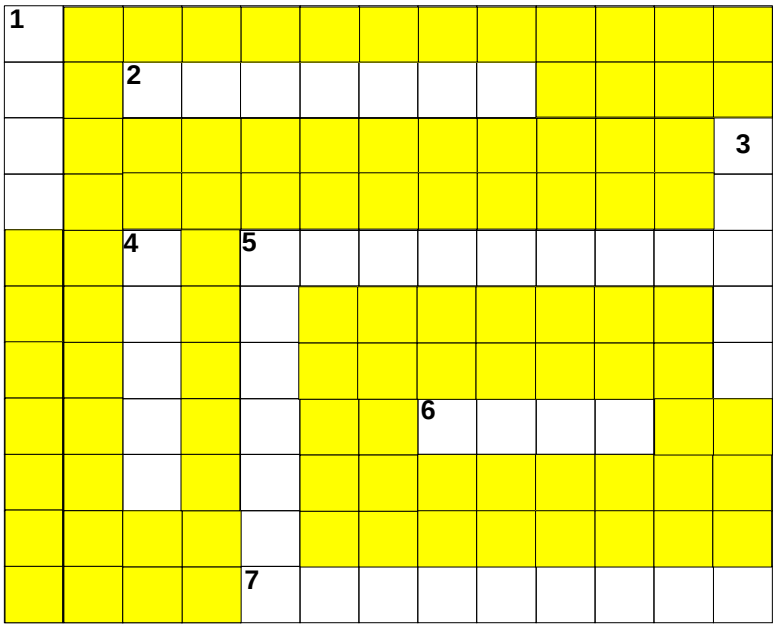
9. List the differences between clayey soil and sandy soil.

10. Sketch the cross section of soil and label the various layers.

11. Razia conducted an experiment in the field related to the rate of percolation. She observed that it took 40 min for 200 mL of water to percolate through the soil sample. Calculate the rate of percolation.

12. Explain how soil pollution and soil erosion could be prevented.

13. Solve the following crossword puzzle with the clues given:



Across

2. Plantation prevents it.
5. Use should be banned to avoid soil pollution.
6. Type of soil used for making pottery.
7. Living organisms in the soil.

Down

1. In desert soil erosion occurs through.
3. Clay and loam are suitable for cereals like.
4. This type of soil can hold very little water.
5. Collective name for layers of soil.

Extended Learning - Activities and Projects

1. Yasir would like to know the difference between raw and baked soil? Investigate how the soil from which matkas are made is different from the soil used to make statues.
2. Saba is worried. She could see a brick kiln from her house. Bricks were being made there. There was so much smoke coming out of the kiln. She was told that the best quality of clay is required for making pottery, statues and bricks. She has seen truck loads of bricks being taken away for construction of buildings. At this rate, she fears, no soil will be left. Are her fears justified? Discuss this problem with your parents, teachers and other experts of your area and prepare a report.
3. Try to find out the moisture content of a soil sample. One method is given here.

   Activity: Take 100 g soil. (Take help from any shopkeeper to weigh the soil.) Place it on a newspaper in the sun and allow it to dry for two hours. This activity is best done in the afternoon. Take care that the soil does not spill outside the newspaper. After drying it, weigh the soil again. The difference in the weight of the soil before and after drying gives you the amount of moisture contained in 100g of soil. This is called the percentage moisture content.

   Suppose your sample of soil loses 10 g on drying. Then

$$\text{Percent of moisture in soil} = \frac{\text{wt. of moisture (g)} \times 100}{\text{Original wt. of soil sample (g)}}$$

   In this example

$$\text{Percent of moisture in soil} = \frac{10 \times 100}{100} = 10\%$$

DO YOU KNOW?

Rivers of North India, which flow from Himalayas, bring a variety of materials including silt, clay, sand and gravel. They deposit their materials called alluvial soil, in the planes of north India. This soil is very fertile and supports nearby half the population of India.

10 RESPIRATION IN ORGANISMS

One day Yasir was eagerly waiting to meet his grandparents who were coming to the town after a year. He was in a real hurry as he wanted to receive them at the bus stop. He ran fast and reached the bus stop in a few minutes. He was breathing rapidly. His grandmother asked him why he was breathing so fast. Yasir told her that he came running all the way. But the question got struck in his mind. He wondered why running makes a person breathe faster. The answer to Yasir question lies in understanding why do we breathe. Breathing is a part of respiration. Let us learn about respiration.

10.1 WHY DO WE RESPIRE?

You know that all organisms are made of small microscopic units called cells. A cell is the smallest structural and functional unit of an organism. Each cell of an organism performs certain function such as nutrition, transport, excretion and reproduction. To perform these functions, the cell needs energy. Even when we are eating, sleeping or reading we require energy. But, where does this energy come from? Can you say why your parents insist that you should eat regularly? The food has stored energy, which is released during respiration. Therefore all living organisms respire to get energy from food. During breathing, we breathe in air. You know that air contains oxygen. We breathe out air which is rich in carbon dioxide. The air we breathe in is transported to all part of the body and ultimately to each cell. Inhaled oxygen from the air helps in the breakdown of food. The process of breakdown of food in the cell with the release of energy is called **cellular respiration.** Cellular respiration takes place in the **cells of all organisms.** In the cell, the food (glucose) is broken down into carbon dioxide and water using oxygen. When breakdown of glucose occurs with the use of oxygen it is called **aerobic respiration.** Food can also be broken down, without using oxygen. This is called **anaerobic respiration.** Breakdown of food releases energy.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

Glucose with use of oxygen release carbon dioxide, water and energy.

Glucose $\xrightarrow{\text{with the use of oxygen}}$ carbon dioxide + water + energy

You should know that there are some organisms such as yeast that can survive in the absence of air. They are called **anaerobes.** They get energy through anaerobic respiration. In the absence of oxygen, glucose breaks down into alcohol and carbon dioxide, as given below:

Glucose $\xrightarrow{\text{without the use of oxygen}}$ alcohol + carbondioxide + energy

Yeasts are single- celled organisms. They respire anaerobically and during this process yield alcohol. They are, therefore, used to make wine and beer.

Our muscle cells can also respire anaerobically, but only for a short time, when there is a temporary deficiency of oxygen. During heavy exercise, fast running **(Fig.10.1)**, cycling, walking for many hours or heavy weight lifting, the demand for energy is high, but the supply of oxygen is very less in the muscle cells to fulfill the demand of energy:

Glucose (In Muscle) $\xrightarrow{\text{In the absence of oxygen}}$ Lactic acid + Energy

Have you ever wondered why you get muscle cramps after heavy exercise? The cramps occur when muscle cells respire anaerobically. The partial breakdown of glucose produces lactic acid which causes muscle cramps. We get relief from cramps after a hot water bath or a massage. Can you guess why it is so? Hot water bath or massage improves circulation of blood. As a result, the supply of oxygen to the muscle cells increases. The increase in the supply of oxygen results in the complete breakdown of lactic acid into carbon dioxide and water.

Fig.10.1 : During exercise, some muscles may respire anaerobically

10.2 BREATHING

Activity 10.1

CAUTION

Do this activity under the supervision of your teacher.

Close your nostrils and mouth

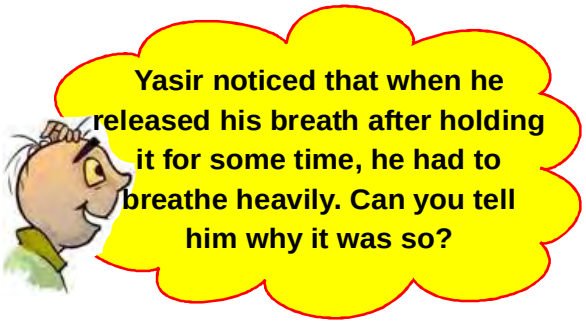
tightly and look at a watch. What did you feel after some time? How long were you able to keep both of them closed? Note down the time period for which you could hold your breath **(Fig. 10.2).**

So, now you know that you cannot survive for long without breathing.

Breathing means taking in air rich in oxygen and giving out air rich in carbon dioxide with the help of respiratory organs. The talking in of air rich in oxygen into the body is called **inhalation** and giving out of air rich in carbon dioxide is known as **exhalation.** It is a continuous process which goes on all the time and throughout the life of an organism.

The number of times a person breathes in a minute is termed as the **breathing rate.** During breathing inhalation and exhalation takes place alternately. A breath means one inhalation plus one exhalation. Would you like to find out your breathing rate? Do you want to know whether it is constant or it changes according to the requirement of oxygen by the body? Let us find out by doing the following activity.

Fig.10.2 : Holding breath



Activity 10.2

Generally we are not aware that we are breathing. However, if you try you can count your rate of breathing. Breathe in

Table 10.1: Changes in breathing rate under different conditions

Name of the classmate	Breathing rate			
	Normal	After a brisk walk for 10 minutes	After running fast for 100 m	At rest
Self				

and out normally. Find out how many times you breathe in and breathe out in a minute? Did you inhale the same number of times as you exhale? Now count your breathing rate (number of breaths/ minute) after brisk walk and after running. Record your breathing rate as soon as you finish and also after complete rest. Tabulate your findings and compare your breathing rates under different conditions with those of your classmates.

.

From the above activity, you must have realized that whenever a person needs extra energy, he/ she breathes faster. As a result more oxygen is supplied to our cells. It speeds up the breakdown of food and more energy is released. Does this explain why we feel hungry after a physical activity?

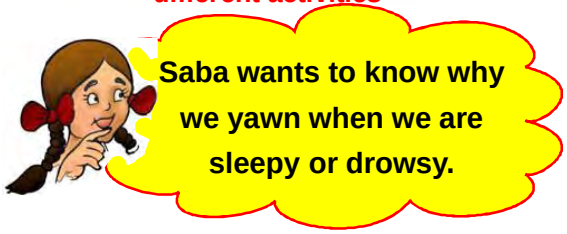
When you feel drowsy, does your breathing rate slow down? Does your body receive sufficient oxygen?

On an average, an adult human being at rest breathes in and out 15 -18 times in a minute. During heavy exercise, the breathing rate can increase upto 25 times per minute. While we exercise, not only do we breathe fast, we also take deep breaths and thus inhale more oxygen .

Activity 10.3

Figure 10.3 shows the various activities carried out by a person during a normal day. Can you say in which activity, the rate of breathing will be the slowest and in which it will be the faster? Assign number to the picture in the order of increasing rate of breathing according to your experience.

Fig.10.3 : Variation in the breathing during different activities



10.3 HOW DO WE BREATHE?

Let us now learn about the mechanism of breathing. Normally we take in air through our nostrils. When we

inhale air, it passes through our nostrils into the **nasal cavity.** From the nasal cavity, the air reaches our **lungs** through the windpipe. Lungs are present in the chest cavity **(Fig. 10. 4).** This cavity is surrounded by ribs on the sides. A large muscular sheet called **diaphragm** forms the floor of the chest cavity **(Fig. 10. 4).** Breathing involves the movement of the diaphragm and the rib cage.

During inhalation, ribs move up and outwards and diaphragm moves down. This movement increases space in our chest cavity and air rushes into the lungs. The lungs get filled with air. During exhalation, ribs move down and inwards, while diaphragm moves up to its former position. This reduces the size of the chest cavity and air is pushed out of the lungs **(Fig. 10.5).** These movement in our

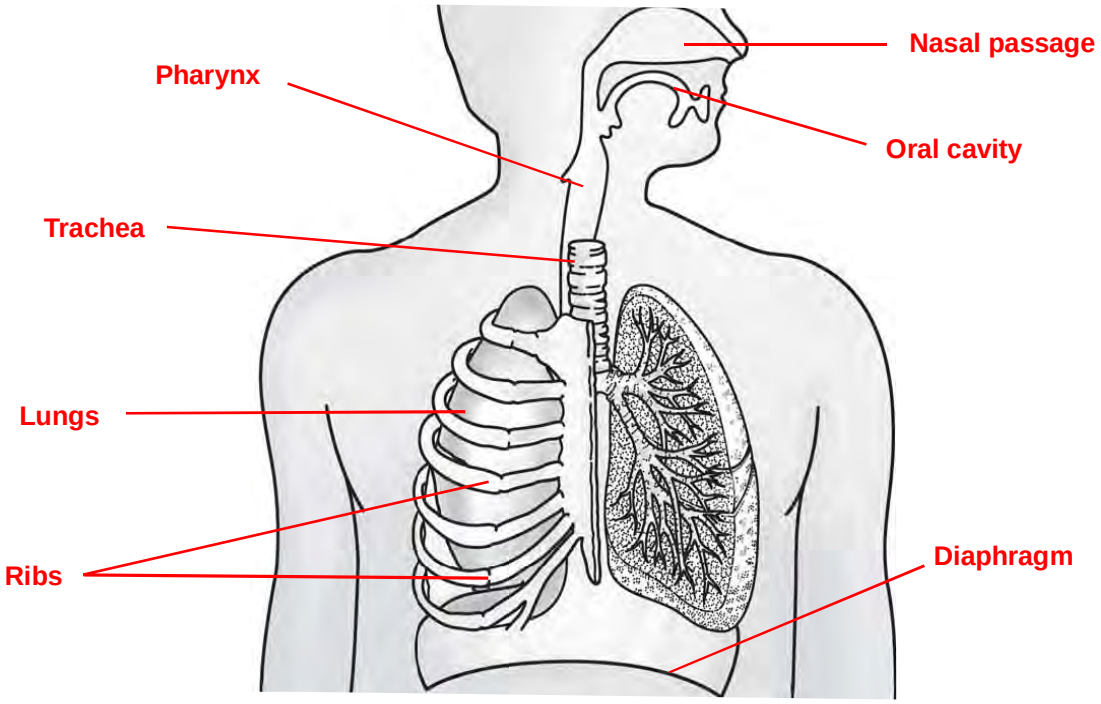


Fig 10.4 : Human respiratory system

The air around us has various types of unwanted particles, such as smoke, dust, pollen, etc. When we inhale, the particles get trapped in the hair present in our nasal cavity. However, sometimes these particles may bypass the hair in the nasal cavity. Then they irritate the lining of the cavity, as a result of which we sneeze. Sneezing expels these foreign particles from the inhaled air and a dust- free, clean air enters our body.

TAKE CARE: When you sneeze, you should cover your nose so that the foreign particles you expel are not inhaled by other persons.

body can be felt easily. Take a deep breath. Keep your palm on the abdomen. What do you find?

After having learnt that during breathing there are changes in the size of chest cavity, children got involved in the chest expansion competition. Everyone was boasting that she/ he could expand it the maximum. How about doing this activity in the class with your classmate?

Smoking damages our lungs. Smoking is also linked to cancer. It must be avoided.

Activity 10.4

Take a deep breath. Measure the size of the chest with a measuring tape **(Fig. 10.6)** and record your observations in **Table 10.2.** Measure the size of the chest when expanded and indicate which classmate shows the maximum expansion of the chest.

We can understand the mechanism of breathing by a simple model.

Activity 10.5

Take a wide plastic bottle. Remove the bottom of the bottle. Get a Y- shaped

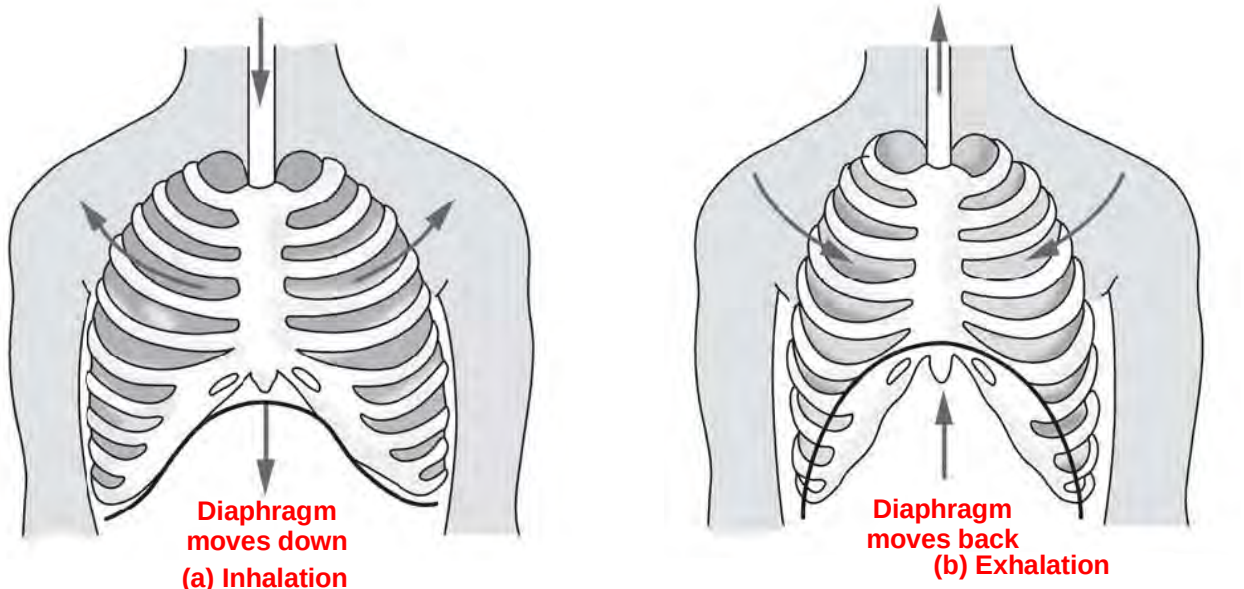


Fig.10.5 : Mechanism of breathing in human beings

Table 10.2 Effect of breathing on the chest size of some classmates

Name of the	Size of the chest		
Classmates	During inhalation	During exhalation	Difference in size

glass or plastic tube. Make a hole in the lid so that the tube may pass through it. To the forked end of the tube fix two deflated balloons. Introduce the tube into the bottle as shown in **Fig. 10.7.** Now cap the bottle. Seal it to make airtight. To the open base of the bottle tie a thin rubber or plastic sheet using a large rubber band.

Fig.10.6 : Measuring chest size

To understand the expansion of the lungs, pull the rubber sheet from the base downwards and watch the balloons. Next, push the rubber/ plastic sheet up and observe the balloons. Did you see any changes in the balloons?

What do the balloons in this model represent? What does the rubber sheet represent?

Now you should be able to explain the mechanism of breathing.

10.4 WHAT DO WE BREATHE OUT?

Activity 10.6

Take a slender, clean test tube or a glass/ plastic bottle. Make a hole in its lid and fix it on the bottle. Pour some freshly prepared lime water in the test- tube. Insert a plastic straw through the hole in the lid in such a way that it dips in lime water. Now blow gently through the straw a few times **(Fig. 10.8).** Is there a change in the appearance of lime water? Can you explain this change on the basis of what you have learnt earlier ?

You are aware that the air we inhale or exhale is a mixture of gases. What do we exhale? Do we exhale only carbon dioxide or a mixture of gases along with it? You must have also observed that if you exhale on a mirror, a film of moisture appears on its surface. From where do these droplets come?

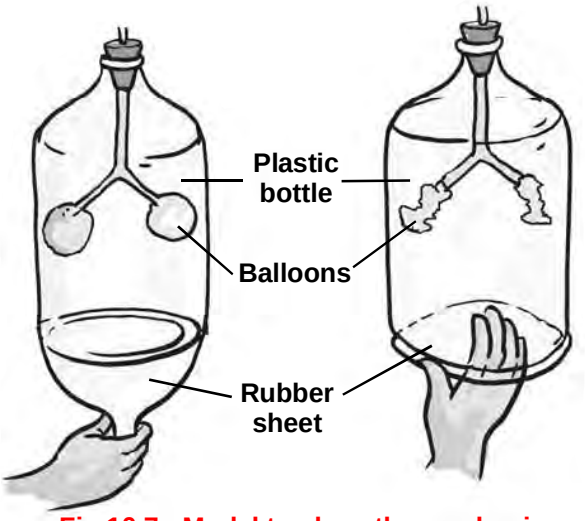


Fig 10.7 : Model to show the mechanism of breathing

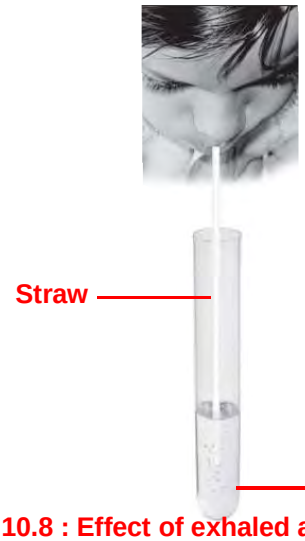


Fig 10.8 : Effect of exhaled air on lime water

Yasir wants to know how much air a person can hold in the lungs.

The percentage of oxygen and carbon dioxide in inhaled and exhaled air.

Inhaled air	Exhaled air
21% oxygen	16.4% oxygen
0.04% Carbon dioxide	4.4% Carbon dioxide

Lungs

10.5 BREATHING IN OTHER ANIMALS

Animals such as elephants, lions, cows, goats, frogs, lizards, snakes and birds have lungs in their chest cavities like the human beings.

How do other organisms breathe? Do they also have lungs like those of human beings? Let us find out.

Yasir wants to know if cockroaches, snails, fish, earthworms, ants and mosquitoes also have lungs.

Cockroach: A cockroach has small openings on the sides of its body. Other insects also have similar openings. These openings are called **spiracles (Fig. 10.9).** Insects have a network of air tubes called **tracheae** for gas exchange**.** Oxygen rich air rushes through spiracles into the tracheal tubes, diffuses into the body tissue and reaches every cell of the body. Similarly, carbon dioxide from the cells goes into the tracheal tubes and moves out through spiracles. These air tubes or tracheae are found only in insects and not in any other group of animals.

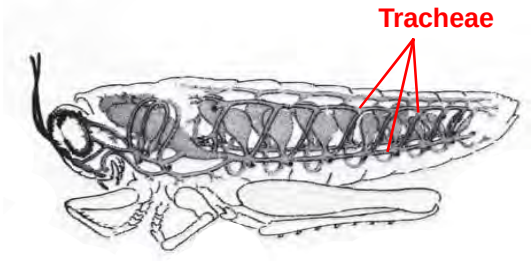
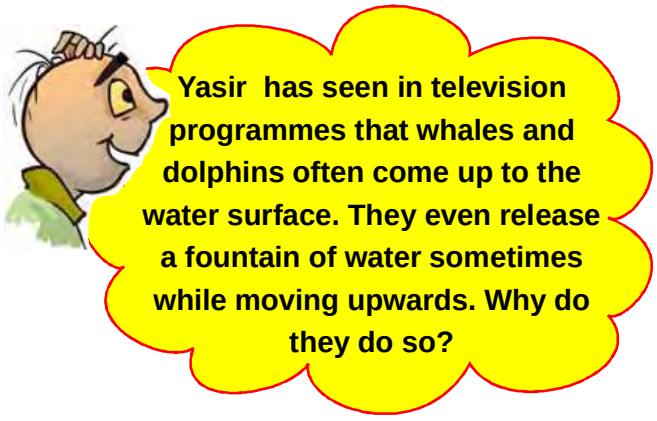


Fig.10.9 : Tracheal system

Earthworm: You have already learnt that earthworms breathe through their skin. The skin of an earthworm feels moist and slimy on touching. Gases can easily pass through them. Though frogs have a pair of lungs like human beings, they can also breathe through their skin, which is moist and slippery.



10.6 BREATHING UNDER WATER

Can we breathe and survive in water? There are many organisms which live in water. How do they breathe under water?

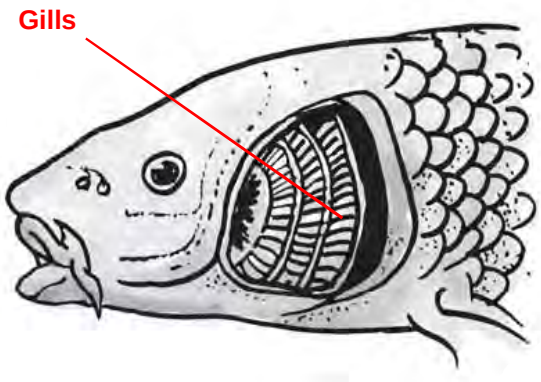
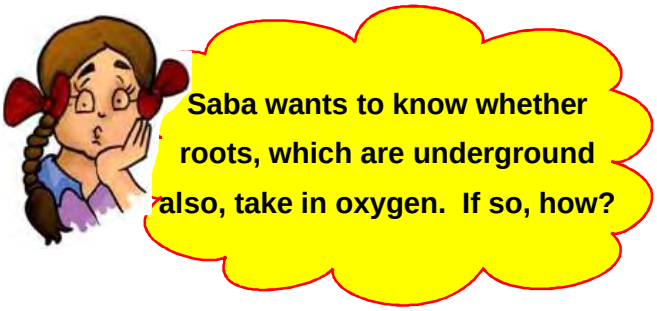


Fig.10.10 : Breathing organs in fish

You have studied in previous class that gills in fish help them to use oxygen dissolved in water. Gills are projections of the skin. You may wonder how gills help in breathing. Gills are well supplied with blood vessels **(Fig.10.10)** for exchange of gases.

10.7 DO PLANTS ALSO RESPIRE?

Like other organisms, plants also respire for their survival as you have already learnt. They also take in oxygen from the air and give out carbon dioxide. In the cells oxygen is used to breakdown glucose into carbon dioxide and water as in other organisms. In plants each part can independently take in oxygen from the air and give out carbon dioxide. You have already learnt in chapter 1 that the leaves of the plants have tiny pores called stomata for exchange of oxygen and carbon dioxide.



Like all other living cells of the plants, the root cells also need oxygen to generate energy. Roots take up air from the air spaces present between the soils

particles **(Fig. 10. 11).**

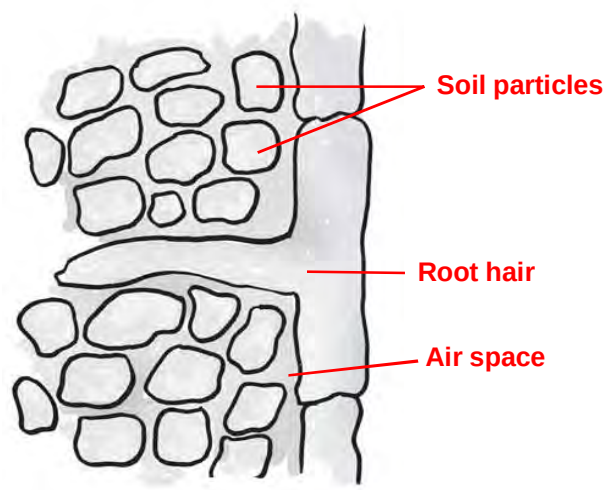


Fig.10.11 : Roots absorb air from the soil

Can you guess what would happen if a potted plant is over watered?

In this chapter you learnt that respiration is a vital biological process. All living organisms need to respire to get the energy needed for the survival.

KEYWORDS

Aerobic respiration	**Diaphragm**	**Inhalation**
Anaerobic respiration	**Exhalation**	**Spiracles**
Breathing rate	**Gills**	**Tracheae**
Cellular respiration	**Lungs**	**Ribs**

What you have learnt

- Respiration is essential for survival of living organisms. It releases energy from the food.
- The oxygen we inhale is used to breakdown glucose into carbon dioxide and water. Energy is released in the process.
- The breakdown of glucose occurs in the cells of an organism (cellular respiration).
- If the food is broken down with the use of oxygen, it is called aerobic respiration. If the breakdown occurs without the use of oxygen, the respiration is called anaerobic respiration.
- During the heavy exercise when the supply of oxygen to our muscle cells is insufficient, food breakdown is by anaerobic respiration.
- Breathing is a part of the process of respiration during which an organisms takes in

the oxygen rich air and gives out air rich in carbon dioxide. The respiratory organs for the exchange of gases vary in different organisms.

- During inhalation, our lungs expand and then come back to the original state as the air moves out during exhalation.
- Increased physical activity enhances the rate of breathing.
- In animals like cow, buffalo, dog and cat the respiratory organs and the process of breathing are similar to those in humans.
- In earthworms, the exchange of gases occurs through the moist skin. In fishes it takes place through gills and in insects through the tracheae.
- In a plant the roots take in air present in the soil. Leaves have tiny pores called stomata through which they exchange gases. The breakdown of glucose in the plant cells is similar to that in other living beings.

EXERCISES

1. Define cellular respiration.

2. Why does an athlete breathe faster and deeper than usual after finishing the race?

3. List the similarities and differences between aerobic and anaerobic respiration.

4. Why do we often sneeze when we inhale a lot of dust-laden air?

5. Take three test tubes. Fill ¾th of each with water. Label them A, B and C. Keep a snail in test-tube A, a water plant in test- tube B and in C, keep snail and plant both. Which test-tube would have the highest concentration of CO_2?

6. **Tick mark (✓) the correct answer**:

(a) In cockroaches, air enters the body through

(i) lungs (ii) gills

(iii) spiracles (iv) skin

(b) During heavy exercise, we get cramps in the legs due to the accumulation of

(i) carbon dioxide (ii) lactic acid

(iii) Alcohol (iv) water

(c) Normal range of breathing rate per minute in an average adult person at rest is

(i) 9-12 (ii) 15-18
(iii) 21-24 (iv) 30-33

(d) During exhalation, the ribs
(i) move outwards (ii) move downwards
(iii) move upwards (iv) do not move at all

7. Match the items in column I with those in column II:

Column I	Column II
(a) Yeast	(i) Earthworm
(b) Diaphragm	(ii) Gills
(c) Skin	(iii) Alcohol
(d) Leaves	(iv) Chest Cavity
(e) Fish	(v) Stomata
(f) Frog	(vi) Lungs and skin
(g) Cockroach	(vii) Tracheae

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

(i) During heavy exercise the breathing rate of a person slows down. (T/F)
(ii) Plants carry out photosynthesis only during the day and respiration only at night. (T/F)
(iii) Frogs breathe through their skin as well as their lungs. (T/F)
(iv) The fishes have lungs for respiration. (T/F)
(v) The size of the chest cavity increases during inhalation. (T/F)

9. Given below is a square of letters in which are hidden different words related to respiration in organisms. These words may be present in any direction upwards, downwards, or along the diagonals. Find the words for your respiratory system. Clues about those words are given below the square.

S	V	M	P	L	U	N	G	S
C	Z	G	Q	W	X	N	T	L
R	M	A	T	I	D	O	T	C
I	Y	R	X	Y	M	S	R	A
B	R	H	I	A	N	T	A	Y
S	T	P	T	B	Z	R	C	E
M	I	A	M	T	S	I	H	A
S	P	I	R	A	C	L	E	S
N	E	D	K	J	N	S	A	T

(i) The air tubes of insects

(ii) Skeletal structure surrounding chest cavity

(iii) Muscular floor of the chest cavity

(iv) Tiny pores on the surface of the leaf

(v) Small openings on the sides of the body of an insect

(vi) The respiratory organs of human beings

(vii) The openings through which we inhale

(viii) An anaerobic organism

(ix) An organism with tracheal system

10. The mountaineers carry oxygen with them because:

(a) At an altitude of more than 5 km there is no air.

(b) The amount of air available to a person is less than that available on the ground.

(c) The temperature of air is higher than on the ground.

(d) The pressure of air is higher than that on the ground.

11. **Give two example of each of the following:**

(1) Animals that breathe through gills _____

(2) Animals that breathe through spiracles _____

(3) Animals that breathe through skin _____

Extended Learning- Activities and Projects

1. Observe fish in an aquarium. You will find flap like structures on both sides of their heads. There are flaps which cover the gills. These flaps open and close alternately. On the basis of these observations, explain the process of respiration in the fish.
2. Visit a local doctor. Learn about the harmful effects of smoking. You can also collect material on this topic from other sources. You can seek help of your teacher or parents. Find out the percentage of people who smoke. If you have a smoker in your family, confront him with the material that you have collected.
3. Visit a doctor. Find out about artificial respirations. Ask the doctor.
   (a) When does a person need artificial respiration?
   (b) Does the person need to be kept on artificial respiration temporarily or permanently?
   (c) From where can the person get supply of oxygen for artificial respiration?
4. Measure the breathing rate of the members of your family and some of your friends. Investigate.
   (a) If the breathing rate of children is different from that of adults.
   (b) If the breathing rate of males is different from that of females.
   If there is a difference in any of those cases, try to find the reason.

You can read more on the following website:
www.health.howstuffworks.com/adam-200142.htm

DO YOU KNOW?

For us oxygen is essential, but for those organisms which do not use it, oxygen is toxic. In fact, for humans and other organisms it may be dangerous to breathe pure oxygen for long.

If we inhale CO (carbon monoxide) produced through incomplete combustion of coal, respiration gets blocked leading to death of an organism.

At high altitude areas, the pressure of air decreases causing problem in inhalation. Thus, the people living there are adapted by having more no. of RBC as compared to those living in low altitude areas.

11 TRANSPORTATION IN PLANTS & ANIMALS

Living organisms need food, water and oxygen for their survival. In case of green plants, carbon dioxide, water and sunlight are required. These substance need to be carried (or transported) to various parts of the body.

In addition, waste materials produced within the body also need to be removed. Do you know? There is a system called transportation system in organisms for this purpose.

In case of plants, there is a system of independent channels, while in animals, transportation is brought about by the **circulatory system**.

