

Chapter 5: Photosynthesis

1. Introduction:

Photosynthesis is the process by which green plants and some other organisms use sunlight to synthesize nutrients from carbon dioxide and water. It primarily takes place in leaves, specifically in the chloroplasts, and is crucial for life on Earth as it produces oxygen and organic compounds.

2. Significance of Photosynthesis:

- Produces oxygen essential for respiration.
 - Synthesizes food (glucose) from inorganic substances.
 - Maintains the atmospheric balance of CO₂ and O₂.
 - Forms the basis of the food chain.
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3. Structure of Chloroplast:

- Contains a double membrane, stroma, and thylakoid stacks called grana.
 - Thylakoid membranes contain chlorophyll where light reactions occur.
 - Stroma is the site for dark reactions.
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4. Stomatal Mechanism (Potassium Ion Exchange Theory):

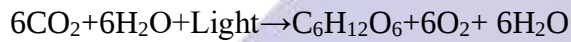
- Stomata open when guard cells absorb potassium ions (K⁺), leading to water influx.
 - Stomata close when potassium ions move out, leading to water loss.
 - This opening and closing mechanism helps regulate gas exchange and transpiration.
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5. The Process of Photosynthesis:

Photosynthesis occurs in two main stages: the Light Phase and the Dark Phase.

A) Light Phase (Photochemical Reaction):

- Takes place in the thylakoid membranes of chloroplasts.
- **Steps:**
 1. Activation of chlorophyll by sunlight.
 2. Photolysis of water (splitting of water molecules).
 - Produces oxygen (O₂), protons (H⁺), and electrons.
 3. Formation of ATP and NADPH (energy molecules) through photophosphorylation.
- **Equation:**



B) Dark Phase (Biosynthetic Reaction):

- Takes place in the stroma.
- Does not require light but uses ATP and NADPH from the light reaction.
- **Steps:**
 1. CO₂ combines with hydrogen released by NADPH to form glucose.
 2. ATP provides the energy for this reaction.

6. Adaptations in Plants for Photosynthesis:

- Broad, flat leaves to maximize light absorption.
 - Presence of chlorophyll to capture light.
 - Stomata for gas exchange.
 - Veins for water transport.
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7. Experiments Related to Photosynthesis:

a) Necessity of Light:

- A leaf is partially covered and exposed to sunlight.
- The exposed part tests positive for starch, proving light is necessary.

b) Necessity of Carbon Dioxide:

- A plant is placed in a setup with potassium hydroxide (KOH) to absorb CO₂.
- The leaf from this setup does not show starch presence, proving CO₂ is necessary.

c) Necessity of Chlorophyll:

- A variegated leaf is used to show that only the green parts produce starch.

d) Release of Oxygen:

- An aquatic plant (like Hydrilla) placed in a beaker releases oxygen bubbles when exposed to sunlight.

e) Formation of Starch:

- A destarched leaf exposed to sunlight tests positive for starch using iodine solution.
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8. Carbon Cycle:

- Involves the circulation of carbon between the atmosphere, biosphere, oceans, and geosphere.
 - Plants absorb CO_2 for photosynthesis and release oxygen.
 - Animals consume oxygen and release CO_2 through respiration.
 - Combustion of fossil fuels and decomposition also release CO_2 .
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9. Key Points:

- Photosynthesis is vital for oxygen production and food synthesis.
 - Involves light-dependent (photochemical) and light-independent (biosynthetic) reactions.
 - Several experiments demonstrate the essential factors for photosynthesis.
 - Stomatal regulation plays a significant role in gas exchange.
 - The carbon cycle ensures the continuous flow of carbon in nature.
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