1 Chapter

Nutrition in Plants

Hi, I'm EeeBee

We'll cover the following key points:

- Modes of Nutrition
- Photosynthesis: Food Making Process in Plants
- Other Modes of Nutrition in Plants

Do you Remember:

Fundamental concept in previous class.

In class 4th we learnt

- Photosynthesis and Transpiration

Still curious? Talk to me by scanning the QR code.

Learning Outcomes

By the end of this chapter, students will be able to:

- Understand the concept of nutrition and its importance for all living organisms.
- Explain the different modes of nutrition, including autotrophic and heterotrophic nutrition.
- Describe the process of photosynthesis as the primary food-making process in plants, highlighting the role of chlorophyll, sunlight, water, and carbon dioxide.
- Identify other modes of nutrition in plants, such as parasitic, saprophytic, and symbiotic nutrition.

Guidelines for Teachers

The teacher can begin the chapter by explaining the necessity of nutrition for survival and growth in organisms. Encourage students to observe plants in their surroundings and identify how they obtain nutrients. Use experiments, such as demonstrating photosynthesis with simple setups, to make the concepts tangible. Illustrating the roles of sunlight and chlorophyll in photosynthesis with animations or hands-on activities can clarify the process. Connecting modes of nutrition to ecosystems and real-world examples.

NCF Curricular Goals and Competencies

This chapter addresses the following learning objectives:

- CG-1 (C 1.3): Understands the role of nutrition in sustaining life processes and maintaining ecological balance.
- CG-4 (C 4.5): Analyzes the significance of photosynthesis in producing food and oxygen, supporting life on Earth.
- CG-6 (C 6.3 and C 6.4): Investigates alternative modes of nutrition in plants, fostering critical thinking and scientific inquiry.

Mind Map

NUTRITION IN PLANTS

Mode of Nutrition

i. Autotrophic

- Organism make their food themselves.

ii. Heterotopic

- Organism depend on others for their food.

Photosynthesis

i. Meaning

- It is the process by which green plants and some other organism use sunlight to synthesize food from Co_2 and water.

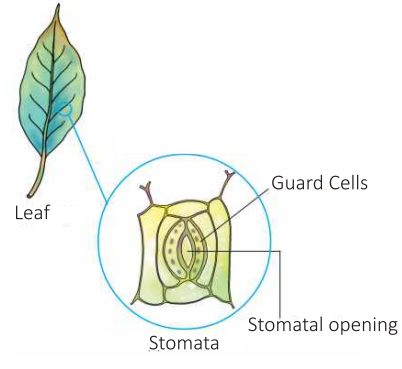
Carbon dioxide + water $\xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$ Carbohydrate + oxygen

ii. Stomata

- It is a type of pore opening on leaf of plants

iii. Chlorophyll

- Green pigment Present in the leaves of plant.



Others modes of nutrition in plants

❖ Meaning

Plants which use Saprotrophic mode of nutrition.

❖ Host

Organisms from which parasites take their food.

❖ Parasites

Organisms that live within or on a host.

❖ Insectivorous Plants

Insect eating plants.

❖ Saprotrophic

In this mode of nutrition, organisms obtain nutrition from dead and decaying matters.

Note:- Some organisms live together and share both shelter and nutrients. This relationship is called symbiosis.

Replenishment of nutrients in the soil

❖ Meaning

Rhizobium bacteria which lives in the roots nodules of leguminous plants and fixes atmospheric nitrogen into nitrites and nitrates in the soil.

Based on NCERT*

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Introduction

All living organisms need food to survive. Carbohydrates, proteins, fats, vitamins and minerals are the components of food. These components are necessary for all living beings. All plants and animals require food for their growth and getting energy. The process of utilization of food by an animal to obtain energy for growth and development is known as nutrition.

In History...

Van Helmont's Experiment (1648): Jan Baptista van Helmont grew a willow tree in a pot for five years and discovered that while the tree grew significantly, the soil mass barely decreased. This led him to conclude that plant growth was not solely due to the consumption of soil, but he wrongly assumed it was primarily due to water.

Joseph Priestley and Photosynthesis (1771): Joseph Priestley discovered that plants could "restore" air that had been "injured" by a candle burning. He found that plants could replenish the oxygen that animals (and fire) consumed.

Modes of Nutrition

Riya and Kabir are exploring plants and animals in their backyard.

