All living organisms need food to survive. It also provides the building blocks for the body of a living organism. There are many life processes which need energy. Some important life processes are nutrition, photosynthesis, respiration, excretion, reproduction, transportation of water, minerals and food.

Both plants and animals require nutrients (carbohydrates, proteins, fats, vitamins and minerals) to derive energy. Food is obtained by different organisms in different ways. Depending on the processes involved in obtaining and utilising food, different organisms follow different types of nutrition. Let us study these in detail.

1.1 MODES OF NUTRITION

There are two main modes of nutrition, based on the nature of raw materials that organisms take from their environment.

**Autotrophic mode of nutrition**

Green plants show autotrophic mode of nutrition. They take simple inorganic substances like carbon dioxide and water from the environment and use them to prepare their own food. Such living organisms which are capable of preparing their own food are known as autotrophs.

**Heterotrophic mode of nutrition**

Most animals show heterotrophic mode of nutrition. They take complex organic food from plants or other animals and then break it down in the body to assimilate (absorb) and use it. Such organisms which cannot prepare their own food and are dependent on other organisms for their food requirements are known as heterotrophs.
Definition
The mode of nutrition in which green plants prepare their own food using simple substances is known as autotrophic mode of nutrition. *Auto* means “self” and *trophism* means “feeding.”

Cells are building blocks of the body of a living being. They are smallest structural and functional unit of an organism. A cell is bound by a cell membrane. It is filled with a jelly-like substance called cytoplasm and has a nucleus in the centre. It is microscopic in size.

1.2 AUTOTROPHS

Autotrophs (green plants) produce food that is used by other living organisms who are incapable of preparing their own food. Autotrophs are, therefore, also called producers.

PHOTOSYNTHESIS – MAKING FOOD

The chemical process through which green plants (containing chlorophyll) combine carbon dioxide and water in the presence of sunlight to prepare food in the form of glucose is called photosynthesis.

Plants take in carbon dioxide and release oxygen through pores on their leaves called stomata (singular: stoma). They take in water and minerals with the help of their roots. This carbon dioxide and water combine when energy from the sunlight, trapped by chlorophyll, reaches them. In the process, glucose and oxygen are formed.

\[
\text{Carbon dioxide} + \text{Water} \xrightarrow{\text{SUNLIGHT} \atop \text{CHLOROPHYLL}} \text{Glucose} + \text{Oxygen}
\]

Requirements for photosynthesis

Photosynthesis requires certain conditions for the progress of the reaction. These are discussed below.

(i) Chlorophyll: Green colour of leaves is due to the presence of this green-coloured pigment. Special cells, called chloroplasts, contain chlorophyll. These are the sites for photosynthetic reactions. Molecules of chlorophyll capture energy from the sunlight during photosynthesis. Leaves of certain plants have other colour pigments due to which they do not look green. However, they do have chlorophyll and thus perform photosynthesis. In some plants, like cactus the leaves are reduced to spines, stems are green in colour and perform photosynthesis.
(ii) **Carbon dioxide**: Plants take in carbon dioxide from the atmosphere through stomata. Guard cells that surround stomata regulate their opening and closing. When guard cells get filled with water, they become turgid (swollen) and the stomata opens, allowing carbon dioxide to enter the leaf. When the guard cells are flaccid, i.e., soft and limp without water, the stomata closes.

(iii) **Sunlight**: Sunlight is essential for photosynthesis as it provides energy required for the reaction. The rate of photosynthesis is also affected by the amount of sunlight.

(iv) **Water**: Plant roots absorb water along with minerals from the soil and transport them to the leaves. They have tube-like structures called vessels which form a continuous path for the transportation of water and nutrients.

With all the components and required conditions in place, the process of photosynthesis takes place producing glucose and releasing oxygen. This glucose (food) is transported to the different parts of the plant through stems. The glucose is converted into starch and is stored in leaves, roots, stems, etc.

In your previous class, you performed the iodine test on leaves to test the presence of starch. When iodine is added to decoloured leaves, they turn blue-black, indicating the presence of starch. Similarly, we can perform different tests to show the necessity of chlorophyll, carbon dioxide and sunlight for the process of photosynthesis.

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**Activity-1**

To show that chlorophyll is necessary for photosynthesis.

The leaves of a coleus, lemon, or croton plant are partly green and partly non-green. Such leaves are called variegated leaves. Pluck a variegated leaf from a plant, perform the iodine test and hold the leaf against a source of light. What do you observe?

You will see only the green part of the leaf turns blue-black. This shows that only that part of the leaf which contains chlorophyll has prepared food.

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**Did You Know?**

In cultivated fields, the demand of minerals in the soil becomes heavy. This deprives the soil of its natural minerals. Therefore, to fulfill the mineral requirements of cultivated crops, minerals need to be added in the form of fertilisers.

**Synthesis of food other than carbohydrates by plants**

The starch produced during photosynthesis is a carbohydrate (made of carbon, hydrogen and oxygen). Plants also need nutrients like proteins and fats to grow and function properly. They take in nitrogen to synthesise proteins. Though it is abundant, nitrogen in air cannot be absorbed directly by plants. So how do plants get nitrogen to make nutrients?