11.1 TRANSPORT OF MATERIALS IN PLANTS

Earlier you have studied that :

(i) Water required for food, manufactured by the plants is absorbed from soil, through the root system, and

(ii) The food is synthesized in the leaves.

The water absorbed from the soil through the root system has to be moved upwards to other plant parts, and the food synthesized in the leaves has to be carried to other plant parts.

The methods of transport in different plants vary.

11.2 TRANSPORT IN UNICELLULAR AND SIMPLE MULTICELLULAR PLANTS

Diffusion is a major method by which transport of material occurs in single celled (unicellular) organisms like *Chlamydomonas* and simple multicelluar plants like *Spirogyra.*

When food is being cooked in your kitchen you can smell it in other rooms in the house.

This is because molecules are leaving the food as a gas and moving around at a high speed, eventually reaching all parts of the house. This is called **diffusion.**

Diffusion *is the movement of particles from a high concentration to a low concentration until they are spread out evenly.*

11.3 TRANSPORT IN HIGHER PLANTS (CONDUCTION)

The mechanism of transport in multicellular higher plants is much more elaborate. The process of diffusion, which is slow, cannot meet the requirements of transport to all parts in a short period of time. How does water reach in our homes. We have pipes for the supply of water in

our homes. In plants also, there are special tubes called **xylem** and **phloem,** which comprise the **conducting tissues** or **vascular tissues.** It is through these tubes that the transport of materials takes place. Xylem and phloem are present in all part of the plant body.

As mentioned above, there are two aspects of transport of substances in plants **(Fig. 11.1).**

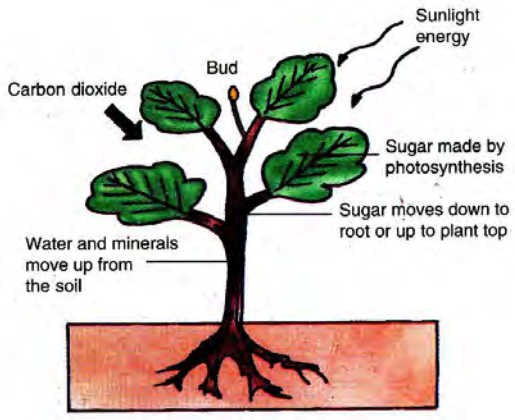


Fig 11.1 : Transport system in plants

(I) Movement of water and minerals takes place from the roots upwards to other plant parts. This movement takes place through the stem and its branches.

(ii) Movement of food materials, synthesized in leaves, to other plant parts.

Transport of water and minerals

Upward movement of water and minerals occurs through pipe-like structures or channels, called **xylem** elements, present in root, stem and leaves of plants. Water is thus carried to the entire plant.

Plants absorb water and minerals by the roots. The roots have root hairs. These root hair increase the surface area of the root for absorbing water and minerals dissolved in water. The root hair absorbs water present between the soil particles and from there it reaches the xylem elements. **(Fig.11.2).**

Transport of food

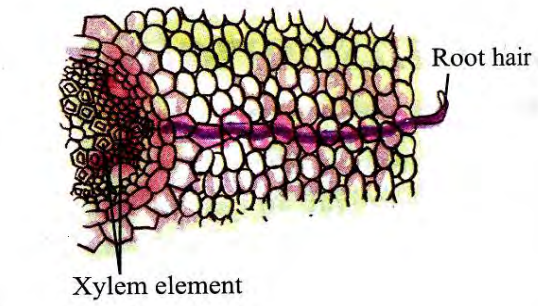


Fig. 11.2 : Root with root hair

The prepared food material is carried in a soluble from through another channel, constituted by **phloem,** from the leaves to all other parts of the body.

How can we show that these two transport systems occur in plants?

Let us perform **Activities 11.1** and

11.2 to learn about the transport of materials in plants.

11.4 TRANSPIRATION

The plants absorb much more water through their root system than what is required for various life activities like growth and photosynthesis. What happens to the rest of the water?

The excess water is lost by the plants in a vapour form to their surroundings by the process of transpiration.

Transpiration *is the process of loss of water in a vapour form from the leaves in plants.*

It occurs through **stomata** present in the leaves by the process of diffusion.

Water absorbed through the roots

ACTIVITY 11.1

To show upward movement of water.

Take a cut shoot (a piece of stem with leaves) of balsam plants and dip it in a red coloured dye (either eosin or safranine) in a flask as shown in Fig. 11.3. Leave it for some time.

Then, take sections from different parts of stem. Examine the sections under the low power of a microscope.

What do you find under the microscope?

You will observe red colour in the stem section.

Now, check weather the entire stem tissue is red or only some parts of section is red.

You will find that only certain parts of the section are red (Fig. 11. 4 A, B).

Which are these parts?

The red coloured area of the stem represents the vascular tissue (xylem) in the stem.

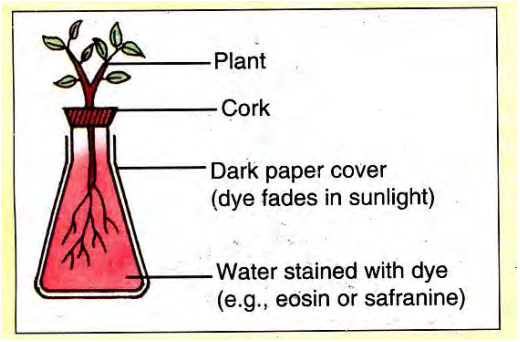


Fig. : 11.3

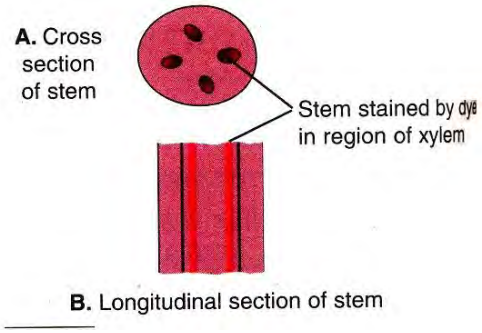


Fig. : 11.4

ACTIVITY 11.2

To show transport of food material.

This is easily demonstrated by the experiment commonly known as 'girdling experiment'. Girdling of stem removes phloem tissue (Fig. 11.5).

If a stem is girdled, the downward and upward movement or food material gets blocked. So the trunk portion shows swelling in the area due to accumulation of food material.

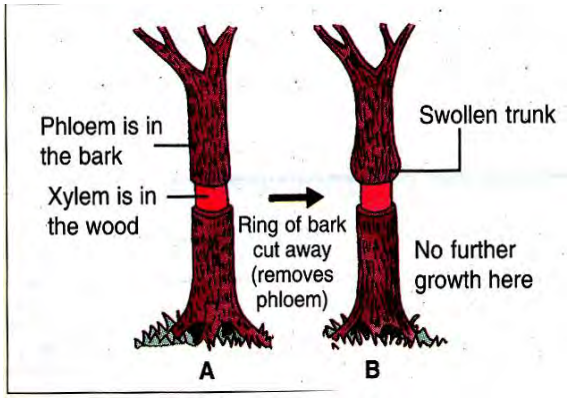


Fig. 11.5 : Girdling experiment

To perform this activity, select one branch of a potted pant. Gently remove its soft part in a small area with the help of a razor blade, as shown in Fig.11.5 A.

Leave the branch after girdling for a week. Observe what happen to the portion of stem above and below the girdled area.

You will find that the part of stem above the girdle is swollen while the lower part is unchanged.

What does it indicate?

The food prepared by the leaves could not be carried below the girdled part of the stem. It therefore, collects above the girdle and the stem there becomes swollen.

is moved upwards within the plant body. A part of it used in the process of photosynthesis, and some of it is also used to keep the plant erect and stop it from wilting (drooping).

The rest is lost as water vapour into the atmosphere from the leaves.The evaporation of water from leaves produces a suction pull which helps to pull the water upwards to great heights.

Importance of Transpiration

1. It results in the transport of water and minerals from the soil to the leaves. In the leaves, water forms the raw material for photosynthesis.
2. It produces a cooling effect which helps in preventing hot sunlight from damaging delicate cells.

ACTIVITY 11.3

To demonstrate transpiration.

You can prove that transpiration takes place by setting up the apparatus shown in Fig. 11.6.Mark clearly the level of the water in each flask. Oil has been added on the surface of water to prevent its evaporation.

Now leave the apparatus for 24 hours. After 24 hours, note the level of water in the two flasks.

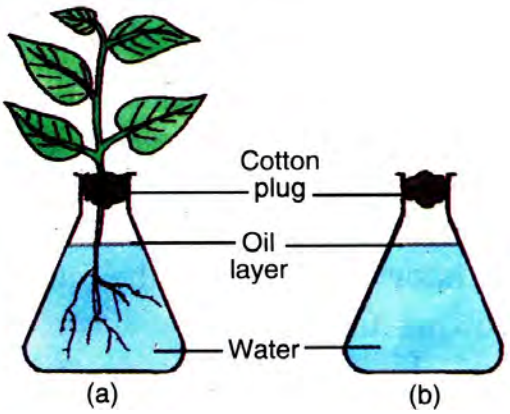


Fig. 11.6

Note down the level of water in flask (a) and (b) .In which flask the level dropped. Why has it ? Explain your results.

ACTIVITY 11.4

To demonstrate that water is given off during transpiration.

What do you need ?

(a) Small- sized well watered potted plant
(b) transparent polythene bag
(C) thread

How to do the test? (Fig. 11.7)

1. Take a small sized well watered potted plant.
2. Cover the plant as shown in figure with a transparent polythene bag. Tie the bag at the base of the stem.
3. Leave the plant in sunlight for a few hours, and then observe.

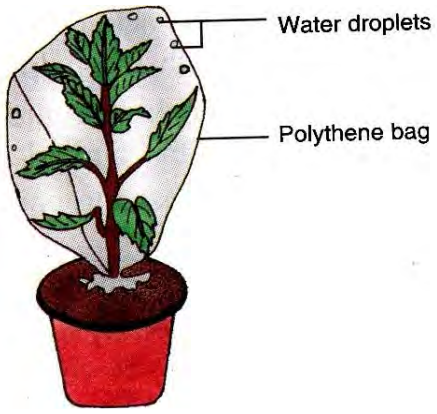


Fig. 11.7

What do you observe? Drops of water on the inside of the bag.
(Water vapour transpired by the plant condenses as water droplets.)

11.5 CIRCULATORY SYSTEM

Circulatory system is a transport system moving substances throughout our body with the help of blood **(Fig.11.8)**. In an adult human body, there are about 5.5 litres of blood, forming the most amazing transportation system in the body. The blood circulates through the body so that it reaches every cell that makes up the body.

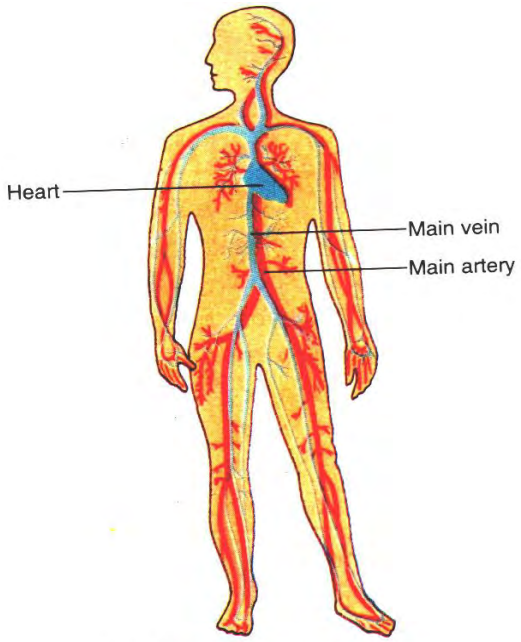


Fig. 11.8 : Circulatory System

Fig. 11.8 : Circulatory System

The circulatory system or the blood performs the following functions:

1. It carries or transports food and oxygen to each body cell.
2. It carries away waste products to organs (like kidneys, lungs and intestine) from where they are excreted out of the body.
3. It protects the body against infection by destroying germs.
4. It helps in blood clotting, thereby preventing excessive blood loss.
5. It regulates body temperature.

The blood moves in the body in tubes called **blood vessels**. The blood vessels are of three types- **arteries, veins and capillaries.**

The circulatory system **(Fig. 11.8)** consists of three part- **(i) Heart, (ii) Blood vessels, (iii) Blood.**

11.5.1 The Heart

The adult human heart is about the size of a clenched fist. It is located in the chest cavity slightly towards the left **(Fig 11.8).** This amazing organ is built like a double-storey house. Each part has two rooms. On the ground floor are the right and left **'ventricles'** and the first floor has the right and left **'auricles** or **atria'**

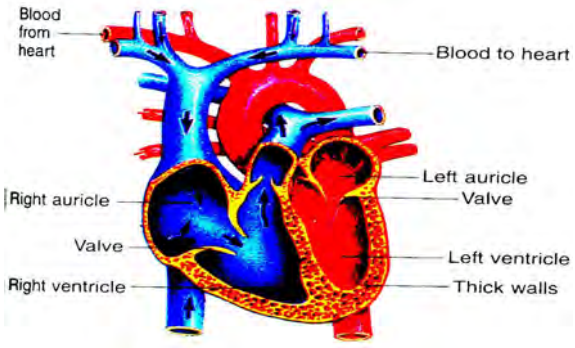


Fig. 11.9 : Internal Structure of Heart

(singular atrium) **(Fig 11.9)** There are doors called **'valves '**between the auricle and ventricle on each side but none in between the two rooms on each floor. There are also exits from the ventricles into arteries and entrance from veins into the auricles.

Actually, the heart consists of two pumps, one on each side. The left side receives the oxygenated blood (blood rich in oxygen) from the lungs and sends it through the body. The right side receives it back again with less oxygen and more carbon dioxide and sends it to the lungs.

11.5.2 The Blood Vessels

Imagine two systems of pipes, one large and one small, both meeting at a central pumping station. This will give you an idea of the circulatory system **(Fig. 11.9)**. The smaller system of pipes goes from the heart to the lungs and back. The larger one goes from the heart to various other parts of the body.

The pipes represent the blood vessels-arteries, veins and capillaries.

Arteries *are blood vessels in which blood is going away from the heart to all parts of body*. **In veins,** *the blood is coming back to the heart*. Arteries are carrying (oxgen rich) blood, and the veins are bringing back impure (carbon dioxide rich) blood loaded with waste products. A network of capillaries forms the connection between the arteries and the veins. The pumping station is the heart.

DO YOU KNOW ?

The human heart weighs about 225 to 340 grams and pumps about 16,360 litres of blood in 24 hours.

Arteries lie deep in the tissues, except at the wrist, at the temple, and along the side of the neck. The pulse can be felt at any of these places. Veins lie closer to the surface of skin and can be seen as greenish blue lines in our hands and legs.

BLOOD

Blood is a red-coloured fluid flowing inside blood vessels. It consists of (i) a liquid part called **plasma,** and (ii) the **cells** or **corpuscles (Fig.11.10)**.

The blood cells are of three types :

(I) **Red blood cells** (RBCs),

(ii) **White blood cells** (WBCs) and

(iii) **Platelets.**

The RBCs, as the name suggest, are red-coloured due to the presence of a red-coloured pigment called **haemoglobin. Haemoglobin is a carrier of oxygen.**

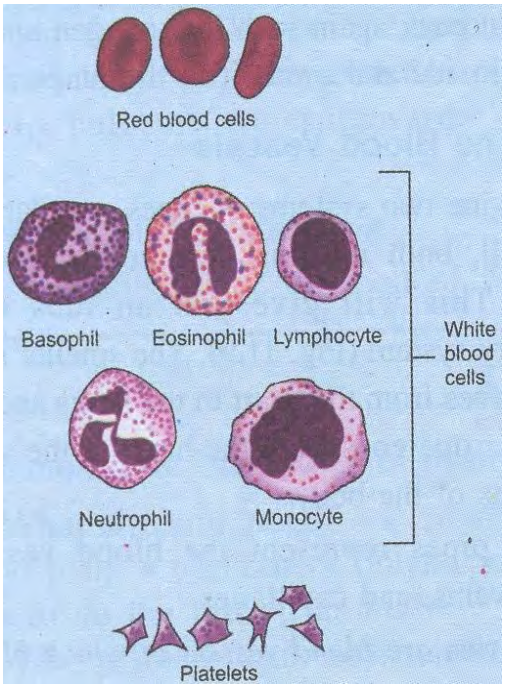


Fig. 11.10 : Types of blood cells (not drawn to scale)

It binds with oxygen and transports it to all parts of body. It would be difficult to provide oxygen to all body cells without haemoglobin.

The WBCs plays an important role in the body as they destroy the germs and help in fighting infection.

The platelets help in **clotting of blood,** whenever there is a blood flow due to some injury.

DO YOU KNOW?

The blood of insects, like the cockroach, is colourless.

Table 11.1: Differences between Arteries and Veins

Arteries	Veins
1. Carry blood away from the heart.	1. Bring blood into the heart.
2. Carry oxygenated blood (except lung artery) which carries carbon dioxide-rich blood to the lungs.	2 Carry deoxygenated blood (except lung vein) which carries oxygen-rich blood from the lungs to the heart.
3. Usually deep seated.	3. Lie closer to skin surface.

To see movement of blood through capillaries, perform the following Activity 11.5.

ACTIVITY 11.5

To see movement of blood.

Place a living tadpole in a small drop of water on a slide under microscope. Examine the thin skin of the tail to see movement of blood through capillaries.

DO YOU KNOW?

The circulation of blood was discovered by an English physician, William Harvey.

11.5.3 BLOOD CIRCULATION

Blood circulates throughout the body by the pumping action of the heart. The deoxygenated blood, (rich in carbon dioxide) is collected from different organs of the body through two major veins (vena cava). The two veins empty blood into the right auricle from here, it enters the right ventricle and is pumped into the **pulmonary artery**. Through this artery, blood is carried to the lungs. Exchange of gases between carbon dioxide and oxygen takes place in the lungs. The pure blood (oxygenated blood) is carried by the pulmonary vein to the left auricle. From here, it enters the left ventricle, and is then carried by an artery called **aorta** to all parts of the body **(Fig.11.11 A).**

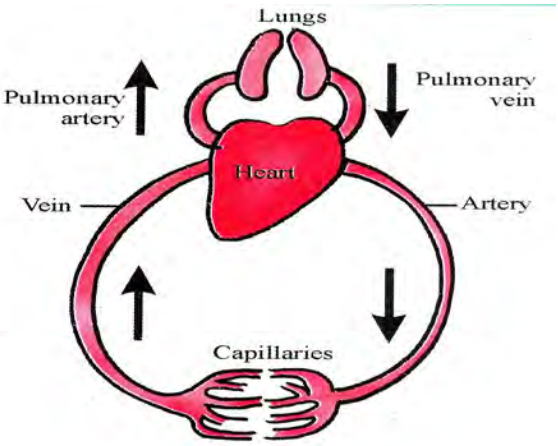


FIG. 11.11B : Schematic diagram of blood circulation

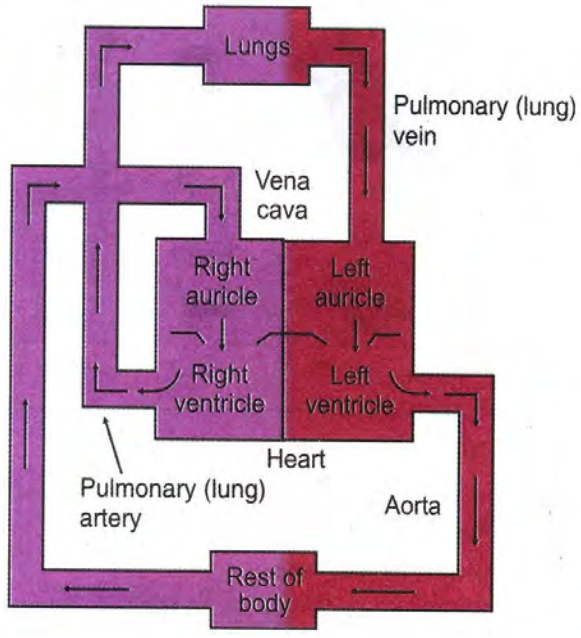


Fig. 11.11A : Blood circulation around the body. The blood always flows in the direction shown.

11.6 HEART BEAT AND PULSE

In a child, the heart beats from 90 to 100 times a minute. In an adult, heart beat varies from 70-72 times per minute. Heart beat increases when you do some

You can perform the following **Activity 11.6 and 11.7** to feel the heart beat and the pulse rate.

ACTIVITY 11.6

To feel the heart beat.

Place your palm on the chest of your friend just below the left nipple. What do you feel?

You feel that heart is beating with a regular rhythm. Now place your ear at the same place. What do you hear?

A distinct sound is heard. It is known as the heart beat.

beat. In fact, he is noting the **pulse,** by feeling the pressure of movement of blood through the artery at your wrist.

The heartbeat can also be measured by using an instrument called **Stethoscope (Fig 11.13).** A stethoscope is a device that amplifies the sound of a heart beat and is used to hear the heart

ACTIVITY 11.7

To Count the Pulse.

Place your two fingers on the wrist of friend in the line of his thumb (Fig 11.12). Wait for some time and note down what you feel.

A throbbing is felt under the fingers. This indicates that some liquid is flowing underneath your finger with a jerk. In fact, when a physician holds your wrist, he counts the number of jerks he feels in a minute.

Fig. 11.12 A

Fig. 11.12 B

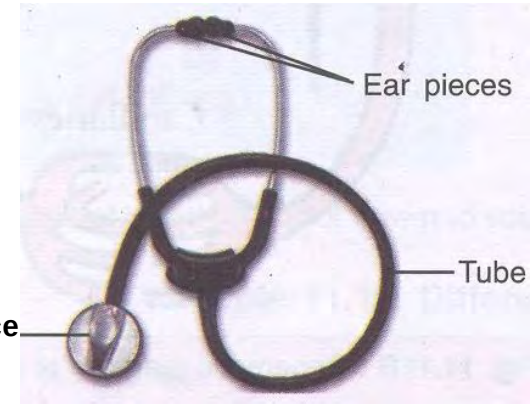


Fig. 11.13 : Stethoscope

A stethoscope consists of three parts:-

(i) a chest piece, which is sensitive to heart beats,

(ii) two earpieces, and

(iv) a tube joining the chest piece and the ear pieces.

You can make a stethoscope of your own. How? This is shown in **Activity 11.8.**

ACTIVITY 11.8

Go to your family doctor and request him to show you the stethoscope, the instrument which he often places on your chest. What does the doctor do with this instrument?

Now prepare a stethoscope of your own. You require a glass funnel, a 50cm long rubber tube and a piece of paper. Fix these items as shown in the Fig. 11.14.

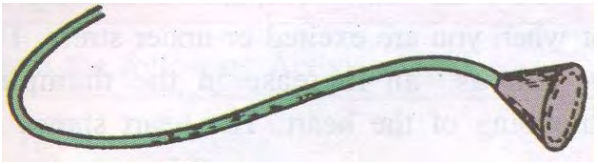


Fig. 11.14

The stethoscope is ready for use. Put the open end of the rubber tubing in one of your ears. Place the funnel on your chest near the heart. Listen carefully the thumping sound. The thumping sound is the heart beat. Count the heart beats per minute. Now run for a short while and again count your heart beats. Do you find any difference between the two counts? Note down and explain your results.

beats in the chest, by placing the chest piece of the stethoscope at the appropriate place.

11.7 EXCRETION

Living organisms perform a number of activities. During these activities, a variety of waste products are

BLOOD PRESSURE

The pumping heart produces a high pressure in our arteries. We call this the **blood pressure.** It rises if we do anything to make our heart-beat faster, or if the arteries become narrower.

Fig. 11.15 : Measuring Blood Pressure

Constant high blood pressure is harmful. It puts a strain on the heart and makes it work harder. It can also cause an artery to burst open. If this happens in the brain it can cause a **stroke.** A stroke can leave someone partly paralysed and unable to speak. Even worse, it can kill them.

produced. For example, some of the food we eat is not used by our bodies. The undigested food is a waste product. During respiration, water, carbon dioxide and heat are produced as wastes. Urea is another waste. It comes from used up protein.

Some of the waste products like urea are very harmful and toxic. These must not be accumulated within the body. Otherwise, accumulation of waste produces health problem. Fortunately, each organism has a mechanism of its own to remove the waste products.

The process of removal of the waste products is called **excretion.**

EXCRETION IN ANIMALS

1. In small aquatic organisms like *amoeba, paramecium, hydra,* etc., most of the metabolic wastes are removed through the general surface of the body

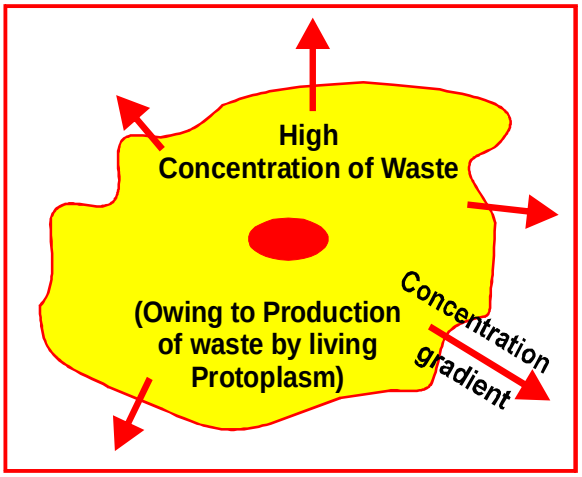


Fig. 11.16 : Excretion in Amoeba

by the simple process of diffusion. Specialized organs of excretion are lacking **(Fig 11.16)**, which shows outward diffusion of dissolved carbon dioxide and waste nitrogen compounds all over the large surface.

2. In large animals, diffusion alone is not sufficient. They have developed specialized organs for excretion. For example, nephridia are present in earthworm and leeches, malpighian tubules in insects and kidneys in vertebrate animals.

11.8 EXCRETION IN HUMANS

Excretory substances in humans are urea, sweat and undigested food. Human body has various organs to get rid of wastes.

1. **Lungs** - for excretion of carbon dioxide and water vapour produced during respiration.
2. **Skin** - for excretion of urea, salt and excess water by means of sweat glands present in the skin.
3. **Large Intestine** - for excretion of some wastes along with faeces through anus.
4. **Kidneys** - for excretion of products like urea and nitrogen in urine.
5. **Liver** - for removal of excess sugar by converting it into glycogen for future use.

11.9 EXCRETORY SYSTEM IN HUMANS

Excretory system consists of the following organs (Fig. 11.17):

1 A pair of kidneys 2 Ureters
3 Urinary bladder 4 Urethra.

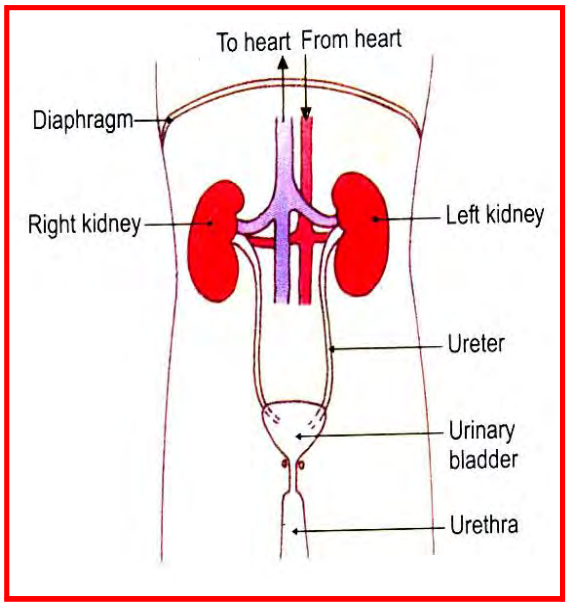


Fig. 11.17 : Excretory system in humans.

Kidneys are bean-shaped structures about 10 centimeters long. They are located just above the waist on either side of the backbone. Each kidney consists of a large number of coiled tube called **nephrons.** Nephrons act as filters. They filter waste products from the blood. The waste materials collected in the kidneys form the liquid **urine.** Urine contains 95 per cent water, 2.5 per cent of urea and 2.5 per cent waste products. Glucose generally is not present in urine. Its presence in urine indicates that the person may be suffering from diabetes.

A narrow tube called the **ureter** runs from the inner side of each kidney.

The ureters, in turn, are connected to the large sac called **urinary bladder.** Urine passes from the kidney through two ureters into the urinary bladder. Urine is collected and stored here.

Leading from the bladder is another tube called the **urethra.** Urethra works as the outlet passage for urine.

DO YOU KNOW?

About 1.00-1.8 litres of urine is passed out by an adult human being in 24 hours.

We all sweat on a hot summer day. Sweating is the production of a watery fluid from sweat glands in the skin. The watery fluid contains dissolved salts. In summer, you may have seen white patches on your clothes. These patches are produced by the salt present in the sweat. Sweating produces a cooling effect.

The rate of sweating depends upon two things - humidity (the amount of water vapour in the air), and air movements. It is more in hot conditions.

Sweating is much more rapid when one exercises in hot climates. Heavy loss of water causes the blood to become thick, so that it no longer circulates properly. Loss of dissolved salts, due to sweating causes muscular pains (cramps). In hot climates, you are, therefore, advised two things- (i) to drink lot of fluids, and (ii) to increase the intake of the salt in diet.

Animals of dog family have sweat glands only in the pads on their claws. Sweating, therefore, is very limited. These animals lose heat by **panting** rapidly with the tongue hanging out.

11.9.2 DIALYSIS

What will you do if you want to separate a mixture of sand and water. You will use the simple technique of **filtration (Fig .11.18).**

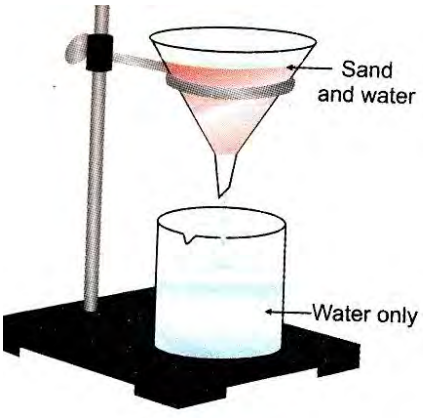


Fig. 11.18 : Filtration

But how to separate a mixture of glucose and starch? For this, the technique of **dialysis** is used **(Fig. 11.19).**

Dialysis is a process or *technique of separating small molecules from larger ones using a semi-permeable membrane* (a membrane which allows only small sized molecules to pass through it).

An egg membrane or cellophane tubing can be used as a semi-permeable membrane.

Through the membrane, glucose will come out while starch will be retained inside, if kept in a beaker of water. Similarly, you can separate a mixture of starch and common salt.

Application of Dialysis

The principle of dialysis is used in an **artificial key machine** (also called **dialysis machine**).

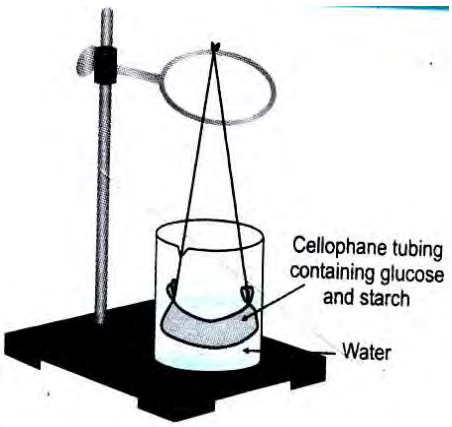


Fig. 11.19 : Dialysis

ACTIVITY 11.9

To separate a mixture of sugar and starch of water using dialysis.

Take a cellophane tubing or an egg membrane and place the given mixture in the tubing or the membrane. Tie the loose ends. Suspend this tubing in a beaker containing water .

Wait for half an hour.

Then, test water in the beaker for starch and sugar. First, test for starch using iodine solution.

What do you find?

No blue black colour, showing that starch has not come out of the semi-permeable membrane in the beaker.

Now test for the presence of glucose in the beaker, using Benedict's test.

Benedict's test

Take the water from the beaker in a test tube and add Benedict's solution to it. Heat the mixture to boiling, then cool it. A brick red precipitate will indicate the presence of glucose.

What do you observe?

A brick red precipitate, indicating the presence of glucose in beaker water.

This machine is used in case of individuals whose kidneys are not able to perform the excretory function. As a result, wastes accumulate in the body, which may even lead to death.

A kidney machine (Fig 11.20) receives blood through a tube connected to an artery in the arm. Inside the machine, blood flows through a **cellulosic dialysis tubing** which allows small molecules including urea, to pass through its walls. The 'cleaned' blood is returned to the patient through a tube connected to vein in the same arm.

The dialysis tubing is bathed in a liquid similar to blood plasma (dialysis solution), except that it lacks the plasma waste substances. Consequently, wastes but not useful substances diffuse out of the blood and are carried away by the machine.

Kidney machines allow patients with kidney failure to remain healthy, provided dialysis is carried out after every few days.

