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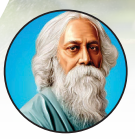


"Plants are the earth's endless effort to speak to the listening heaven." – **Rabindranath Tagore**

Life Processes in Plants

The Big Question

What if there were no plants—no trees, flowers, fruits, or fresh air? Plants are the quiet heroes of life on Earth, creating the oxygen we breathe and the food we eat. But how do they do it? Let's uncover the fascinating processes inside these green powerhouses.

Meet EeeBee.AI

Hi, scientists! I'm EeeBee, your guide on this green adventure. Ever wondered how plants grow or make food? Join me as we explore the amazing life of plants and discover their secret superpowers!

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

Learning Outcomes

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

- Recall what plants need to grow
- Explain how photosynthesis works
- Describe the roles of sunlight, chlorophyll, water, and carbon dioxide
- Identify plant parts like stomata, xylem, and phloem
- Compare photosynthesis and respiration
- Investigate through simple experiments

From Last Year's Notebook

- Photosynthesis and Transpiration
- Factors Influencing Seed Germination

Science Around you

Plants are essential to life—from feeding us to supporting ecosystems. Farmers, scientists, and even astronauts study plant growth to solve real-world challenges, like food security and climate change. Understanding how plants work helps us understand our future.

NCF Curricular Goals and Competencies

CG 10.1 – Understand photosynthesis as the process by which plants make food using sunlight.
CG 10.2 – Learn how plants absorb water, transport nutrients, and respire.

Mind Map

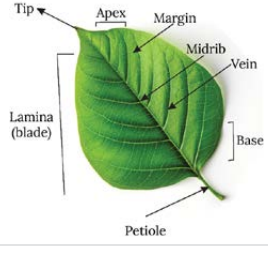
Life Processes in Plants

How Do Plants Grow?

- Continuous growth due to meristematic tissues.
- **Apical:** length , Lateral: thickness , Intercalary: rapid growth in grasses.
- **Factors:** light, water, nutrients, temperature, hormones.

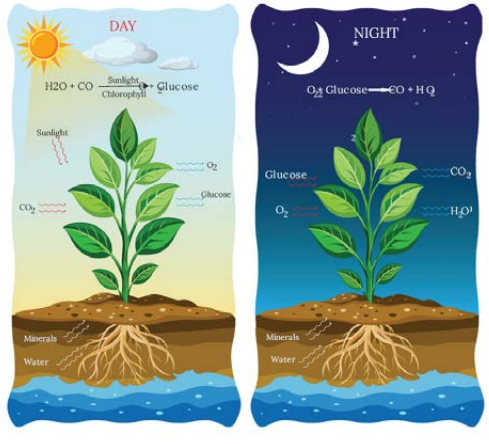
How Do Plants Get Food for Their Growth?

- **Plants** = autotrophs.
- **Raw materials:** CO_2 (stomata) + H_2O (roots) + Sunlight.
- **Occurs in leaves (chlorophyll)** → makes Glucose + O_2.



Do Plants Respire?

- Plants respire day & night (Glucose + O_2 → CO_2 + H_2O + Energy).
- Gas exchange via stomata, lenticels, roots.
- **Day** → O_2 release, Night → CO_2 release.



Transport in Plants

- **Xylem**: water & minerals ↑ (transpiration pull + root pressure).
- **Phloem:** food transport (leaves → rest of plant).

In Focus

- How Do Plants Grow?
- How Do Plants Get Food for their Growth?
- Transport in Plants
- Do Plants Respire?

From History's Pages

The understanding of plant life processes evolved over centuries. Early scientists like Jan van Helmont (1600s) explored plant growth. In the 1700s, Joseph Priestley and Jan Ingenhousz discovered that plants release oxygen and need sunlight for food production. Later, discoveries about stomata, xylem, and phloem advanced our knowledge of transport in plants. The invention of microscopes allowed scientists to study plant cells in detail, forming the basis of modern plant biology and the life processes we study today.

Introduction

Life processes in plants include vital functions like photosynthesis, respiration, transport, and excretion that help them survive, grow, and reproduce. Unlike animals, plants perform these processes silently and efficiently using their specialized structures. This chapter explores how plants absorb nutrients, make their own food, transport water and minerals, and remove waste. Understanding these processes is essential to appreciate the role plants play in sustaining ecosystems and supporting life on Earth.

How Do Plants Grow?

Have you ever noticed how a small seedling transforms into a tall, leafy plant? This remarkable transformation is a result of growth, a fundamental life process. Just like us, plants need certain things to grow and thrive. But what exactly are these needs, and how do plants acquire them? In this section, we will explore the basic requirements for plant growth and begin to understand the intricate ways plants interact with their environment. We will cover the importance of water, sunlight, and nutrients from the soil.

Essential Requirements for Plant Growth

Plants, like all living organisms, require specific conditions and substances to grow, develop, and reproduce. These essential requirements are broadly categorized into physical factors and chemical factors. Physical factors include sunlight and temperature, which influence the rate of metabolic processes. Chemical factors primarily involve water, carbon dioxide, and various mineral nutrients obtained from the soil.

Fig. 10.1 Essential Requirements for Plant Growth

The availability and balance of these factors dictate the health and vigor of a plant. For instance, insufficient water can lead to wilting, while a lack of sunlight can result in stunted growth and pale leaves. Understanding these basic needs is crucial for successful agriculture and horticulture.

Role of Water in Plant Growth

Water is arguably the most critical component for plant life. It serves multiple vital functions. Firstly, water is a primary raw material for photosynthesis, the process by which plants produce their food. Without water, photosynthesis cannot occur. Secondly, water acts as a solvent, dissolving essential mineral nutrients from the soil, which are then absorbed by the roots and transported throughout the plant. This transport system, known as the xylem, relies on water to carry nutrients to leaves, stems, and flowers. Thirdly, water helps maintain **turgor pressure** within plant cells, providing structural rigidity and preventing wilting. When plant cells are full of water, they become firm, allowing the plant to stand upright. Lastly, water helps regulate plant temperature through transpiration, a process similar to sweating in animals, where water vapor is released from leaves.

Fig. 10.2 Role of Water in Plant Growth

Role of Sunlight in Plant Growth

Sunlight is the ultimate energy source for almost all life on Earth, and plants are the primary converters of this energy. Plants capture light energy using a special pigment called chlorophyll, primarily located in their leaves. This captured light energy is then used to power photosynthesis, converting carbon dioxide and water into glucose (food) and oxygen. Without adequate sunlight, plants cannot produce enough food, leading to poor growth, yellowing of leaves (chlorosis), and eventually death. The intensity, duration, and quality of light all play a significant role in plant growth. Different plants have different light requirements; some thrive in full sun, while others prefer shade.

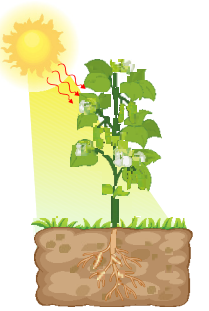


Fig. 10.3 Role of Sunlight in Plant Growth

Role of Soil Nutrients in Plant Growth

Soil gives plants important nutrients that help them grow strong and healthy. While sunlight and water help plants make food and energy, the soil provides minerals that plants need for many life processes. These nutrients enter the plant through its roots. Some nutrients, like nitrogen, phosphorus, and potassium, are needed in large amounts. Nitrogen helps plants grow green leaves, phosphorus is good for strong roots and flowers, and potassium helps plants stay healthy and fight diseases. Other nutrients like iron, zinc, and manganese are needed in smaller amounts, but they are still very important for plant growth. How much of these nutrients plants get depends on the type of soil, its acidity, and helpful microbes living in it.

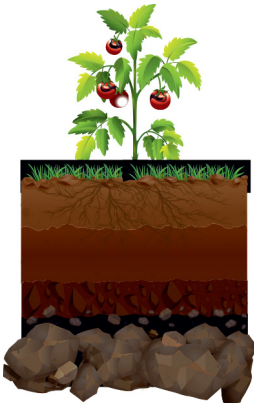


Fig. 10.4 Role of Soil Nutrients in Plant Growth

Examples and Applications

1. **Agriculture and Crop Yield:** Farmers meticulously manage water supply through irrigation systems and ensure adequate sunlight exposure by proper plant spacing. They also enrich the soil with fertilizers containing nitrogen, phosphorus, and potassium (NPK) to boost crop growth and yield. For example, a paddy field requires abundant water, while a wheat field needs well-drained soil and plenty of sunlight.

