

SCIENCE

TEXTBOOK FOR CLASS-VII

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FOREWORD

The Jammu and Kashmir Board of School Education (JKBOSE) is committed to initiate the process of review and revision of school curriculum. The National Curriculum Framework recommends that a child's life at school must be linked to its life outside the school so that knowledge of latest innovations and developments in Science and Technology can affect the human life qualitatively. The syllabi and the textbooks developed on the basis of NCF signify an attempt to implement this basic idea of experiential learning and negating rote learning. The Science curriculum is the tool which helps the students to arrive at the desired truth. A strong foundation in science is a must to develop scientific culture which is the need of the hour.

This textbook of Science for class VII attempts to enhance this endeavour by giving higher priority and space to opportunities for contemplation and wondering, discussion in small groups and activities requiring hands-on-experience. It would facilitate and encourage innovativeness and creativity in students thereby enabling them to take decisions and solve the problems in day to day life.

As per the guidelines of NEP, contextualization has been done with special reference to local specific contents in the textbooks.

The JKBOSE has also introduced a special feature of having QR codes energizing the textbooks, which connects the students as well as teachers to a chapter specific QR code, thereby getting access to online and offline content.

The JKBOSE gratefully acknowledges the use of content material from Science textbook of Class VII published by National Council of Educational Research and Training (NCERT), New Delhi in preparing the textbook. The JKBOSE appreciates the sincere efforts and hard work of

Ms. Manisha Sarin (KAS), Secretary JKBOSE and Dr. Sudhir Singh, Director Academics, JKBOSE and all the experts who contributed to the review and revision of the textbook. The process of systemic reforms and continuous improvement in the quality of textbooks is our top most priority. JKBOSE always welcomes comments and suggestions which will enable us to undertake revisions and refinement in future endeavours.

Prof. (Dr.) Parikshat Singh Manhas
Chairman, JKBOSE



ACKNOWLEDGEMENT

This textbook of Science for class VII, 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 contents have been developed in a lucid and exhibitve manner to enable the students to comprehend all the topics with clarity. The JKBOSE is grateful to all the subject experts for their valuable contribution and efforts in the development of this textbook.

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I would like to place on record my appreciation for the efforts and contribution of the CDR Wings JKBOSE for developing this textbook of Science Class VII.

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

Dr. Sudhir Singh
Director Academics, JKBOSE



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NOTES

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.



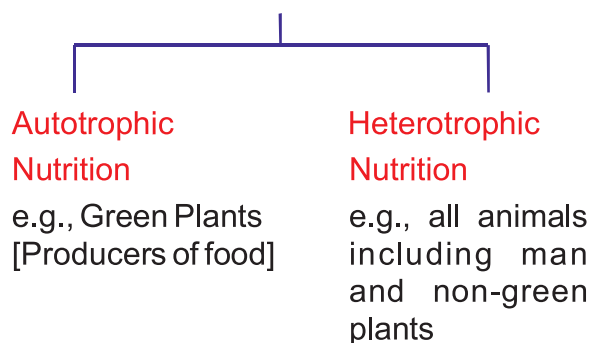
Yasir wants to know how plants prepare their own food.

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



Saba wants to know why our body cannot make food from carbon dioxide, water and minerals like plants do

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)].



Yasir wants to know how water and minerals absorbed by roots reach the leaves.

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.



Saba wants to know what is so special about the leaves that they can synthesise food but other parts of the plant cannot.

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.

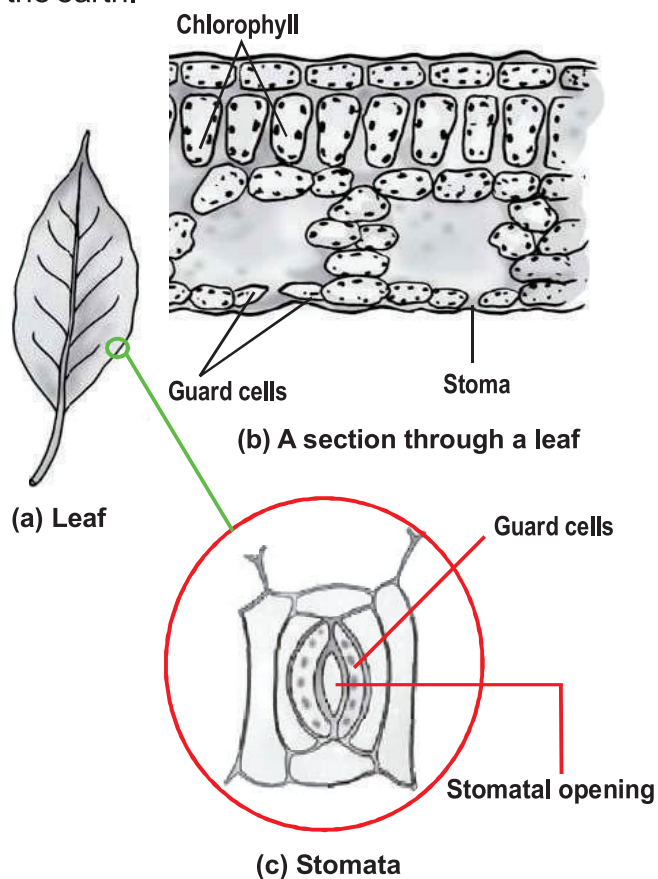


Fig. 1.1

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:

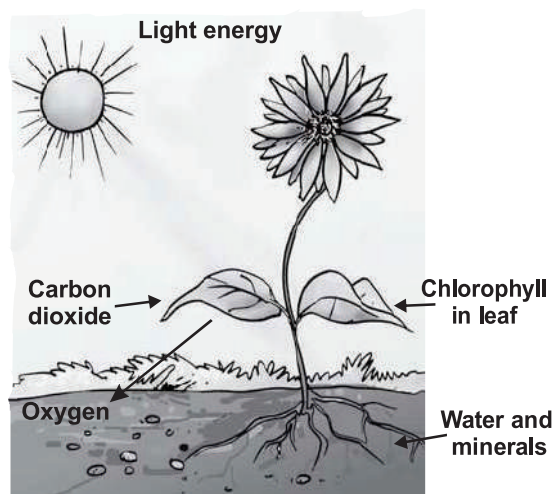


Fig.1.2: Diagram showing photosynthesis



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.

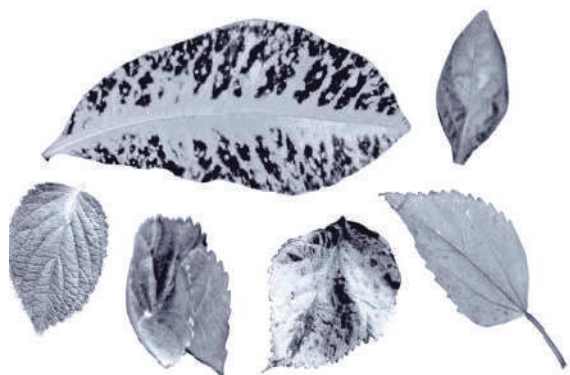


Fig.1.3: Leaves of various colours

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?



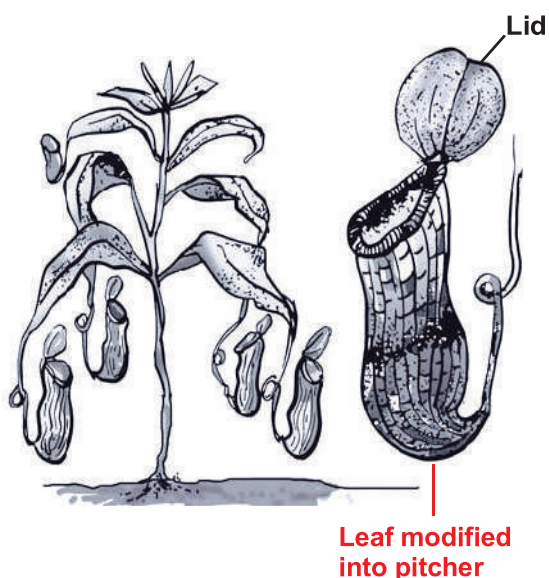


Fig.1.5: Pitcher plant showing lid and pitcher

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.



Saba is keen to know whether her beautiful shoes, which she wore on special occasions, were spoiled by fungi during the rainy season. She wants to know how fungi appear suddenly during the rainy season.



Yasir says once his grandfather told him that his wheat fields were spoiled by a fungus. He wants to know if fungi cause diseases also.



Saba told him that many fungi like yeast and mushrooms are useful, but some fungi cause diseases in plants, animals and humans. Some fungi are also used in medicines.

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 calledsince they synthesise 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 inand 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 occurrence 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](http://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.

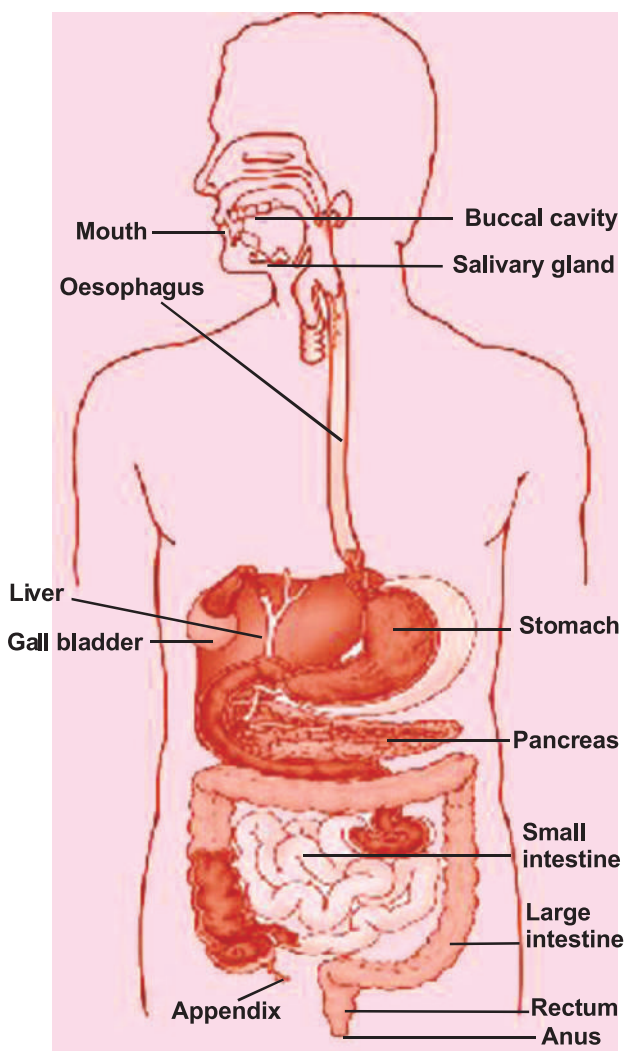


Fig.2.2: Human digestive system

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 know 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**).

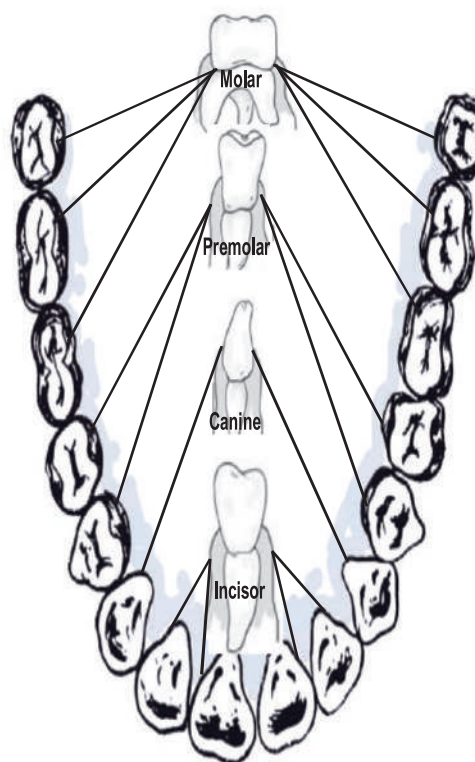


Fig.2.3: Arrangement of teeth and different type of teeth

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**

Table 2.2

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.

