CHAPTER 1: NUTRITION IN PLANTS

- Living organisms such as plants and animals survive on food.
- The food gives them the energy to perform several activities in their life and helps in the growth.
- **Nutrients** - Certain substances are present in the foods that help in the survival of the organisms. These special substances are called nutrients for example, proteins, vitamins, carbohydrates, minerals and fats.
- Some living organisms like plants synthesize their food by themselves by themselves while others such as animals depend upon the plants and other animals for their food.

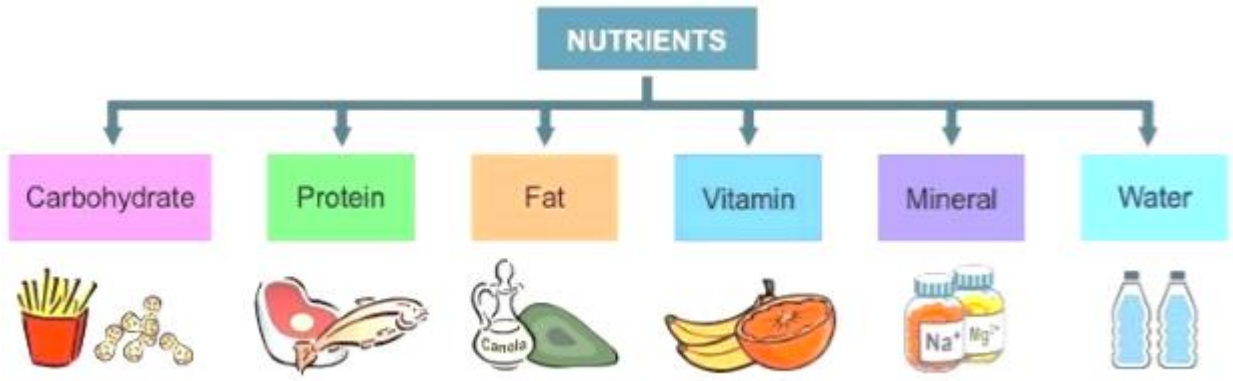


Figure 1: Different Nutrients

Mode of Nutrition in Plants

What is nutrition?

Nutrition can be defined as a process by which organisms take in the food and utilize it in order to survive. Based on the mode of nutrition organisms can be divided into two categories:

- **Autotrophic Organisms** - They can prepare their food by themselves such as plants
- **Heterotrophic Organisms** - They depend upon other organisms for their food such as animals

How do plants prepare their food?

Plants prepare their food with the help of certain raw materials that they gather from their surroundings:

- water
- carbon dioxide
- sunlight
- minerals
- chlorophyll

The process by which plants prepare their food by using these raw materials is called **Photosynthesis**.

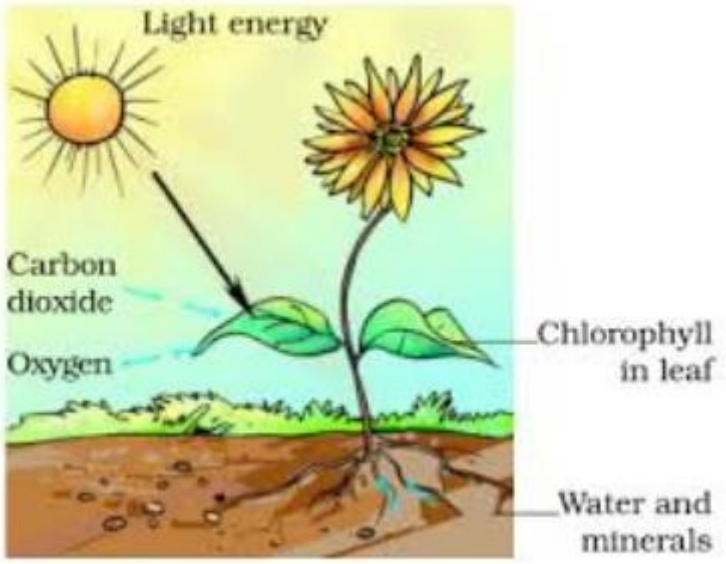


Figure 2: Photosynthesis

Where is the food made in plants?

