10 NUTRITION IN PLANTS

Fig.1

I grew from a mango seed. How large am I ? So much I produce, plenty for me and plenty for all.

How do plants produce so much that they are able to feed other organisms dependent on them?

For ages people have been pondering over this and till three hundred and fifty years ago we believed what Aristotle had said over two thousand years ago. According to him plants could produce everything from what they took from the soil.

In the year 1648 a Belgian scientist Jan Baptista Von Helmont conducted an experiment that continued for five years. He took a small willow tree and planted it in a large pot of soil. Before he did this he carefully measured the mass of the dry soil and the mass of the tree.

He covered the soil with a lid so that nothing could fall onto the surface of the soil and add to its mass.

Fig 2
Von Helmont

There were holes in the lid so that the tree could grow out of the soil and so that air and water could reach the roots.

Van Helmont left the tree for five years, giving it only rain water to drink. At the end of the five years he measured the mass of the tree and the mass of the dry soil for a second time. The results of this experiment are shown below:

Fig. 3

This experiment changed the belief of hundreds of years! This was because Von Helmont arrived at a result that –

Mass (kg)			
	At start	After five years	Change in mass (kg)
Tree	2.27	76.74	74.47
Dry soil	90.72	90.66	0.06

1. The substances needed for the growth of a plant do not come from the soil only.
2. The plant grows because of the water it gets.

Do you think Von Helmont's conclusions were correct?

Fig 4
Stephen Hales

People tried to check this and thus experiment after experiment followed. Stephan Hales described the leaves as organs of transpiration (loss of excess water from plant body) and he said that plants exchange gases with their surrounding air.

Furthermore, he was the first to point out a possible role of light in plant nutrition.

It was Priestley who carried out a sequence of experiments. He could demonstrate that what animals were doing to the air was being reversed by plants. That is, according to him, if animals were making the air impure, plants were making it pure.

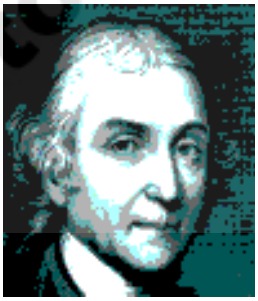

Fig 5
Priestley

Ingenhouz tried to repeat Priestley's experiments under different conditions and found that only the green parts of plants when exposed to sunlight could do that. Several scientists started working on what green plants were doing with water and air and sunlight and till date we know that-

Fig 5
Ingenhouz

Green parts of plants use carbon dioxide in the presence of sunlight (as well as other sources of light) along with water to make glucose, starch and other food materials. This process of making food materials is called as photosynthesis and such plants are called Autotrophs.

List the four major things needed by plants to carry out the process of photosynthesis.

In nature, the presence of the green substance in leaves is essential for photosynthesis to take place. This green substance is called chlorophyll.

$$\text{Carbon dioxide + Water} \xrightarrow[\text{and chlorophyll}]{\text{In the pre sence of sunlight}} \text{Glucose + Oxygen}$$

Where does water come from?

Plants get water from the soil through their roots while the process of photosynthesis takes place in the leaves. So how does the water reach the leaves from the roots? What path does it follow?

Let us recall the experiment done in the chapter " Plants: Parts and Function" , which showed how water is transported in the plant body.

Fig 6

- On the basis of this experiment, what conclusion can you draw about the functions of the root and stem in the nutrition of plants?

  Farmers sprinkle urea in rice or wheat fields whenever the leaves turn yellow. The leaves soon become green again.

- Why is it necessary to irrigate the fields after sprinkling urea? Think it over and answer with reasons.

- The farmer sprinkles urea in the soil of his field. How does the urea affect the leaves of the crop?

This experiment and the information about urea tell us how and from where plants get water and other nutrients dissolved in it.

Exchange of air

Plants get water from the soil through their roots. They use carbon dioxide of air. This job is done by the leaves. The leaves have tiny holes through which the exchange of air takes place. These holes are so minute you can only see them with the help of a microscope. They are called stomata. It is through the stomata that the exchange of air in leaves takes place continuously. You have seen the picture of stomata in your ClassVI science textbook.

