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Nutrition in Plants

Learning Objectives

- To define nutrition.
- To understand the various modes of nutrition.
- To explain the autotrophic mode of nutrition.
- To elaborate the conditions necessary for autotrophic mode of nutrition.
- To exemplify heterotrophic mode of nutrition.

All living organisms show some basic characteristics that qualify them to be a part of the living world. They need food, water, air; they show growth and movement; they are able to produce their own kind; they age and die. Of all these characteristics, the most important factor that helps life to go on is energy. How would one feel if one has to go without food for a day? Imagine if the same happens for a week or more! The organism will not be able to survive. Thus in order to survive, it is important to nourish the body. This is done through a constant mode of **nutrition** or the process of taking in food and water by living organisms to obtain the energy required for the daily activities.

Obtaining Nourishment

Different organisms need different kinds of nutrients for their growth. Animals feed on smaller animals or they depend on plants for their food. The nutrient requirement of the human body includes five basic nutrients—carbohydrates, fats, proteins, vitamins and minerals; in addition to water and roughage. It is supplied through animal and plant sources of food.

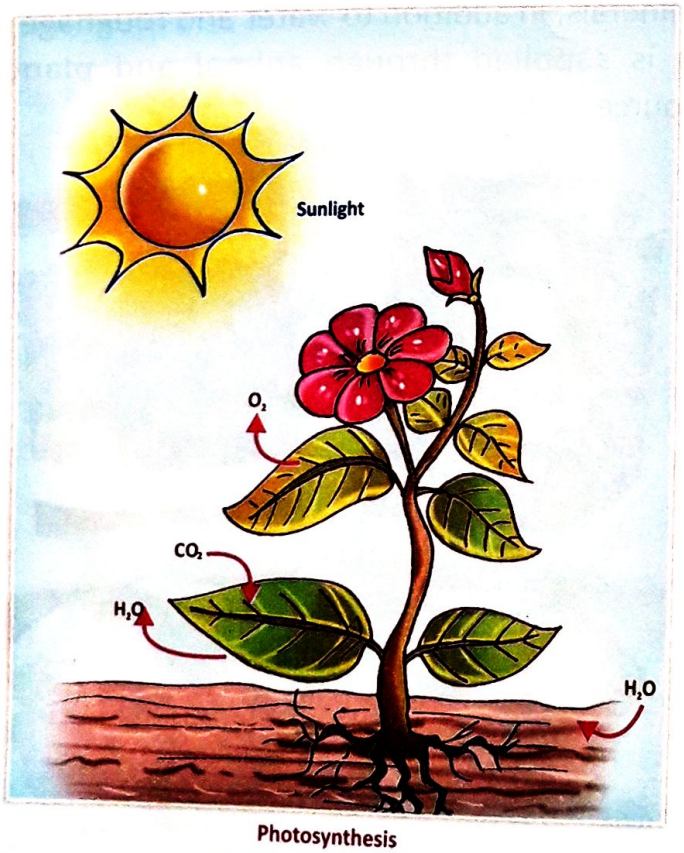
Vegetarian and Non-Vegetarian Dishes

MODES OF NUTRITION

Autotrophic Mode

The word autotrophic can be understood as *auto*—self and *trophos*—nutrition. The mode of nutrition in which the organism prepares its own food is called **autotrophic mode of nutrition**. Green plants are the only living organisms that prepare their own food in the presence of sunlight and simple raw materials like carbon dioxide and water. The process, also called **photosynthesis**, takes place in the presence of a green pigment called **chlorophyll**. It is present in the leaves in elliptical structures called **chloroplasts**. The chlorophyll absorbs the light essential for the reaction.

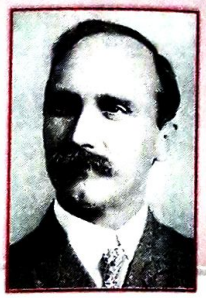
$$CO_2 + H_2O \xrightarrow[\text{chlorophyll (in the leaves)}]{\text{sunlight}} \text{Glucose} + O_2 \text{ (carbohydrate)}$$



Photosynthesis

Quick Facts

The term photosynthesis was coined by the scientist Charles Reid Barnes in 1893.