- Leaves are also known as the **Food Factories** of the plants as they are the places where food is prepared.
- Different parts of the plants like roots gather the raw materials from the environment and then transfer them to the leaves where photosynthesis takes place.
- **Transportation of water and Minerals in plants** - The roots of the plants absorbs the water and minerals of the soil and then transports them to the leaves via stems and branches.

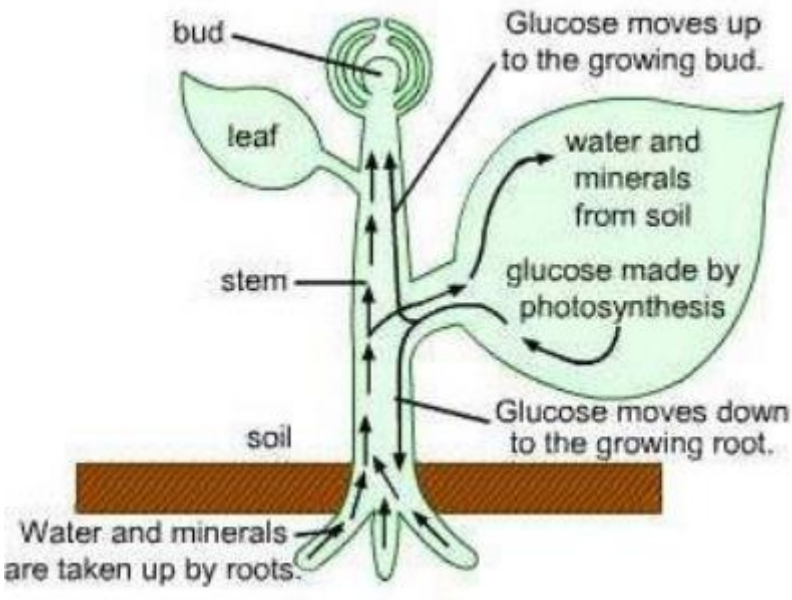


Figure 3: Transportation of water and Minerals in plants

- **Inhalation of Carbon Dioxide** - There are tiny holes or pores present on the surface of the leaves called **Stomata** that take in the carbon dioxide present in the atmosphere.