Fig 7 - Stomata

We know that plants take water through their roots and air though the stomata of their leaves (there are some other parts like loose tissues and lenticels present on the bark of plant through which exchange of air takes place). We also know that leaves contain the green substance, chlorophyll. What else is needed for photosynthesis?

The next question is whether the process of forming starch by combining carbon dioxide and water requires light. Let us try to find out.

If light is absent

A description of an experiment is given here. Read it, try and find out what effect light has on the formation of starch in leaves. The experiment was done with a plant called Chaina rose (Mandara), but it can be performed with any plant.

You need to find out if starch is present in

leaves. You already know how to test for starch, but a problem arises if you try this test with leaves. Leaves are green in colour. When iodine solution is put on a leaf, it should turn blue if starch is present. However, the green colour of the leaf disguises the blue colour. So you must first remove the green colour of the leaves if you want to test whether they contain starch. The way to do this is to first put the leaves in a boiling tube and boil them in alcohol. This is a bit difficult. You need to be careful while boiling leaves in alcohol.

In the experiment described here, 4 to 5 leaves of a Chaina rose plant were plucked in the afternoon. After removing their green colour in the way described above, they were put in diluted iodine solution. The leaves turned black. Why did this happen?

In the second part of the experiment, 4 to 5 leaves of the same plant were covered with black paper without removing them from the plant. The way the black paper was cut and fixed to the leaves is shown in the figure 8.

Fig. 8

These leaves were plucked two days later. Their green colour was removed and they were dipped in iodine solution. The leaves turned black in the pattern shown in the figure.

Do You Know?

Preservation of plant parts like leaves, flowers or whole plant is a treditional designery art. If the plants are not available in a particular place then the plant physiologists collect those plants where they available and make them in the preservative form. This is commonly known as herberium They study those plants, and these preserved plants also helpful for the future studies.

Can you tell by looking at the figure where starch is present and where it is not?

Did the entire leaf get light after it was covered with black paper? If this was not the case, which parts of the leaf did not get light?

Did starch form only in those parts that got light?

On the basis of this experiment, what connection do you see between light and starch formation?

Do plants produce only starch?

In the chapter 'Our food', you read that starch, fats and proteins are present in food. They are also present in plants. Where do these substances come from? Plants produce sugar first, which is converted to starch and then other compound as well. But plants need other nutrient elements to do this.

The main nutrients needed are nitrogen, potassium and phosphorus. Plants require many other nutrient elements as well, but these are needed only in minute quantities. Hence, they are called micronutrients. Plants absorb these nutrient elements from the soil through their roots. Unfortunately, at this stage we cannot perform any experiment to study these nutrient elements.

Other modes of nutrition in plants

Have you seen yellow thread-like structures twining around the stem, branches and leaves of some trees? Fig 10 shows such a plant.

Fig. 10

This thread-like plant is Cuscuta. It neither has leaves nor chlorophyll. How do they survive? From where do they get nutrition? Cuscuta takes food from the plant on which it is climbing.Like humans and animals such plants depend on the food produced by other plants. This mode of nutrition is called heterotrophic nutrition.

Parasitic plants develop special roots called haustoria, which penetrate into the tissues of the host plant and absorb food materials from them.

Plants that grow on dead and decaying matter

Often after rains we find umbrella like structures growing from the ground. Such plants are called saprophytes. They grow on dead/ decaying matter.

Fig. 11

You might have seen black and white spots appearing on bread pieces, pickles, when kept in moist places. These spots develop due to the growth of fungi, which is a type of plant.

All these types of plants do not contain chlorophyll so they simply absorb organic material usually from decaying matter.

- Try to find out the different types of saprophytes that you may find growing around you? If they are too small try to observe them with a hand lens.
- Draw the pictures of the saprophytes and write the places where you found them.