MODES OF NUTRITION

The methods of obtaining food are called modes of nutrition.

There are mainly two modes of nutrition:

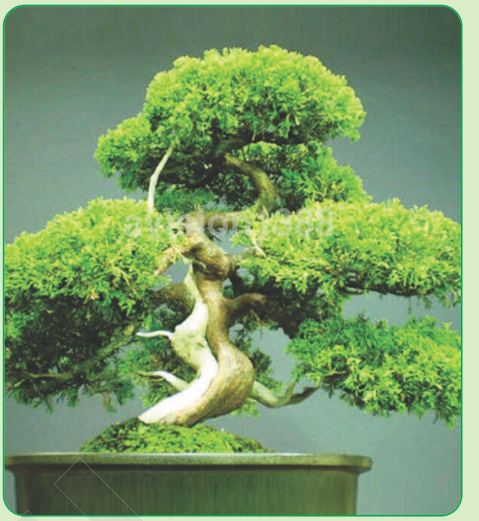
- Autotrophic Nutrition
- Heterotrophic Nutrition

Autotrophic Mode of Nutrition

Green plants take carbon dioxide and water from the environment and transform them into glucose and oxygen with the help of Sun's energy, trapped by a green pigment called chlorophyll.

Those organisms which can make food themselves from simple substances by the process of photosynthesis are called autotrophs, and their mode of nutrition is called autotrophic nutrition.

These green plants produce food not only for themselves, they also make food for non green plants as well as for animals.



Heterotrophic Mode of Nutrition

Those organisms which cannot make food themselves by the process of photosynthesis and take food from green plants or animals, are called heterotrophs, and their mode of nutrition is called heterotrophic nutrition.

Let's recall what we know

Apply Concept in Context

Apply

Provide two examples of organisms that can exhibit both autotrophic and heterotrophic modes of nutrition under specific conditions.

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking

Examine Further

Analyse

- Research examples of how industries utilize organisms with specific modes of nutrition (e.g., autotrophs in biofuel production or heterotrophs in waste management).
- What are the key physiological features that help distinguish autotrophs from heterotrophs?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking, Research

Self-Assessment Questions

Evaluate

Define autotrophic and heterotrophic nutrition and explain their importance in ecosystems.

Skills Covered: Evaluation, Logical thinking

Creative Insight

Create

List ten organisms from your surroundings and categorize them based on their mode of nutrition (autotrophic and heterotrophic). For heterotrophs, identify if they are saprophytic, parasitic, or holozoic. Present this information creatively in a table or chart with columns for organism type, habitat, and mode of nutrition.

Skills Covered: Creativity, Critical and logical thinking, Brainstorming, Observation

