

# Nutrition in Plants

1

## LEARNING OBJECTIVES

After completion of the chapter, students will be able to

1. understand different modes of nutrition.
2. explain photosynthesis and materials required to carry out photosynthesis.
3. demonstrate the importance of photosynthesis.
4. differentiate between autotrophic and heterotrophic nutrition.
5. describe the way plants synthesise proteins.

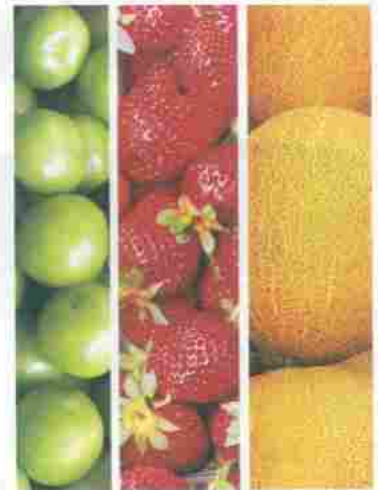
Each living organism requires to carry out basic processes (such as reproduction, growth, nutrition, respiration, etc.) to maintain life. For carrying out all the life processes, each living organism needs daily supply of energy which is provided by the food consumed by them.

Food contains substances that provide nourishment to the body. These are called nutrients.

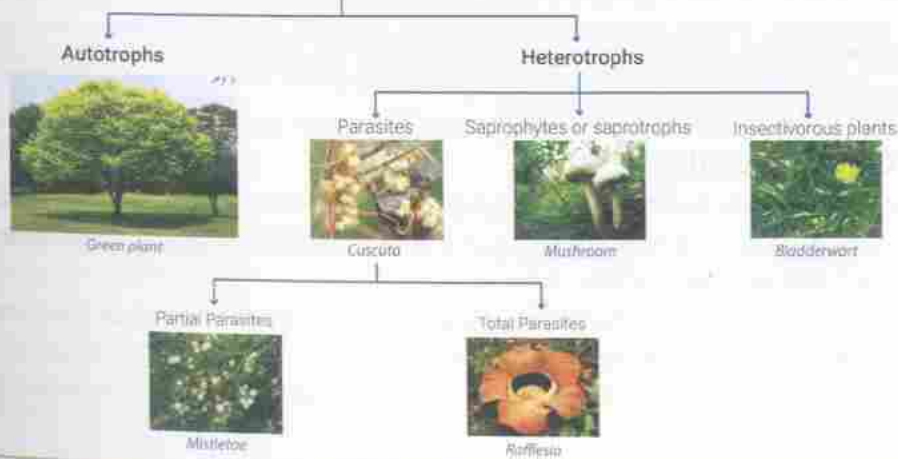
### ► What is Nutrition?

The process of taking in food by an organism and its utilisation by the body is known as nutrition.

There are two modes of nutrition in living organisms: Autotrophic nutrition and Heterotrophic nutrition.



### NUTRITION IN PLANTS





**Autotrophic Nutrition:** The word 'auto' means self and 'trophos' means nourishment. Autotrophic plants make their own food by the process known as photosynthesis. All green plants and some bacteria are able to prepare their own food and are known as autotrophs.

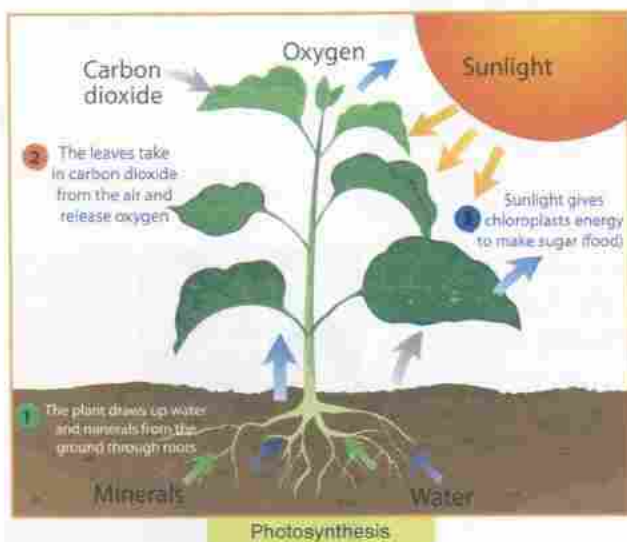
**Heterotrophic Nutrition:** The word 'heteros' means other and 'trophos' means nutrition. Heterotrophic organisms obtain their food from the bodies of other organisms.