Special mode of obtaining nutrition in insectivorous plants:

A few plants manufacture their own food but also obtain a part of their nutrition from insects. Leaves of these plants are specially modified to trap insects. These plants grow in areas deficient in nitrogen. Hence they meet their nitrogen requirements from insects. Being green in colour, they can manufacture their own food. Droseras, Utricularia, Venusflytrap are examples of some such insectivorous plants. These are also called as carnivorous plants.

Fig. 12

Some plants like those of the Dal family have a type of bacteria growing on their roots in nodules. The bacteria fixes nitrogen for the plant while it gets shelter in the roots of these plants. Such an association is beneficial to both groups and called symbiosis.

Fig. 13

Do you know?

There are colonies of algae and fungi living together in a symbiotic relationship! These colonies are known as Lichens. This relationship starts with the attack of algal colony by a type of fungus. It is an example of balanced parasitism then. Later as algae survive, they are given protection from intense light and conditions of drying up due to the presence of fungus colony. The fungus gets food from its partner.

Fig. 14

Let us green our environment so that we will never worry about oxygen and food!

Key words:

Nutrition, Autotroph, Chlorophyll, Photosynthesis, Stomata, Saprophyte, Insectivorous, carnivorous, Symbiosis, Fungi

What we have learnt

- Green parts of plants use carbon dioxide in the presence of sunlight (as well as other sources of light) along with water to make glucose, starch and other food materials. This process of making food materials is called photosynthesis.
- Plants that do not photosynthesize depend on other means of getting their nutrition.
- Saprophytes live on decaying organic matter.
- Insectivorous plants fulfill their nitrogen deficiency by trapping insects.
- In symbiosis, organisms share their food and shelter.

Improve your learning

1. A potted plant is kept in light for a day and one of its leaves is tested for starch. The same plant is kept in the dark for two days and another leaf is tested for starch. Will there be a difference in the results of the two experiments? Give reasons for your answer.
2. What happens if leaves of a green plant are coated with oil?

   (Hint: What will be the effect on stomata?)

3. Do you think saprophytes help us in keeping the environment clean?

(Hint: What do saprophytes feed on?)

4. Differentiate between following with some examples.

(i) Parasite and saprophyte

(ii) Host and parasite.

5. Fill in the blanks and give reasons

(i) Green plants are ..... in nature

(ii) The food synthesized by the plants is stored as .....

(iii) Saprophytes depend on ..... for food.

6. Name the following:

(i) Pores through which leaves exchange gases.

(ii) Plants that act as scavenger of nature.

(iii) Those plants that share food and shelter.

(iv) Plants which cannot make their own food and obtain it from host.

7. Tick the correct answer

(i) Cuscuta is an example of

a). Autotroph b). Parasite
c). Saprophyte d). Symbiont

(ii) Haustoria are

a). Roots b). Stems
c). Leaves d). All of them

(iii) Raw materials involved in the process of photosynthesis

a). Carbon dioxide b). Water
c). Sun light d). All of them

8. Circle the insectivorous plant among the plants given below.

(a) Hibiscus (b) Teak

(c) Nepanthus (d) Aloevera

9. Collect information about experiments of Joseph Priestly and Ingen Houz from Internet and make a brief note on them.

10. Do you agree with von Helmont? If nutrients absorbed by plants from soil is equal to the mass of plant / tree what will happen? Think and write your hypothesis.

11. Why are some plants called insectivorous plants? Give reasons.

12. Designery leaves - select any broad leaved potted plant. Cut a card board with a design of your choice and seal the selected leaf with the card board. Let the plant stand under the sun for a week then remove the card board you will get designery leaves plant. Try to make more leaves with designs and display your plant but don't forget to present your writeup.

13. Collect a leaf. Take peels from both sides of the leaf and observe stomata size, shape and number under microscope. Write your findings.

14. Prathima said "Mushroom is also a plant" is she correct? How would you support her?

15. Photosynthesis is the way plants make food in every leaf by using different items. Write your feelings on this.