# Biological Membranes and Transport: Osmosis in Plant and Animal Cells

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# Outline

- What Is Osmosis
- Definition of Important Terminology
- Types of Tonicity and Their Effects
- Materials
- Procedure
- Expected Results

# Objectives

By the end of this lab, students should be able to:

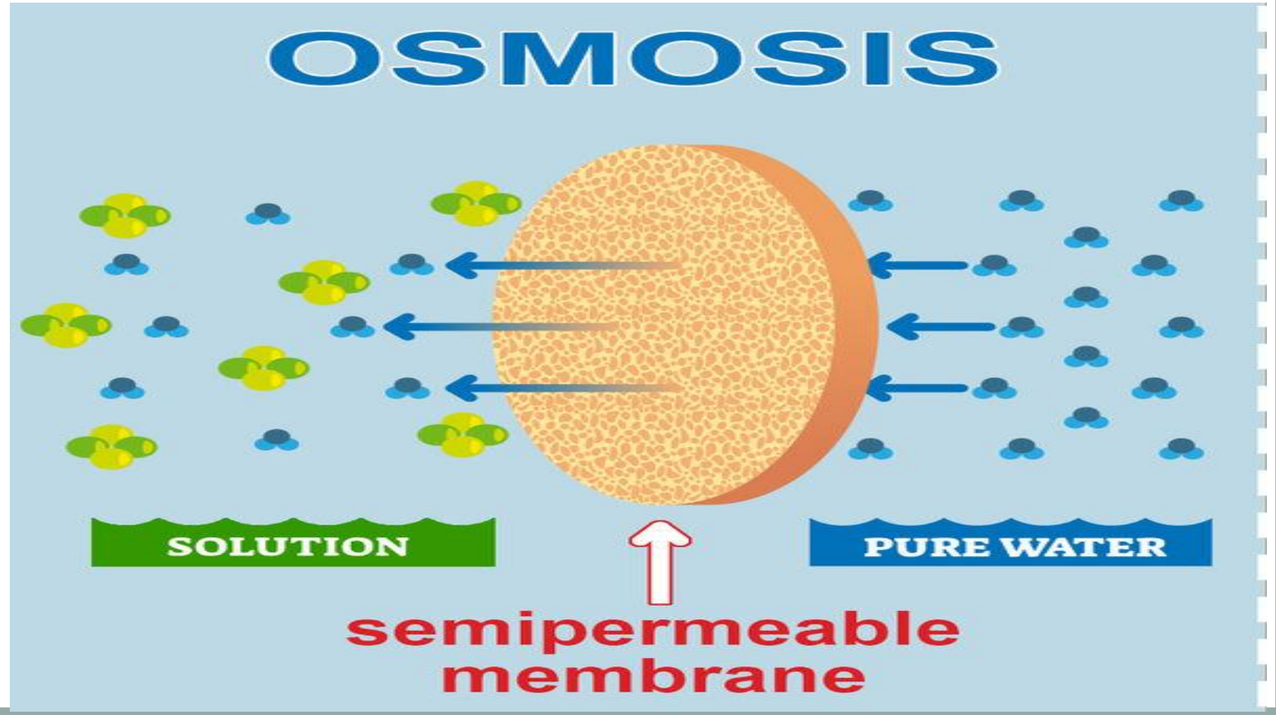
- Understand the principles of osmosis.
- Differentiate between osmosis in plant cells and animal cells.
- Visualize and interpret osmosis under the microscope using onion and cheek cells.

# ❖ What Is Osmosis?

# ❖ What Is Osmosis?

- Osmosis is the **passive movement** of water molecules across a **semipermeable membrane** from a region of **low solute concentration** to a region of **high solute concentration**.

- Water moves to balance solute concentrations on both sides of the membrane.



# ❖ Definition of Important Terminology:

1. **Solute**: A substance dissolved in a solvent (e.g., salt, sugar).

2. **Solvent**: The liquid in which solutes dissolve (usually water).

3. **Semipermeable membrane**: A membrane that allows some molecules (e.g., water) to pass but blocks others.

