1 Nutrition in Plants

In Class VI you learnt that food is essential for all living organisms. You also learnt that carbohydrates, proteins, fats, vitamins and minerals are components of food. These components of food are called **nutrients** and are necessary for our body.

All living organisms require food. Plants can make food for 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.

Boojho 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. The 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 utilisation 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 food prepared by plants. They are called **heterotrophs** (*heteros* = other).

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

Now we may ask where the food factories of plants are located: whether food is made in all parts of a plant or only in certain parts? How do plants obtain the raw materials from the surroundings? How do they transport them to the food factories of plants?

1.2 Photosynthesis — Food Making Process in Plants

Leaves are the food factories of plants. Therefore, all the raw materials must reach the leaf. Water and minerals present in the soil are absorbed by the roots and transported to the leaves. Carbon dioxide from air is taken in

Cells

You have seen that buildings are made of bricks. Similarly, the bodies of living organisms are made of tiny units called **cells**. Cells can be seen only under the microscope. Some organisms are made of only one cell. The cell is enclosed by a thin outer boundary, called the **cell membrane**. Most cells have a distinct, centrally located spherical structure called the **nucleus** (Fig. 1.1). The nucleus is surrounded by a jelly-like substance called **cytoplasm**.

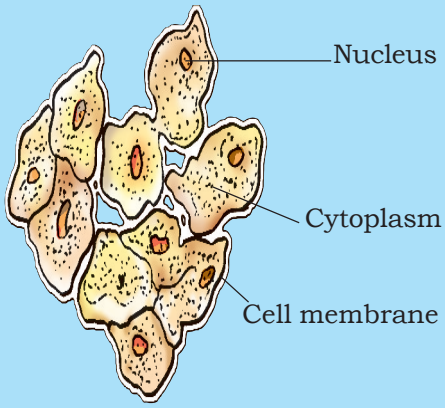


Fig. 1.1 *Cell*

through the tiny pores present on the surface of leaves. These pores are surrounded by 'guard cells'. Such pores are called **stomata** [Fig. 1.2 (c)].

Boojho 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 root, the stem, the branches and the leaves. They form a continuous path or passage for the nutrients to reach the leaf. They are called vessels. You will learn more about transport of materials in plants in Chapter 11.

Paheli 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 the 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 prepare). 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 in the absence of 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

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.

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

During photosynthesis, chlorophyll containing cells of leaves (Fig. 1.2), in the presence of sunlight, use carbon dioxide and water to synthesise carbohydrates (Fig. 1.3). The process can be represented in an equation:

$$\text{Carbon dioxide} + \text{water} \xrightarrow[\text{chlorophyll}]{\text{sunlight}} \text{Carbohydrate} + \text{oxygen}$$

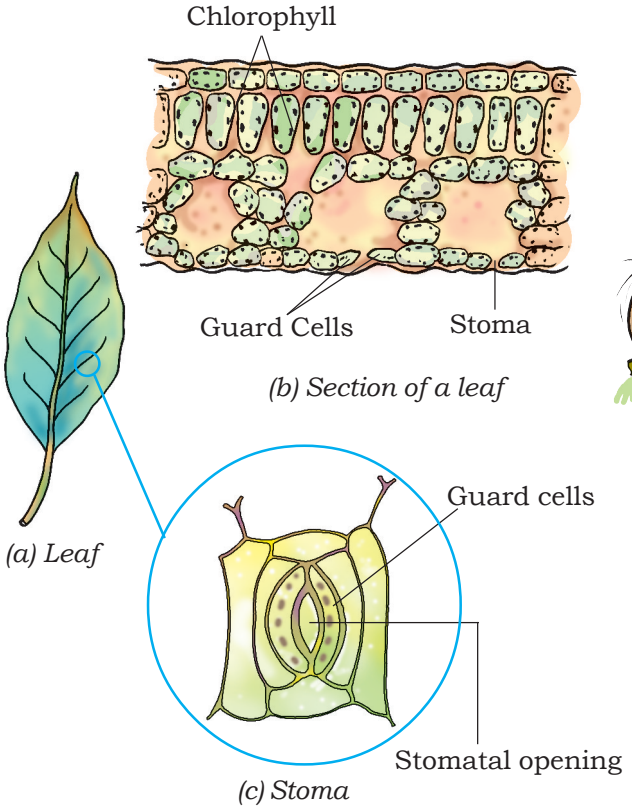


Fig. 1.2

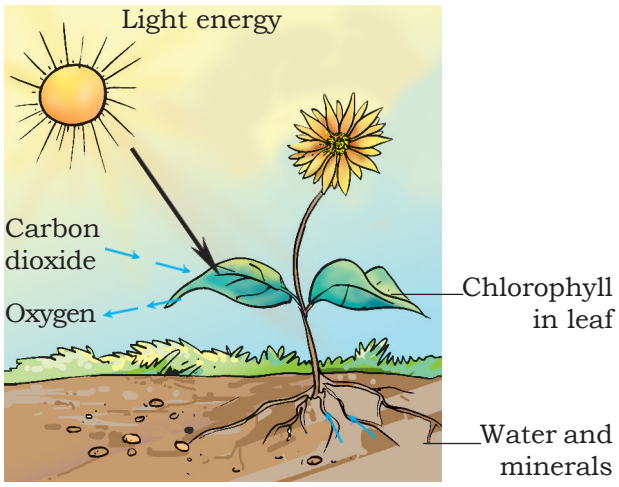


Fig. 1.3 *Diagram showing photosynthesis*

During the process oxygen is released. The presence of starch in leaves indicates the occurrence of photosynthesis. Starch is also a carbohydrate.

Boojho has observed some plants with deep red, violet or brown leaves. He wants to know whether these leaves also carry out photosynthesis.

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 sunlight.

Perform iodine test with the leaves of both the 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. 1.4). Photosynthesis takes place in these leaves also.

Fig. 1.4 *Leaves of various colours*

You often see slimy, green patches in ponds or stagnant water bodies. These are generally formed by the growth of organisms called **algae**. Can you guess why algae are 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 synthesise carbohydrates through the process of photosynthesis. The carbohydrates are made of carbon, hydrogen and oxygen. These are used to synthesise 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 are absorbed by the plants along with water. Also, you might have seen farmers adding fertilisers rich in nitrogen to the soil. In this way the plants fulfil their requirements of nitrogen along with the other constituents. Plants can then synthesise proteins and vitamins.

1.3 Other Modes of Nutrition in Plants

There are some plants which do not have chlorophyll. They cannot synthesise food. How do they survive and from where do they derive nutrition? Like humans and animals such plants depend on the food produced by other plants. They use the **heterotrophic mode** of nutrition. Look at Fig. 1.5. Do you see a yellow wiry branched structure twining around the stem and branches of a tree? This is a plant called *Cuscuta* (Amarbel). It does not have chlorophyll. It takes readymade food from the plant on which it is climbing. The plant on which it climbs is called the **host**. Since it deprives the host of valuable nutrients,

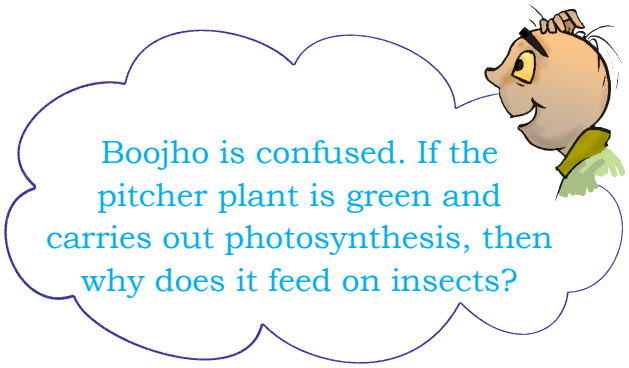
Fig. 1.5 *Cuscuta (Amarbel) on host plant*

Cuscuta is called the **parasite**. Are we and other animals also a kind of parasites? You should think about it and discuss with your teacher.

Paheli 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. 1.6. The pitcher-like or jug-like structure is the modified part of leaf. The apex of the leaf forms a lid which can open and close the mouth of the pitcher. Inside the pitcher there are hair which entangle the trapped insect. The lid closes and the insect is trapped. The insect is killed by the juices secreted in the pitcher and its nutrients are absorbed. Such insect-eating plants are called **insectivorous plants**.

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



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

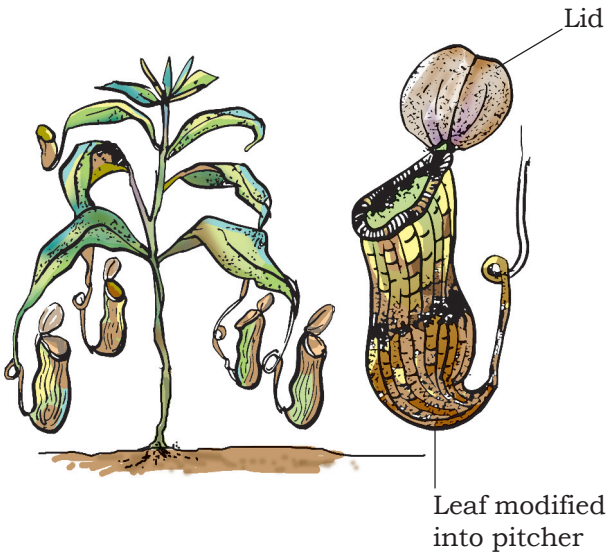


Fig. 1.6 *Pitcher plant showing lid and pitcher*

1.4 Saprotrophs

You might have seen packets of mushrooms sold in the vegetable

market. You may have also seen fluffy umbrella-like patches growing in moist soils or on rotting wood during the rainy season (Fig. 1.7). Let us find out what type of nutrients they need to survive and from where they get them.

Fig. 1.7 *Packet of mushrooms, a mushroom growing on decayed material*

Boojho 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.

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 them (Fig. 1.8). What is the colour of these patches? Observe the patches under a microscope or a magnifying glass. Write down your observations in the notebook. You will see cotton-like threads spread on the piece of bread.