### ► Autotrophic Mode of Nutrition

Green plants can make their own food. The synthesis of food takes place in leaves as leaves are the food factory of the plants.

Those organisms which can make food themselves from simple substances by the process of photosynthesis are called **autotrophs**.

### Photosynthesis



The process by which green plants can produce their own food and energy using carbon dioxide and water in the presence of sunlight is known as **photosynthesis**.

The process of photosynthesis (*photo* = light; *synthesis* = to combine) can be summarised as:



In this process, a simple carbohydrate called 'glucose' is produced as food. The glucose is then converted into a complex carbohydrate called 'starch'. The starch is stored as food in the various parts of plant. Oxygen gas produced during photosynthesis, goes into the air and is utilised by all the living organisms for their survival.

### Materials Required for Photosynthesis

The materials required to carry out photosynthesis are as follows:

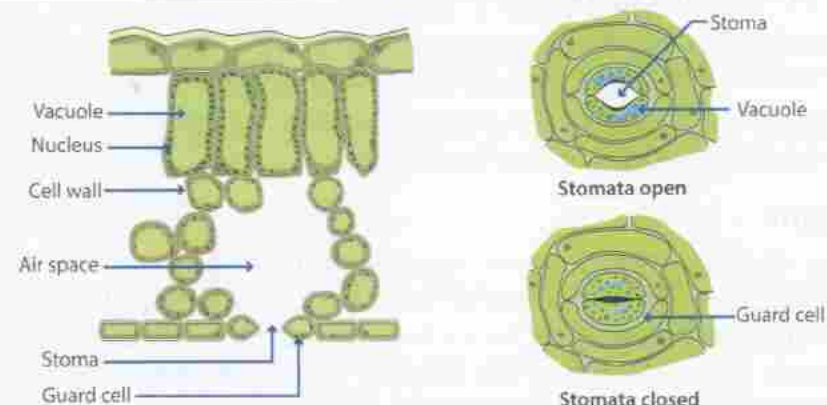
#### 1. Water and Minerals

The roots of a plant absorb water and nutrients from the soil with the help of root hairs. Plants have tissues (xylem) through which minerals and water move from the roots upwards to the leaves. Photosynthesis can only occur with the help of water.

#### 2. Carbon dioxide

It is taken from the air by the plants. Carbon dioxide from the air is taken in through tiny pores present on the leaves called **stomata**. Stomata are surrounded by guard cells.

The guard cells control the opening and closing of stomata. These are present abundantly on the lower surface of a leaf. Oxygen is released from the stomata as a waste product of photosynthesis from the plant body.



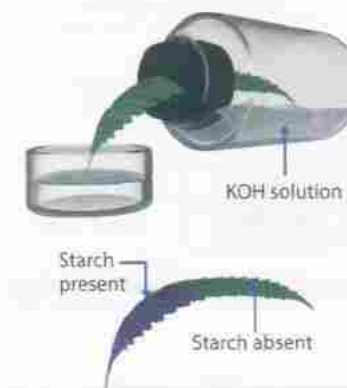
A section through a leaf

Open and closed stomata

### ACTIVITY 1.1

**To prove that carbon dioxide is necessary for photosynthesis**

- Take a potted plant with long leaves and place it in the dark for 2–3 days to make it starch free.
- Take a leaf from this plant and insert half of it in a bottle containing caustic potash through a split cork.
- Caustic potash absorbs carbon dioxide, hence the portion of the leaf in the bottle will not get carbon dioxide.
- The portion of the leaf outside the bottle will get carbon dioxide.
- Cork the bottle and place it in sunlight for a few hours.
- Test the leaf for starch. Make a note of the part of the leaf that turns blue-black.



### 3. Chlorophyll

The leaves have a green pigment called chlorophyll that helps it to capture light energy from the sun. It is present in chloroplasts. Without chlorophyll, plants cannot use energy of the sunlight to prepare their food.