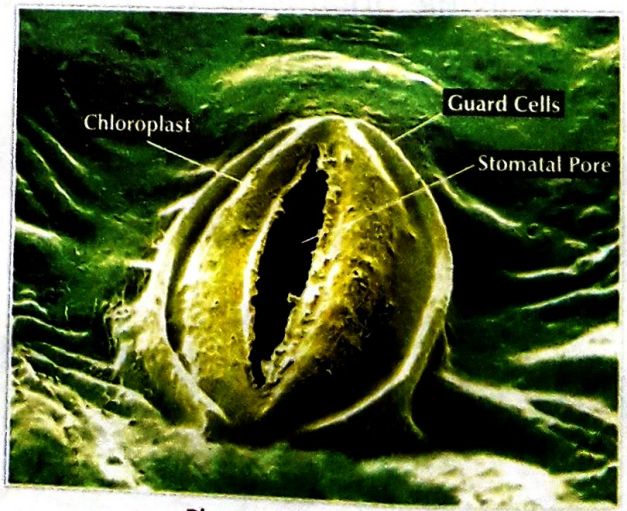
Ans D2

Photosynthesis is a **two-stage** process. The first stage is the **light reaction** wherein the sunlight is absorbed by chlorophyll and the second reaction is the **dark reaction** in which the trapped light is used in the synthesis of starch. Both these reactions take place in the chloroplast.

Raw materials for photosynthesis:

- Chlorophyll
- Light
- Carbon dioxide
- Water

The carbon dioxide required for the reaction is obtained from the air. It enters the leaf through the **stomata**. The apparatus, which causes opening and closing of stomata present on the underside of the leaf, comprises of two guard cells. Their function is to carry out exchange of gases, they give out oxygen released in the chloroplast as a result of photosynthesis and take in carbon dioxide.) Ans D3



Placement of Stomata

Think Tank

Do marine plants also undertake photosynthesis?

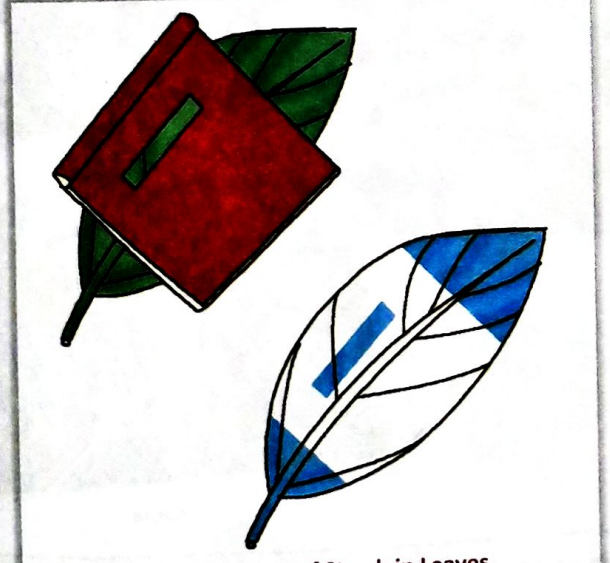
Experiment– 1.1

Aim: To show that light is necessary for photosynthesis.

Method: Take a potted plant and destarch its leaves by keeping it in dark for 2 days. Take a black or dark paper and cut a simple I shape in it by using a stencil. Cover one leaf with this paper. Leave the set up in sunlight for 4-6 hours.

Detach the leaf and test it for presence of starch.

Observation:



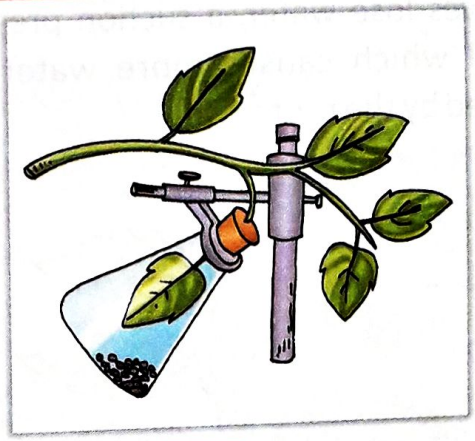
Testing Presence of Starch in Leaves

Experiment– 1.2

Aim: To show that carbon dioxide is necessary for the process of photosynthesis.

Method: Place a potted plant in absolute dark for a day. This destarches the plant. Now select a healthy leaf from the plant. Place potassium hydroxide in a conical flask so that it absorbs all carbon dioxide from it. Gently take the selected leaf and insert it into the flask with the help of a split cork. Leave the plant in the sun for a few hours and test for the presence of starch.