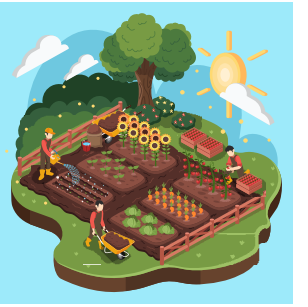


Fig. 10.5 Agriculture and Crop Yield

Keywords

Turgor pressure: It is the pressure of water pushing against the cell wall in plant cells. It helps keep the plant firm and upright.

2. **Hydroponics and Aeroponics:** These modern farming techniques demonstrate the critical role of water and nutrients. In hydroponics, plants are grown in nutrient-rich water solutions without soil, showcasing that soil is primarily a medium for delivering water and minerals, not an absolute necessity for growth itself. Aeroponics takes this a step further, misting nutrient solutions directly onto plant roots suspended in air.

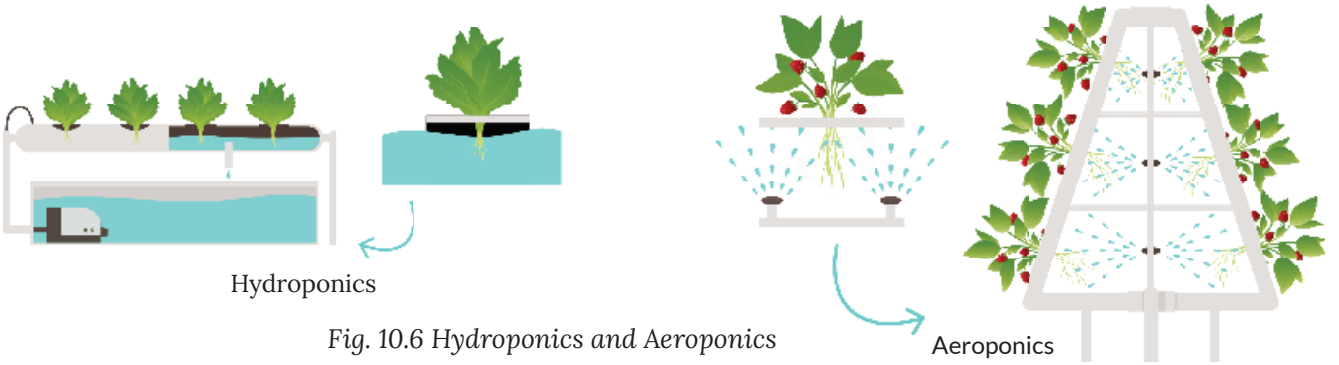


Fig. 10.6 Hydroponics and Aeroponics

3. **Greenhouses:** Greenhouses are designed to optimize sunlight and temperature for plant growth, especially in colder climates. They allow controlled environments where light intensity can be regulated, and **supplemental lighting** can be provided, demonstrating the direct impact of light on growth.

Fig. 10.7 Greenhouses

Fig. 10.8 Planting Trees in Urban Areas

4. **Planting Trees in Urban Areas:** City planners consider sunlight availability and soil quality when planting trees. Trees planted in shaded areas or in poor, compacted soil often show stunted growth compared to those in open, well-irrigated spaces, illustrating the combined effect of these factors.

Fact Flash

Did you know that the tallest living tree, Hyperion, a Coast Redwood in California, stands at over 115 meters (380 feet) tall? Imagine the incredible amount of water and nutrients its roots must absorb and transport all the way to its highest leaves! This highlights the efficiency of the plant's transport system.

Common Misconceptions

× **Misconception:** Plants "eat" food from the soil.

✓ **Correction:** Plants do not "eat" food like animals. Instead, they absorb water and dissolved mineral nutrients from the soil, which are raw materials. Their actual "food" (glucose) is produced internally through the process of photosynthesis using sunlight, water, and carbon dioxide. The soil provides essential building blocks, not ready-made food.

Keywords

Supplemental Lighting: It is extra light provided to plants when natural sunlight is not enough. It helps plants grow better, especially indoors or during cloudy days.

× **Misconception:** All plants need direct sunlight to grow.

✓ **Correction:** While most plants need sunlight, the amount and intensity vary greatly. Some plants, like ferns and many houseplants, are adapted to low light conditions and can be damaged by direct, intense sunlight. Others, like cacti, thrive in full sun. It's about finding the right light conditions for each specific plant species.

Science Around You

- **Environmental Science:** Plant growth plays a crucial role in carbon sequestration, helping to mitigate climate change by absorbing carbon dioxide from the atmosphere. Environmental scientists study plant growth patterns to understand ecosystem health and develop strategies for reforestation and biodiversity conservation.
- **Biotechnology:** Scientists are using genetic engineering to develop crops that are more resilient to drought, require fewer nutrients, or can grow in challenging environments, directly applying knowledge of plant growth processes.

Activity

Investigating the Role of Water and Light in Seed Germination and Early Growth

- **Objective:** To observe the impact of water and light on seed germination and the initial growth of seedlings.
- **Materials Required:**

  Small transparent plastic cups (3), Cotton wool or paper towels, Fast-germinating seeds (e.g., moong beans, mustard seeds), Water, Measuring scale/ ruler, Marker
- **Procedure:**
  1. **Preparation:** Label the three cups A, B, and C.
  2. **Cup A (Water + Light):** Place a layer of moist cotton wool at the bottom of the cup. Sprinkle 5-7 seeds on the cotton. Place this cup in a well-lit area (e.g., windowsill) and ensure the cotton remains moist by adding a few drops of water daily.

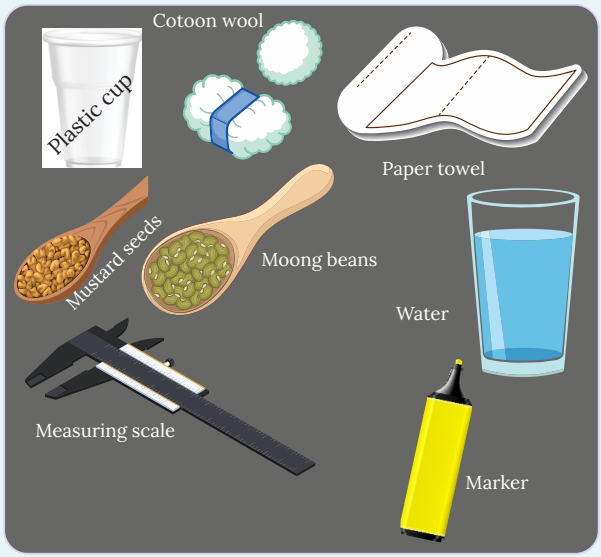


Fig. 10.9 Materials Required

  3. **Cup B (Water + Dark):** Place a layer of moist cotton wool at the bottom of the cup. Sprinkle 5-7 seeds on the cotton. Place this cup in a completely dark place (e.g., inside a cupboard or covered with an opaque box) and ensure the cotton remains moist daily.
  4. **Cup C (No Water + Light):** Place a layer of dry cotton wool at the bottom of the cup. Sprinkle 5-7 seeds on the cotton. Place this cup in a well-lit area. Do NOT add any water.
- **Observation:** Observe the cups daily for 7-10 days. Record
  - Number of seeds germinated in each cup.
  - Appearance of seedlings (color, height, stem thickness).
  - Any other noticeable differences.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. **Which of the following is NOT an essential requirement for plant growth?**
   a) Sunlight ☐ b) Water ☐
   c) Oxygen ☐ d) Carbon dioxide ☐

Understanding

2. **What is the primary role of water in photosynthesis?**
   a) To provide structural support to the plant. ☐
   b) To dissolve minerals from the soil. ☐
   c) To act as a raw material for food production. ☐
   d) To regulate plant temperature. ☐
3. **A plant kept in a dark room for several days will likely:**
   a) Grow taller and stronger. ☐ b) Produce more flowers. ☐
   c) Turn yellow and stop growing. ☐ d) Absorb more water. ☐

Short Answer Question:

4. Explain why a plant needs both sunlight and water to grow effectively.
5. Name two macronutrients that plants absorb from the soil and state their general functions.