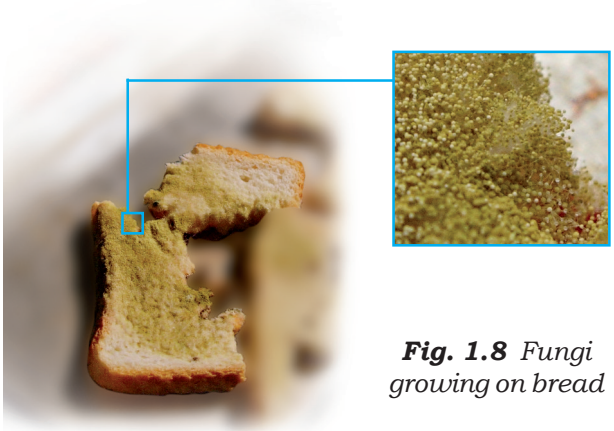


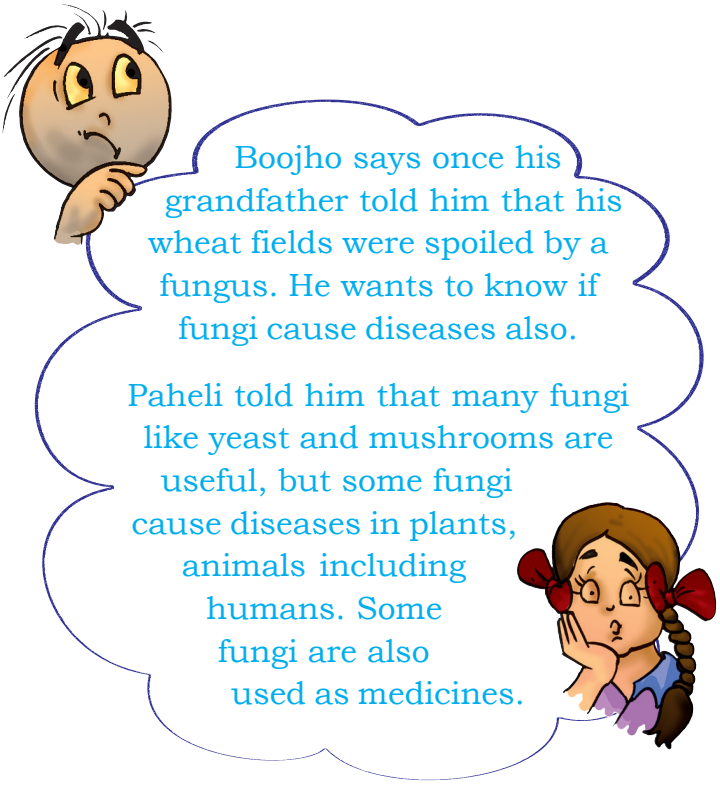
Fig. 1.8 *Fungi growing on bread*

These organisms are called **fungi**. They have a different mode of nutrition. They absorb the nutrients from the bread. This mode of nutrition in which organisms take in nutrients from dead and decaying matter is called **saprotrophic nutrition**. Such organisms with saprotrophic mode of nutrition are called **saprotrophs**.

Fungi also grow on pickles, leather, clothes and other articles that are left in hot and humid weather for long time. During the rainy season they spoil many things. Ask your parents about the menace of fungi in your house.

The fungal spores are generally present in the air. When they land on

Paheli 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.



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 both shelter and nutrients. This relationship is called **symbiosis**. For example, certain fungi live inside the roots of plants. The plants provide nutrients to the fungus and, in return, the fungus provides water and certain nutrients.

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 prepares and provides food to the fungus.

1.5 How Nutrients are Replenished in the Soil

Have you seen farmers spreading manure or fertilisers in the fields, or gardeners using them in lawns or in pots? Do you know why this is done?

You learnt that plants absorb minerals and nutrients from the soil. So, their amounts in the soil keep on declining. Fertilisers and manures contain nutrients such as nitrogen, potassium, phosphorous, 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 can fulfil the nutrient requirement of plants.

Usually crop plants absorb a lot of nitrogen and 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. Hence, addition of fertilisers and manures enriches the soil. The bacterium called *Rhizobium* can take atmospheric nitrogen and convert it into a usable form. But *Rhizobium* cannot make its own food. So it often lives in the roots of gram, peas, *moong*, beans and other legumes and provides them with nitrogen. 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 can reduce the use of nitrogenous fertiliser where leguminous

plants are grown. Most of the pulses *(dals)* are obtained from leguminous plants.

In this chapter you learnt that most of the plants are autotrophs. Only a few plants are parasitic or 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 need food and utilise it to get energy for growth and maintenance of their body.
- Green plants synthesise food for themselves by the process of photosynthesis. They are autotrophs.
- Plants like *Cuscuta* are parasites. They take food from the host plant.
- Plants use simple chemical substances like carbon dioxide, water and minerals for the synthesis of food.
- Chlorophyll, water, carbon dioxide and sunlight are the essential requirements for photosynthesis.
- Complex chemical substances such as carbohydrates are the products of photosynthesis.
- Solar energy is absorbed by the chlorophylls present in leaves/plants.
- Oxygen is produced during photosynthesis.
- Oxygen released in photosynthesis is utilised by living organisms for their survival.
- Many fungi derive nutrition from dead and decaying matter. They are saprotrophs.
- A few plants and all animals are dependent on others for their nutrition and are called heterotrophs.

Exercise

1. Why do organisms 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 plants are the ultimate source of food.
6. Fill in the blanks:
   (a) Green plants are called _____ since they synthesise their own food.
   (b) The food synthesised by plants is stored as _____.
   (c) In photosynthesis solar energy is absorbed by the pigment called _____.
   (d) During photosynthesis plants take in _____ and release _____ gas.
7. Name the following:
   (i) A parasitic plant with yellow, slender and branched stem.
   (ii) A plant that is partially autotrophic.
   (iii) The pores through which leaves exchange gases.
8. Tick the correct answer:
   (a) *Cuscuta* 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 (iv) pitcher plant (iv) rose
9. Match the items given in Column I with those in Column II:

Column I	**Column II**
Chlorophyll	Rhizobium
Nitrogen	Heterotrophs
Cuscuta	Pitcher plant
Animals	Leaf
Insects	Parasite

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 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) Petals

12. Choose the correct option from the following:

    Plants take carbon dioxide from the atmosphere mainly through their:

    (i) roots (ii) stem (iii) flowers (iv) leaves

13. Why do farmers grow many fruits and vegetable crops inside large green houses? What are the advantages to the farmers?

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 the centres. Cover a part of two leaves with these papers and secure them with paper clips (Fig. 1.9). Keep the plant in sunlight for 2–5 days. Observe the difference in the colour of the covered and the uncovered portions on the leaf. Perform iodine test on this leaf. Did the two parts show different 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.

Fig. 1.9 *Experiment to test the occurrence of photosynthesis*

2. Visit a green house if there is one near your place. Observe how they grow 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

Did you know?

Light is so important to plants that their leaves grow in many patterns so as to absorb maximum sunlight.

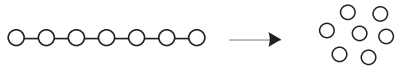
2 Nutrition in Animals

You have learnt in Chapter 1 that plants can prepare their own food by the process of photosynthesis but animals cannot. Animals get their 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 nutrient requirement, mode of intake of food and its utilisation 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 of food such as carbohydrates are complex substances. These complex substances cannot be utilised as such. So they are broken down into simpler substances. The breakdown of complex components of food into simpler substances is called **digestion**.



Complex substance Simpler substances

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 animals 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 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.

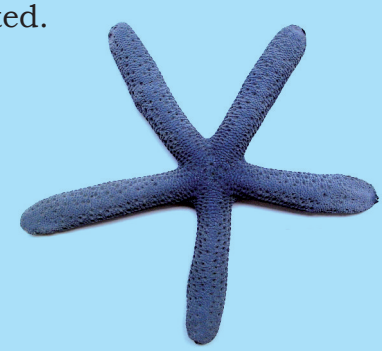


Fig. 2.1 *Starfish*

2.2 Digestion in Humans

We take in food through the mouth, digest and utilise 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 (Fig. 2.2) which begins at the buccal cavity and ends at the anus. The canal can be divided into various compartments: (1) the **buccal cavity,** (2) foodpipe 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 various compartments. The inner walls of the stomach and the small intestine, and the various glands associated with the canal such as **salivary glands**, the **liver** and the **pancreas** secrete digestive juices. The digestive juices convert complex

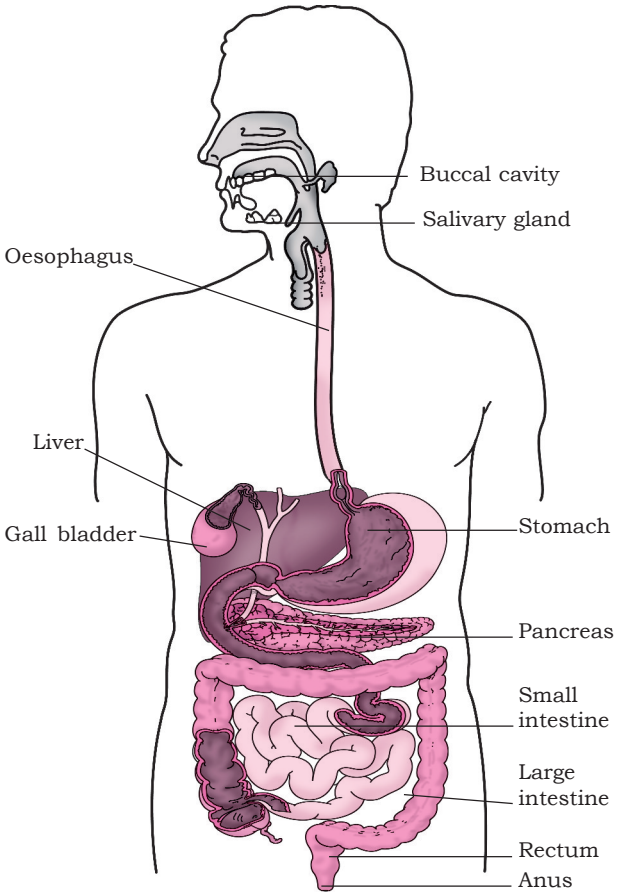


Fig. 2.2 *Human digestive system*

substances of food into simpler ones. The digestive tract and the associated glands together constitute the **digestive system**.

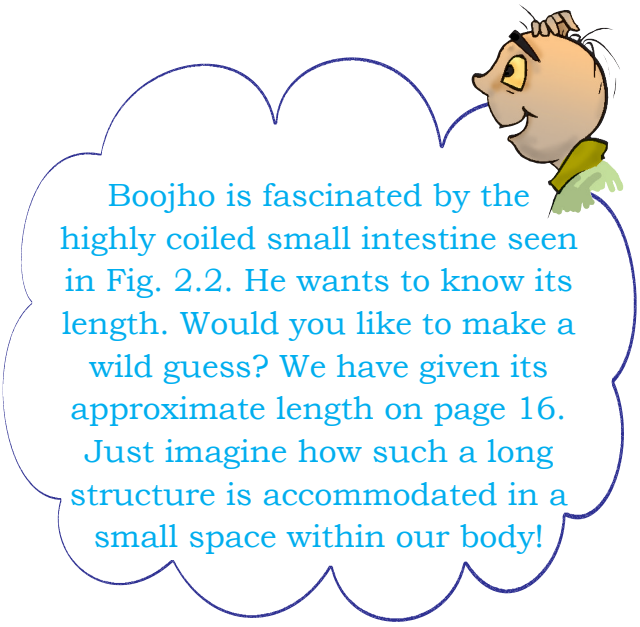
Now, let us know what happens to the food in different parts of the digestive tract.

