Transport Through Cell Membrane

OSMOSIS

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CELL MEMBRANE

- **It's a selective semi permeable membrane that allows the passage of some substances through it and excludes others**
- **its thickness is about 7.5-10 nanometers**

  (75-100 angstrom)
- **<u>The cell membrane is composed of :-</u>**

1)Lipid (42%) and divided into :-

a. Phospholipids (25%).

b. Cholesterol (13%).

c. Other lipids (4%).

2)Protein 55% .

3)Carbohydrate (Glycoprotein and glycolipids)(3%).

Structure of the cell membrane

- **The cell membrane is composed of:**

a)Lipids:

- Lipids of the cell membrane are mainly phospholipids and cholesterol.

Function of membrane lipids :

a) A basic structure.

b) Barrier that prevent water evaporation.

c) Cholesterol determines the degree of the permeability to water soluble substances & controls fluidity of cell membrane.

b . Proteins : Present as:

a) Integral protein : that penetrate the whole thickness of the membrane.

b) Peripheral proteins : that attached to outer or inner surfaces.

Function of membrane proteins:

a) A basic structure.

b) Act as channels for ions which can open or close by conformationnel changes in protein molecules.

c) Enzymes that catalyze some reactions e.g., adenyl cyclase.

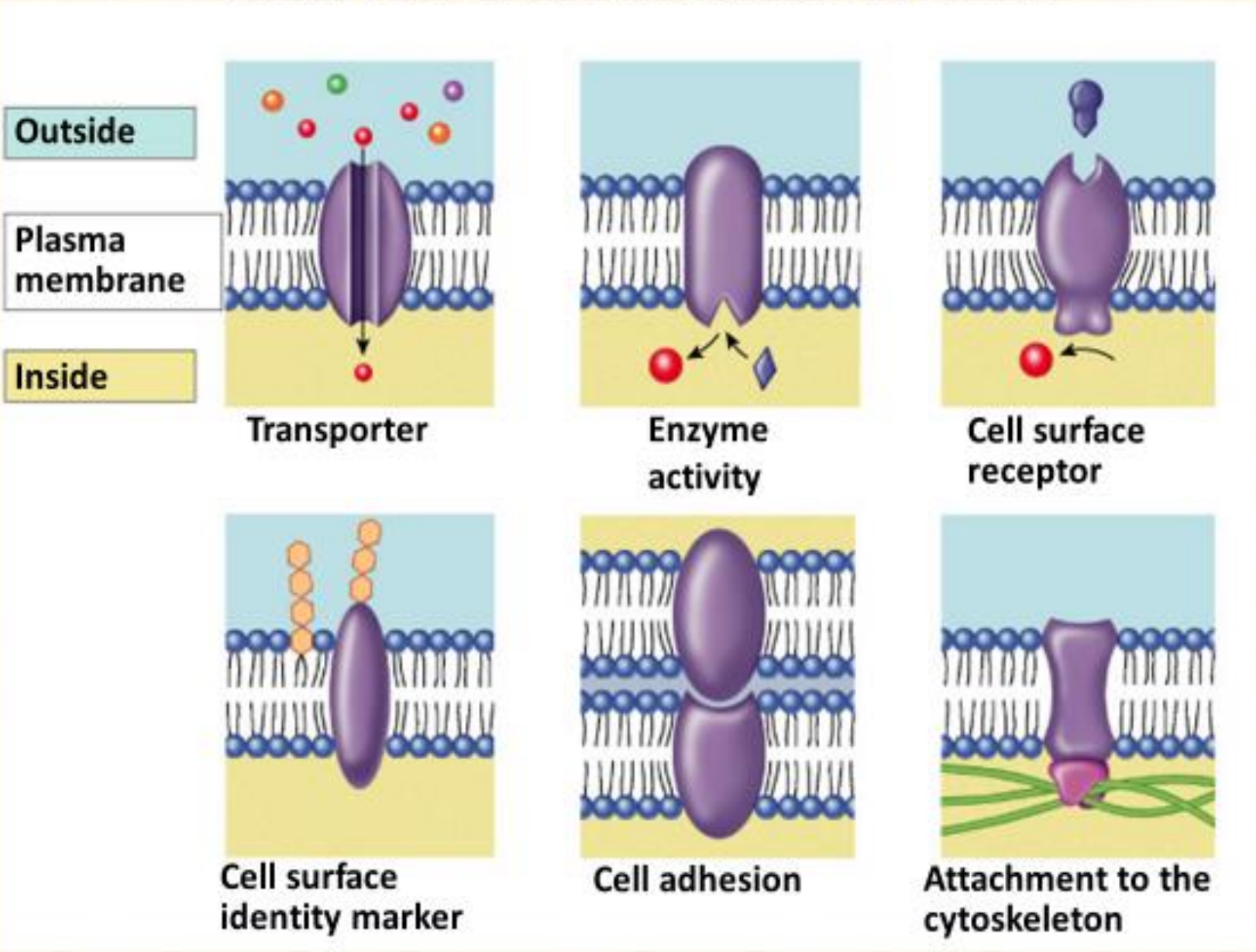
d) Ion pump e.g., Na +/ K +pump.