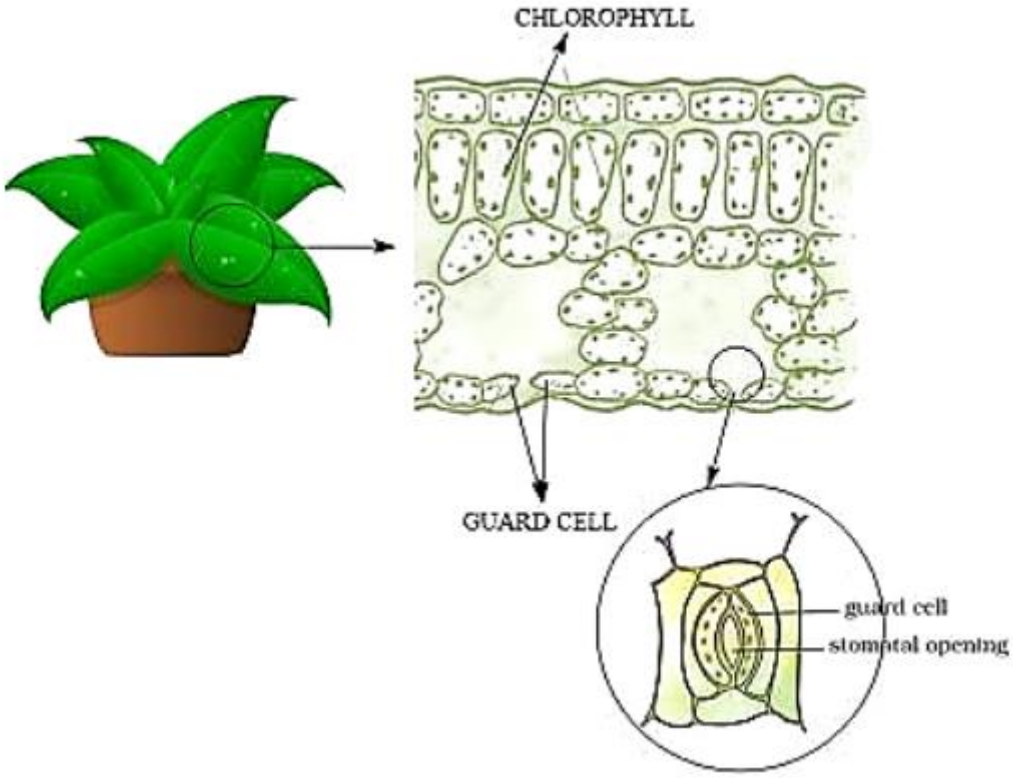


Figure 4: Stomata on leaves and the Chlorophyll

- **Presences of Chlorophyll in the Leaves** - A substance called Chlorophyll is present in the leaves of the plants. It is a green colour pigment. The chlorophyll not only provides green colour to the leaves but also helps in the process of photosynthesis. Chlorophyll captures the sunlight and along with other raw materials prepares the food in the leaves.
- This process of photosynthesis only occurs in the daytime in the presence of Sunlight hence it is called **Photosynthesis**, photo means light.

Why sun is called the ultimate source of energy for all living organisms?

We know that the plants use solar energy to make their food. The herbivores animals depend upon the plants for their food. Animals (carnivores) that do not eat plants depend upon the herbivores animals. Therefore, all of the living organisms directly or indirectly receive their energy from the Sun.

Cells in Living Organisms

All living organisms are made up of tiny structures called cells. Some organisms (microscopic) contains only one cell while others plants and animals contain many cells of different kinds. Parts of a cell:

- **The Nucleus** - Every cell has a nucleus present in the centre that performs various functions of the cell.
- **The Cell Membrane** - Every cell has an outer boundary which protects the cell called the **Cell Membrane**.
- **The cytoplasm** - Every cell has a gel-like structure present in it called the **Cytoplasm**.

- **Cell organelles:** These are membrane bound structures found within a cell in the cytoplasm. The cell organelles have special function associated with them. Different cell organelles found in the cell are:
  - **Mitochondria** – Produces energy for the cell
  - **Endoplasmic Reticulum** – Produces lipids and proteins in cell
  - **Golgi apparatus** – Helps in exporting materials out of cell
  - **Lysosomes** – Help in digestion in the cell

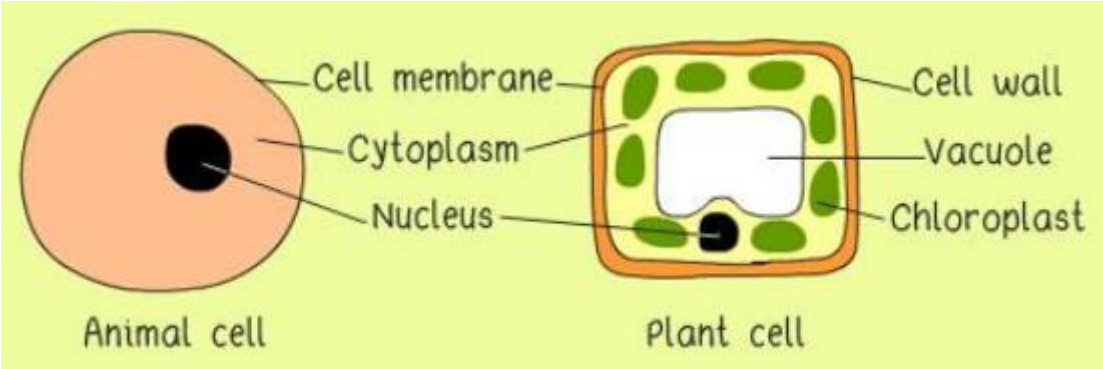


Figure 5: Structure of Cell in Animals and Plants

Can photosynthesis take place in other parts of the plant?

Yes, green stems and branches of the plants can also undergo the process of photosynthesis. For example, plants in the desert area like cactus do not have leaves but they still exist there because their stem produces the food for the plant.