The mouth and buccal cavity

Food is taken into the body through the mouth. The process of taking food into

Milk teeth and permanent 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 **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 body is called **ingestion**. We chew the food with the teeth and break it down mechanically into small pieces. Each tooth is rooted in a separate socket in the gums (Fig. 2.3). Our teeth vary in appearance and perform different functions. Accordingly they are given different names (Fig. 2.3).

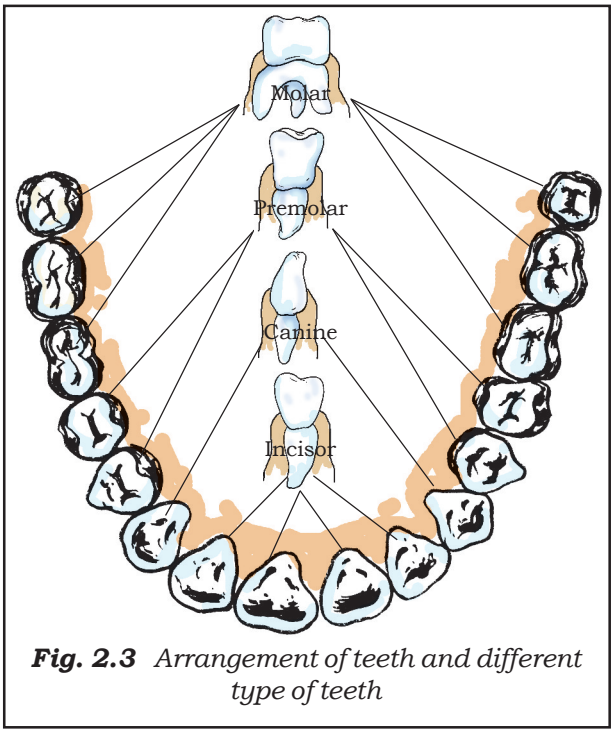


Fig. 2.3 *Arrangement of teeth and different type of teeth*

Activity 2.2

Wash your hands. Look into the mirror and count your teeth. Use your index 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 to 5 minutes. Add 3–4 mL 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 results with your classmates and your teacher. The **saliva** breaks down the **starch** into sugars.

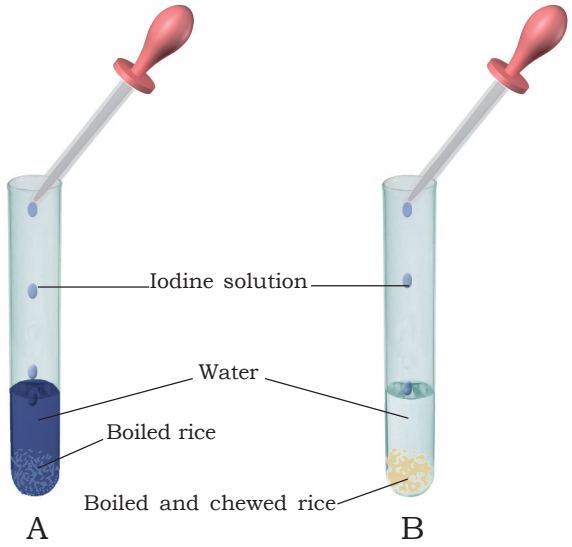


Fig. 2.4 *Effect of saliva on starch*

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

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. 2.5). 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.

Fig. 2.5 *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 foodpipe. 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 foodpipe. If, by chance, food particles enter the windpipe, we feel choked, get hiccups or cough.

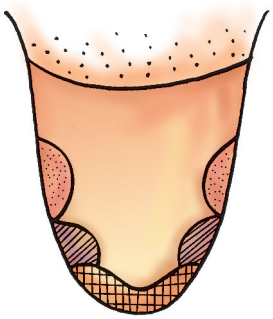


Fig. 2.6 *Regions of the tongue for different tastes*

position of taste buds by the following activity.

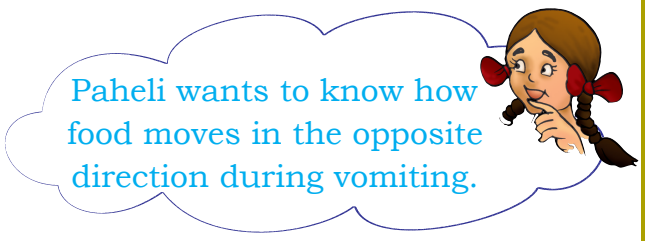
Activity 2.4

1. Prepare a separate sample each of (i) sugar solution, (ii) common salt solution, (iii) lemon juice and (iv) juice of crushed neem leaf or bitter gourd.
2. Blindfold one of your classmates and ask her/him to take out the tongue and keep it in straight and flat position.
3. Use a clean toothpick to put the above samples one by one on different areas of the tongue as shown in Fig. 2.6. 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 foodpipe/oesophagus

The swallowed food passes into the foodpipe or oesophagus. Look at Fig. 2.2. The foodpipe runs along the neck



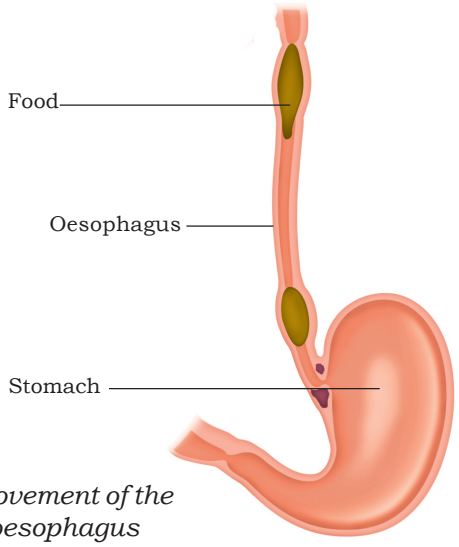


Fig. 2.7 *Movement of the food in the oesophagus of the alimentary canal*

and the chest. Food is pushed down by movement of the wall of the foodpipe. 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 stomach

The stomach is a thick-walled bag. Its shape is like a flattened J and it is the widest part of the alimentary canal. It receives food from 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 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 is about 7.5 metres long. It receives secretions from the liver and the pancreas. Besides, its wall also secretes juices.

The liver is a 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 the **gall bladder** (Fig. 2.2). The bile plays an important role in the digestion of **fats**.

The pancreas is a large cream coloured gland located just below the stomach (Fig. 2.2). The pancreatic juice acts on carbohydrates, fats and proteins and changes them into simpler forms.

The working of the stomach was discovered by a strange accident. In 1822, a man named Alexis St. Martin was badly hit by a shot gun. The bullet had seriously damaged the chest wall and made a hole in his stomach. He was brought to an American army doctor William Beaumont. The doctor saved the patient but he could not close the hole properly and left it bandaged (Fig. 2.8). Beaumont took it as a great opportunity to see the inside of the stomach through the hole. He made some wonderful observations.

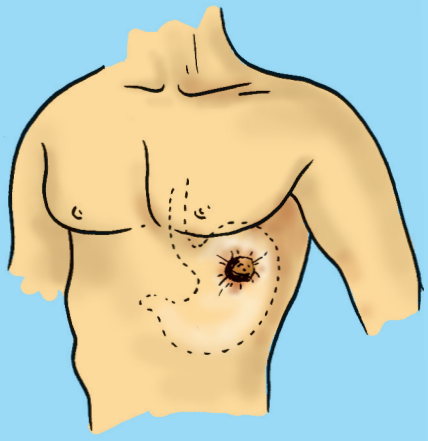


Fig. 2.8 *Alexis St. Martin's shotgun wound*

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.

The partly digested food now reaches the lower part of the small intestine where the intestinal juice completes the digestion of all components of the food. The carbohydrates get broken into simple sugars such 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 the intestine. This process is called **absorption**. The inner walls of the small intestine have thousands of finger-like outgrowths. These are called **villi** (singular villus). Can you guess what the role of villi could be in the intestine? The villi increase the surface area for absorption of the digested food. Each villus has a network of thin and small blood vessels close to its surface. The surface of the villi absorbs the digested 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**.

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

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**).

Paheli wants to know why these animals cannot chew food properly at the time they take it in?

Boojho wants to know why we cannot digest cellulose like the cattle do.

partially digested and is called **cud**. But later the cud returns to the mouth in small lumps and the animal chews it. This process is called **rumination** and these animals are called **ruminants**.

The grass is rich in **cellulose**, a type of carbohydrate. In ruminants like cattle, deer, etc., bacteria present in rumen helps in digestion of cellulose. Many animals, including humans, cannot digest cellulose.

Animals like horses, rabbit, etc., have a large sac-like structure called Caecum between the oesophagus and the small 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

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 **pseudopodia** or false feet for movement and capture of food.

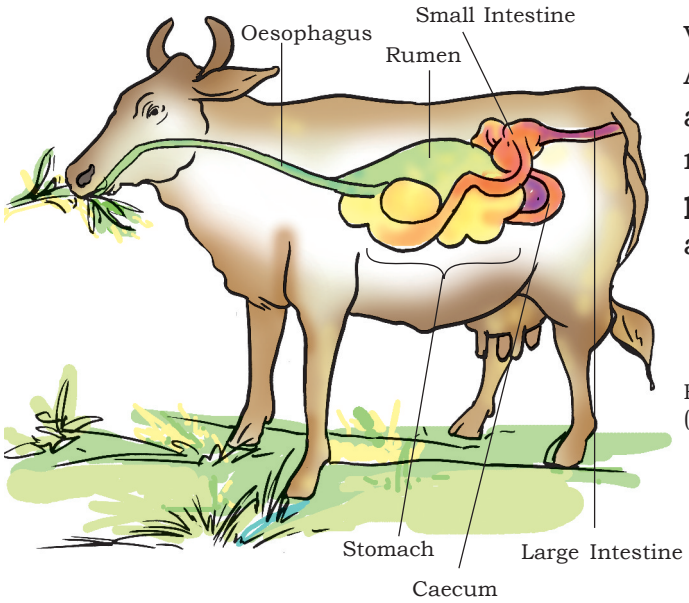


Fig. 2.9 *Digestive system of ruminant*

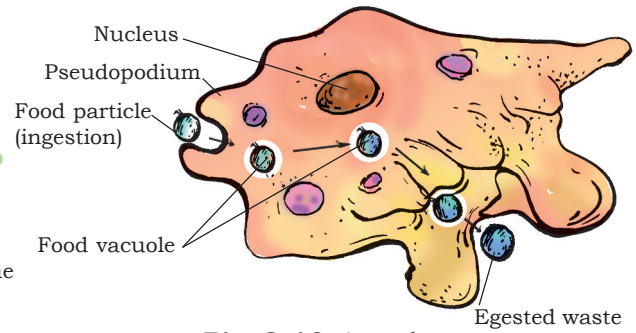


Fig. 2.10 *Amoeba*

Amoeba feeds on some microscopic organisms. When it senses food, it pushes out pseudopodia 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 a later chapter you will learn about the transport of food absorbed by the intestine to the various parts of the body.