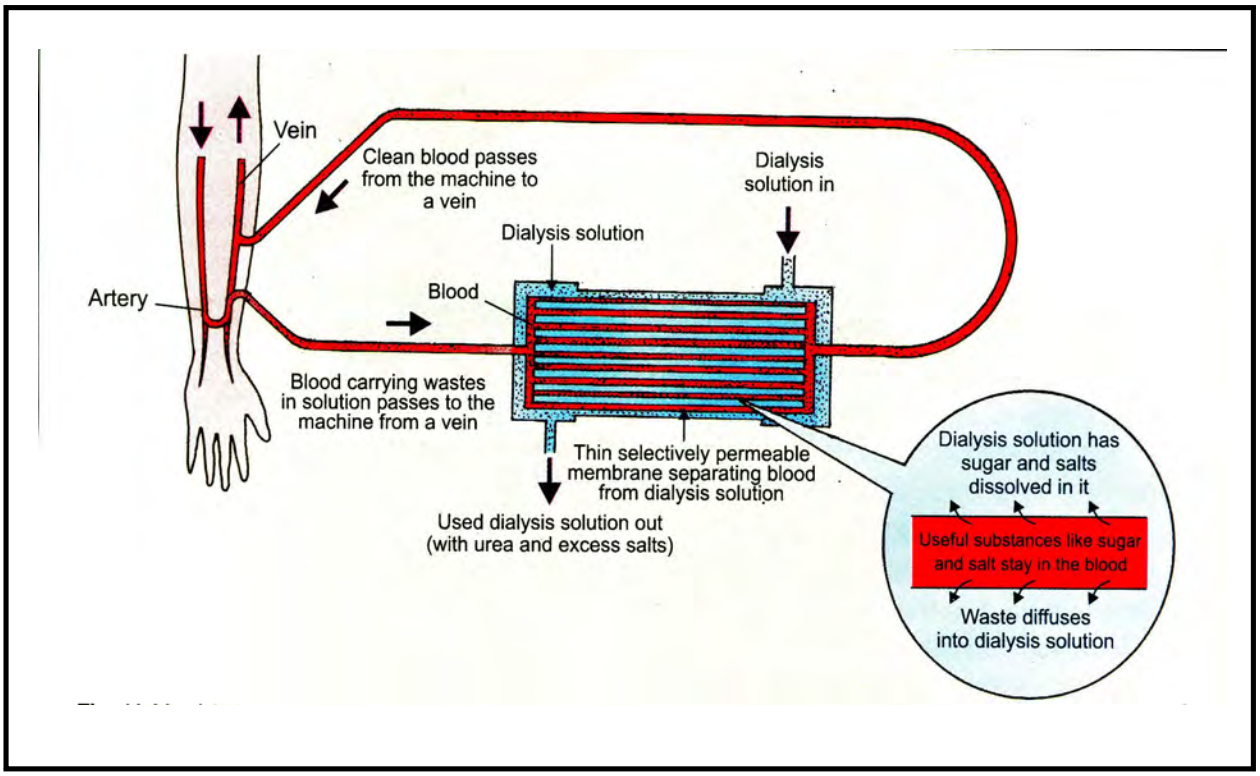


Fig. 11.20 : A kidney machine at work. A thin semi-permeable membrane separates the patient's blood from the dialysis solution. Wastes from the blood diffuse into the dialysis solution.

KEYWORDS

Artery	Heart	Capillaries
Heartbeat	Circulation	Phloem
Dialysis	Transpiration	Diffusion
Vein	Excretion	Xylem
Haemoglobin		

What you have learnt

- (a) In living organisms, food, gases and waste products have to be transported from one part of the body to another.
  (b) In unicellular organisms, transport occurs by diffusion.
  (c) In higher multicellular organisms, transport occurs, through **blood.**
  (d) In higher plants, transport occurs through **xylem and phloem.** Movement of water and minerals occurs through xylem, while that of food materials through phloem.
  (e) A lot of water is lost by plants in vapour form through stomata during **transpiration.**
  (f) Transpiration produces a suction force which pulls water from the soil to above ground parts.
- (a) In humans, the circulatory system consists of **heart, blood vessels (arteries, veins and capillaries)** and **blood.** Arteries carry oxygenated **blood** while veins, deoxygenated blood.
  (b) Blood consists of liquid **plasma** and cells (**RBCs, WBCs** and **platelets**).
- The red colour of blood is due to pigment haemoglobin, present inside RBCs.
- The process of removal of waste products produced in the body is known as excretion.
- In unicellular organisms, excretion takes place through the general body surface by the process of diffusion.
- Excretion in humans occurs from lungs (carbon dioxide and water vapour), skin (sweat), Kidneys (urine), and liver (wastes from blood). Major excretory organ, however, is the kidney.
- Excretory system in humans consists of a pair of kidneys, ureters, urinary bladder and urethra. A number of filtering tubes called nephrons are present in each kidney.

EXERCISES

(I) Multiple Choice Questions - Tick mark (✓) the correct choice.

(1) In plants ,materials are transported through

(a) xylem (b) xylem and phloem

(c) phloem (d) root hair

(2) Food is transported in the plants through

(a) xylem (b) root hair

(c) phloem (d) diffusion

(3) Water absorption is more because

(a) of xylem (b) of more transpiration

(c) of phloem (d) more water is required by the plant body

(4) Water absorption through roots can be increased by keeping the plant

(a) in bright light (b) in dim light

(c) in the shade (d) covered with a polythene bag

(5) The colour of blood is red due the presence of

(a) chlorophyll (b) anthocyanin

(c) haemoglobin (d) red blood cells

(6) In an adult normal rate of heartbeat is

(a) 72 times per minute (b) 92 times per minute

(c) 82 times per minute (d) 62 times per minute

(7) Blood cells which protect the body from infection are

(a) RBCs (b) Platelets

(c) WBCs (d) Haemoglobin

(II) Fill in the blanks:

1. In most animals, circulation is brought about by a liquid called _____.

2. Blood moves through tubes called _____.

3. Two useful things that are circulated in all animals are_____and _____.

4. The liquid part of blood is called _____.

5. The substance in red blood cells that links up with oxygen is called _____.

6. The red colour of the blood is due to the presence of _____.

7. Excretion of wastes in unicellular organisms takes place by _____.

8. Getting rid of waste materials in living beings is called_____.

9. Most liquid wastes are excreted through the _____.

10. Skin helps in the excretion of water and _____.

11. In man, carbon dioxide is excreted through _____.

12. Kidneys are made up of a number of filters called _____.

13. Kidneys are connected to the urinary bladder by long tubes called _____.

14. Artificial kidney machines work on the principle of _____.

(III) Match the Column A with those in Column B.

Column A	Column B
1. Heart	(a) A living pump
2. Food and oxygen	(b) Can poison an organism
3. Waste products	(c) Movement of materials
4. Carrier of oxygen	(d) Materials needed by every living thing.
5. Circulation	(e) Pipes for transport in man
6. Arteries and Veins	(f) Red blood cells

(IV) Write true or false in front of the statements given below:

Statements **(True /False)**

1. In *spirogyra*, transport of materials takes place through osmosis. _____

2. Xylem and phloem are vascular tissues. _____

3. 'Girdling experiment demonstrates food synthesis in plants. _____

4. Platelets help in clotting of blood. _____

5. In Hydra, excretion takes place through diffusion._____

(V) Answer the following questions:

1. How does transport of materials take place in unicellular plants?

2. Define diffusion.

3. What are two aspects of transport in higher plants?

4. Mention the functions of (a) Xylem and (b) Phloem.

5. Name a process by which water loss takes place in plants.

6. Define the following:

(i) Circulatory system (ii) Arteries (iii) Veins

7. Name the main parts of the circulatory system.

8. Mention the functions of blood.

9. Describe the functions of the following:

(i) Heart (ii) Blood vessels

(iii) Red blood cells (iv) White blood cells

(v) Platelets

10. Describe, in brief, the circulatory system in human beings.

11. Name the organ from which oxygenated blood goes into the heart.

12. Define excretion.

13. How does excretion occur in lower animals?

14. Why is the process of excretion important for living beings?

15. Name the various organs of excretion in humans.

16. What waste products are removed by the following parts?

(a) Skin (b) Kidneys

(c) Lungs (d) Large intestine

17. Name the organs of excretion in earthworms, insects and vertebrates.

18. Define sweating.

19. What is the importance of sweating?

For more information, read on the following websites :

www.health.howstuffworks.com/adam-200142.html

http://www.funsci.com/fun3_en/blood/blood.html

12 REPRODUCTION IN PLANTS

Organisms which are born, show growth, reach adulthood and live for some more time till after death attaining their maximum life span. How then a particular type of organism continue to exist? This is possible only through one of the most important life processes called multiplication or reproduction. All living organisms reproduce. What it means in simple terms is that living organisms produce young ones of their own kind. For examples, a cat produces kittens which grow into adult cats. In plants too, seeds grow into young seedlings. The seedlings in due course of time develop into mature plants, as in a mango tree.

Reproduction is one of the most important property of living organisms. It means creating new life, producing young ones of their own kind.

12.1. WHY LIVING ORGANISMS NEED TO REPRODUCE?

All living organisms have a fixed life span. During their life span, the organisms perform various life functions including reproduction. In an annual plant, for example, the life span is about one year, and in a perennial plant, it goes up to many years. Then the organisms die, leaving behind individuals of their own kind. This they ensure by reproducing during their life span. If they would not reproduce, then after their death, there would be no organism left. The species would thus perish.

Reproduction is thus, the means of perpetuation of species.

DO YOU KNOW ?

Do you know, at one time people thought that living things could come from dead (once alive) or non- living (never alive) matter. This was however, disproved subsequently.

12.2 MODES OF REPRODUCTION

How do you grow new plants?

You have studied about the structure of a flower. You also have studied that flowers produce seeds. Seeds are formed by the fusion of a male gamete with a female gamete. We sow these seeds and grow more plants of the

same type. This is the most common method of growing new plants. This type of reproduction is called **sexual reproduction.**

Can we grow new plants without seeds?

Yes, there are some plants which do grow without seeds. These plants give rise to new plants from a part of stem; root or leaf. These parts of the plants are called **vegetative parts.**

For example, a new plant of rose is produced by growing a cutting from one of its branches. This type of reproduction, which takes place without seeds, is called **asexual reproduction.**

Sexual reproduction is characterized by the fusion of two cells **(gametes)** usually coming from two parents. New plants are produced from seeds.

Asexual reproduction, on the other hand, is any type of reproduction that does not involve the union of gametes. New individual is produced from a single parent.

Methods of Asexual Reproduction

1. Fission-binary and multiple
2. Budding
3. Fragmentation
4. Spore formation
5. Regeneration
6. Vegetative propagation

12.3 ASEXUAL REPRODUCTION IN PLANTS

A. Binary fission

It is a most common method of asexual reproduction in which an organism divides into two. It is common among plants in unicellular organisms like bacteria **(Fig. 12.1)** and some algae and fungi. In this method, the organisms divide itself into almost two equal halves. Nucleus also divides into two parts. Each of the two parts then grows into full size.

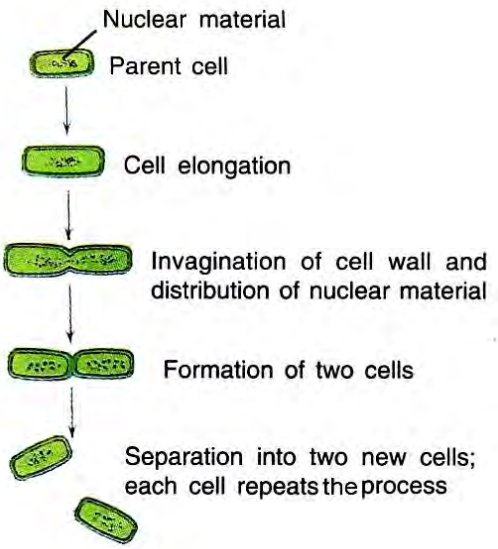


Fig. 12.1 : Binary Fission in Bacteria

B. Budding

Budding is commonly observed in yeast. A bulb-like projection, called the **bud,** is formed on the body. The nucleus

of the body divides into two. Then, one of the two nuclei passes into the bud. The bud detaches itself from the parent body. It grows to full size and becomes a new individual **(Fig. 12.2).**

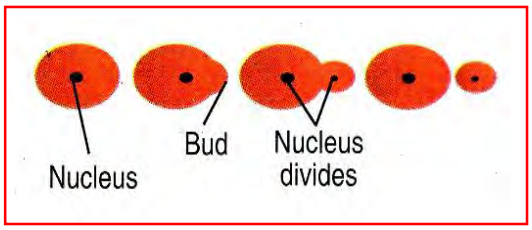


Fig. 12.2 : Budding in yeast

C. Fragmentation

In some filamentous organism such as Spirogyra (an alga), the filaments break up into two or more fragments **(Fig. 12.3).** Each fragment or piece grows into a new individual.

D. Spore formation

In non-flowering plants (the plants which do not produce seeds), like fungi (Mucor), bacteria, ferns or mosses, formation of spores is a common method of reproduction **(Fig. 12.4).**

Spores are very small, covered by very thick walls which help them to survive adverse conditions in the environment, like high temperature, scarcity of water and lack of food. The spores give rise to new organisms under favourable conditions.

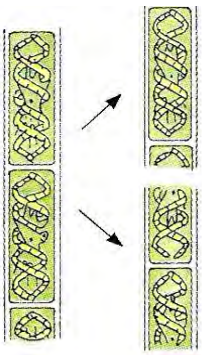


Fig. 12.3 : Fragmentation in Spirogyra

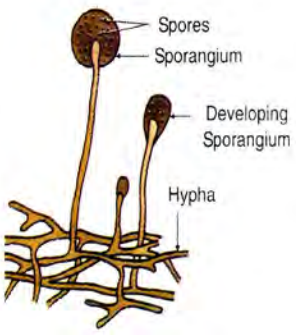


Fig. 12.4 : Spore formation in Mucor (a fungus)

E. Regeneration

In your garden, you mow the grass, and again next week, it needs mowing.

Each organism can repair itself in some or the other way. New cells grow to replace damaged or lost cells.

The ability of living things to repair them-selves or grow lost parts is called **regeneration.** Plants generally have greater powers of regeneration than animals do.

DO YOU KNOW ?

Every time you wash your hands, you wash off hundreds of skin cells. New skin cells are always being regenerated.

F. Vegetative Reproduction This is an asexual method of reproduction in plants where vegetative parts, namely, the root, stem or leaf, give rise to new plants. No reproductive organs take part in this method of reproduction and therefore, no

seeds are produced.

Vegetative Propagation by Roots- In sweet potato, dahlia or asparagus, the swollen roots are present. New plants arise from these swollen roots buried in the soil **(Fig. 12.5).**

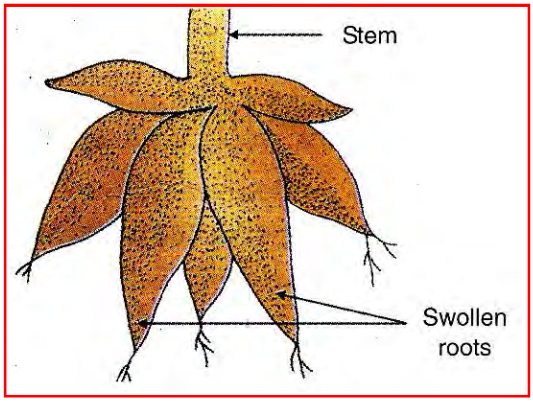


Fig. 12.5 : Roots of Dahlia

Activity 12.1

Take about 10 gram of yeast powder and put it in a glass beaker containing warm water in which a spoonful of sugar has been dissolved. Keep the beaker in a warm place (at about 35^0 to 40^0C). After an hour, take a drop of solution from the beaker on a glass slide, and observe the slide under the microscope. Make a sketch of what you observe. You will observe budding in yeast. Yeast powder can be obtained from a bakery or a chemist shop.

Activity 12.2

To grow your own fungi like bread mould take a small piece of bread, a paper napkin, a small jar or bottle with cap and water.

Now perform the activity as follows:

a) Cut a piece of napkin to fit in the bottom of the jar.

b) Pour a small amount of water into the jar-just enough to wet the paper napkin completely.

c) Place a piece of bread on the moist paper napkin.

d) Cap the jar loosely. This is very important.

e) Place the jar in a dark place where it is not cold.

f) Look at it everyday for a week and draw pictures showing how the mould looked during its growth stages.

Activity 12.3

Take swollen roots of sweet potato or asparagus. Place some of these roots in a flower pot containing moist soil. Observe after a few days.

What do you observe ?

New plants will grow from the roots buried in the soil.

Vegetative Propagation by Stems- A number of plants like potato, ginger, sugarcane and gladiolus multiply by stems.

Potato plants produce flowers, fruits and seeds. Yet, they never grow into plants.

The potato which you eat is in fact an underground swollen stem (tuber) which contains stored food material. If you observe a potato with a magnifying glass, you will find 'scars'. These scars are called 'eyes'. The 'eyes' on the potato tuber sprout (germinate) and give rise to new plants **(Fig.12.6).**

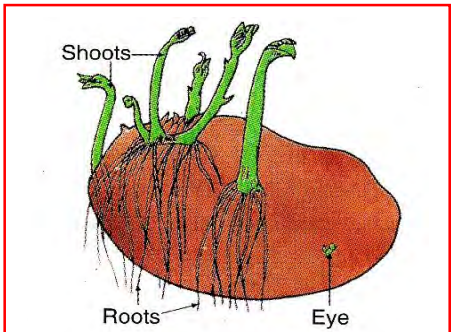


Fig. 12.6 : A sprouted potato tuber showing the development of many plants.

Activity 12.4

Take a potato tuber and observe it with a hand lens. You will be able to see 'eyes' on it. Now, cut a piece of it and plant the cut piece in a pot containing soil. Observe the new plant (roots, stem and levels) developing from the cut potato piece.

Likewise, ginger is a modified swollen underground stem **(rhizome)** with stored food. Under favorable conditions, the buds on the stem give rise to new plants.

In strawberry, long stems grow over the soil surface and are called **runners (Fig. 12.7).** Buds which are present on the stem grow into new plants.

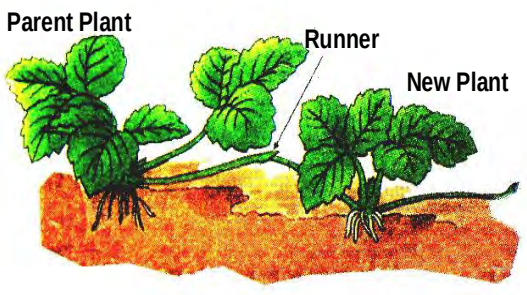


Fig. 12.7 : Runner in strawberry

Vegetative Propagation by Leaves

Some plants like *Bryophyllum* (sprout leaf plant), Begonia can be propagated by leaves. In *Bryophyllum,* plantlets develop from the margins of intact leaves. These plantlets, on being detached, develop into independent plants **(Fig. 12.8).**

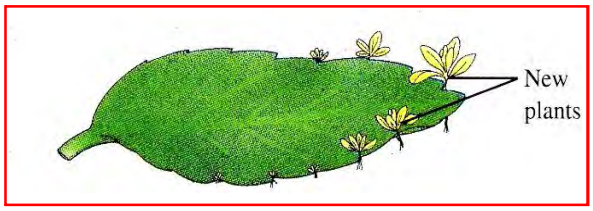


Fig. 12.8 : Buds present in individual notches along the margin of a Bryophyllum leaf are capable of forming new plants.

Advantages of Vegetative Reproduction

1. It is an easier, rapid and less expensive method of propagation. Plants can be grown in much less time.
2. Seedless plants can be raised.
3. Plants produced by this method are identical copies of the parent plants and show no variations.
4. Plants like banana, sugarcane, sweet potato, rose and jasmine do not produce viable seeds. Such plants can be easily grown by this method.

Activity 12.5

Take a Bryophyllum leaf and place it on the moist soil in a dish or a flower pot. Take care that margins of the leaf remain in touch with the moist soil.

Observe after 2-3 days.

Some small plants with fine roots and shoots will come out from the notches of the leaf.

Now, separate a small plant from the leaf notch and plant it in soil in another pot.

Observe what happens.

In a few days, you will find that a mature plant develops.

Artificial methods of Vegetative Propagation

Because of the advantages offered by vegetative propagation, humans have used this method for artificial multiplication of useful plants. For this reason, such multiplication methods are called artificial methods of vegetative propagation. Some of these methods are as follows:

1. **Cutting,** as in rose and sugarcane.
2. **Layering,** as in jasmine (Chameli) plant.
3. **Grafting,** as in case of mango.

4. Tissue culture

1. Cutting: (a) Stem Cuttings: Cuttings are short lengths of the plant which, when removed and placed in soil, with suitable conditions develop roots and leaves and grow into independent plants. **(Fig 12.9)**

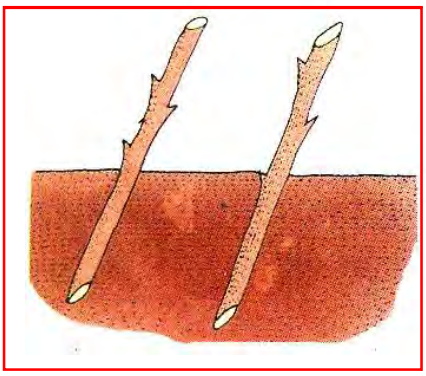


Fig. 12.9 :Cutting in rose

Sometimes the stem cutting has to be dipped into a rooting hormone to stimulate rooting. Rose, coleus, bougainvillea, sugarcane and cactus are easily propagated by cuttings.

(b) Root cuttings: In certain plants like lemon, tamarind, etc., root cuttings when put in the damp soil give rise to roots and shoots and form new plants.

2. Layering (Fig. 12.10): The lower branch of the stem is bent so that a part of the stem is buried under the soil. The growing tip remains above the soil surface. After sometime, roots grow from the stem part buried in the soil. Now this new plant can be cut from the parent plant and planted as a new independent plant. This method is used in plants like jasmine, strawberry and bougainvillea.

Fig. 12.10 : Layering in Jasmine

3. Grafting (Fig. 12.11): In grafting, the desired plant is derived from two different individuals. The root portion taken from one plant is called the stock while the stem portion from the other is called the scion. Scion is the plant which one wants to propagate and so it is grafted on to the stock. The grafting ends of the stock and scion are obliquely cut and placed face to face. Then the two ends are tied tightly.

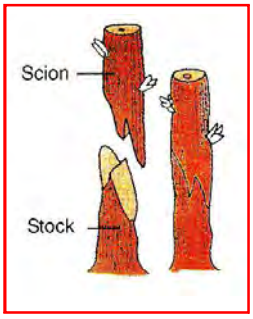


Fig. 12.11 :Grafting

4. Tissue culture: In this method, a tissue is taken from the tip of a plant as it is composed of undifferentiated and immature rapidly dividing cells. The tissue is grown in a suitable medium containing necessary nutrients and

hormones. The tissue grows into an unorganized mass called callus. Small parts of this callus are put in another medium which induces the formation of plantlets. The plantlets can be transplanted in the soil or in pots. This technique is also called **micro propagation (Fig 12.12).**

Since in a very short time, unlimited number of plants can be produced, this technique is being used for the propagation of disease-free orchids, carnation, gladiolus, chrysanthemum, potato, sugarcane and other plants.

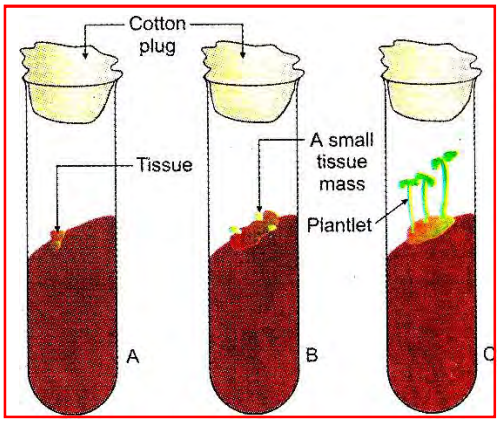


Fig. 12.12 :Tissue Culture

Activity 12 .6

Visit a nearby nursery and note down the names of ten plants growing there. With the help of a gardener (mali), find out the method of multiplication followed in the case of these plants.

12.4 SEXUAL REPRODUCTION

In nature, sexual reproduction occurs in plants as well as animals. **It is the most common method of reproduction.**

As stated earlier, two parents, one male, and the other female, are required for sexual reproduction. Two types of reproductive cells, called **gametes** are produced from the reproductive organs of two parents. Male parent produces the **male gamete** and the female parent produces the **female gamete.**

A male gamete is usually small with a nucleus and little cytoplasm. The female gamete is larger, with a nucleus and more cytoplasm than the male.

The fusion of the two gametes is called **fertilization.** The product of fusion of the two gametes is called the **zygote.**

The male gamete in a flowering plant is a nucleus in the pollen grain; in most animals, it is the sperm. The female

gamete in plants is a large egg cell in the ovule; while in animals, it is the ovum.
After fertilization, the zygote undergoes cell division and growth. Ultimately, forms the new individual.

Thought for you : Imagine, there was no sexual reproduction in man, and man could reproduce asexually. What would be the consequences of such a reproductive process in man, and other organisms ?

Why do we need sexual reproduction?

Sexual reproduction brings about a fusion of gametes from both the parents. The zygote so formed thus possesses characters of both parents. This also helps to bring variations among new individuals. You can now understand why children of the same parents show variations. Do you find such variations in organisms reproducing asexually?

12.5 SEXUAL REPRODUCTION IN PLANTS

In the last class, you have learnt about the structure of a flower. To recall, a flower has commonly four parts. These parts, in order from the outside are sepals, petals, stamens and pistil **(Fig. 12.13).** Of these four parts, stamens and carpels are the important parts, as these take part in sexual reproduction. The **stamens** are the male reproduction part, while the **pistil** (or carpel) is the female part.

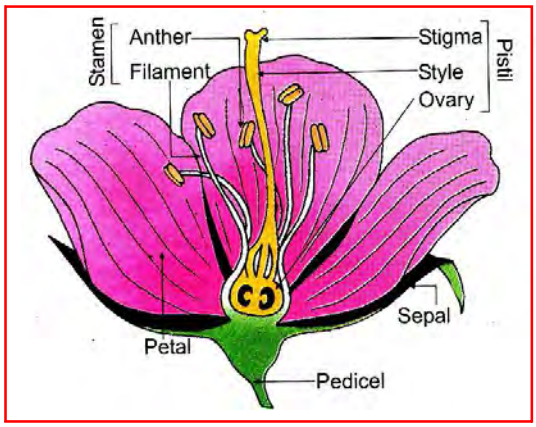


Fig. 12.13 : Parts of a flower

A **stamen** consists of an **anther** and a **filament (Fig. 12.14).** An anther is a swollen structure present on the tip of the filament. The anther produces a powdery substance called the **pollen grains.**

Fig. 12.14: A stamen

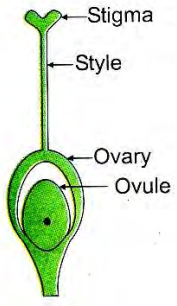


Fig. 12.15: A pistil

Pollen grains contain the male sex cell or male gamete. Pollen grains are light and can be carried by wind, water or insects.

A **pistil** consists of a basal swollen portion called the **ovary.** The ovary continues into a long **style** and ends in a knob-like part, the **stigma (Fig 12.15).** The ovary contains many **ovules.** The female sex cell or gamete (egg) is present inside the ovule **(Fig. 12.16).**

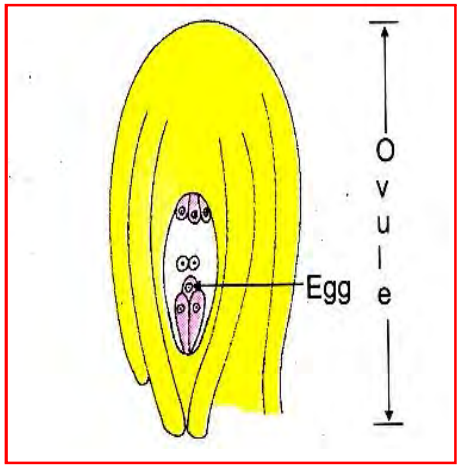


Fig. 12.16: Female gamete inside the ovule

In many plants, the male and female parts are present in the same flower. Such flowers are called **bisexual.** Examples pea, rose, mustard, sunflower and china-rose.

In some, the male and the female parts are borne in different flowers. Such flowers are called **unisexual.** Examples-date palm, papaya, mulberry, corn and cucumber.

Pollination

Pollination is the transfer of pollen grains from the ripe anther to the stigma. The transfer of pollen grains to the stigma can take place in two ways:

1. Within the same flower or between flowers of the same plant called **Self Pollination.**
2. Between flowers from different plants of the same species called **Cross Pollination (Fig 12.17).**

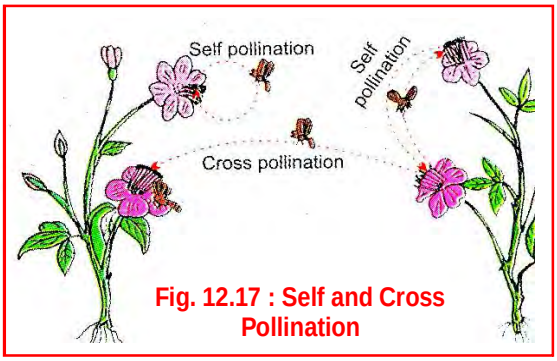


Fig. 12.17 : Self and Cross Pollination

Cross pollination often involves various external agencies to carry pollen grains from one flower to another one. These agencies may be air, water, insects or animals. Most flowers are pollinated by insects.

When you visit a garden during flowering season, you observe many butterflies, bees and moths. What are the insects doing? Though these insects visit the flower for nectar or honey, at the same time, they help in pollination **(Fig 12.18).**

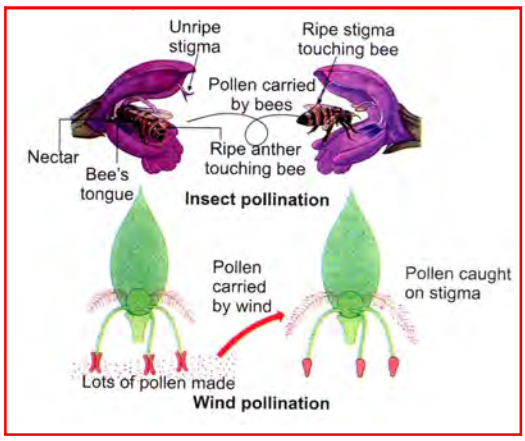


Fig. 12.18 : Insect and wind-pollination

Perform the **Activity 12.7** to see what the insects do when they visit a flower.

When an insect visits a flower, the pollen grains get deposited on the body of the insects. When this insect visits another flower, the deposited pollen grains now get dusted on the stigma of the second flower, thus bringing about the transfer of pollen grains from the anther to the stigma **(pollination).**

Activity 12.7

Catch an insect immediately after it has visited a flower. Dust its body on a white paper with a fine brush. With the help of a hand lens, observe the paper.

Do you find something on the paper?

Yes, you find that there are small rounded structures. These are the **pollen grains,** which were deposited on the insect's body when it visited the flower to collect nectar or honey.

Activity 12.8

Observe the flowers and the method of pollination in sunflower, china-rose, salvia and maize. Make these observations in nature. Note down in your notebook what you observe. Use a hand lens while observing the pollen grains.

You will make the following observations:

(1) The flowers in case of sunflowers, china-rose and salvia are large, coloured and showy. But in case of maize, flowers are small and not coloured.

(2) Flowers in case of sunflower, china-rose and salvia have either scent or nectar. But in case of maize, flowers have no scent or nectar.

(3) Pollen grains in the first three flowers are sticky and bigger in size, so that these can stick on the insect's body. In case of maize, pollen grains are very small in size and dry. Such pollen grains can be easily carried by wind.

The wind-blown pollen grains are caught by stigmas which hang out.

What do you conclude from your observations?

(1) Flowers in case of sunflower, china-rose and salvia **(Fig. 12.18)** are insect- pollinated.
(2) Flowers in case of maize are wind-pollinated.

Fertilization

Fertilization is a step between pollination and seed formation.

The fusion of the male gamete with the female gamete is called **fertilization.**

During fertilization, the following events take place:

(1) The pollen grains germinate on the stigma, and pollen tubes develop. The pollen tubes move downwards into the style **(Fig. 12.20)**. The pollen tubes are carriers of male gametes **(Fig. 12.19.).**

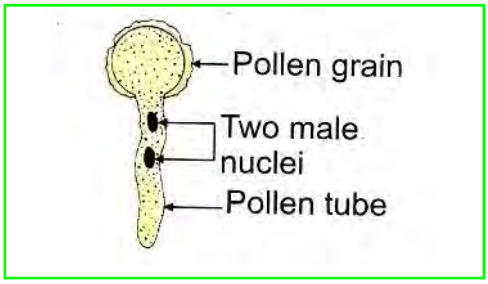


Fig. 12.19 : Pollen grain develops into a tube carrying male gametes.

(2) One pollen tube finally enters the ovule, where female gamete is located **(Fig.12.20).**

Female gamete or egg cell is present inside the ovule.