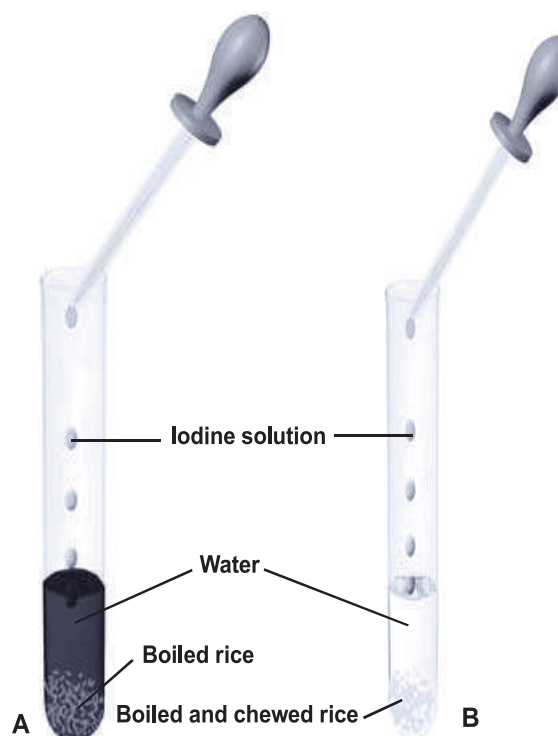


Fig.2.4: Effect of saliva on starch

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 choked, get hiccups or cough.

Activity 2.4

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.

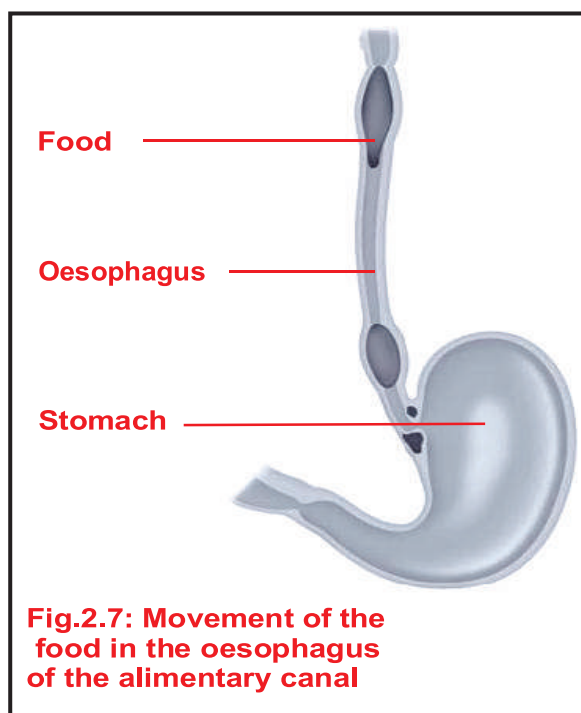
1. Prepare a separate sample each of (i) sugar solution (ii) common salt solution (iii) lemon juice and (iv) juice of crushed neem leaf or bitter gourd.
2. Blindfold one of your classmates and ask her/him to take out the tongue and keep it in straight and flat position.

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.

Saba wants to know how food moves in the opposite direction during vomiting.



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 shotgun. 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.

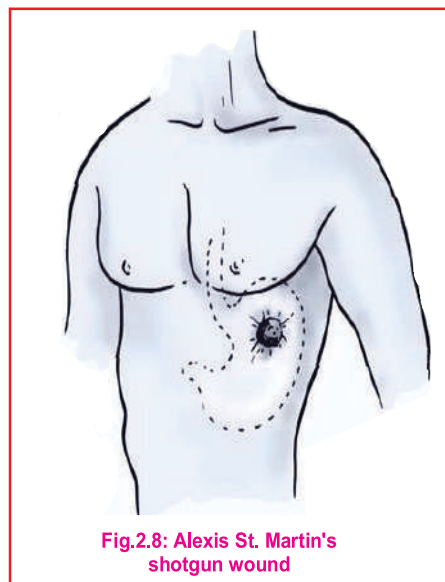


Fig.2.8: Alexis St. Martin's shotgun wound

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)**.

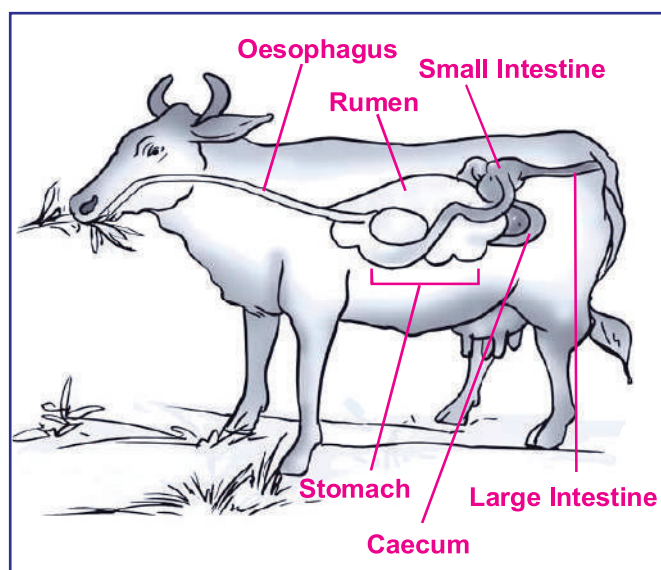
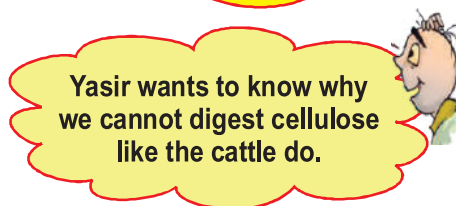
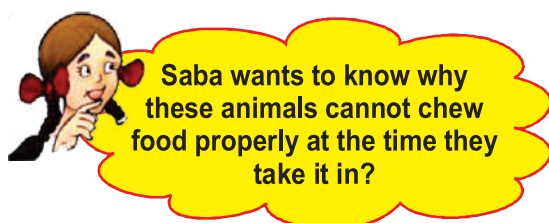


Fig.2.9: Digestive system of ruminant

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.

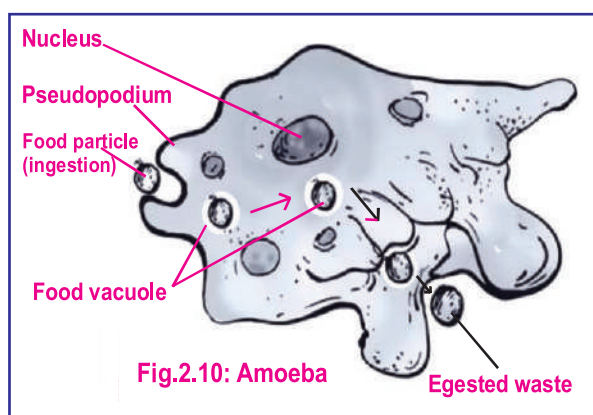
So far you have learnt about animals which possess the digestive system. But there are many small organisms which do not have a mouth and a digestive system. Then, how do they acquire and digest food? In the section below you will learn another interesting way of food intake.

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**).

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

Amino acid

Amoeba

Assimilation

Bile

Buccal Cavity

Canine

Cellulose

Digestion

Egestion

Fatty acid

Food vacuole

Gall bladder

Glycerol

Incisor

Ingestion

Liver

Milk teeth

Molar

Permanent teeth

Oesophagus

Pancreas

Premolar

Pseudopodia

Rumen

Ruminant

Rumination

Salivary glands

Villi

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 secretory 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 secrete 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:

- The main steps of nutrition in humans are _____, _____, _____, _____ and _____.
- The largest gland in the human body is _____.
- The stomach releases hydrochloric acid and _____ juice which act on food.
- The inner wall of the small intestine has many finger-like outgrowths called _____.
- Amoeba digests its food in the _____.

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

- Digestion of starch starts in the stomach. (T/F)
- The tongue helps in mixing food with saliva. (T/F)
- 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
<u>Food Components</u>	<u>Product(s) of digestion</u>
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.**

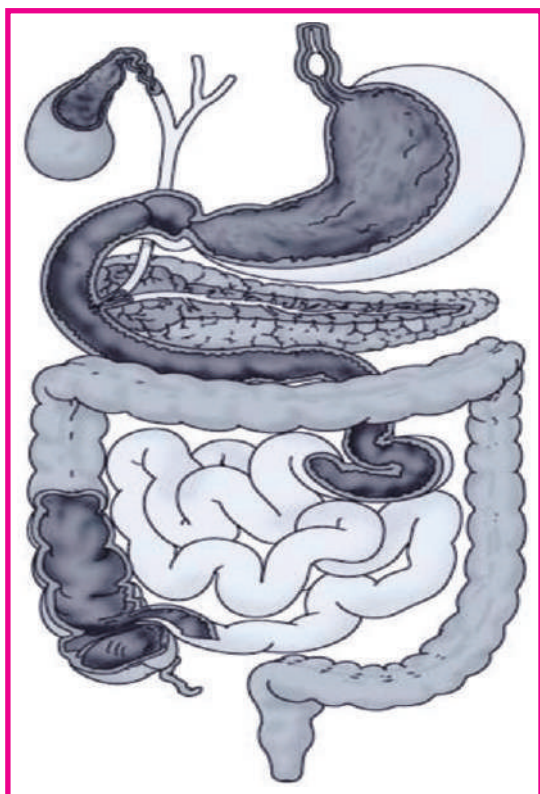


Fig.2.11: A part of human digestive system

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

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.

3.1 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 3.1**. Mark these objects as hot or cold.

Table 3.1: 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 3.1

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.3.1**).

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

Do both the hands get the same feeling ?

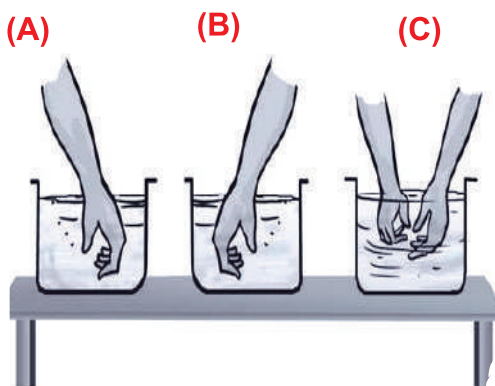
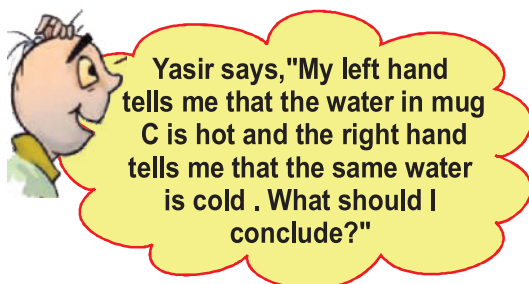


Fig. 3.1: Feeling water in three mugs



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**.

3.2 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 the one shown in

Fig. 3.2

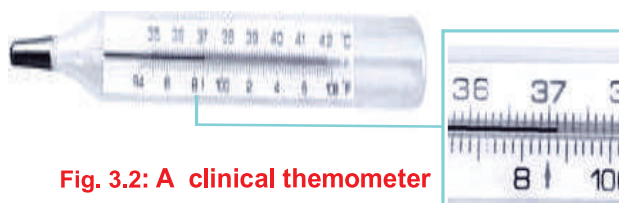
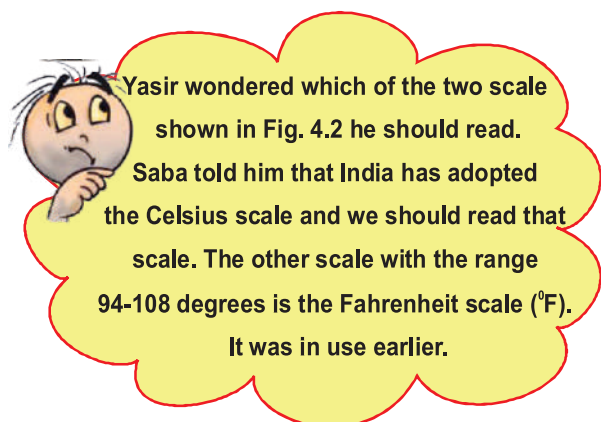


Fig. 3.2: A clinical thermometer

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 $^{\circ}\text{C}$.