### ACTIVITY 1.2

**To prove that green plants produce food or starch by photosynthesis (or chlorophyll is essential for photosynthesis)**

- Take a variegated croton leaf which contains green coloured patches. (Variegated means some parts of the leaves are white due to absence of chlorophyll).
- Boil it in alcohol in a water bath to dissolve out green pigment and decolourise the leaf.
- Remove the leaf from boiling alcohol and dip it in hot water.
- Spread the decolourised leaf on a flat white surface and drop iodine solution on it. The parts containing green portion will turn blue-black but the white parts will stain brown or yellow with iodine.
- Thus, starch is present only in the green area (where chlorophyll is present) of the leaf.

#### Do You Know?

Only 0.02% of light energy falling on earth is used by plants for photosynthesis.



Variegated croton leaf



Leaf after tested with starch



### Leaves of Various Colours

The leaves having colours other than green also have chlorophyll in them. The large amount of red, brown, violet and other pigments mask the green colour. So, Photosynthesis takes place in these leaves also. eg., leaves of some plants such as coleus and croton are multicoloured.

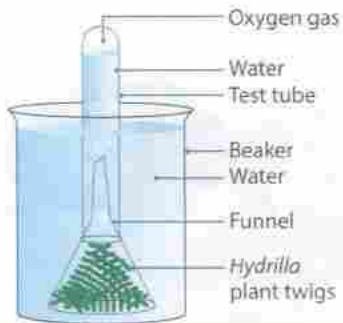
### 4. Sunlight

The solar energy captured by the leaves with the help of chlorophyll gets converted into the chemical energy of food. This chemical energy gets stored in the form of plant food. Since, all the food on this earth is made by utilising solar energy, therefore, sun is the ultimate source of energy for all living organisms.

### ACTIVITY 1.3

To prove that light is necessary for photosynthesis

- Take some twigs of an aquatic plant like *Hydrilla* in beaker filled with water.
- Invert a funnel over the twigs. Invert a test tube filled with water on the stem of the funnel.
- Keep this set-up in sunlight for sometime.
- What do you observe?
- You will notice air bubbles (oxygen gas) coming out from the twigs. If this set-up is kept in the dark, no air bubbles come out. This shows that sunlight is necessary for photosynthesis.



Light is necessary for photosynthesis



Algae

### Photosynthesis by Algae

You must have seen patches of slimy, green layer floating on the surface of a pond or lake or in other stagnant water bodies. These are generally formed by the growth of organisms called *Algae*. Algae are a large group of simple, plant like organisms. It contains chlorophyll which gives them the green colour. They can also prepare food by photosynthesis.

### Importance of Photosynthesis

- It is the most important biological process on which all living organisms depend, directly or indirectly, for food.
- This process maintains the balance of carbon dioxide and oxygen in the environment.
- It provides us oxygen for breathing.

**Note:** Photosynthesis takes place mostly in the green leaves of plants but in some plants like cactus, it takes place in the green fleshy stem, as the leaves are reduced to spines to reduce loss of water by transpiration.



### Synthesis of Plant Foods Other than Carbohydrate

Carbohydrates that plants synthesize during photosynthesis is made up of carbon, hydrogen and oxygen. These are used to synthesize other components such as proteins and fats.

- (i) **Plants Make Starch as Food:** Starch is stored in various parts of a plant such as roots, stem, leaves and seeds. e.g., Seeds of wheat and rice have

- a lot of starch. Potato and carrot plants store a lot of starch in their roots.
- (ii) **Plants Make Fats (Oils) as Food:** Seeds of sunflower plant contains oil stored in it. Such seeds are called oil-seeds.
- (iii) **Plants Make Proteins as Food:** Proteins contain nitrogen. Though, large amount of nitrogen is present in the air, plants cannot absorb this directly. They get nitrogen in two ways:
  - (a) Rhizobium bacteria present in the soil converts atmospheric nitrogen to water soluble compounds. Plants absorb these compounds along with water.
  - (b) Farmers add fertilisers rich in nitrogen to the soil.

### Sample Questions

1. Photosynthesis requires chlorophyll, and a few other raw materials. Add the missing raw materials to the list given below:  
Water, minerals, \_\_\_\_\_, \_\_\_\_\_ [NCERT Exemplar]
- Ans.** Sunlight/light energy, carbon dioxide.
2. A goat eats away all the leaves of a small plant (balsam). However, in a few days, new leaves could be seen sprouting in the plant again. How did the plant survive without leaves? [NCERT Exemplar]
- Ans.** Plants store the food they produced by photosynthesis in the stem and roots. So, when goat eat all the leaves of the plant, the plant fulfill its requirement by the food stored in stem and roots.