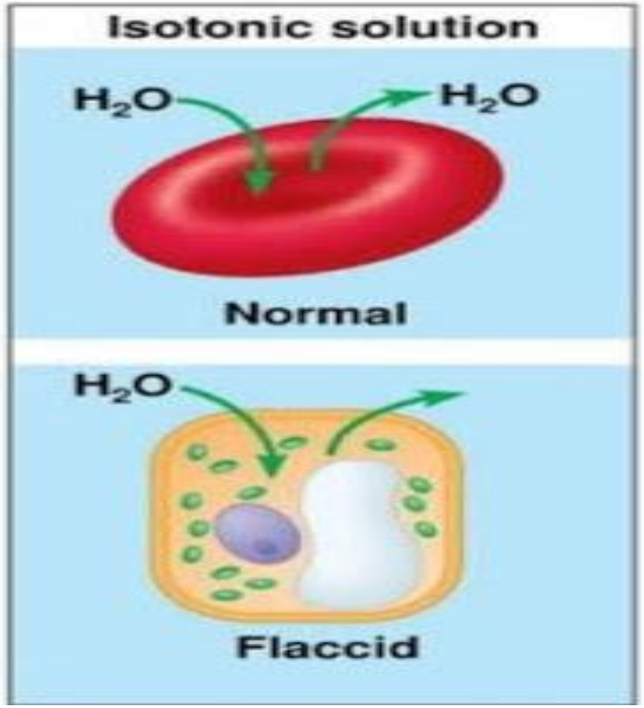
4. **Tonicity:** The ability of a surrounding solution to cause a cell to gain or lose water.

# ❖ Types of Tonicity and Their Effects

➢ **Isotonic Solution:** The solute concentration outside the cell is equal to that inside the cell.

➢ **Water Movement:** No net movement of water.

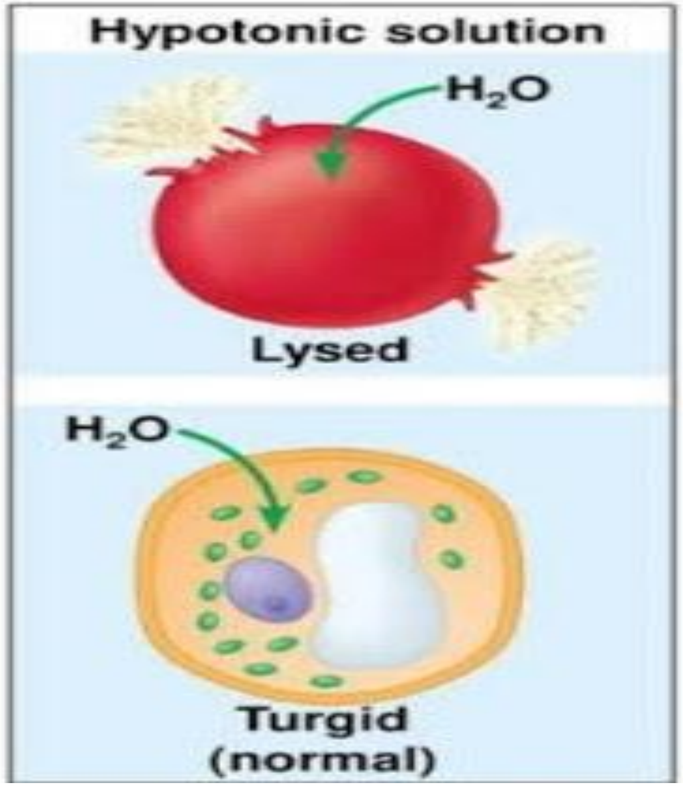
| Effect on Cell | |
|---|---|
| Animal cells | Maintain normal shape |
| Plant cells | Slightly flaccid (less turgor pressure) |
| Example | 0.9% saline (normal saline) used in IV fluids |



- **Hypotonic Solution:** The solute concentration outside the cell is lower than inside the cell.

- **Water Movement:** Water enters the cell.