(3) Finally the male gamete fuses with the female gamete. This completes the process of fertilization. The fusion product or the cell formed as a result of fusion of the two gametes is called Zygote. The zygote soon develops into an **embryo (body plant).**

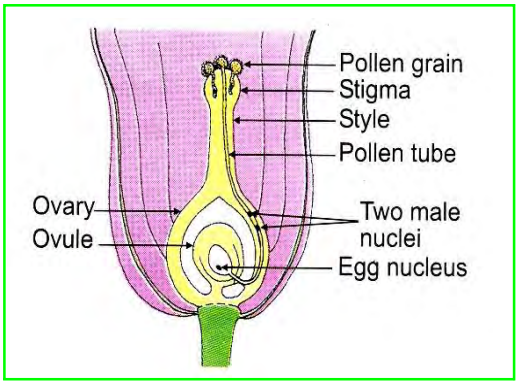


Fig. 12.20 : Process of fertilization

Formation of Fruit and Seed

What happens to the flower after fertilization? If you observe carefully, you may see following changes in a flower:

(1) The flower loses its bright colour.
(2) The sepals, petals, and stamens fall off.
(3) The ovary increases in size and becomes the fruit. The fruit thus is

the ripened ovary.

(4) The ovary wall becomes the fruit wall.

(5) Inside the ovary, the ovules develop to form the **seeds.**

The Fruit : Let us perform the following **Activity 12.11.**

Fruits of the type of pea are called **dry fruits.** The fruit wall in such a fruit is thin and dry.

Activity 12.9

Take a cavity slide (a cavity slide is a microscopic slide with a small cavity in it). Put a few drops of 3% sugar solution in the cavity. With the help of a fine brush, collect some pollen grains from a mature anther and dust these on the sugar solution. Place a cover slip on the cavity of the slide.

Leave the slide undisturbed for some time and then observe under the microscope. What do you observe?

You will find small tubes coming out from the pollen grains **(Fig. 12.19).**

Activity 12.10

Examine the stigmas of a number of flowers found in your garden, under the low power of a microscope. Pollen grains may be seen adhering to them. Now place a drop of water and crush the stigmas between two slides. You may see pollen tubes.

Activity 12.11

Examine a pea fruit and a mango fruit. Remove the outer covering in both these fruits. What do you observe?

In case of pea fruit, once the outer green covering is removed, the rounded seeds become visible **(Fig. 12.21).** The fruit wall in pea is thin and dry.

In a mango fruit, after the removal of the outer covering, you find the freshly portion which you eat. Inside the freshly portion, a stony part of the fruit wall is present. Seed is present inside

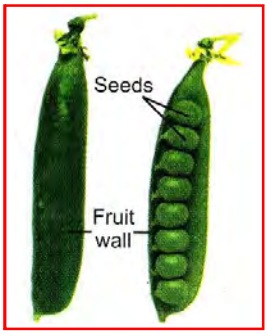


Fig. 12.21 : Fruit of pea

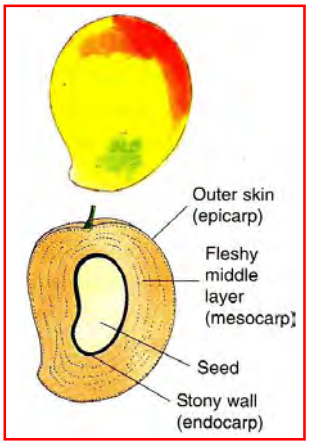


Fig. 12.22 : Fruit of mango

the stony wall **(Fig. 12. 22).** The fruit wall in mango has, therefore three layers:-

(i) Outer skin **(epicarp).**

(ii) Middle fleshy portion **(mesocarp),** and

(iii) Inner stony wall **(endocarp).**

Activity 12.12

Collect the fruits of bean, lady finger, sun flower, maize, tomato, brinjal, orange, coconut and plum. Study these fruits and classify them as dry and fleshy fruits giving reasons.

Examples of dry fruit : Cotton, lady finger, maize, sunflower, bean.

On the other hand, mango fruit is a **fleshy fruit,** as the fruit wall is thick and fleshy.

Examples of fleshy fruit : Tomato, brinjal, orange, coconut, plum.

Functions of fruits

(I) The fruit wall gives **protection to the seeds** and therefore, to the embryo.

(Ii) The fruit is a **store house of food** material.

(Iii) The fruit helps in the dispersal of seeds.

Seed

A seed contains an **embryo,** one or two **cotyledons** and a protective **seed coat (Fig 12.23).** The embryo, after germination of the seed, develops into a new plant. The cotyledons often contain reserve food material for the developing plant.

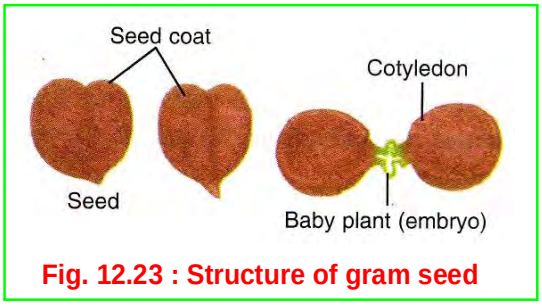


Fig. 12.23 : Structure of gram seed

12.6 DISPERSAL OF SEEDS AND FRUITS

For a seed to give rise to a new plant, certain favourable conditions are necessary. A seed must fall on a suitable place where favourable conditions are present. How are seeds carried or dispersed to such a place?

Can you imagine what would happen if the seeds were to germinate near the plant itself and not get dispersed to distant

places?

Let us study the following seeds or fruits to know about the mechanism of dispersal.

Collect seeds/ fruits of drumstick, maple, calotropis (madar), gokhru (tribulus), okra (xanthium) and coconut, with the help of your class teacher.

Examine these seeds or fruits. What do you find?

You will find different situations:-

(I) In some cases like madar **(Fig 12. 24)**, the seeds are small and dry. A fine tuft of fine hair is present on the tip of each seed. These seeds are carried to far- off places by wind.

(ii) In maple, the fruit has flat, wing-like light structure **(Fig 12.25).** Like madar, these fruits are dispersed by wind.

(iii) In gokhru and xanthium, the fruits are thorny **(Fig 12.26)** and stick to our clothes as we pass by them. These fruits also stick to bodies of passing animals. The animals as well human beings help in dispersal.

(iv) In case of coconut which is grown on the sea shore, the fruit is large and fibrous **(Fig 12.27).** It falls in water, and being fibrous it floats in water, it is thus carried away from the parent plant by water currents.

Fig. 12.24 : Seed of madar

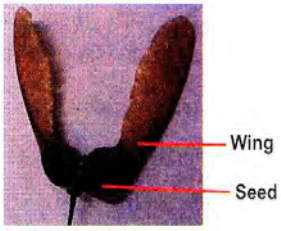


Fig. 12.25 : Fruit of maple

(A) (B)

Fig. 12.26 :A. Fruit of gokhru B. Fruit of Xanthium

Fig. 12.27 : Fibrous fruit of coconut dispersed by water

Thus, seeds and fruits may be dispersed to places away from the parent plant by various means like wind, animals, or water.

Seed dispersal helps the plants to (i) prevent overcrowding, (ii) avoid competition for water, mineral and sunlight, and (iii) spread to new habitats.

KEYWORDS

Asexual reproduction	Binary fission	Bisexual
Budding	Cutting	Embryo
Fertilization	Gametes	Grafting
Layering	Pollination	Regeneration
Tissue culture	Unisexual	Vegetative propagation

What you have learnt

- Reproduction is the process in which living organisms produce new individuals of their own kind. It is the means of perpetuation of species.
- Broadly, there are two modes of reproduction - Asexual and sexual.
- Asexual reproduction involves only one parent. Sex organ or gametes are not involved.
- Different types of asexual reproduction are fission, budding, fragmentation, spore formation, regeneration and vegetative reproduction.
- Sexual reproduction involves two parents. Two types of gamete are formed. The male parent produces the male gamete (sperm) and the female parent produces the female gamete (ovum).
- In higher plants, flowers are the reproductive organs. Stamens are the male reproductive organs producing male gamete, while pistil is the female reproductive part producing the female gamete or egg inside the ovule.
- Pollination (transfer of pollen grains from the anthers to the stigma) and fertilization (fusion of male gamete with the female gamete) results in fruit and seed.
- Fertilized egg is called zygote.
- Sexual reproduction brings about variations among new individuals. No variation is caused by asexual reproduction.
- Seed dispersal takes place by wind, water and animals.

EXERCISES

(I) Multiple choice questions - Tick mark (✓) the correct choice.

1. The common method of reproduction in bacteria is

(a) budding (b) fragmentation

(c) binary fission (d) all the above

2. Budding is commonly seen in

(a) Yeast (b) Grasses

(c) Amoeba (d) Bryophyllum

3. Reproduction or propagation by stem is common in

(a) Rose (b) Potato

(c) Sweet potato (d) Bryophyllum

4. Unisexual flowers are found in

(a) Mulberry (b) Mustard

(c) Pea (d) Sunflower

5. A seed consists of

(a) Embryo (b) Seed coat and cotyledons

(c) Embryo and seed coat (d) Seed coat and endosperm

6. An embryo of a seed consists of

(a) Plumule (b) Radicle, plumule and cotyledons

(c) Plumule and radicle (d) Radicle and cotyledons

(II) Fill in the blanks:

(a) Budding is a kind of _____ reproduction.

(b) The amount of cytoplasm in the parent cell is _____ than the amount in the bud.

(c) Yeast cells reproduce by _____.

(d) Binary fission produces cells of _____ size.

(e) Budding produces cells of _____size.

(f) Fungi, ferns and mosses reproduce by_____.

(g) Male sex cells in plants are called _____.

(h) The two kinds of pollination are _____ and _____.

(III) State whether the statement given below are true or false:-

Statements **False/True**

(a) Asexual reproduction is more common than the sexual reproduction.

(b) Producing life is called respiration.

(c) Bacteria and yeast reproduce by asexual reproduction.

(d) Reproduction by spores is a method of asexual reproduction.

(e) A potato tuber is really an underground stem.

(f) A whole new plant can grow from the eye of a tuber.

(g) Cutting and grafting are natural means of reproduction.

(h) Most organisms have the capacity of regeneration in some or the other ways.

(i) Stamens make eggs cells.

(j) A fertilized egg becomes a seed.

(k) Flowers which possess stamens and pistils are called unisexual.

(l) Insect pollinated flowers are brightly coloured.

(IV) Differentiate between the following:

1. Asexual reproduction and sexual reproduction.

2. Binary fission and budding.

3. Self pollination and cross pollination

4. Insect pollination flowers and wind pollination flowers

5. Zygote and embryo

(V). Find the odd one out, giving reasons:

1. Gamete, budding, fragmentation, regeneration.
2. Cutting, grafting, layering, binary fission.
3. Ovary, stigma, style, pollen grain.

(VI) Name the following:

1. Part of the flower where ovule is found.
2. Three agents of pollination.
3. The place where fertilization occurs in the flowering plant.

(VII) Mention the functions of the following:

1. Flower 2. Anther
3. Ovary 4. Stigma
5. Seed dispersal

(VIII) Answer the following Questions:

1. Why is reproduction necessary for living organisms?

2. How much of the parent's nuclear material does each daughter cell get during reproduction by binary fission?

3. What kind of reproduction is binary fission?

4. How many parents take part in binary fission?

5. Describe the various methods of asexual reproduction?

6. Describe the various methods of vegetative reproduction?

7. Mention two characteristic features of wind Pollinated flowers.

8. Mention two features of insect-pollinated flowers.

9. Describe the various steps leading to the formation of seeds in plants.

10. Describe the various ways by which seeds are dispersed.

(IX) Spell the missing word

Fill in the missing letters to spell the terms that fit the definition

1.	___t___g___a	(a) Top part of pistil
2.	___g____	(b) Female gamete
3.	___m___r___ o	(c) Baby plant
4.	___u___d___n___	(d) Method of asexual reproduction

(X) Spot the odd term

In each of the following set one terms does not belong to the set. Circle that term.

1.	Sexual reproduction	asexual reproduction	one parent
2.	Sexual reproduction	asexual reproduction	two parents
3.	Binary fission	bacteria	yeast
4.	Binary fission	budding	yeast
5.	Stamen	anther	style

For more information, read on the following websites:

www.edumedia-science. com/a437_P2-blog-call.html

http:///koning.ecsu.ctstate4.edu/plants_Human/flowerstructure.html.

13 MOTION AND TIME

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

Table 13.1 gives some common examples of motion. Identify the type of motion in each case.

Table 13.1: Some examples of different types of motion

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

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

13.1 SLOW OR FAST

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

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

ACTIVITY 13.1

Look at **Fig. 13.1.** It shows the position of some vehicles moving on a road in the same direction at some instant of time. Now look at **Fig. 13.2.** It shows the position of the same vehicles after some time. From your observation of the two figures, answer the following question:

Which vehicles is moving faster of

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

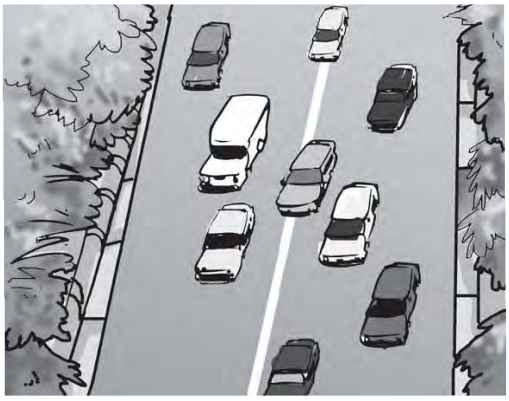


Fig. 13.1 : Vehicles moving in the same direction on a road

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

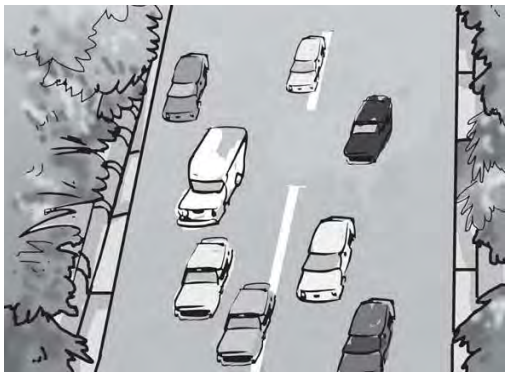


Fig. 13.2 : Position of vehicles shown in Fig. 13.1 after some time

The distance covered by you after 5 minutes would be much smaller than that covered by bus. Would you say that the bus is moving faster than the bicycle?

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

13.2 SPEED

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

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

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

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

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

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

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

13.3 MEASUREMENT OF TIME

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

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

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

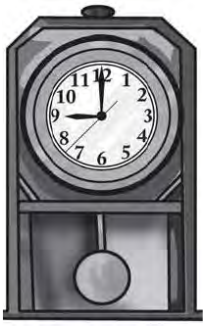
Often we need to measure intervals of time which are much shorter than a day. Clocks or watches are perhaps the most common time measuring devices. Have you ever wondered how clocks and watches measure time?

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

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

suspended from a rigid stand by a thread **{Fig13.4 (a)}.** The metallic ball is called the **bob** of the pendulum.

Fig13.4 (a) shows the pendulum at rest in its mean position. When the bob of the pendulum is released after taking it slightly to one side, it brings to move to and fro **[Fig.13.4(b)].** The to and fro motion of a simple pendulum is an example of a periodic or an **oscillatory** motion.



(a) Wall clock

(b) Table clock

(c) Digital clock

Fig. 13.3: Some common clocks

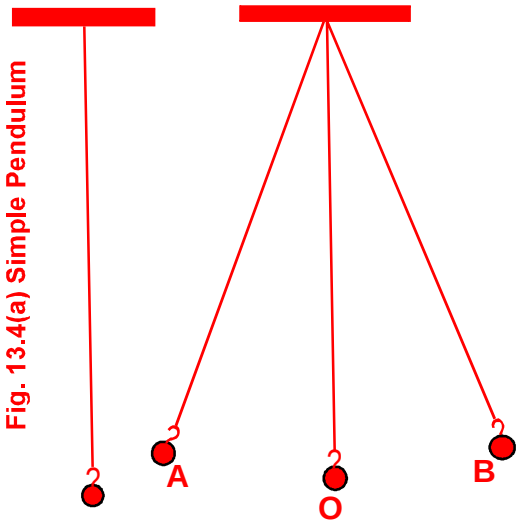


Fig. 13.4(a) Simple Pendulum

Fig. 13.4(b): Different positions of the bob of an oscillating simple pendulum

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

ACTIVITY 13.2

Set up a simple pendulum as shown **Fig 13.4 (a)** with a thread or string of length nearly one metre. Switch off fans nearby. Let the bob of the pendulum come to rest at its mean position. Mark the mean position of the bob on the floor below it or on the wall behind it.

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

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

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

Now release the bob from its displaced position. Remember that the bob is not to be pushed when it is released. Note the time on the clock when the bob is at it mean position. Instead of the mean position you may note the time when the bob is at one of its extreme positions. Measure the time the pendulum takes to complete 20 oscillations. Record your observations in **Table 13.2.** The first observation shown is just a sample. Your observation could be different from this. Repeat this activity a few times and record your observations. By dividing the time taken for 20 oscillations by 20, get the time taken for one oscillation, or the time period of the pendulum.

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

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

Nowadays most clocks or watches have an electric circuit with one or more cells. These clocks are called quartz clocks. The time measured by quartz clocks is much more accurate than that by the clocks available earlier.

Table 13.2

Time period of a simple pendulum

Length of the string = 100 cm

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

UNITS OF TIME AND SPEED

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

What would be the basic unit of speed?

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

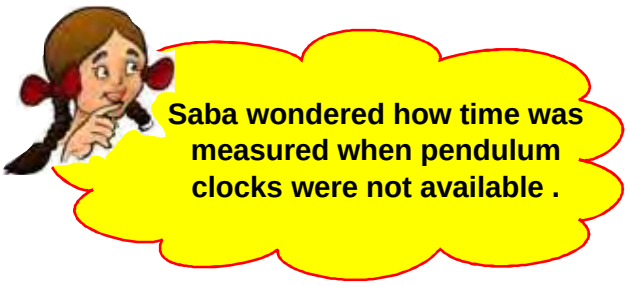
You must remember that **the symbols of all units are written in singular**. For example, we write 50 km and not 50 kms or 8 cm and not 8cms.

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

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

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

How small or large is a time interval of one school? The time taken in saying aloud “two thousand and one” is nearly by one second. Verify it by counting aloud from “two thousand and one” to "two thousand and ten”. The pulse of a normal healthy adult at rest beats about 72 times in a minutes that is about 12 times in 10 seconds. This rate may be slightly higher for children.



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

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

Many time measuring devices were used in different parts of world before the pendulum clocks became popular. Sundials, water clocks and sand clocks are some examples of such devices. Different designs of these devices were developed in different parts of the world **(Fig 13.5).**

(a) Sundial at Jantar Mantar, Delhi

(b) Sand clock

(c) Water clock

Fig. 13.5 : Some ancient time-measuring devices

13.4 MEASURING SPEED

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

ACTIVITY 13.3

Draw a straight line on the ground with chalk powder or lime and ask one of your friends to stand 1 to 2m away from it. Let your friend gently roll a ball along the ground in a direction perpendicular to the line. Note the time at the moment the ball crosses the line and also when it comes to rest **(Fig. 13.6).** How much time does the ball take to come to rest?

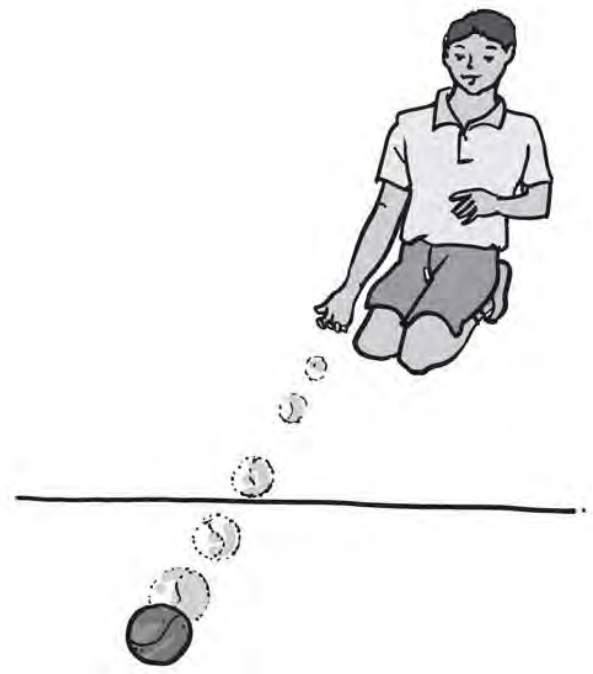


Fig. 13.6 : Measuring the speed of a ball

Measure the distance between the point at which the ball crosses the line and the point where it comes to rest. You can use a scale or measuring tape. Let different groups repeat the activity. Record the measurements in **Table 13.3.** In each case calculate the speed of the ball.

You may now like to compare your speed of walking or cycling with that of your friends. You need to know the distance of the school from your home or from some other point. Each one of you can then measure the time taken to cover that distance and calculate your speed. It may be interesting to know who amongst you is the fastest. Speeds of some living organisms are given in **Table 13.4.** in km/h. You can calculate the speeds in m/s yourself.

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

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

Distance covered = Speed x Time.

Table 13.3: Distance moved and time taken by a moving ball

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

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

Time taken = Distance / Speed

You might have seen a meter fitted on top of a scooter or a motorcycle. Similarly, meters can be seen on the dashboards of cars, buses and other vehicles. **Fig 13.7** shows the dashboard of a car. Note that one of the meters has km/h written at one corner. This is called a **speedometer.** It records the speed directly in km/h. There is also another meter that

Table 13.4 : Fastest speed that some animals can attain

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

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

While going for a school picnic, Saba decided to note the reading on the odometer of the bus after every 30 minutes till the end of the journey. Later on she recorded her readings in **Table 13.5.**

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

Table 13.5: Odometer reading at different times of the journey

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

Fig. 13.7 : The dashboard of a car

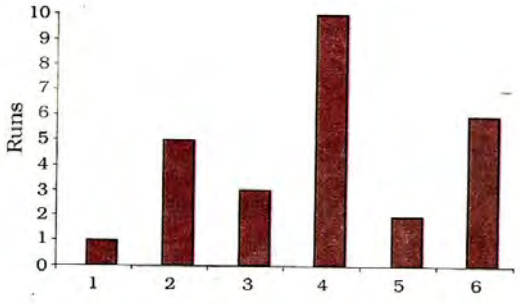
3.5 DISTANCE-TIME GRAPH

You might have seen that newspapers, magazines, etc., present information in various forms of graphs to make it interesting. The type of graph shown in **Fig 13.8** is known as a bar graph. Another type of graphical representation is a pie chart **(Fig.13.9).** The graph shown in **Fig 13.10** is an example of the line graph. The distance time graph is a line graph. Lets us learn to make such a graph.

Take a sheet of graph paper. Draw two lines perpendicular to each other on it, as shown in **Fig. 13.11.** Make the horizontal line as XOX'. It is known as the x-axis. Similarly mark the vertical line

YOY'. It is called y- axis. The point of intersection of XOX' and YOY' is known as origin O. The two quantities between which the graph is drawn are shown along these two axes. We show the positive values on the X-axis along OX. Similarly, positive values on the y-axis are shown along OY. In this chapter we shall consider only the positive values of quantities. Therefore, we shall use only the shaded part of the graph shown in **Fig. 13.11.**

Fig. 13.8: A bar graph showing runs scored by a team in each over



Yasir and Saba found out the distance traveled by a car and the time taken by it to cover that distance. Their data is shown in **Table 13.6.**

Table 13.6 The motion of a car

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

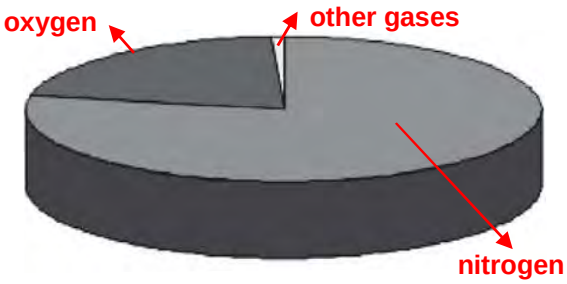


Fig. 13.9 : A pie chart showing composition of air

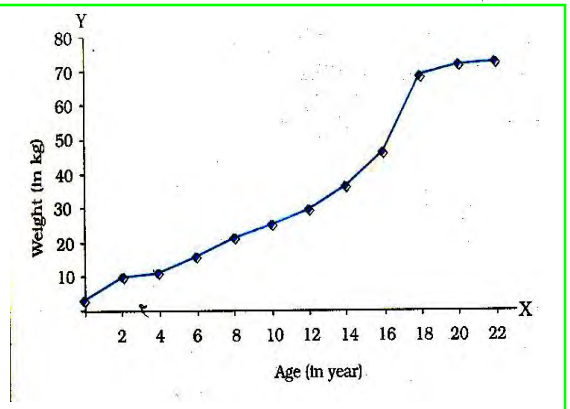


Fig. 13.10 : A line graph showing change in weight of a man with age

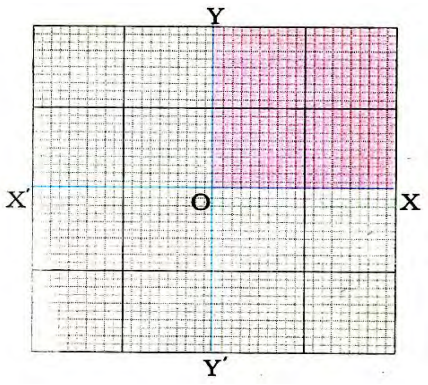


Fig. 13.11 : x-axis and y-axis on a paper

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

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

them as OX and OY as shown in **Fig. 13.11.**

- Decide the quantity to be shown along the x-axis and that to be shown along the y-axis. In this case we show the time along the x-axis and the distance along the y-axis.
- Choose a scale to represent the distance and another to represent the time on the graph. For the motion of the car scales could be
  Time : 1min = 1cm
  Distance 1km = 1cm
- Mark values for the time and the distance on the respective axes according to the scale you have chosen. For the motion of the car mark the time 1min, 2min,… on the x-axis from the origin O. Similarly, mark the distance 1km, 2km... on the y-axis **(Fig13.12).**

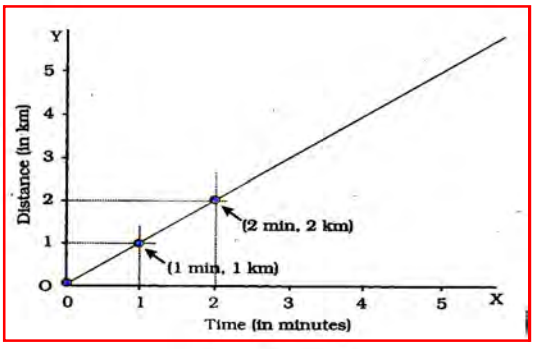


Fig. 13.12 : Making a graph

- Now you have to mark the points on the graph paper to represent each set of values for distance and time. Observation recorded as S.No. 1 in **Table 13.6.** Shows that at time 0 min the distance moved is also Zero. The point corresponding to this set of values on the graph will therefore be origin itself. After 1 minute, the car has moved a distance of 1 km. To mark this set of values look for the point that represents 1 minute on the x-axis. Draw a line parallel to the y-axis at this point. Then draw a line parallel to the x-axis from the point corresponding to distance 1km on the y-axis. The point where these two lines intersect represents this set of values on the graph **(Fig 13.12).** Similarly, mark on the graph paper the points corresponding to different sets of values.
- **Fig. 13.13** shows the set of points on the graph corresponding to positions of the car at various times.

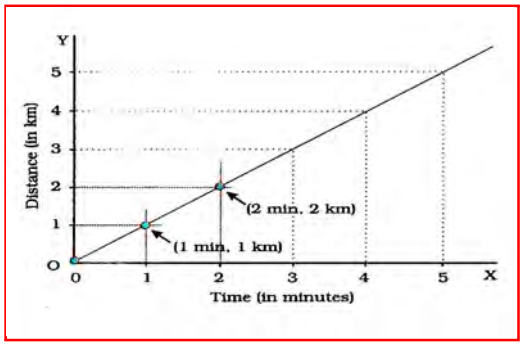


Fig. 13.13 : Making a graph

- Join all the point on the graph as shown in **Fig. 13.13**. It is a straight

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

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

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

- Let us again consider the motion of the bus that took Saba and her friends to the picnic. The distance covered and time taken by the bus are shown in Table Fig.13.5. The total distance covered by the bus is 80 km.If we decide to choose a scale 1km =1 cm, we shall have to draw an axis of length 80 cm. This is not possible on a sheet of paper. On the other hand a scale 10 km = 1 cm would require an axis of length only 8 cm. This scale is quiet convenient. However, the graph may cover only a a small part of the graph paper. Some of the points to be kept in mind while choosing the most suitable scale for drawing a graph are:
- the difference between the highest and the lowest value of each quantity.
- the intermediate values of each quantity, so that with the scale chosen it is convenient to mark the value on the graph ,and
- to utilize the maximum part of the paper on which the graph is to be drawn.

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

Distance: 5 km = 1cm, and

Time: 6 min = 1cm

Can you now draw the distance-time graph for the motion of the bus? Is the graph drawn by you similar to that shown in **Fig. 13.13** ?

Distance-time graph provide a variety of information about the motion when compared to the data presented by the table. For example, **Table 13.5** gives information about the distance moved by the bus only at some definite time intervals. On the other hand, from the distance-time graph we can find the distance moved by the bus at any instant of time. Suppose we want know how much distance the bus has traveled at 8:15 AM. We mark the point

corresponding to the time (8:15 AM) on the x-axis. Suppose this point is A. Next we draw a line perpendicular to the x-axis (or parallel to the y-axis) at point A. We then mark the point, T, on the graph at which this perpendicular line intersects it **(Fig. 13.14).** Next, we draw a line through the point T parallel to the x-axis. This intersects the y-axis at the point B. The distance corresponding to the point B on the y-axis, OB, gives us distance in km covered by the bus at 8:15 AM. How much is this distance in km? Can you now help Saba to find the distance moved by the bus at 9:45 AM? Can you also find the speed of the bus from its distance-time graph ?

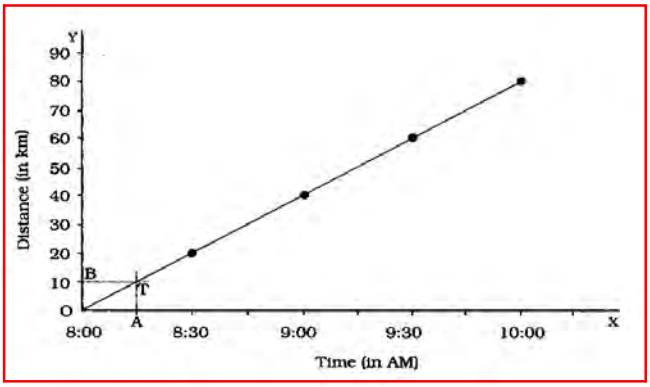


Fig. 13.14 : Distance-time graph of the bus

KEYWORDS

Bar graph	**Oscillation**	**Time period**
Graphs	**Simple pendulum**	**Uniform motion**
Non-uniform motion	**Speed**	**Unit of time**

What you have Learnt

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

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

EXERCISES

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

the school.

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

(i) A car moving with a constant speed.

(ii) A car parked on a road side.

8. Which of the following relations is correct?

(i) Speed = Distance x Time (ii) $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$

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

9. The basic unit of speed is:

(i) km / min (ii) m / min

(iii) km /h (iv) m / s

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

(i) 100 km (ii) 25 km

(iii) 15 km (iii) 10 km

11. Suppose the two photographs, shown in **Fig.13.1 and Fig.13.2,** had been taken at an interval of 10 seconds. If a distance of 100 metres is shown by 1 cm in these photographs, calculate the speed of the blue car.

12. Fig. 13.15 shows the distance-time graph for the motion of two vehicles A and B.

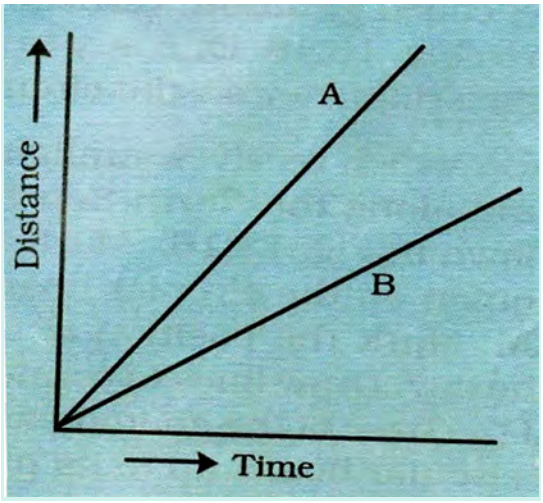
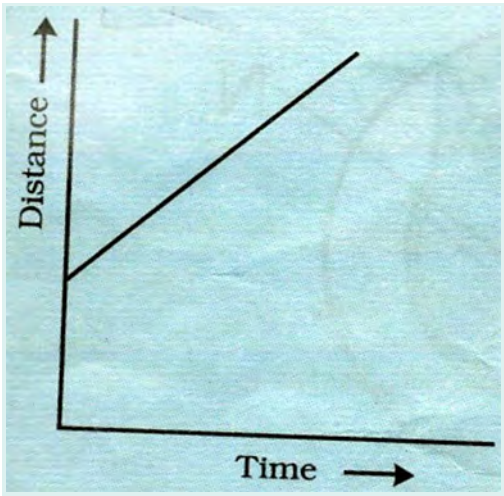


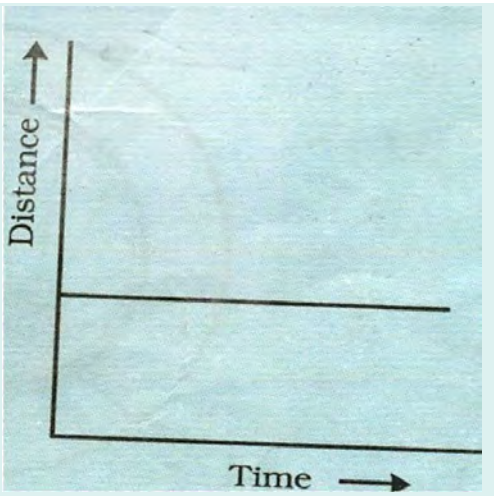
Fig. 13.15 : Distance -time graph for the motion of two cars

Which one of them is moving faster?