- **Rhizobium bacteria** present in soil are capable of ‘fixing’ nitrogen, i.e., taking atmospheric nitrogen and converting it to soluble forms to be absorbed by the plants.
• Nitrogen can be added through fertilisers, which is then readily absorbed by the plants.

### InText Questions

**Q.1** Why is nutrition necessary for living organisms?
**Q.2** What is the difference between autotrophic and heterotrophic modes of nutrition?
**Q.3** Give two examples each of autotrophs and heterotrophs.

**Q.4** During photosynthesis, plants produce food in the form of _______________.

**Q.5** Plants mainly require three nutrients for their growth. What are they?

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### 1.3 HETEROTROPHS

Animals and non-green plants like bacteria and fungi obtain their nutrition from other organisms as they cannot prepare their own food. This mode of nutrition is known as **heterotrophic nutrition**.

**Heterotrophic plants**: According to the modes of nutrition, heterotrophic plants can be classified as:

(a) **Parasites**: Organisms which depend on other organisms for food and shelter are called **parasites**. The organism which provides food and shelter to a parasite is called **host**. The parasite grows on or inside the body of the host and derives its nutrition from the host.

For example, cuscuta/dodder (**amarbel**) is parasitic on a wide variety of plants, including potato, chrysanthemum, dahlia and petunia. It has root-like structures that suck food from the host plant.

Organisms which depend on the host organism only for some nutrients are called **partial parasites**. For example, mistletoe grows on a variety of trees like mango and eucalyptus. It bears evergreen leaves that can carry out photosynthesis on their own. It relies on the host mainly for minerals and water.

(b) **Saprophytes**: Organisms which grow on and derive nourishment from dead and decaying organic matter are called **saprophytes** or **saprotrophs**. This mode of nutrition is known as saprophic nutrition. Some non-green plants like snow orchid, Indian pipe, fungi (like mushrooms) and bacteria are saprophytes. They secrete digestive juices to convert the solid dead and decaying matter into liquid and derive their nutrients from it.
(c) **Insectivores**: Organisms which consume insects as a part of their regular diet are called **insectivores**. Insectivorous plants and animals have special body parts that help them catch insects. Pitcher plant, bladderwort, venus flytrap and sundew are some insectivorous plants with specialised structures for catching insects. For example, in pitcher plant the leaf in the shape of a pitcher and the apex of leaf forms a lid for it. Inside the pitcher there are hair which are in downward direction. When an insect sits on the leaf, it slips inside and gets trapped in the hair while the lid closes. Insectivorous plants are green plants which are capable of photosynthesis, but derive most or some nutrients from insects. They usually grow in places where the soil is poor in nutrients, especially nitrogen.

(d) **Symbiotic plants**: The interaction between two different organisms which live close, physically and benefit from each other is called **symbiosis**. A symbiotic relationship is a mutually beneficial relationship.
For example, lichens are composite organisms. They have one fungal partner and one algal partner. Algae are autotrophs. They synthesise organic food for themselves and also provide it to their fungal partner. Fungi are saprophytes. They are capable of absorbing water and minerals from the material they are growing on. They supply their algal partner with water and minerals. Fungi also provide shelter to the algal partner.
Another example is **Rhizobium-legume symbiosis**. Rhizobium is a bacterium which is capable of fixing atmospheric nitrogen to a form which can be readily used by plants. It lives in the roots of leguminous plants such as peas, and provides them with nitrogen. Legumes provide food and shelter to Rhizobium in return.

**How are nutrients replenished in the soil?**
Plants absorb mineral nutrients from the soil and therefore, the amount of minerals in the soil keeps on declining. These nutrients need to be added back to the soil to enrich it. **Decomposers** play an important role in replenishing the soil with nutrients.
Decomposers like bacteria and fungi release enzymes on dead plant and animal waste. These enzymes release nutrients trapped in the dead bodies and waste matter, and return them to the soil. Usually crops require a lot of nitrogen to make proteins. After a harvest, the soil becomes deficient in nitrogen. Farmers need to add manure and fertilisers to replenish the lost nutrients. Addition of fertilisers enriches the soil with nitrogen, potassium and phosphorus.
Another way of adding nutrients back to the soil is growing leguminous crops. The symbiotic relationship between legumes and nitrogen-fixing bacteria like Rhizobium is very beneficial for farmers as it helps replenish nutrients in the soil, especially nitrogen.

**DO THIS**

Moisten a slice of bread and keep it in a warm place for 2-3 days. You will notice some colourful fluffy patches growing on it. These can be white, green, or brown in colour. What are these? These are fungal patches.