Keywords

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

What you have learnt

- Animal nutrition includes nutrient requirement, mode of intake of food and its utilisation in the body.
- The human digestive system consists of the alimentary canal and secretory glands. It consists of the (i) buccal cavity, (ii) oesophagus, (iii) stomach, (iv) small intestine, (v) large intestine ending in rectum and (vi) anus. The main digestive glands which secrete digestive juices are (i) the salivary glands, (ii) the liver and (iii) the pancreas. The stomach wall and the wall of 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 protein 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 animal chews it peacefully.
- Amoeba ingests its food with the help of its false feet or pseudopodia. The food is digested in the food vacuole.

Exercises

1. Fill in the blanks:
   (a) The main steps of nutrition in humans are _____, _____, _____, _____ and _____.
   (b) The largest gland in the human body is _____.
   (c) The stomach releases hydrochloric acid and _____ juices which act on food.
   (d) The inner wall of the small intestine has many finger-like outgrowths called _____.
   (e) Amoeba digests its food in the _____ .
2. Mark 'T' if the statement is true and 'F' if it is false:
   (a) Digestion of starch starts in the stomach. (T/F)
   (b) The tongue helps in mixing food with saliva. (T/F)
   (c) The gall bladder temporarily stores bile. (T/F)
   (d) The ruminants bring back swallowed grass into their mouth and chew it for some time. (T/F)
3. Tick (✓) mark the correct answer in each of the following:
   (a) Fat is 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) foodpipe (iii) small intestine (iv) large intestine

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

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

5. What are villi? What is their location and function?
6. Where is the bile produced? Which component of the food does it help to digest?
7. Name the type of carbohydrate 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 in 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
	(vii) Release of faeces

12. Label Fig. 2.11 of the digestive system.

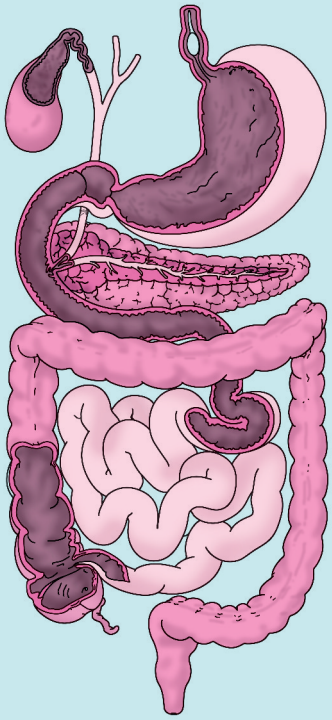


Fig. 2.11 *A part of human digestive system*

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) Till when does a patient need to be given glucose?
   (iii) How does glucose help the patient recover?

   Write the answers in your notebook.
2. Find out what vitamins are and get the following information.
   (i) Why are vitamins necessary in the diet?
   (ii) Which fruits 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.

3. Collect data from your friends, neighbours and classmates to know more about "milk teeth".

Tabulate your data. One way of doing it is given below:

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 and find the average age at which children lose the milk teeth. You may take help of your friends.

Did you know?

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

3 Fibre to Fabric

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

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

Animal fibres — wool and silk

3.1 Wool

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

Activity 3.1

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

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

Fig. 3.1 *Sheep with thick growth of hair*

Animals that yield wool

Several breeds of sheep are found in different parts of our country (Table 3.1). However, the fleece of sheep is not the only source of wool, though wool commonly available in the market is

sheep wool (Fig. 3.1). Yak (Fig. 3.2) wool is common in Tibet and Ladakh. Mohair is obtained from angora goats, (Fig. 3.3) found in hilly regions such as Jammu and Kashmir.

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

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

Activity 3.2

Collect pictures of animals whose hair is used as wool. Stick them in your scrap book. If you are unable to get pictures, try and draw them from the ones given in this book.

Find out words for sheep, goat, camel and yak in your local language and also in other languages of our country.

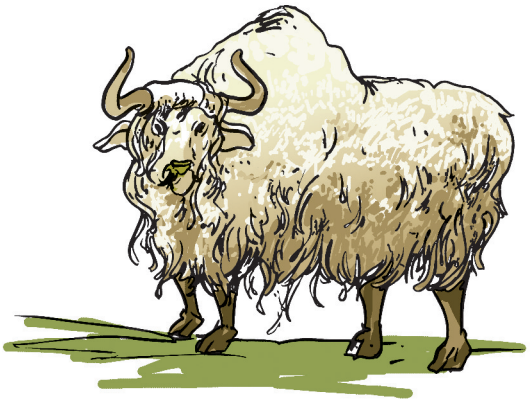


Fig. 3.2 *Yak*

Fig. 3.6 *Llama*

Activity 3.3

Procure outline maps of India and the world. Find out and mark the places on the map where you find animals that provide wool. Use different colours to denote the location for different wool yielding animals.

Fig. 3.3 *Angora goat*

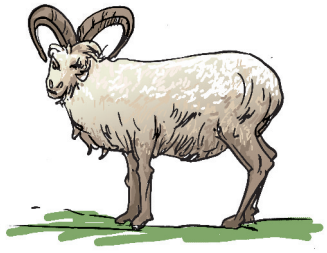


Fig. 3.4 *Goat*

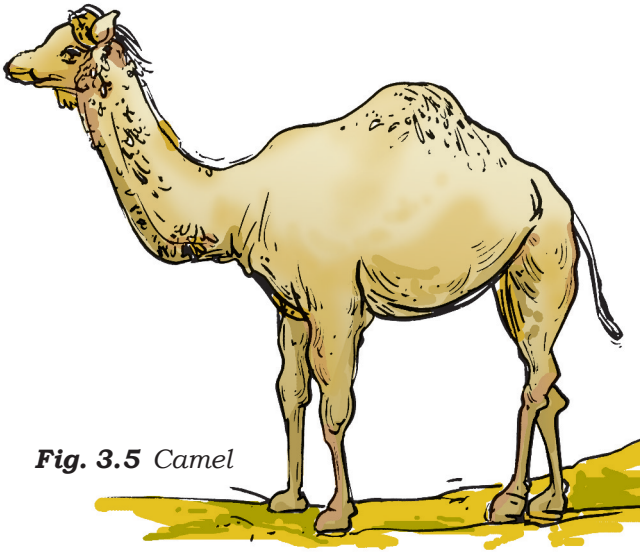


Fig. 3.5 *Camel*

Fig. 3.7 *Alpaca*

From fibres to wool

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

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

Sheep are reared in many parts of our country for wool. Table 3.1 gives the names of some breeds of sheep reared in our country for producing wool. The quality and texture of the fibres obtained from them is also indicated in the table.

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

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

Processing fibres into wool

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

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

Table 3.1 Some Indian breeds of sheep

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

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

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

Step IV: The small fluffy fibres, called burrs, are picked out from the hair. These are the same burrs which sometimes appear on your sweaters. The fibres are scoured again and dried. This is the wool ready to be drawn into fibres.

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

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

Fig. 3.8 *(a) Shearing a sheep*

Fig. 3.8 *(b) Scouring in tanks*

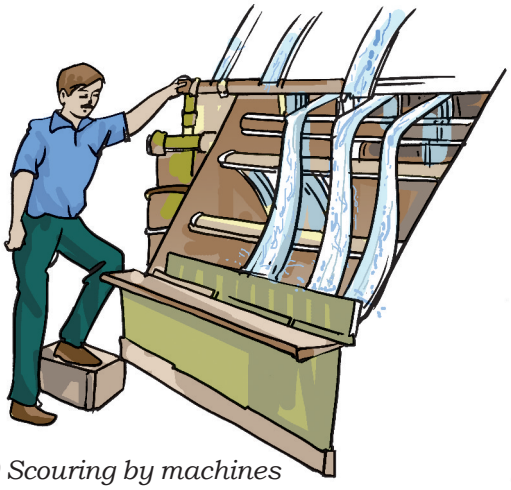


Fig. 3.8 *(c) Scouring by machines*

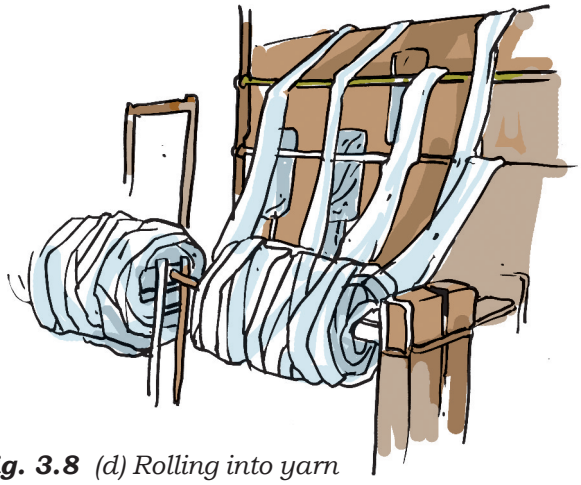


Fig. 3.8 *(d) Rolling into yarn*

The processing of fibre into wool can be represented as follows:

Shearing → Scouring → Sorting → Cleaning of burrs

↓

Rolling ← Dyeing

Occupational hazard

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

Boojho is wondering why it hurts when someone pulls his hair but not when he goes for a haircut.

Boojho is wondering why a cotton garment cannot keep us as warm in winter as a woollen sweater does.