Bloom's Taxonomy

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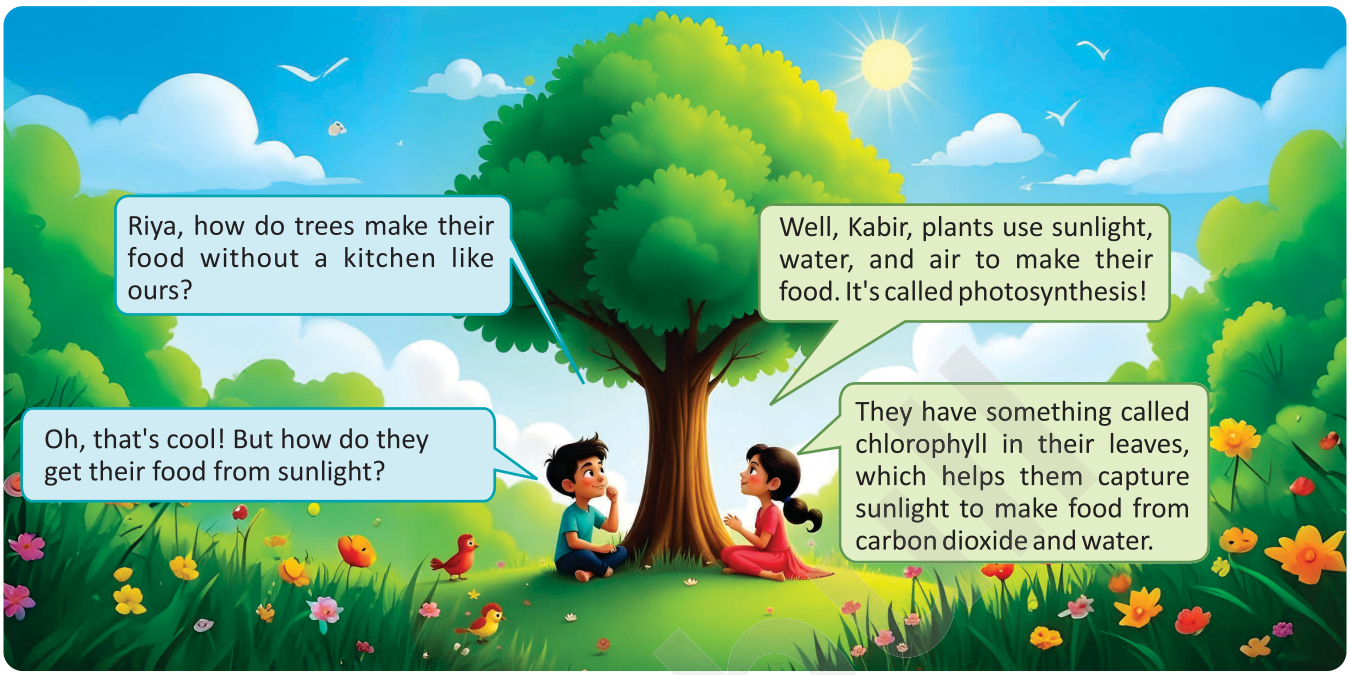
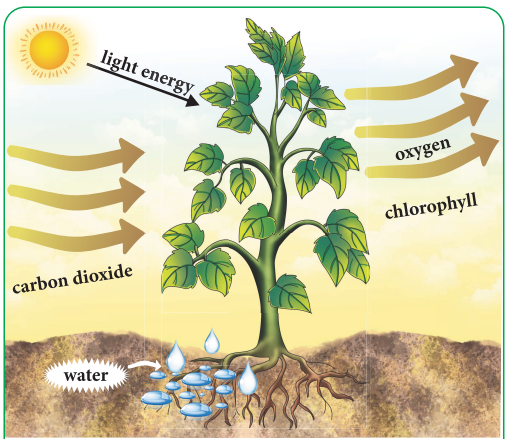
Photosynthesis: Food Making Process in Plants

Riya and Kabir are sitting under a tree in the park.



Green plants are called producers, and their green color comes from specific parts of the plant.

Usually the leaves. For this reason leaves are called food factories of a plant. However, other parts of a plant too play a role in its nutrition.



Schematic diagram showing photosynthesis

Photosynthesis takes place in leaves in following steps:

- The word photosynthesis is derived from two words; photo means light and synthesis means to combine.
- There are tiny pores present mostly on the underside of leaves. These are called stomata (singular stoma). Each stoma is surrounded by two guard cells. Leaves absorb carbon dioxide from air through stomata.
- The roots absorb water and minerals from the soil.
- The water, minerals and nutrients absorbed by the roots get transported to the leaves by the pipes or tubes which run through the entire plant forming a vessel system.
- Chlorophyll is the green pigment present in plants. Chlorophyll captures energy from sunlight, and uses it to prepare food from carbon dioxide and water.
- The process of collection of simple substances such as water and minerals from the soil and

carbon dioxide from the air; utilising sunlight as a source of energy and conversion of these simple substances into glucose is known as photosynthesis.

During the process of photosynthesis, light energy is converted into chemical energy. The plants absorb energy from the Sun and use it to convert carbon dioxide and water into glucose and oxygen. Glucose is converted into other complex substances that get stored in the plant. Plants use glucose to obtain energy, through the process of respiration. The following equation summarises photosynthesis:

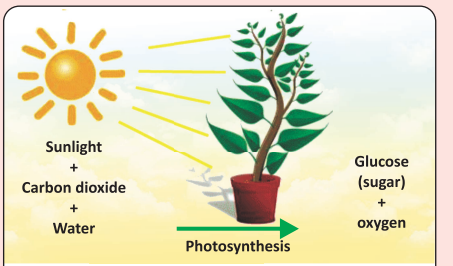
$$6\,CO_2 + 6\,H_2O \longrightarrow C_6H_{12}O_6\,(Glucose) + 6O_2$$

The by-products of photosynthesis are oxygen and water, which are released through the **stomata** during day time. The food is sent to the other parts of the plant through the veins. Without photosynthesis, life would be impossible on the Earth. We cannot imagine survival of any living organism in the absence of plants, as they not only provide food but also oxygen which is necessary for respiration.

