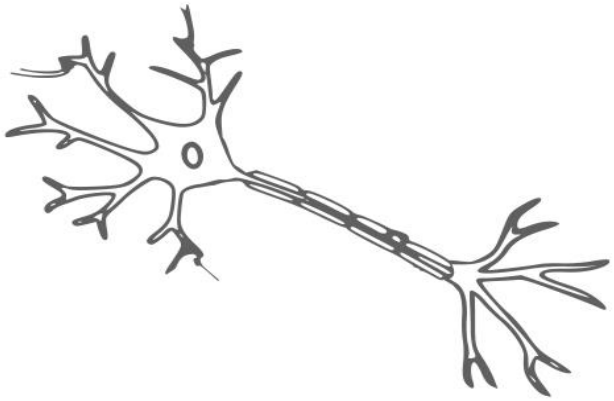
Sheet no. 3

Physiology



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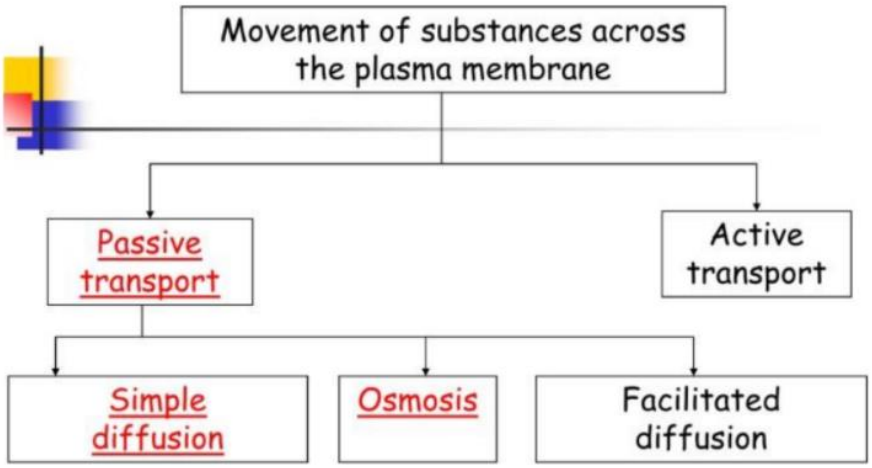
In the previous sheet, we discussed the types of proteins in plasma membrane and talked breifly about their functions , one type of plasma membrane imbeded proteins are channels proteins that are responsible for transporting ions from one side to another , we will discuss the types of transporting molecules and ions in this sheet [3].

TRANSPORT ACROSS THE CELL MEMBRANE

- The movement of substances across the plasma membrane are divided into two , the active transport and the passive transport .



Passive transport

The movment of Particles across the plasma membrane without the consumption of micro-energetic molecules (ATP) rather use kinetic energy , Types of passive transports :-

1 – simple diffusion

2- facilltated diffusion

3- Osmosis

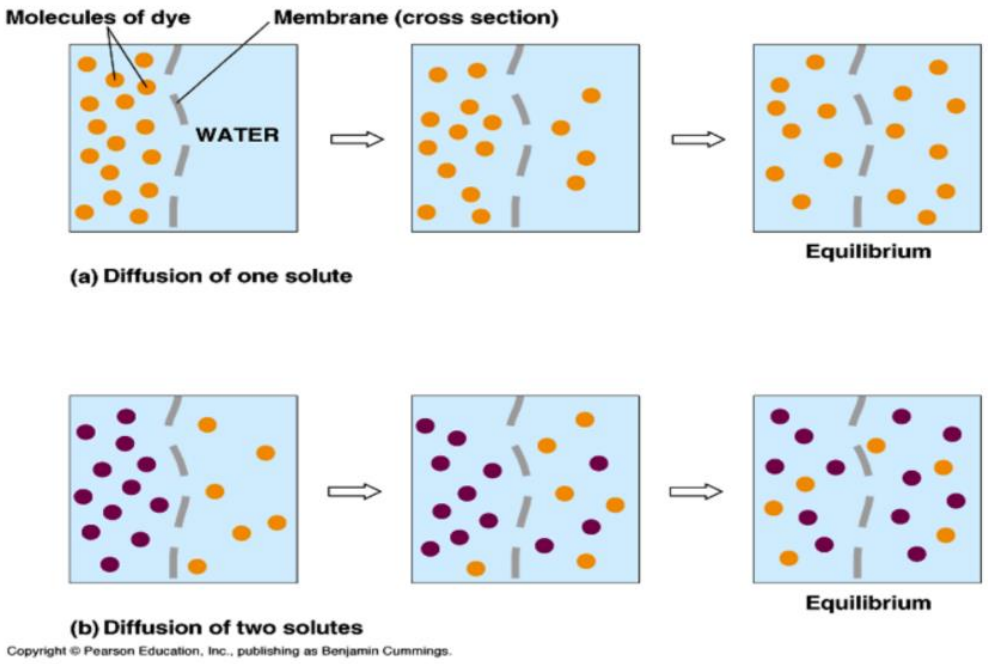
4- Filtration

A) Simple Diffusion

It is the type of passive transport in which ions can move across the phospholipid bilayer because they are soluble in lipids , and it Is the only type of transport that is not carrier midiated also occurs down the electrochemical gradient (downhill) , doesnt require ATP for transporting (ATP independent) .