Activity 3.4

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

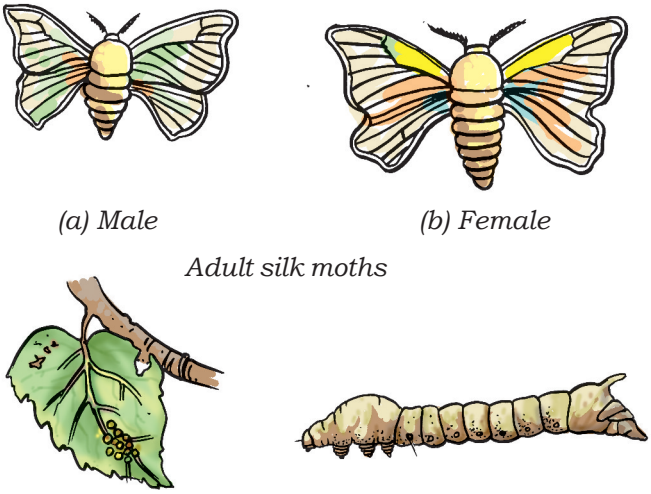
3.2 Silk

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

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

Life history of silk moth

The female silk moth lays eggs, from which hatch larvae which are called **caterpillars** or **silkworms**. They grow in size and when the caterpillar is ready to enter the next stage of its life history called **pupa**, it first weaves a net to hold itself. Then it swings its head from side to side in the form of the figure of eight (8). During these movements of the head, the caterpillar secretes fibre made of a



(a) Male *(b) Female*

Adult silk moths

(c) Eggs on mulberry leaves *(d) Silkworm*

(e) Cocoon *(f) Cocoon with developing moth*

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

protein which hardens on exposure to air and becomes silk fibre. Soon the caterpillar completely covers itself by silk fibres and turns into pupa. This covering is known as **cocoon**. The further development of the pupa into moth continues inside the cocoon (Fig. 3.9). Silk fibres are used for weaving silk cloth. Can you imagine that the soft silk yarn is as strong as a comparable thread of steel!

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

Sericulture or culture of silkworms is a very old occupation in India. India produces plenty of silk on a commercial scale.

Activity 3.5

Collect pieces of silk cloth of various types and paste them in your scrap book. You can find them in a tailor's shop among the heap of waste cut pieces. Take help of your mother, aunt or teacher and identify the types of silk such as mulberry silk, *tassar* silk, *eri* silk, *mooga* silk, etc. Compare the texture of these silks with that of the artificial silk pieces, which contain synthetic fibres. Try and collect pictures of different moths whose caterpillars provide the various types of silk.

Activity 3.6

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

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

Activity 3.7

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

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

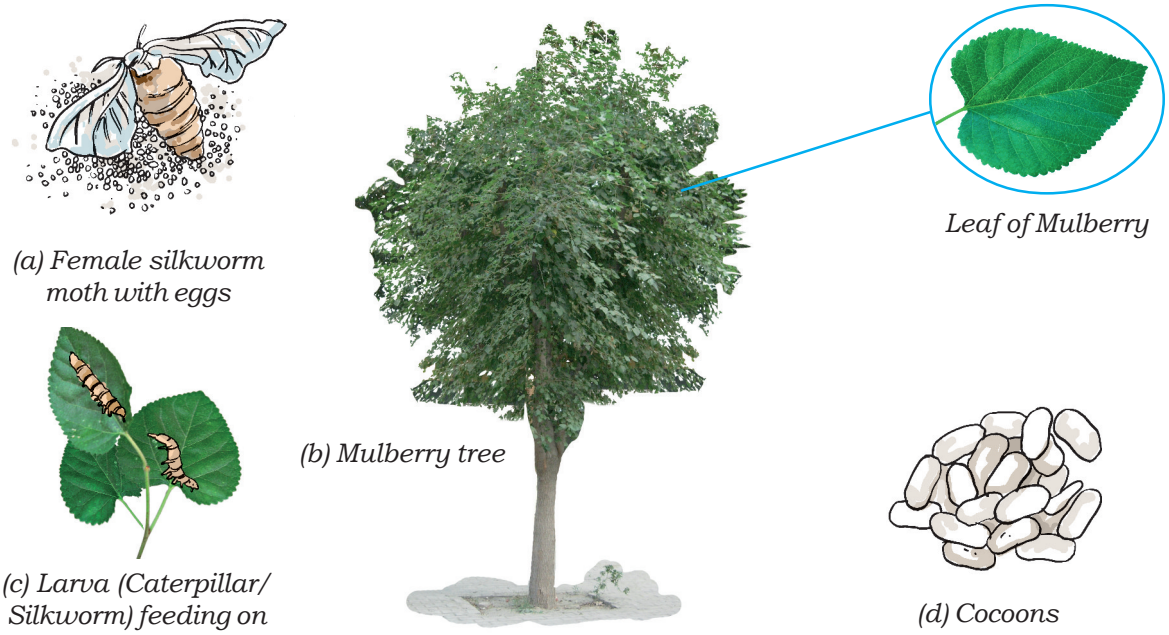
In India, women are significantly involved in various kinds of industries related to silk production. These are rearing of silkworms, reeling of silk from cocoons and processing of raw silk into fabrics. By their enterprise, they contribute to the nation's economy. China leads the world in silk production.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

From cocoon to silk

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

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

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



(a) Female silkworm moth with eggs

(b) Mulberry tree

Leaf of Mulberry

(c) Larva (Caterpillar/ Silkworm) feeding on mulberry leaves

(d) Cocoons

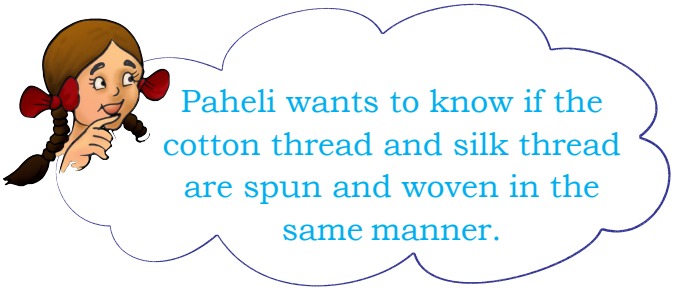
Fig. 3.10 *Rearing silkworms*

Discovery of silk

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

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

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



Keywords

Cocoon	Scouring	Silk moth
Fleece	Sericulture	Silkworm
Reeling	Shearing	Sorting

What you have learnt

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

Exercises

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

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

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

   Answer the following:

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

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

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

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

3. Which of the following does not yield wool?

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

4. What is meant by the following terms?

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

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

   Shearing, _____, sorting, _____, _____, _____.

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

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

   Sericulture, floriculture, moriculture, apiculture and silviculture.

   Hints: (i) Silk production involves cultivation of mulberry leaves and rearing silkworms.

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

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

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

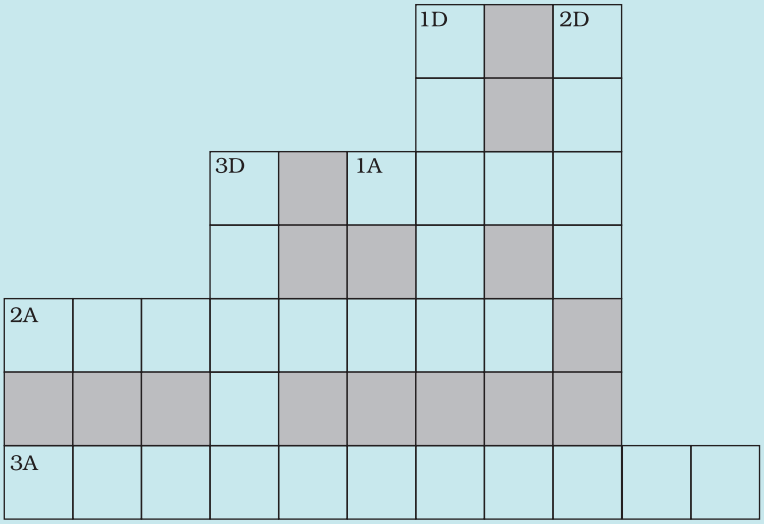
9. Given below is a crossword puzzle based on this lesson. Use hints to fill in the blank spaces with letters that complete the words.

Down

(D) 1 : Thorough washing
2 : Animal fibre
3 : Long thread like structure

Across

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



Extended Learning — Activities and Projects

1.

Paheli wants to know the maximum length of continuous silk thread that can be obtained from a cocoon.

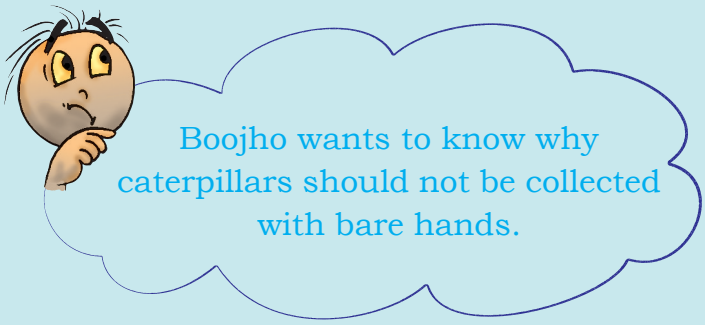
Find out for her.

2.

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

Do you have any idea?

3.



Can you help him?

4. Paheli wanted to buy a silk frock and went to the market with her mother. There they found that the artificial (synthetic) silk was much cheaper and wanted to know why. Do you know why? Find out.

5. Someone told Paheli that an animal called 'Vicuna' also gives wool. Can you tell her where this animal is found? Look for this in a dictionary or an encyclopaedia.

6. When handloom and textile exhibitions are held, certain stalls display real moths of various varieties of silk and their life histories. Try and visit these stalls with elders or teachers and see these moths and stages of their life history.

7. Look for eggs of any moth or butterfly in your garden or park or any other place full of plants. They look like tiny specks (dots) laid in a cluster on the leaves. Pull out the leaves containing eggs and place them in a cardboard box. Take some leaves of the same plant or another plant of the same variety, chop them and put them in the box. Eggs will hatch into caterpillars, which are busy eating day and night. Add leaves everyday for them to feed upon. Sometimes you may be able to collect the caterpillars. **But be careful**. Use a paper napkin or a paper to hold a caterpillar.

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

Did you know?

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

4 Heat

In Chapter 3 you 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 feeling 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 inside the house. How do we know 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 answers to some of these questions.

4.1 Hot and Cold

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

Table 4.1: Hot and cold objects

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

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

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

Activity 4.1

Take three small tubs/containers. Label them as A, B and C. Put cold water in mug A and hot water in mug B. Mix

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

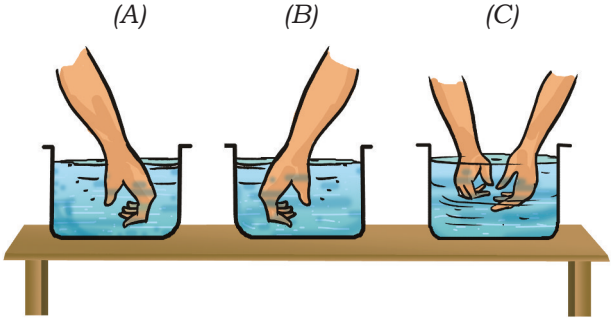


Fig. 4.1 *Feeling water in three containers*

some cold and hot water in mug C. Now dip your left hand in mug A and the right hand in mug B. After keeping the hands in the two mugs for 2–3 minutes, put both the hands simultaneously in mug C (Fig. 4.1). Do both the hands get the same feeling?