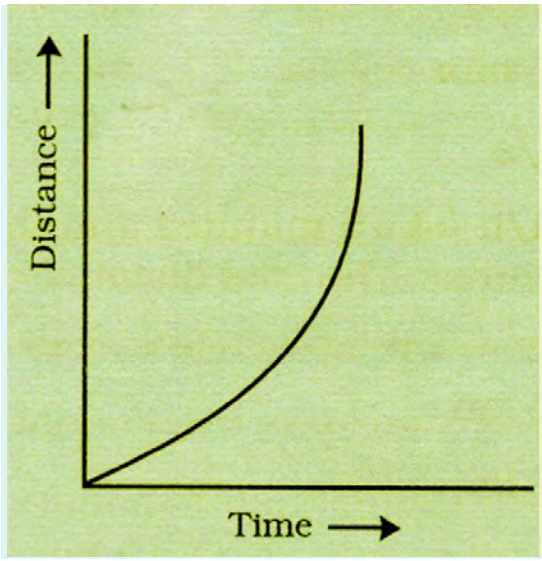
13. Which of the following distance time graph shows a truck moving with speed which is not constant?



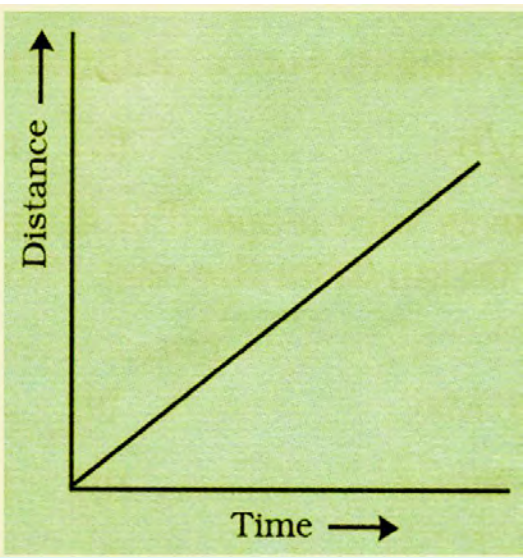
(i)



(ii)



(iii)



(iv)

Extend Learning - Activities and Projects

1. You can make your own sundial and use it to mark the time of the day at your place. First of all find the latitude of your city with the help of an atlas. Cut out a triangular piece of a cardboard such that its one angle is equal to the latitude of your place and the angle opposite to it is a right angle. Fix this piece, called **gnomon,** vertically along a diameter of a circular board as shown in **Fig. 13.16.** One way to fix the gnomon could be to make a groove along a diameter on the circular board.

   Next, select an open space, which receives sunlight for most of the day. Mark a line on the ground along the North-South direction. Place the sundial in the sun as shown in **Fig. 13.16.** Mark the position of the tip of the shadow of the gnomon on the circular board as early in the day as possible, say 8:00 AM. Mark the position of the tip of the shadow every hour throughout the day. Draw lines to connect each point marked by you with the centre of the base of the gnomon as shown in **Fig.13.16.** Extend the lines on the circular board up to its periphery. You can use this sundial to read the time of the day at your place. Remember that the gnomon should always be placed in the North-South direction as shown in **Fig.13.16.**

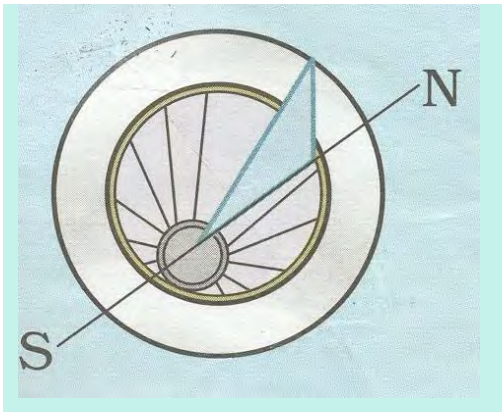


Fig. 13.16

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

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

3. Make a model of a sand clock which can measure a time interval of 2 minutes **(Fig.13.17) .**

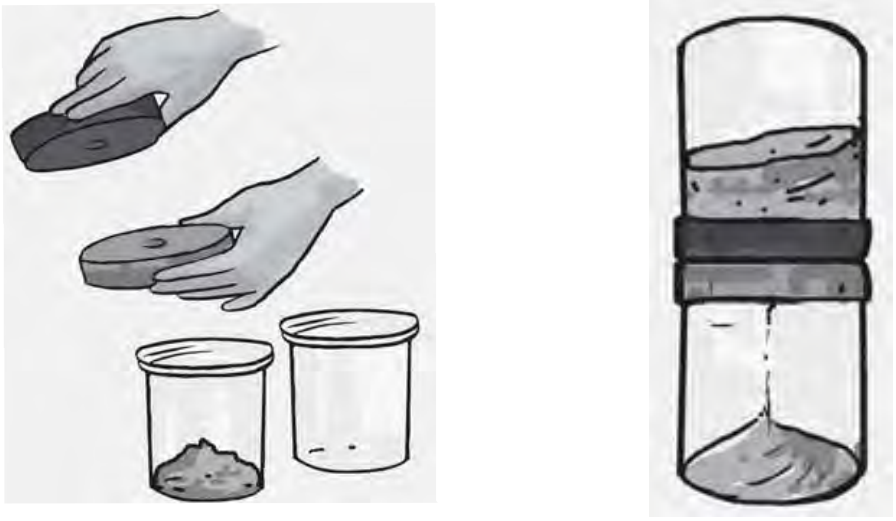


Fig.13.17

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

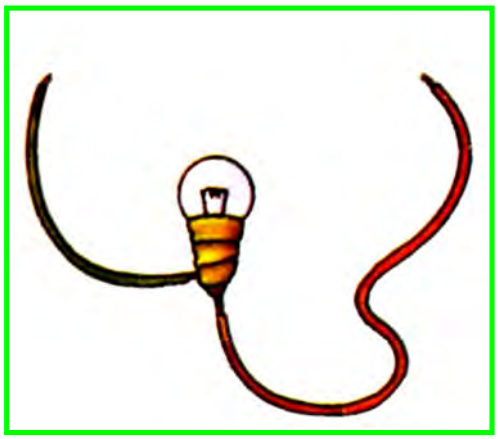
DO YOU KNOW ?

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

14 ELECTRIC CURRENT AND CIRCUITS

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

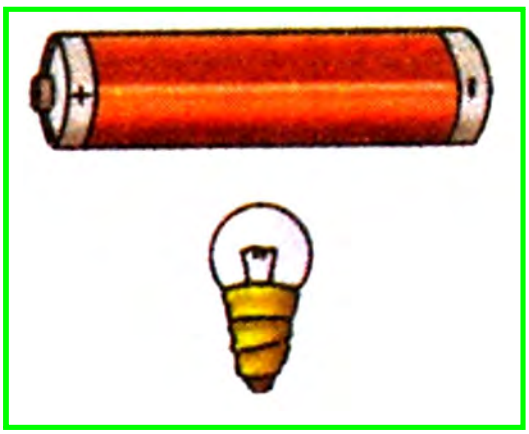
Look at the following pictures.



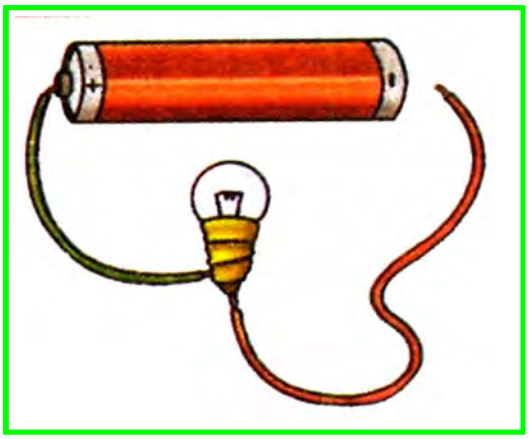
(a)

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

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



(b)



(c)

There are three conditions that need to be fulfilled for electric current to flow: **a source, an unbroken path**, and **a metal wire**. Why do you need a metal wire? What will happen if we introduce a rubber band in the path as shown in **Fig 14.1**. Will the bulb glow? No! Can you say why? The bulb does not glow as the rubber band is

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

If we replace the rubber band with metal key **(Fig. 14.2)**, will the bulb glow? Yes! the metal key, being a conductor, will let the electric current to flow through it, thus fulfilling all the conditions required to make the bulb glow.

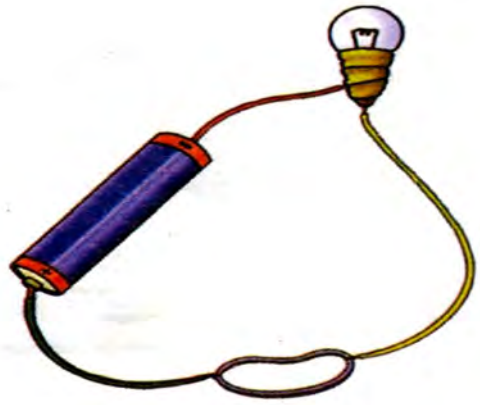


Fig.14.1: The bulb does not glow if an insulator is introduced in the path of the current

The unbroken path through which electric current can flow is called an ***electric circuit***. **Figure14.2** shows an electric circuit consisting of a cell, a bulb, wires, and a conductor.

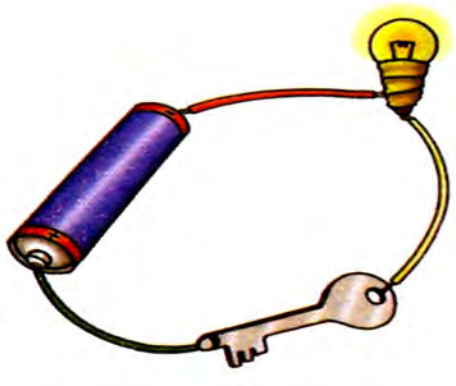


Fig.14.2: The bulb glows if a conductor is introduced in the path of the current

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

14.1 ELECTRIC CIRCUIT DIAGRAMS

You know what an electric circuit is. Look at the electric circuit in **Fig. 14.3.** It consists of a cell, a small torch bulb, and a switch. Can we represent the circuit in some other way? Let us find out.

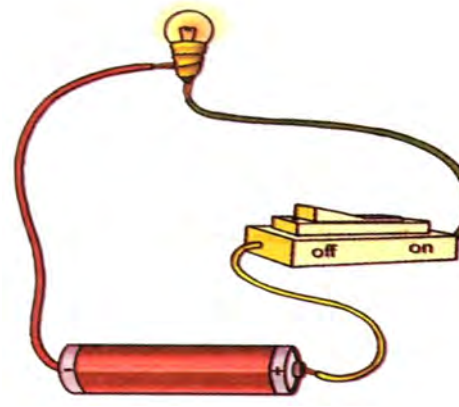


Fig.14.3: An electric circuit

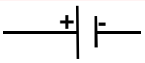
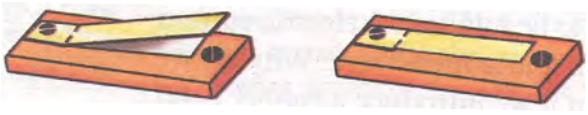
For the sake of simplicity, scientists have developed a standard method of drawing an electrical circuit. This is known as ***circuit diagram***. In a circuit diagram, the various components of the circuit are represented by standard symbols. **Table 14.1** gives the standard symbols used for some common electrical components. These are also called ***elements*** of an electrical circuit.

Using these symbols, we can draw the circuit diagram for the circuit given in **Figure14.3** as shown in **Figure 14.4**. This is when the switch is ON. Can you draw a circuit diagram for a circuit given in **Figure 14.3**, but with switch OFF?

You can practice drawing circuit diagrams with a various elements in it. The important points to remember are:

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

Table 14.1: Standard symbols used for some basic components of electric circuits

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

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

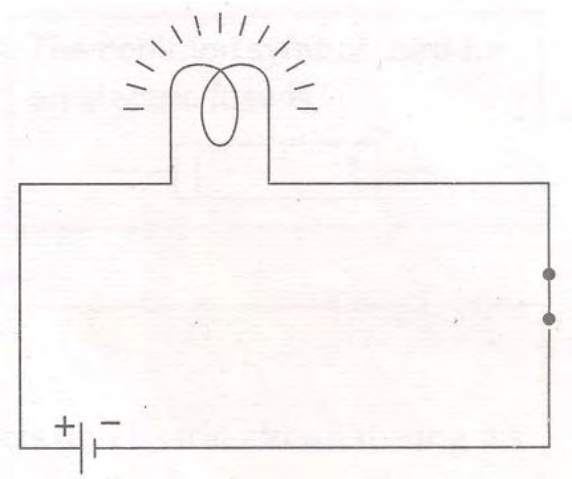


Fig.14.4: Circuit diagram

14.2 HEATING EFFECT OF CURRENT

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

This is because when an electric current passes through a wire, the wire gets heated up. You will come across many appliances at your home in which electric current causes heating. Can you think some of appliances that get heated up just like a bulb when electric current passes through them? Electric toasters, electric irons, hot plates, electric hairdryers, electric ovens are some appliances that get hot when electric current passes through them. See **Figure 14.5.**

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

Fig.14.5: Appliances that work on the heating effect of current

ACTIVITY

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

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

Procedure:

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

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

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

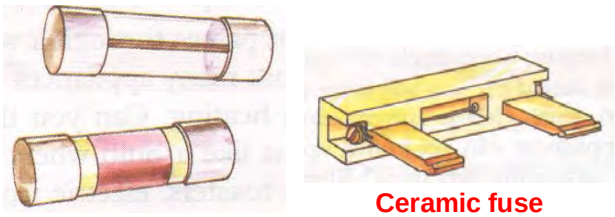
14.3 ELECTRIC FUSE

You know that electric appliances work when an electric current passes through them. But have you ever wondered what will happen if a large amount of electric current passes through an appliance such as an electric iron, refrigerator, television, or a hairdryer? If a large amount of current is drawn inside an appliance, it causes the wires to get overheated, and the appliance gets damaged. This situation arises as a result of some fault in the circuit and can be extremely dangerous as it can lead to a fire.

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

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

See **Figure 14.6.** It shows some electric fuses.



Cartridge fuses

Ceramic fuse

Fig.14.6: Electric fuses

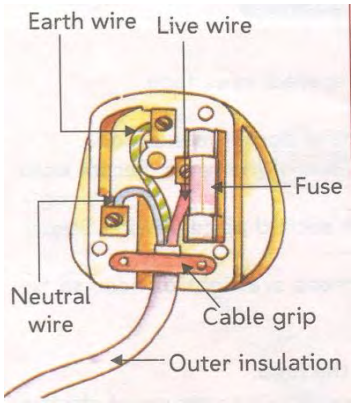
Fact File

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

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

Where would you commonly find an electric fuse?

Fuses are commonly found inside electric plugs.



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

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

Principle of an Electric Fuse

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

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

The common symbol used for an electric fuse is

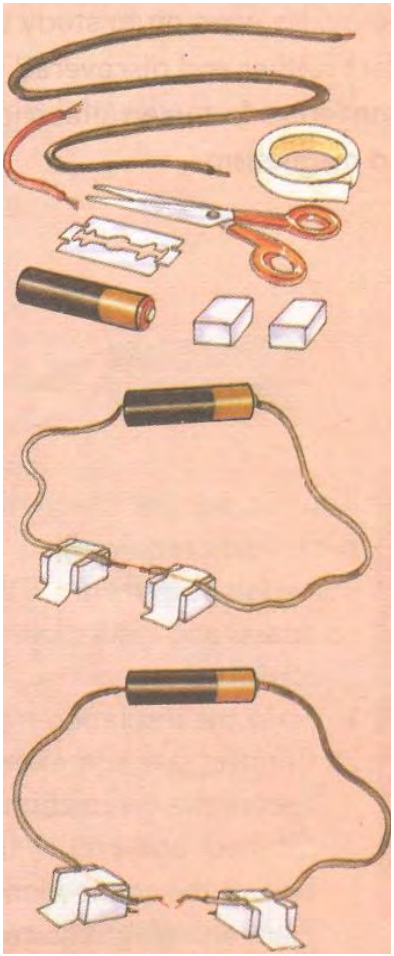
Miniature circuit breaker

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

ACTIVITY

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

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



Procedure:

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

LET'S ANSWER

(I) Match the following

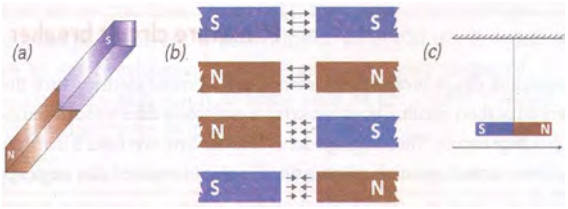
Column A	Column B
1. Circuit diagram	(a) Heating of a conductor due to an electric current
2. Joule heating	(b) Fuse
3. Safety device	(c) Fuse wire
4. Melts easily	(d) A drawing of an electrical circuit with standard symbols

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

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

Hans Christian Oersted
1777-1851

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



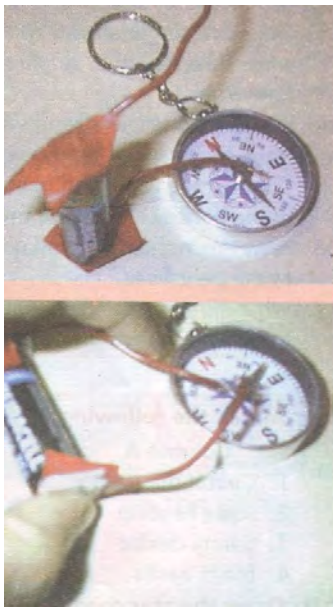
1. A magnet has two poles, namely the _____ pole and the _____ pole.
2. Like poles of a magnet _____ each other and unlike poles _____ each other.
3. A magnet when suspended freely aligns itself in the _____ direction.

14.4 MAGNETIC EFFECT OF ELECTRIC CURRENT

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

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

ACTIVITY



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

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

Procedure:

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

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

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

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

ELECTROMAGNET

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

Wrap a wire around a soft iron piece (known as the core). When an electric current is passed through the wire, the iron piece behaves like a magnet. A magnet made by using such an arrangement is called an *electromagnet*. See **Figure 14.7** Can an electromagnet attract iron pieces?

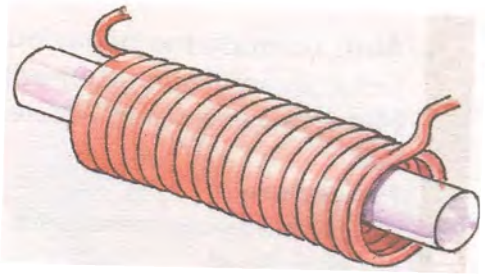


Fig.14.7: An electromagnet

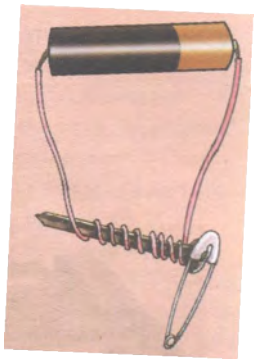
DO YOU KNOW WHAT A SOLENOID IS?

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

ACTIVITY

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

Materials required: 1.5 V cell, iron nail, a safety pin, and a piece of wire. (There are two types of wires commonly available. In one type, if you strip the insulation you will see many thin metal strands, and in another type there is only one thick wire. Get the one with a single thick wire).



Procedure:

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

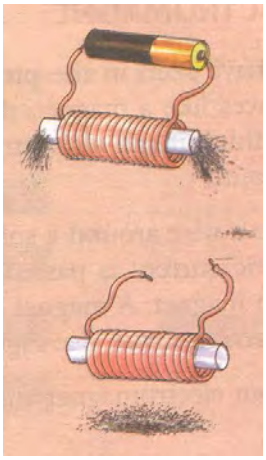
What do you see? The safety pin gets attracted to the iron nail.

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

The strength of an electromagnet depends on the number of turns of the wire around the core and the amount of current passing through it. More the number of turns more will be the magnetic effect. See **Figure 14.8**. But can you say what will happen if the current passing through the coil is switched off? Will it still attract the safety pin? No, the iron piece will lose its magnetic effect, i.e., it will stop behaving like a magnet and, thus, will not attract the safety pin.

Fig.14.8: An Iron nail attracts more safety pins when wrapped with a coil with more number of turns

ACTIVITY



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

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

Procedure:

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

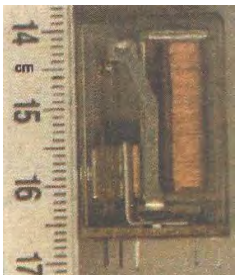
USES OF ELECTROMAGNETS

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

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

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

In electric motors: Electric motors use magnets, and find wide application in electric fans, washing machines, refrigerators, etc.



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

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

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

14.5 ELECTRIC BELL

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

Let us see how an electric bell works:

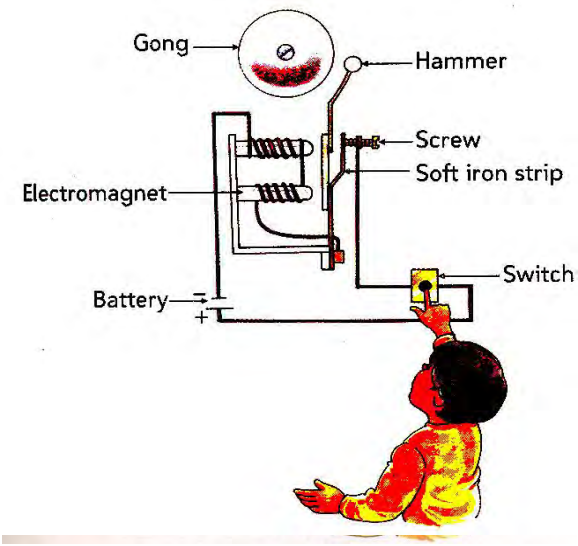
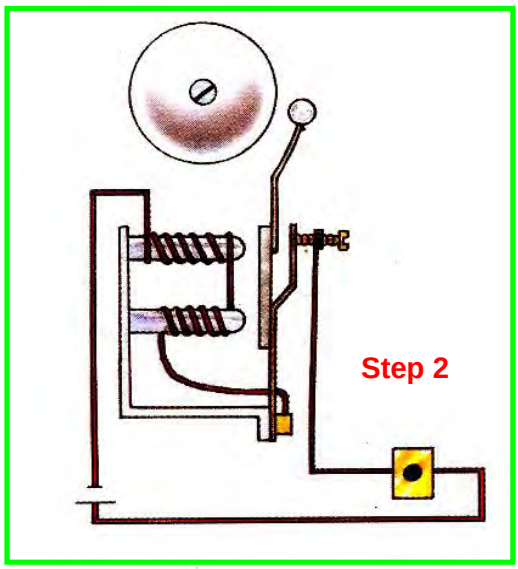
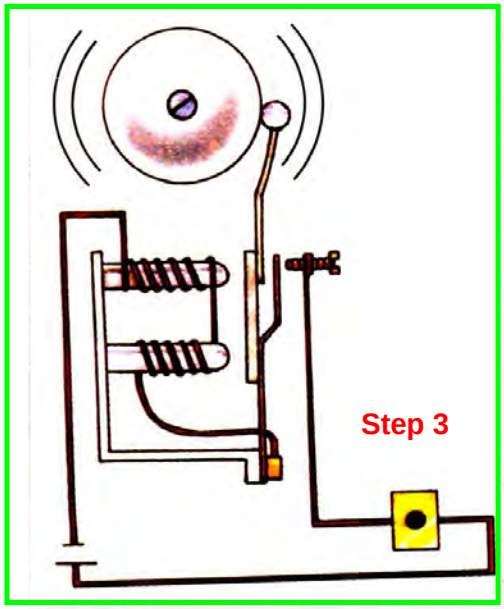


Fig. 14.9: Working of an Electric Bell

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



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



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

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

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

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

ELECTRIC BUZZER

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

(a) ..... (b) ..... (c).....

LET'S ANSWER

State whether the following statements are true or false.

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

KEYWORDS

Electric circuit **Circuit diagram** **Ohmic or Joule heating**

Electric fuse **Electromagnet** **Coil**

What you have learnt

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

Electric circuit diagrams

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

Heating effect of electric current

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

Electric fuse

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

Magnetic effect of electric current

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

Electromagnet

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

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

Electric bell

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

EXERCISES

A. Fill in the blanks:

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

B. Choose the correct answer:

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

3. An electric fuse is

(a) a safety device (b) an appliance

(c) used to produce electric current (d) use to heat a room

4. When we bring a magnetic compass near a current carrying wire,

(a) it deflects the magnetic needle of the compass

(b) it makes the magnetic needle point North

(c) it makes the magnetic needle point South

(d) it has no effect on the magnetic needle

5. A coil refers to

(a) an electrical wire (b) a fuse

(c) a current carrying conductor (d) a wire twisted in the from of a circle

6. An electromagnet acts like a magnet

(a) when a current is passed through the coil

(b) all the time

(c) because it has a magnetic core

(d) only if a current does not pass through the coil.

7. In an electric bell, we have

(a) an electromagnet (b) a hammer

(c) an interrupter (d) all of these

8. In an electric bell, which of these gets attracted to the electromagnet?

(a) the hammer (b) the gong

(c) the soft iron strip (d) the screw

9. Which of these does not use heating effect of current?

(a) electric toaster (b) electric fan

(c) electric Iron (d) room heater

10. An electric fuse wire melts if the amount of current flowing through it.

(a) more than a minimum amount (b) less than a minimum amount

(c) more than a maximum amount (d) less than a maximum amount

C. Answer the following questions

1. What is an electrical circuit?

2. Draw an electrical circuit with an electrical cell, a bulb, and an 'ON' switch.

3. Why does an electric bulb get hot if it is kept 'ON' for a little while?

4. Name three appliances that use the heating effect of electric current.

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

Think and Answer

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

Fun Time

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

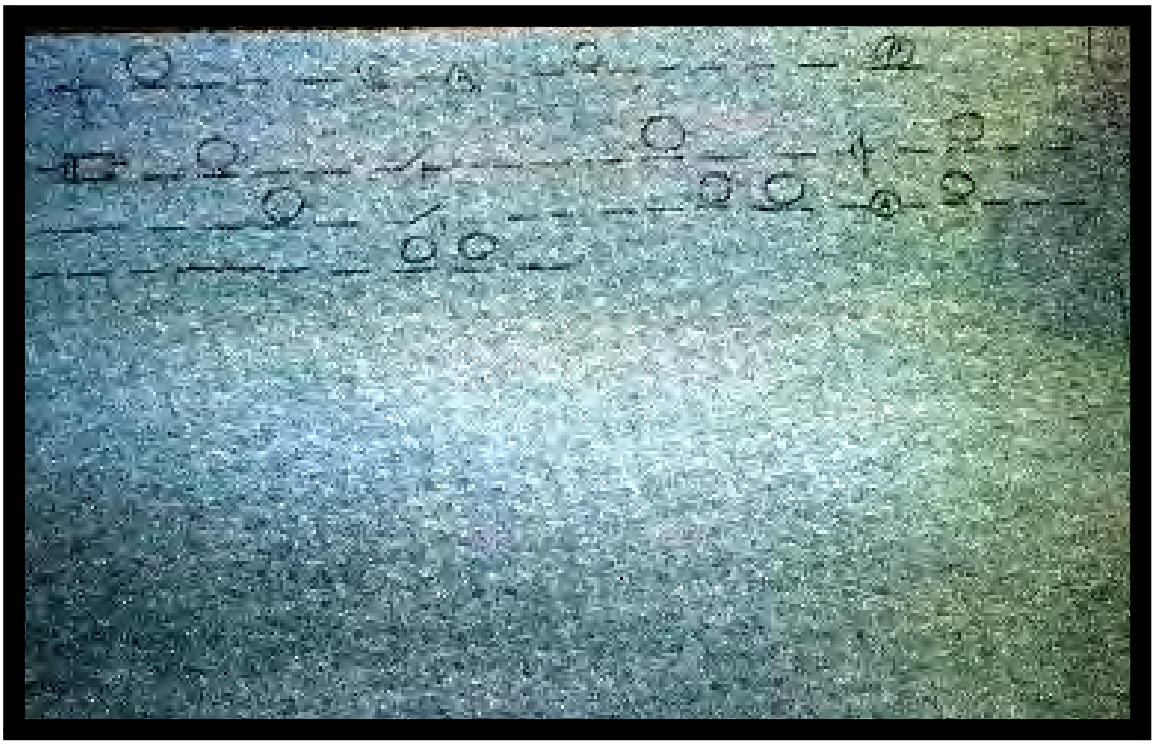
An *ammeter* is a device used to measure the flow of electric current in a circuit. It is represented by the Symbol Ⓐ

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

Here is the story of the professor and his students.

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

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



Project Ideas

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

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

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

Procedure:

(a) Find out as many appliances and devices as possible, used by us, which are based on the heating effect of electric current. Get colourful pictures of them, and stick them on a chart paper. Write a few lines below each picture explaining what each appliance / device is used for. Title this chart 'Uses of Heating Effect of Electric Current.'

(b) Make a second chart with the title 'Heating Effect of Electric Current-Disadvantages'. In this chart explain how the heating effect that can be so useful in many devices can also be a disadvantage in many other places.

Outdoor Activity

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

For more information:

http://www.tpub.com/doeelecscience/electricalscience236.htm.
(accessed 15 Sep. 06)

Teacher's Notes

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

15 LIGHT

You might have seen a beam of sunlight when it enters a room through a narrow opening or a hole. You may have also observed beams of light from the headlamps of scooters, cars and engines of trains **(Fig.15 (a)).**

Fig. 15.1 (a): Rail Engine

Similarly, a beam of light can be seen from a torch. Some of you may have noticed a beam of searchlight from a light house or from an airport tower **(Fig.15.1 (b)).**

What do these experiences suggest?

Fig. 15.1 (b): Light House

15.1 Light Travels Along A Straight Line

Yasir recalls an activity, in which he looked at a lit candle first through a straight pipe and then through a bent pipe **(Fig.15.2)**. Why was Yasir not able to see the candle flame through a bent pipe?

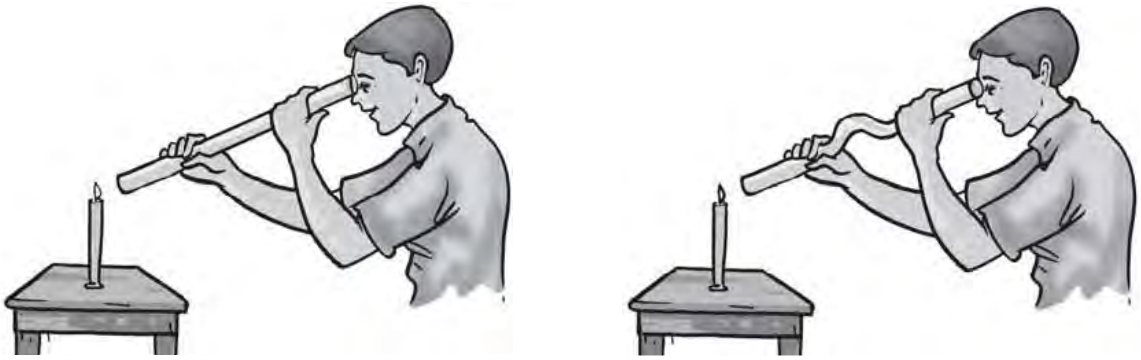


Fig.15.2: Looking at a candle through a straight and bent pipe

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

15.2 REFLECTION OF LIGHT

One way to change the direction of light is to let it fall on a shiny surface. For example, a shining stainless steel plate or a shining steel spoon can change the direction of light. The surface of water can also act like a mirror and change the path of light. Have you ever seen the reflection of trees or buildings in water **(Fig.15.3)**?

Fig.5.3: Reflection of objects in water

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

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

Saba remembers the story of the lion and the rabbit from the Panchtantra, in which the rabbit befooled the lion by showing him his reflection in water (Fig.15.4).

Fig.15.4: Reflection of lion in water

Activity 15.1

Take a torch. Cover its glass with a chart paper which has three slits as shown in **Fig.15.5**.