A clinical thermometer reads temperature from 35°C to 42°C .

Activity 3.2

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 $\frac{1}{5} = 0.2^{\circ}\text{C}$.

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 $^{\circ}\text{C}$.

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.3.3: Correct method of reading a clinical thermometer

Saba measured her body temperature. She got worried as it was not exactly 37°C .



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 3.3

Measure the body temperature of some of your friends (at least 10) with a clinical thermometer. Record your observations as in **Table 3.2**.

Table 3.2: Body temperature of some persons

Name	Temperature ($^{\circ}\text{C}$)

Is the body temperature of every person 37°C .

The temperature of every person may not be 37°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°C or above 42°C . This is the reason that this thermometer has the range 35°C to 42°C



Yasir got a naughty idea. He wanted to measure the temperature of hot milk using a clinical thermometer. Saba stopped him from doing so.

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.

3.3 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

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.

lowest temperature it can measure.

The range of a laboratory thermometer is generally from -10°C to 110°C . 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 the 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. 3.5**).
- ◆ 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 3.4

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. 3.4**). Observe the movement of mercury in the thermometer. Wait till the mercury thread becomes steady.



Fig.3.4: 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 3.5

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. 3.5**).

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



Fig. 3.5: 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.



3.4 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 does 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 3.6

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. 3.6**). 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?

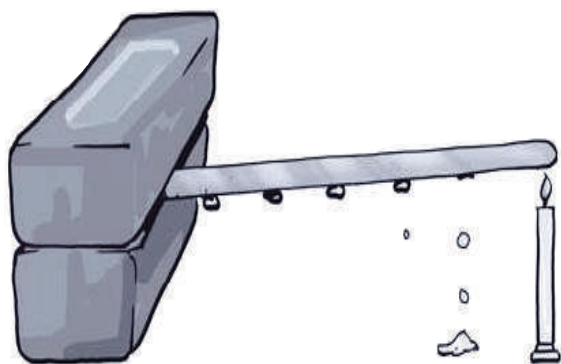


Fig.3.6: Flow of heat through a metal strip

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 3.7

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.3.7**).



Fig.3.7: Conduction of heat by different materials

Wait for a few minutes. Touch the other end. Enter your observation in **Table 3.3**

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

Table: 3.3

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 3.8

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. 3.8**).

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.3.8: 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 3.9

Light a candle. Keep one hand above the flame and one hand on the side of the flame (**Fig. 3.9**). 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.3.9 : 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. 3.10). The water cools down more

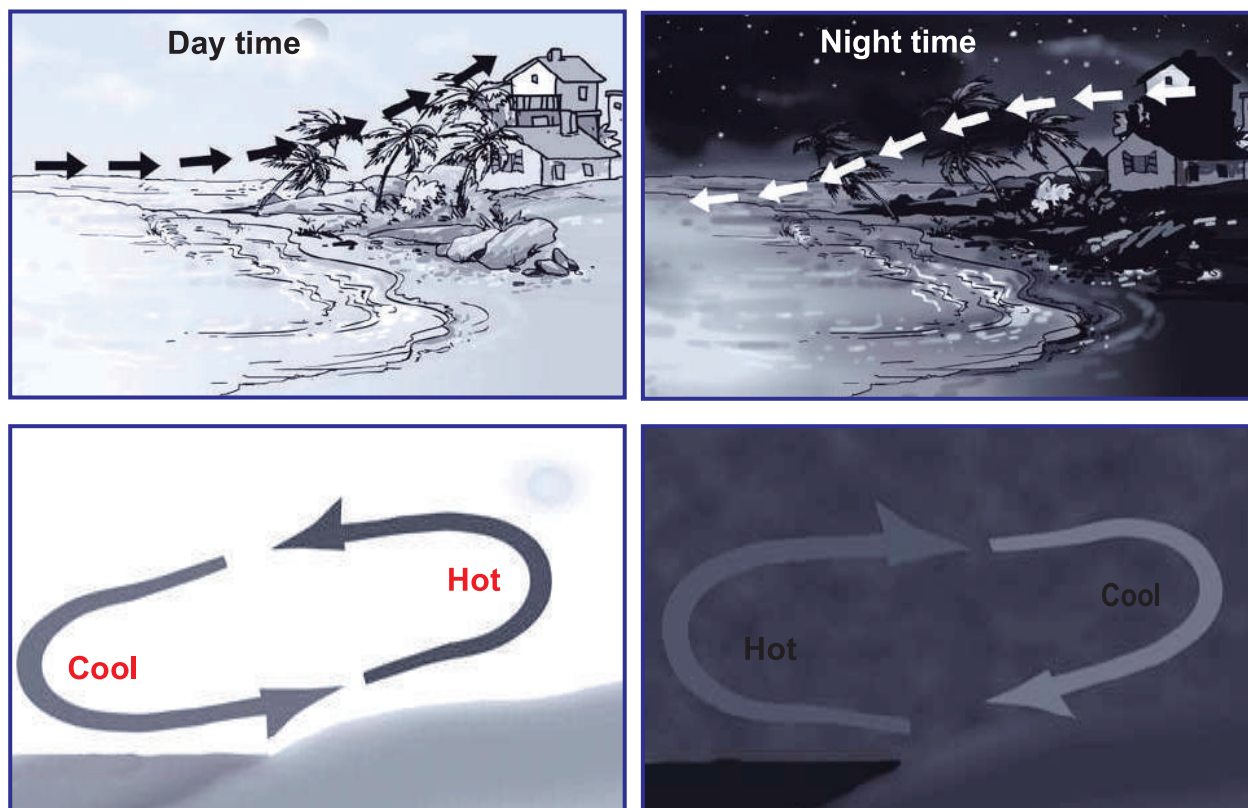


Fig. 3.10

slowly than the land. So, the cool air from the land moves towards the sea. This is called the **land breeze**. **Fig. 3.10** 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?

3.5 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 3.10

Take two identical tin cans. Paint the outer surface of one black and of the other white (**Fig. 3.11**). 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.3.11: Containers with black and white surface

Activity 3.11

Fill the two cans used in Activity 3.10 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 woollen 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
Conduction
Conductor
Convection

Insulator
Land breeze
Radiation

Sea breeze
Temperature
Thermometer

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°C to 42°C . For other purpose, we use the laboratory thermometers. The range of these thermometers is usually from -10°C to 110°C .
- ❖ The normal temperature of the human body is 37°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. 3.13**. Mark where the heat is being transferred by conduction, by convection and by radiation.



Fig. 3.13

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. 3.14**. Cut out the paper along the line. Suspend the paper as shown in **Fig. 3.14** above a lighted



Fig. 3.14

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°C and of freezing water as 100°C . However, this order was reversed very soon.



4

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 4.1

Table 4.1

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

- 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.

- Do not taste all substances above. Some of them can be poisonous. Always ask your elders, teachers, before you taste an unknown substance.

4.1 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 4.2: 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 mineral 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 **fatty acids**.
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 4.3 gives the list of common bases and the substance in which they are found in small amounts.

Table 4.3: 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 ₄ OH	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 4.1

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**.

4.2 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.

4.3 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.4.1(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.4.1(b)] or blue Litmus Paper [Fig.4.1(c)]. These strips are bound in the form of a tiny booklets and supplied to chemical laboratories.



Fig.4.1 (a) : Lichen plant

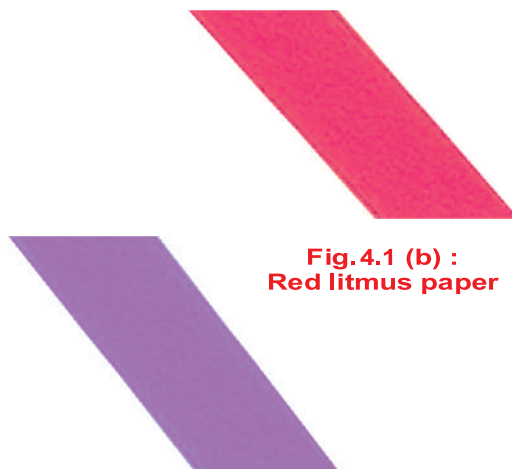


Fig.4.1 (b) :
Red litmus paper

Fig.4.1 (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 4.2

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 4.4: 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 4.3

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 4.2.
- 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 4.4

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 4.2
- 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 rose 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.

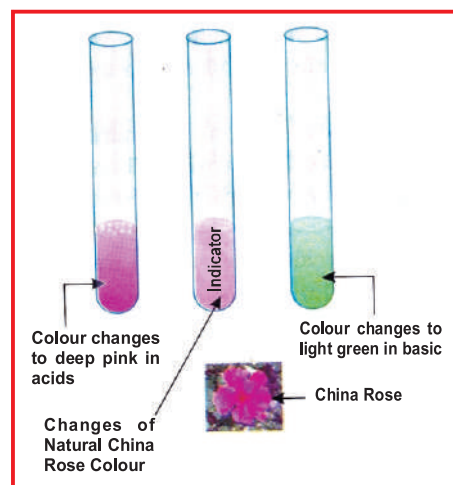


Fig. 4.2 : China rose as an indicator

4.4 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.

4.5 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.

4.6 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 :

4.7 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 4.5

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.

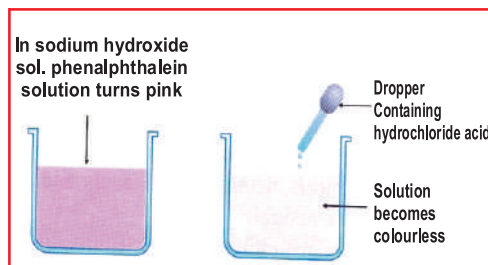


Fig. 4.3 (a)

Fig. 4.3 (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 colourless.

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.



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 form 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.

- Name the acid which is present in the sting of ants
(a) Acetic acid (b) Formic acid (c) Oxalic acid (d) Tartaric acid
- Blue litmus turns red in which solution:
(a) Acidic solution (b) Basic solution (c) Both acidic and basic solutions
(d) Neutral solution
- Which of the following is not a mineral acid ?
(a) Hydrochloric acid (b) Sulphuric acid (c) Citric acid (d) Nitric acid
- 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

- 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.
- 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.
- 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.



5

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.5.1 Paper pieces

5.1 PHYSICAL CHANGES

Activity 5.1

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.5.1).

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

Activity 5.2

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 5.3

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 5.4

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 5.5

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 5.1** and **5.2** above, you saw that paper and a piece of chalk underwent changes in size. In **Activities 5.3** and **5.4**, water changes its state (from solid to liquid or from gas to liquid). In **Activity 5.5**, 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.5.2: Rusting of iron

5.2 CHEMICAL CHANGE

A change with which you are quite 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. 5.2)**. 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 5.6

(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. 5.3). When it is completely burnt it leaves behind a powdery ash.

Does the ash look like the magnesium ribbon?