Boojho says,"My left hand tells me that the water in mug C is hot and the right hand tells me that the same water is cold. What should I conclude?"

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

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

4.2 Measuring Temperature

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

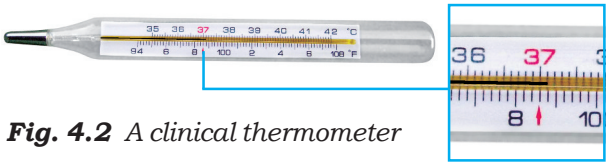


Fig. 4.2 *A clinical thermometer*

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 °C.

Boojho wondered which of the two scales shown in Fig. 4.2 he should read. Paheli told him that India has adopted the celsius scale and we should read that scale. The other scale with the range 94–108 degrees is the Fahrenheit scale (°F). It was in use earlier.

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

Activity 4.2

Reading a thermometer

Let us learn how to read a thermometer. First, note the temperature difference indicated between the two bigger marks. Also note down the number of divisions

Precautions to be observed while using 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.

(shown by smaller marks) between these marks. Suppose the bigger marks read one degree and there are five divisions between them. Then, one small division can read $\frac{1}{5} = 0.2\,°C$.

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

Fig. 4.3 *Correct method of reading a clinical thermometer*

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.

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

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

Activity 4.3

Measure the body temperature of some of your friends (at least 10) with a

Table 4.2: Body temperature of some persons

Name	Temperature (°C)

clinical thermometer. Record your observations as in Table 4.2.

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. That is the reason that this thermometer has the range 35°C to 42°C.

Boojho got a naughty idea. He wanted to measure the temperature of hot milk using a clinical thermometer. Paheli 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.

4.3 Laboratory Thermometer

How do we measure the temperature of other objects? For this purpose, there are other thermometers. One such thermometer is known as the laboratory thermometer. The teacher will show you

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.

this thermometer. Look at it carefully and note the highest and the lowest temperature it can measure. The range of a laboratory thermometer is generally from –10°C to 110°C (Fig. 4.4). Also, as you did in the case of the clinical thermometer, find out how much a small division on this thermometer reads. You would need this information to read the thermometer correctly.

Let us now learn how this thermometer is used.

Activity 4.4

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

Fig. 4.4 *A laboratory thermometer*

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

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

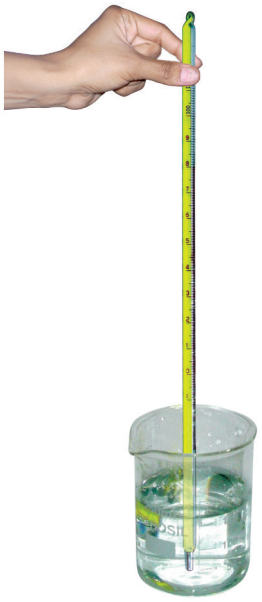


Fig. 4.5 *Measuring temperature of water with a laboratory thermometer*

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

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

Let us try to answer this question.

Activity 4.5

Take some hot water in a beaker or a mug. Dip the thermometer in water. Wait till the mercury thread becomes steady and note the temperature. Now take out the thermometer from water. Observe carefully what happens now. Do you notice that as soon as you take the 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

Boojho now understands 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.

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

body temperature? Obviously, it is not convenient to use the laboratory thermometer for this purpose.

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

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

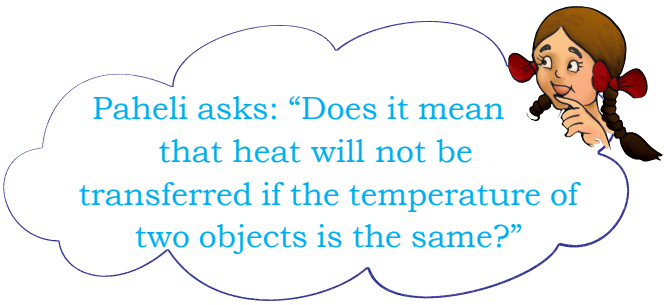
What is the use of the kink? It prevents mercury level from falling on its own.

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

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

4.4 Transfer of Heat

You might have observed that a frying pan becomes 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.

Activity 4.6

Take a rod or flat strip of a metal, say of aluminium or iron. Fix a few small wax pieces on the rod. These pieces should be at nearly equal distances (Fig. 4.7). Clamp the rod to a stand. If you do not find a stand, you can put one end of the rod in between bricks. Now, heat the other end of the rod and observe.

What happens to the wax pieces? Do these pieces begin to fall? Which piece falls the first? Do you think that heat is

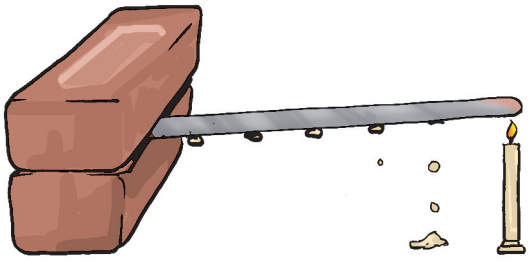


Fig. 4.7 *Flow of heat through a metal strip*

transferred from the end nearest to the flame to the other end?

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

Fig. 4.8 *Conduction of heat by different materials*

heat is transferred by the process of conduction.

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

Activity 4.7

Heat water in a small pan or a beaker. Collect some articles such as a steel spoon, plastic scale, pencil and divider. Dip one end of each of these articles in hot water (Fig. 4.8). Wait for a few minutes. Touch the other end. Enter your observation in Table 4.3.

Table 4.3

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

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

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

Activity 4.8

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

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

When water is heated, the water near the flame gets hot. Hot water rises up. The cold water from the sides moves down towards the source of heat. This water also gets hot and rises

Fig. 4.9 *Convection of heat in water*

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?

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

Activity 4.9

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

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

Fig. 4.10 *Transfer of heat by convection in air*

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

The people living in the coastal areas experience an interesting phenomenon. During the day, the land gets heated faster than the water. The air over the land becomes hotter and rises up. The cooler air from the sea rushes in towards the land to take its place. The warm air from the land moves towards the sea to complete the cycle (Fig. 4.11). 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. The water cools down more slowly than the land. So, the cool air from the land moves towards the sea. This is called the **land breeze**.

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.

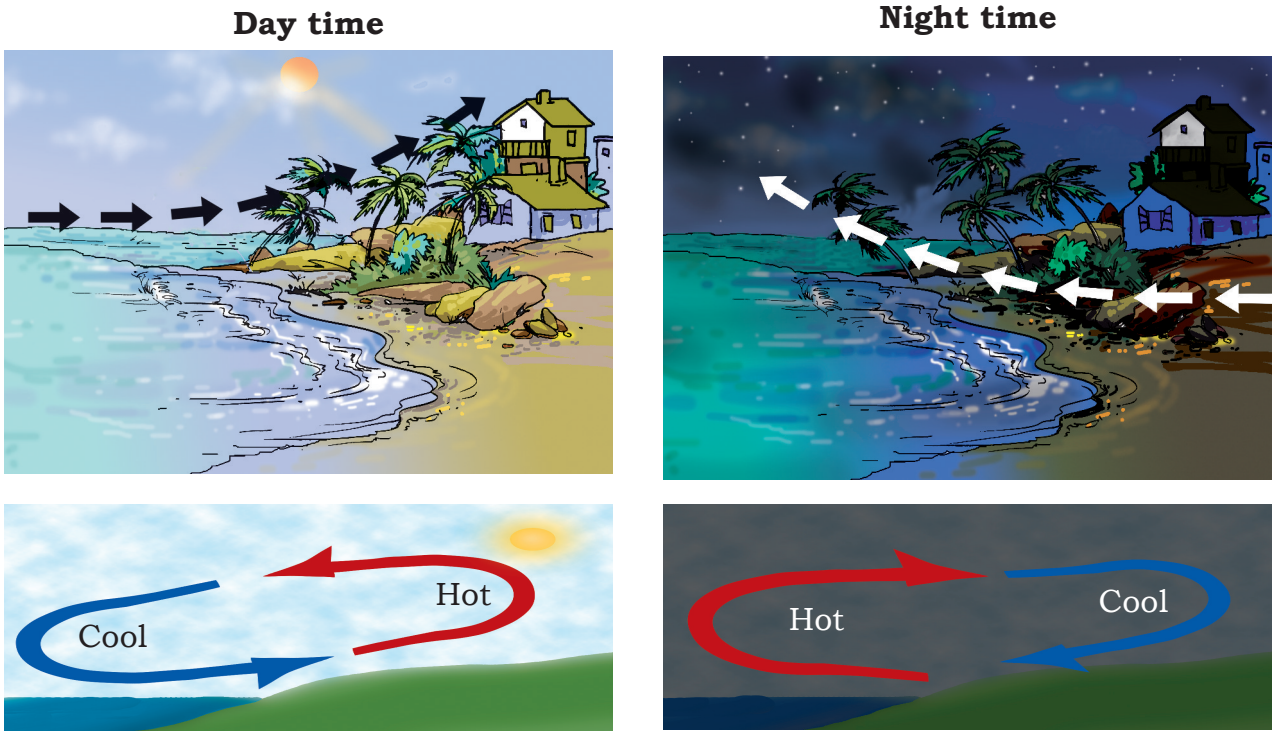


Fig. 4.11 *Sea breeze and Land breeze*

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 transfers heat to the surroundings by radiation. Our body too, gives heat to the surroundings and receives heat from it by radiation.

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

4.5 Kinds of Clothes We Wear in Summer and Winter

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

Activity 4.10

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

We often use electricity and fuels like coal and wood to keep our houses cool or warm. Is it possible to construct buildings, that are not affected much by heat and cold outside? This can be done by constructing outer walls of buildings so that they have trapped layers of air. One way of doing this is to use hollow bricks, which are available these days.

Fig. 4.12 *Containers with black and white surface*

which can is the water warmer? You can feel the difference even by touching water in the two cans.

Activity 4.11

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

Do these activities suggest to you the reason why it is more comfortable to wear white or light-coloured clothes in the summer and dark-coloured clothes in the winter? 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 more 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	Insulator	Sea breeze
Conduction	Land breeze	Temperature
Conductor	Radiation	Thermometer
Convection		

What you have learnt

- Our sense of touch is not always a reliable guide to the degree of hotness of an object.
- Temperature is a measure of the degree of hotness of an object.
- Thermometer is a device used for measuring temperature.
- Clinical thermometer is used to measure our body temperature. The range of this thermometer is from 35°C to 42°C. For other purposes, 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. In liquids and gases the heat is transferred by convection. No medium is required for transfer of heat by radiation.
- The materials which allow heat to pass through them easily are conductors of heat.
- The materials which do not allow heat to pass through them easily are called insulators.
- Dark-coloured objects absorb more heat 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 an 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 spoon is dipped in a cup of hot milk. Heat is transferred to its other end by the process of _____.