**Intext Questions**

Q.1. What do we call a mutually beneficial relation?
Q.2. Name any five saprophytes.
Q.3. Which among the following is a parasite?
   (a) Venus flytrap  (c) Pitcher plant  (b) Amarbel  (d) All of them

**IMPORTANT TERMS**

- **Autotrophs**: Organisms that make their own food.
- **Heterotrophs**: Organisms that cannot prepare their own food but depend on other living organisms for their food requirements.
- **Photosynthesis**: Process by which green plants utilise carbon dioxide and water to make food in the presence of chlorophyll and sunlight.
- **Chlorophyll**: A pigment responsible for the green colour of leaves.
- **Chloroplasts**: Special cells found on leaves and stems of plants where photosynthesis takes place.
- **Stomata**: Small pores on the undersides of leaves through which exchange of gases takes place.
- **Parasites**: Organisms which grow on or inside the body of other organisms and derive nutrition from them.
- **Host**: Organisms that provide food and shelter to parasites.
- **Partial parasites**: Organisms that depend on hosts for only some nutrients.
- **Saprophytes**: Organisms which grow on and derive nourishment from dead and decaying organic matter.
- **Insectivores**: Organisms which consume insects.
- **Insectivorous plants**: Green plants that are capable of photosynthesis but derive some or most of their nutrients from insects.
- **Symbiosis**: Interaction between two organisms that live close physically and benefit from each other.

**SUMMARY**

1. Nutrition can be categorised into autotrophic and heterotrophic modes based on the kind of raw material organisms take in from the environment.
2. Organisms can be classified into autotrophs and heterotrophs depending on whether they can make their own food or not. Autotrophs can synthesise their own food, whereas heterotrophs depend on other organisms for food.
3. Autotrophic plants prepare food in the form of starch through the process of photosynthesis.
4. Photosynthesis takes place in the chloroplasts of green leaves and requires sunlight, carbon dioxide, chlorophyll and water.
5. Water and minerals are absorbed by the fine root hairs present in the roots of plants.
6. The rate of photosynthesis increases when a plant receives more sunlight.
7. There are different kinds of heterotrophic plants, depending on the food source they utilise, namely – parasites, saprophytes, insectivores and symbiotic plants.
8. Decomposers and symbiotic plants help replenish soil with nutrients.

**Exercises**

Q.1. **MULTIPLE CHOICE QUESTIONS:**
1. Heterotrophic organisms obtain ________ food from the environment.
   (a) simple  (b) compound  (c) complex  (d) no

2. Chlorophyll is present in special structures in the cells called:
   (a) xylem  (b) phloem  (c) chloroplasts  (d) nucleus
3. Organisms which consume insects as a part of their regular diet are called: 
   (a) carnivores   (b) omnivores   (c) parasites   (d) insectivores

4. Insectivorous plants usually grow in soil deficient in: 
   (a) oxygen   (b) carbon   (c) nitrogen   (d) all of these

5. Gaseous exchange in plants takes place through: 
   (a) stomata   (b) chloroplasts   (c) roots   (d) stems

6. Organisms that depend on host organisms for their food. _____________

7. Organisms which derive nutrition from dead and decaying matter. _____________

8. Cells regulating the opening and closing of stomata. _____________

Q.3 SHORT ANSWER QUESTIONS:

1. Define nutrition.
2. What is unique about lichens?
3. What are hosts?
4. Write the reaction of photosynthesis.
5. What do you understand by partial parasites?
6. Why are nitrogenous fertilisers not added in the soil in which leguminous plants are grown?
7. Give the main types of heterotrophic nutrition in plants with examples.

Q.4 LONG ANSWER QUESTIONS:

1. Describe saprophytic mode of nutrition with examples.
2. What is photosynthesis? Explain.

HOTS Questions (Higher Order Thinking Skills):

1. A farmer grows tomatoes in a greenhouse. He keeps bright lights on in the greenhouse at night. What will be the effect on the growth of tomatoes?
2. Plants get their food from a chemical reaction in their cells. The reaction uses carbon dioxide (gas) and water (liquid) to make glucose (solid). How can a gas and a liquid react to form a solid? Discuss.

Activities

(A) Classroom Activity
   Collect pictures of plants showing various modes of nutrition. Work in groups to collect information about each mode of nutrition and its examples.
   Prepare a chart on the mode of nutrition selected by your group.

(B) Conversational Activity
   Photosynthesis in green plants is different from partially green plants. Discuss.

(C) Exploration Activity
   Visit a nursery and explore the various methods practised by the gardener to keep different plants alive and healthy. Some plants require less sunlight and some more; some plants grow only in plenty of water and some need water very scarcely. Collect all the information and share with your friends.

(D) Experiment/Project
   Get two cuttings from the stem of a rose plant. Grow one cutting in a pot filled with soil and put it in shade.
   Put the second cutting in a sealed flask of water on a sunny windowsill.
   Which cutting in your opinion will grow and why?

Value Based Questions:

Rakesh observed the dodder plant on the stem of a tree in his garden. It was growing luxuriantly on the tree. He asked his gardener to remove it.

Now, answer the following questions based on the information given above:

1. Why was it important to remove the dodder plant from the garden?
2. What values are displayed by Rakesh in this course of action?