Applying

Long Answer Question:

6. Design a simple experiment to demonstrate that plants need sunlight for healthy growth. Describe your setup, procedure, expected observations, and conclusion.

How Do Plants Get Food for their Growth?

We've learned that animals obtain food by eating other organisms. But what about plants? They don't have mouths or stomachs, yet they grow and thrive. This section will unravel the incredible secret of how plants produce their own food, a process fundamental to nearly all life on Earth. We will delve into the "food factories" of plants – their leaves – and explore the key ingredients and conditions required for this magical transformation. This concept will cover photosynthesis, the role of leaves, chlorophyll, and the exchange of gases.

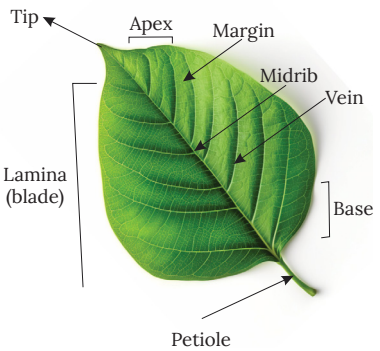


Fig. 10.10 Staructure of Leave

Leaves: The 'Food Factories' of Plants

Leaves are the primary sites for food production in most plants, earning them the nickname "food factories." Their structure is perfectly adapted for this role. They are typically broad and flat, maximizing the surface area exposed to sunlight. The green color of leaves comes from a pigment called chlorophyll, which is crucial for capturing light energy. Within the leaf cells, specialized organelles called chloroplasts contain chlorophyll and are where photosynthesis takes place. The network of veins in leaves transports water and nutrients to the cells and carries away the manufactured food. The presence of tiny pores, called stomata, on the leaf surface allows for the exchange of gases necessary for photosynthesis.

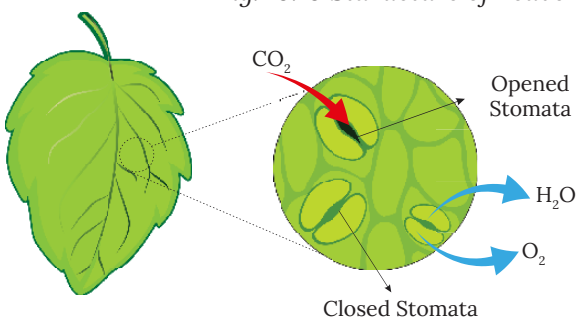


Fig. 10.11 Stomata in Leaves

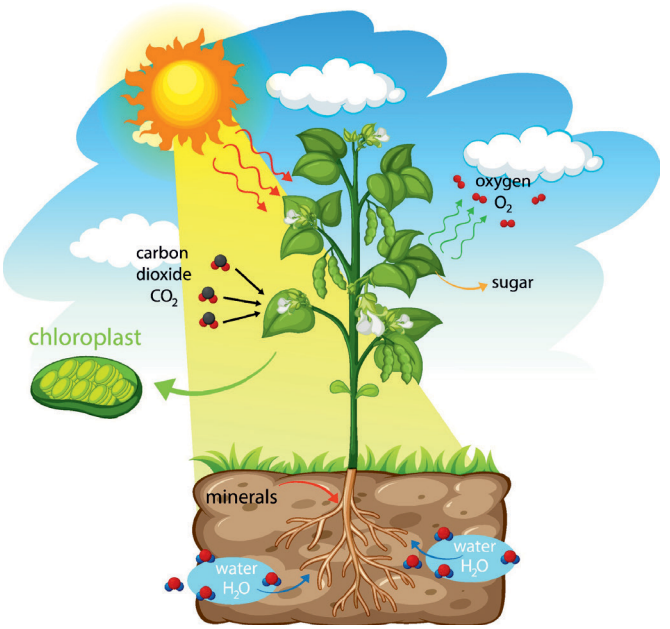


Fig. 10.12 Photosynthesis

Photosynthesis: The Process of Food Production

Photosynthesis is the biochemical process by which green plants, algae, and some bacteria convert light energy into chemical energy, in the form of **glucose** (a simple sugar). This process uses carbon dioxide from the atmosphere and water absorbed from the soil as raw materials. Oxygen is released as a byproduct. The word equation for photosynthesis is:

Word Equation

Carbon dioxide + Water → Glucose + Oxygen

Chemical Equation

$$6CO_2 + 6H2O \xrightarrow{\text{sunlight, chlorophyll}} C_6H_{12}O_6 + 6O_2$$

Chlorophyll and its role in Photosynthesis

Chlorophyll is a green pigment found in the leaves of plants. It is present inside small cell parts called chloroplasts. Chlorophyll gives leaves their green color and plays a very important role in the process of photosynthesis, which is how plants make their own food. The main job of chlorophyll is to absorb sunlight, especially red and blue light, and use that energy to help turn carbon dioxide from the air and water from the soil into glucose, a type of sugar. This sugar is the plant's food and gives it energy to grow, make flowers, and carry out other life functions. Without chlorophyll, plants would not be able to trap sunlight and make food. If a plant does not have enough chlorophyll, its leaves may turn yellow and the plant may become weak and unhealthy. Therefore, chlorophyll is essential for a plant's survival and healthy growth.

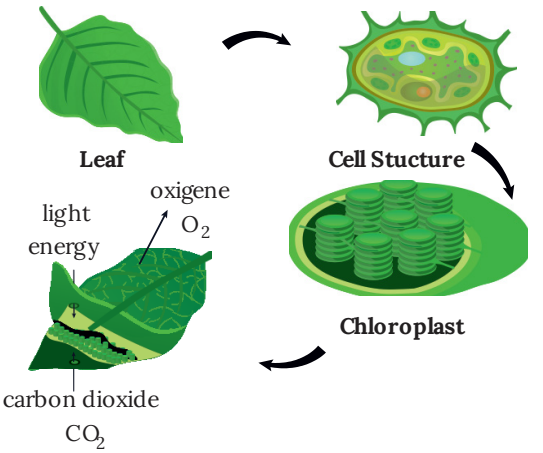


Fig. 10.13 Role of Chlorophyll in Photosynthesis

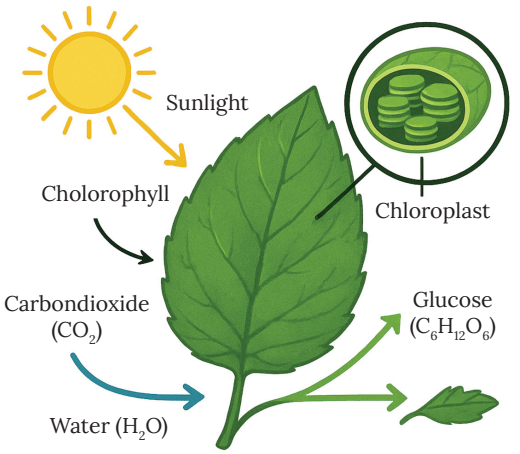


Fig. 10.14 Role of Sunlight in Photosynthesis

Role of Sunlight in Photosynthesis

Sunlight plays a very important role in photosynthesis, the process by which plants make their own food. It provides the energy needed to start and carry out the chemical reactions inside the plant's leaves. The green pigment chlorophyll absorbs sunlight and uses it to change water and carbon dioxide into glucose, which is the food for the plant. Without sunlight, plants cannot make food and will not survive. The more sunlight a plant gets (up to a certain limit), the faster it can make food. This is why most plants grow better in places with plenty of light.

Keywords

Glucose is a simple sugar (monosaccharide) that serves as a primary source of energy for cells. It has the chemical formula $C_6H_{12}O_6$ and is commonly found in fruits, honey, and blood.

Role of Carbon Dioxide in Photosynthesis

Carbon dioxide (CO_2) is a very important gas that plants need to make their food. Plants take in carbon dioxide from the air through tiny openings on their leaves called stomata. Inside the green parts of the leaf, called chloroplasts, this gas is used to make glucose, which is a type of sugar and food for the plant. This part of the process does not need sunlight and is called the light-independent reaction.The amount of carbon dioxide in the air can affect how fast a plant makes food. If there is more carbon dioxide (but not too much), the plant can make food faster. That's why some greenhouses add extra carbon dioxide to help plants grow better.