e) Carrier that facilitate the membrane transport.

f) Receptors for drugs or hormones.

g) ↓ surface tension of the membrane ↑ membrane elasticity.

Many Functions of Membrane Proteins



c. Carbohydrate (glycocalex):

Carbohydrates (glycocalex) form a loose coat that cover the outer surface of the membrane.

- ❖ They formed of glycoprotein and glycolipids.

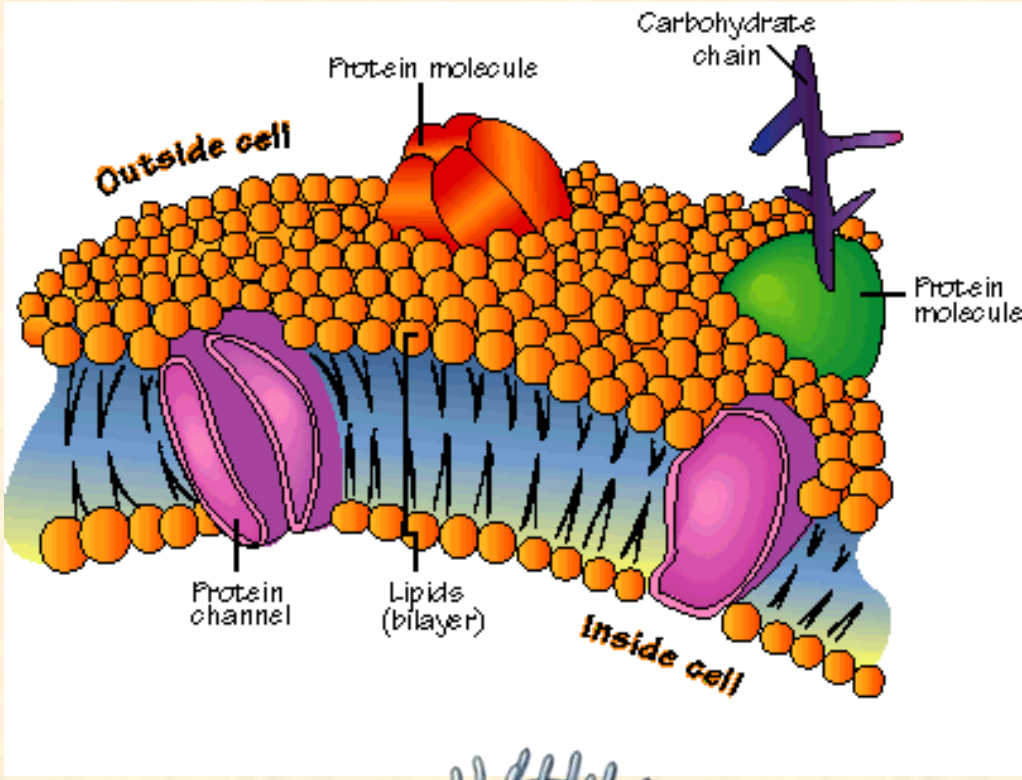
Function of glycocalex:

a) Carry –ve charge so repel –ve charged molecules.