Activity

Aim : To show sunlight is necessary for photosynthesis.

Materials required: A potted plant, beaker, burner, black paper, alcohol, iodine solution, dropper.



Activity to show that sunlight is necessary for photosynthesis

Method:

1. Take a healthy potted plant and keep it in a dark room for 2-3 days to destarch the leaves.
2. Cover one of its leaves partly with a strip of black paper and put the plant in sunlight for few hours.
3. Pluck this covered leaf and remove the black strip.
4. Remove the green coloured chlorophyll from the leaf by boiling it first in water and then in alcohol. In this way, we get a decolourised leaf. Wash the leaf with water again.
5. Add a few drops of iodine over the colourless leaf.

Observation: You observe that the part of leaf covered with black paper does not turn blue-black while other parts turn blue-black.

Conclusion: The covered part of the leaf could not get sunlight, hence there is no starch in this part. This shows that sunlight is needed for making starch, i.e. sunlight is necessary for photosynthesis.

KEYWORDS

Stomata: They are tiny pores present on the surface of leaves and stems, primarily in plants, that facilitate gas exchange by allowing oxygen and carbon dioxide to pass in and out.

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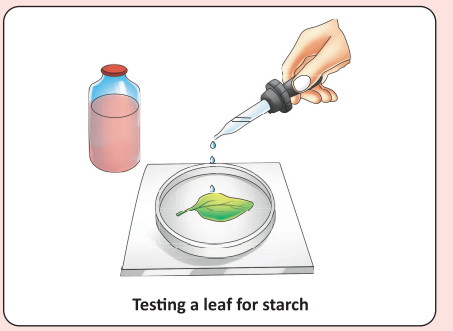
Activity

Aim : To test presence of starch in leaf

Materials required: Green leaf, test tube, ethanol, water, beaker, heating lamp, iodine solution and petridish.


Testing a leaf for starch

Method:

1. Pluck a green leaf from a plant kept in sunlight.
2. Boil the leaf in water for a few minutes to soften it. Place the leaf in a test tube of ethanol. Let the test tube stand in a beaker and warm the water till the ethanol begins to boil. The ethanol will dissolve the chlorophyll and decolourise the leaf.

   (Caution: Do not boil the ethanol directly on flame).
3. Now wash the leaf well with cold water to remove the ethanol.
4. Place it in a petridish and add a few drops of iodine solution.

Observation: The colour of the leaf changes to blue-black due to presence of starch.

Conclusion: The presence of starch confirms the photosynthesis has taken place.

Let's recall what we know

Apply Concept in Context

Apply

- Provide two examples of plants that perform photosynthesis but have unique adaptations for surviving in specific environments (e.g., desert or aquatic).
- How does the process of photosynthesis in plants relate to their habitat or environmental conditions?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking

Examine Further

Analyse

- Research examples of how industries utilize photosynthesis for sustainable practices (e.g., algae for biofuels or plants in carbon capture).
- What are the key adaptations in plants that allow them to perform photosynthesis in extreme conditions, such as deserts or underwater?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking, Research

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Self-Assessment Questions

Evaluate

- Define photosynthesis and explain its importance for life on Earth.
- Which plants in your surroundings perform photosynthesis, and how do they contribute to their ecosystem?

Skills Covered: Evaluation, Logical thinking

Creative Insight

Create

List ten plants from your surroundings and categorize them based on their photosynthetic adaptations. For each plant, describe its habitat and any special features related to photosynthesis. Present this information creatively in a table or chart with columns for plant type, habitat, and photosynthetic adaptations.

Skills Covered: Creativity, Critical and logical thinking, Brainstorming, Observation, Organization

Other Modes of Nutrition in Plants

Riya and Karan are exploring the garden.

Most of the plants have green pigments called chlorophyll and can make their own food. But some plants which do not have chlorophyll, cannot synthesize their own food. Such non-green plants depend on the food produced by other plants. They are known as heterotrophs and the mode of nutrition they use is called heterotrophic nutrition.