Spread a sheet of chart paper on a smooth wooden board. Fix a plane mirror strip vertically on the chart paper **(Fig.15.5)**. Now direct the beam of light on

the mirror from the torch with slits. Place the torch in such a way that its light is seen along the chart paper on the board. Now adjust its position so that the light from the torch strikes the plane mirror at an angle **(Fig.15.5)**.

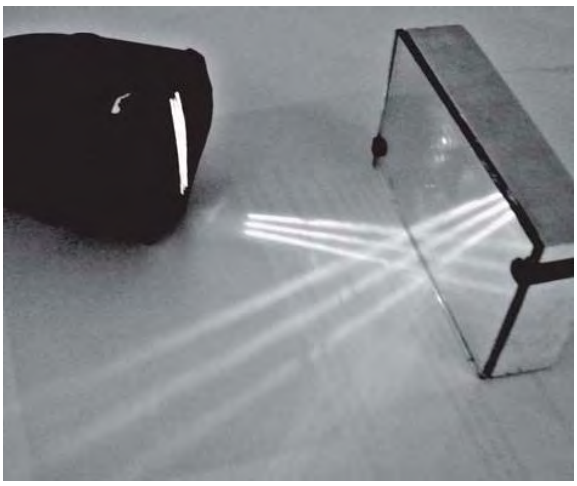


Fig.15.5: Reflection of light from a mirror

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

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

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

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

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

Activity 15.2

CAUTION

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

Place a lighted candle in front of a plane mirror. Try to see the flame of the candle in the mirror. It appears as if similar candle is placed behind the mirror. The candle, which appears behind the mirror, is the **image** of the candle formed by the mirror **(Fig.15.6)**. The candle itself is the **object.**

Fig.15.6: Image of a candle in a plane mirror

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

the image in each case.

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

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

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

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

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

Activity 15.3

Take a chart paper, if a chess board is not available. Draw on a chart paper 64 (8x8) squares of equal size. Draw a thick line in the middle of the paper. Fix a plane mirror vertically on this line. Place any small object, such as a pencil sharpener, at the boundary of the third square counting from the mirror **(Fig.15.7)**. Note the position of the image. Now shift the object at the boundary of the fourth square. Again note the position of the image. Did you find any relation between the distance of the image from the mirror and that of the object in front of it?

Fig.15.7: Locating image in a plane mirror

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

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

15.3 RIGHT OR LEFT

When you see your image in a

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

Activity 15.4

Stand in front of a plane mirror and look at your image. Raise your left hand. Which hand does your image raise **(Fig. 15.8)**? Now touch your right ear. Which ear does your hand touch in your image? Observe carefully. You will find that in the mirror the 'right' appears ' left' and the 'left' appears 'right'. Note that only sides are interchanged; the image does not appear upside down.

Fig.15.8: Left hand appears on the right side in the image

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

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

Can you now understand why the word 'AMBULANCE' is written as in **Fig. 15.9**? When the driver of a vehicle ahead of an ambulance looks in her/his rear view mirror, she/he can read 'AMBULANCE 'written on it and give way to it. It is the duty of every one of us to allow an ambulance to pass without blocking its way.

Fig.15.9: An ambulance

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

15.4 PLAYING WITH SPHERICAL MIRRORS

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

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

Activity 15.5

Take a stainless steel spoon. Bring the outer side of the spoon near your face and look into it. Do you see your image in it **(Fig.15.10)**? Is this image different from what you seen in a plane mirror? Is this image erect? Is the size of the image the same, smaller or larger?

Now look at your image using the inner side of the spoon. This time you may find your image is erect and larger in size. If you increase the distance of the spoon from your face. You may see your image inverted **(Fig.15.11)**. You can also compare the image of your pen or pencil instead of your face.

Fig.15.10: Images from the outer side of a spoon

Fig.15.11: Images from the inner side of a spoon

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

If the reflecting surface of a spherical mirror is concave, it is called a concave mirror. If the reflecting surface is convex, then it is called a convex mirror **(Fig.15.12)**.

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

We know that the image of an

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

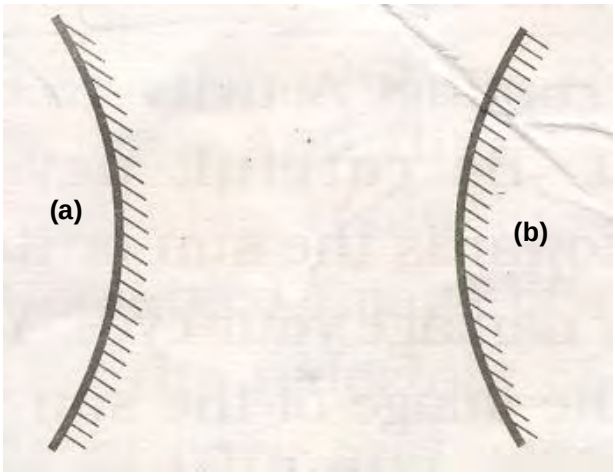


Fig.15.12: A concave and a convex mirror

Why are concave and convex mirrors called spherical mirrors?

Take a rubber ball and cut a portion of it with a knife or a hacksaw blade **(Fig.15.13 (a)) (Be careful. Ask an elder person to help you in cutting the ball).** The inner surface of the cut ball is called concave and the outer surface is called convex **(Fig.15.13 (b)).**

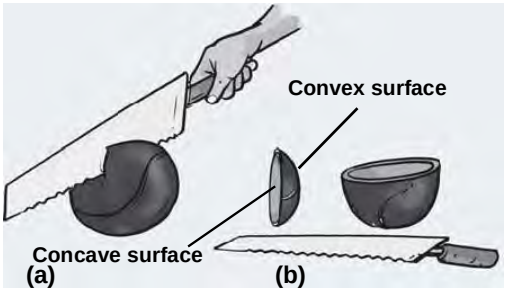


Fig.15.13: A spherical mirror is a part of a sphere

Activity 15.6

CAUTION

You will conduct **Activity 15.6** in the sunlight. Be careful; never look directly towards the sun or its image as it may damage your eyes. You may look at the image of the sun when it is drawn on a screen or a wall.

Take a concave mirror. Hold it facing the sun. Try to get the light reflected by the mirror on a sheet of paper. Adjust the distance of the paper until you get a sharp bright spot on it **(Fig.15.14)**. Hold the mirror and the sheet of paper steady for a few minutes. Does the paper start burning?

This bright spot is in fact the image of the sun. Notice that this image is formed on a screen. An image formed on a screen is called a **real image.** Recollect that in **Activity 15.2** the image formed by a plane mirror could not be obtained on a screen. Such an image is called a **virtual image.**

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

Fig.15.14: A concave mirror forms a real image of the sun

Activity 15.7

Fix a concave mirror on a stand (any arrangement to keep the mirror steady would do) and place it on a table **(Fig.15.15)**. Paste a piece of white paper on a cardboard sheet (say about 15 cm x 10 cm). This will act as a screen. Keep a lighted candle on the table at a distance of about 50 cm from the mirror. Try to obtain the image of the flame on the screen. For this, move the screen till a sharp image of the flame is obtained. Make sure that, the screen does not obstruct the light from the candle falling on the mirror. Is this image real or virtual? Is it of the same size as the flame?

Fig.15.15: Real images formed by a concave mirror

Now move the candle towards the mirror and place it at different distances from it. In each case try to obtain the image on the screen. Record your observation in **Table 15.1.** Is it possible to obtain the image on the screen when the candle is too close to the mirror **(Fig.15.16)**?

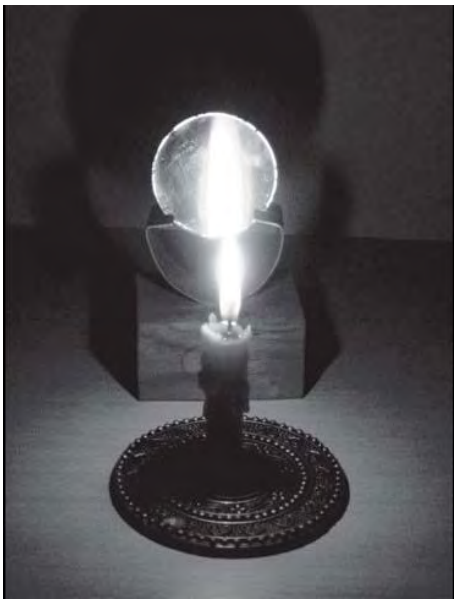


Fig.15.16: Virtual image formed by a concave mirror

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

Concave mirrors are used for many purposes. You might have seen doctors using concave mirrors for examining eyes, ears, nose and throat. Concave mirrors are also used by dentists to see an enlarged image of the teeth **(Fig.15.17)**.

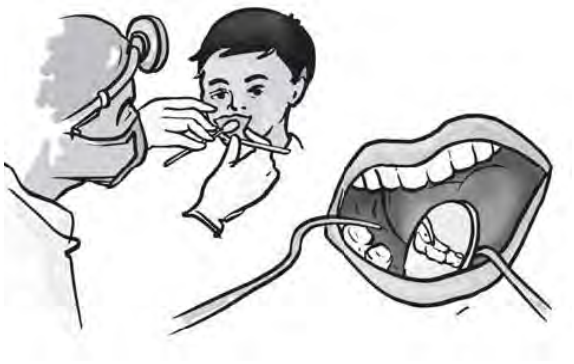


Fig.15.17: A dentist examining a patient

The reflectors of torches, headlights of cars and scooters are concave in shape **(Fig.15.18).**

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

Fig. 15.18: Reflector of a torch

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

Note that the reflecting surface of the bell is convex.

Activity 15.8

Repeat **Activity 15.7** now with a convex mirror in place of a concave mirror **(Fig. 15.19)**.

Fig.15.19: Images formed by a convex mirror

Record your observations in a table similar to **Table 15.1**.

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

Can you now recognize the mirrors used as side mirrors in scooters? These are convex mirrors. Convex mirrors can form images of objects spread over a large area. So, these help the drivers to see the traffic behind them **(Fig. 15.20)**.

Fig.15.20: Convex mirror as side view mirror

Table 15.1: Image formed by a concave mirror for object placed at different distance from it

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

15.5 IMAGES FORMED BY LENSES

You might have seen a magnifying glass. It is used to read very small print **(Fig. 15.21).** You might have also used it to observe the body parts of a cockroach or an earthworm. The magnifying glass is actually a type of lens.

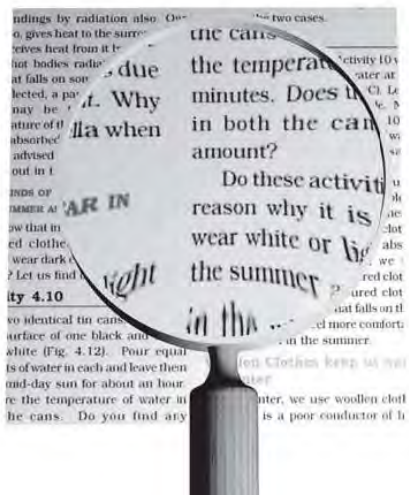


Fig.15.21: A magnifying glass

Lenses are widely used in spectacles, telescopes and microscopes. Try to add a few more uses of lenses to this list.

Get some lenses. Touch and feel them. Can you find some difference just by touching? Those lenses which feel thicker in the middle than at the edges are convex lenses **(Fig.15.22(a))**.Those which feel thinner in the middle than at the edges are concave lenses **(Fig.15.22(b))**. Notice that the lenses are transparent and light can pass through them.

Let us play with lenses.

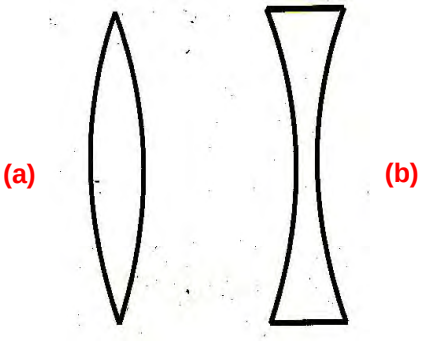


Fig.15.22: (a) A convex lens and (b) A concave lens

CAUTION

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

Activity 15.9

Take a convex lens or a magnifying glass. Put it in the path of sunrays. Place a sheet of paper as shown in **(Fig.15.23)**. Adjust the distance between the lens and the paper till you get a bright spot on the paper. Hold the lens and the paper in this position for a few minutes. Does the paper begin to burn?

Fig.15.23: Real image of the sun by a convex lens

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

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

Let us find out.

A convex lens converges (bends inward) the light generally falling on it **(Fig.15.24 (a))**. Therefore, it is called a **converging lens**. On the other hand, a concave lens diverges (bends outward) the light and is called a **diverging lens (Fig. 15.24 (b))**.

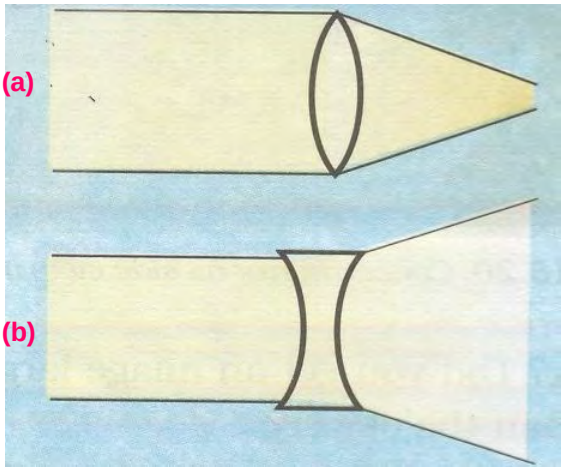


Fig.15.24

Activity 15.10

Take a convex lens and fix it on a stand as you did with the concave mirror. Place it on a table. Place a lighted candle at a distance of about 50cm from the lens **(Fig. 15.25 (a)).** Try to obtain the image of the candle on a paper screen placed on the other side of the lens.

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

Now vary the distance of the candle from the lens **(Fig.15.25 (b))**. Try to

(a)

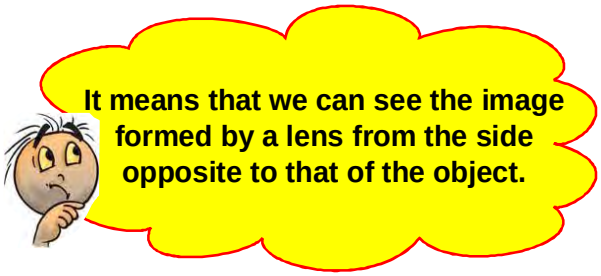
(b)

Fig.15.25: Image by a convex lens for object placed at different distances from it.

Fig.15.26: A virtual image formed by the convex lens

Fig.15.27: Image formed by a concave lens

obtain the image of the candle flame every time on the paper screen by moving it. Record your observations as you did in **Activity 15.7** for the concave mirror.



Did you get in any position which was erect and magnified **(Fig.15.26)**. Could this image be obtained on a screen? Is the image real or virtual? This is how a convex lens is used as a magnifying glass.

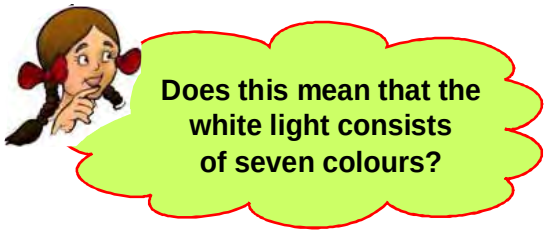
In a similar fashion study the images formed by a concave lens. You will find that image formed by a concave lens is always virtual, erect and smaller in size than the object **(Fig. 15.27)**.

15.6 SUNLIGHT- WHITE OR COLOURED?

Have you ever seen a rainbow in the sky? You might have noticed that it appears usually after the rain when the sun is low in the sky. The rainbow is seen as a large arc in the sky with many colours **(Fig.15.28)**.

Fig.15.28: A rainbow

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



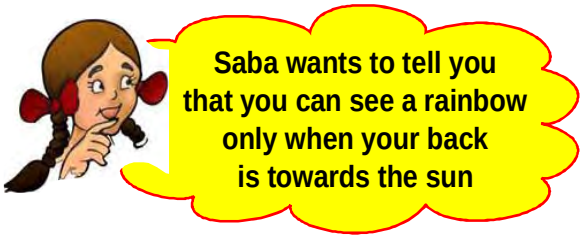
You might have seen that when you blow soap bubbles, they appear colourful. Similarly, when light is reflected from the surface of a compact disk **(**CD), you see many colours **(Fig. 15.29).**

Fig.15.29: A CD placed in sun

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

Activity 15.11

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



What do you observe? Do you see colours similar to those in a rainbow **(Fig.15.30)**? This shows that the sunlight consists of seven colours. The sunlight is said to be white light. This means that

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

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

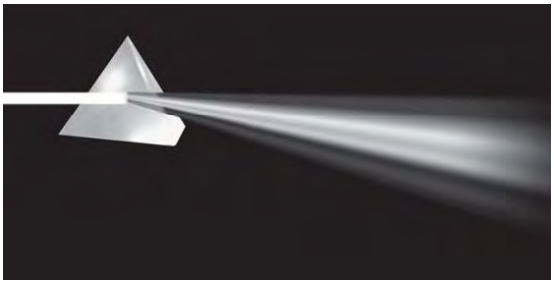


Fig.15.30: A prism splits sunlight into seven colours

Activity 15.12

Take a circular cardboard disc of about 10 cm diameter. Divide this disc into seven segments. Paint the seven rainbow colours on these segments as shown in **Fig.15.31 (a)**. You can also paste-coloured papers on these segments. Make a small hole at the centre of the disc. Fix the disc loosely on the tip of a refill of a ball pen. Ensure that the disc rotates freely**(Fig. 15.31 (a)).** Rotate the disc in the daylight. When the disc is rotated fast, the colours get mixed together and the disc appears to be whitish **(Fig.15.31 (b))**. Such a disc is popularly known as Newton's disc.

Fig.15.31: (a) A disc with seven colours (b) it appears white on rotating

Saba has a brilliant idea! She has prepared a small top with a small circular disc with seven rainbow colours painted on it **(Fig.15.32)**. When the top rotates it appears nearly white.

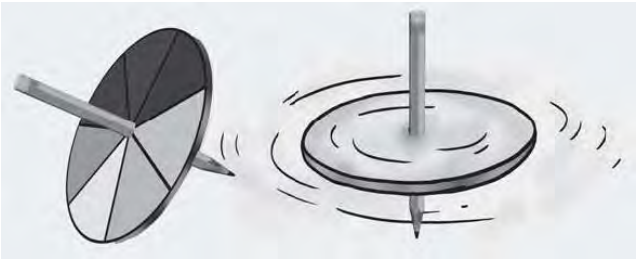


Fig.15.32: A top with seven colours

KEYWORDS

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

What you have learnt

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

EXERCISES

1. Fill in the blanks:

(a) An image that cannot be obtained on a screen is called _____.

(b) Image formed by a convex _____is always virtual and smaller in size.

(c) An image formed by a _____mirror is always of the same size as that of the object.

(d) An image which can be obtained on a screen is called a _____ image.

(e) An image formed by a concave _____cannot be obtained on a screen.

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

(a) We can obtain an enlarged and erect image by a convex mirror. (T/F)

(b) A concave lens always form a virtual image. (T/F)

(c) We can obtain a real, enlarged and inverted image by a concave mirror. (T/F)

(d) A real image cannot be obtained on a screen. (T/F)

(e) A concave mirror always forms a real image. (T/F)

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

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

4. State the characteristics of the image formed by a plane mirror ?

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

Discuss your findings ?

6. What is a virtual image? Give one situation where a virtual image is formed?

7. State two differences between a convex and a concave lens?

8. Give one use each of a concave and a convex mirror?

9. Which type of mirror can form a real image?

10. Which type of lens always forms a virtual image?

Choose the correct option in question 11-13

11. A virtual image larger than the object can be produced by a

(i) Concave lens (ii) Concave mirror

(iii) Convex mirror (iv) Plane mirror

12. David is observing his image in a plane mirror. The distance between the mirror and his image is 4 m. If he moves 1 m towards the mirror, then the distance between David and his image will be

(i) 3 m (ii) 5 m

(iii) 6 m (iv) 8 m

13. The rear view mirror of a car is a plane mirror. A driver is reversing his car at a speed of 2 m/s. The driver sees in his rear view mirror the image of a truck parked behind his car. The speed at which the image of the truck appears to approach the driver will be

(I) 1 m/s (ii) 2 m/s

(iii) 4 m/s (iv) 8 m/s

Extending Learning - Activities and Projects

1. Play with a mirror

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

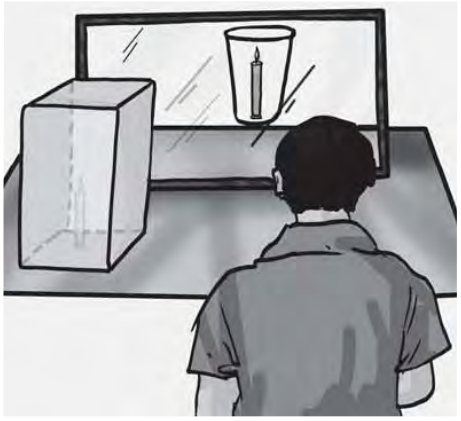


Fig.15.33: Candle burning in water

2. A burning candle in water

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

3. Make a rainbow

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

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

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

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

6. Role play

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

You can read more on the following websites:

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

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

DO YOU KNOW?

The mirrors can be used as weapons. Archimedes, a Greek scientist, is said to have done just that more than two thousands years ago. When the Romans attacked Syracuse, a coastal city-state in Greece, Archimedes used mirror arranged as shown in **Fig. 15.34.** The mirrors could be moved in any direction. They were positioned in such a way that they reflected the sunlight on the Roman soldiers. The soldiers were dazzled by the sunlight. They did not know what was happening. They got confused and ran away. This was an example of triumph of ideas over military might.

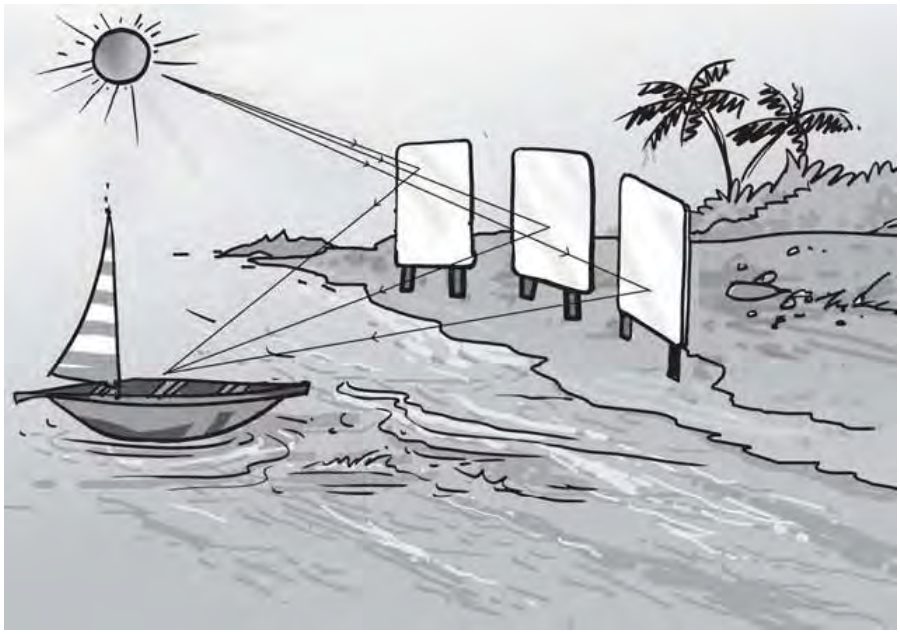


Fig.15.34: Archimedes mirrors

16 WATER

In previous chapters, we studied that we (animals too) depend directly or indirectly on plants. Can you guess a substance on which all, including plants depend? Also, which substance do you use in maximum amount during whole day? Obviously, water. Water is life. One cannot live without water. Besides drinking, bathing and washing, water is used for many other purposes. It is used in the construction of houses. The different industries, factories and mills cannot run without water. They require plenty of water. Growth and development of plants can never be imagined without water.

16.1 WATER AS A NATURAL RESOURCE

Water is essential for sustenance of life. It is an important medium for all the life processes and acts as universal solvent. It is a prime natural resource. We have both the surface and ground water. India has rich water bodies consisting of rivers, lakes, streams and ponds. The surface and ground water available to us comes from the rainfall and snow, which are a part of the water cycle.

Jammu and Kashmir state is bestowed with rich resources of good quality water, both surface as well as underground water. Glaciers, snow beds and snow fed perennial rivers carry large quantity of good quality water.

Our water requirement depends entirely on nature. Whenever the water cycle in nature is disrupted, the ecological balance in nature is disturbed.

Water is often wasted during its use. The rivers and the canals near the big cities get polluted due to industrial wastes or sewages which are thrown into them. Indiscriminate felling of plants by man, to satisfy his greed, has also upset the water cycle in nature. This has resulted in water shortage. Water is renewable only if it is protected against wastage and pollution, and if a thick cover of forest plants is maintained.

16.2 IMPORTANCE OF WATER FOR SUSTAINING LIFE

Every plant, animal and human being needs water to stay alive. But human beings depend on water more

than just to stay alive. We also need it for our way of life. We need water in our homes to brush our teeth, cook food and wash utensils. We need water for irrigation. Let us learn in detail.

1. Water in living things: Every organism consists mostly of water. Your body is about 65 per cent water. So is that of a mouse. An elephant and an ear of corn are about 70 per cent. A potato and an earthworm are about 80 per cent water. A tomato is about 95 per cent water.

All living things need a lot of water to carry out their life processes. Plants, animals and human beings must take in nutrients (food substances). Watery solutions help to dissolve these nutrients and carry them to all parts of an organism's body.

Every living thing must keep its water supply near normal, or it will die. A person can live without food for more than two months, but can live without water for only about a week. If the body loses more than 20 per cent of its normal water content, a person will die painfully. Human beings must take in about 2.4 litres of water a day. This intake can be in the form of the water we drink, or the water in other beverages we drink, or the water in the food we eat.

Water has properties of fluidity and solubility. These properties make it useful in the process of digestion, blood circulation and excretion, etc. Water also helps in regulating our body temperature by the process of sweating.

2. Water in the home : In our homes, we require water for cleaning, cooking, bathing and carrying away wastes.

Each person may use an average of about 260 liters of water a day in the home.

3. Water for irrigation: Most of the plants that people raise need great quantities of water. People raise most of their crops in areas that have plenty of rain. But to produce enough food for their needs, people must also irrigate dry areas.

In J&K state, irrigation is done 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 .

The seeds of many plants are transported by water. When they fall in water, they float and are carried away to

far off places. Several varieties of plants have spread from one place to another in this manner.

Fig.16.1: Use of water in irrigation

4. Water for Industry: The largest single use of water is by industry. An industry uses water in many ways. It uses water for cleaning fruits and vegetables before canning and freezing them.

Fig.16.2: Water is used in cooling hot steel

Fig.16.3: Water is used in soft drinks manufacturing

It uses water as a raw material in soft drinks, canned foods and many other products. It uses water to air-condition and clean factories. But most of the water used by the industry is for cooling. For example, water cools the steam used in producing electric power from fuel. It cools the hot gases produced in refining oil and the hot steel made by the steel mills.

5. Water for power: People use water to produce electric power to light homes and to run factories. Electric power stations burn coal or other fuel to turn water into steam. The steam supplies the energy to run machines that will produce electricity. Hydroelectric power stations use the energy of falling water from waterfalls and dams to turn the water turbines that drive a generator to produce electricity.

Fig.16.4: A hydroelectric power station

Hydroelectic Power Stations in J&K

1. The Sind Valley Hydroelectric Project
2. Mohra Hydroelectric Power Station
3. The Pahalgam Hydroelectric Project
4. Lower Jhelum Hydel project
5. Salal Hydroelectric Project
6. Uri Hydroelectric Dam
7. Dul Hasti Hydroelectric Project
8. Chutak Hydroelectric Project
9. Pakal Dul Hydroelectric Project
10. Kiru Hydroelectric Project

6. Water for transport and recreation:

After people learned to build small boats, they began using rivers and lakes to carry themselves and their goods. Later, they built larger boats and sailed across the ocean in search of new lands and new trade routes.

Today, people still depend on water transportation to carry such heavy and bulky products as machinery, coal, grain and oil.

Fig.16.5: Water transportation

People build most of their recreation areas along lakes, rivers and seas. They enjoy water sports such as swimming, fishing and sailing. Many people also enjoy the beauty of a quiet lake, a thundering waterfall, or a roaring surf.

Now, you must have understood the importance of water. **Save water, water will save you!**

Fig.16.6: Recreational uses of water

Worksheet 16.1

1. By what percent water is your body?
2. By what percent water is a potato?
3. How much water do you require for different activities? Calculate the quantity of water used for different activities and put them in a tabular form.

Activities where water is used	Water is used in terms of litres
Bathing	_____
Drinking	_____
Washing clothes	_____
Cleaning utensils	_____
Cleaning house	_____

4. List any four uses of water in industries.
5. What is the use of water in hydroelectric power stations?

16.3 SOURCES OF WATER

Water which fulfils all your necessities, where does it come from? Taps, tube wells, water tanks, rivers, lakes, etc., are

some sources of water. If you are living in a city, have you thought from where does water come in taps? From where does water come in reservoir in the village or city? How do the rivers and lakes get filled? After thinking, you will realize that all these sources get water from rain. Rain is the main source of water.

Famous Rivers of J&K : Ravi, Ujh, Chenab, Tawi, Kishenganga, Indus, Jehlum.

1. Rivers and Lakes: Most cities that depend on rivers for water are located at the river banks. The amount of water in a river can vary from time to time. It depends on the amount of rain fall over the land which drains into the river and the amount of snow that melts on mountains. Snow on high mountains is the source of big rivers.

Fig.16.7: A river

Important canals of J&K.

1. Jammu Region :

(i) Ranvir Singh Canal
(ii) Partap Canal
(iii) Kathua Canal
(iv) Tawi Canal
(v) Duddar Canal
(vi) Pargol Canal
(vii) Ujh Canal
(viii) Basant pur Canal
(ix) Raigarh Canal
(x) Ravi Canal.

2. Kashmir Region :

(i) Martand canal
(ii) Zainagir canal
(iii) Lalkul (Pohru)
(iv) Dadikul (Liddar)
(v) Sumbal Khul (Sukhang)
(vi) Nandikul (Anantnag)
(vii) Avantipur (Liddar)
(viii) Zainapora (Vishu)
(ix) Rishipora Canal.

3. Ladakh Region:

(i) Chuchot Mayur
(ii) Thikasay Mayur
(iii) Khangral Canal
(iv) Kharbu Thang
(v) Zangla Canal
(vi) Khaksar Canal
(vii) Khurbathang Canal .

During a dry spell, a river`s water level may fall sharply. Then, a city may not have enough water. For this reason, many cities that depend on small rivers store

water during rainy periods, and they always have a good supply. Some build a dam on the river and store water behind it in a reservoir. Others store water in a pond or small lake.

Fig.16.8: A freshwater lake

Lakes of Jammu and Kashmir state:

Famous lakes of Jammu region:

(i) **Sanasar lake**

(ii) **Mansar and Saruinsar lake**

Famous lakes of Kashmir region:

(i) **Dal lake**

(ii) **Wular lake**

(iii) **Manasbal lake.**

Famous lakes of Ladakh region:

(i) **Pangong lake**

(ii) **Tsomoriri lake**

2. Sea water: Oceans are the largest reservoir of natural water because streams and rivers flow into them. Almost 97 per cent of all water is in the oceans. But this water is too salty to be used for drinking, farming and manufacturing.

Fig.16.9: An ocean

3. Ground water: Many cities are not near rivers or lakes. They use water that is stored underground. This water comes from rain that seeps into the ground. As it trickles downwards, it fills the space between grains of sand and cracks and pores in rocks. In time, the water reaches a layer of rocks or other material that is watertight. The water collects above the watertight layer, and the ground becomes saturated (soaked). This saturated zone is called an **aquifier**. The upper limit of the zone is called the **water table**.

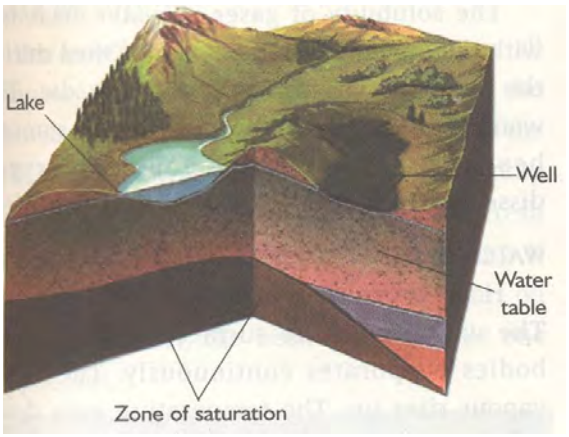
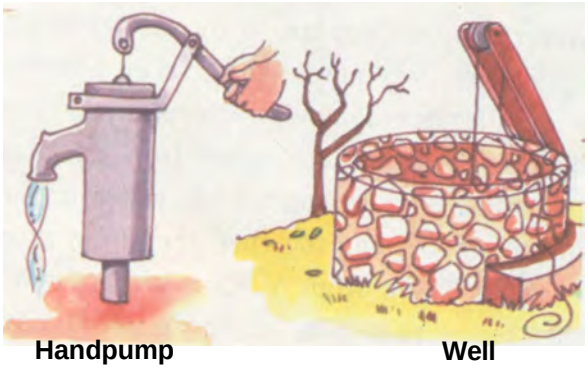


Fig.16.10: Ground water

Limestone bodies of Reasi limestone and permo- Triassic limestone bodies of warevan valley Banihal, Gulabgarh and Mandi areas are good reservoirs of good quality ground water. Sirowal /Trai belt of Jammu region contains groundwater. This water emerges in the from of springs and flowing tube wells as seen in Rajpura, Beliain, Jandi, Banechak area of Hiranagar. This ground water is used for irrigating paddy fields.