### ✓ CHECK YOUR PROGRESS

1. Observe the experimental set-up given in figure and answer the questions that follow:
  - (a) What is the aim of this experiment?
  - (b) Name a water plant that can be used in the experiment.
  - (c) Which gas is collected at the end of the experiment?
2. Study the equation given below and answer the questions that follow.



- (a) What does the equation depict?
- (b) Where does it occur?
- (c) What happens to the products?
- (d) What are the conditions required for this process to occur?

### ► Heterotrophic Mode of Nutrition

There are some plants which do not contain chlorophyll and so they cannot prepare their own food. They depend upon other plants or organisms to obtain their nourishment. These plants are said to have heterotrophic mode of nutrition and are called *heterotrophs*.



The orange wiry stems of dodder are attached to thyme plants

#### Do You Know?

Algae differ from plants as they do not have proper roots, stems and leaves.



Heterotrophs have been classified into following categories:

### Parasites



Fungi— A saprophyte

The organisms that derive nutrition from the body of other organisms are known as parasites. The organism that a parasite uses to derive its nutrition is called a **host**. All parasitic plants feed on other plants as either **partial parasites**, i.e., obtaining some of their nutrition from the host, or **total parasites**, i.e., dependent completely on the host for nutrition. Common examples of partial parasites are painted cup (parasitic on roots) and mistletoe (parasitic on branches of mango and *mahua trees*). Total parasitic plants are dodder, *Cuscuta (amarbel)*, certain tropical plants of the Rafflesiaceae family. The animals such as lice, bed bugs, leeches and mosquitoes that suck blood from our body are also parasites.

### Saprophytes

Saprophytes are those organisms that cannot manufacture their own food through the process of photosynthesis but obtain nutrition from dead and decaying plants and animal matter. Most common examples of saprophytes are mushrooms, moulds and certain types of fungi and bacteria. They secrete digestive juices on dead and decaying matter and convert it into a solution. Then they absorb the nutrients from it. This mode of nutrition in which organisms take in nutrients in **solution form** from dead and decaying matter is called **Saprotrophic nutrition**. Saprophytic organisms are commonly seen during or after the rain. Fungi are commonly seen growing on leather, clothes, pickles during the hot and humid weather.

Fungal spores are generally present in the air. They start germinating when they land on wet and warm things. Fungi can be useful as well as harmful. For example, fungi such as mushrooms and yeast are useful as they are used as a vegetable and a ingredient for producing alcohol respectively. Some fungi are used for making medicines. e.g., Penicillium. Fungi also cause diseases in plants and human beings.

### ACTIVITY 1.4

#### Observe the growth of moulds

- Take a slice of bread. Keep it on a plate and sprinkle some water on it.
- Keep it in a warm and dark place.
- Observe it after 2-3 days.
- You will notice some fluffy growth on it. These patches may be white, green, brown or of any other colour.
- Use a hand lens to see it; these are moulds.



Venus fly trap

### Insectivorous Plants

There are some green plants which obtain their nourishment partly from soil and atmosphere and partly from small insects are called **insectivorous plants**. Common examples of such plants are pitcher plant, bladderwort and Venus fly trap. These plants trap insects, kill them, consume them and throw out the

waste. These plants have leaves that are modified to catch insects.

In a pitcher plant, the leaf is modified into a pitcher-like structure. The tip of the leaf forms a lid that can open and close the mouth of the pitcher. Inside the pitcher, there are hairs which are directed downwards. When an insect gets attracted towards the pitcher and lands on it, the lid closes. The pitcher secretes digestive juices which digest the trapped insect.

Insectivorous plants do not get enough nitrogen and so, they eat insects to fulfill their need for nitrogen.

### Symbiotic Plants

This is another method of heterotrophic nutrition in which two different organisms live together and share shelter and nutrients is called **symbiotic relationship**. For example, certain fungi live in the roots of plants. Plants provide nutrients to the fungi and fungi, in turn, provides water and minerals. The association of algae and fungi form organisms called **lichens**. The algae and fungi mutually benefit each other and in the process fulfill all their needs. The alga makes food, which is also used by the fungus. The fungus, in turn, gives the alga, water and minerals it obtains from the substratum on which it lives.