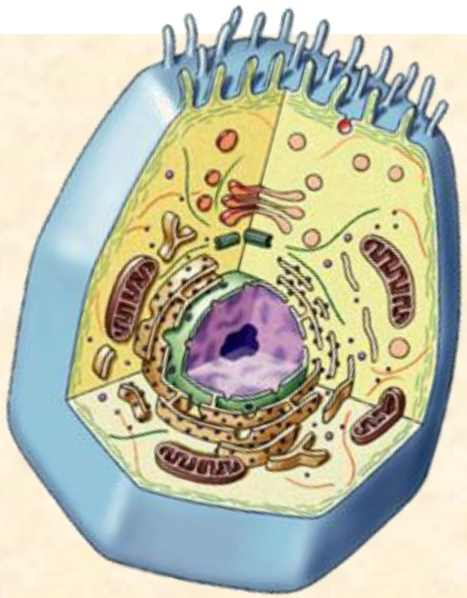
b) Attach cells to each others.

c) Act as receptors for hormones as insulin.

d) Play a role in cell- cell recognition (Immune function)



Movement across the Cell Membrane



TRANSPORT ACROSS CELL MEMBRANE

I-Passive transport:

1-Diffusion:

a)Simple diffusion. b) Facilitated diffusion.

2-Osmsis.

3-Filtration.

II-Active transport:

1-Primary Active transport.

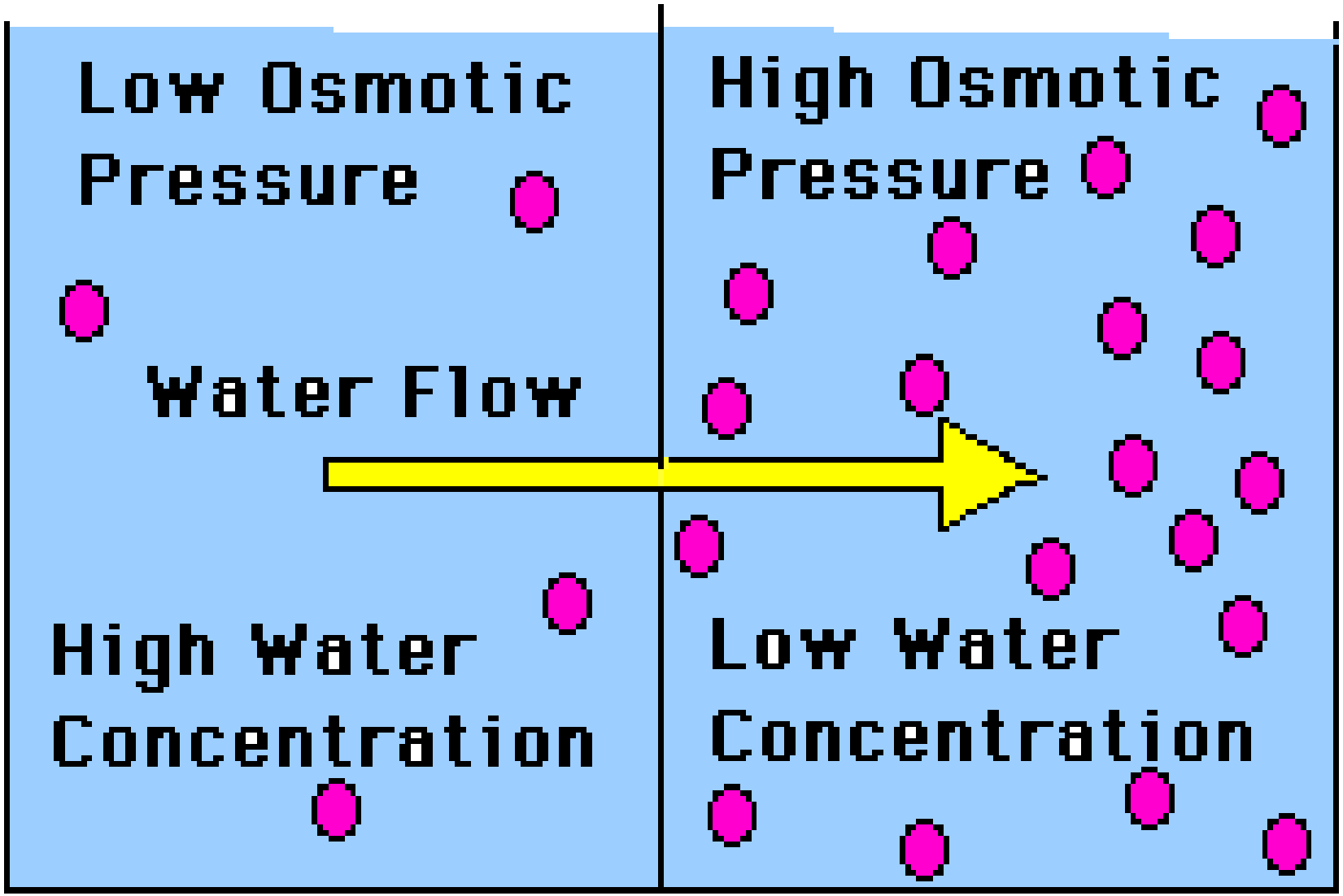
2-Secondary Active transport.

