

Chapter 3: Absorption by Roots

1. Introduction:

Absorption by roots is the process through which roots absorb water and minerals from the soil to support the plant's growth and metabolic functions.

2. Processes Involved in Water Absorption:

1. Imbibition:

- Absorption of water by solid particles (like cell walls) causing them to swell.
- Example: Dry seeds absorbing water and swelling.

2. Diffusion:

- Movement of molecules from a region of higher concentration to a region of lower concentration.
- Example: Gases like oxygen and carbon dioxide diffusing into or out of cells.

3. Osmosis:

- Movement of water molecules through a semipermeable membrane from a dilute solution to a concentrated solution.
 - **Osmotic Pressure:** The pressure required to stop the movement of water molecules through osmosis.
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3. Root Pressure:

- A force developed in the roots that pushes water upward through the xylem.
 - Helps in the upward movement of water, especially at night when transpiration is low.
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4. Turgidity and Flaccidity:

- **Turgidity:** When a cell is full of water and the cell membrane presses against the cell wall.
- **Flaccidity:** Loss of water from a cell, causing it to shrink.
- **Plasmolysis:** The process where the cell membrane pulls away from the cell wall due to water loss.
- **Deplasmolysis:** Re-absorption of water by a plasmolyzed cell, restoring its turgidity.

5. Absorption of Water and Minerals:

- **Active Transport:**
 - Movement of minerals against the concentration gradient using energy (ATP).
 - Example: Uptake of ions like potassium from the soil.
 - **Passive Transport:**
 - Movement along the concentration gradient without energy expenditure.
 - Example: Osmosis and diffusion of water.
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6. Structure of Root Hair:

- Root hairs are thin, tubular extensions of root epidermal cells.
 - Increase surface area for efficient water absorption.
 - Semi-permeable membrane allows selective uptake of water and minerals.
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7. Mechanism of Water Absorption:

- Water moves from the soil into the root hairs by osmosis.
 - Travels through root cortex via:
 - **Apoplast Pathway:** Through cell walls and intercellular spaces.
 - **Symplast Pathway:** Through cytoplasm and plasmodesmata.
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8. Ascent of Sap:

- Upward movement of water and dissolved minerals from roots to leaves through the xylem.
 - Forces responsible:
 - **Root Pressure:** Pushes water upward.
 - **Cohesive and Adhesive Forces:** Cohesion between water molecules and adhesion to xylem walls.
 - **Transpirational Pull:** Evaporation of water from leaves creates a negative pressure, pulling water upward.
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9. Experiments:

- Demonstrations to show water conduction through xylem:
 - Using colored water to visualize upward movement through plant stems.
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10. Key Points:

- Roots absorb water through root hairs via osmosis.
 - Active and passive transport facilitate mineral absorption.
 - The ascent of sap occurs due to root pressure, cohesion-adhesion forces, and transpirational pull.
 - Water conduction experiments help visualize the movement of water through xylem.
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