Why is the process of photosynthesis important?

- There will be no food if the plants would stop conducting the photosynthesis process.
- The plants take in carbon dioxide and produce oxygen during the process of photosynthesis. Hence, without this process, it would not be possible to survive on earth as they would be no oxygen.

Production of Oxygen and Carbohydrates by the Plants

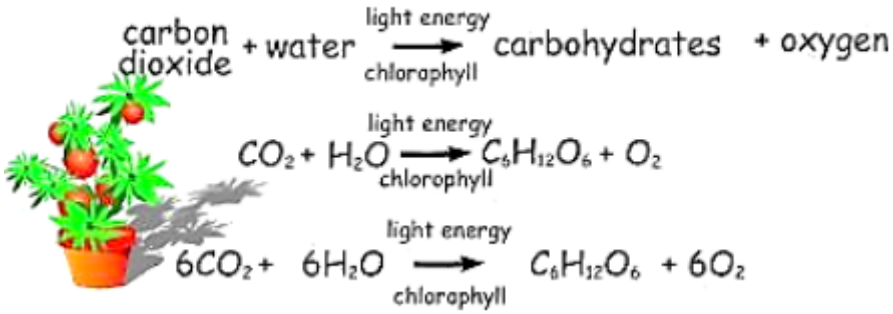


Figure 6: Production of Oxygen and Carbohydrates

Plants use carbon dioxide and water in presence of the sunlight and chlorophyll to produce carbohydrates and oxygen. The carbohydrates thus produced by the plants are converted into starch.