Depending on their mode of nutrition, all the heterotrophic plants are divided into two main groups:

- Parasites
- Saprophytes

Parasitic Nutrition

A parasite is an organism that lives in or on another organism and derives nutrients from it. The organism from which a parasite gets its nutrients from is called the host.

For example : Cuscuta (amarbel) is a rootless plant. It entagles itself around the host-plant and derives food from it. It is often called the devil's hair.

Mistletoe has green leaves. But its roots penetrate into the bark of the host tree, get water and minerals required for its process of photosynthesis.

Saprotrophic/Saprophytic Nutrition

The non-green plants which obtain their food (or nutrition) from dead and decaying organic matter are called saprophytes. The mode of nutrition in which the organism (saprotrophs) obtains its food from dead and decaying organic matter of plants and animals is called saprotrophic nutrition. For example fungi (like moulds, mushrooms, and yeast) and many other kinds of bacterias are saprotrophs. Certain bacteria are also saprophytes. They are called saprophytic bacteria.

Did You Know ?

We cannot always see parasites but 75% of the world's creatures belong to this group.

Activity

Aim: To study the growth of fungi.

Materials Rquired: A piece of bread, water and a box with lid.

Procedure: Moisten the bread with water and keep it in the closed box at a warm place for a few days.

Observation: You will see whitish-green and brown patches on the bread. Observe these under strong magnifying glasses or microscope in the school. Draw the structure of what you see.

Conclusion: The patches are formed due to the growth of fungus.

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Insectivorous Nutrition

There are some green plants which obtain their food partially from the soil and atmosphere and partially from small insects.

Pitcher plant

Those green plants which supplement their nutrients by trapping and digesting animals, particularly insects are called insectivores or insectivorous plants.

The insectivorous plants have specialised leaves to catch the insects. Even though all of them are green and can perform photosynthesis, they rely partially on insects and small animals for their supply of nitrogenous compounds. These insectivores trap insects by various methods, kill them and digest them to obtain nitrogen compounds (as amino acids) for their growth. Some common examples of insectivores are: Pitcher plant, Sundew, Venus flytrap and Bladder wort. A pitcher plant uses a pitcher like organ to trap insects and digest them.

In pitcher plants, the **lamina** (blade) of the leaf is modified into a hollow tube called pitcher. The top part of the leaf (called leaf apex) forms a lid which can open or close the mouth of the pitcher. There are hair inside the pitcher which are directed downwards. When an insect falls in the pitcher, the lid closes automatically. The trapped insect gets entangled in the hair of the pitcher and hence cannot come out. After some time the insect dies in the pitcher. The walls of the pitcher secrete digestive juices which digest the proteins present in the body of insect to form simpler **nitrogenous compounds**. These simpler nitrogenous compounds are absorbed by the walls of the pitcher and used by the whole **pitcher** plant.

Did You Know ?

Insectivorous plants are also known as carnivorous plants.

KEYWORDS

Lamina: The lamina is the broad, flat part of a leaf that is primarily responsible for photosynthesis.

Nitrogenous compounds: Nitrogenous compounds are essential nutrients for plant growth, aiding in the synthesis of proteins and enzymes. These compounds are absorbed from the soil in the form of nitrates or ammonium.

Pitcher: The pitcher is a modified leaf structure in carnivorous plants that traps and digests insects. It contains digestive enzymes or fluids to extract nutrients from prey.

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Let's recall what we know

Apply Concept in Context

Apply

- Provide two examples of plants that exhibit other modes of nutrition (e.g., parasitic or insectivorous) under specific conditions.
- How does the mode of nutrition in a plant relate to its habitat or environmental conditions?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking

Examine Further

Analyse

- Research examples of how humans utilize plants with unique modes of nutrition (e.g., parasitic plants in medicine or insectivorous plants for pest control).
- What are the key structural features that help distinguish insectivorous plants from other plants?
- List some examples of plants that adapt their mode of nutrition to extreme environments, such as nutrient-poor soils or dense forests.

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking, Research

Self-Assessment Questions

Evaluate

- Define parasitic and insectivorous modes of nutrition and explain their importance in nature.
- Which plants in your surroundings exhibit parasitic or insectivorous nutrition, and how do they interact with the ecosystem?

Skills Covered: Evaluation, Logical thinking

Creative Insight

Create

List ten plants with unique modes of nutrition from your surroundings or studies and categorize them (e.g., parasitic, saprophytic, or insectivorous). Create a table or chart with columns for plant name, habitat, and mode of nutrition.