III-Endocytosis & Exocytosis.

2)Osmosis

- It is the diffusion of **solvent** molecule (water)down its concentration gradient from a region of low concentration of **solute** (to which the membrane is impermeable)

to region of high concentration of **solute** through a semi permeable membrane.


Low Osmotic Pressure
High Osmotic Pressure
Water Flow
High Water Concentration
Low Water Concentration

Characters of osmosis

1. Net diffusion of H2O **(solvent)** across a selectively permeable membrane.

2. Movement of H2O from a high H2O to lower H2O until equilibrium is reached.

3. **Two** requirements for **osmosis**:

a. Difference in solute concentration on the two sides of the membrane.

b. Membrane must be impermeable to the solute.

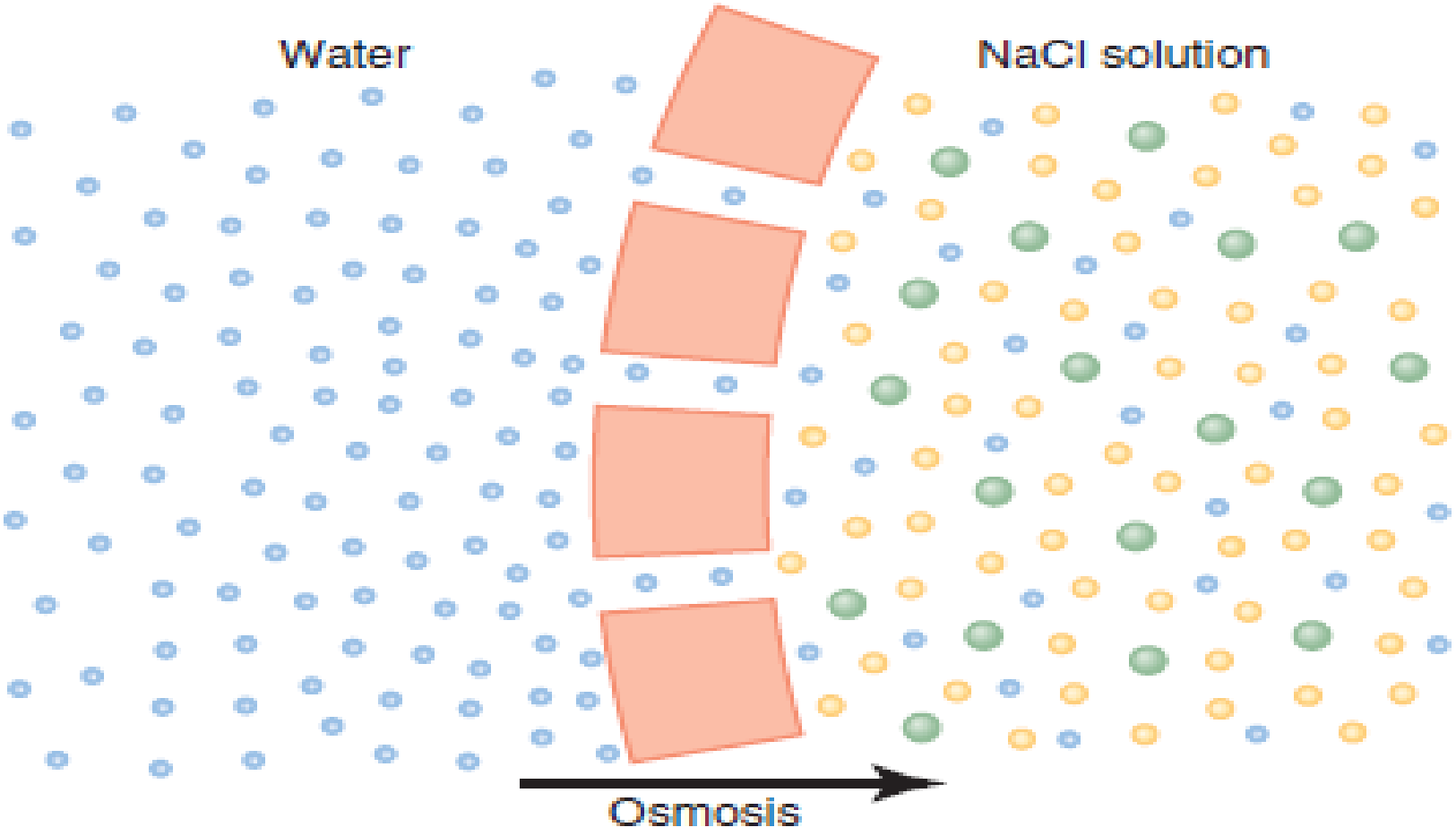
Osmotic pressure

- **Osmotic pressure**:- Is the pressure needed to stop osmosis (to prevent the solvent migration)
- **Factors affecting osmotic pressure:**

1. Number of non-diffusible particles regardless of their mass or their nature.

2. Chemical activity of the solute particles that provides potential pressure across cell membrane ionizing solutes (e.g., NaCl) are more osmotically active than non-ionizable solutes (e.g., glucose).