Fact Flash

The Earth's early atmosphere had very little oxygen. It was the evolution of photosynthetic organisms, like **cyanobacteria** and later plants, over billions of years that gradually filled the atmosphere with oxygen, making it suitable for the evolution of complex life forms like animals and humans!

Release of Oxygen During Photosynthesis

Oxygen (O_2) is a gas that plants give out as a result of photosynthesis. This oxygen comes out through small holes in the leaves called stomata. The oxygen is made from water that the plant takes in from the soil. During the light-dependent part of photosynthesis, the water molecules are split, and oxygen is released.This oxygen is very important because humans, animals, and other living things need it to breathe. Plants help keep the air clean by taking in carbon dioxide and giving out oxygen. This cycle helps keep the right balance of gases in the Earth's atmosphere.

Scientific Examples and Applications

Starch Test in Leaves

A simple way to check if a leaf has done photosynthesis is by using the iodine test. If a leaf is boiled and treated with iodine solution, it will turn blue-black if starch is present. Starch is the stored food made during photosynthesis. This test proves that the plant made food using sunlight.

Variegated Leaves

Some leaves have both green and white (non-green) areas. Only the green parts have chlorophyll and can do photosynthesis. When tested with iodine, only the green areas turn blue-black. This shows that chlorophyll is needed for making food in plants.

Aquatic Plants and Oxygen Bubbles

When aquatic plants like Hydrilla are placed in water and exposed to sunlight, they release oxygen bubbles. These bubbles are easy to see and prove that oxygen is released during photosynthesis. If we put the setup in the dark, the bubbles stop, showing that sunlight is needed for the process.

Algae Blooms

In lakes and ponds, when there are too many nutrients, algae grow very fast (called algae blooms). These algae do a lot of photosynthesis during the day, making a lot of oxygen. But when they die and rot, they use up oxygen, which can harm fish and other animals. This shows how photosynthesis can affect the whole environment.

Keywords

Cyanobacteria are photosynthetic microorganisms that produce oxygen and glucose using sunlight, water, and carbon dioxide. They were among the first organisms to perform photosynthesis and helped form Earth's oxygen-rich atmosphere.

Common Misconceptions

× **Misconception:** Plants only perform photosynthesis during the day and respiration at night.

✓ **Correction:** Plants perform photosynthesis only when light is available (typically during the day). However, they perform respiration (breaking down food for energy) continuously, 24 hours a day, just like animals. During the day, the rate of photosynthesis is usually much higher than respiration, so there is a net release of oxygen. At night, only respiration occurs, leading to a net release of carbon dioxide.

× **Misconception:** The green color of plants is due to chlorophyll reflecting all green light.

✓ **Correction:** Chlorophyll primarily absorbs red and blue wavelengths of light for photosynthesis. It reflects green light, which is why plants appear green to our eyes. So, it's the **reflection** of green light, not the absorption, that gives plants their characteristic color.

Science Around You

- **Atmospheric Balance:** Photosynthesis is crucial for maintaining the balance of oxygen and carbon dioxide in the atmosphere. Without it, atmospheric oxygen levels would deplete, and carbon dioxide levels would rise, making the Earth uninhabitable for most life forms.
- **Food Chain Foundation:** Photosynthesis forms the base of almost all food chains on Earth. Plants are producers, converting light energy into chemical energy, which is then transferred to herbivores, and then to carnivores.

Activity

Demonstrating Oxygen Release During Photosynthesis

- **Objective:** To observe the release of oxygen gas by an aquatic plant during photosynthesis.
- **Materials Required:**

  A beaker (500 ml or larger), A small funnel, A test tube, Fresh aquatic plant (e.g., Hydrilla, Elodea), Water, Sunlight or a bright lamp

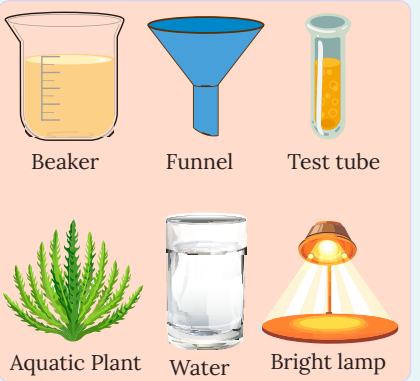


Fig. 10.15 Materials Required

- **Procedure:**
  1. **Setup:** Fill the beaker about two-thirds full with water.
  2. **Plant Placement:** Place a few sprigs of the aquatic plant inside the beaker.
  3. Funnel Inversion: Invert the funnel over the aquatic plant, ensuring the plant is completely covered by the funnel and the funnel's stem points upwards.
  4. **Test Tube Placement:** Fill the test tube completely with water. Carefully invert the water-filled test tube over the stem of the funnel, ensuring no air bubbles enter the test tube. The mouth of the test tube should be submerged in the water in the beaker.
  5. Light Exposure: Place the entire setup in direct sunlight or under a bright lamp for several hours.
- **Observation Table:**

  Observe the setup after a few hours. You should see small bubbles rising from the aquatic plant and collecting in the inverted test tube, displacing the water.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. **Which of the following is a byproduct of photosynthesis?**
   a) Carbon dioxide ☐ b) Glucose ☐
   c) Water ☐ d) Oxygen ☐
2. **The green pigment in leaves that captures sunlight is called:**
   a) Stomata ☐ b) Xylem ☐
   c) Chlorophyll ☐ d) Phloem ☐

Understanding

3. **What is the primary function of stomata in leaves?**
   a) To transport water. ☐ b) To store food. ☐
   c) To exchange gases. ☐ d) To provide structural support. ☐

Short Answer Question:

Applying

4. Why are leaves often called the "food factories" of plants?
5. If you place a plant in a completely dark room, why will it eventually die even if you water it regularly?

Long Answer Question:

Analyzing

6. Describe the process of photosynthesis, including the raw materials needed, the energy source, the main product, and the byproduct. Explain the role of each component.

Transport in Plants

Imagine a tall building. How does water reach the top floors? There's a complex system of pipes and pumps, right? Plants, especially tall trees, face a similar challenge: how do they transport water from their roots all the way up to their highest leaves, and how do they distribute the food made in the leaves to every part of the plant, including the roots? This section will explore the fascinating internal transport systems that allow plants to move essential substances throughout their bodies, ensuring every cell receives what it needs to survive and grow. We will cover the roles of xylem and phloem.

Transport of Water and Minerals (Xylem)

Plants absorb water and dissolved mineral nutrients from the soil primarily through their roots. This absorption occurs through root hairs, which greatly increase the surface area for uptake. Once absorbed, water and minerals need to be transported upwards to all parts of the plant, especially the leaves where photosynthesis occurs. This upward transport is facilitated by a specialized vascular tissue called **xylem**. Xylem consists of a network of hollow, interconnected tubes that run throughout the plant, from the roots, through the stem, and into the leaves. The movement of water through the xylem is driven by a combination of root pressure and, more significantly, by **transpiration** pull. Transpiration is the evaporation of water from the leaf surface through stomata, which creates a continuous pulling force that draws water upwards, much like sipping water through a straw.

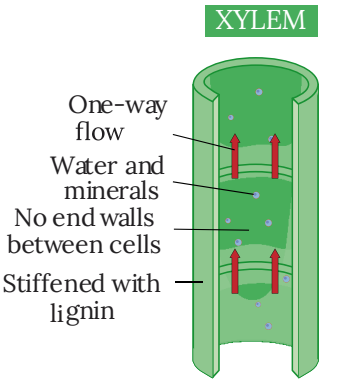


Fig. 10.16 Xylem

Keywords

Transpiration is the process by which plants lose water as water vapor through tiny pores called stomata in their leaves.

Transport of Food (Phloem)

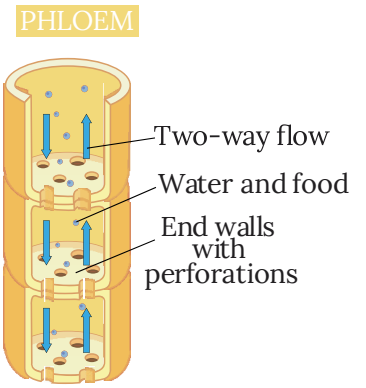


Fig. 10.17 Phloem

While water and minerals are transported upwards by the xylem, the food (glucose, converted to sucrose for transport) produced during photosynthesis in the leaves needs to be distributed to all other parts of the plant, including the roots, fruits, and growing tips, where it is needed for energy or storage. This downward and lateral transport of food is carried out by another specialized vascular tissue called **phloem**. Phloem consists of living cells, unlike the dead cells of mature xylem, and forms a network of tubes running alongside the xylem. The movement of food through the phloem, known as translocation, is an active process that requires energy. It occurs from areas of high sugar concentration (source, typically leaves) to areas of low sugar concentration (sink, such as roots or developing fruits).

