Nutrition in Plants

Modes of Nutrition

We know that all living organisms require food to survive. You may wonder what is there in food which helps in the survival of organisms? Well, the answer is nutrients. Organisms consume nutrients, which enable them to carry out various body functions.

The process by which an organism consumes food is called **nutrition**, which are then utilized by the body for various functions.

Autotrophic Nutrition: The term 'autotroph' is derived from the Greek word '*Auto'* meaning self and '*trophos'* meaning nutrition.

In this mode of nutrition, organisms prepare or synthesize their own food with the help of inorganic raw materials in the presence of sunlight. These organisms are known as **autotrophs**. All green plants and some bacteria are autotrophs.

Heterotrophic Nutrition: The term 'heterotroph' is derived from the Greek words '*Heteros'* meaning different or other, and '*trophos'* meaning nutrition.

In this mode of nutrition, organisms obtain energy from the intake of complex organic substances, generally from plant and animal sources. These organisms are known as **heterotrophs**. All fungi and animals and some bacteria are heterotrophs.

Let us study about various types of heterotrophs.

Herbivores: These are the animals that feed directly on plants. For example, cow, goat, rabbit etc.

Carnivores: The animals that feed on herbivores are known as carnivores. For example, tiger, lion etc.

Omnivores: This includes the animals which eat both plants and animals. For example, humans etc.

Saprophytes: These are the organisms that feed on dead and decayed organic matter. For example, bacteria, mushroom etc.

Parasites: These are the organisms that live inside or on the body of other living organisms called the Host and obtain food from them. For example, *Cuscuta* plant that obtains food from green plants, *Ascaris* that lives in the intestine of humans etc.

Insectivorous plants: Some plants live in the areas where the soil is deficient in nitrogen. These plants trap insects and obtain nitrogen from them. These plants are called as insectivorous plants

Summary of differences between autotrophs and heterotrophs

Autotrophs	Heterotrophs
They obtain energy by preparing food from inorganic substances such as CO_2 and water in the presence of sunlight.	They obtain energy from complex organic substances by consuming plants or other animals.
These organisms are called **producers** as they manufacture their own food.	These organisms utilize the food manufactured by producers. Hence, they are called **consumers**.
Green plants, algae are autotrophs.	Animals and fungi are heterotrophs.

Do You Know?

Plants do not always have an autotrophic mode of nutrition. They can be parasitic, carnivorous, or saprophytic.

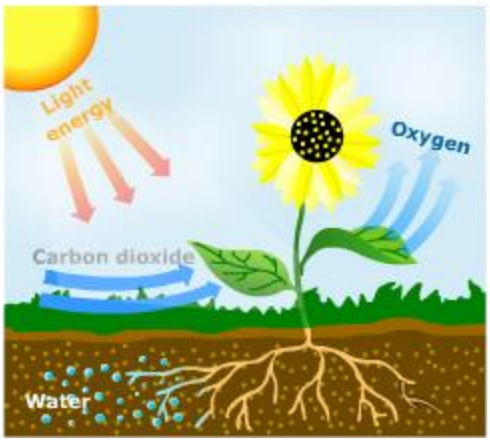
Rafflesia is a root parasite. It draws water and minerals from the roots of other plants.

Cats are purely obligate carnivores. They cannot digest fruits, vegetables, pulses, grains etc. They need a high level of protein in their diet. They lack an efficient system for digesting plant products. A cat's digestive system is specialized to suit a carnivorous eating habit.

Leaves are the food factories of plants. They are the sites where the synthesis of food occurs in plants.

But why do only leaves manufacture food for plants? What process is involved in the synthesis of food?

The leaves of plants contain a green pigment called chlorophyll. This pigment captures the sun's energy, which is used to prepare food from carbon dioxide and water. The process of synthesis of food using sunlight, carbon dioxide, and water is known as photosynthesis.



Since solar energy is essential for plants to prepare food, we can say that sun is the ultimate source of energy for plants.

What happens during photosynthesis? During the process of photosynthesis, the leaves containing chlorophyll convert carbon dioxide and water into carbohydrates in the presence of sunlight. This process can be represented in the form of the following equation:

Carbohydrates, which are produced during photosynthesis, are ultimately converted into starch to be stored in plants.

Know Your Scientists:

Year	1770	1779	1854
Name of scientist	Joseph Priestley	Jan Ingenhousz	Julius Von Sachs
Discovery/Finding	Concluded that air is necessary for the growth of a plant. He discovered the fact that plants restore oxygen in the air.	Concluded that sunlight is essential for plant processes that purify the air. He also discovered that the green parts of plants release oxygen.	Discovered that the chlorophyll is located in special bodies called chloroplast. Green parts of plants are where glucose is made, which is stored as starch.