Examples of ios that can be transported through simple diffusion (CO2 , O2 , NO , stereohormones , monoglycerides).

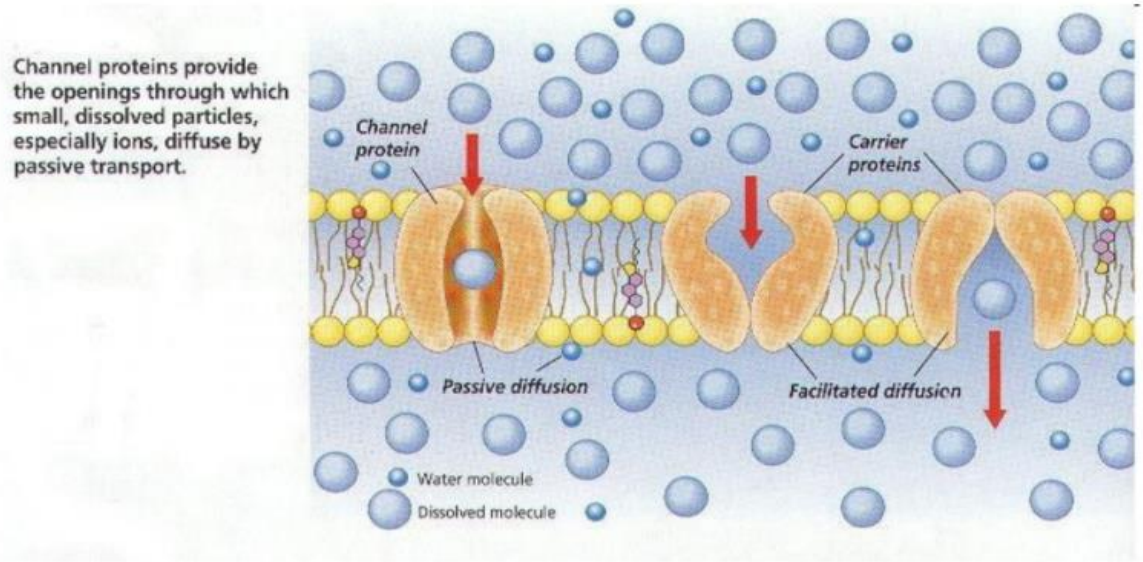
- **The particles move from an area of high concentration to lower by diffusing into the phospholipid bilayer until they reach equilbrium .**



Diffusion through channel

Is an another type of **Simple diffusion** in which particles (hydro-soluble) cross the membrane by moving throgh channel proteins without the consumption of ATP from an area of high concentration to an area of lower one until it reaches equilibrium .

Diffusion through channels



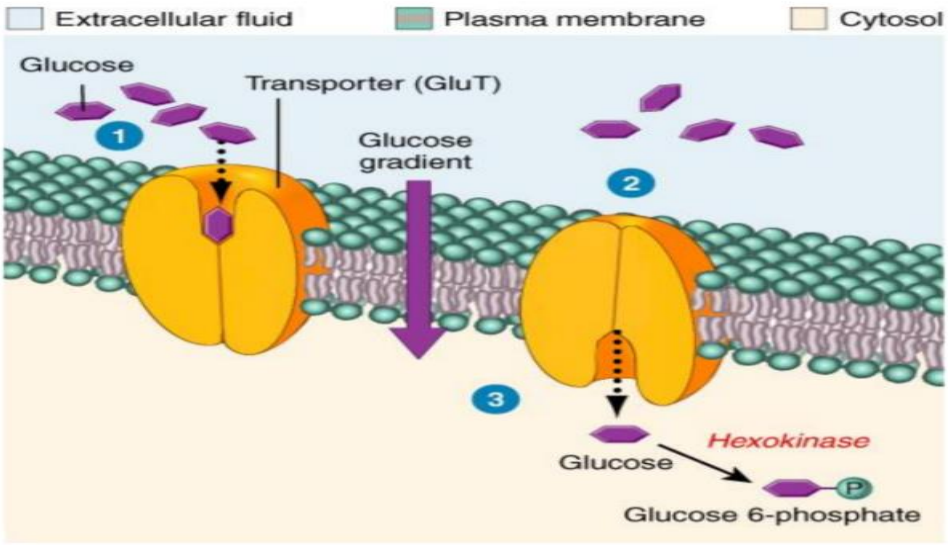
{ Note that counting channel transport as a facilltated or simple diffusion is depending on the indiviuals POV and we will not be asked in the exam whether the diffusion through channel is simple or faciltated } .

B) Facilitated Diffusion

Is a carrier-mediated way of transporting that doesn't require ATP and its down the concentration gradient (downhill).