Pitcher plant



Lichens

### Differences between autotrophic and heterotrophic plants

Autotrophic plants	Heterotrophic plants	
	Green plants	Parasites
<ul style="list-style-type: none"> <li>■ All green plants are able to manufacture their own food from inorganic substances through the process of photosynthesis.</li> </ul>	<ul style="list-style-type: none"> <li>■ These organisms live on or inside another living organism and derive their nutrition from the host wholly or partly without contributing anything to the latter.</li> </ul>	<ul style="list-style-type: none"> <li>■ These organisms cannot manufacture their own food by photosynthesis and instead derive their nutrition from dead and decaying plant and animal matter.</li> </ul>
<ul style="list-style-type: none"> <li>■ These plants contain the green pigment called chlorophyll.</li> </ul>	<ul style="list-style-type: none"> <li>■ They do not contain chlorophyll.</li> </ul>	<ul style="list-style-type: none"> <li>■ They do not contain chlorophyll.</li> </ul>
<ul style="list-style-type: none"> <li>■ Such organisms are totally dependent on themselves to meet their energy requirements.</li> </ul>	<ul style="list-style-type: none"> <li>■ Such organisms show partial or complete dependence on host for their survival.</li> </ul>	<ul style="list-style-type: none"> <li>■ Such organisms are dependent on dead autotrophs or heterotrophs.</li> </ul>
<ul style="list-style-type: none"> <li>■ These organisms lie at the base of a food chain.</li> <li>■ Examples: Rose, banyan tree and all green plants.</li> </ul>	<ul style="list-style-type: none"> <li>■ These organisms constitute higher levels in a food chain.</li> <li>■ Examples: Painted cup, mistletoe, <i>rafflesia</i>, etc.</li> </ul>	<ul style="list-style-type: none"> <li>■ These organisms act upon all levels in a food chain.</li> <li>■ Examples: Mushrooms, moulds, fungi, certain bacteria, etc.</li> </ul>

### ► How are Nutrients Replenished in the Soil?

We know that plants absorb mineral and nutrients from the soil. Plants require a lot of nitrogen to make proteins. Although the air contains a lot of nitrogen gas (in soluble form), it cannot be used by plants directly. Therefore, the atmospheric nitrogen is converted by various ways to a form that can be absorbed by plants. This is known as **nitrogen fixing**.

Some bacteria have the ability to fix nitrogen. The bacterium called *Rhizobium*



can take atmospheric nitrogen and convert it into a soluble form. *Rhizobium* cannot make its own food. It lives in the roots of peas, gram and other legumes and provides them nitrogen, in return, the plants provide food and shelter to the bacteria. Thus, they have a **symbiotic relationship**. This association is useful to farmers as they can reduce the use of nitrogen fertiliser to the soil.

### Sample Questions

Q. 1. Nitrogen is an essential nutrient for plant growth. But farmers who cultivate pulse crops like green gram, bengal gram, black gram, etc. do not apply nitrogenous fertilisers during cultivation. Why?

[NCERT Exemplar]

Ans. Roots of pulses (leguminous plants) have a symbiotic association with a bacterium called *Rhizobium* which fixes nitrogen. Hence, farmers need not use nitrogenous fertilisers.

Q. 2. Wheat dough if left in the open, after a few days, starts to emit a foul smell and becomes unfit for use. Give reason.

[NCERT Exemplar]

Ans. Carbohydrates in wheat dough, encourage growth of yeast and other saprophytic fungi which break down carbohydrates and emit a foul smell.

