

# **Brain Builder Coaching Center**

## **Class – X ICSE**

### **Absorption by Roots**

#### **1. Importance of Water and Minerals**

- Water is essential for photosynthesis, transpiration, and maintaining turgidity.
- Minerals are needed for various metabolic activities.
- Absorbed by root hairs in the region of maturation.

#### **2. Characteristics of Roots for Absorption**

- Large surface area due to numerous root hairs.
- Thin, permeable cell walls.
- Close contact with xylem vessels.
- Presence of vacuole containing concentrated cell sap for osmosis.
- Living cells with mitochondria for energy (active absorption).

#### **3. Structure of a Root Hair**

- Outgrowth of an epidermal cell.
- Composed of cell wall, cell membrane, cytoplasm, nucleus, and large vacuole.
- Cell sap is hypertonic, aiding in water absorption via osmosis.

#### **4. Physical Processes Involved**

##### **Inhibition**

- Absorption of water by colloidal substances.
- E.g., swelling of dry seeds.

##### **Diffusion**

- Movement of molecules from a region of higher concentration to lower concentration.
- Passive process.

## Osmosis

- Movement of water from higher water potential to lower water potential through a semi-permeable membrane.
- A type of diffusion specific to water.

### Types of Osmosis:

- **Endosmosis:** Entry of water into the cell (cell placed in hypotonic solution).
- **Exosmosis:** Exit of water from the cell (cell placed in hypertonic solution).

### Osmotic Pressure

- Pressure required to prevent osmosis.
- Indicates the tendency of a solution to absorb water.

### Turgidity and Flaccidity

- **Turgid Cell:** Fully filled with water; firm.
- **Flaccid Cell:** Water is lost; limp and soft.

### Plasmolysis and Deplasmolysis

- **Plasmolysis:** Shrinking of cytoplasm due to water loss in hypertonic solution.
- **Deplasmolysis:** Restoration of turgidity when plasmolysed cell is placed in hypotonic solution.

## 5. Osmosis and Tonicity – Experiment and Explanation

### Types of Tonicity:

- **Hypotonic Solution:** Lower solute concentration outside; water enters the cell → becomes turgid.
- **Isotonic Solution:** Equal solute concentration; no net water movement.
- **Hypertonic Solution:** Higher solute concentration outside; water leaves the cell → becomes plasmolysed.

### Osmosis Experiment: Potato Osmoscope

**Aim:** To demonstrate osmosis using a potato osmoscope.

**Apparatus:** Potato tuber, sugar solution, distilled water, beaker, dropper.

**Procedure:**

1. Cut a potato and hollow out a cavity in the center.
2. Fill cavity with sugar solution.
3. Place the potato in a beaker containing distilled water.
4. Leave undisturbed for 1–2 hours.

**Observation:** Water enters cavity, level rises.

**Inference:** Water moves from low to high solute concentration through the semi-permeable potato wall → proves osmosis.

**Demonstration of Osmosis in Plant Cells:**

**Apparatus:** Rhoeo leaf, salt/sugar solution.

**Procedure:**

1. Mount leaf peel in hypertonic solution.
2. Observe under microscope.

**Observation:** Cytoplasm shrinks away (plasmolysis). If placed in water later, deplasmolysis occurs.

## **6. Mechanism of Absorption**

### **Passive Absorption**

- Water enters due to transpiration pull.
- Root cells play little role.
- Occurs when transpiration rate is high.

### **Active Absorption**

- Requires ATP energy.
- Root cells actively take up ions.
- Water follows due to osmotic gradient.

### **Active and Passive Transport (Minerals)**

- **Active:** Against concentration gradient using ATP.
- **Passive:** Along concentration gradient without ATP.

## 7. Root Pressure

- Pressure developed in roots due to active absorption.
- Helps in pushing water up.
- Evident during night or early morning (guttation).

## 8. The Rise of Water – Ascent of Sap

### Xylem

- Main tissue responsible for upward water transport.

### Forces Involved

- **Cohesive Forces:** Attraction between water molecules.
- **Adhesive Forces:** Attraction between water molecules and xylem walls.
- **Transpiration Pull:** Evaporation of water from leaves pulls water upward.
- Together these generate continuous water column in xylem.

## 9. Importance of Root Hairs

- Increase absorptive surface area.
- Penetrate soil particles.
- Involved in water and mineral uptake.

## 10. Experiments

### 1. Root Pressure Demonstration

**Apparatus:** Balsam plant, rubber tubing, capillary tube or manometer.

#### Procedure:

- Cut the stem and attach rubber tube to root.
- Observe water exudation or pressure rise in manometer. **Inference:** Water is pushed upward due to root pressure.

### 2. Water Movement Through Xylem

**Apparatus:** Plant with white flowers/stems, coloured water (e.g., red ink).

**Procedure:**

- Cut stem and place in coloured water.
- Observe colour moving up to petals. **Inference:** Water travels through xylem.

### **3. Plasmolysis in Plant Cells**

**Apparatus:** Rhoeo leaf, salt solution, microscope.

**Procedure:**

- Mount leaf peel in strong salt solution.
- Observe shrinking of cytoplasm. **Inference:** Demonstrates plasmolysis.

### **4. Demonstration of Xylem Pathway Using Dye**

**Apparatus:** Herbaceous stem, eosin solution/safranin.

**Procedure:**

- Place cut stem in dye.
- Section stem after few hours.
- Observe coloured xylem.

### **5. Demonstration of Tonicity Effects**

**Apparatus:** Grapes or Rhoeo peel, beakers, distilled water, salt solution.

**Procedure:**

- Place grape/peel in three beakers: distilled water, isotonic solution, salt solution.
- Observe changes (swelling, no change, shrinkage).

**Inference:** Demonstrates hypotonic, isotonic, and hypertonic environments.