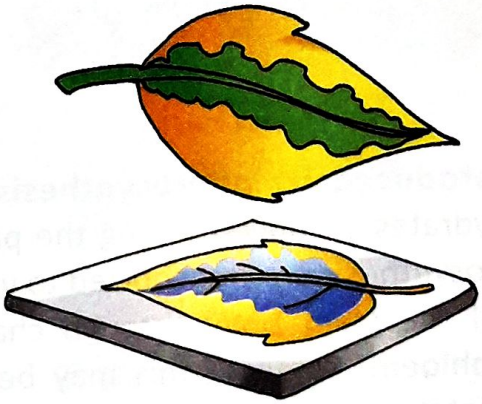
Observation:



Experiment– 1.3

Aim: To prove that chlorophyll is necessary for the process of photosynthesis.

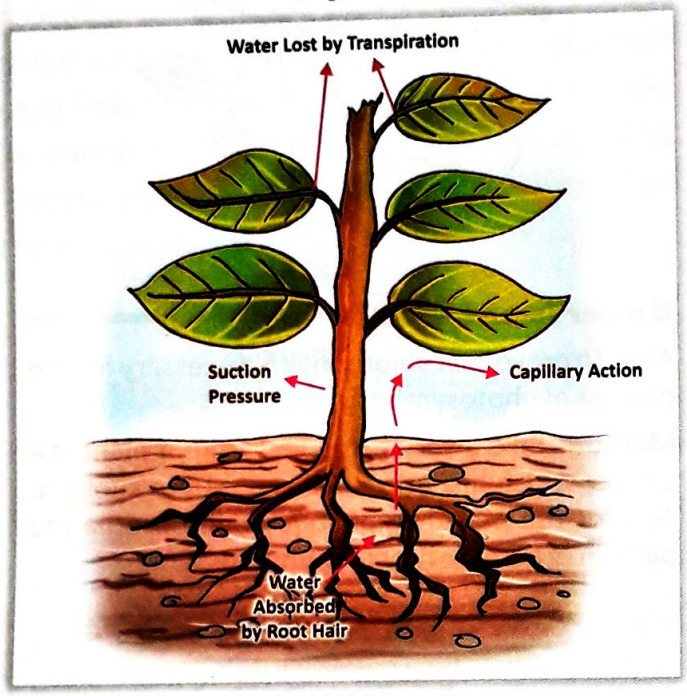
Method: Take a variegated leaf from a plant like coleus, which has been well exposed to sunlight. Test for the presence of starch and observe the pattern of blue black colour obtained.



Think Tank

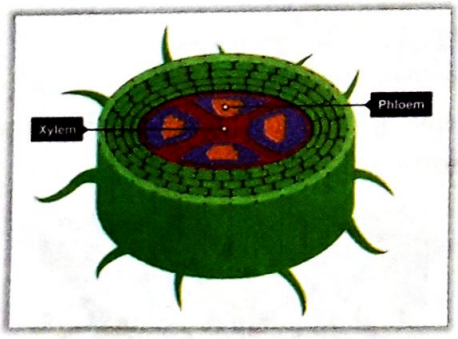
How do the variegated leaves in crotons prepare their food?

The other important raw material for photosynthesis is **water**. The roots of the plants absorb water from the soil and transport it to the leaves of the plant through channels called **xylem**. After the photosynthetic reaction, the excess water is expelled from the leaves, again through the stomata by a process called **transpiration**. As the leaves lose water, a suction pressure is created which causes more water to be absorbed by the roots. Ans D 4



Transpiration

Food produced by photosynthesis: The carbohydrates produced during the process of photosynthesis are transported to various parts of the plant body through channels called **phloem**. Some of this may be used immediately while the extra is stored as **starch**.



Xylem and Phloem in Plants

Plants also produce proteins and fats besides carbohydrates. Chickpeas, pulses and lentils are all rich sources of plant proteins. These proteins are synthesised from simple carbohydrates using nitrogen and sulphur absorbed from the soil. Mustard, sesame, sunflower and coconut are rich sources of oils and fats.