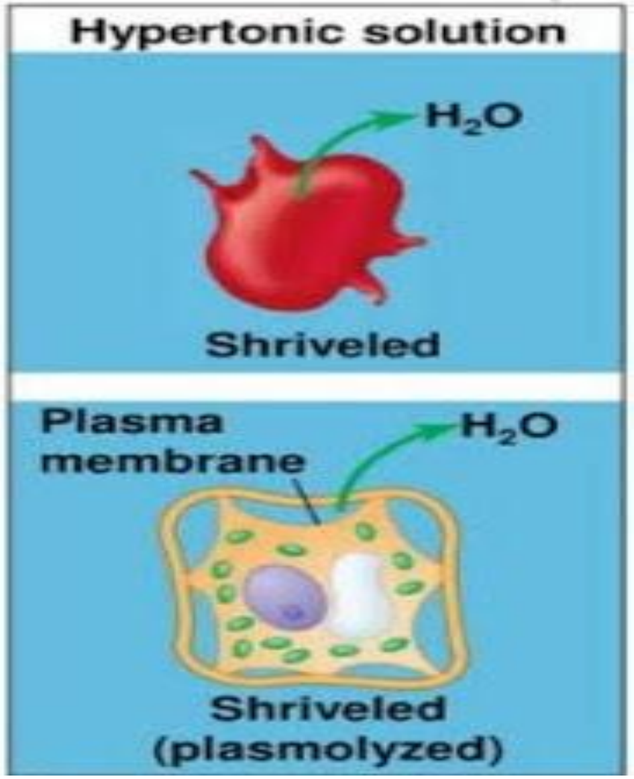
| Effect on Cell | |
|---|---|
| **Animal cells** | **Swell and may burst (lysis).** |
| **Plant cells** | **Swell but do not burst due to cell wall become turgid (ideal state for plants).** |
| **Example** | **Distilled water** |



- **Hypertonic Solution:** The solute concentration outside the cell is higher than inside the cell.

- **Water Movement:** Water leaves the cell.

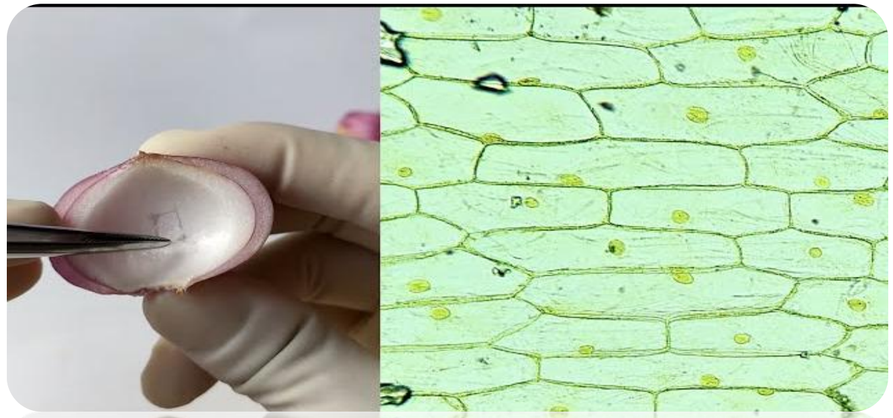
| Effect on Cell | |
|---|---|
| **Animal cells** | **Shrink** |
| **Plant cells** | **Cytoplasm pulls away from the cell wall (plasmolysis), causing wilting** |
| **Example** | **10% saline or high-sugar solutions** |



# ❖ Osmosis in Different Cell Types:

- **Plant Cells (e.g., onion cells):**

✓ Surrounded by cell wall: prevents bursting.



- **Animal Cells (e.g., cheek cells):**

✓Surrounded only by a plasma membrane.

# ❑ Osmosis in Onion Cells:

✓ Aim: To observe the effects of osmosis on plant cells by immersing red onion epidermal cells in solutions of different tonicities and examining the cellular changes under a microscope.

## ❖ Materials:

- Red onion (outer layers)
- Microscope slides and coverslips
- Light microscope
- Distilled water (hypotonic solution)
- 5–10% salt solution (hypertonic solution)
- Isotonic saline (optional)
- Forceps, scalpel or blade
- Dropper or pipette
- Paper towels

# ❖ Procedure:

**1. Prepare the Onion Epidermis:**

- Peel a thin transparent layer of epidermis from the red onion using forceps.
- Place it flat on a microscope slide.

**2. Initial Observation (Control):**

- Add a drop of **distilled water** to the sample.
- Cover with a coverslip and observe under 400x magnification.

- **Record:** Observe **turgid cells** : The central vacuole is full, and the cell membrane is pushed tightly against the cell wall.

**3. Hypertonic Treatment (Plasmolysis):**

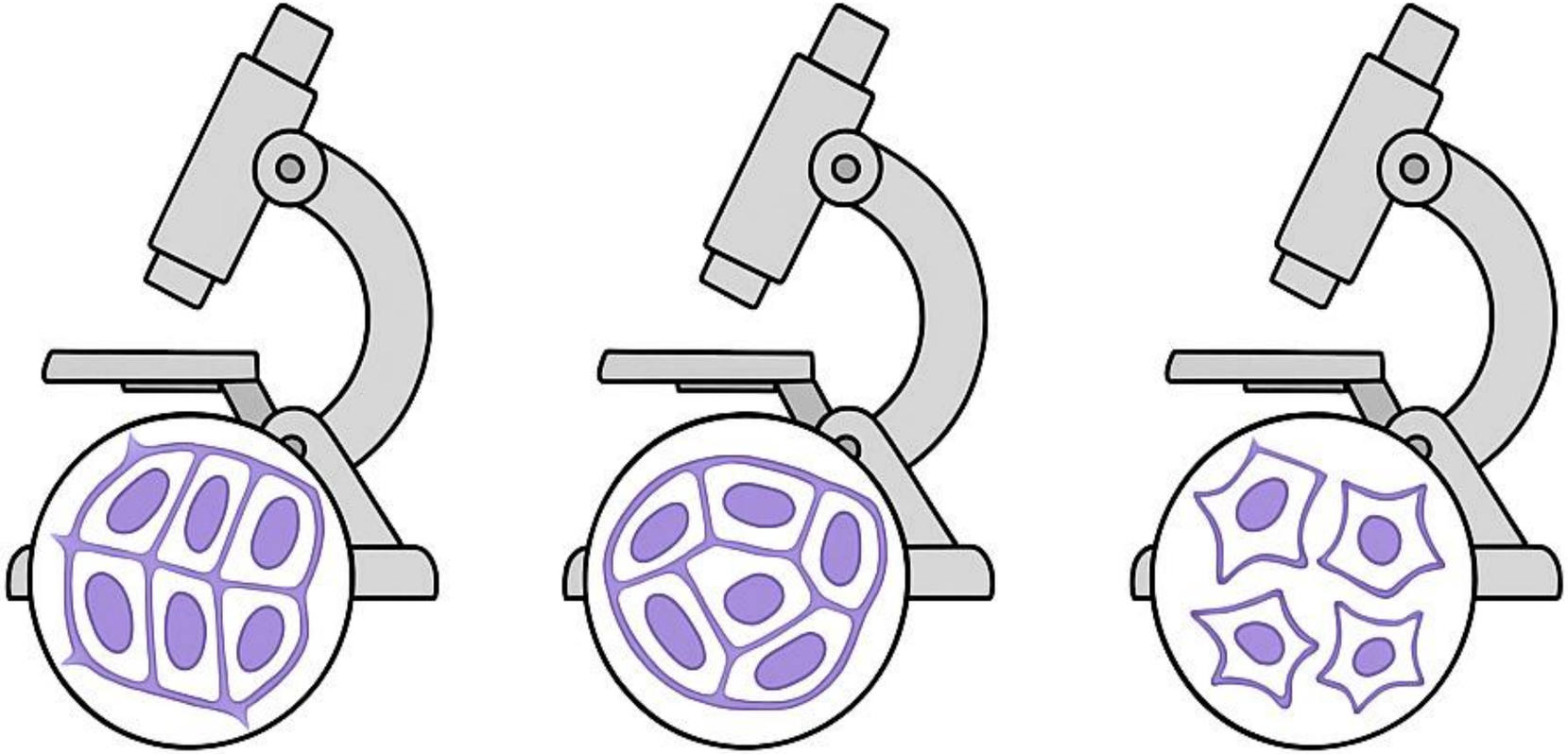
- Remove the water with paper towel.
- Add a drop of **5–10% salt solution (NaCl)**.
- Observe under microscope after 5–10 minutes.
- **Result:** Cells undergo **plasmolysis** — the cytoplasm and plasma membrane shrink away from the cell wall due to water loss.

**4. Hypotonic Reversal (Deplasmolysis):**

- Carefully rinse the slide and add **distilled water** again.
- Observe to see if the cells return to their turgid state.

- **Result:** Water re-enters cells by osmosis; some cells may regain turgidity (partial **deplasmolysis**).

# Osmosis in Onion Cells



**Hypotonic Solution**

Turgid Cell

**Isotonic Solution**

Flaccid Cell

**Hypertonic Solution**

Plasmolyzed Cell

# ❑ Osmosis in Human Cheek Cells:

✓ Aim: To investigate the effect of osmosis on animal cells (cheek epithelial cells) by exposing them to solutions of different tonicities and observing cellular changes under a microscope.

## ❖ Materials:

- Sterile cotton swab or toothpick
- Microscope slides and coverslips
- Light microscope
- Distilled water (hypotonic solution)
- 5–10% salt solution (hypertonic solution)
- Isotonic saline (0.9% NaCl)
- Dropper or pipette
- Methylene blue stain (optional, to highlight nuclei)
- Paper towel

# ❖ Procedure:

**1. Collect Cheek Cells:**

- Gently scrape the inside of your cheek with a sterile swab or toothpick.
- Smear it onto a clean slide.

**2. Stain (Optional):**

- Add a drop of methylene blue to make the nucleus and cell structure more visible.

**3. Apply Isotonic Solution (Control):**

- Add a drop of **0.9% saline**.
- Cover with coverslip and observe under microscope at 400x magnification.

- **Observation**: Normal, plump cheek cells with visible nuclei.

## 4. Apply Hypertonic Solution (Plasmolysis in Animal Cells):

- Remove saline and add a drop of **5–10% salt solution**.
- Wait 5 minutes, then observe.

- **Observation**: Cells shrink and appear crenated as water moves out of the cells.

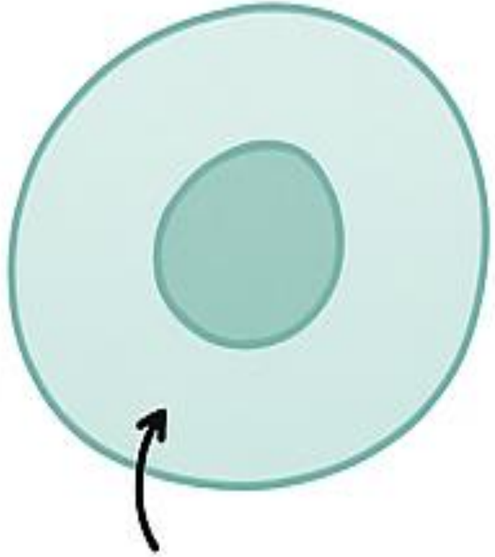
## 5. Apply Hypotonic Solution:

- Remove salt and add **distilled water**.

- Wait and observe.

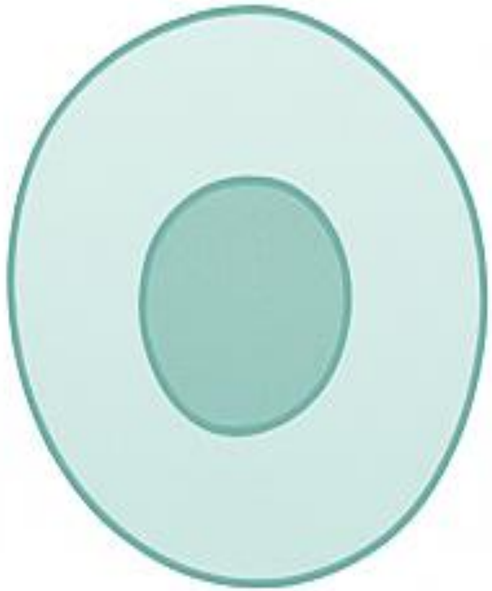
- **Observation**: Cells may swell and in extreme cases, **lyse** (burst), though this is rarely visible.

## Hypotonic Solution



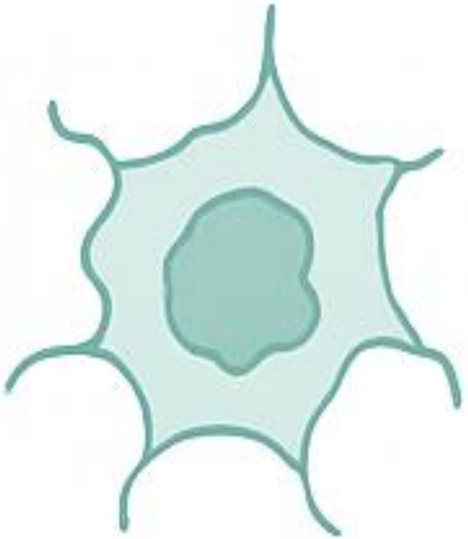
Water enters the cell

## Isotonic Solution



No net water movement

## Hypertonic Solution



Water leaves the cell

# References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# Thanks