Skills Covered: Creativity, Critical and logical thinking, Brainstorming, Observation, Organization

Bloom's Taxonomy

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SUMMARY

Plants, as primary producers, play a crucial role in ecosystems by creating their own food through various nutritional processes. This topic covers the modes of nutrition, the process of photosynthesis, and other unique strategies plants employ to obtain nutrients.

Modes of Nutrition

Plants exhibit two primary modes of nutrition:

1. **Autotrophic Nutrition:** Most plants are autotrophs, meaning they produce their own food using sunlight, carbon dioxide, and water.
2. **Heterotrophic Nutrition:** Some plants depend on other organisms for nutrition due to specific environmental conditions or adaptations.

Photosynthesis: The Food-Making Process in Plants

Photosynthesis is the process by which autotrophic plants prepare food in the form of glucose. The key steps involve:

- **Raw Materials:** Plants use sunlight, water from the soil, and carbon dioxide from the air.
- **Chlorophyll:** The green pigment in leaves traps sunlight.
- **Chemical Reaction:** Using sunlight, water, and carbon dioxide, plants produce glucose and release oxygen as a by-product.

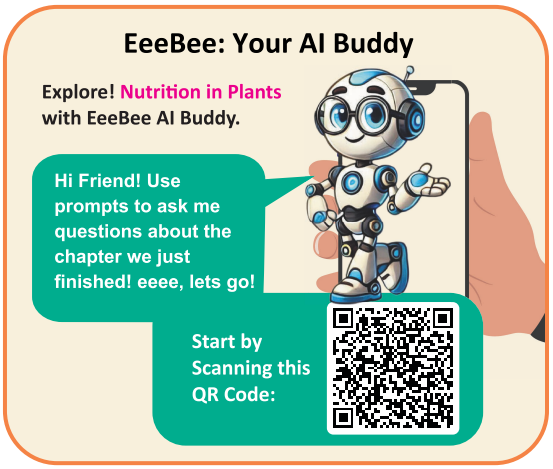
$$6CO_2 + 6H_2O + \text{Light Energy} \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2$$

This process not only sustains plants but also supports life on Earth by providing energy and oxygen.

Other Modes of Nutrition in Plants

Certain plants have evolved unique modes of nutrition to survive in challenging environments:

1. **Parasitic Plants:** Plants like Cuscuta (dodder) obtain nutrients from a host plant by attaching to it.
2. **Insectivorous Plants:** Plants such as the Venus flytrap and pitcher plant trap and digest insects to supplement nutrients, especially in nutrient-poor soils.
3. **Saprophytic Plants:** Plants like Monotropa (Indian pipe) feed on dead and decaying organic matter.
4. **Symbiotic Plants:** Plants like lichens and legumes form partnerships with fungi or bacteria to exchange nutrients.



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EXERCISE

That turn curiosity into confidence—let's begin!

Gap Analyzer™
Take a Test

A. Choose the correct answer.

1. Which of the following is an example of autotrophic nutrition?
   (a) Mushroom ☐ (b) Cactus ☐
   (c) Venus flytrap ☐ (d) Human ☐
2. What is the role of chlorophyll in photosynthesis?
   (a) Absorb water ☐ (b) Absorb sunlight ☐
   (c) Release oxygen ☐ (d) Trap carbon dioxide ☐
3. Which gas is released during photosynthesis?
   (a) Oxygen ☐ (b) Carbon dioxide ☐
   (c) Nitrogen ☐ (d) Hydrogen ☐
4. Which mode of nutrition is observed in parasitic plants?
   (a) Producing food themselves ☐ (b) Feeding on insects ☐
   (c) Obtaining nutrients from a host ☐ (d) Feeding on dead matter ☐
5. Which part of the plant absorbs water for photosynthesis?
   (a) Stem ☐ (b) Roots ☐
   (c) Flowers ☐ (d) Leaves ☐

B. Fill in the blanks.

1. Plants that produce their own food using sunlight are called _____.
2. The process of preparing food in plants is called _____.
3. Insectivorous plants obtain nutrients by trapping _____.
4. The green pigment in leaves responsible for photosynthesis is _____.
5. Plants like Cuscuta show a _____ mode of nutrition.