Cities obtain underground water by drilling wells that reach below the water table and pumping up the water.



Handpump Well

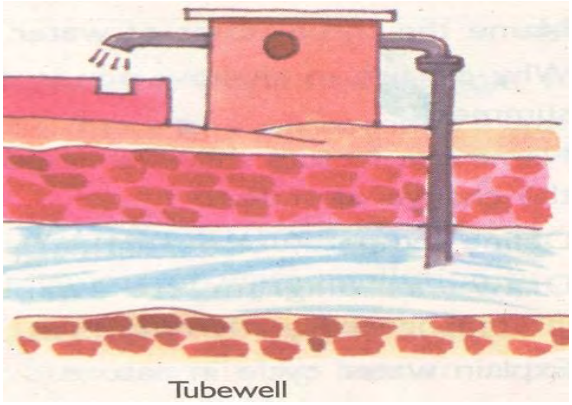


Fig.16.11: Underground water sources

Hot water springs are found at Tatapani near Kalakote, district Rajouri, Tatapani in Dhamkund Sangaldan area of Gool Valley, district Doda, and Tatowain in Rin Nai, east of Jnshan in Marwa valley. The water of these springs is Known to cure skin diseases and therefore of great tourist attraction.

The underground water may rise until it finds a way out to the surface to form a flow of water called a spring. The spring water is filtered and clean. Spring water is usually cold. However, some springs are warm or hot.

WORKSHEET 16.2

1. Name the main source of water.
2. Name the main source of water at your home.
3. What is the source of underground water?
4. Why do we not use sea water?
5. From where does water come in rivers and streams?
6. Define water table.
7. What is a spring? Is spring water drinkable?

16.4 DIFFERENT STATES OF WATER

Water exists in three states - solid, liquid and gaseous. The water in wells, ponds, rivers, lakes and seas is in the liquid state. At high altitudes on

mountains or in very cold regions like the North or South pole, much water freezes to form ice, the solid state. In air, water exists as vapour, i.e., in the gaseous state.

The molecules that make up water are always moving. The form, water takes, depends on how fast the molecules move. The molecules in solid water (ice) are close together and almost motionless. The molecules in liquid water are far apart and move about freely. The molecules in water vapour, move about violently and bump into one another.

INTERCHANGEABILITY OF DIFFERENT STATES OF WATER

The existence of water in three physical states is mainly the function of temperature and pressure. The interconversion of water is brought about by the change of temperature and pressure.

When water is heated, it changes into gaseous state. This change takes place at a particular temperature, called boiling point. The **boiling point** of water is **100^{0}C**.

When water is kept in the freezer of a refrigerator, it solidifies into ice. This change also takes place at a particular temperature, which is called **freezing point**. The freezing point of water is **0^{0}C**.

When the ice is kept in open, it starts melting and changes into the liquid state, i.e., water.

The phenomenon of change of one state of water into another and back to the original state is called **interchangeability.**

The overall process can be shown as:

$$\underset{\text{(Solid)}}{\text{Ice}} \underset{-\text{Heat}}{\overset{+\text{Heat}}{\rightleftharpoons}} \underset{\text{(Liquid)}}{\text{Water}} \underset{-\text{Heat}}{\overset{+\text{Heat}}{\rightleftharpoons}} \underset{\text{(Gas)}}{\text{Water Vapour}}$$

DO YOU KNOW?

Ice acts as a preservative by inhibiting the destructive action of bacteria, yeast and mould.

16.5 WATER AS A SOLVENT

An important property of water is its ability to dissolve many substances. When water evaporates to form cloud, it is a pure form of water. But when it falls as rain water, many gases from air dissolve in it. After falling on the ground, it comes in contact with several minerals and salts and dissolves some of them. Hence, it is called a **universal solvent**.

Large water surfaces like rivers, lakes and oceans are in direct contact with atmospheric air. The gases like oxygen and carbon dioxide are soluble in water. It is only the dissolved oxygen which helps aquatic organisms to survive

in water. Fish have special organs called **gills** which help them in taking up the dissolved oxygen.

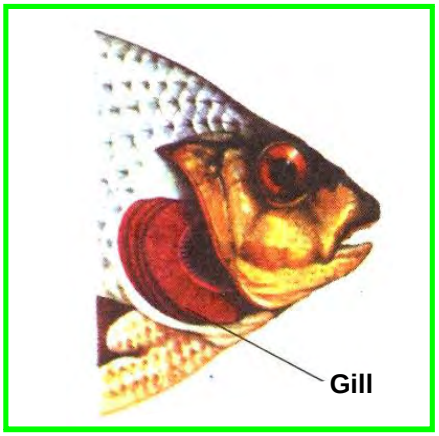


Fig.16.12: The gills of a fish

Aquatic plants use carbon dioxide dissolved in water for preparation of their food.

The solubility of gases in water decreases with the increase in temperature. Often during the summer, fish in shallow ponds die. The water in the ponds becomes hot due to summer heat. As a result, the amount of oxygen dissolved in water is reduced and fishes die.

16.6 WATER CYCLE IN NATURE

Have you ever seen a river, or a lake, or a sea. The water from the surface of these water bodies evaporates continuously. The water vapour rises up. The temperature goes down as we go higher and higher. When the air containing water vapour cools at upper altitudes, the water droplets are formed. The water droplets adhere to the dust particles which are present in the air. The group of water droplets along with dust particles forms clouds. The clouds are moved from one place to another place by wind. When water droplets in the cloud come together, they form drops of water. These drops of water are heavy and they fall as rain. Thus, the cycle goes on and is called the **water cycle in nature.**

WORKSHEET 16.3

1. Name the three states of water.
2. Why do fish in shallow ponds die during summer?
3. Name the factors that are responsible for the change of state.
4. Define temperature.
5. Draw a diagram to explain the interchangeability of water.
6. Explain water cycle in nature.
7. Give examples to show that water is a universal solvent.
8. Name two things which cannot dissolve in water.
9. At what temperature does the water boil ?
10. At what temperature does the water freeze ?

16.7 WATER POLLUTION

You have learnt that water is important for all living organisms. Do you

know what are the different sources of water? Three fourth part of the earth is covered with water. Such a huge quantity of water on earth is in oceans, while the fresh water, which we use, is in very less quantity. If we imagine that the total quantity of water on earth is bucketful, the fresh water is only one teaspoonful.

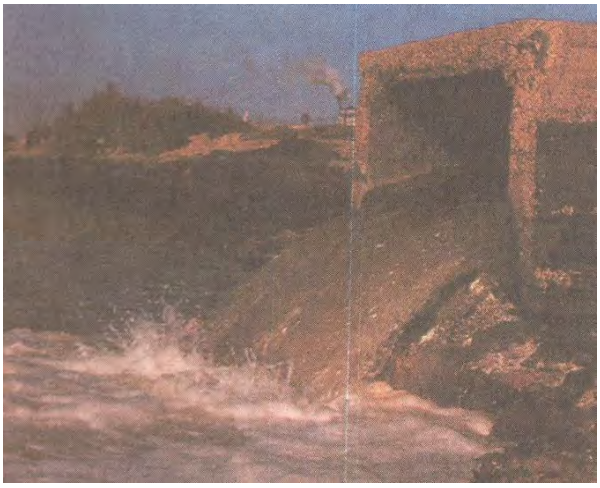


Fig.16.13: A sewage polluting water

Water is regarded as polluted when it changes its quality or composition, directly or indirectly as a result of man`s activities, so that it becomes less suitable for drinking purposes, domestic use, agricultural practice, fisheries or other purposes. All kinds of water resources, like ponds, rivers, lakes and oceans, are polluted by a variety of waste materials which are the direct result of population explosion and large scale industrialization.

CAUSES OF WATER POLLUTION

Various causes of water pollution are:

1. Domestic sewage: Discharge of sewage water containing human urine and faeces, animal dung, cloth washing, etc., into lakes, rivers and other water bodies is one of the most common primary sources of water pollution, especially near big cities. Gutter water and faulty drainage system may also pollute water.

Wular lake is a large fresh water lake in Bandipora district in J&K. It faces environmental threats including the conversion of large parts of the lake's catchment areas into agricultural land, pollution from fertilizers and animals waste, hunting of water fowl and migratory brids and weed infestation in the lake itself.

2. Industrial wastes: The industrial wastes play a major role in the pollution of water. They include toxic substances

DO YOU KNOW?

One fifth of the world`s population, 1.2 billion people, regularly drink polluted drinking water. One person dies every six seconds from drinking disease-contaminated water.

such as chloride, ammonia, hydrogen sulphide, different acids and salts of metals like copper, zinc, lead, nickel, mercury, arsenic, etc. The throwing of these wastes into water bodies is also an important cause of water pollution.

3. Agricultural wastes: Various minerals and organic wastes are carried to the lakes, rivers and other water reservoirs from agricultural fields where a variety of fertilizers, insecticides and herbicides are applied almost throughout the year.

4. Oil pollution: Crude oil during transport in ships is discharged into the sea water. Oil refineries situated near sea shore also pollute water.

PREVENTION OF WATER POLLUTION

1. Septic tank treatment should be used for individual houses of communities.
2. The sewage and factory wastes have to be cleaned before they flow into the water reservoirs.
3. Biological treatment for the sewage should be carried out.
4. The use of fertilizers and herbicides should be judicious and minimal.
5. The use of synthetic detergents should be minimized.
6. Dead bodies of humans and animals

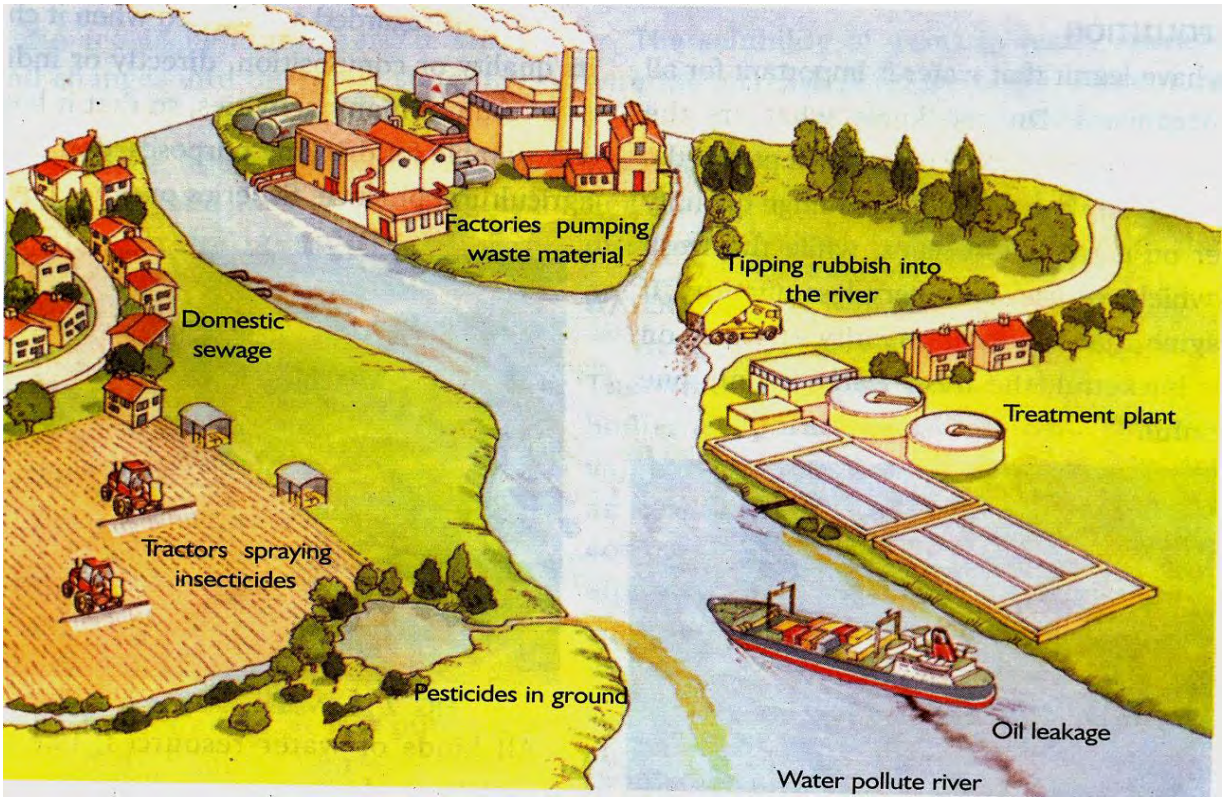


Fig.16.14: Types of pollution

should not be thrown into the river.

7. The excreta and other garbage should be treated in a biogas plant to get fuel as well as manure.
8. The water of rivers, streams, lakes and ponds should be purified. This is done by the government. One such example is the **Ganga Purification Project**. The Government of India has undertaken the project to prevent the pollution of the Ganga river. Under this project, water treatment plants have been set up to treat the industrial and domestic waste water entering the river.
9. A large number of trees should be planted along the river banks.

16.8 POTABLE WATER

The water which is used for drinking purpose is known as **potable water**. It should be clean and fresh. It should not contain suspended or soluble impurities and harmful germs such as bacteria.

Water from rivers and lakes contains both suspended and soluble impurities. Before supply, it is purified for drinking purpose. The following steps are taken to purify water from natural resources:

1. Sedimentation: Alum is added to the water tank. It helps in quick settling of fine suspended materials. The water becomes partly clean.

2. Filtration: In this process, the partly clear water is filtered through sand filters. All insoluble impurities are removed here.

3. Chlorination: Chlorine or bleaching powder is added to filtered water. Bleaching powder also contains chlorine. Chlorine kills bacteria. Now this water is free from harmful germs. This water is fit for drinking purposes.

4. Aeration: Aeration improves taste and odour. In this process, water is usually sprayed through air. The oxygen in the air takes away the bad taste and odour.

16.9 COMPOSITION OF WATER

Water is a compound. Its molecular formula is H_2O. This formula tells us that a

WORKSHEET 16.4

1. What is domestic sewage? What does it contain?
2. Name the metals whose salts are contained in industrial wastes.
3. How can you say that a given sample of water is polluted?
4. Why is the river water not fit for drinking purposes?
5. What are the properties of potable water?
6. What is the importance of aeration for purifying water?
7. Why do we add alum to water tanks?

molecule of water is composed of two atoms of hydrogen and one atom of oxygen.

Although boiling converts water into steam and on cooling it gives ice, the chemical composition of water in its three states, solid (ice), liquid (water) and gaseous (steam), is the same.

However, water molecules can be split into its constituent elements, i.e., hydrogen and oxygen by passing electric current through it. This method of using electricity to split the molecules is called **electrolysis.**

This activity shows that water is made up of two volumes of hydrogen and

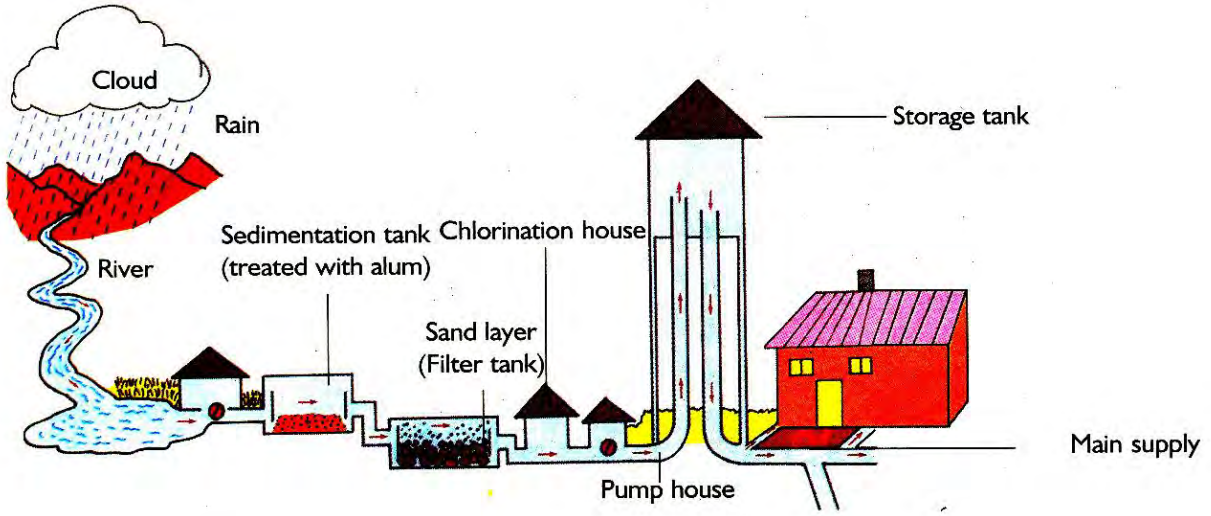


Fig.16.15: Supply of drinking water to a town

ELECTROLYSIS OF WATER

ACTIVITY

Fill three fourth of a voltameter with water. Add 2-3 drops of sulphuric acid to make it good conductor of electricity. Set up the apparatus as shown in **Fig. 16. 17**.

Fill two test tubes with water and invert them over the two electrodes made of steel or carbon, not allowing any water in the test tube to spill. Connect the electrodes to the source of electricity (a battery). You will see the bubbles rising to the top of the test tubes and gases collecting in them over the water.

Are the volumes of gases in both the tubes same? One test tube seems to be collecting more gas than the other. After one of the test tube is filled about half with gas, measure the height of the gas column in each test tube. The ratio of the collected gases seems to be 2:1. When one of the test tubes is filled with gas, remove it slowly and cork it.

Now test this gas by bringing a burning splinter near its mouth and open the cork. The gas burns with a popping sound and water is formed. This gas is **hydrogen**.

Similarly, test the gas from the other test tube when filled with gas by burning a glowing splint. The splint catches fire and burns brightly. This property is of **oxygen** gas.

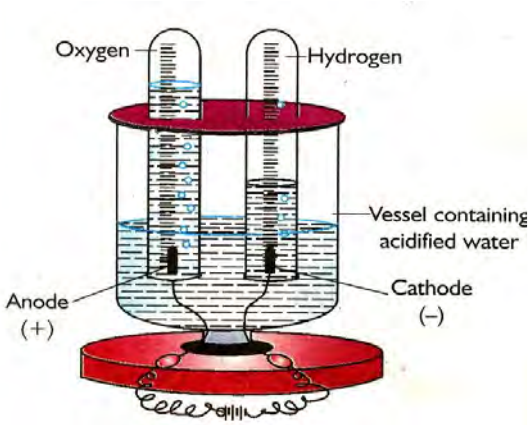


Fig.16.16: Electrolysis of Water

one molecule of oxygen, i.e., the volume ratio of hydrogen and oxygen is 2:1. Thus, the chemical formula of water is H_2O.

16.10 PHYSICAL PROPERTIES OF WATER

1. Nature: Pure water is clear, colourless, tasteless and odourless liquid.

2. Boiling point: Pure water boils at 100°C.

3. Freezing point: Pure water freezes at 0°C. At higher pressure, the freezing point of water is slightly less than 0°C. If impurities are present in water, the water freezes at a temperature less than 0°C.

4. Density: The density of water is 1g/cc at 4°C.

5. Heat capacity: Heat capacity is the ability of a substance to absorb heat without becoming much warmer itself. This property of water is used to cool engines and thus, prevents them from getting hot. This property of water is made use of in air coolers.

6. Conduction: Pure water is a bad conductor of heat and electricity.

7. Solubility: Water can dissolve almost any substance.

ACTIVITY

To determine the boiling point of water.

Fill a beaker half with water. As shown in Fig.16.18, use a stand to fix a thermometer upright in the beaker with the bulb of thermometer immersed in the water. Heat the beaker. After some time the water will start boiling. Note the temperature. At this time, the thermometer shows a temperature of about 100°C. This temperature is called the boiling point of water.

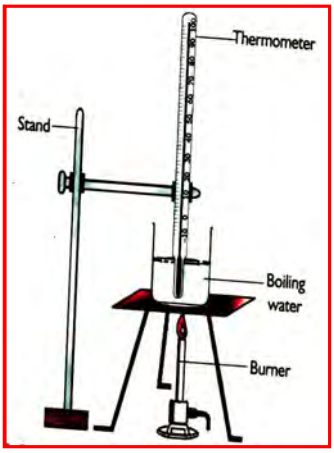


Fig.16.17: Determining the boiling point of water

ACTIVITY

To determine the freezing point of water.

Take some pieces of ice in a beaker. As shown in the figure, stand a Celsius thermometer amongst them. Measure the temperature of ice. The ice melts and the thermometer shows a constant temperature of approximately 0°C. The temperature remains the same till all the ice has melted. You know that this temperature, 0°C is known as the freezing point of water.

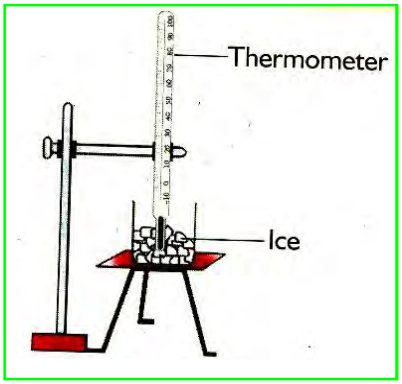


Fig.16.18: Determining the freezing point of water

Look at **Fig.16.20.** It is a desert cooler. Water is kept in a tray at the bottom. A pump circulates this water which drips on the mats kept at sides, keeping them constantly wet. The fan takes the warm air in from outside. The air enters through mats and evaporates the water. The evaporating water absorbs heat from the air and cools it. The cool air is then pushed into the room by the fan. As a result, we get cool air.

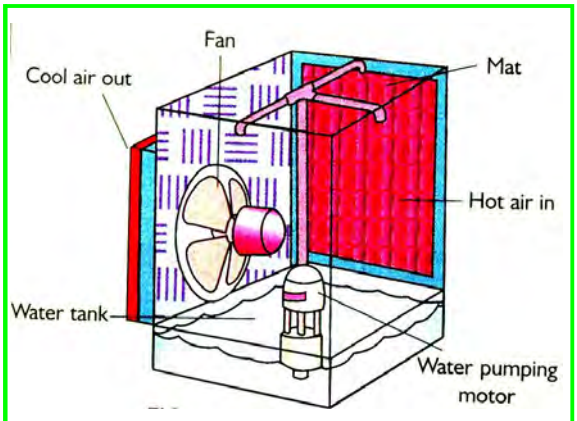


Fig.16.19: A desert cooler

16.11 RELATIVE VOLUME AND DENSITY OF WATER AND ICE

The density of a substance is the amount of mass it contains for each unit of its volume. The density of a substance is calculated by dividing its mass by its volume, i.e.,

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Most substances expand in volume when they are heated. Therefore, when substances are heated, their density decreases. Water behaves differently. It contracts or takes up less volume, when heated from 0°C to 4°C, and its density increases. Above 4°C, water expands when heated, and its density decreases.

Most substances contract when they freeze. In such substances, the density of the solid is higher than the density of the liquid. Again, water is an exception. It expands when it freezes; its density decreases. Ice floats on water

because lower density substances float in liquids of higher density. The lower density of ice helps in letting fish survive.

16.12 SALINITY OF SEA WATER

As sea water is salty, it cannot be used for drinking. Rain water falling on earth flows in the form of rivulets, streams and rivers into the sea. As it flows over the land, many salts in the soil dissolve in it and are carried into the sea. Materials released by volcanoes and under sea springs also add salts to the sea. Rivers also bring fresh water to the sea, which lowers the salinity of sea water near river mouth.

ACTIVITY

Take some wax in a metal bowl. Heat it slowly till it melts. Add a piece of solid wax in molten wax. You will notice that the solid wax sinks to the bottom. This shows that the solid wax is heavier than the liquid wax.

Now, put a piece of ice in a container filled with water. The ice floats on water. We can say that ice is lighter than water or ice has less density than water.

Drinking salty water makes a person vomit. If it is necessary to evacuate a person`s stomach, doctors prescribe salty water.

ACTIVITY

Take two pods of seedlings of the same plant. Water them everyday, one with plain (tap) water and the other with saline water.

What do you observe?

The seedling which was watered with saline water did not grow properly. This activity shows that saline water is not suitable for agriculture.

Fig.16.20: Saline water is not suitable for Plants

Many plants also cannot tolerate saline water. Saline water cannot be used in industries either. Use of saline water spoils the machinery gradually and puts it out of use.

Saline water may cause metals to corrode.

Use of saline water in heaters and boilers causes deposits of salts on heating elements and soon renders them useless.

The presence of dissolved salts and gases impart a characteristic taste to drinking water.

16.13 DESALINATION OF SEA WATER

The process of removing dissolved salts from saline water is called **desalination.**

DO YOU KNOW?

Our body needs iodine. Lack of iodine causes goitre. The drinking water available in the vicinity of sea contains adequate quantity of iodine. Iodine is not found in water in high mountainous regions. Hence, goitre is prevalent among people living at high altitudes away from the sea due to lack of iodine in their bodies.

Desalination of sea water is done as follows:

1. Sea water is collected in a huge tank.
2. The tank is connected with another tank through a semi - permeable membrane.
3. High pressure is applied from an external source on saline water.
4. The pressure retains salts and allows only water to pass through semi-permeable membrane.
5. Pure water collected in the tank is used to meet the domestic need, in industries and irrigation projects.

WORKSHEET 16.5

1. Which property of water makes the ice float on its surface?
2. What is the formula of density?
3. Why is the sea water salty?
4. How can sea water be used for irrigation?
5. Name the element which is found in sea water but not in water at high mountains.

What you have learnt

- Water is essential for all living beings.
- The ocean is the major sources of water. Other sources are rivers, lakes, ponds, streams, springs, wells and rains.
- Water from any natural surrounding is seldom safe to drink.
- People in cities get water from taps.
- Water cycle in nature is continuous.
- Water exists in three states solid, liquid and gaseous.
- The water which is used for drinking purpose is called potable water.
- Pure water is colourless, odourless, tasteless and transparent liquid.
- Ice which is a solid form of water is lighter than water.

- The lower density of ice helps in letting fish survive.
- The heat capacity of water is high and its conductivity is poor.
- Hydrogen and oxygen combines in the ratio of 2 : 1 by volume to form water.
- Water dissolves many substances.
- Oxygen dissolved in water is utilised by aquatic organisms during respiration.
- Water gets easily polluted.
- Water pollution is harmful for living organisms.
- Water pollution is caused by industries and by improper health practices.
- Water pollution can be controlled.
- Dissolved salts in water cause salinity.
- Sea water is highly saline. Each litre of this contains about 35 grams of dissolved salts.
- High salinity of water is harmful for agriculture, to animals and for human use.
- Presence of certain salts make water hard.

EXERCISES

I. Answer the following questions in one word or a figure:

1. What is the apparatus used for the electrolysis of water called?
2. What is the volume ratio for hydrogen to oxygen in water?
3. At what temperature does water change into steam?
4. At what temperature does water change into ice?
5. At what temperature is the density of water maximum?
6. What is the composition of water?
7. Which is lighter: water or ice?
8. Name the largest source of water on earth.
9. Name a liquid which is heavier than water.
10. Name a chemical which is used to kill germs in water.

II) Fill in the blanks.

1. Water helps in the_____ of seeds and fruits.
2. About 97% of water is in the _____.
3. The property of _____makes water useful in the process of digestion.
4. The human body has about 70% of water by _____.
5. Seed cannot_____ without water.
6. Removing dissolved salts from saline water is called_____.
7. The process of using electricity to split water molecule is called _____.
8. The _____ of liquid water is 1 g/cc.

9. The density of water is maximum at _____.
10. The freezing point of water is_____.

III) Write 'True' or 'False' against each of the following statements:

1. Ice has lower density than water._____
2. Rain water is the purest form of natural water._____
3. The solubility of gases in water increases with the increase in temperature. _____
4. During the summer, the amount of oxygen dissolved in water is increased and fish die. _____
5. Pure water tastes sweet. _____
6. The use of fertilizers pollutes water _____
7. The ratio of oxygen to hydrogen in water is 2:1. _____
8. The states of water are interchangeable. _____

IV. Answer the following questions:

1. State any three physical properties of water.
2. How will you determine the freezing point of water?
3. How will you determine the boiling point of water?
4. Briefly describe the water cycle in nature.
5. Mention five uses of water.
6. How is water polluted?
7. How can pollution of water be prevented?
8. What is electrolysis? Describe in brief the electrolysis of water.
9. Mention the names of some industries which pollute water.
10. Give the names of some metals whose compounds are toxic.
11. Why is saline water not suitable for drinking?
12. What is potable water? Give its characteristics.
13. Name the elements that water is composed of.
14. Name two physical changes that take place in the water cycle.
15. How will you determine that a given sample of water is pure or polluted?
16. What is salinity? Describe the process of desalination.

V. Choose the correct answer:

1. At which temperature is the density of water maximum?
   (a) 0^0C (b) 4^0C (c) -4^0C (d) 100^0C
2. What is the volume ratio of oxygen to hydrogen in water?
   (a) 1:2 (b) 1:3 (c) 2:1 (d) 3:1
3. Which one of the following liquids has the greatest heat capacity?
   (a) Water (b) Glycerine (c) Kerosene (d) Oil
4. Which one of the following metals is not affected by water?
   (a) Sodium (b) Potassium (c) Calcium (d) Boron

DO YOU KNOW ?

✍ There is an area in the Caribbean Sea known as the Bermuda Triangle. Many ships and planes have mysteriously disappeared here. Is there some supernatural force at work here, spiriting people away to another planet or pulling them to their death in the sea below? Although many disappearances are reported to have happened in calm weather, investigations show that an area is given to sudden storms. Hurricanes often begin here and it is not surprising that many planes and ships have been lost.

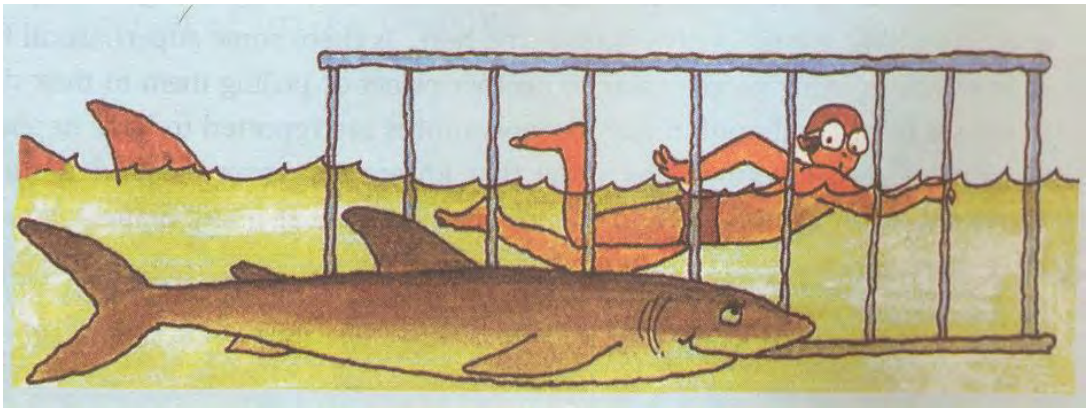
✍ The Ancient Greeks write of an idyllic island called **Atlantis** which disappeared into the sea. Why did it disappear? According to the story, the sea god was so angry at how greedy and dishonest the people had become, he shook the island for a day and a night before the sea swamped it forever. Many people have wondered whether Atlantis really existed and historians think that the legend is based on the island of Thera, known as Santorini. In 1450 B.C., a huge volcanic explosion shook the island. Most of th island disappeared beneath the sea and tidal wave flooded the island round about. Probably destroying the Minoan Civilization of the nearby island, Crete.

✍ Although the oceans are so important, we are polluting them in many different ways. Millions of tons of oil flow into oceans every year. Some of this comes form oil tankers which are involved in accidents. Sometimes, ships illegally wash their empty tanks in the sea. In 1989, fifty million litters of oil spilled in to the oceans. Much of this came from a tanker called the Exxon Valdez' which was involved in an accident when oil was spilled off the Alaskan coast. Millions of marine creatures died as a result. During the Gulf War in February 1991, Iraq set fire to more than 550 oil wells. This was an act of environmental

vandalism which future generation will have to pay for by way of polluted oceans.
Cities like Mumbai and Rio de Janeiro, which lie along the coast, often dump waste directly into the sea. Many countries do not bother to treat or clean their sewage in any way but allow it to flow untreated into the oceans.

- The saltiest seas are in the Middle East where hot sun evaporates the water and makes it saltier and saltier. The red sea is so salty you cannot sink into it, the salt keeps you floating.