- The osmotic pressure is expressed in **osmoles or milliosmoles** which can be converted to mmHg, since **one milliosmole =** about **19.3 mmHg**.



Osmosis at a cell membrane when a sodium chloride solution is placed on one side of the membrane and water is placed on the other side.

Standard international units

- 1 Mole = MW of solute in grams.
- 1 m Mole = 1/1000 mole .

- 1 Osmol = $\frac{1\ mole/Liter\ water}{No.\ of\ free\ particles\ (valence\ )}$

- **Glucose**

- 1 mole = MW in gm = 180 gm glucose.

1 Osmol = $\dfrac{1\ mole(180\ gm)/Liter\ water}{No.\ of\ free\ particles\ (valence,\ 1)}$

- **Na cl**

1 mole = MW of Na in gm + MW of cl in gm = 58.5 gm. Na cl.

1 Osmol = $\frac{1\ mole(58.5\ gm)/Liter\ water}{No.\ of\ free\ particles\ or\ valence\ (2)}$ **= 29.25 gm / L.**

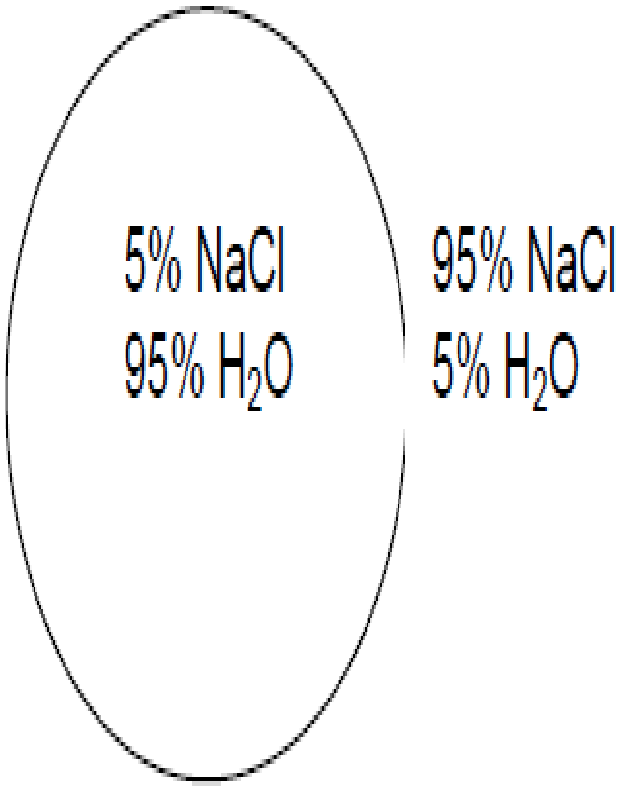
- ***Osmolarity*** = It is the number of Osmols dissociated in 1 *liter* of solvent.
- ***Osmolality*** = It is the number of Osmols dissociated in 1 *K gm* of solvent.
- ***Tonicity*** = The Osmolarity related to plasma (two solutions separated by a semipermeable membrane).