Vascular Bundles

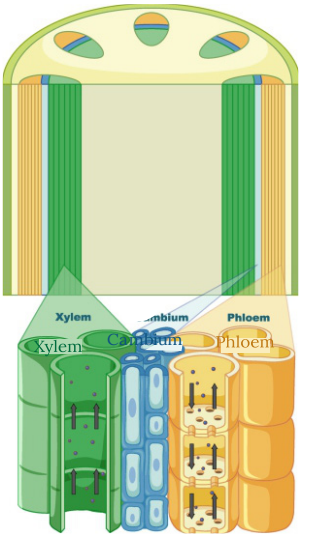


Fig. 10.18 Vascular Bundles

Xylem and phloem tissues are typically found together in structures called **vascular bundles**. These bundles are essentially the plant's "veins" or "arteries," forming a continuous transport system throughout the plant body. In stems, vascular bundles are often arranged in a ring or scattered pattern, while in leaves, they form the intricate network of veins visible to the naked eye. The efficient arrangement of xylem and phloem within these bundles ensures that water and nutrients are delivered to every cell, and manufactured food is transported away from the leaves to where it is needed for growth, storage, or metabolic activities. This integrated transport system is crucial for the survival and overall health of the plant.

Examples and Applications

1. **Maple Syrup Production:** Maple trees are tapped to collect their sap, which is rich in sugars. This sap is transported through the phloem from the leaves (where sugars are produced) to other parts of the tree, especially the roots for storage over winter. This is a direct application of understanding phloem transport.
2. **Watering Plants:** When you water a plant, the water is absorbed by the roots and transported upwards through the xylem to all parts. If a plant is wilting, providing water quickly revives it as the xylem refills, restoring turgor pressure in the cells.
3. **Nutrient Deficiencies:** If a plant shows symptoms of nutrient deficiency (e.g., yellowing leaves), it often indicates a problem with the absorption of minerals by the roots or their transport through the xylem. Farmers and gardeners use this knowledge to diagnose and treat plant health issues.

Maple Syrup


Watering Plants

Nutrient Deficiencies

Fig. 10.19

Fact Flash

Some of the tallest trees on Earth, like the Coast Redwoods, can transport water over 100 meters (more than the length of a football field!) against gravity, purely through the power of transpiration pull and the cohesive properties of water molecules. This is an incredible feat of natural engineering!

Common Misconceptions

× **Misconception:** Water is pushed up the plant by root pressure alone.

✓ **Correction:** While root pressure does contribute to water movement, especially over short distances and at night, the primary force for water transport in tall plants is **transpiration pull**. The evaporation of water from leaves creates a strong suction that pulls the water column upwards through the xylem.

× **Misconception:** Plants absorb all their food from the soil.

✓ **Correction:** Plants absorb water and mineral nutrients from the soil, which are raw materials. Their actual "food" (sugars) is manufactured internally in the leaves through photosynthesis. This manufactured food is then transported throughout the plant via the phloem.

Science Around You

- **Drug Delivery Systems:** Researchers are studying how plants transport substances to potentially develop new ways to deliver drugs or nutrients within biological systems, drawing inspiration from the efficiency of xylem and phloem.
- **Horticulture and Floristry:** Florists often cut the stems of flowers underwater to prevent air bubbles from entering the xylem, which would block water uptake and cause the flowers to wilt prematurely. This is a direct application of understanding xylem function.

Activity

Observing Water Transport in a Celery Stalk

- **Objective:** To visually demonstrate the upward transport of water through xylem vessels in a plant stem.
- **Materials Required:**

  Fresh celery stalk (with leaves if possible), A glass of water, Food coloring (red or blue works best), Sharp knife (adult supervision required), Magnifying glass (optional)
- **Procedure:**

  1. Preparation: Fill the glass about halfway with water. Add several drops of food coloring to the water and stir well.
  2. **Celery Cut:** With adult supervision, carefully cut about 1-2 cm off the bottom of the celery stalk. This fresh cut will help with water absorption.

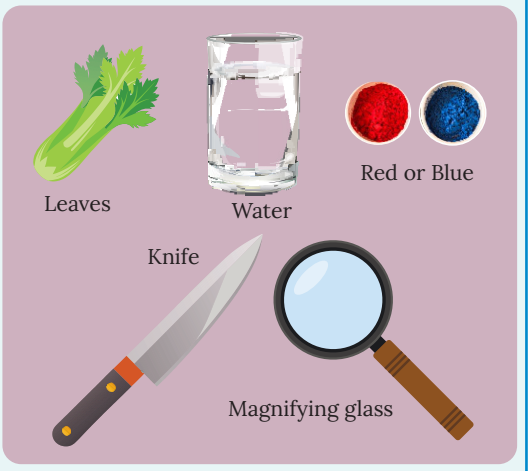


Fig. 10.20 Materials Required

3. **Placement:** Place the cut end of the celery stalk into the colored water.
4. **Observation:** Leave the celery stalk in the colored water for several hours, or preferably overnight.
5. **Examination:** After the observation period, remove the celery stalk from the water. Observe the leaves and the stem. You should see the colored water moving up into the leaves, especially along the veins. With adult supervision, you can also carefully cut a thin cross-section from the middle of the celery stalk. Use a magnifying glass to observe the small, colored dots or rings within the stalk – these are the xylem vessels that transported the colored water.

- **Expected Results:**

  The leaves and veins of the celery stalk will show traces of the food coloring, particularly noticeable in the small tubes if a cross-section is made.

- **Conclusion:**

  This activity provides a clear visual demonstration of how water is absorbed by the plant and transported upwards through specialized tubes (xylem) within the stem to the leaves and other parts.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. **Which plant tissue is responsible for transporting water and minerals from the roots to the leaves?**

   a) Phloem ☐ b) Xylem ☐

   c) Stomata ☐ d) Chlorophyll ☐

2. **The process of transporting food from leaves to other parts of the plant is called:**

   a) Photosynthesis ☐ b) Transpiration ☐

   c) Translocation ☐ d) Respiration ☐

Applying

3. **If a plant's xylem vessels were blocked, what would be the most immediate consequence?**

   a) The plant would stop producing oxygen. ☐

   b) The plant would be unable to absorb carbon dioxide. ☐

   c) Water and minerals would not reach the leaves. ☐

   d) Food would not be transported to the roots. ☐

Analyzing

Short Answer Question:

4. Differentiate between the functions of xylem and phloem in plants.
5. Explain how transpiration helps in the upward movement of water in tall trees.

Understanding

Long Answer Question:

6. Imagine a plant that has just produced a lot of sugar in its leaves through photosynthesis. Describe how this sugar would be transported to the roots of the plant for storage, mentioning the specific tissue involved and the general direction of movement.

Do Plants Respire?

We know that animals breathe in oxygen and breathe out carbon dioxide, a process called respiration, to get energy from their food. But what about plants? Do they also "breathe"? Do they need oxygen? This section will explore the process of respiration in plants, revealing how they release the energy stored in the food they produce during photosynthesis. We will understand that respiration is a continuous process in all living cells, including those of plants, and its vital role in providing energy for growth and other life functions. This concept will cover the process of respiration, its inputs and outputs, and its relationship with photosynthesis.

Respiration in Plants

Respiration is a fundamental life process that occurs in all living cells, including those of plants. It is the process by which organisms break down glucose (food) to release energy for their metabolic activities. Unlike photosynthesis, which builds up complex molecules, respiration breaks them down. While plants produce their own food through photosynthesis, they still need to convert this stored chemical energy into a usable form **(ATP - adenosine triphosphate)** to power processes like growth, nutrient uptake, and reproduction. Plant respiration occurs continuously, day and night, in all living cells of the plant, including roots, stems, and leaves.