Curiosity Corner:

Now, not all leaves are green in colour. Does photosynthesis take place in these leaves too?

Yes, Leaves which are not green in colour also contain chlorophyll. They are not green in colour because they contain other pigments such as red, brown, yellow etc, which mask the green colour of leaves.

Can you tell why potted plants are advised to be placed in well-lit areas?

Plants require sunlight to manufacture food. Without sunlight, photosynthesis cannot take place in plants, and can even lead to the death of plants. Hence, it is advisable to place potted plants in areas receiving sufficient sunlight.

We now know that plants require water and carbon dioxide, in the presence of sunlight, to carry out photosynthesis. How are raw materials supplied to plants?

The tiny pores found on the underside of leaves are called **stomata**. It allows the entry of CO_2 from the atmosphere so that it can be used for photosynthesis and releases the oxygen produced by the plants.

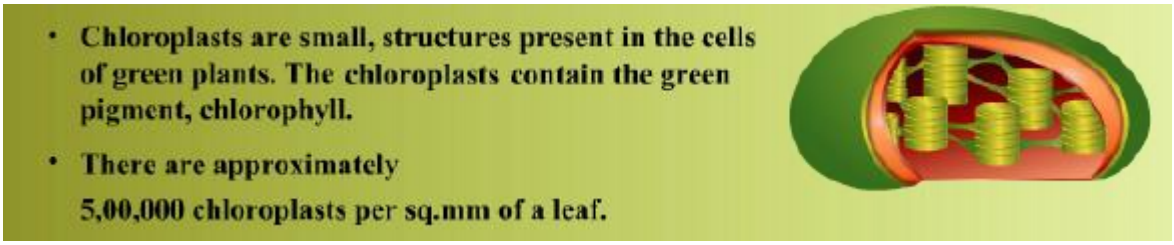
Leaf Leaf section Stomata

Structure of stomata:
Stomata are small openings present on the lower surface of leaves. These openings are surrounded by two bean shaped cells called guard cells. These guard cells contain chloroplast. In guard cells, the outer wall is thin while the inner wall is thick.

Regulation of stomata:
Opening and closing of stomata is regulated by these guard cells. During day time, in the presence of sunlight, water moves into the guard cells making them to swell up. As they swell up, their outer thin walls bulge outward, as a result of which the inner walls move apart from each other. This results in the opening of stomata.

During night, the water moves out of the guard cells which makes them flaccid. This causes the inner walls to come together, as a result of which stomata closes.

Do you know the cell organelle of the plant cell that carries out the process of photosynthesis? It is **chloroplast**.



Chloroplast is divided into two regions namely, **grana** and **stroma**.

In the **grana** region, reactions which depend on sunlight take place. These reactions are also known as light dependent or light reactions. In these reactions, water molecules break down into oxygen and hydrogen ions on absorption of energy from sunlight. Plants release oxygen gas in this phase and chemical energy obtained from

light energy is stored in the form of ATP. This chemical energy is required in the preparation of starch in the reactions independent of light.

In the **stroma** region, light independent or dark reactions take place in which chemical energy produced in the grana region is used to convert carbon dioxide into starch.

Photosynthesis is affected by various factors, such as:

- **Light**: Photosynthesis can occur only up to a certain level of concentration of light. Above that level of light, chlorophyll is destroyed and photosynthesis is affected.
- **Temperature**: At higher temperatures, photosynthesis does not take place and similarly at lower temperatures the rate of photosynthesis is less.
- **CO_2**: CO_2 levels also affect the rate at which photosynthesis is carried out. Low levels of CO_2 means lower rate of photosynthesis.

Nitrogen Fixing Bacteria- Rhizobium

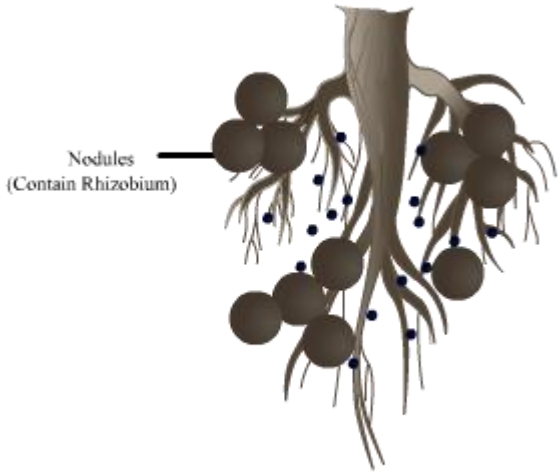
Nitrogen is essential for plants to make proteins. Plants cannot directly utilize the nitrogen available in the atmosphere. They require nitrogen in the soluble form.