### ✓ CHECK YOUR PROGRESS

1. Match the columns.

**Column I**

- Host
- Pitcher plant
- Partial parasite
- Lichen
- Total parasite

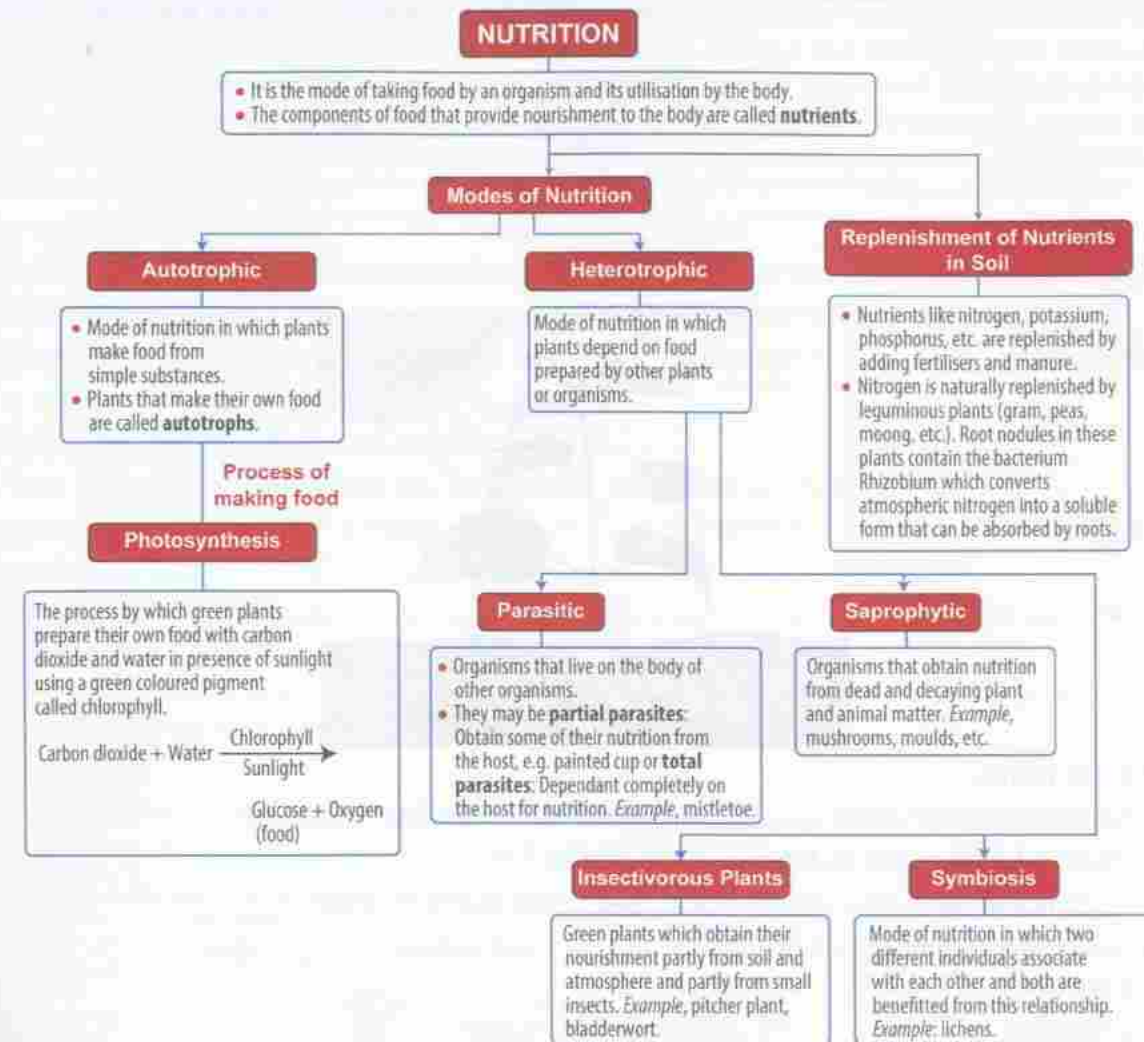
**Column II**

- Algae and fungi
- Cuscuta*
- Insectivorous
- Mistletoe
- Used by parasite

2. Give one word for the following:

- (a) These plants obtain their nitrogen supply from insects.
- (b) These organisms lie at the base of food chain.
- (c) The relationship between *Rhizobium* and roots of pea plant.
- (d) These are seen growing on leather during or after rain.

## SUMMARY—A FLOW CHART



### NCERT EXERCISE

Q. 1. Why do organisms take food?

Ans. Organisms need food for obtaining energy to do work, and for growth and development of body.

Q. 2. Distinguish between a parasite and a saprotroph.

Ans.

S.No.	Parasite	Saprotroph
(i)	They obtain nutrition from the body of other organisms.	They obtain nutrition from dead and decaying plants and animals.
(ii)	Example: <i>Cuscuta</i> , dodder, etc	Example: Mushroom, moulds, etc.