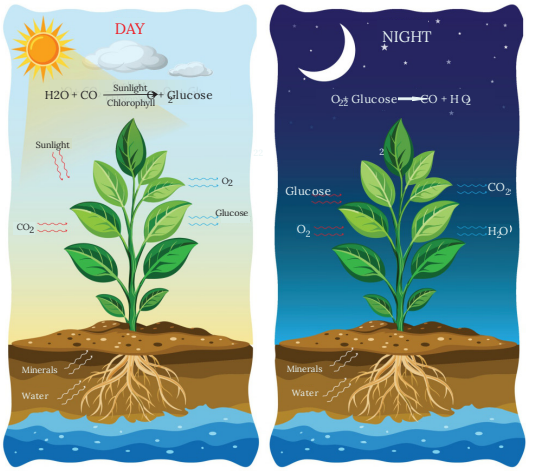


Fig. 10.21 Respiration in Plants

Aerobic Respiration in Plants

Most plants use aerobic respiration, which means they need oxygen to get energy from food. In this process, glucose (sugar) is completely broken down using oxygen to give carbon dioxide, water, and a lot of energy.

Word Equation

Glucose + Oxygen → Carbon dioxide + Water + Energy

This process happens mostly in a part of the cell called the mitochondria (known as the "powerhouse" of the cell).

Plants take in oxygen through:

- Stomata (in leaves)
- Lenticels (in stems)
- Root surfaces (from air spaces in the soil)

The carbon dioxide made during respiration may be used for photosynthesis during the day or released into the air.

- Aerobic respiration happens all the time, even when there is no sunlight.
- It gives energy that helps the plant grow, repair parts, and stay alive.
- Without this energy, plants cannot take in minerals or move water inside them.
- So, respiration is just as important as photosynthesis for plant survival.

Keywords

ATP (Adenosine Triphosphate) is the energy-carrying molecule used by cells to perform various activities. It stores and provides energy for processes like photosynthesis, respiration, movement, and growth in living organisms.

Relationship Between Photosynthesis and Respiration

Photosynthesis and respiration are two interconnected and complementary processes that are vital for life on Earth. Photosynthesis is the process of building food (glucose) using light energy, carbon dioxide, and water, while releasing oxygen. Respiration is the process of breaking down that glucose using oxygen to release energy, while producing carbon dioxide and water. They are essentially opposite processes in terms of overall chemical reactions and energy flow:

- **Photosynthesis:** Energy storage (light energy to chemical energy), builds complex molecules, consumes CO_2, releases O_2.
- **Respiration:** Energy release (chemical energy to usable energy), breaks down complex molecules, consumes O_2, releases CO_2.

During the day, plants perform both processes, but photosynthesis usually occurs at a much higher rate, leading to a net uptake of CO_2 and release of O_2. At night, only respiration occurs, resulting in a net release of CO_2 and uptake of O_2. This continuous cycle helps maintain the balance of gases in the atmosphere.

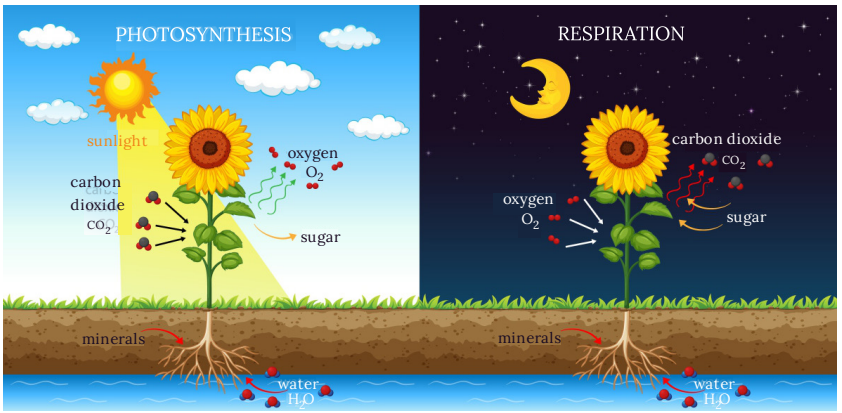


Fig. 10.22 Photosynthesis and Respiration

Examples and Applications

Fruit Ripening

Many fruits continue to respire even after being harvested. This respiration process breaks down starches into sugars, leading to the sweet taste of ripe fruits. The rate of respiration affects how quickly fruits ripen and spoil. This is why fruits are often stored in cool places to slow down respiration.

Root Respiration

Plant roots, being underground, also respire. They absorb oxygen from the air pockets in the soil. If soil becomes waterlogged, these air pockets are filled with water, depriving roots of oxygen. This can lead to root rot and plant death, demonstrating the critical need for oxygen in root respiration.

Composting

The decomposition of plant material in a compost pile is largely driven by microbial respiration. Microorganisms break down organic matter, releasing heat and carbon dioxide, a process similar to cellular respiration on a larger scale

Planting in Pots

Overwatering potted plants can lead to waterlogged soil, which reduces oxygen availability for root respiration. This often causes the plant to wilt and eventually die, even with plenty of water, highlighting the importance of well-drained soil for root health.

Fact Flash

Some plants, like the "corpse flower" (Amorphophallus titanum), generate their own heat through a process called thermogenic respiration. This heat helps to volatilize foul-smelling compounds, attracting pollinators like carrion beetles and flies!

Common Misconceptions

× **Misconception:** Plants only "breathe" out carbon dioxide.

✓ **Correction:** Plants perform respiration, which involves taking in oxygen and releasing carbon dioxide, just like animals. However, during the day, the rate of photosynthesis (which takes in CO_2 and releases O_2) is much higher than respiration, so there is a net release of oxygen. At night, only respiration occurs, leading to a net release of carbon dioxide.

× **Misconception:** Plants don't need oxygen.

✓ **Correction:** Plants absolutely need oxygen for aerobic respiration, which is how they release energy from the food they produce. While they produce oxygen during photosynthesis, they also consume it for their own metabolic needs.

Science Around You

- **Food Storage:** Understanding plant respiration is crucial for storing fruits and vegetables. By controlling temperature, humidity, and atmospheric composition (e.g., reducing oxygen, increasing CO_2), respiration rates can be slowed down, extending the shelf life of produce.
- **Brewing and Fermentation:** While not strictly plant respiration, the principles of anaerobic respiration (fermentation) are used in brewing beer, making wine, and baking bread, where yeast (a type of fungus) breaks down sugars to produce alcohol or carbon dioxide.

Activity

Demonstrating Carbon Dioxide Release During Seed Respiration

- **Objective:** To show that germinating seeds release carbon dioxide as a product of respiration.
- **Materials Required:** A small conical flask or clear jar, A small handful of soaked (germinating) moong beans or similar seeds, A small test tube, Lime water (calcium hydroxide solution), A cork or stopper with a hole, A bent glass tube or straw, Cotton wool
- **Procedure:**
  1. **Prepare Seeds:** Soak moong beans in water overnight. Drain them and keep them in a moist cloth for a day or two until they just start to sprout (germinate).
  2. **Set up Flask:** Place a layer of moist cotton wool at the bottom of the conical flask. Add the germinating seeds on top of the cotton.
  3. **Seal Flask:** Insert the cork with the bent glass tube into the mouth of the flask, ensuring it's airtight. The short end of the tube should be above the seeds.
  4. **Prepare Test Tube:** Pour about 5-10 ml of clear lime water into the small test tube.

5. **Connect:** Place the open end of the bent glass tube into the lime water in the test tube, ensuring the tube is submerged.
6. **Observe:** Leave the setup undisturbed for several hours or overnight in a dark place.