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

4. Match the following :

(i)	Land breeze blows during	(a)	summer
(ii)	Sea breeze blows during	(b)	winter
(iii)	Dark coloured clothes are preferred during	(c)	day
(iv)	Light coloured clothes are preferred during	(d)	night

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

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

Fig. 4.13

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

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

Extended 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.

   You can add more questions which come to your mind.
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 paper strip tightly around an iron rod. Try to burn the paper with candle while rotating the iron rod continuously. Does it burn? Explain your observation.

4. Take a sheet of paper. Draw a spiral on it as shown in the Fig. 4.14. Cut out the paper along the line. Suspend the paper as shown in Fig. 4.14 above a lighted candle. Observe what happens. Think of an explanation.

Fig. 4.14

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 top of the hot water bottle. Hold both the bottles firmly. Ask some other person to pull the postcard. Observe what happens. Explain.

Did you know?

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

5 Acids, Bases and Salts

We use in our daily life a large number of substances such as lemon, tamarind, common salt, sugar and vinegar. Do they have the same taste? Let us recall tastes of some edible substances listed in Table 5.1. If you have not tasted any of these substances taste it now and enter the result in Table 5.1.

CAUTION

1. Do not taste anything unless asked to do so.
2. Do not touch anything unless asked to do so.

Table 5.1

Substance	Taste (sour/bitter/ any other)
Lemon juice	
Orange juice	
Vinegar	
Curd	
Tamarind (*imli*)	
Sugar	
Common salt	
Amla	
Baking soda	
Grapes	
Unripe mango	
Cucumber	

You find that some of these substances taste sour, some taste bitter, some taste sweet and some taste salty.

5.1 Acids and Bases

Curd, lemon juice, orange juice and vinegar taste sour. These substances taste sour because they contain **acids**. The chemical nature of such substances is **acidic**. The word acid comes from the Latin word *acere* which means sour. The acids in these substances are natural acids.

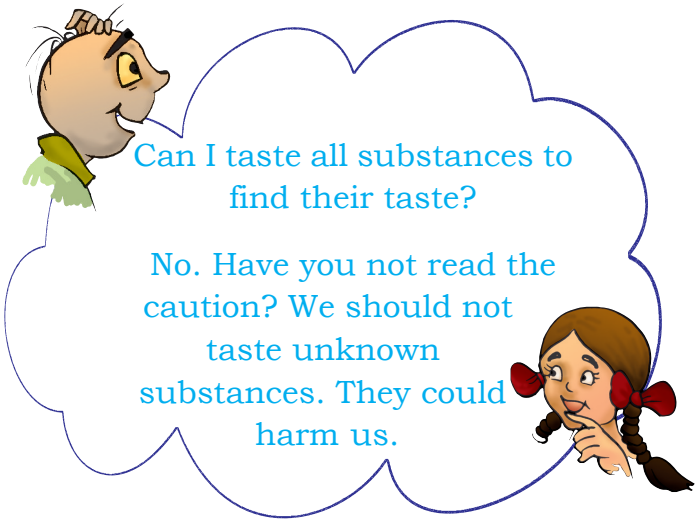
What about baking soda? Does it also taste sour? If not, what is its taste? Since, it does not taste sour it means, that it has no acids in it. It is bitter in taste. If you rub its solution between fingers, it feels soapy. Generally, substances like these which are bitter in taste and feel soapy on touching are known as **bases**. The nature of such substances is said to be **basic**.

If we cannot taste every substance, how do we find its nature?

Special type of substances are used to test whether a substance is acidic or basic. These substances are known as **indicators**. The indicators change their colour when added to a solution containing an acidic or a basic substance. Turmeric, litmus, china rose petals (*Gudhal*), etc., are some of the naturally occurring indicators.

Do you know?

Name of acid	Found in
Acetic acid	Vinegar
Formic acid	Ant's sting
Citric acid	Citrus fruits such as oranges, lemons, etc.
Lactic acid	Curd
Oxalic acid	Spinach
Ascorbic acid (Vitamin C)	*Amla*, Citrus fruits
Tartaric acid	Tamarind, grapes, unripe mangoes, etc.
All the acids mentioned above occur in nature	
Name of base	**Found in**
Calcium hydroxide	Lime water
Ammonium hydroxide	Window cleaner
Sodium hydroxide/ Potassium hydroxide	Soap
Magnesium hydroxide	Milk of magnesia

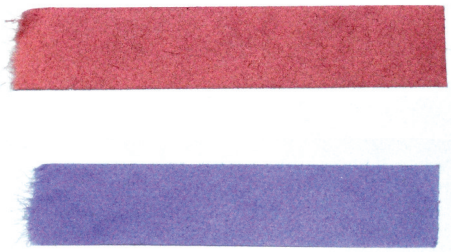


5.2 Natural Indicators around Us

Litmus: A natural dye

The most commonly used natural indicator is litmus. It is extracted from **lichens** (Fig. 5.1a). It has a mauve (purple) colour in distilled water. When added to an acidic solution, it turns red and when added to a basic solution, it turns blue. It is available in the form of a solution, or in the form of strips of paper, known as litmus paper. Generally, it is **available as red and blue litmus paper** (Fig. 5.1b).

(a)



(b)

Fig. 5.1 *(a) Lichens, and (b) Red and blue litmus paper*

Activity 5.1

- Mix some water with lemon juice in a plastic cup/tumbler/test tube.
- Put a drop of the above solution on a strip of the red litmus paper with the help of a dropper.
  Is there any change in colour?
- Repeat the same exercise with the blue litmus paper.

Note down if there is any change in colour.

Perform the same activity with the following substances:

Tap water, detergent solution, aerated drink, soap solution, shampoo, common salt solution, sugar solution, vinegar, baking soda solution, milk of magnesia, washing soda solution, lime water. If possible make solutions in distilled water.

Record your observations as in Table. 5.2.

In your Table, are there any substances on which litmus had no effect? Name those substances.

The solutions which do not change the colour of either red or blue litmus are known as **neutral** solutions. These substances are neither acidic nor basic.

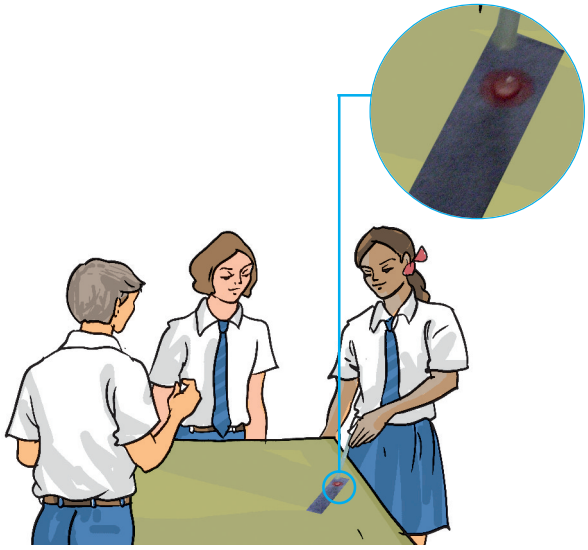


Fig. 5.2 *Children performing litmus test*

Turmeric is another natural indicator

Activity 5.2

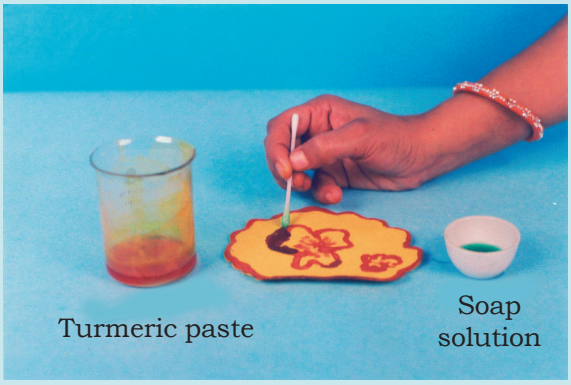
- Take a tablespoonful of turmeric powder. Add a little water and make a paste.
- Make turmeric paper by depositing turmeric paste on blotting paper/filter paper and drying it. Cut thin strips of the yellow paper obtained.
- Put a drop of soap solution on the strip of turmeric paper.
  What do you observe?

To prepare limewater, take some water in a tumbler and add some lime (*chuna*) into it. Stir the solution and keep it for some time. Pour a little from the top. This is lime water.

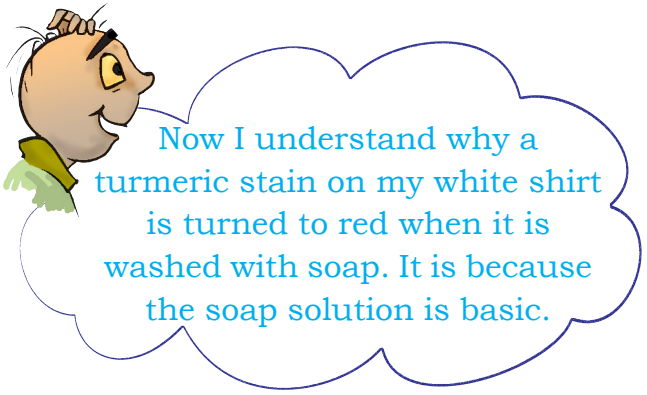
Table 5.2

S. No.	Test solution	Effect on red litmus paper	Effect on blue litmus paper	Inference

You can prepare a greeting card for your mother on her birthday. Apply turmeric paste on a sheet of plane white paper and dry it. Draw a beautiful flower with soap solution with the help of a cotton bud. You will get a beautiful greeting card.



Similarly test the solutions listed in Table 5.3 and note down your observations. You may try solutions of other substances also.