How is atmospheric nitrogen supplied to plants in the soluble form without the use of fertilizers?

A bacterium called ***Rhizobium*** plays an important role in this process.

Rhizobium converts atmospheric nitrogen into the soluble form, which can then be taken in by plants. However, since *Rhizobium* cannot prepare its own food, it establishes itself in the roots of other plants and provides them with nutrients. Plants, in turn, provide the bacterium with food and shelter. Thus, there exists a symbiotic relationship between the bacterium and plants.

Rhizobium lives in the roots of gram, peas, *moong*, beans, and other leguminous plants. It is not present in the roots of all plants.



Do you know why farmers plant leguminous plants along with other crops in their fields?

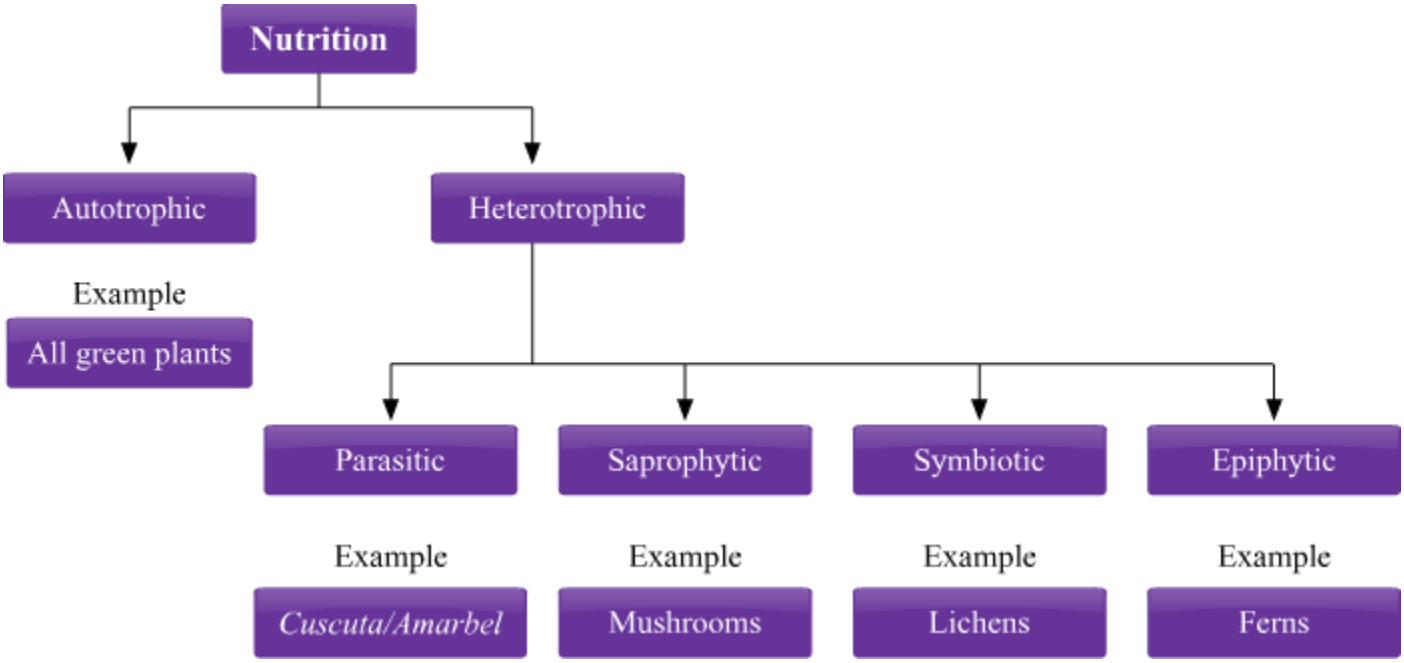
Leguminous plants enrich the soil by fixing atmospheric nitrogen with the help of *Rhizobium* bacterium, which is present in their roots. They also help in reducing the use of fertilizers in the soil. It is for this reason farmers plant leguminous plant along with other crops in their fields.

Heterotrophic Nutrition in Plants

Do all plants manufacture their own food?