- When two solutions separated by a semipermeable membrane have the same osmotic pressure, they are **isotonic**; that is, no water will flow between them because there is no osmotic pressure difference across the membrane.
- When two solutions have different osmotic pressures, the solution with the lower osmotic pressure is **hypotonic**, and the solution with the higher effective osmotic pressure is **hypertonic**.
- Water will flow from the **hypotonic** solution into the **hypertonic.**

- If two solutions have the same calculated Osmolarity, they are called **isosmotic**.
- If two solutions have different calculated osmolarities, the solution with the higher Osmolarity is called **hyperosmotic**, and the solution with the lower Osmolarity is called **hypoosmotic.**
- **N B** : 1 m Osmol exerts OP = 19.3 mmHg, and Plasma Osmolarity = 300 m Osmol.

ACTIVITY

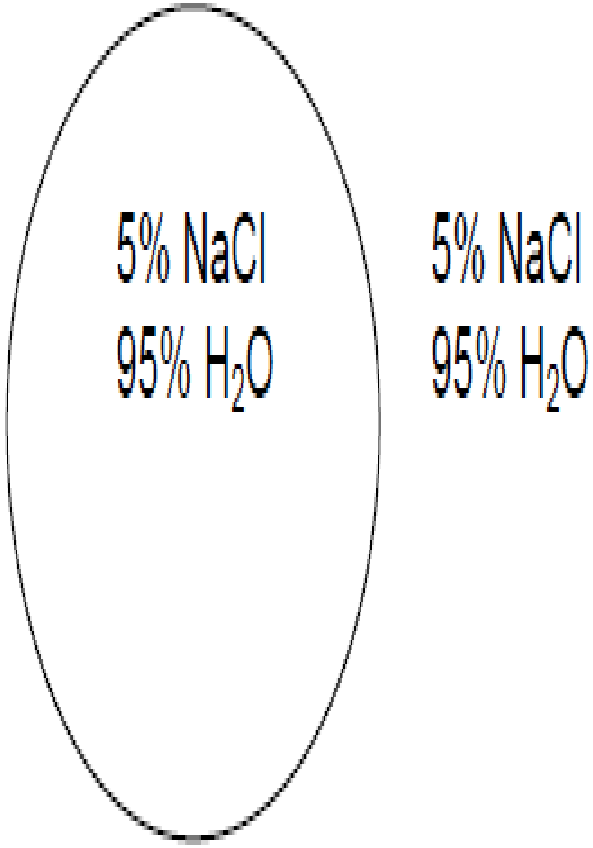
1.



a. Water will flow _____ (into the cell, out of the cell, in both directions).

b. The cell will _____ (shrink, burst, stay the same).

2.



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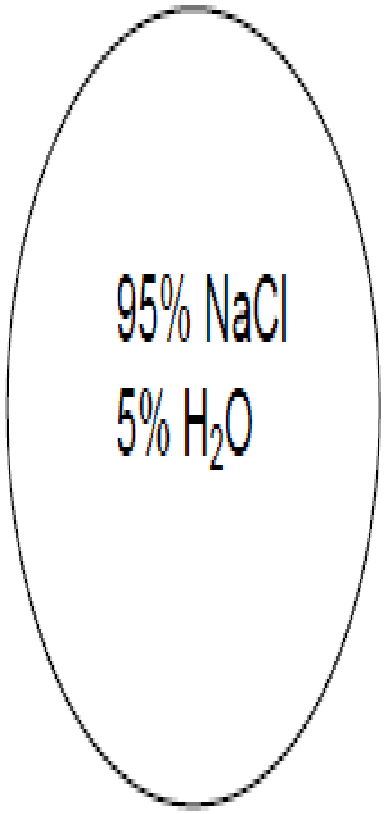

a. Water will flow _____ (into the cell, out of the cell, in both directions).

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THank you