Fig. 10.23 Materials Required

- **Expected Results:** After some time, the clear lime water in the test tube will turn milky or cloudy.
- **Explanation:** The germinating seeds are living organisms and are actively respiring. During respiration, they break down stored food and release carbon dioxide gas. This carbon dioxide travels through the bent glass tube and bubbles into the lime water. Carbon dioxide reacts with calcium hydroxide (lime water) to form insoluble calcium carbonate, which appears as a milky precipitate, thus confirming the presence of CO_2.
- **Conclusion:** This activity demonstrates that germinating seeds respire and release carbon dioxide as a byproduct.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. **Which of the following is a product of respiration in plants?**
   a) Glucose ☐ b) Oxygen ☐
   c) Energy ☐ d) Chlorophyll ☐
2. **Where does most of the aerobic respiration occur in a plant cell?**
   a) Chloroplast ☐ b) Nucleus ☐
   c) Mitochondria ☐ d) Vacuole ☐

Understanding

3. **During the night, plants primarily:**
   a) Perform photosynthesis only. ☐
   b) Perform respiration only. ☐
   c) Perform both photosynthesis and respiration. ☐
   d) Neither perform photosynthesis nor respiration. ☐

Short Answer Question:

4. Why is respiration essential for plants, even though they produce their own food through photosynthesis?
5. What are the raw materials and products of respiration in plants?

Evaluating

Long Answer Question:

6. Compare and contrast photosynthesis and respiration in plants, highlighting their relationship in maintaining atmospheric balance.

SUMMARY

1. How Do Plants Grow?

Plants grow continuously throughout their life, unlike animals which stop growing after reaching a certain size. This continuous growth is due to the presence of special tissues called meristematic tissues. These tissues are located at specific regions of the plant, such as the tips of roots and shoots (apical meristems), around the girth of the stem (lateral meristems), and at the base of leaves or internodes (intercalary meristems). Cells in meristematic tissues are highly active, divide rapidly, and are responsible for increasing the length (primary growth) and girth (secondary growth) of the plant. Growth in plants is influenced by various factors including light, water, nutrients, temperature, and hormones.

2. How Do Plants Get Food for their Growth?

Plants are autotrophs, meaning they produce their own food. This process is called photosynthesis. Photosynthesis primarily occurs in the leaves, specifically within the chloroplasts that contain the green pigment chlorophyll.

The raw materials required for photosynthesis are:

- **Carbon dioxide (CO_2):** Absorbed from the atmosphere through small pores on the leaves called stomata.
- **Water (H_2O):** Absorbed from the soil by the roots and transported to the leaves.

3. Transport in Plants

Plants have specialized vascular tissues for the transport of water, minerals, and food throughout their body.

- **Xylem:** Responsible for transporting water and dissolved minerals from the roots upwards to all aerial parts of the plant, including leaves. This upward movement is primarily driven by transpiration pull (the suction created by water loss from leaves) and to a lesser extent by root pressure (water pushed into xylem by root cells).

4. Do Plants Respire?

Yes, plants respire continuously, just like animals. Respiration is the process by which plants break down the glucose (food) they produce (or store) to release energy for their metabolic activities, such as growth, nutrient absorption, and maintenance.

The process of respiration in plants involves the intake of oxygen and the release of carbon dioxide and water vapor. This exchange of gases primarily occurs through the stomata in leaves, lenticels in stems, and the general surface of roots.

The overall chemical equation for respiration is:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$

While photosynthesis occurs only during the day (in the presence of light), respiration occurs 24 hours a day. During the day, the rate of photosynthesis is usually much higher than respiration, so plants take in CO_2 and release O_2. At night, when there is no light, photosynthesis stops, but respiration continues, so plants primarily take in O_2 and release CO_2.

Example Based Questions

Multiple Choice Questions

1. **Which process allows plants to prepare their own food?**

   (a) Respiration (b) Photosynthesis
   (c) Transpiration (d) Germination

   Answer: (b) Photosynthesis

   Explanation: In photosynthesis, plants use sunlight, carbon dioxide, and water to prepare food (glucose). This process occurs in the green pigment chlorophyll present in leaves.

2. **Which tissue is responsible for transporting water from roots to other parts of the plant?**

   (a) Phloem (b) Xylem
   (c) Stomata (d) Cambium

   Answer: (b) Xylem

   Explanation: Xylem transports water and minerals absorbed by roots to stems and leaves. Phloem, on the other hand, transports prepared food from leaves to other plant parts.

3. **During respiration in plants, which gas is taken in and which is released?**

   (a) Oxygen taken in, Carbon dioxide released
   (b) Carbon dioxide taken in, Oxygen released
   (c) Nitrogen taken in, Oxygen released
   (d) Oxygen taken in, Nitrogen released

   Answer: (a) Oxygen taken in, Carbon dioxide released

   Explanation: Like animals, plants also respire. They take in oxygen to release energy from food and give out carbon dioxide as a waste product.

Short Answer Questions

4. **What role does sunlight play in the growth of plants?**

   Answer: Sunlight provides the energy required for photosynthesis, the process by which plants prepare their food. Without sunlight, plants cannot produce glucose, which is essential for their growth, reproduction, and survival. That is why plants kept in dark rooms become weak and pale.

5. **How do plants obtain water and minerals from the soil?**

   Answer: Plants absorb water and minerals from the soil through their root hairs. The absorbed water moves upward through xylem vessels, reaching stems and leaves, where it is used in photosynthesis and other processes. This continuous transport is vital for plant growth and food preparation.

6. **Do plants respire at night only? Explain.**

   Answer: No. Plants respire all the time (day and night) because they need energy continuously. During respiration, they take in oxygen and release carbon dioxide. However, in the daytime, the process of photosynthesis also takes place, which releases more oxygen than they use in respiration.

Long Answer Questions

7. **Describe the process of photosynthesis. Why is it important for both plants and animals?**

   Answer:

   Process of Photosynthesis:

   - Green leaves absorb sunlight through chlorophyll.
   - Roots absorb water and minerals from soil.
   - Leaves take in carbon dioxide from the air through stomata.
   - With sunlight, plants prepare glucose (food) and release oxygen.

$$\text{Carbon Dioxide} + \text{Water} \xrightarrow{\text{Sunlight/ Chlorophyll}} \text{Glucose} + \text{Oxygen}$$

   Importance:

   - Plants use glucose for growth, storage, and energy.
   - Oxygen released is essential for respiration of all living beings.
   - Photosynthesis forms the base of the food chain.

   Conclusion: Photosynthesis makes plants producers of food and oxygen, supporting all life on Earth.

Gap Analyzer™
Complete Chapter Test

EXERCISE

A. Choose the correct answer.

1. Which tissue is responsible for the continuous growth in the length of a plant?
   (a) Xylem ☐ (b) Phloem ☐
   (c) Apical meristem ☐ (d) Lateral meristem ☐
2. The green pigment essential for photosynthesis is:
   (a) Xanthophyll ☐ (b) Carotene ☐
   (c) Anthocyanin ☐ (d) Chlorophyll ☐
3. Water is transported from the roots to the leaves of a plant through:
   (a) Phloem ☐ (b) Stomata ☐
   (c) Xylem ☐ (d) Lenticels ☐
4. Which gas is released by plants during respiration?
   (a) Oxygen ☐ (b) Carbon dioxide ☐
   (c) Nitrogen ☐ (d) Methane ☐
5. The process of transport of food from leaves to other parts of the plant is called:
   (a) Transpiration ☐ (b) Absorption ☐
   (c) Translocation ☐ (d) Photosynthesis ☐

B. Fill in the blanks.

1. The rapid division of cells in _____ tissues is responsible for plant growth.
2. Plants absorb carbon dioxide from the atmosphere through tiny pores called _____.
3. The upward movement of water in plants is mainly due to the suction force created by _____.
4. Plants break down glucose during _____ to release energy for their life processes.
5. Food (sugars) synthesized in leaves is transported to other parts of the plant via _____.

C. Write True or False.

1. Plants grow only during their seedling stage. ____
2. Photosynthesis produces carbon dioxide and water. ____
3. Translocation is the process of water absorption by roots. ____
4. Plants respire both during the day and at night. ____
5. Chlorophyll is found in the roots of a plant. ____

D. Define the following terms.

1. Meristematic Tissues
2. Photosynthesis
3. Transpiration
4. Xylem
5. Respiration (in plants)

E. Match the columns.

	Column A		Column B
1.	Stomata	(a)	Gas exchange for photosynthesis/respiration
2.	Chlorophyll	(b)	Absorbs sunlight energy
3.	Phloem	(c)	Transport of food
4.	Lateral Meristem	(d)	Responsible for girth increase
5.	Respiration	(e)	Energy production from glucose

F. Assertion and Reason

Instructions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is NOT the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

e) Both A and R are false.