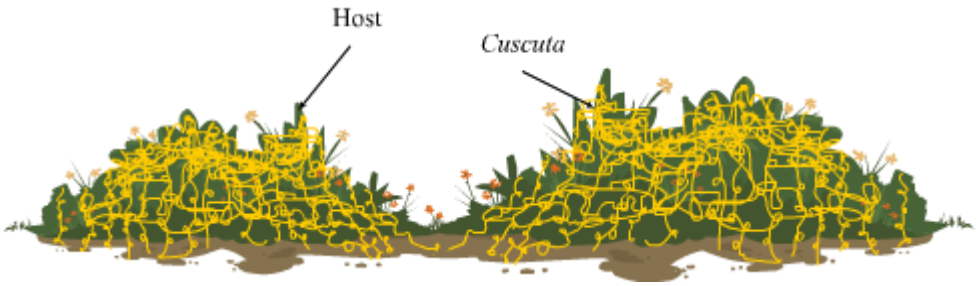
No. All plants do not manufacture their own food. Some plants are dependent on other plants for food. Thus, they exhibit heterotrophic mode of nutrition.

Heterotrophic nutrition in plants is of several types.



Parasitic nutrition

You must have observed yellow tubular structures coiling around the stems of plants or on the branches of trees.



What do you think this is? Is it a root or a stem?

The yellow tubular structure found in plants is another plant called *Cuscuta* or *Amarbel*. This plant cannot manufacture its own food as it lacks chlorophyll. Therefore, it survives by growing on the body of another plant, deriving nutrients from this plant in the process. This mode of nutrition is known as **parasitic mode of nutrition**. *Cuscuta* is known as a **parasite** as it deprives the other plant of its nutrients. The plant on which it grows is known as the **host**.

The parasitic mode of nutrition is not limited to plants only. Animals such as mosquitoes, bed bugs, lice, and leech also exhibit parasitic mode of nutrition.

Insectivorous plants

Do you know that some plants eat other animals?

Some plants trap insects and digest them to obtain nutrients. Such insect-eating plants are known as **insectivorous plants**.

Pitcher plant

Pitcher

How do these plants catch insects? Which feature allows these plants to catch insects?

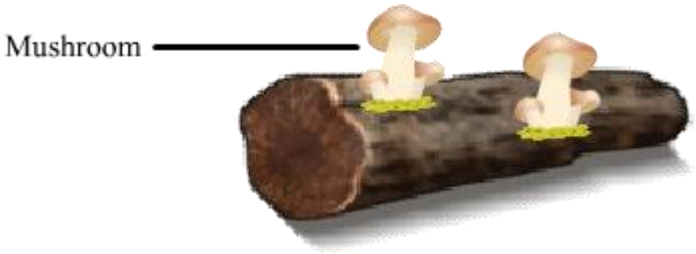
Insectivorous plants are green and can carry out the process of photosynthesis. Then, why do they eat insects for nutrition?

Insectivorous plants grow in regions where soil is very poor in nutrients. Therefore, in order to obtain sufficient nutrients for their growth, they feed on insects.

Saprotrophic nutrition

Do you know what mushrooms are?

Mushrooms are neither plants nor animals rather they form another group of organisms which show some plants features and some animal features. They are called fungi. Fungi feed upon dead and decaying plants and animals. They show saprotrophic mode of nutrition.



Let’s study through this video what saprotrophic nutrition is?

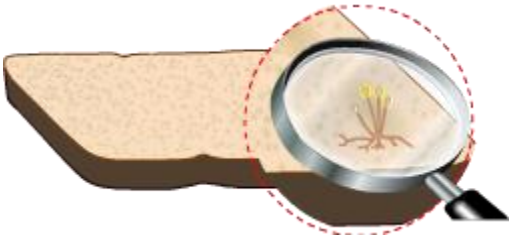
Since fungi can grow on any moist surface, they spoil several things during the rainy season. However, not all fungi are harmful. Some fungi such as yeast and mushrooms are useful because they are edible.

How do fungi grow on different things?

Fungal spores are present in air. When these spores land on a moist surface, they germinate to give rise to fungus.

Let us perform the following activity to understand this better.

Sprinkle some water on a piece of bread in order to make it moist. Now, place this piece of bread in a moist place. After 2-3 days, you will notice fluffy patches of different colours growing on the bread. They are called **bread fungi** or **mould.**



Symbiotic Relationship: There are certain organisms that live in association with other plants or animals and share their resources. In this kind of relationship, both the partners are benefitted by the relationship.

