1 Nutrition in Plants

0758CH01

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 synthesise 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

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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**.

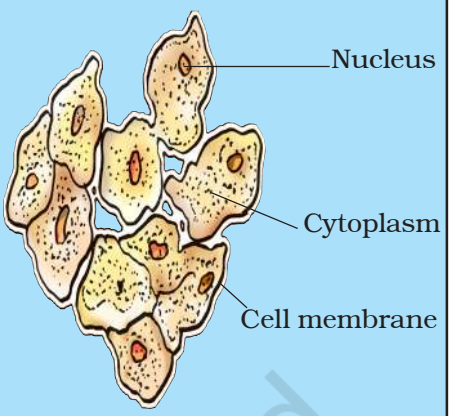


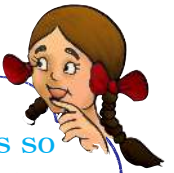
Fig. 1.1 Cell

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 7.



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 combine). So we find that chlorophyll, sunlight, carbon dioxide and water are necessary to carry out the process of photosynthesis. It is a unique process on the earth. The solar energy is captured by the leaves and stored in the plant in the form of food. **Thus, sun is the ultimate source of energy for all living organisms**.

Can you imagine life on earth 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

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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:

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

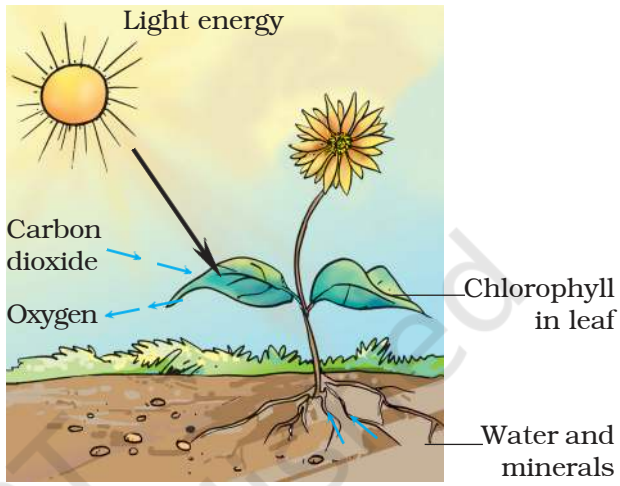


Fig. 1.3 Diagram showing photosynthesis

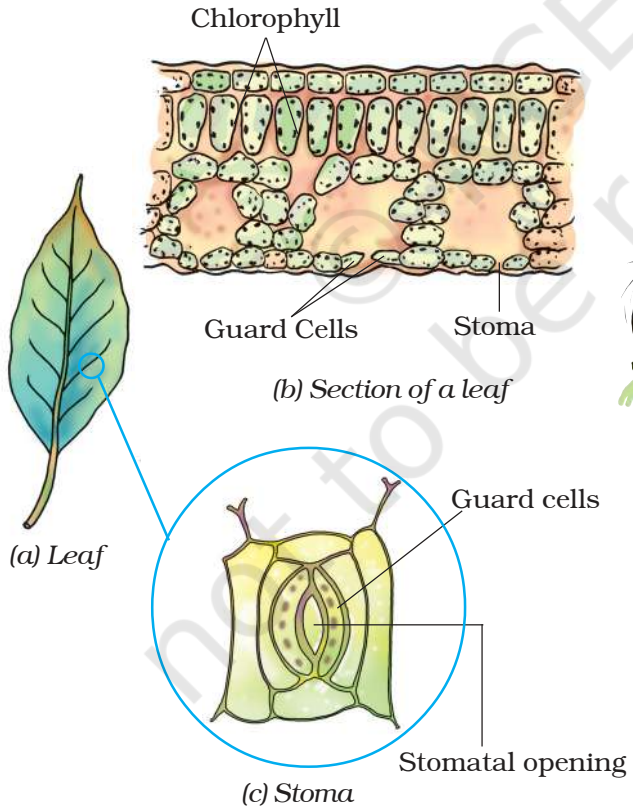
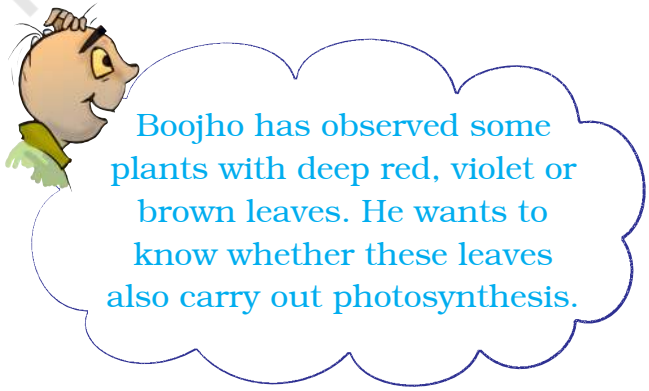


Fig. 1.2

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



Activity 1.1

Take two potted plants of the same kind. Keep one in the dark (or in a black box) for 72 hours and the other in sunlight.

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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,

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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 are directed downwards. When an insect lands in the pitcher, the lid closes and the trapped insect gets entangled into the hair. The lid closes and the insect is trapped. The insect is digested by the digestive 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?

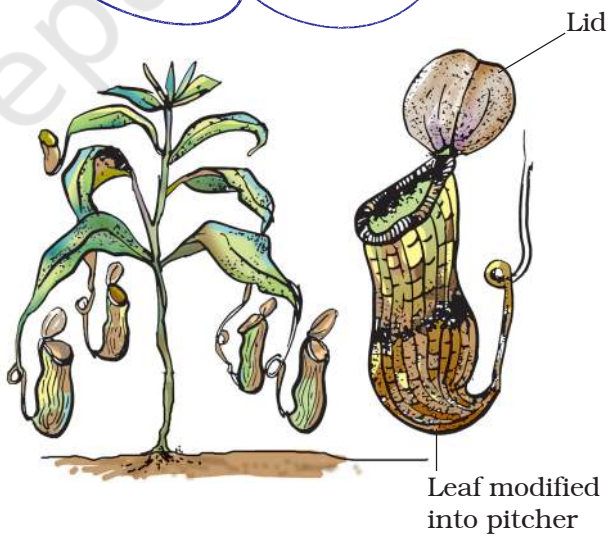


Fig. 1.6 *Pitcher plant showing lid and pitcher*

1.4 Saprotrophs

You might have seen packets of mushrooms sold in the vegetable

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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.

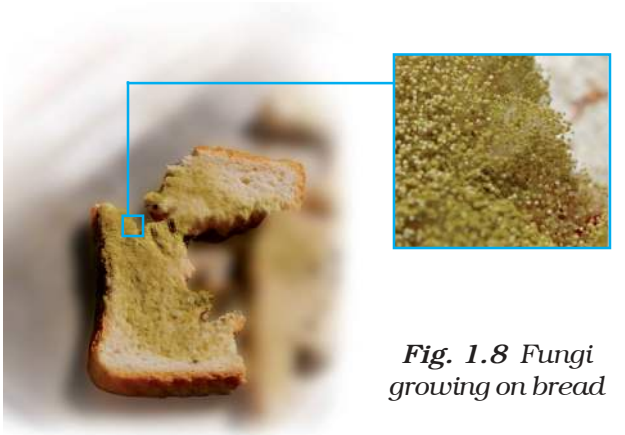


Fig. 1.8 Fungi growing on bread

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.

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

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



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. 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

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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.

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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)

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(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.

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