Chloroplast and the Process of Photosynthesis

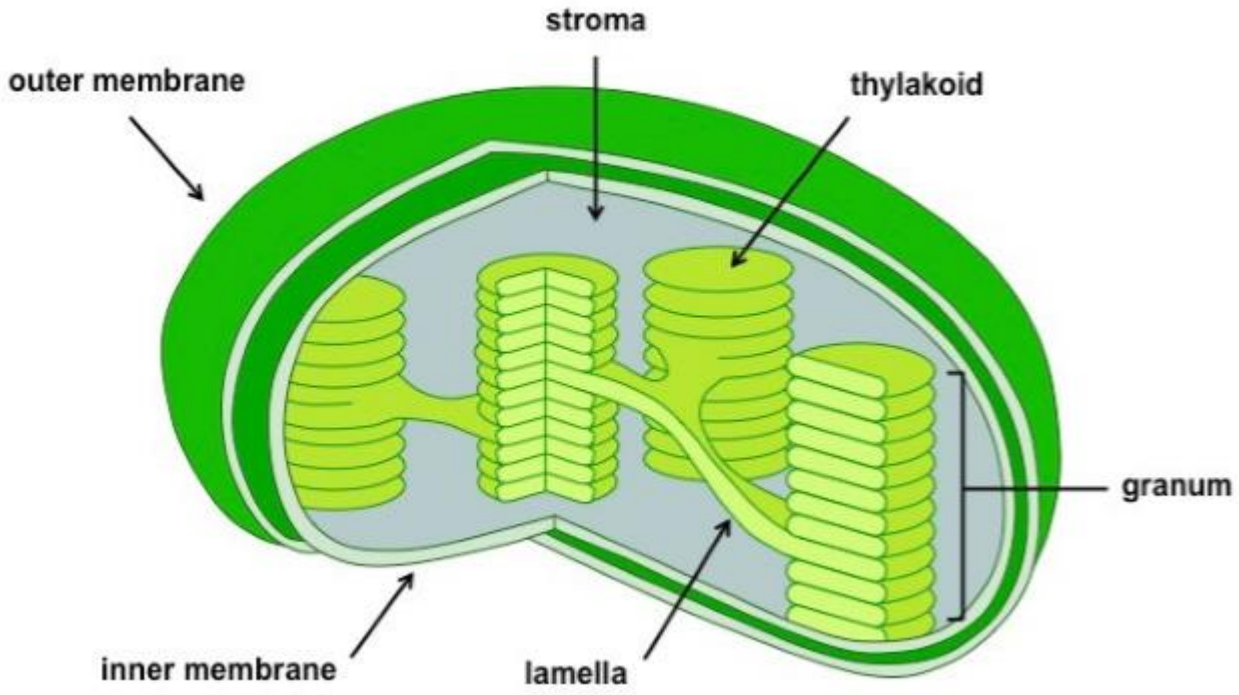


Figure 7: Structure of Chloroplast

- Chloroplasts are special cell organelles that are found only in plant cells. They are called the food producers of the plant cells.
- The chloroplasts are surrounded by two membranes called the **Inner and Outer Membrane**. The inner membrane surrounds **stroma** and **thylakoid** stacks.
- The chlorophyll molecules are present on each of the thylakoids. The chloroplasts convert the sunlight into sugars that are used by the plant cells.
- Hence, chloroplasts allow the conduction of the process of photosynthesis. The **chlorophyll** that can absorb the sunlight is present inside the chloroplasts.
- When the light of the sun hits the chloroplasts and the chlorophyll, the light energy is converted into chemical energy found in compounds such as ATP and NADPH.
- Then these energy molecules move into the stroma where carbon dioxide is attached to them. As a result of the molecular reactions, oxygen and glucose are created.

Can leaves which are red or Brown or violet in colour conduct photosynthesis?

Yes, the chlorophyll is also present in leaves that are not green in color. They are of different colours because the other colour pigments are more than the green colour pigments in such leaves.

Algae contain chlorophyll

Algae are green coloured organisms found in the stagnant water. They get their green color from chlorophyll. Since they have chlorophyll in them they are capable of conducting photosynthesis. (olympiads)

Figure 7: Algae in Water

How do plants generate proteins and fats?

- Along with carbohydrates, plants can also produce proteins and fats which are formed with the help of Nitrogen.
- Nitrogen is present in large amounts in the air but plants cannot consume the nitrogen directly from the atmosphere.
- The soil often contains some bacteria that are capable of converting the nitrogen into nitrates which can be the used by the plants.
- Also, fertilizers used by farmers and gardeners contain a high amount of Nitrogen which mixes into the soil and is used by the plants.

Nutrition in Plants that do not contain Chlorophyll

Many plants do not contain any chlorophyll. Hence they are unable to prepare their food by themselves. Therefore, they rely on other plants and animals for their food.

1. Parasitic Plants - Some plants live on another plant for their nutrition. These are called parasites. The plants on which these parasitic plants survive are called the host. For Example, cuscuta is a parasitic plant.

Figure 8: Yellow color Cuscuta plant growing over green plants

2. Insectivorous Plants - Some plants depend upon insects for the food and thus are called **Insectivorous**. The leaves of these plants are modified into a pitcher like structure. The top part of the leaves acts as a lid which can open and close the pitcher. The pitcher contains hair in a downward direction which traps the insects. The pitcher on capturing the insect secretes some digestive juices which help in the digestion of the insect. For Example, Dischidia and Nepenthes