China Rose as Indicator

Activity 5.3

Collect some China rose (*Gudhal*) petals and place them in a beaker. Add some

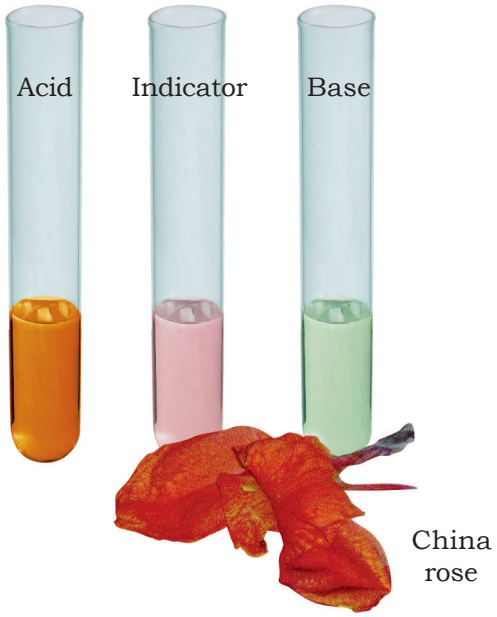


Fig. 5.3 *China rose flower and indicator prepared from it*

Table 5.3

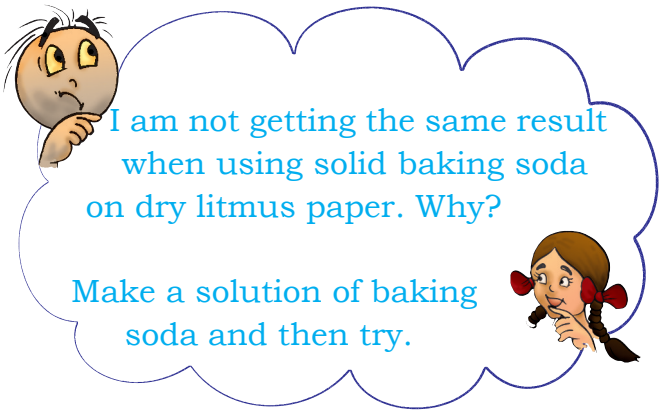
S. No.	Test solution	Effect on turmeric solution	Remarks
1.	Lemon juice		
2.	Orange juice		
3.	Vinegar		
4.	Milk of magnesia		
5.	Baking soda		
6.	Lime water		
7.	Sugar		
8.	Common salt		

Table 5.4

S. No.	Test solution	Initial colour	Final colour
1.	Shampoo (dilute solution)		
2.	Lemon juice		
3.	Soda water		
4.	Sodium hydrogencarbonate solution		
5.	Vinegar		
6.	Sugar solution		
7.	Common salt solution		

warm water. Keep the mixture for some time till water becomes coloured. Use the coloured water as an indicator. Add five drops of the indicator to each of the solutions given in Table 5.4.

What is the effect of the indicator on acidic, basic and neutral solutions? China rose indicator (Fig. 5.3) turns acidic solutions to dark pink (magenta) and basic solutions to green.



Paheli brought the following paheli (riddle) for you.

Coffee is brown
And bitter in taste.
Is it an acid?
Or a base?
Don't give the answer
Without any test,
You are in the dark
With its taste.

Activity 5.4

The teacher is requested to get the dilute solution of the following chemicals from his/her school laboratory or from a nearby school: hydrochloric acid, sulphuric acid, nitric acid, acetic acid, sodium hydroxide, ammonium hydroxide, calcium hydroxide (lime water).

Table 5.5

S. No.	Name of acid	Effect on litmus paper	Effect on turmeric paper	Effect on China rose solution
1.	Dilute hydrochloric acid			
2.				
3.				

Are you familiar with the term acid rain? Have you ever heard about damaging effect of acid rain? As the name indicates the rain containing excess of acids is called an acid rain. Where do these acids come from? The rain becomes acidic because carbon dioxide, sulphur dioxide and nitrogen dioxide (which are released into the air as pollutants) dissolve in rain drops to form carbonic acid, sulphuric acid and nitric acid respectively. Acid rain can cause damage to buildings, historical monuments, plants and animals.

CAUTION

Great care should be taken while handling laboratory acids and bases because these are corrosive in nature, irritating and harmful to skin.

Demonstrate the effect of the three indicators on each of these solutions. Record your observations in Table 5.5.

5.3 Neutralisation

We have learnt that acids turn blue litmus red and bases turn red litmus blue. Let us see what happens when an acid is mixed with a base.

We are going to use an indicator you have not used so far. It is called **phenolphthalein**.

Activity 5.5

To be demonstrated by the teacher in the class

Fill one fourth of a test tube with dilute hydrochloric acid. Note down its colour. Note down the colour of phenolphthalein solution also. Add 2–3 drops of the indicator to the acid. Now shake the test tube gently. Do you observe any change in colour of the acid?

Add to the acidic solution a drop of sodium hydroxide solution by a dropper. Stir the tube gently. Is there any change in the colour of the solution? Continue adding the sodium hydroxide solution drop by drop while stirring till the pink colour just appears.

Now add one more drop of dilute hydrochloric acid. What do you observe? The solution again becomes colourless. Again add one drop of sodium hydroxide solution. Is there any change in colour? The solution again becomes pink in colour.

It is evident that when the solution is basic, phenolphthalein gives a pink colour. On the other hand, when the solution is acidic, it remains colourless.

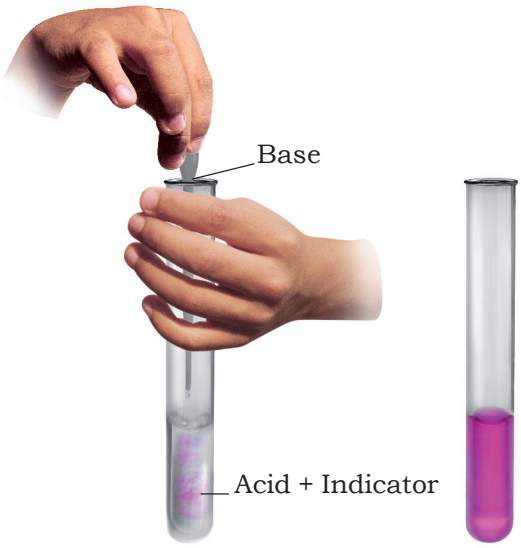


Fig. 5.4 *Process of neutralisation*

When an acidic solution is mixed with a basic solution, both the solutions neutralise the effect of each other. When an acid solution and a base solution are mixed in suitable amounts, both the acidic nature of the acid and the basic nature of the base are destroyed. The resulting solution is neither acidic nor basic. Touch the test tube immediately after neutralisation. What do you observe? In neutralisation reaction, heat is always produced, or evolved. The evolved heat raises the temperature of the reaction mixture.

In neutralisation reaction a new substance is formed. This is called **salt**. Salt may be acidic, basic or neutral in nature. Thus, neutralisation can be defined as follows:

The reaction between an acid and a base is known as neutralisation. Salt and water are produced in this process with the evolution of heat.

Acid+Base → Salt+Water
(Heat is evolved)

The following reaction is an example:

Hydrochloric acid (HCl) + Sodium hydroxide (NaOH) →

Sodium chloride (NaCl) + Water (H_2O)

Boojho added dilute sulphuric acid to lime water. Will the reaction mixture become hot or cool?

5.4 Neutralisation in Everyday Life

Indigestion

Our stomach contains hydrochloric acid. It helps us to digest food, as you have learnt in Chapter 2. But too much of acid in the stomach causes indigestion. Sometimes indigestion is painful. To relieve indigestion, we take an antacid such as milk of magnesia, which contains magnesium hydroxide. It neutralises the effect of excessive acid.

Ant bite

When an ant bites, it injects the acidic liquid (formic acid) into the skin. The effect of the acid can be neutralised by rubbing moist baking soda (sodium hydrogencarbonate) or calamine solution, which contains zinc carbonate.

Soil treatment

Excessive use of chemical fertilisers makes the soil acidic. Plants do not grow well when the soil is either too **acidic** or too **basic**. When the soil is too acidic, it is treated with bases like quick lime (calcium oxide) or slaked lime (calcium hydroxide). If the soil is basic, organic matter (compost) is added to it. Organic matter releases acids which neutralises the basic nature of the soil.

Factory wastes

The wastes of many factories contain acids. If they are allowed to flow into the water bodies, the acids will kill fish and other organisms. The factory wastes are, therefore, neutralised by adding basic substances.

Keywords

Acid	Basic	Neutralisation
Acidic	Indicator	Salt
Base	Neutral	

What you have learnt

- Acids are sour in taste. Generally, bases are bitter in taste and soapy to touch.
- Acid turns blue litmus red. Bases turn red litmus blue.
- Substances which are neither acidic nor basic are called neutral.
- Solutions of substances that show different colour in acidic, basic and neutral solutions are called indicators.
- An acid and a base neutralise each other and form a salt. A salt may be acidic, basic or neutral in nature.

Exercises

1. State differences between acids and bases.
2. Ammonia is found in many household products, such as window cleaners. It turns red litmus blue. What is its nature?
3. Name the source from which litmus solution is obtained. What is the use of this solution?
4. Is the distilled water acidic/basic/neutral? How would you verify it?
5. Describe the process of neutralisation with the help of an example.
6. Mark 'T' if the statement is true and 'F' if it is false:
   (i) Nitric acid turn red litmus blue. (T/F)
   (ii) Sodium hydroxide turns blue litmus red. (T/F)
   (iii) Sodium hydroxide and hydrochloric acid neutralise each other and form salt and water. (T/F)
   (iv) Indicator is a substance which shows different colours in acidic and basic solutions. (T/F)
   (v) Tooth decay is caused by the presence of a base. (T/F)
7. Dorji has a few bottles of soft drink in his restaurant. But, unfortunately, these are not labelled. He has to serve the drinks on the demand of customers. One customer wants acidic drink, another wants basic and third one wants neutral drink. How will Dorji decide which drink is to be served to whom?
8. Explain why:
   (a) An antacid tablet is taken when you suffer from acidity.

(b) Calamine solution is applied on the skin when an ant bites.

(c) Factory waste is neutralised before disposing it into the water bodies.

9. Three liquids are given to you. One is hydrochloric acid, another is sodium hydroxide and third is a sugar solution. How will you identify them? You have only turmeric indicator.

10. Blue litmus paper is dipped in a solution. It remains blue. What is the nature of the solution? Explain.

11. Consider the following statements:

(a) Both acids and bases change colour of all indicators.

(b) If an indicator gives a colour change with an acid, it does not give a change with a base.

(c) If an indicator changes colour with a base, it does not change colour with an acid.

(d) Change of colour in an acid and a base depends on the type of the indicator.

Which of these statements are correct?

(i) All four (ii) a and d (iii) b, c and d (iv) only d

Extended Learning — Activities and Projects

1. Using the knowledge of acids and bases, write a secret message with the help of baking soda and beet root. Explain how it works.

(**Hint:** Prepare baking soda solution in water. Use this solution to write the message on a sheet of white paper with a cotton bud. Rub a slice of fresh beet root over the message.)

2. Prepare red cabbage juice by boiling a piece of red cabbage in water. Use it as an indicator and test the acidic and basic solutions with it. Present your observations in the form of a table.

3. Bring the soil sample of your area, find out if it is acidic, basic or neutral. Discuss with farmers if they treat the soil in any manner.

4. Visit a doctor. Find out the medicines, he prescribes to treat acidity. Ask him how acidity can be prevented.

Did you know?

Each cell in our body contains an acid, the **deoxyribonucleic acid** or **DNA**. It controls every feature of the body such as our looks, colour of our eyes, our height etc. Proteins that build part of our cells are also made of **amino acids**. The fats in our body contain **fatty acids**.