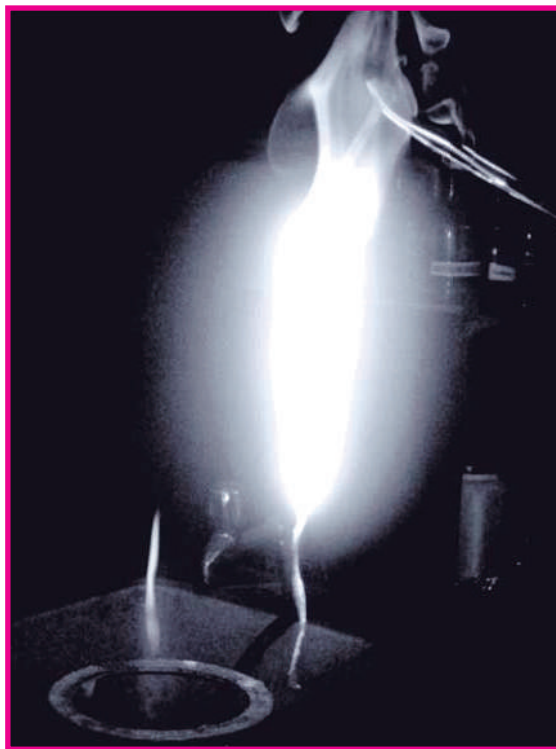
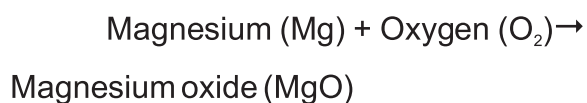


Fig.5.3: Magnesium ribbon burning

The change can be represented by the following equation:



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 form of the following equation:

Magnesium oxide (MgO) + water (H_2O) $\rightarrow$ Magnesium hydroxide [$\text{Mg}(\text{OH})_2$].

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 5.7

(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. 5.4**).

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.5.4: 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
 $\rightarrow$ Iron sulphate solution (green) + copper (brown deposit)

Activity 5.8

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. 5.5**

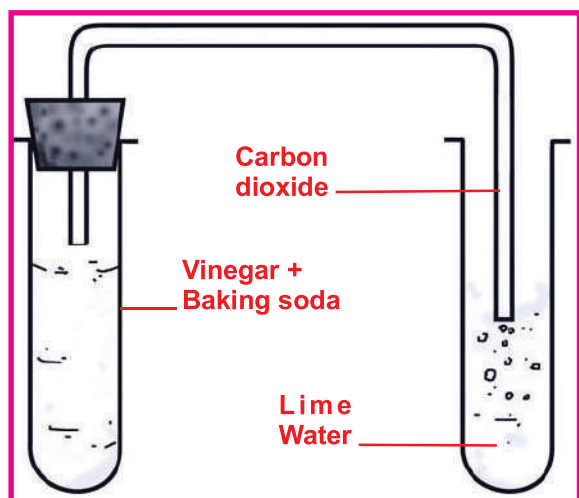


Fig.5.5: Set up to pass gas through lime water

What happens to the lime water?

The change in the test tube is as follows:

Vinegar (Acetic acid)+Baking soda (Sodium hydrogen carbonate) $\rightarrow$ Carbon dioxide + other substances

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

Carbon dioxide (CO_2) + Lime water [$\text{Ca}(\text{OH})_2$] $\rightarrow$ 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 5.6 - 5.8**, you saw that in each change, one or more new substances were formed. In **Activity 5.6**, the ash was the new substance formed when magnesium was burnt. In **Activity 5.7**, 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 5.8**, 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 why 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 4, 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.



5.3 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) $\rightarrow$ 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.



Oh, that is why my friend Sarish is always complaining about iron articles rusting so fast. She lives near the coast.

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.

5.4 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 5.9

(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.

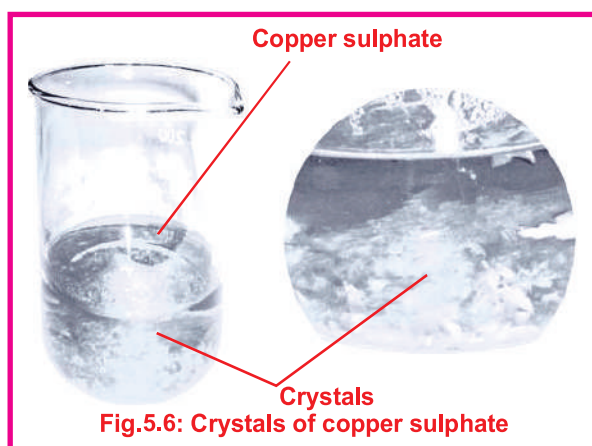


Fig.5.6: Crystals of copper sulphate

KEYWORDS

Chemical change

Chemical reaction

Crystallization

Galvanization

Physical change

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 from 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 full 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.5.7**) 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.5.7 Iron pillar



6

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 stuck 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.

6.1 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.



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.6.1**), 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 $\xrightarrow[\text{(In Muscle)}]{\text{In the absence of oxygen}}$
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.6.1: During exercise, some muscles may respire anaerobically

6.2 BREATHING

Activity 6.1

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. 6.2**)

So, now you know that you cannot survive for long without breathing.

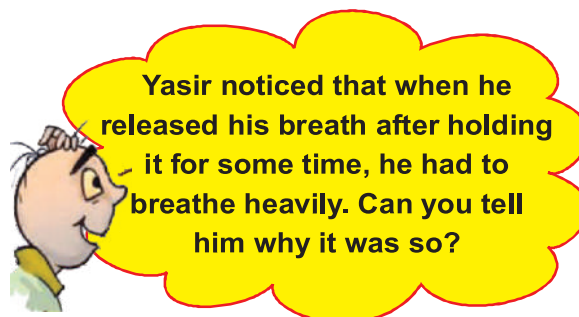
Breathing means taking in air rich in oxygen and giving out air rich in carbon dioxide with the help of respiratory organs. The taking in of air rich in oxygen into the body is called **inhalation** and giving out of air rich in carbon dioxide is known as **exhalation**. It is a continuous process which 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.6.2 : Holding breath



Activity 6.2

Generally we are not aware that we are breathing. However, if you try you can count your rate of breathing. Breathe in

Table 6.1: Changes in breathing rate under different conditions

Name of the classmate	Breathing rate			At rest
	Normal	After a brisk walk for 10 minutes	After running fast for 100 m	
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 6.3

Figure 6.3 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.

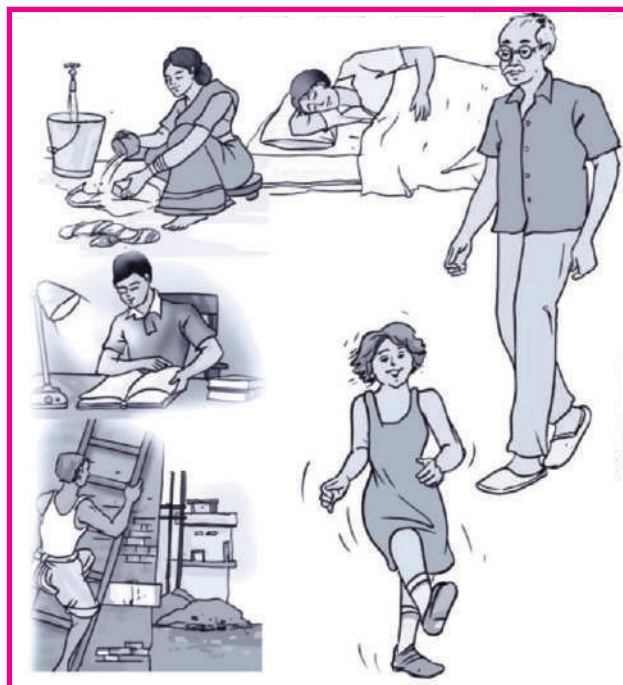
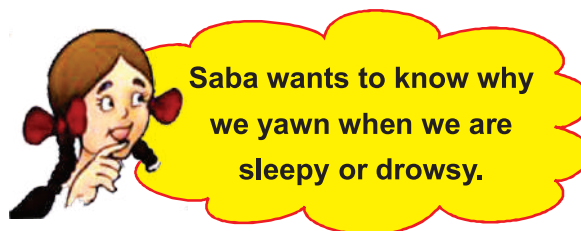


Fig.6.3 : Variation in the breathing during different activities



6.3 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. 6.4**). This cavity is surrounded by ribs on the sides. A large muscular sheet called **diaphragm** forms the floor of the chest cavity (**Fig. 6.4**). 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. 6.4**). These movement in our

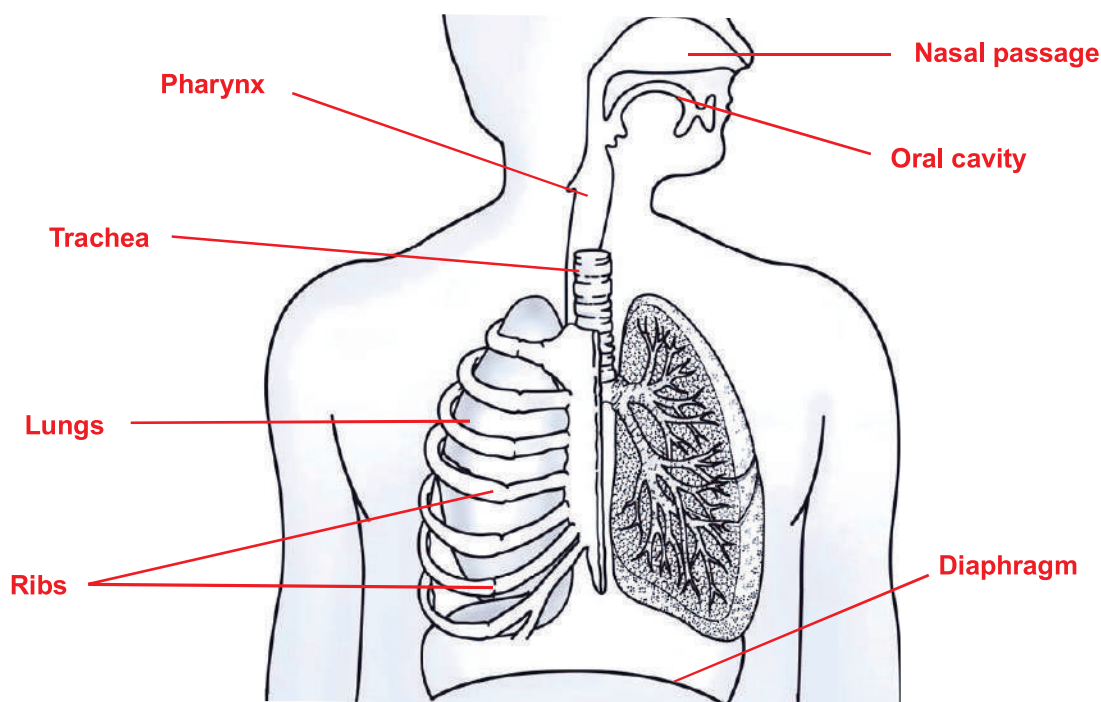


Fig 6.4 : Human respiratory system

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 6.4

Take a deep breath. Measure the size of the chest with a measuring tape (**Fig. 6.4**) and record your observations in **Table 6.2**. 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 6.5

Take a wide plastic bottle. Remove the bottom of the bottle. Get a Y- shaped

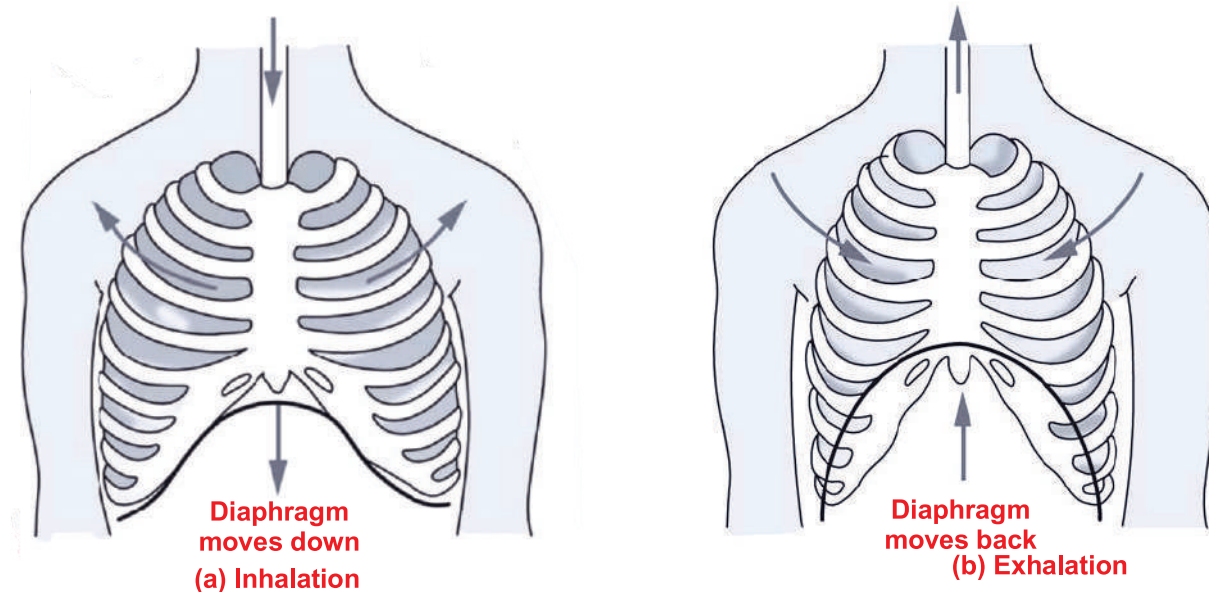


Fig.6.5 : Mechanism of breathing in human beings

Table 6.2 Effect of breathing on the chest size of some classmates

Name of the Classmates	Size of the chest		
	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. 6.7**. 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.6.6 : 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.