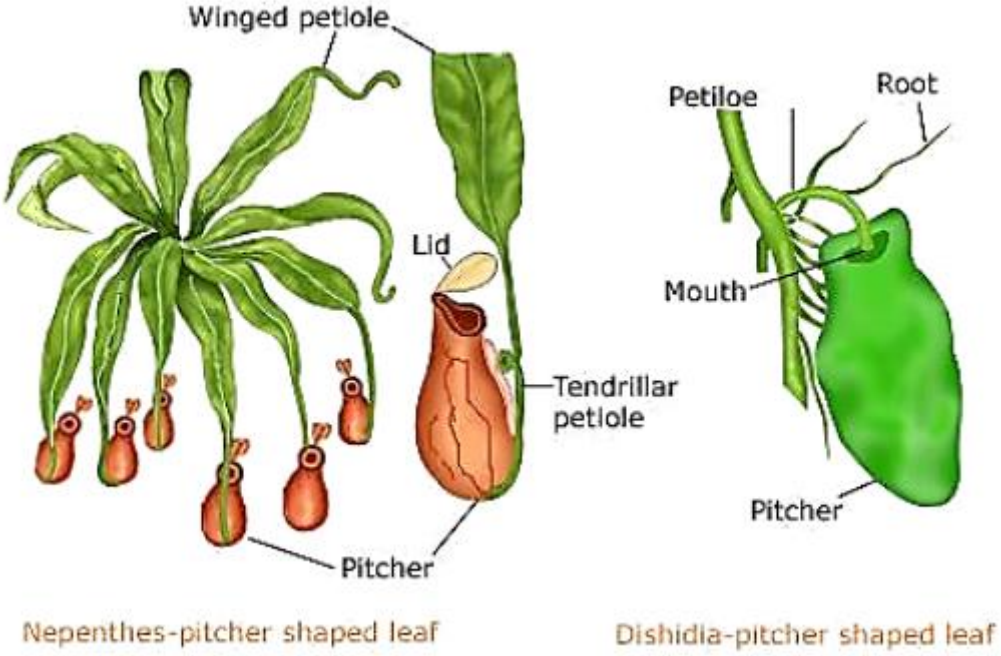


Figure 9: Insectivorous Plants

3. Saprotrophs - Some organisms survive on decaying food and organisms. This mode of nutrition is called saprotrophic nutrition and the organisms that survive because of the saprotrophic nutrition are called **Saprophytes**.

How do saprophytes obtain their nutrition?

- The saprophytes secrete digestive juices on the decaying and dead matter.
- These juices convert the matter into a solution.
- The saprophytes that absorb the nutrients from the solution.
- For Example, Fungi (yeast and mushrooms) are a saprophytes that can be found on stale food and pickles which are exposed to the hot and humid environment.

Figure 10: Fungi growing on Bread

4. **Symbiotic Relationship** - Sometimes organisms live together to share shelter and food with each other. These are said to have a symbiotic relationship.

Examples of organisms living in a symbiotic relationship:

- Some fungi live in the roots of the trees. These fungi take food from the trees and in return help the trees in absorbing water and nutrients from the soil.
- Sometimes an organism that contains chlorophyll such as algae lives in association with a fungus (together called as **Lichens**). The algae provide food and nutrition to the fungus while the fungus provides water, minerals and shelter to the algae.

