

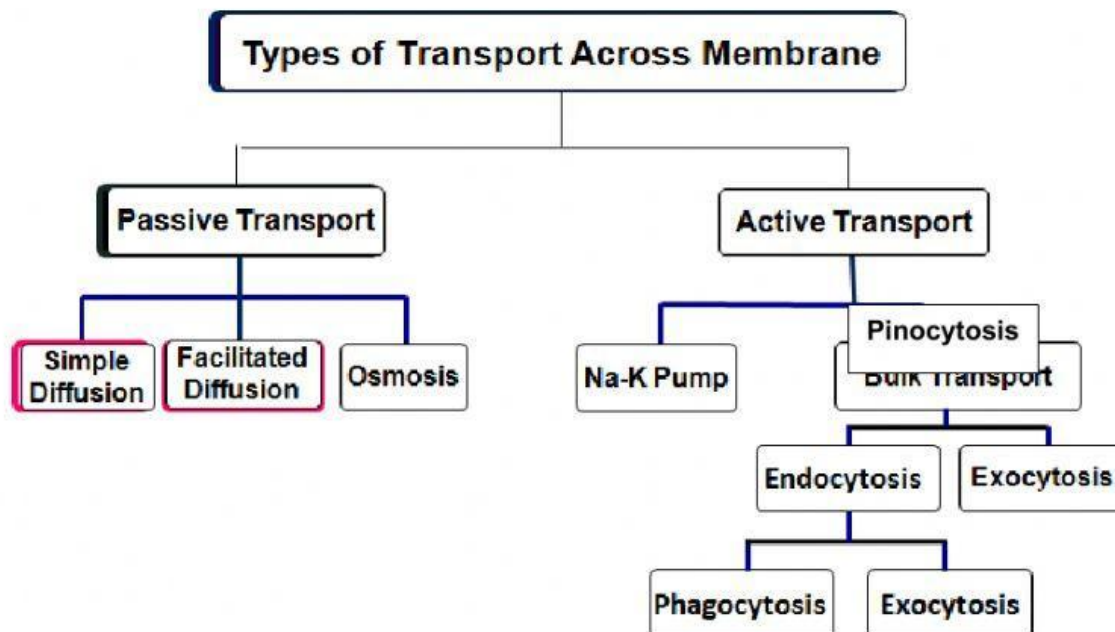
2.4 CELL TRANSPORT

Learning outcomes

At the end of this lesson, students should be able to:

I. Describe the following processes:

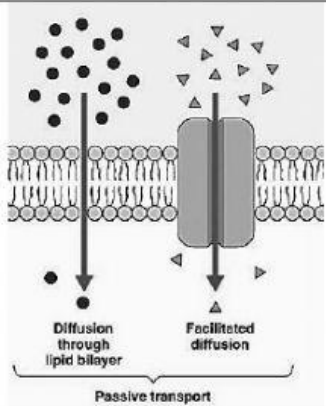
- Diffusion
- Facilitated diffusion
- Osmosis
- Active transport



a) Passive Transport • Movement of a substance across membrane down concentration gradient. • Across a selective permeable membrane. • Without using energy	b) Active Transport • Movement of a substance across membrane against concentration gradient. • Across a selective permeable membrane • using energy
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A. Passive transport

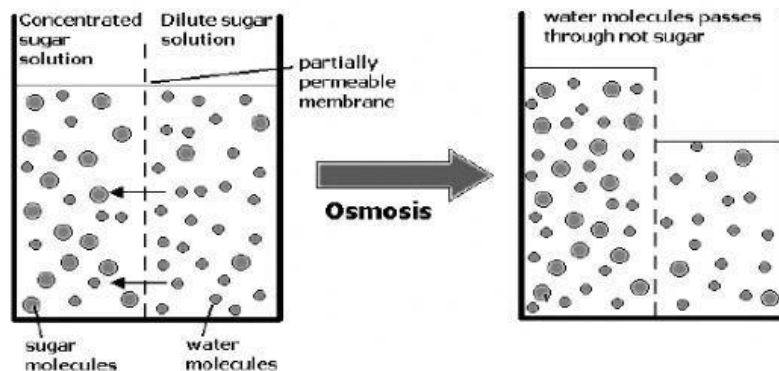
i. _____ diffusion	ii. _____ diffusion
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• Movement of a substance down the concentration gradient across phospholipid bilayer. • Without using energy	• Movement of a substance down the concentration gradient with the help of transport protein. • Without using energy
Example: - Small, polar molecule (H_2O, glycerol) - Small, Non polar molecule (O_2, CO_2) - Lipid soluble molecule (steroid, cholesterol)	Example: Ions & polar molecule (Na^+ , Cl^- , glucose, amino acids)

iii. Osmosis

Definition:

“Osmosis is the movement of _____ molecules across _____ permeable membrane from the region of _____ water potential to a region of _____ water potential and no _____ is required”.



Water Potential**Definition:**

Tendency of water molecule to move from one region to another region

Symbol ~ Ψ (Psi)

Pure water has the highest water potential, $\Psi = 0$ kPa



Water potential is calculated using the following formula:

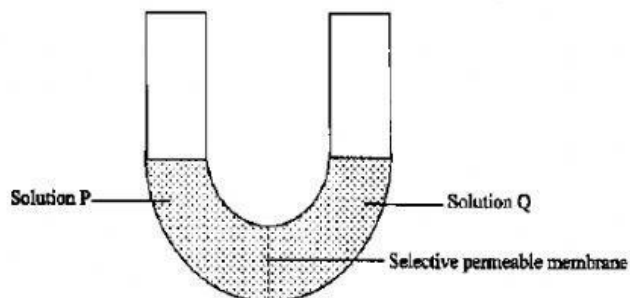
$$\text{Water potential } (\Psi) = \text{Solute potential } (\Psi_s) + \text{Pressure potential } (\Psi_p)$$

Solute potential (Ψ_s)

- A measure of the change in water potential of a solution due to the presence of solute molecules
- When solute molecules are dissolved in pure water, it reduces its water potential, becoming negative (-ve)
- Symbol, ψ_s (always has -ve value)
- A solution with less solute than the other, has higher water potential

Test your understanding!

Solution P is 5M sucrose while solution Q is 10M sucrose.



Which solution has higher water potential? Give a reason for your answer.

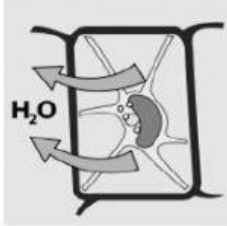
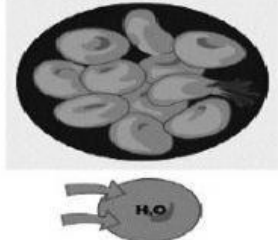
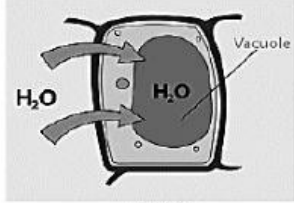
Solution: _____

Reason:

Pressure potential (Ψ_p)

- The component of water potential due to the hydrostatic pressure that is exerted on cell wall.
- In turgid plant cells it usually has a positive value as the entry of water causes the protoplast to push against the cell wall (turgor pressure)

Type of solution

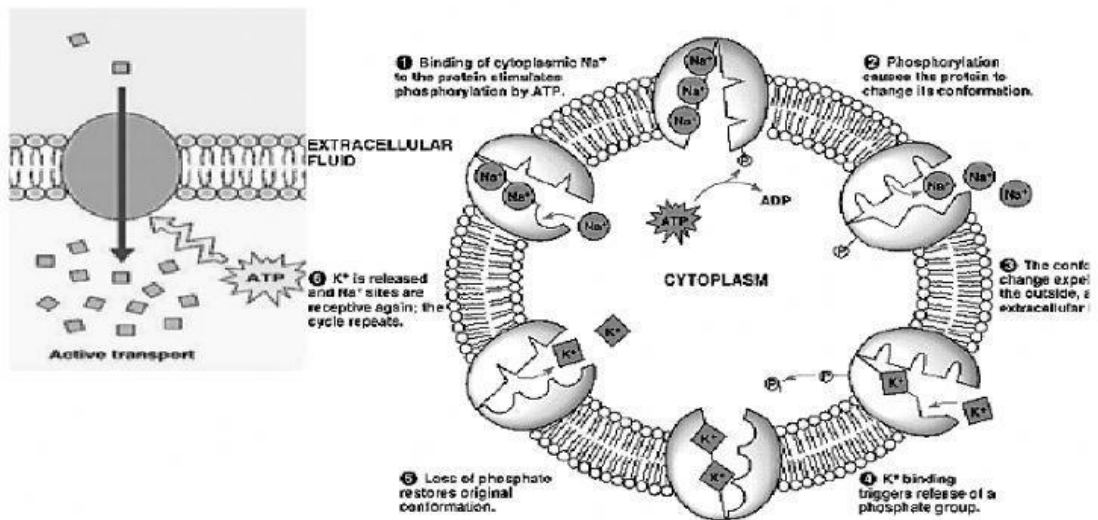
solution	solution	solution
<u>Same</u> concentration of solute relative to another solution What happen when a cell is put in an isotonic solution? Answers:	<u>High</u> concentration of solute relative to another solution What happen when a cell is put in a hypertonic solution? Hypertonic  Hypotonic  Hypotonic  Turgid - The cell has higher water potential than outside the cell. - Water moves out from the cell by osmosis - Animal cell becomes _____ - In plant cell, water moves out from vacuole → vacuole shrinks. - Plasma membrane detached & pulled away from the cell wall. - Plant cell becomes _____	<u>Low</u> concentration of solute relative to another solution What happen when a cell is put in a hypotonic solution? - Water potential outside the cell is higher than in the cell. - Water from outside moves into the cell by osmosis. - Animal cell swell (if too much water moves in, it may lysed / burst). - If erythrocyte burst ~ _____ - Plant cell becomes _____