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

Ans. (i) Take two potted plants of the same kind.  
 (ii) Keep one in the dark (or in a black box) for 72 hours and the other in the sunlight.  
 (iii) Take one leaf from each of the plants.  
 (iv) Put few drops of iodine solution on each of the leaves.  
 (v) The leaf kept in the sunlight will turn blue-black due to presence of starch formed by photosynthesis, while the leaf kept in the dark will not turn blue-black because of absence of starch.



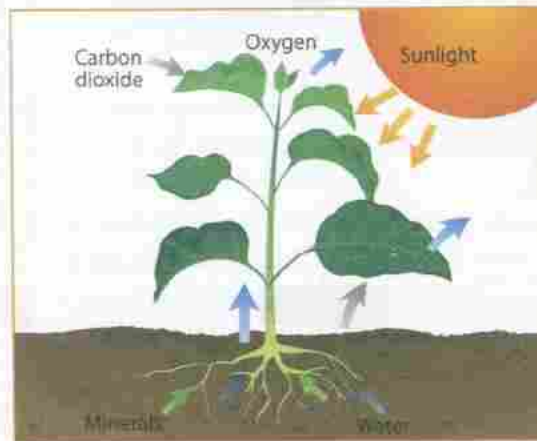
Q. 4. Give a brief description of the process of synthesis of food in green plants.

Ans. The process of synthesis of food in green plants is called photosynthesis. The raw materials for this process are water, carbon dioxide and sunlight. Water and minerals present in the soil are absorbed by the roots and transported to the leaves. Carbon dioxide from air is taken in through the stomata present on the leaf surface. During photosynthesis, chlorophyll containing cells of leaves, in the presence of sunlight, use carbon dioxide and water to synthesise carbohydrates. The process can be represented as an equation:



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

Ans.



Q. 6. Fill in the blanks.

- (a) Green plants are called \_\_\_\_\_ since they synthesise their own food.
- (b) The food synthesised by the plants is stored as \_\_\_\_\_.
- (c) In photosynthesis solar energy is absorbed by the pigment called \_\_\_\_\_.
- (d) During photosynthesis plants take in \_\_\_\_\_ and release \_\_\_\_\_ gas.

Ans. (a) autotrophs (b) starch  
(c) chlorophyll (d) carbon dioxide, oxygen

Q. 7. Name the following:

- (a) A parasitic plant with yellow, slender and tubular stem.
- (b) A plant that is partially autotrophic.
- (c) The pores through which leaves exchange gases.

Ans. (a) *Cuscuta* (b) Pitcher plant (c) Stomata

Q. 8. Tick the correct answer:

- (i) *Cuscuta* is an example of
  - (a) autotroph
  - (b) parasite
  - (c) saprotroph
  - (d) host
- (ii) The plant which traps and feeds on insects is
  - (a) *Cuscuta*
  - (b) china rose
  - (c) Pitcher plant
  - (d) Rose

Ans. (i)–(b); (ii)–(c).

Q. 9. Match the items given in Column I with those in Column II.

Column I	Column II
(a) Chlorophyll	(i) Bacteria
(b) Nitrogen	(ii) Heterotrophs
(c) <i>Cuscuta</i>	(iii) Pitcher plant
(d) Animals	(iv) Leaf
(e) Insects	(v) Parasite

Ans. (a)–(iv); (b)–(i); (c)–(v); (d)–(ii); (e)–(iii).

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

- (a) Carbon dioxide is released during photosynthesis. (T/F)
- (b) Plants which synthesise their food are called saprotrophs. (T/F)
- (c) The product of photosynthesis is not a protein. (T/F)
- (d) Solar energy is converted into chemical energy during photosynthesis. (T/F)

Ans. (a)–F; (b)–F; (c)–T; (d)–T

Q. 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

Ans. (ii) Stomata.

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

Ans. (iv) leaves.

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

Ans. Farmers grow many fruits and vegetables crops inside large green houses because green house provide favourable conditions for these crops.

Advantages:

- (i) Wide variety of plants can be grown.
- (ii) It protect the plants from pests and predators.
- (iii) It provides suitable temperature for the growth of plants.

## ASSESSMENT

### A. Objective Type Questions

#### I. Multiple Choice Questions

Tick (✓) the correct option.