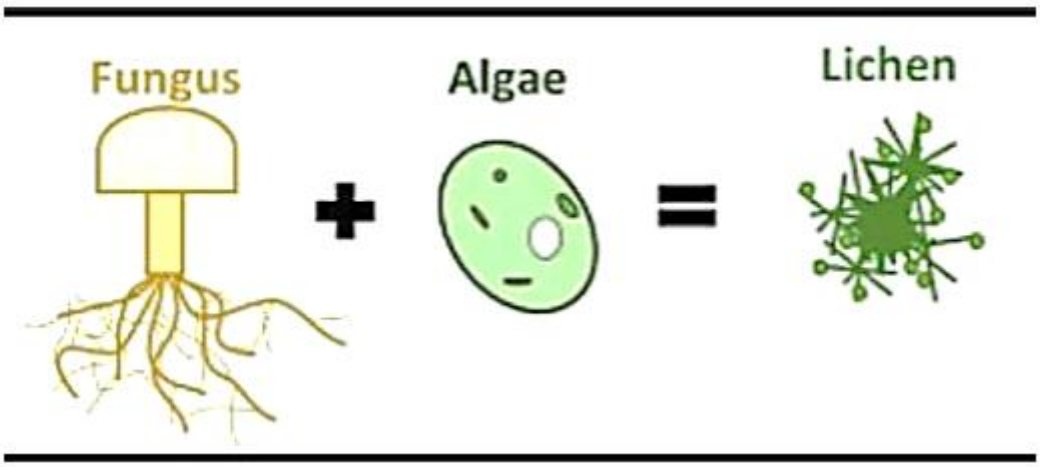
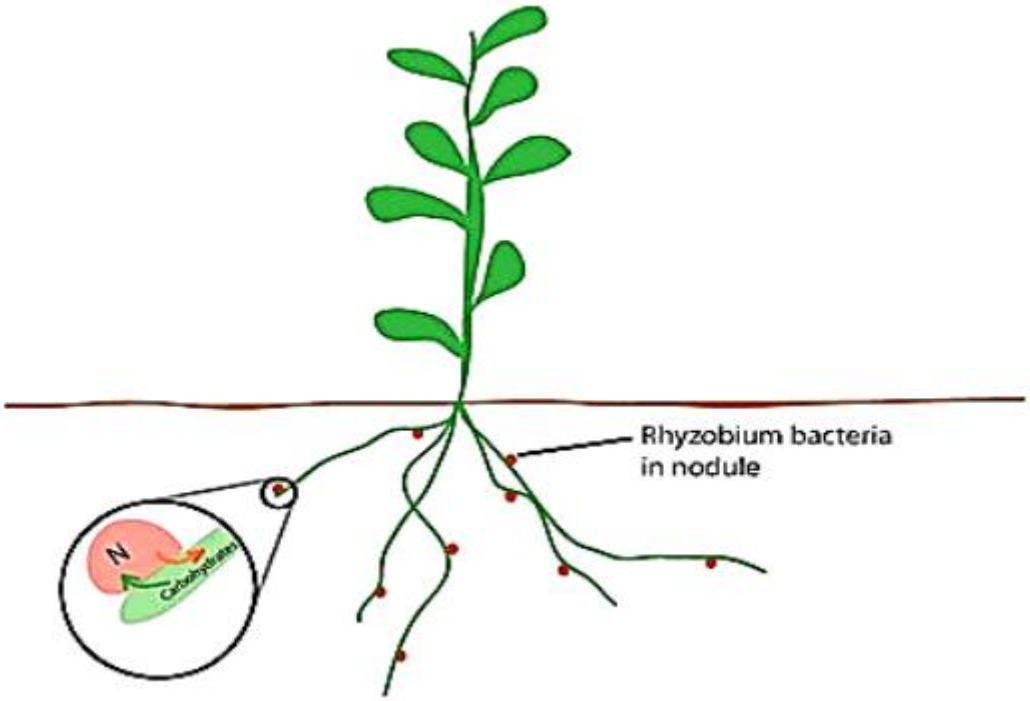


Figure 11: Lichens

Replenishing the Soil with Nutrients

- Plants get their nutrients from the soil mainly hence there is a need to replenish the soil again with nutrients so that the plants can survive on it.
- Fertilizers and manure are often used to replenish the soil with the nutrients. They contain potassium, phosphorus and nitrogen all of which are important for the plants.
- A **bacterium called Rhizobium** is present in the soil which can convert nitrogen present in it in the form that can be consumed by the plants.
- The rhizobium generally lives in the roots of the plants such as peas, beans, grams and legumes and provides nitrogen to these plants. This again is an example of a symbiotic relationship. The farmers often do not need to use fertilizers while growing such crops. (Olympiads)



QUESTION AND ANSWERS:

Q: Why do organisms need to take food?

A: All living organisms require food to survive. It gives them energy to perform various activities. All activities such as playing, running, walking, studying, etc. require energy. The various components present in our food such as carbohydrates, proteins, fats, vitamins, and minerals provide energy to our body. These are also important for growth and development of the body.

Q: Distinguish between a parasite and a saprotroph.

ANSWER:

Parasite	**Saprotroph**
The organism that grows on the body of another organism and derives nutrients from it is known as a parasite.	The organism that obtains nutrients from the dead or decaying organic matter is called saprotroph.
Examples of parasites are *Cuscuta* and orchids.	Examples of saprotrophs are fungi and some bacteria.

Question 3:

How would you test the presence of starch in leaves?

ANSWER:

Experiment to test the presence of starch in leaves:

Take two healthy green potted plants of the same type. Keep one potted plant in a dark room for one or two days in order to remove all the starch from the leaves. Keep the other plant in sunlight. Now, take one leaf from each potted plant and put a few drops of iodine solution on them. Then note down the observation.