Chickpea


Lentil


Sunflower

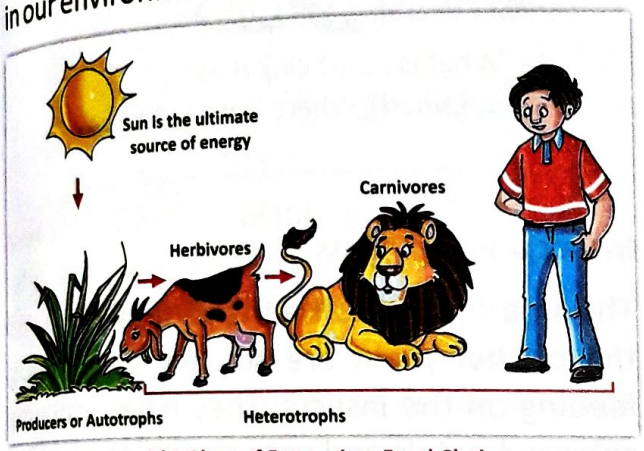

Sesame

Quick Review

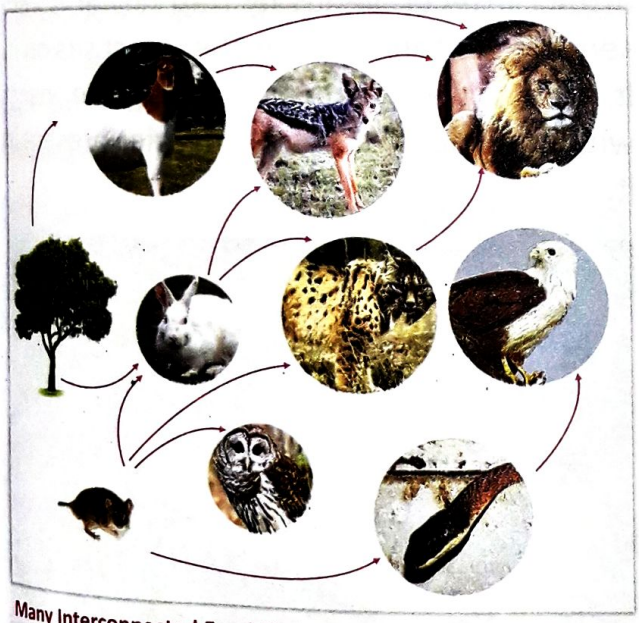
1. What is nutrition?
2. What is the role of chloroplasts in the plant leaves?
3. What happens in the second stage of photosynthesis?
4. What is the difference between xylem and phloem?

Heterotrophic Mode

The word heterotrophic can be understood as *heteron*—other and *trophos*—nutrition. The mode of nutrition in which the organism depends on another organism for its nutrition is called **heterotrophic mode of nutrition**. Human beings, animals and non-green plants depend directly or indirectly on green plants for food. The dependence of heterotrophs on autotrophs for nutrition explains the existence of various **food chains** in our environment.



The Flow of Energy in a Food Chain



Many Interconnected Food Chains in Nature Form a Food Web

HETEROTROPHIC NUTRITION IN PLANTS

Heterotrophic plants may be divided into the following categories, according to their mode of deriving nutrition.

Parasitic Plants

These plants thrive on the body of another green plant to obtain nutrition. In a parasitic relationship, it is only the **parasitic plant** that benefits, **the host plant**. Over a period of time, the host plant begins to wither away. Parasitic plants develop special roots called **haustoria** which penetrate into the tissues of the host plant. It functions to absorb the nutrition prepared by the host plant.

Cuscuta

Mistletoe

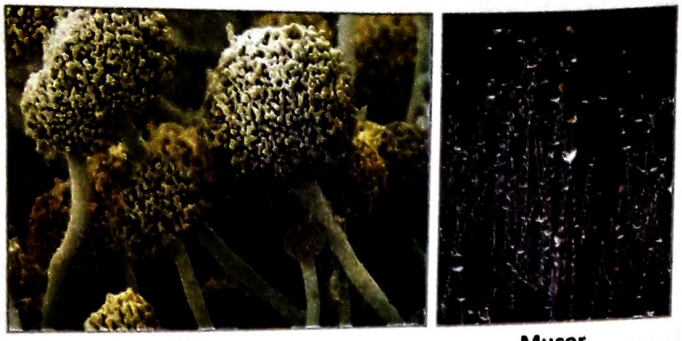
Parasitic Plants

Quick Facts

The parasitic plant— Rafflesia, is the world's largest flower, and emits an odour of decaying flesh. A single flower can weigh up to 10 kilograms with a diameter of up to 106 cm.

Saprophytic Plants

The word saprophyte can be understood as *sapro*—rotten and *phyton*—plants. Thus **saprophytes** are plants that obtain their nutrition from the decaying plant matter like rotting leaves and twigs.



Rhizopus Mucor

Saprophytic Plants

Ans D2

The roots of the saprophytes contain fungi that are capable of digesting the dead and decaying matter, which can be converted into useful material for the plant.