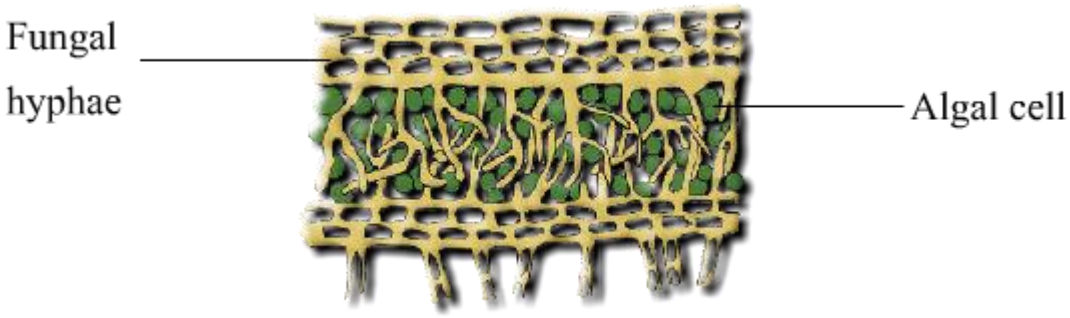
Can you recall an organism which shares a symbiotic relationship with another organism?

Have you seen patches of grey-green organisms growing on trees?

Let us understand what these organisms are.

They are lichens. Lichens are a good example of symbiotic relationship. Lichens are an association between fungus and green algae.

While fungi absorb water and minerals, and provide shelter, algae produce food through photosynthesis. Since fungi and algae share a symbiotic relationship with each other, they are called **lichens**.



Some interesting facts:

Do you know that pollination, which is carried out by honeybees and other insects, is an example of symbiotic relationship? Insects help plants in reproduction, which in turn provide them with food such as nectar.

Some plants are able to utilize nitrogen from soil because of the presence of certain symbiotic bacteria in their roots.

Epiphytic nutrition: This mode of nutrition is found in those plants which grow on other plants known as host, but are independent of the host plant for nutrition. They mainly depend on the host plant for support and moisture. For example, ferns, orchids etc.

Mineral Nutrition

We know that plants absorb minerals from soil.

What minerals are required by plants?

In total, there are sixteen minerals required by plants. Some minerals are required in small quantities and are called **micronutrients**. Minerals required in larger quantities are called **macronutrients**. Nutrients are essential elements, which are used by plants in large quantities.

The table lists the various nutrients required by plants.

Macronutrient	Micronutrient
Phosphorus Magnesium Potassium Nitrogen Calcium Sulphur	Molybdenum Manganese Chlorine Copper Boron Zinc Iron

The table below separates the nutrients obtained from different sources.

Source	Nutrient
Air	Carbon and Oxygen
Water	Hydrogen and Oxygen
Soil	Macronutrient and Micronutrient

When nutrients are not available to plants, physiological activities such as growth, reproduction decreases and vulnerability to diseases increases. Providing proper quantity of nutrients to plants ensures proper growth.

The amount of minerals in soil can decrease due to their continuous utilization by plants.

Does soil contain an unlimited amount of nutrients? Certainly not!

How are the minerals absorbed by plants replenished in the soil? This is done by adding manures and fertilizers to soil. These substances contain nutrients such as nitrogen, potassium, phosphorus etc. that help in enriching the soil.

Manures and fertilizers

Do you know what manure is?

Collect kitchen waste, plant waste, ash, newspaper, food scraps, etc. Mix them with soil and add some water. Stir and mix the contents regularly. Allow the materials to decompose. This mixture is rich in organic matter, renders soil fertile, and promotes luscious growth of plants.

This mixture is called **manure.** Therefore, manure is decomposed animal and plant waste. It increases the water-holding capacity of soil.

Composition of manure

Manure is a source of many plant nutrients. It is composed of organic matter and minerals. Ammonia, nitrate, organic substances, etc. are predominant organic matters found in manures. Manures are mostly composed of micronutrients such as zinc (Zn), manganese (Mn), copper (Cu), magnesium (Mg), sodium (Na), etc.

Types of manures:

Manures can be classified as **compost** and **green manure** based on the kind of biological material used. Let us explore the different types of manures.

What we looked at so far are natural materials used as sources of nutrition for plants.

Composting is done under certain conditions. The quantity of the prepared material may vary, depending upon the availability of decomposing material. It may also depend upon the season, as decomposition is slow during the rainy season.

What if plant nutrients are required in large quantities? Are there any synthetic nutrients available?

Fertilizers are plant nutrients, which are commercially available. They can be organic or inorganic in nature. They ensure healthy growth and development in plants by providing them with nitrogen, phosphorus, potassium, etc.

However, the addition of fertilizers to soil requires special guidelines to be followed (such as dosage, time, post addition precautions, etc.).

How is composting better than manufacturing fertilizers? Are there any advantages (or disadvantages) associated with the use of fertilizers in comparison to manures?

They are mostly inorganic compounds, which can readily dissolve in water. They are easily available for plants.

They are a good source of nitrogen, phosphorus, and potassium. However, they are good only for a short term use.