- In July 1978, Walter Poenisch swam from Cuba, an island in the Caribbean Sea to Florida in the U.S. The waters are so dangerous that he swam inside a shark cage and took just over 34 hours to complete the 207 km journey.



17 FORESTS: OUR LIFELINE

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

“This is because the forests serve as green lungs and water purifying systems in nature”. Prof. Ahmad explained. The children were confused. Prof. Ahmad realized that the children had not visited a forest. The children also wanted to know more about the forest, so they decided to visit it with Prof. Ahmad.

17.1 Visit to a Forest

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

Ayman then took them to a place at a height to show them the broad view of the forest. Children were surprised because they could not see any land **(Fig.17.1).** The different treetops had formed green cover over the land.

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

Fig.17.1 : A view of a forest

While coming down, they got excited on hearing a sudden sound of birds and some noise from the top branches of the trees. Ayman told them to relax since it was a normal phenomenon here. Because of the children's presence, some monkeys had climbed higher up on the trees where they disturbed the birds. Animals often give this type of warning call to alert other animals. Ayman also told them that many other animals like boars, bisons, jackals, porcupines and elephants live in the deeper areas of the forest **(Fig .17.2).** Prof. Ahmad cautioned children that they should not go deep into the forest.

Yasir and Saba remembered that they have studied about forest as an example of a habitat **(Fig. 17.3).** They

Fig.17.2 : Some forest animals

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

Fig.17.3 : Forest as habitat

The land where the childern were walking was uneven and covered with many trees. Ayman helped them to identify sal, teak, semal, sheesham, neem, palash, fig, khair, amla, bamboo, kachnar **(Fig 17.4).** Prof. Ahmad pointed out that there are several other trees, shrubs, herbs and grasses in the forest . The trees were also covered with different types of creepers and climbers. The sun was barely visible through the leaves of the trees, making it quite dark inside the forest.

Activity17.1

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

Neem

Bamboo

Sheesham

Semal

Fig17.4 : Some forest plants

from material which may have been obtained from the forest.

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

You might have many wooden items on your list like plywood, fuel wood, boxes, paper, matchsticks, and furniture. Do you know that gum, oils, spices, fodder for animals and medicinal plants are also some of the products which we get from the forest **(Fig.17.5).**

Saba wondered who would have planted these trees. Prof. Ahmed replied that in nature trees produce enough seeds and the forest floor provides favourable conditions for them to germinate and develop into seedlings and saplings. Some grow up into trees. He added that branchy part of a tree above the stem is known as the **crown** of the tree **(Fig 17.6).**

Fig.17.5 : Forest products

Prof. Ahamd asked childern to look up and observe how the branches of the tall trees look like a roof over the plants in the forest. He told them that this is called a **canopy (Fig.17.7).**

Activity17.2

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

Fig.17.6 : Some crown shapes

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

Prof. Ahmad pointed out that trees had crowns of different types and sizes. These had created different horizontal layers in the forest. These are known as understoreys **(Fig.17.7).** Gaint and tall trees constituted the top layer followed by shrubs and tall grasses, and herbs form the lowest layer.

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

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

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

They came across numerous insects, spiders, squirrels, ants and various other small animals on the bark of the trees, plants leaves and on decaying leaves of the forest floor **(Fig.17.8).**They started making sketches of these

Fig.17.7 : Canopy and under storeys in a forest

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

Fig.17.8 : Forest floor

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

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

Activity17.3

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

Saba asked. " There are so many trees here. Also, there are many forests like this. What difference will it make if we cut some trees for a factory?"

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

Grass → insects→ frogs → snakes → eagle.

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

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

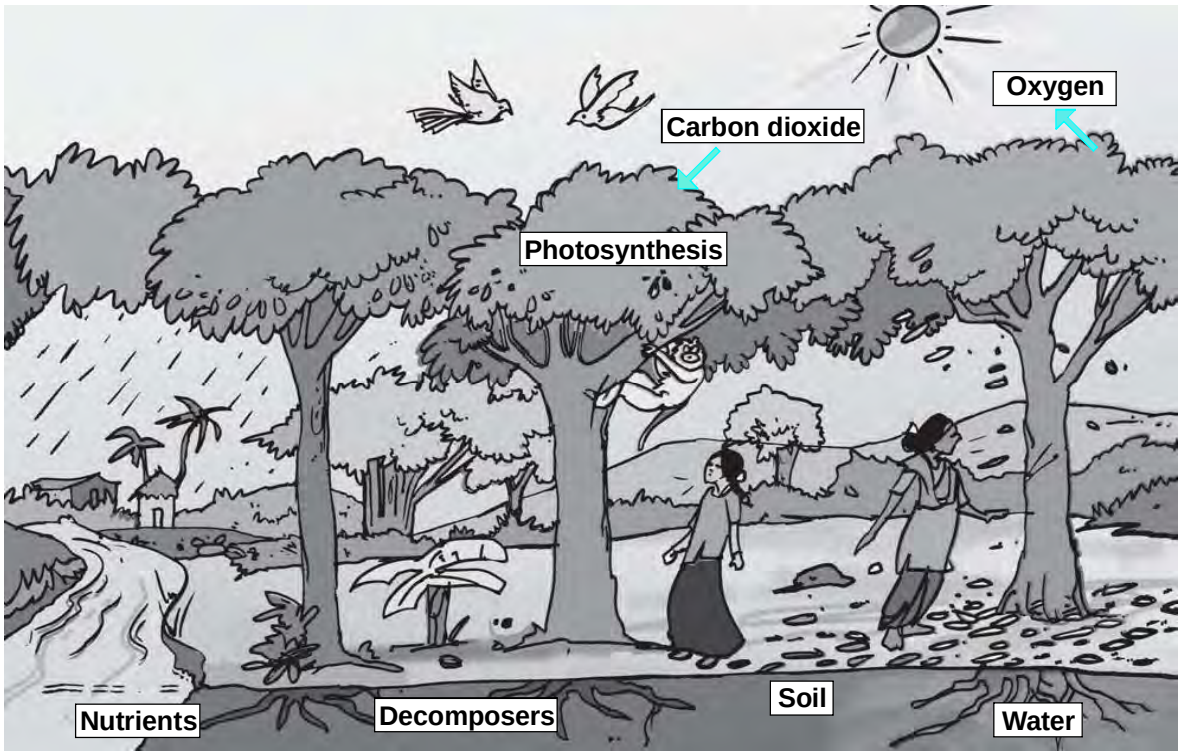


Fig.17.9 : Interrelationship of plant, soil and decomposers in a forest

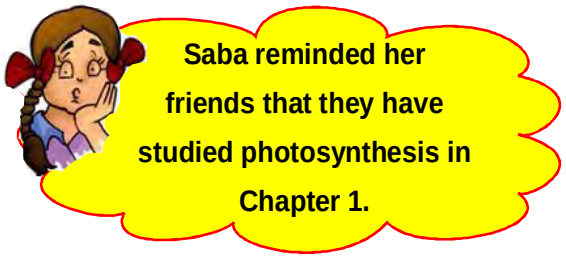
organisms and micro- organisms that live in the soil. Saba wondered what mushroom and other micro-organisms eat. Prof. Ahmad replied that they feed upon the dead plants and animal tissues and convert them into a dark coloured substance called **humus.**

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

The micro- organisms which convert the dead plants and animals into humus are known as **decomposers.** These micro-organism play an important role in the forest. Soon, Saba removed some dead leaves and discovered under them a layer of humus on forest floor. The presence of humus ensures that the nutrients of the dead plant and animals are released into the soil. From soil these nutrients are again absorbed by the roots of the living plants. “What happens if an animal dies in the forest?" Sheila asked. Ayman replied that the dead animals become food for vultures, crows, jackals and insects. In this way, the nutrients are cycled. So, nothing goes waste in a forest **(Fig. 17.9).**

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

green lungs. Prof Ahmad explained that plants release oxygen through the process of photosynthesis. The plants help to provide oxygen for animal respiration. They also maintain the balance of oxygen and carbon dioxide in the atmosphere **(Fig 17.10).** That is why forests are called lungs.



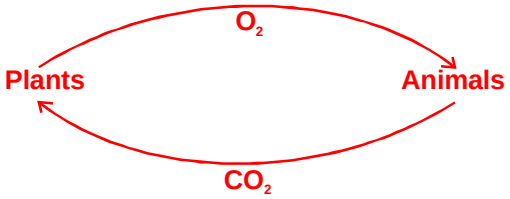


Fig.17.10 : Balance of oxygen and carbon dioxide

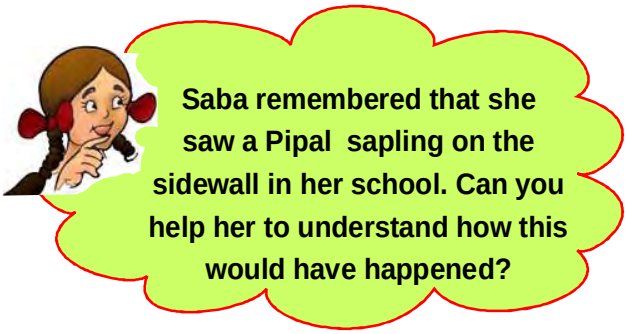
The children saw clouds forming in the sky. Yasir recalled what he had learnt about the water cycle in class VI. Trees take in water from their roots and release water vapour into the air through evaporation.

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

Ayman told them that the forest is not just home to plants and animals. Many people also live in the forest. Some of them may belong to different tribes. Ayman explained that these people depend mostly on the forests. The forest provides them with food, shelter, water and medicines. They have traditional knowledge about many medicinal plants in the forest.

While Yasir was drinking water from a small stream, he saw some deer crossing the stream **(Fig. 17.11).** They disappeared into the bushes. The dense bushes and the tall grasses provide animals with the food and shelter. They also protect them from carnivores that live in the forest.

Fig.17.11: Deer in a forest



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

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

Fig.17.12 : A sapling on a wall

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

It was about afternoon and the children wanted to go back. Ayman suggested another route for going back . While they were going back, it started raining. However, surprisingly, they saw that the raindrops were not hitting the forest floor directly . The uppermost layer of the forest canopy intercepted the flow of raindrops, and most of the water was coming down through the branches and the stems of the trees. From the leaves it was dripping slowly over branches of the shrubs and herbs **(Fig.17.13).** They found that the ground was still dry. After about half an hour, the rain stopped. They noticed that the layer of dead leaves over the forest floor appeared wet now. But water did not stagnate in the forest.

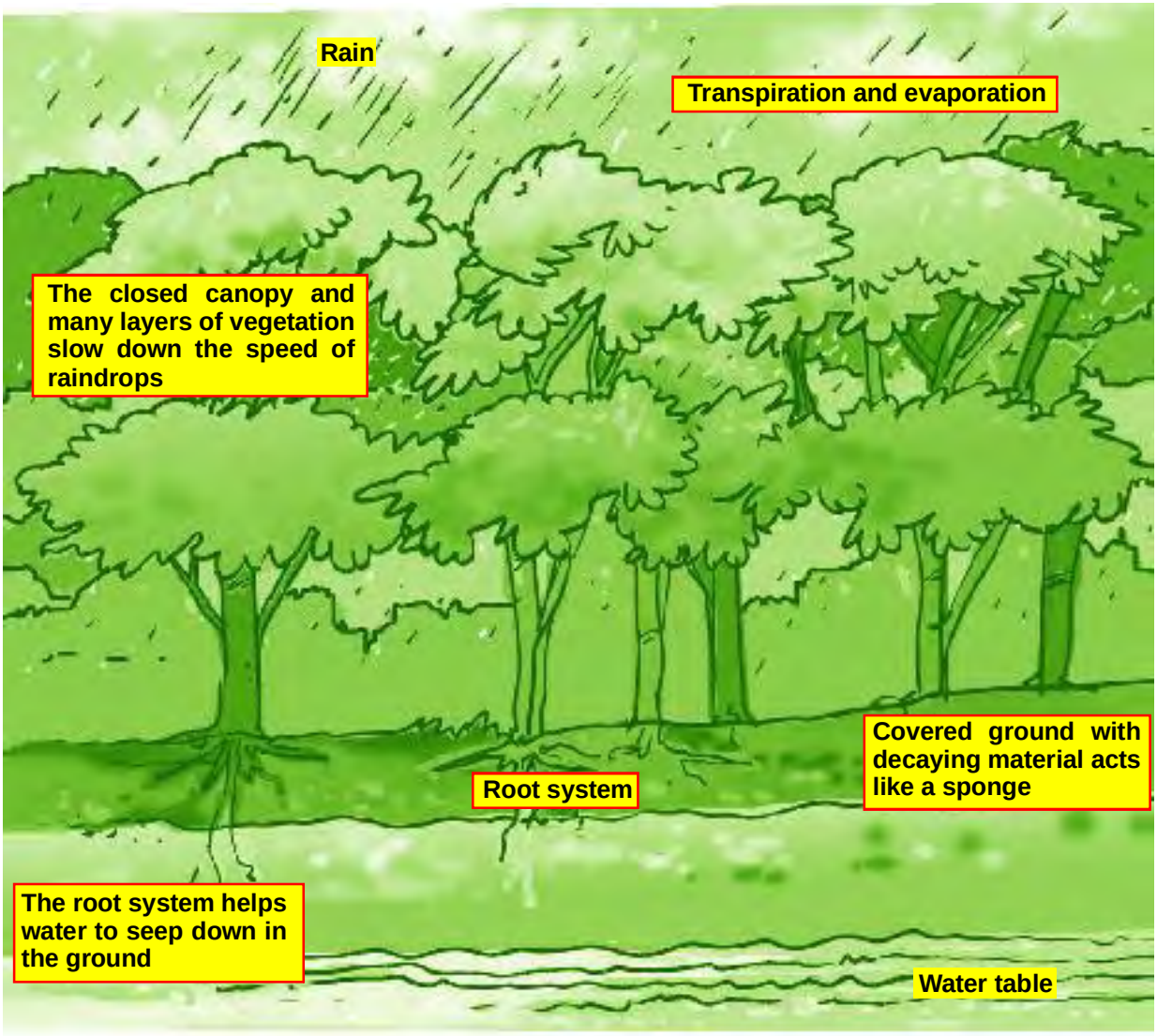


Fig.17.13 : Rainwater drips from the trees and seeps into the ground

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

What would happen if it rains heavily in your town?

Prof. Ahmad told them that the forest also acts as a natural absorber of rainwater and allows it to seep. It helps to maintain the water table throughout the year. Forests not only help in controlling floods but also help to maintain the flow of water in the streams so that we get a steady supply of water. On the other hand, if trees are not present, rain hits the ground directly and may flood the area around it. Heavy rain may also damage the soil. Roots of trees normally bind the

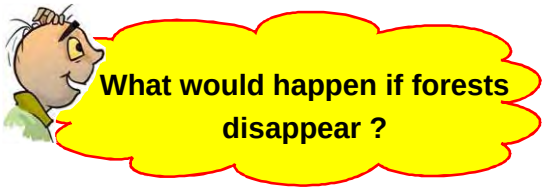
soil together, but in their absence the soil is washed away or eroded.

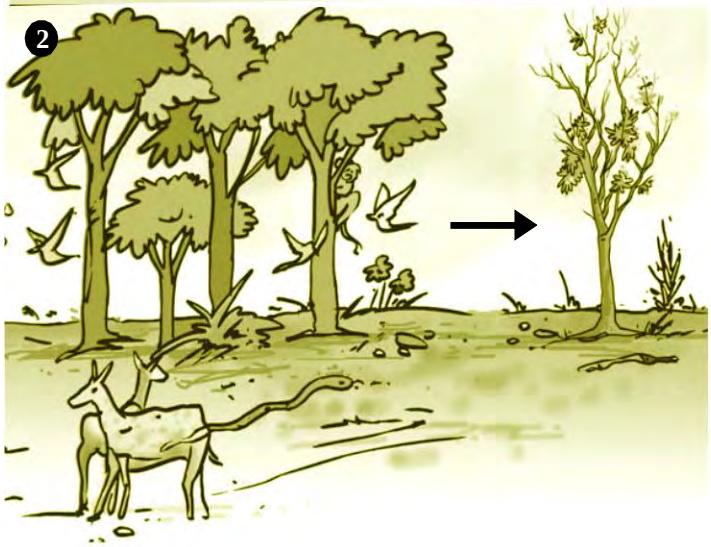
The children spent an hour at Ayman's village on their way back. The weather of the village was quite pleasant. Villagers told them that due to the surrounding forest, they receive good rainfall. The air also remained cool. Noise pollution, too is less because the forest absorbs the noise of the nearby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

The children learnt about the history of the village. It surprised them that the villages and the agricultural fields of that area were created after clearing the forest about sixty years ago. Ayman's grandfather told them that when he was young, the village was not as large as it was now. It was also surrounded by forests. Construction of roads, building, industrial development and increasing demand of wood created pressure on the forest and it started vanishing. He was not happy that the forest adjoining their village is not regenerating and is on the verge of disappearing due to overgrazing of animals and indiscriminate felling of trees. Prof. Ahmad said that if we did things wisely we could preserve forest and environment as well as have development.

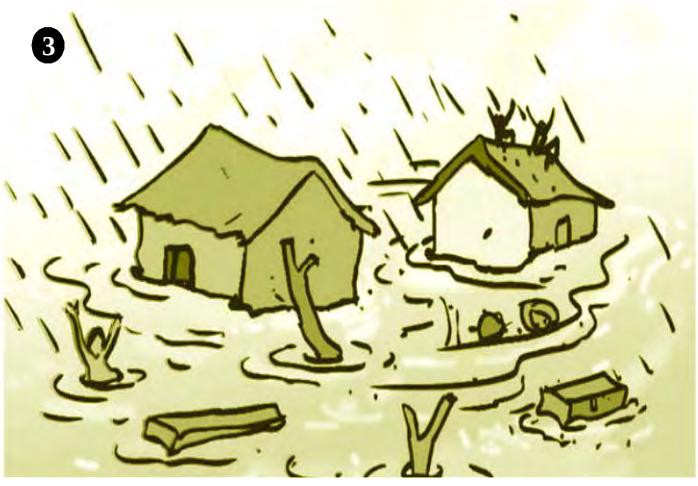
Children prepared a few pictures to show the consequences of such an event.

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





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



KEYWORDS

Canopy	Deforestation	Seed dispersal
Crown	Humus	Soil erosion
Decomposers	Regeneration	Understorey

What you have learnt

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

EXERCISES

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

7. Fill in the blanks:

(a) The insects, butterflies, honeybees and birds help flowering plants in_____.

(b) A forest is a purifier of _____ and _____.

(c) Herbs form the_____ layer in the forest.

(d) The decaying leaves and animal droppings in a forest enrich the_____.

8. Why should we worry about the conditions and issues related to forests far from us?

9. Explain why there is a need for variety of animals and plants in a forest.

10. In **Fig 17.15**, the artist has forgotten to put the labels and directions on the arrows. Mark the directions on the arrows and label the diagram using the following labels:

clouds, rain, atmosphere, carbon dioxide, oxygen, plants, animals, soil, roots, water table.

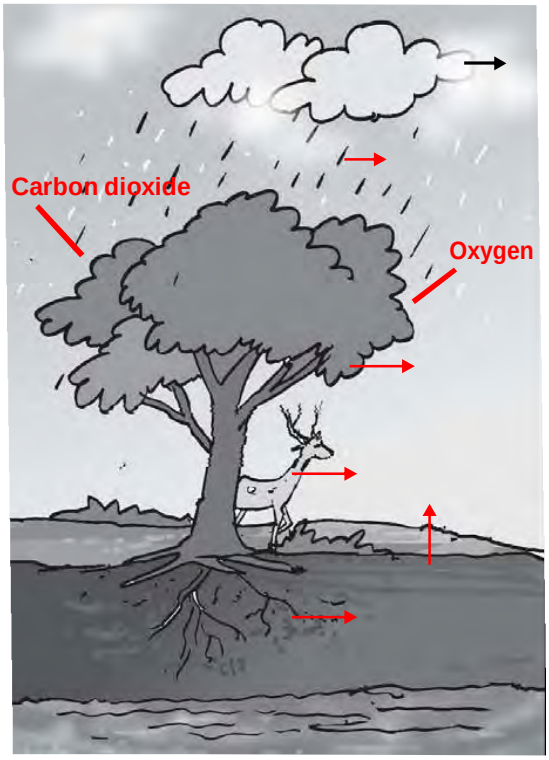


Fig. 17.15

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

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

12. Which of the following statements is not correct?

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

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

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

14. Tick mark (✓) the correct choice

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

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

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

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

(3) Deforestation results in

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

(4) A food chain includes :

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

Extended Learning - Activities and Projects

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

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

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

DO YOU KNOW?

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

18 WASTEWATER STORY

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

Dirty! Are you surprised?

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

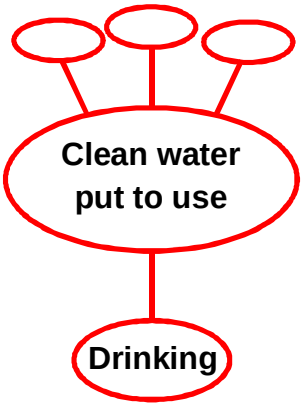
18.1 WATER OUR LIFELINE

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

Activity 18.1

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

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



WATER FOR LIFE 2005-2015

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

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

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

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

18.2 WHAT IS SEWAGE?

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

Activity 18.2

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

Record colour, odour and any other observation. Discuss with your friends and your teacher and fill up the following **Table 18.1.**

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

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

Inorganic impurities - Nitrates, Phosphates, metals.

Nutrients - Phosphorous and Nitrogen.

Bacteria - Such as which cause cholera

Table 18.1: Contaminant survey

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

and typhoid.

Other microbes - Such as which cause dysentery.

18.3 Water Freshens Up - An Eventful Journey

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

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

Activity 18.3

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

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

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

18.4 TREATMENT OF POLLUTED WATER

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

Activity 18.4

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

- Fill a large glass jar ¾ full of water. Add some dirty organic matter such as grass pieces or orange peels, a small amount of detergent, and a few drops of an ink or any color.
- Cap the jar, shake it well and let the mixture stand in the sun for two days.
- After two days, shake the mixture and pour a small sample into the test tube. Label this test tube

"Before treatment; Sample 1". How does it smell?

- ★ Use an aerator from an aquarium to bubble air through the sample in the glass jar. Allow several hours for aeration; leave the aerator attached overnight. If you do not have an aerator, use a mechanical stirrer or a mixer. You may have to stir it several times.
- ★ The next day when aeration is complete, pour another sample into a second test tube. Label it as **"After aeration; Sample 2"**
- ★ Fold a piece of filter paper to from a cone. Wet the paper with tap water and then insert the cone in a funnel. Mount the funnel on a support.
- ★ Place layers of sand, fine gravel and finally medium gravel in the funnel **(Fig.18.2).** (An actual filtration plant does not use filter paper, but the sand filter is several metres deep).
- ★ Pour the remaining aerated liquid through the filter into the beakers. Do not allow the liquid to spill over the filter. If the filtered liquid is not clear, filter it a few times till you get clear water**.**
- ★ Pour a sample of the filtered water into a third test tube labelled **"Filtered; Sample 3".**
- ★ Pour another sample of the filtered water into a fourth test tube. Add a small piece of a chlorine tablet. Mix well until the water is clear. Label the test tube **"Chlorinated; Sample 4".**
- ★ Observe carefully the samples in all the test tubes. **Do not taste!** Just smell them!

Fig.18.2 : Filtration process

Now answer the following questions:

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

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

18.5 WASTEWATER TREATMENT PLANT (WWTP)

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

1. Wastewater is passed through bar screens. Large objects like rags, sticks, cans, plastic packets, napkins are removed **(Fig. 18.3)**

Fig.18.3 : Bar screen

2. Water then goes to a grit and sand removal tank. The speed of the incoming wastewater is decreased to allow sand, grit and pebbles to settle down **(Fig 18.4).**

Fig.18.4 Grit and sand removal tank

3. The water is then allowed to settle in a large tank which is sloped towards the middle. Solids like faeces settle at the bottom and are removed with a scraper. This is the **sludge.** A skimmer removes the floatable solids like oil and grease. Water so cleared is called clarified water **(Fig. 18.5).**

Fig.18.5 : Water clarifier

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

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

4. Air is pumped into the clarified water to help aerobic bacteria to grow. Bacteria consume human waste, food waste, soaps and other unwanted matter still remaining in clarified water (**FIg. 18.6)**

Fig.18.6 : Aerator

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

The activated sludge is about 97% water. The water is removed by sand drying beds or machines. Dried sludge is used as manure, returning organic matter and nutrients to the soil.

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

Become an active citizen

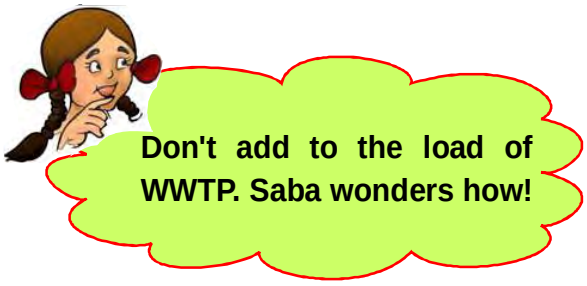
Waste generation is a natural part of human activity. But we can limit the type of waste and quantity of waste produced. Often we have been repelled by offensive smell. The sight of open drains is disgusting. The situation worsens in the rainy season when drains start overflowing. We have to wade through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

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

DO YOU KNOW?

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

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



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

(i) The flow of sewage

(ii) Siltation

(iii) Large scale illegal encroachment

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

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

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

18.6 BETTER HOUSE KEEPING PRACTICES

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

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

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

- ✓ Chemicals like paints, solvents, insecticides, motor oil, medicines may kill microbes that help purify water. So do not throw them down the drain.
- ✓ Used tea leaves, solid food remains, soft toys, cotton, sanitary towels, etc. should also be thrown in the dustbin **(Fig. 18.7)**.

Fig.18.7 : Do not throw everything in the sink

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

18.7 SANITATION AND DISEASE

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

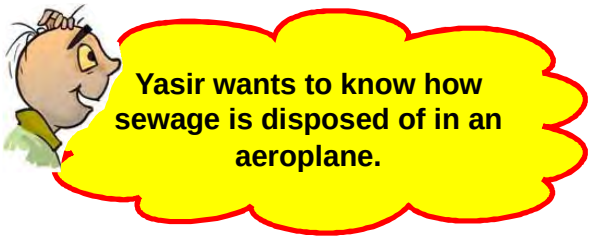
Let us look at our own country. A vast number of our people are still without sewerage facilities. Where do they relieve themselves?

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

18.8 ALTERNATIVE ARRANGEMENT FOR SEWAGE DISPOSAL

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

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



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

18.9 SANITATION AT PUBLIC PLACES

In our country fairs are organized periodically. A large number of people participate in them. In the same way railway stations, bus depots, airports, hospitals are very busy places. Thousands of people visit them daily. Large amount of waste is generated here. It must be disposed off properly otherwise epidemics could break out.

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

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

Conclusion

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

KEYWORDS

Aeration	Contaminant	Sewerage
Aerobic bacteria	Sanitation	Sludge
Anaerobic bacteria	Sewage	Wastewater
Biogas	Sewer	

What you have learnt

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

EXERCISES

1. Fill in the blanks:

(a) Cleaning of water is a process of removing _____ .

(b) Wastewater released by houses is called _____ .

(c) Dried _____ is used as manure.

(d) Drains get blocked by _____ and _____ .

2. Water is sewage? Explain why it is harmful to discharge untreated sewage into rivers or seas.

3. Why should oils and fats not be released in the drains? Explain.

4. Describe the steps involved in getting clarified water from waste water.

5. What is sludge? Explain how it is treated.

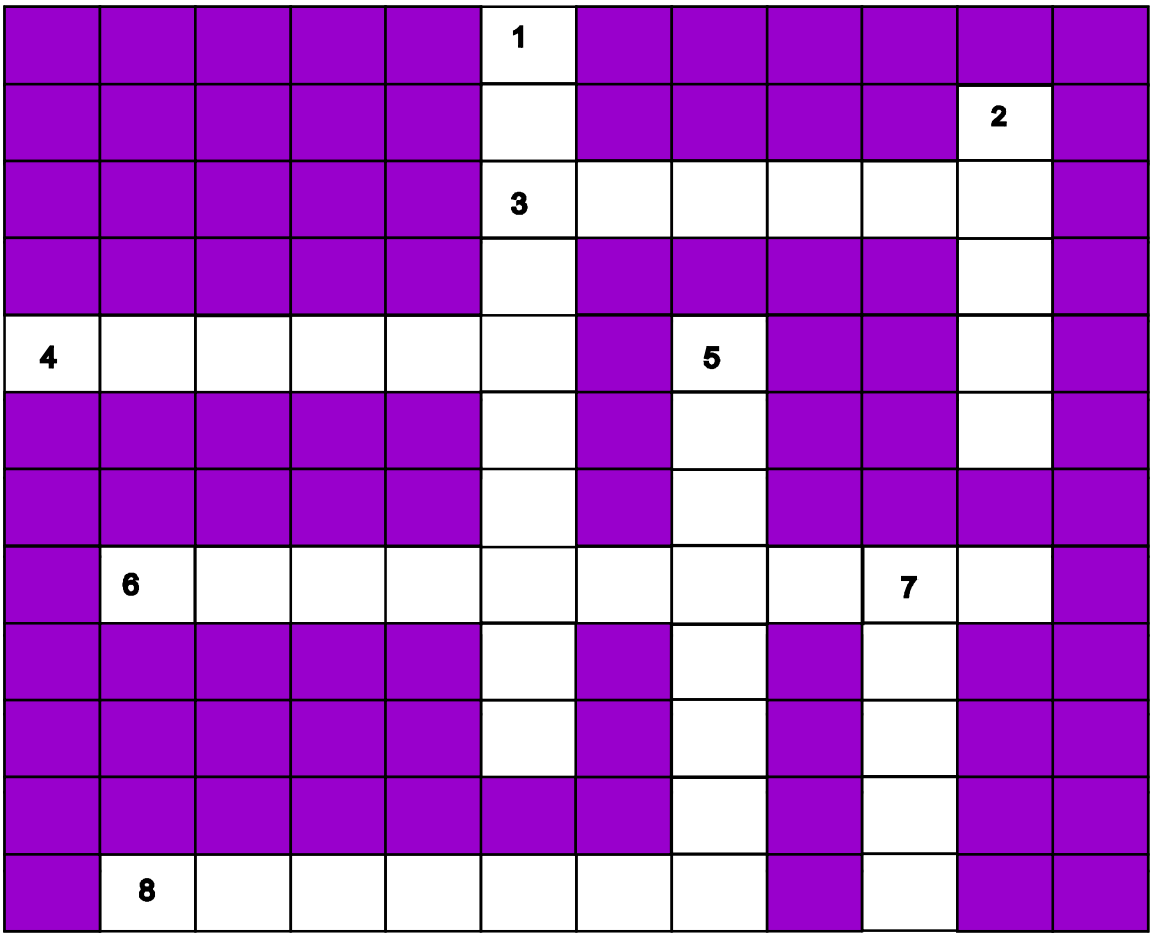
6. Untreated human excreta is a health hazard. Explain.

7. Name two chemicals used to disinfect water.

8. Explain the function of bar screens in a wastewater treatment plant.

9. Explain the relationship between sanitation and disease.

10. Outline your role as an active citizen in relation to sanitation.



11. Here is a crossword puzzle: Good Luck!

Across

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

Down

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

12. Study the following statements about ozone.

(a) It is essential for breathing of living organisms.

(b) It is used to disinfect water.

(c) It absorbs ultraviolet rays.

(d) Its proportion in air is about 3%.

Which of these statements are correct?

(i) (a), (b) and (c)

(ii) (b) and (c)

(iii) (a) and (d)

(iv) All four

13. Tick mark (✓) the correct answers.

1. The disease caused by polluted water

(a) Jaundice (b) Dysentery

(c) Cholera (d) All of these

2. Malaria can be triggered by

(a) Open drains (b) Closed drains

(c) Taps (d) Pipe lines

3. Waste that can be broken down by bacteria

(a) Biological (b) Biochemical

(c) Biodegradable (d) Chemical

4. Stage of wastewater treatment for removing large particles

(a) Disinfection (b) Secondary

(c) Primary (d) Chlorination

Extending Learning - Activities and Projects

1. Construct a crossword puzzle of your own using the keywords.
2. Then and now: Talk to your grandparents and other elderly people in the neighbourhood. Find out the sewage disposal systems available to them. You can also write letters to people living in far off places to get more information. Prepare a brief report on the information you collect.
3. Visit a sewage treatment plant.

   It could be as exciting and enriching as a visit to a zoo, a museum, or a park. To guide your observation here are a few suggestions.

   Record in your notepad.

   Place _____ Date _____ Time _____

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

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

For more information, consult:

Millennium Development Goals:
http" // www.un.org/millenniumgoals/
"water for life" International Decade for Action:
http"// www.un.org/waterforlifedecade/:
World Water Day Themes and Importance.
http// www.worldwaterday.org/
Through the ages Development of Sanitation:
http" // www.cep.unep.org/pubs/techreports/tr43en/Household%20Systems. htm.

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

An early engineering feat: Indus valley civilization

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