1. **Assertion:** Plants release oxygen during the day.
   Reason: The rate of photosynthesis is higher than respiration during the day.
2. **Assertion:** Xylem transports food in plants.
   Reason: Xylem vessels are hollow tubes that form a continuous network.
3. **Assertion:** Leaves are the primary sites for photosynthesis.
   Reason: Leaves contain stomata for gas exchange and chloroplasts with chlorophyll.

G. Give reasons for the following statements.

1. Why do plants primarily appear green?
2. Why is sunlight essential for photosynthesis?
3. Why do farmers sometimes prune the tips of plants?
4. Why do plants absorb water from the soil mainly through their roots?
5. Why is it often advised not to sleep under trees at night?

H. Answer in brief.

1. Explain the difference between primary and secondary growth in plants and which meristematic tissues are responsible for each.
2. Describe the role of stomata in the process of photosynthesis and gas exchange in plants.
3. Outline the main differences in the function of xylem and phloem tissues in plants.
4. Why is transpiration considered both a 'necessary evil' and a beneficial process for plants?

I. Answer in detail.

1. Elaborate on the process of photosynthesis in plants.
2. Perform a comprehensive comparison between photosynthesis and respiration in plants.
3. Analyze the various factors that influence the rate of plant growth.
4. Plants exhibit continuous growth due to specific tissues. Explain this phenomenon.

SKILL-BASED PRACTICE

Activity Time

STEM

Observing Transpiration

Materials Needed: A healthy potted plant, A clear plastic bag, A rubber band, Sunlight

Activity Steps:

- Water the potted plant thoroughly.
- Cover one of the plant's leaves (or a small branch with several leaves) with the clear plastic bag.
- Tie the mouth of the bag securely around the stem/branch with a rubber band to make it airtight.
- Place the potted plant in direct sunlight.
- Observe the inside of the plastic bag after a few hours.

Materials Required

Questions:

1. What did you observe inside the plastic bag after a few hours?
2. Where did the substance you observed come from?
3. What plant process does this activity demonstrate?
4. Why was it important to seal the bag tightly and place the plant in sunlight?

Skills Covered: Experimental Setup, Observation, Understanding Transpiration, Cause-and-Effect

Creativity

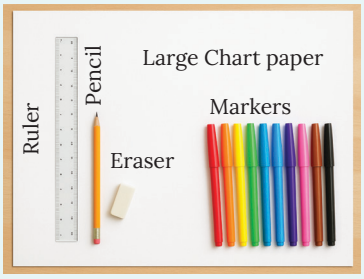
Art

"Plant Life Processes" Flowchart/Diagram

Task: Design a large, colourful flowchart or diagram that illustrates the interconnections between photosynthesis, respiration, and transport in a plant. Use arrows to show the flow of materials (water, minerals, CO_2, O_2, glucose) and label the key organs involved (roots, stem, leaves) and tissues (xylem, phloem, stomata).

Materials: Large chart paper or drawing board, Variety of coloured markers or pens, Ruler, Pencil and eraser

Optional: Glitter, stickers, or cut-outs to enhance visual appeal



Materials Required

Questions:

1. How did you visually represent the main processes (photosynthesis, respiration, transport) and their locations?
2. What specific materials did you show flowing between different parts of the plant, and how did you indicate their direction?
3. How does your flowchart help explain the overall "Life Processes" occurring within a plant?

Skills Covered: Creativity, Visual Representation, Conceptual Understanding of Plant Processes

Gas Exchange Comparison

Group Activity

Comparing Gas Exchange in Plants (Day vs. Night)

1. **Setup A (Day):** Place a small potted plant (e.g., a money plant) in a large, transparent bell jar. Place a small beaker containing a few drops of bromothymol blue solution (an indicator that turns yellow in acidic conditions, blue in neutral/alkaline, green in slightly acidic). Seal the bell jar and place it in bright sunlight for several hours.
2. **Setup B (Night/Dark):** Set up an identical bell jar with a similar plant and bromothymol blue solution. Seal it, but place it in a completely dark cupboard for several hours or overnight.
3. Record the initial color of the bromothymol blue in both setups.
4. After the observation period, record the final color of the solution in both setups. (Note: Carbon dioxide makes bromothymol blue turn yellow/green).

Questions:

1. What was the final colour of the bromothymol blue in Setup A (daylight)? What does this indicate about the gas exchange?
2. What was the final colour of the bromothymol blue in Setup B (darkness)? What does this indicate about the gas exchange?
3. Explain the difference in observations between Setup A and Setup B in terms of photosynthesis and respiration in plants.
4. Why was it important to use a sealed bell jar for this experiment?

Skills Covered: Scientific Testing, Observation, Understanding Gas Exchange in Plants, Teamwork

The Wilting Plant

Case Study

A student, Rohan, forgot to water his favorite potted plant for several days. When he finally remembered, he found the plant's leaves drooping and looking dull. He immediately watered it thoroughly, and to his surprise, after a few hours, the leaves started to regain their turgor and stand upright again.

Questions:

1. What essential substance was the plant lacking that caused its leaves to droop?
2. Which part of the plant is responsible for absorbing this substance from the soil?
3. Which tissue transports this substance from the roots to the leaves?
4. What force helps pull this substance upwards to the leaves, even against gravity?
5. Explain why the leaves regained their upright position after Rohan watered the plant.

Skills Covered: Classification, Analysis, Teamwork, Communication, Scientific Investigation

Source Based Question

Source Passage (Discovery of Photosynthesis, 1779 – Jan Ingenhousz):

"Hundreds of years ago, people wondered how plants make their own food. In 1779, a Dutch scientist named Jan Ingenhousz discovered something very important. He showed that green plants use sunlight to make food and give out oxygen. This process is called photosynthesis. He noticed that plants only give out oxygen in the presence of sunlight, not in the dark.

Later, scientists found that plants take in carbon dioxide from the air and water from the soil. With the help of sunlight and chlorophyll (the green pigment in leaves), they prepare their own food in the form of sugar. This food not only helps the plant grow but also provides energy to animals and humans who eat plants. The oxygen released during photosynthesis is necessary for the survival of all living beings on Earth. Thus, photosynthesis is one of the most important life processes in plants."

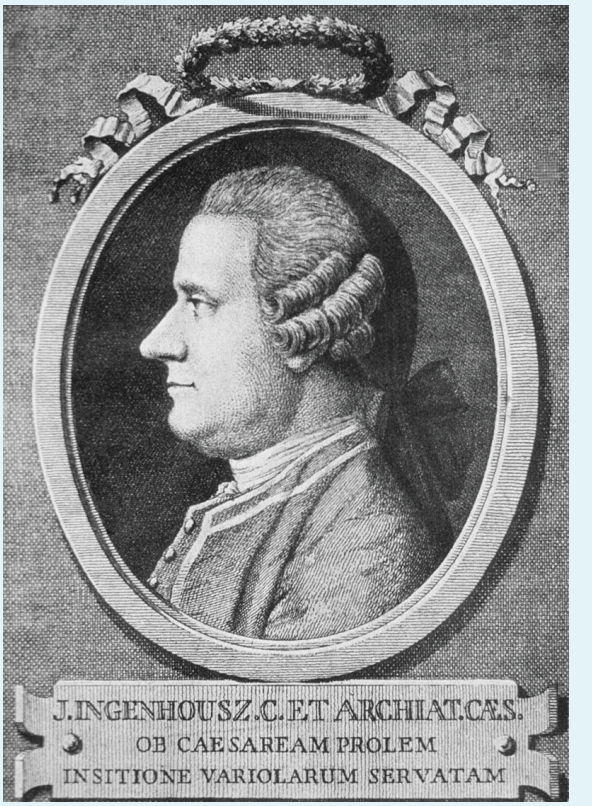


Image Credit: Wikipedia

Questions:

1. **Understanding the Discovery**
   - Who discovered that plants make food using sunlight and give out oxygen?
   - What is the process called in which plants prepare their own food?
2. **Cause and Effect**
   - Why do plants give out oxygen only in sunlight and not in darkness?
   - How does photosynthesis help both plants and animals?
3. **Thinking Deeper**
   - What would happen if plants stopped carrying out photosynthesis?
   - Can you think of a way in which this process connects plants, animals, and humans together?

Skills Covered: Observation, Curiosity, Critical thinking, Connecting real-life observations