- Which one of the following is not a saprophyte?
  - (a) Mushroom
  - (b) *Cuscuta*
  - (c) Bread mould
  - (d) Bacteria
- An organism that can convert atmospheric nitrogen into soluble form is
  - (a) fungi
  - (b) algae
  - (c) Rhizobium
  - (d) virus
- Iodine gives blue-black colour in the presence of
  - (a) cellulose
  - (b) protein
  - (c) fat
  - (d) starch
- Which part of the plant gets carbon dioxide from the air for photosynthesis?
  - (a) Stomata
  - (b) Root hair
  - (c) Sepals
  - (d) Leaf veins



5. Which of these is not necessary for photosynthesis?
- (a) Carbon dioxide  (b) Chlorophyll   
 (c) Light  (d) Nitrogen
6. When we observe the lower surface of a leaf through a magnifying lens we see numerous small openings. Which of the following is the term given to such openings? [NCERT Exemplar]
- (a) Stomata  (b) Lamina   
 (c) Midrib  (d) Veins
7. Pitcher plant traps insects because it [NCERT Exemplar]
- (a) is a heterotroph  (b) grows in soils which lack in nitrogen.   
 (c) does not have chlorophyll  (d) has a digestive system like human beings.
8. The term that is used for the mode of nutrition in yeast, mushroom and bread mould is [NCERT Exemplar]
- (a) autotrophic  (b) insectivorous   
 (c) saprophytic  (d) parasitic
9. In the absence of which of the following, will photosynthesis not occur in leaves? [NCERT Exemplar]
- (a) Guard cells  (b) Chlorophyll   
 (c) Vacuole  (d) Space between cells

II. Fill in the blanks.

- Green plants are called \_\_\_\_\_, because they synthesise their own food.
- The small pores on the lower surface of a leaf are called \_\_\_\_\_.
- The mode of nutrition in lichens is \_\_\_\_\_.
- Plants show \_\_\_\_\_ and \_\_\_\_\_ modes of nutrition.
- The leaves of cactus are reduced to spines or thorns, to reduce loss of water by \_\_\_\_\_.

III. Write True or False for each statement. Rewrite the false statements correctly.

- Chlorophyll traps sunlight for photosynthesis. \_\_\_\_\_
- Carbon dioxide is the waste product of photosynthesis. \_\_\_\_\_
- The alga and fungus together are known as lichens. \_\_\_\_\_
- Plants require a lot of potassium to make proteins. \_\_\_\_\_
- Parasites do not contain chlorophyll. \_\_\_\_\_
- Photosynthesis in the plants like cactus takes place in roots. \_\_\_\_\_

B. Very Short Answer Questions

- What is nutrition?
- How are nutrients in the soil replenished?
- What is symbiosis?
- How does exchange of gases takes place in leaves?
- What is photosynthesis?
- What is the first step in photosynthesis?
- Sunlight, chlorophyll, carbon dioxide, water and minerals are raw materials essential for photosynthesis. Do you know where they are available? Fill in the blanks with the appropriate raw materials. [NCERT Exemplar]

- (a) Available in the plant: \_\_\_\_\_ (b) Available in the soil: \_\_\_\_\_  
 (c) Available in the air: \_\_\_\_\_ (d) Available during day: \_\_\_\_\_
8. Observe the diagram alongside and label the following terms given in the box. [NCERT Exemplar]

Stomatal opening, guard cell



C. Short Answer Questions

- Why do organisms need to take food?
- What are insectivorous plants? Give two examples of insectivorous plants.
- How does a pitcher plant trap an insect?
- What are total and partial parasites? Give examples.
- What is the importance of photosynthesis?

D. Long Answer Questions

- With the help of an activity prove that chlorophyll is essential for photosynthesis.
- How would you demonstrate that light is necessary for photosynthesis?
- Explain symbiotic relationship in *Rhizobium* and leguminous plants.
- “Life on the earth would be impossible in the absence of photosynthesis.” Give reasons to support this statement. [NCERT Exemplar]
- Distinguish between the following.
 

(a) Parasite and Saprophyte. (b) Autotrophs and Heterotrophs.

E. Higher Order Thinking Skills (HOTS)

- How can algae and fungi mutually benefit each other?
- Why do leaves grow in different patterns?
- If the plant is not green coloured, will it photosynthesise or not?
- Is it possible for plants to grow in artificial light like tube light.
- Complete the web chart:

