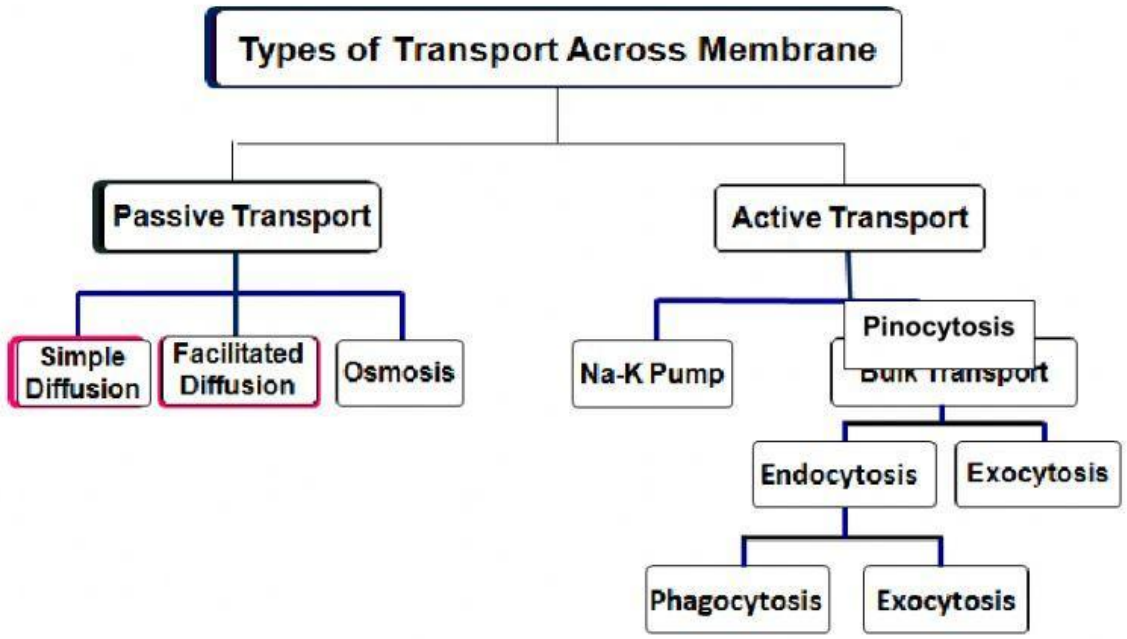
## 2.4 CELL TRANSPORT

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

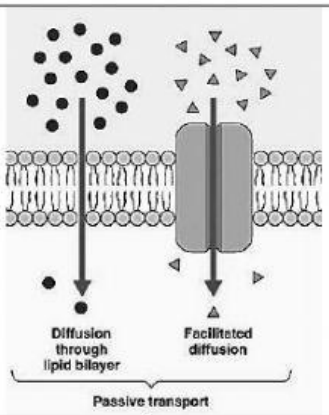
I. **Describe the following processes:**
- **Diffusion**
- **Facilitated diffusion**
- **Osmosis**
- **Active transport**




| a) **Passive Transport** | b) **Active Transport** |
|---|---|
| • Movement of a substance across membrane **down** concentration gradient.<br>• Across a selective permeable membrane.<br>• Without using energy | • Movement of a substance across membrane **against** concentration gradient.<br>• Across a selective permeable membrane<br>• using energy |

### A. Passive transport

| | |
|---|---|
| i. _____ diffusion | ii. _____ diffusion |

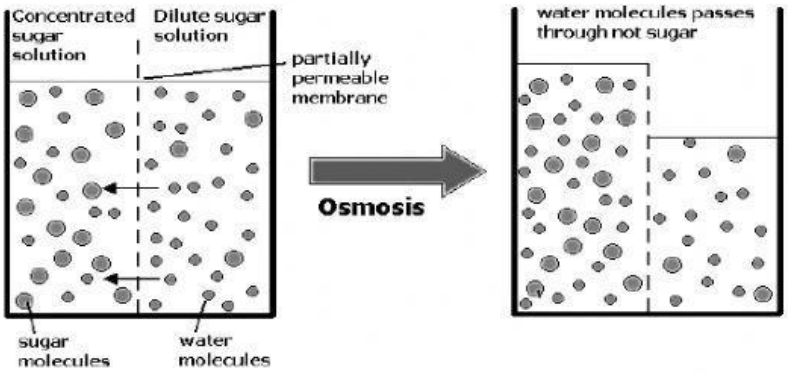



| | |
|---|---|
| • Movement of a substance down the concentration gradient across phospholipid bilayer. | • Movement of a substance down the concentration gradient with the help of transport protein. |
| • Without using energy | • Without using energy |
| **Example:**<br>i. Small, polar molecule ($H_2O$, glycerol)<br>ii. Small, Non polar molecule ($O_2$, $CO_2$)<br>iii. Lipid soluble molecule (steroid, cholesterol) | **Example:**<br>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, Ψ = 0 kPa

Water potential is calculated using the following formula:

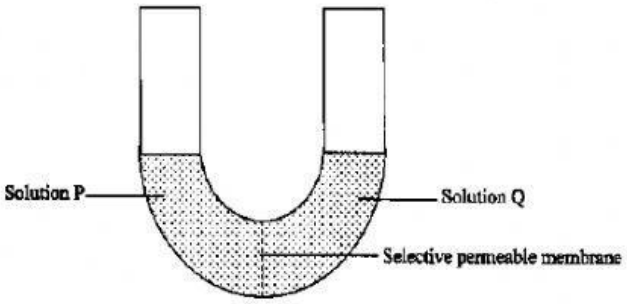
**Water potential (Ψ) = Solute potential ($\Psi_S$) + Pressure potential (Ψp)**

## Solute potential (Ψs)

- 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, $\psi_s$ (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: _____

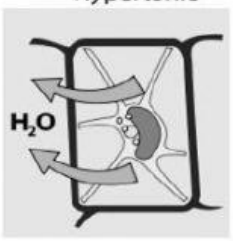
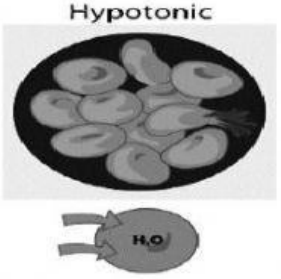
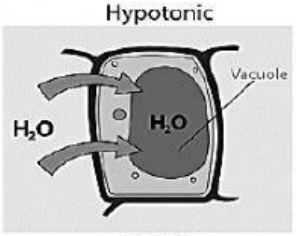
Reason:

_____

## Pressure potential (Ψp)

- 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**

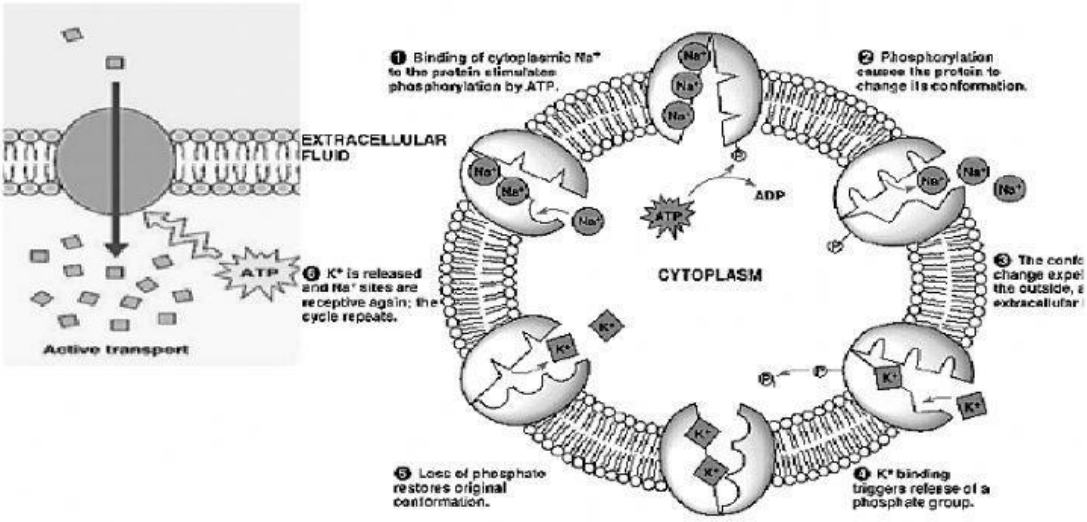
| _____ solution | _____ solution | _____ solution |
|---|---|---|
| Same concentration of solute relative to another solution | High concentration of solute relative to another solution | Low concentration of solute relative to another solution |
| What happen when a cell is put in an isotonic solution?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

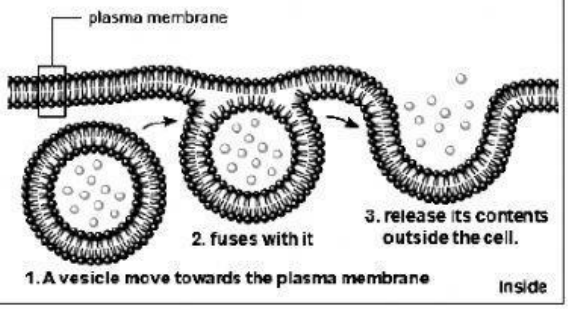


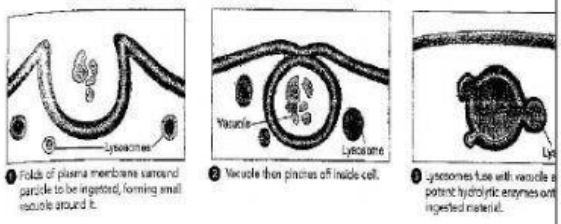
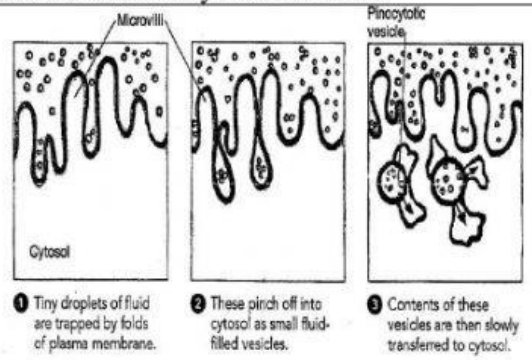

Outside the cell: $[Na^+] \uparrow$, $[K^+] \downarrow$

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

- 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 into the cell<br>✓ Requires energy<br>✓ Involves invagination (folding) of cell membrane (cannot occur in plant cell due to the presence of cell wall)<br><br>2 types:<br>a) Phagocytosis<br>b) Pinocytosis | ✓ A process in which cells release substance out of the cell.<br>✓ Vesicle move towards cell membrane & fuse with it<br>✓ Substance within vesicles are released outside the cell (during secretion)<br><br>  <br> |

| 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 |
|  <br> |  <br> |