Mushrooms can also be seen growing on rotting plant wastes during the rainy season.

Mushroom

Quick Facts

Fungal spores are always present in air, waiting for the ideal conditions—warm temperature and moisture for growth. This is seen in rainy season when a slice of bread left outside readily shows fungal growth.

Many mushrooms are edible and relished as a delicacy. Yeast is also a form of fungus that is used in fermenting dosa, idli, bhatura and cake batters.

Yeast

Think Tank

What is penicillin? How is it obtained? Where is it used?

Insectivorous Plants

The amazing plants like the **venus fly trap** and the **pitcher plant** are actually carnivorous, feeding on the insects. They have brilliantly coloured petals and very strong odours that attract insects. Venus fly trap flower is very sensitive to touch and as the insect sits on it, it immediately folds, consuming the insect with the help of digestive enzymes present in it.

Venus Fly Trap

When the insect sits on the leaf of pitcher plant, it slips into a long tube that contains

the digestive juices. The slippery sides ensure that the insect cannot crawl out. The lid also closes further ensuring that the insect is completely trapped.

Pitcher Plant

Ans D5

(~~Such~~ insectivorous plants generally grow in soils that are deficient in calcium and nitrogen, as in marshy areas. Though they are capable of photosynthesis but they compensate for the nutrition deficit through their insect diet.)

The **sundew plant** leaves have tentacles with a sticky substance that causes the insect to stick to it. The sticky substance, also called **mucilage,** then digests the insect.

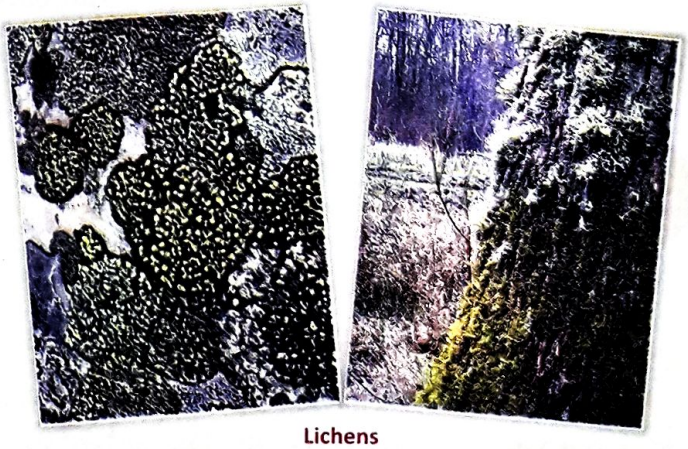
Sundew

Symbiotic Plants

There are many kinds of plants growing in an area that are competing with each other for nourishment. However, there are examples in nature that show perfect harmony and living with shared benefits of shelter and nutrition. Such plants that benefit from each other are called **symbiotic plants**. In a symbiotic relationship, no plant can survive independent of the other. For example, certain fungi live in the roots of trees in a symbiotic system called **mycorrhiza**. The tree provides nutrients to the fungus and in return the fungus absorbs water and mineral salts from the soil.

Mycorrizal Fungus

Lichens are also symbiotic organisms, often seen growing as clusters of leaves on rocks or tree trunks. Lichens are a combination of an algae that carries out the function of photosynthesis and a fungus that provides shelter, water and minerals.



Lichens

Think Tank

Rhizobium existing on the root nodules of the pea plant are also an example of symbiotic relationship. Find out how.

REPLENISHING THE LOST NUTRIENTS

Year after year, crops growing on the same plot of land consume the nutrients from the soil. Thus, there arises a need to add fertilisers and manures to the field. While manures are naturally made from decaying plant wastes, fertilisers are chemically synthesised in laboratries and are enriched in nutrients like nitrogen, potassium and phosphorus. The government now advocates a laboratory test of the soil by experts so that the exact amount of nutrient required may be added to the soil.

Fertilisers and Manure

Key Words

Nutrition	The process of taking in food and drink by living organisms.
Autotrophic nutrition	The mode of nutrition in which the organism prepares its own food.
Transpiration	The process by which excess water is expelled through the stomata of the leaves.
Heterotrophic nutrition	The mode of nutrition in which the organism depends on another organism for its nutrition.
Food chain	The series showing the dependence of one organism on another for food.
Food web	Many interconnected food chains together make up the food web.
Parasitic plants	The plants which depend on other green plants for their survival.
Saprophytic plants	The plants that obtain their nourishment from decaying plants.
Mucilage	Sticky substance on leaves of sundew plant.
Symbiotic plants	Plants that benefit from each other and live in harmony.