B. Active transport

Two different types of active transport are as follows:

i. Sodium-Potassium Pump

This active transport is carried out _____ concentration gradient. Involves specific transport _____ present in the cell membrane whereby _____ from ATP is required.

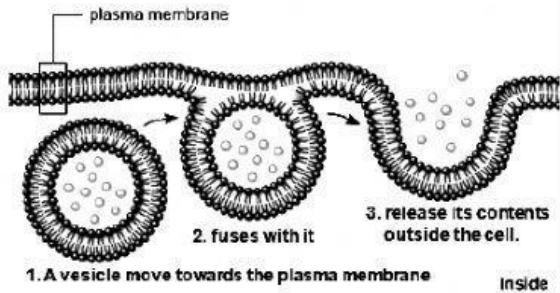


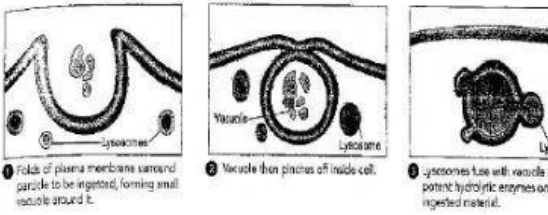
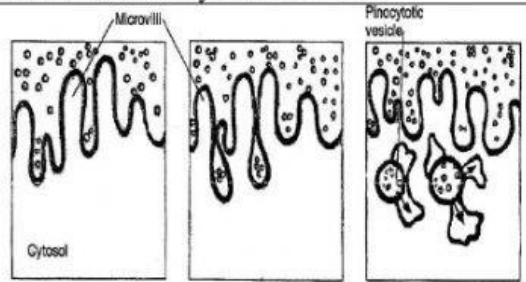
Outside the cell: $[\text{Na}^+] \uparrow, [\text{K}^+] \downarrow$

Inside the cell : $[\text{Na}^+] \downarrow, [\text{K}^+] \uparrow$

- 3 Na⁺ in the cell binds to a specific site of transport protein
- The binding of Na⁺ stimulates the hydrolysis of ATP into ADP + P_i
- P_i binds to transport protein (phosphorylation) & change its conformation
- Causes it to pump 3 Na⁺ to the outside, Increasing its concentration outside the cell
- 2 K⁺ outside the cell binds to a specific site of transport protein
- Stimulates the release of phosphate group from the transport protein
- Causes transport protein to restore its original conformation
- 2 K⁺ is pumped into the cell, Increasing its concentration inside the cell
- Na-K pump is important for transmission of nerve impulses

ii. Bulk Transport

a) _____	b) _____
✓ A process in which bulk substances are taken <u>into</u> the cell ✓ Requires energy ✓ Involves invagination (folding) of cell membrane (cannot occur in plant cell due to the presence of cell wall) 2 types: a) Phagocytosis b) Pinocytosis	✓ A process in which cells release substance <u>out</u> of the cell. ✓ Vesicle move towards cell membrane & fuse with it ✓ Substance within vesicles are released outside the cell (during secretion)  1. A vesicle move towards the plasma membrane 2. fuses with it 3. release its contents outside the cell. plasma membrane Inside

a) Phagocytosis	b) Pinocytosis
A process when _____ particles are taken into the cell	A process when _____ materials are taken into the cell
Involved formation of _____	Involved formation of _____
The substance are _____ and _____ into cytoplasm	The dissolved substance are _____ directly into cytoplasm
Involve hydrolytic enzyme from _____ for digestion	Does not involve _____
Example : bacteria are engulfed by macrophage	Intake of dissolved solutes by absorptive cells of the kidney and intestines
 1. folds of plasma membrane surround particle to be ingested, forming small vesicle around it. 2. Vesicle then pinches off inside cell. 3. Lysosomes fuse with vesicle & potent hydrolytic enzymes are ingested material.	 Microvilli Cytosol Pinocytotic vesicle 1. Tiny droplets of fluid are trapped by folds of plasma membrane. 2. These pinch off into cytosol as small fluid-filled vesicles. 3. Contents of these vesicles are then slowly transferred to cytosol.