6.4 WHAT DO WE BREATHE OUT?

Activity 6.6

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. 6.8**). 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?

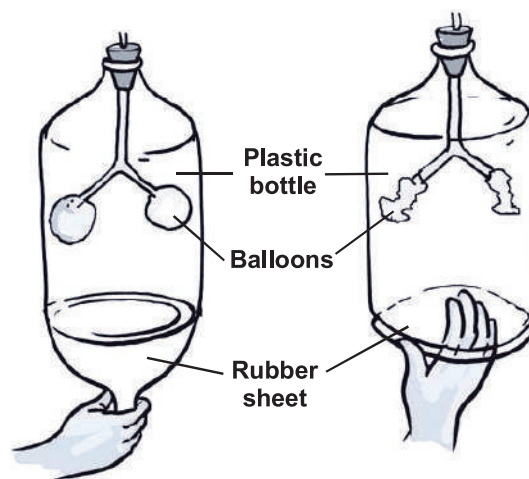


Fig 6.7 : Model to show the mechanism of breathing

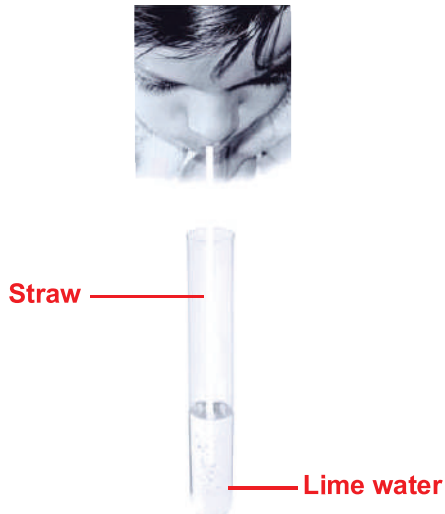
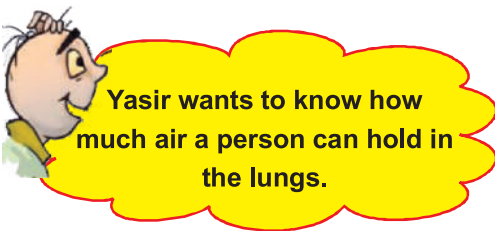
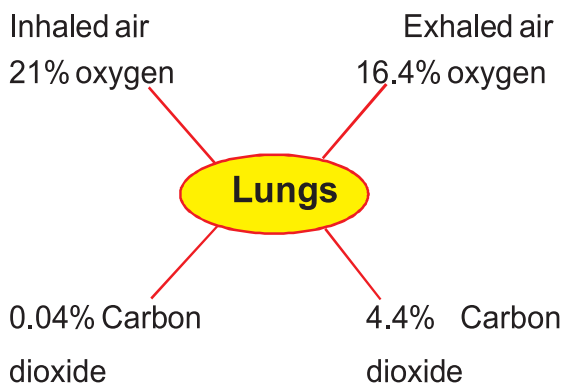


Fig 6.8 : Effect of exhaled air on lime water



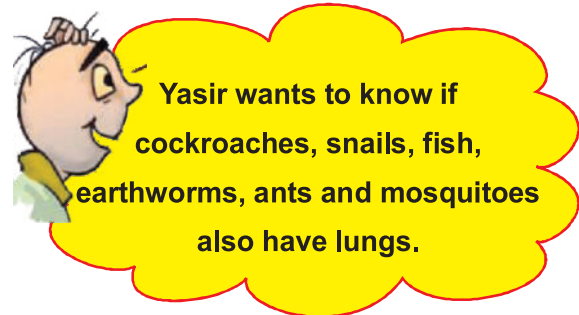
The percentage of oxygen and carbon dioxide in inhaled and exhaled air.



6.5 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.



Cockroach: A cockroach has small openings on the sides of its body. Other insects also have similar openings. These openings are called **spiracles** (Fig. 6.9). 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.

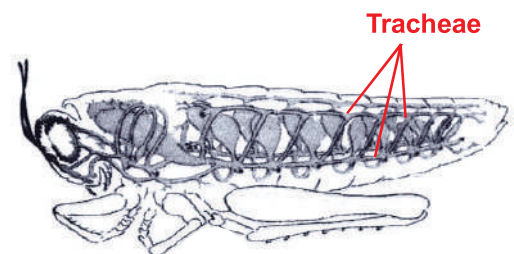
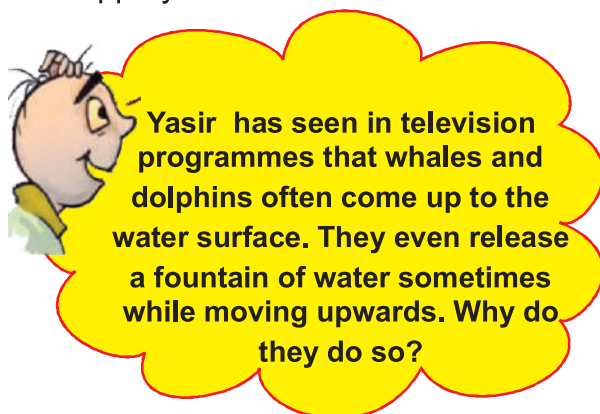


Fig.6.9: Tracheal system



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.



6.6 BREATHING UNDER WATER

Can we breathe and survive in water? There are many organisms which live in water. How do they breathe under water?

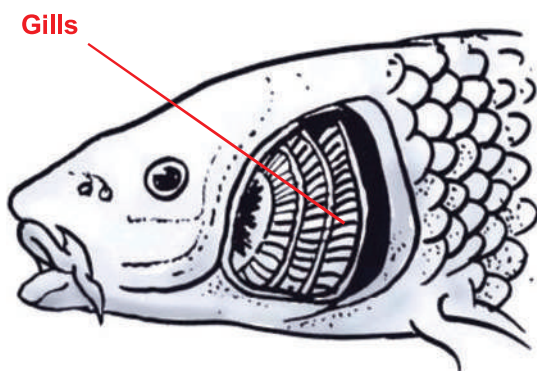
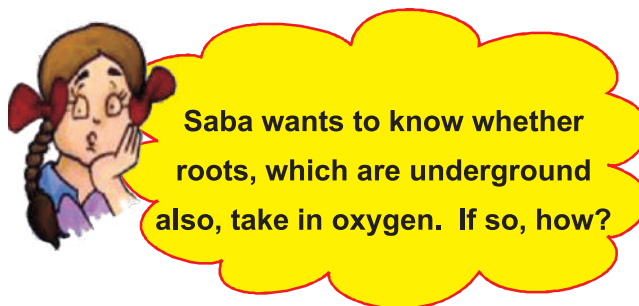


Fig. 6.10: Breathing organs in fish

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. 6.10**) for exchange of gases.

6.7 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. 6.11)

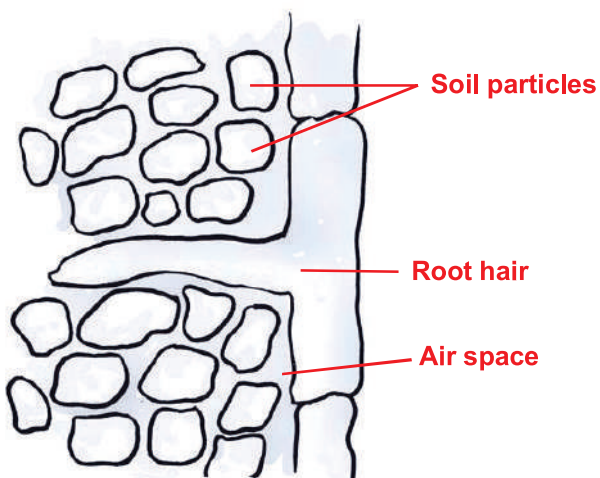


Fig.6.11 : Roots absorb air from the soil

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

Anaerobic respiration

Breathing rate

Cellular respiration

Diaphragm

Exhalation

Gills

Lungs

Inhalation

Spiracles

Tracheae

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 $\frac{3}{4}$ th 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.



7

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**.

7.1 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.

7.2 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 multicellular 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.

7.3 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. 7.1**).

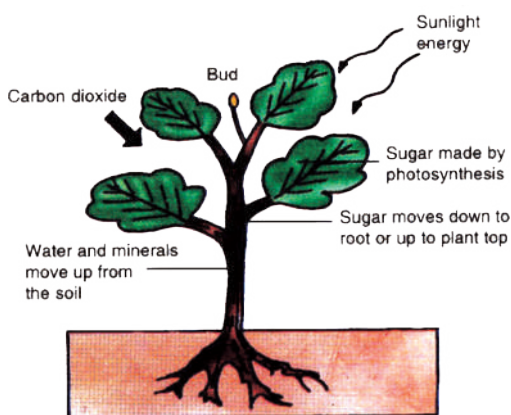


Fig 7.1 : Transport system in plants

(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.7.2**).

Transport of food

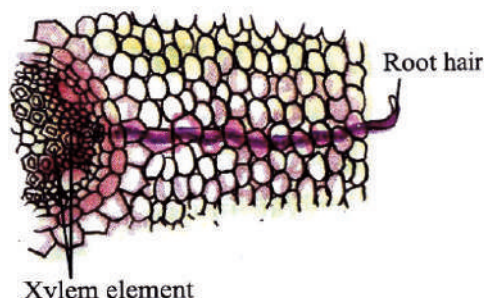


Fig. 7.2 : Root with root hair

The prepared food material is carried in a soluble form 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 7.1** and

7.2 to learn about the transport of materials in plants.

7.4 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 7.1

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 safranin) in a flask as shown in Fig. 7.3. 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 whether 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. 7.4 A, B).

Which are these parts?

The red coloured area of the stem represents the vascular tissue (xylem) in the stem.

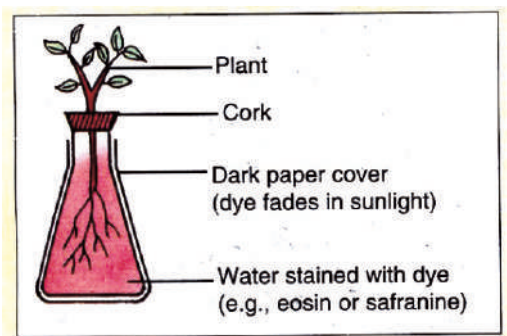


Fig. : 7.3

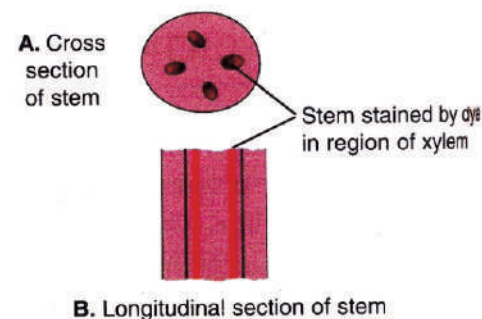


Fig. : 7.4

ACTIVITY 7.2

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. 7.5).

If a stem is girdled, the downward and upward movement of food material gets blocked. So the trunk portion shows swelling in the area due to accumulation of food material.

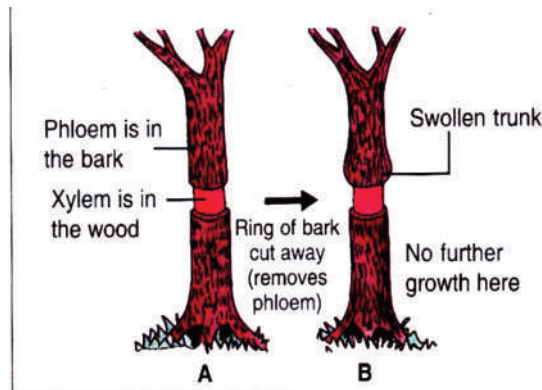


Fig. 7.5 : Girdling experiment

To perform this activity, select one branch of a potted plant. Gently remove its soft part in a small area with the help of a razor blade, as shown in Fig. 7.5A.

Leave the branch after girdling for a week. Observe what happens 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 is 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.

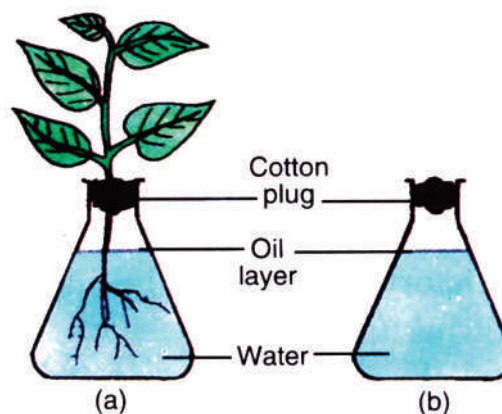
Importance of Transpiration

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 7.3**To demonstrate transpiration.**

You can prove that transpiration takes place by setting up the apparatus shown in Fig. 7.6. 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. 7.6**

Note down the level of water in flask (a) and (b). In which flask the level dropped. Why has it? Explain your results.

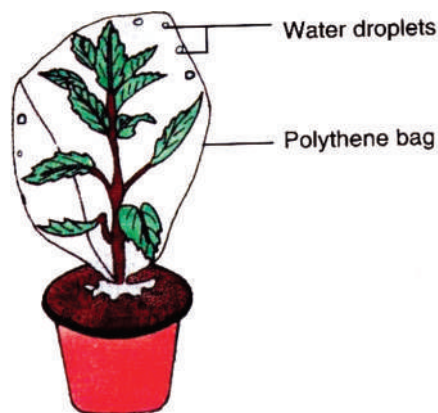
ACTIVITY 7.4**To demonstrate that water is given off during transpiration.****What do you need ?**

- (a) Small- sized well watered potted plant
- (b) transparent polythene bag
- (C) thread

How to do the test? (Fig. 7.7)

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.

What do you observe? Drops of water on the inside of the bag.
(Water vapour transpired by the plant condenses as water droplets.)

**Fig. 7.7**

7.5 CIRCULATORY SYSTEM

Circulatory system is a transport system moving substances throughout our body with the help of blood (**Fig 7.8**). 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.

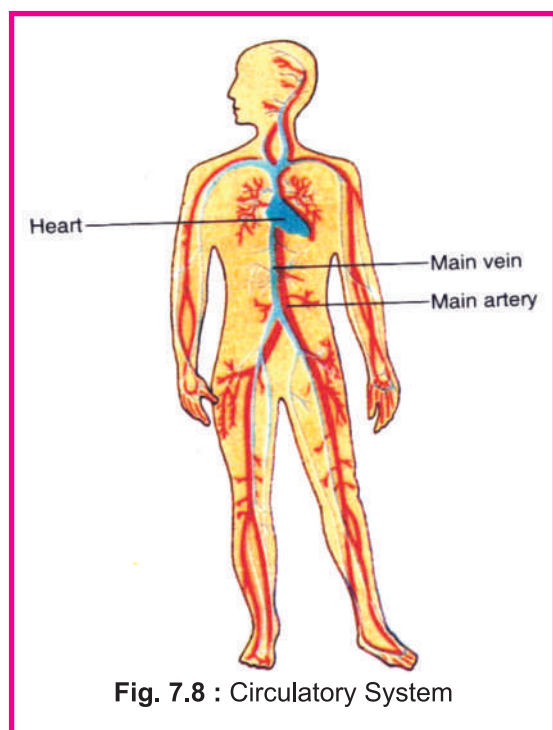


Fig. 7.8 : Circulatory System

Fig. 7.8 : Circulatory System

Fig. 7.8 : 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. 7.8**) consists of three part- (i) **Heart**, (ii) **Blood vessels**, (iii) **Blood**.

7.5.1 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 7.8**). This amazing organ is built like a double-storey house. Each part has two rooms. On the ground floor are the right

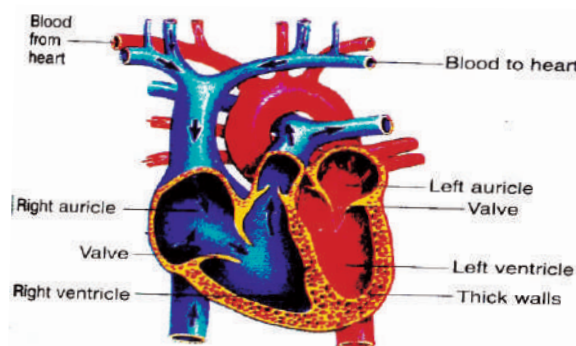


Fig. 7.9 : Internal Structure of Heart

and left '**ventricles**' and the first floor has the right and left '**auricles or atria**'

(singular atrium) **(Fig 7.9)** 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.

7.5.2 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. 7.9)**. 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 (oxygen 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.7.10)**.

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**.



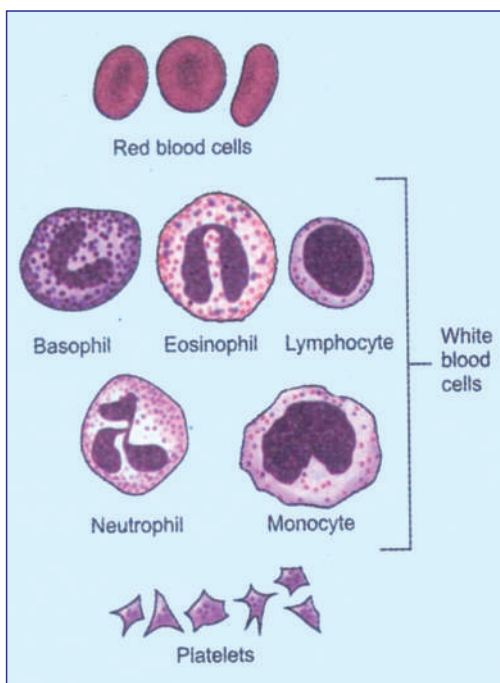


Fig. 7.10 : Types of blood cells
(not drawn to scale)

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 play 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 7.1: 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 7.5

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.

7.5.3 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. 7.11 A**).

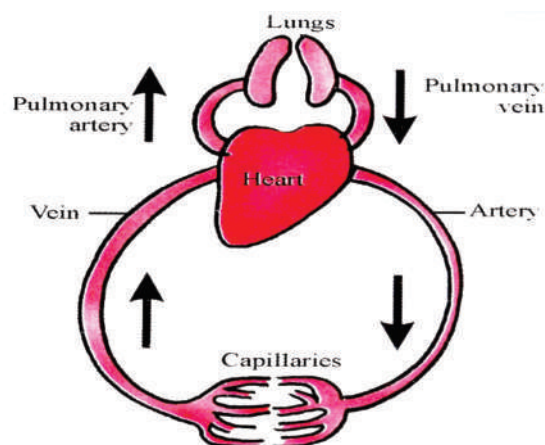


FIG. 7.11B : Schematic diagram of blood circulation

7.6 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 extra work such as running, cycling or when you are excited or under stress. This can be felt as an increase in the thumping or throbbing of the heart. The heart shows regular contraction and relaxation. This rhythmic contraction followed by expansion constitutes a heart beat.

You have often seen that a physician hold your wrist and counts your heart

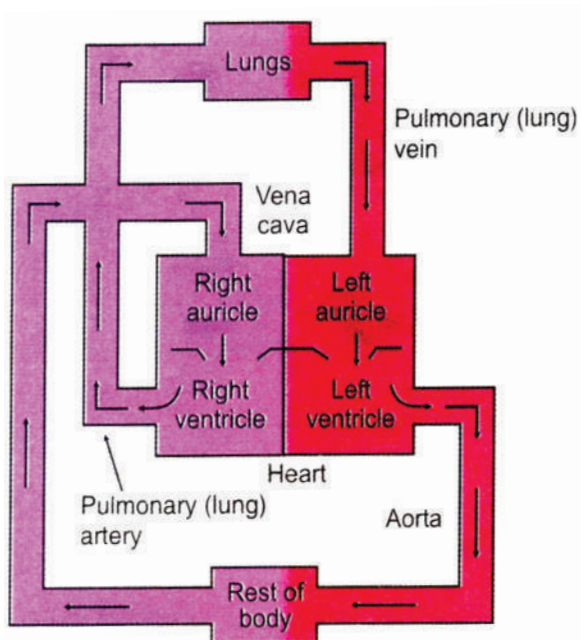


Fig. 7.11 A : Blood circulation around the body. The blood always flows in the direction shown.



You can perform the following **Activity 7.6** and **7.7** to feel the heart beat and the pulse rate.

ACTIVITY 7.6

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 7.13)**. A stethoscope is a device that amplifies the sound of a heart beat and is used to hear the heart

ACTIVITY 7.7

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. 7.12A



Fig. 7.12B

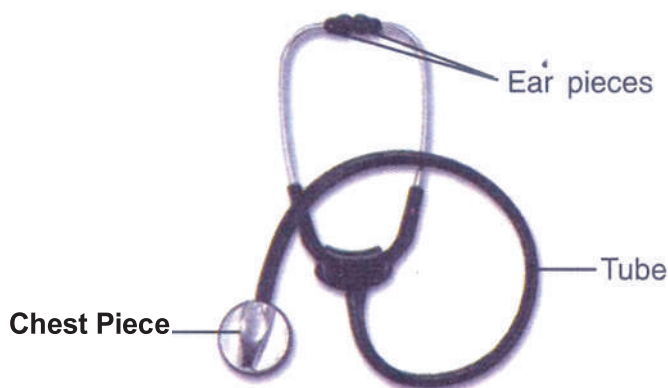


Fig. 7.13 : Stethoscope

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 7.8**

ACTIVITY 7.8

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 7.14.



Fig. 7.14

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.

7.7 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.

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.



Fig. 7.15 : Measuring Blood Pressure

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

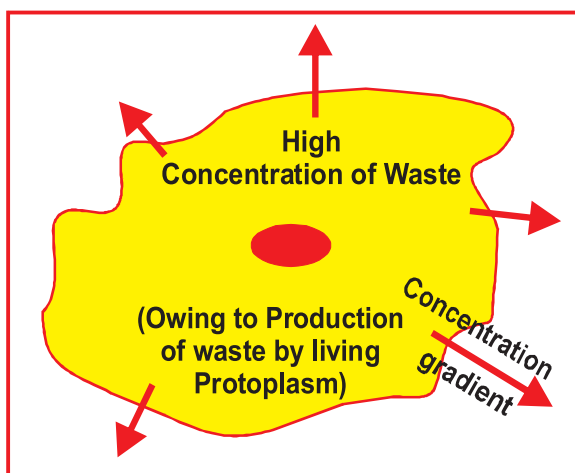


Fig. 7.16 : Excretion in Amoeba

by the simple process of diffusion. Specialized organs of excretion are lacking (**Fig 7.16**), 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.

7.8 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.



7.9 EXCRETORY SYSTEM IN HUMANS

Excretory system consists of the following organs (Fig.7.17):

- | | |
|---------------------|------------|
| 1 A pair of kidneys | 2 Ureters |
| 3 Urinary bladder | 4 Urethra. |

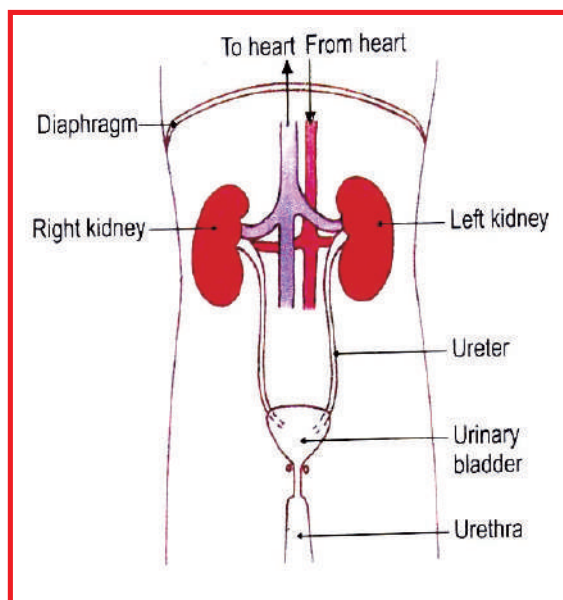


Fig. 7.17: Excretory system in humans.

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.

7.9.1 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. 7.18).

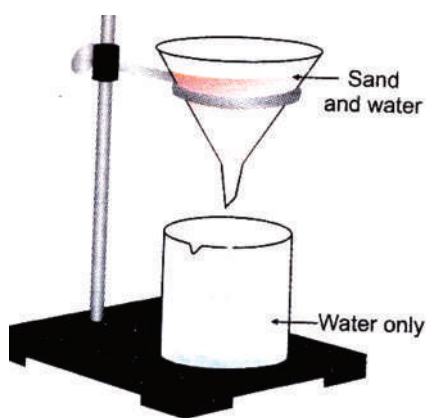


Fig. 7.18 : Filtration

But how to separate a mixture of glucose and starch? For this, the technique of **dialysis** is used (Fig. 7.19).

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 kidney machine** (also called **dialysis machine**).

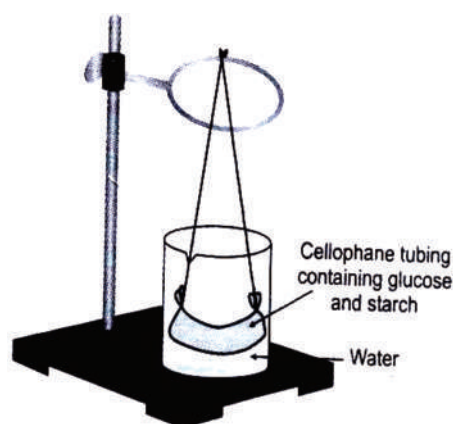


Fig. 7.19 : Dialysis



ACTIVITY 7.9

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 7.20) 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.



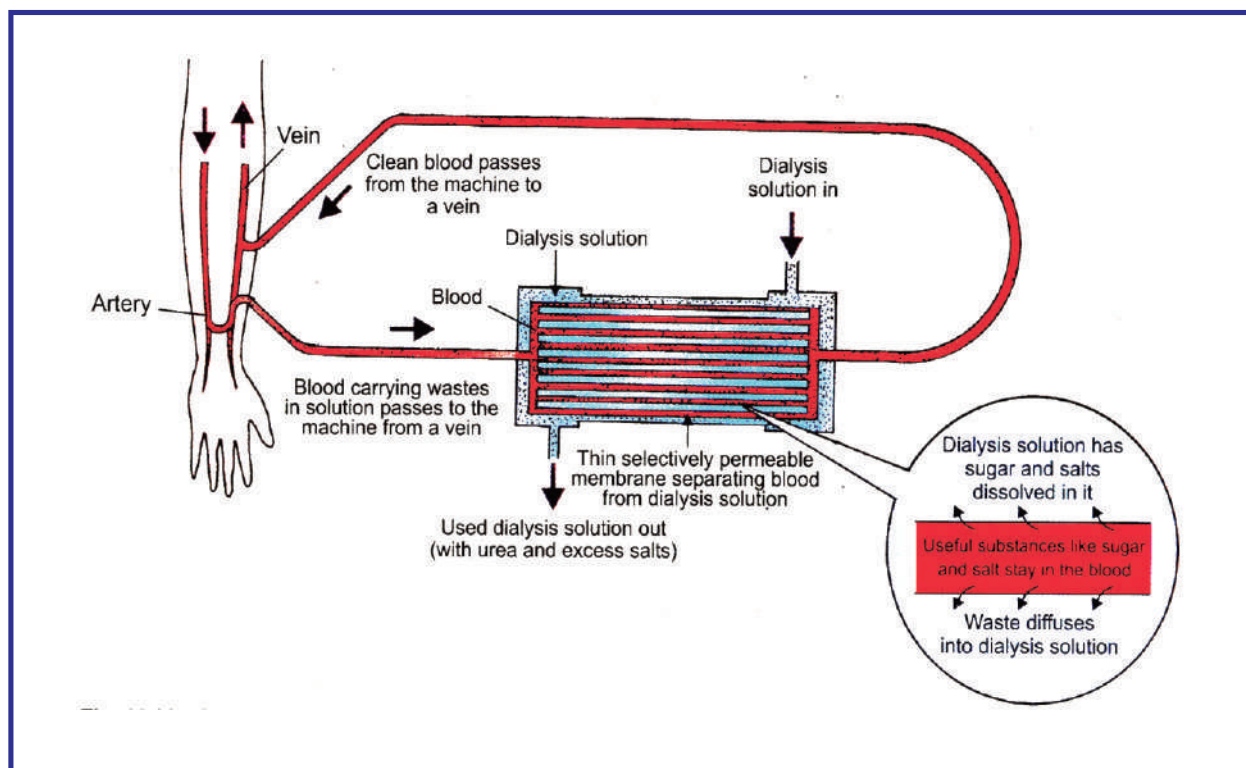


Fig. 7.20 : A kidney machine at work. A thin semi-permeable membrane separates the patient's blood from the dialysis solution. Wastes from the blood diffuse into the dialysis solution.

KEYWORDS

Artery

Heartbeat

Dialysis

Vein

Haemoglobin

Heart

Circulation

Transpiration

Excretion

Capillaries

Phloem

Diffusion

Xylem



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



8

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.

8.1. 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.

8.2 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

8.3 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. 8.1**) 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.

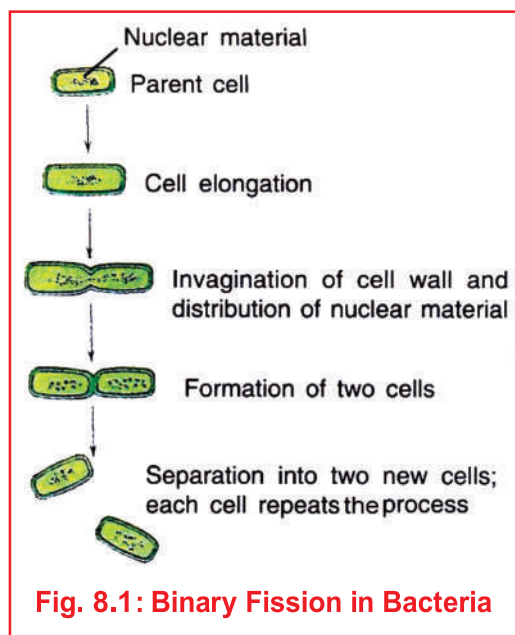


Fig. 8.1: Binary Fission in Bacteria

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. 8.2**).

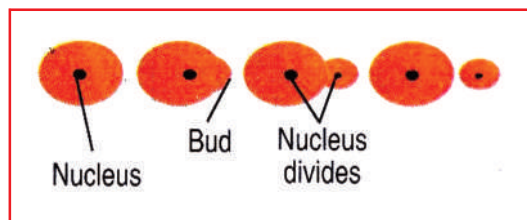


Fig. 8.2 : Budding in yeast

C. Fragmentation

In some filamentous organism such as Spirogyra (an alga), the filaments break up into two or more fragments (**Fig. 8.3**). 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. 8.4**).

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.

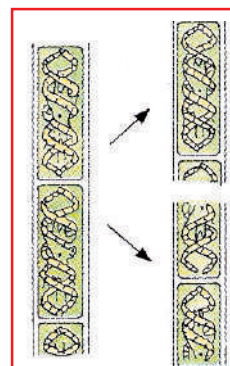


Fig. 8.3 : Fragmentation in Spirogyra

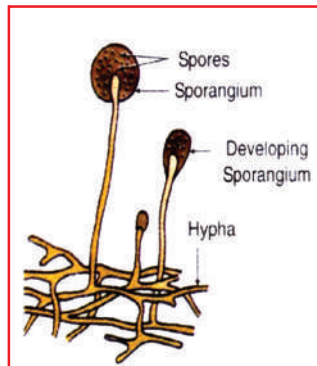


Fig. 8.4 : Spore formation in Mucor (a fungus)

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. 8.5**).

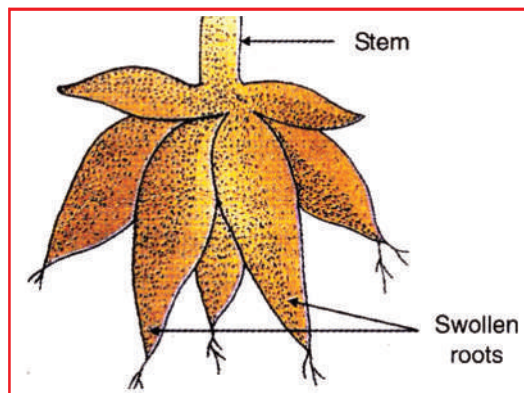


Fig. 8.5 : Roots of Dahlia

Activity 8.1

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° to 40°C). 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 8.2

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:

- Cut a piece of napkin to fit in the bottom of the jar.
- Pour a small amount of water into the jar-just enough to wet the paper napkin completely.
- Place a piece of bread on the moist paper napkin.
- Cap the jar loosely. This is very important.
- Place the jar in a dark place where it is not cold.
- Look at it everyday for a week and draw pictures showing how the mould looked during its growth stages.



Activity 8.3

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. 8.6**).

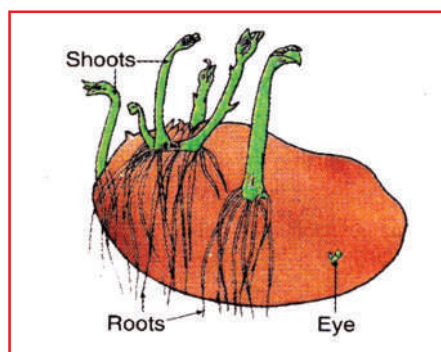


Fig. 8.6 : A sprouted potato tuber showing the development of many plants.

Activity 8.4

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 leaves) 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. 8.7**). Buds which are

present on the stem grow into new plants.

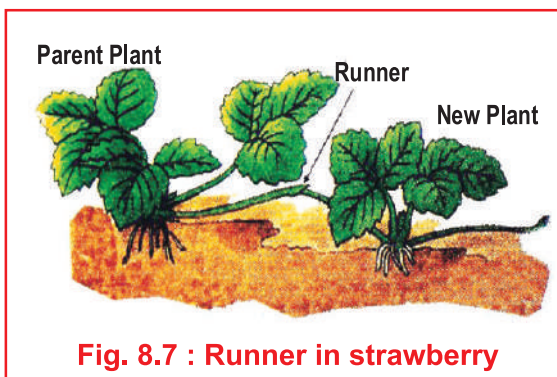


Fig. 8.7 : Runner in strawberry



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. 8.8**).