Points to Remember

- It is important for all organisms to nourish themselves.
- The chlorophyll present in the chloroplast on the cells absorb the essential light for photosynthesis.
- Photosynthesis is a two stage process. The light reaction involves the absorption of sunlight whereas the dark reaction involves the synthesis of starch.

- Stomata is responsible for exchange of gases. The carbon dioxide enters the leaf and oxygen is expelled.
- Xylem is responsible for the transport of water and phloem for food throughout the plant.
- The extra food in plants is stored as starch.
- Parasitic plants develop special roots called haustoria to penetrate the tissue of the host plant.
- Saprophytes derive nutrition from decaying plant matter like rotting leaves.
- Insectivorous plants are very brightly coloured and emit very strong odours to attract insects.
- Symbiotic plants live together sharing shelter and nourishment.
- Manure is made from decaying plant wastes, fertilisers are chemically synthesised in laboratories.

Exercises

A. Tick (✓) the correct option in each case.

1. _____ is the process essential for providing nourishment.
   a. Digestion ✓
   b. Nutrition
   c. Respiration
   d. None of these
2. Which nutrient is not absorbed directly by the plants?
   a. Carbohydrate
   b. Protein
   c. Nitrogen ✓
   d. Vitamins
3. Photosynthesis is a _____ process.
   a. two stage ✓
   b. three stage
   c. four stage
   d. six stage
4. Light reaction involves the absorption of _____.
   a. chlorophyll
   b. carbon dioxide
   c. water
   d. sunlight ✓
5. Following is not a function of stomata:
   a. to expel CO_2 ✓
   b. to absorb CO_2
   c. to expel excess water
   d. to expel O_2
6. The absorption of water by the roots of the plants is due to:
   a. gravitational pull
   b. suction pressure ✓
   c. transpiration
   d. both b and c ✓
7. Following is a saprophyte:
   a. Mistletoe
   b. Mucor ✓
   c. Lichen
   d. Venus fly trap

B. Fill in the blanks.

1. Autotrophic nutrition involves photosynthesis.
2. The plant structure containing chlorophyll is called leaves.
3. Shape of chloroplast is elliptical
4. There are two guard cells in stomata.
5. Parasitic plants thrive on host bodies.
6. Saprophytic plants obtain nutrition from dead decaying matter.
7. Saprophytic is made of two words sapro and phyton.
8. Symbiotic plants live together sharing shelter and nourishment.

C. Very short answer questions.

1. Name the two basic modes of nutrition. Autotrophic and Heterotrophic
2. What is the function of chlorophyll? It absorbs the light for photosynthesis
3. What is light reaction? Absorption of sun light by chlorophyll
4. What is transpiration? Pg. no. - 10
5. What is the difference between xylem and phloem?
   Xylem transport water where as phloem transport food.
6. What is haustoria? Pg. no. - 11
7. Name the five basic nutrients required for human body. Pg. no. - 7
8. Name the raw materials required for photosynthesis.
   Chlorophyll, light, carbondioxide and water.

D. Short answer questions.

1. What is the significance of nutrition for a living body? Pg. no - 7
2. What are the two stages of photosynthesis? Pg. no. - 8
3. What are the functions of stomata? Pg. no. - 8
4. What causes absorption of water from the roots? Pg. no - 10
5. Why do insectivorous plants need to feed on insects? Pg. no - 13
6. How does a saprophyte digest its food? Pg. no - 12
7. State the difference between manures and fertilisers. Pg. no - 14
8. What is mucilage? Pg. no. - 14

E. Long answer questions.

1. Differentiate between the following with examples.
   a. Autotrophs and Heterotrophs
   b. Saprophytic and Parasitic plants
   c. Symbiotic and insectivorous plants

2. How will you prove that:
   a. Starch is produced as a result of photosynthesis.
   b. Chlorophyll is essential for photosynthesis.
3. Replenishing the soil is necessary. Explain. Pg. no. – 14

F. Solve the crossword.

Clues:

Down

2. Plants that obtain their nutrition from decaying plant matter.
5. The second stage in photosynthesis.
6. The tissues transporting food in plants.
7. The tissues transporting water across the plant body.
8. Symbiotic organisms that are a combination of algae and fungus.

Across

1. The process of taking in food.
2. The form in which prepared food is stored by the plants.
3. The pigment present in chloroplast that traps sunlight.
4. An example of a plant with variegated leaves.