Plants kept in light and dark conditions

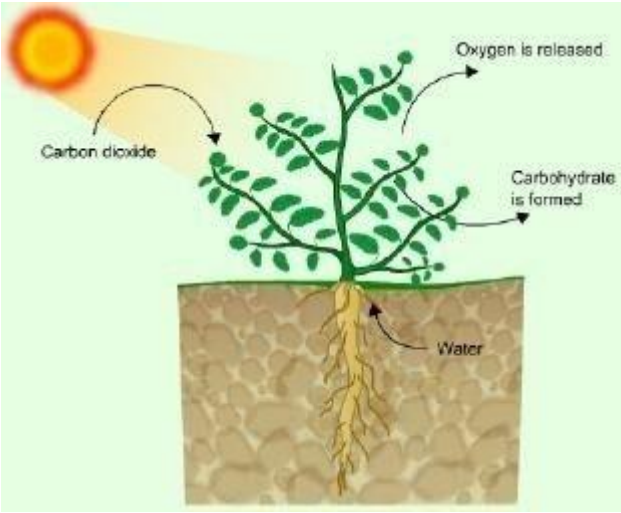
No blue black colour will be observed on the leaves of the plant kept in the dark room. This indicates the absence of starch. Blue black colour will be observed on the leaves of the plant kept in sunlight. This indicates the presence of starch.

Question 4:

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

ANSWER:

Photosynthesis is defined as the process in which the chlorophyll-containing plant cells synthesise food in the form of carbohydrates, using carbon dioxide and water in the presence of solar energy.



Photosynthesis

Sources of raw materials required for photosynthesis:

(a) Water is taken in from the roots of the plant and is transported to the leaves.

(b) Carbon dioxide from the air enters the leaves through the tiny pores called stomata and diffuses to the cells containing chlorophyll.

(c) Solar energy is used to break water into hydrogen and oxygen. This hydrogen is combined with carbon dioxide to form food for the plants, which is ultimately used by the animals as well.

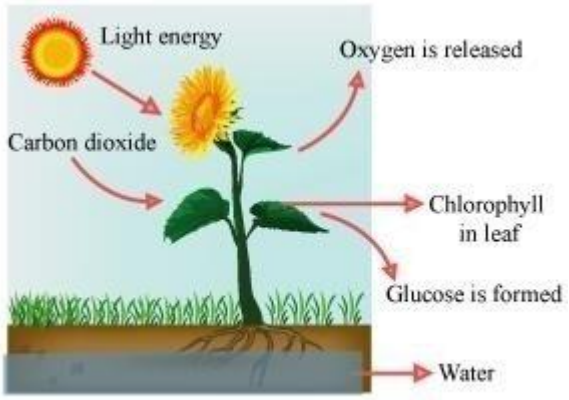
Thus, photosynthesis can be represented by the following equation.

$$\text{Carbon dioxide} + \text{Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Carbohydrates} + \text{Oxygen}$$

Question 5:

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

ANSWER:



Photosynthesis

Question 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 captured by the pigment called _____.

(d) During photosynthesis plants take in _____and release _____.

ANSWER:

(a) Green plants are called __autotrophs__ since they synthesise their own food.

(b) The food synthesised by the plants is stored as __starch__.

(c) In photosynthesis solar energy is captured by the pigment called chlorophyll__.

(d) During photosynthesis plants take in __carbon dioxide__ and release __oxygen__.

HOMEWORK

Question 7:

Name the following:

(i) A parasitic plant with yellow, slender and tubular stem.

(ii) A plant that has both autotrophic and heterotrophic mode of nutrition.

(iii) The pores through which leaves exchange gases.

Question 8:

Tick the correct answer:

(a)*Amarbel* is an example of

(i) autotroph

(ii) parasite

(iii) saprotroph

(iv) host

(b)The plant which traps and feeds on insects is

(i) *Cuscuta*

(ii) china rose

(iii) pitcher plant

(iv) rose

Question 9:

Match the items given in Column I with those in Column II:

Column I	**Column II**
Chlorophyll	Bacteria
Nitrogen	Heterotrophs
Amarbel	Pitcher plant
Animals	Leaf
Insects	Parasite

Question 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)

Question 11:

Choose the correct option from the following:

Which part of the plant takes in carbon dioxide from the air for photosynthesis?

(i) Root hair

(ii) Stomata

(iii) Leaf veins

(iv) Sepals

Question 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

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