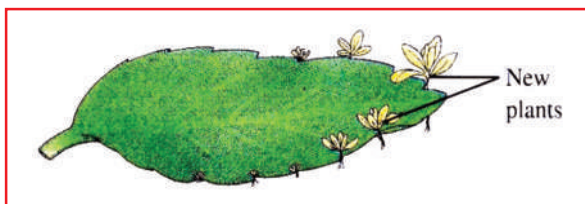


Fig.8.8 : Buds present in individual notches along the margin of a Bryophyllum leaf are capable of forming new plants.

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 8.5

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. 8.9)

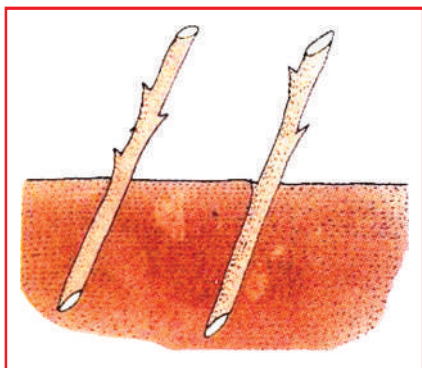


Fig. 8.9 : Cutting in rose

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. 8.10): 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



Fig. 8.10 : Layering in Jasmine

method is used in plants like jasmine, strawberry and bougainvillea.

3. Grafting (Fig. 8.11): 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

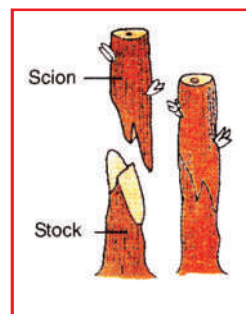


Fig. 8.11 : Grafting

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.

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 8.12)**.

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.

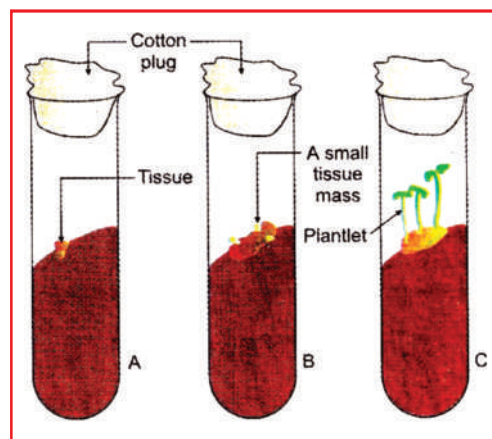


Fig 8.12 :Tissue Culture

Activity 8.6

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.

8.4 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?

8.5 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. 8.13**). 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.

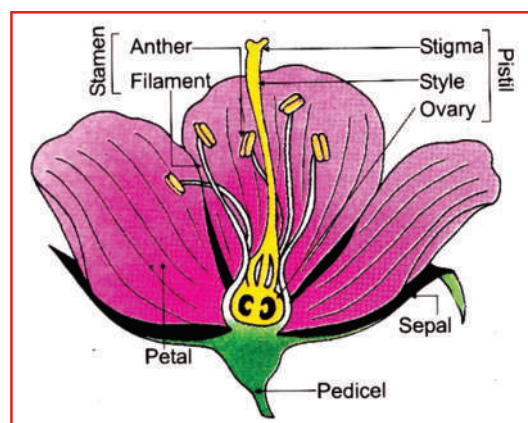


Fig. 8.13 : Parts of a flower

A **stamen** consists of an **anther** and a **filament** (**Fig. 8.14**). An anther is a swollen structure present on the tip of the filament. The anther produces a powdery substance called the **pollen grains**.

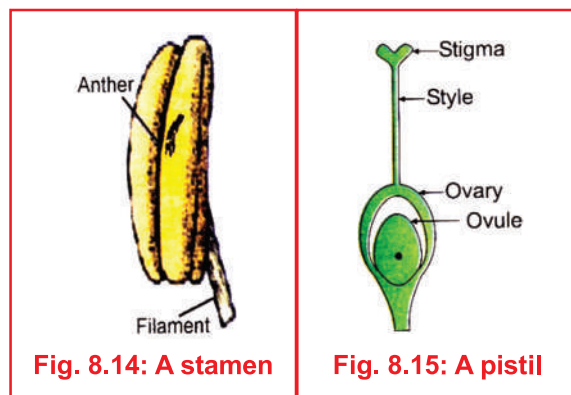


Fig. 8.14: A stamen

Fig. 8.15: 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 8.15). The ovary contains many **ovules**. The female sex cell or gamete (egg) is present inside the ovule (Fig 8.16).

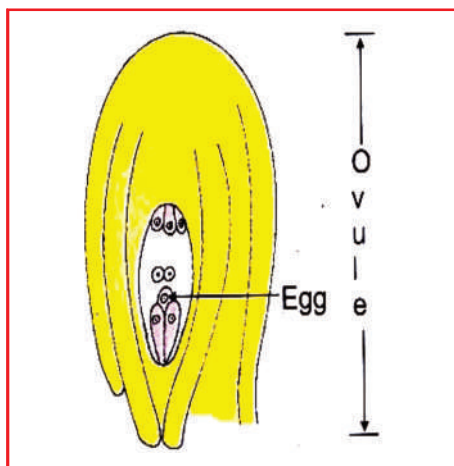


Fig 8.16: Female gamete inside the ovule

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 8.17).

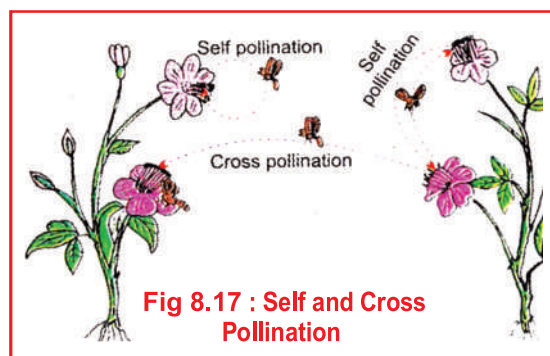


Fig 8.17 : Self and Cross Pollination

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 8.18).

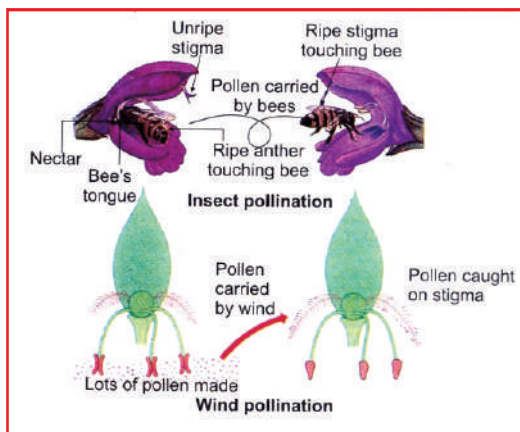


Fig. 8.18 : Insect and wind-pollination

Perform the **Activity 8.7** 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 8.7

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 8.8

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. 8.18**) 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. 8.20**). The pollen tubes are carriers of male gametes (**Fig. 8.19**).

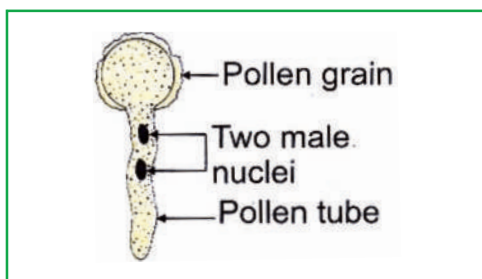


Fig. 8.19 : Pollen grain develops into a tube carrying male gametes.

- (2) One pollen tube finally enters the ovule, where female gamete is located (**Fig. 8.20**). Female gamete or egg cell is present inside the ovule.
- (3) Finally the male gamete fuses with

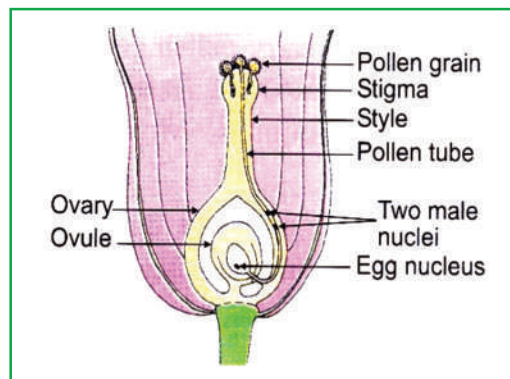


Fig. 8.20 : Process of fertilization

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)**.

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 8.11.**

Fruits of the type of pea are called **dry fruits**. The fruit wall in such a fruit is thin and dry.

Activity 8.9.

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. 8.19**).

Activity 8.10

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 8.11

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. 8.21**). The fruit wall in pea is thin and dry.

In a mango fruit, after the removal of the outer covering, you find the fleshy portion which you eat. Inside the fleshy portion, a stony part of the fruit wall is present. Seed is present inside

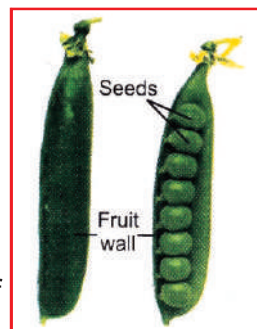


Fig. 8.21: Fruit of pea

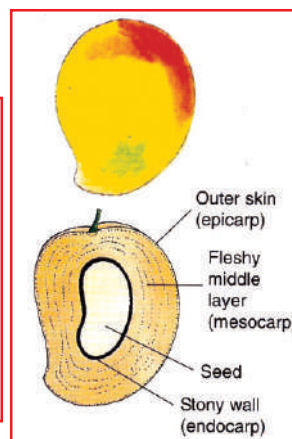


Fig. 8.22 : Fruit of mango

the stony wall (**Fig. 8.22**). 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 8.12

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.
- (li) The fruit is a **store house of food material**.
- (lii) The fruit helps in the dispersal of seeds.

Seed

A seed contains an **embryo**, one or two **cotyledons** and a protective **seed coat** (**Fig 8.23**). The embryo, after germination of the seed, develops into a

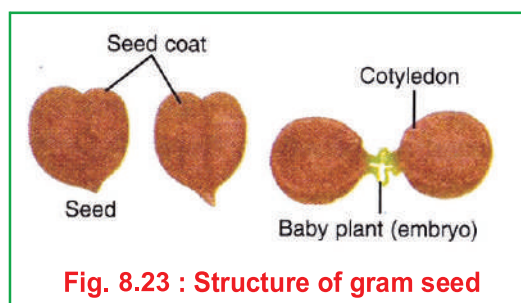


Fig. 8.23 : Structure of gram seed

new plant. The cotyledons often contain reserve food material for the developing plant.

8.6 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 8.24**), 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 8.25**). Like madar, these fruits are dispersed by wind.
 - (iii) In gokhru and xanthium, the fruits are thorny (**Fig 8.26**) 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 8.27**). It falls in water, and being fibrous it floats in water, it is thus carried away from



Fig. 8.24 : Seed of madar

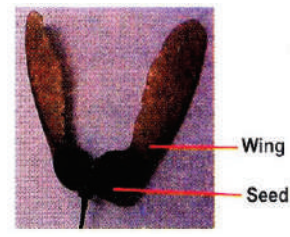
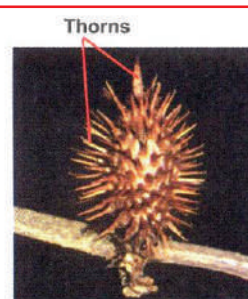


Fig. 8.25 : Fruit of maple



(A)
Fig. 8.26 : A. Fruit of gokhru



(B)
Fig. 8.26 : B. Fruit of Xanthium



Fig. 8.27 : Fibrous fruit of coconut dispersed by water

the parent plant by water currents.

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