C. Write True or False.

1. Chlorophyll is found in the roots of plants. _____
2. Photosynthesis uses carbon dioxide and releases oxygen. _____
3. Insectivorous plants are autotrophs. _____
4. Saprophytic plants feed on dead and decaying organic matter. _____
5. Photosynthesis occurs only in green parts of the plant. _____

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D. Define the following terms.

1. Autotrophic nutrition
2. Heterotrophic nutrition
3. Photosynthesis
4. Parasitic plants
5. Saprophytic plants

E. Match the columns.

Column A	Column B
1. Autotrophs	(a) Cuscuta
2. Parasitic plants	(b) Trap sunlight
3. Chlorophyll	(c) Pitcher plant
4. Insectivorous plants	(d) Prepare their own food
5. Saprophytic plants	(e) Feed on decaying matter

F. Give reasons for the following statements.

1. Autotrophic plants are essential for life on Earth.
2. Parasitic plants depend on host plants for nutrients.
3. Saprophytic plants thrive in nutrient-rich decaying matter.
4. Photosynthesis occurs only in the presence of sunlight.
5. Insectivorous plants trap insects to compensate for poor soil nutrients.

G. Answer in brief.

1. What are autotrophic and heterotrophic modes of nutrition?
2. How do parasitic plants obtain their nutrients?
3. Why is chlorophyll essential for photosynthesis?
4. What role do insectivorous plants play in nutrient-deficient environments?
5. What is the importance of photosynthesis in maintaining ecological balance?

H. Answer in detail.

1. Explain the difference between autotrophic and heterotrophic nutrition with examples.
2. Describe the process of photosynthesis with a labeled diagram.
3. Discuss the adaptations of insectivorous plants to their environment.
4. Explain the importance of photosynthesis for life on Earth.
5. How do parasitic plants and saprophytic plants differ in their modes of nutrition?

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NEP Corner

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No More Rote Learning!

NEP 2020 emphasizes understanding and creativity over memorization. Your projects, activities, and practical knowledge matter more than cramming for exams.

Skill-based Activity

Curious Minds at Work

STEM

Observe your surroundings and identify one plant with a unique mode of nutrition (e.g., parasitic, insectivorous). Write a question about how its specific adaptation (e.g., trapping insects, attaching to a host) helps it survive. Using the scientific method, describe the steps you would take to answer your question.

Skills Covered: Critical and logical thinking, Brainstorming, Analytical thinking, Problem-solving, Curiosity, Observation, Decision-making skills

Wonders of Nutrition

Art

Identify and sketch a creative representation of a plant's nutritional process, such as photosynthesis or insect-trapping mechanisms. Write a short description explaining the role of structures like leaves or traps in this process. Present your work to the class.

Skills Covered: Creativity, Critical and logical thinking, Applicative thinking

Modes of Nutrition in Action

Group Activity

In groups, explore different modes of nutrition in plants. Create a chart categorizing plants based on their nutrition type (e.g., autotrophic, parasitic, insectivorous) and list examples. Present your findings with practical examples from nature or agriculture.

Skills Covered: Critical and logical thinking, Brainstorming, Teamwork, Communication, Applicative thinking, Decision-making skills

Technology in Focus

Case to Investigate

Explore and research how knowledge of photosynthesis is applied in technologies like greenhouse farming or algae-based biofuels. Write a short report on how these innovations rely on plant nutrition processes and their benefits for food security and energy.

Skills Covered: Critical and logical thinking, Brainstorming, Research, Applicative thinking

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Sustainability Spotlight

Aligning with SDGs

Research a program or initiative that promotes sustainable farming or conservation of plants with unique nutrition types (e.g., insectivorous plants in pest control). Highlight its key features and how it aligns with sustainable development goals. Present your findings to the class.

Aligned with: SDG 12 – Responsible Consumption and Production, SDG 13 – Climate Action

Skills Covered: Critical and logical thinking, Brainstorming, Research, Problem-solving, Ethics

Mapping Nutrition

Integrated Learning

Using the Internet, create a map showing regions where plants with specific nutrition types (e.g., insectivorous or parasitic) are commonly found. Explain how these plants adapt to their environment and how geography influences their mode of nutrition.

Integrated Learning: Geography and Biology

Skills Covered: Critical and logical thinking, Brainstorming, Analytical thinking, Applicative thinking

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