Allows large molecule such as (amino acid , glucose [note that glucose molecule doesn't reach equilibrium because once they enter the cytosol the become phosphorylated] , Galactose, Fructose) to cross the membrane with the help of carries proteins .

Facilitated Diffusion



In simple diffusion the relation between the Diffusion rate and concentration is linear Means increasing concentration will result in Increasing the rate of diffusion.

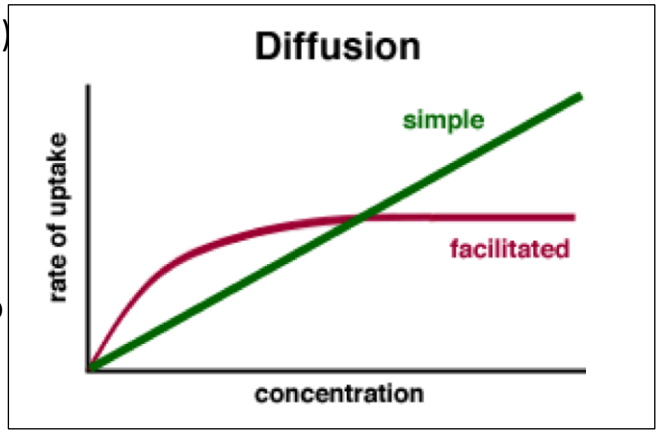
While in **facilitated diffusion** its proportional But non-linear due to a limitation called (Vmax) when The rate of diffusion reaches the (Vmax) {the Maximum velocity of transport}

It stops from increasing even if the Concentration continue to do so; that's due to The fixed number of membrane carriers.

Fick's Law

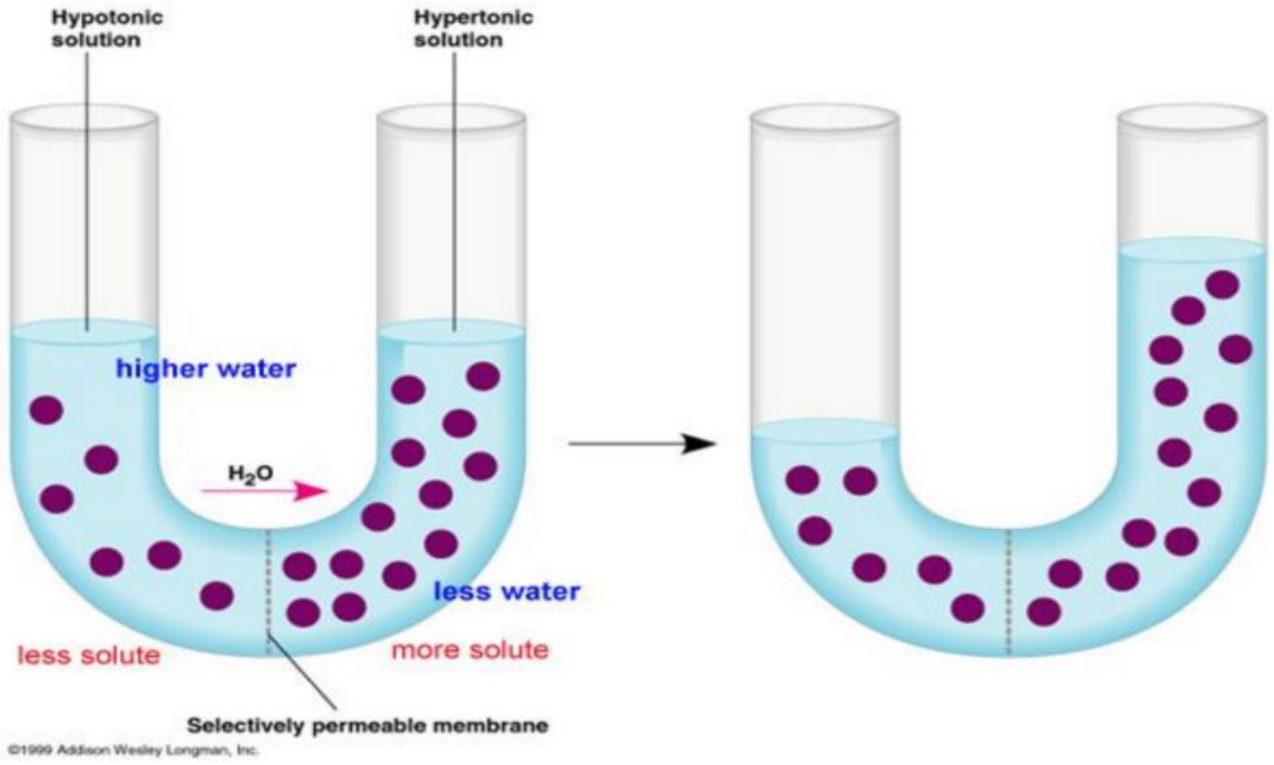
- $J = P.\Delta C$
- $P = D.A/\Delta X$
- $J = D.A.\Delta C/\Delta X$

J = Flux (Rate of diffusion)
P = Permeability
D = Diffusion Coefficient
A = Surface area
C = Concentration
X = Membrane thickness



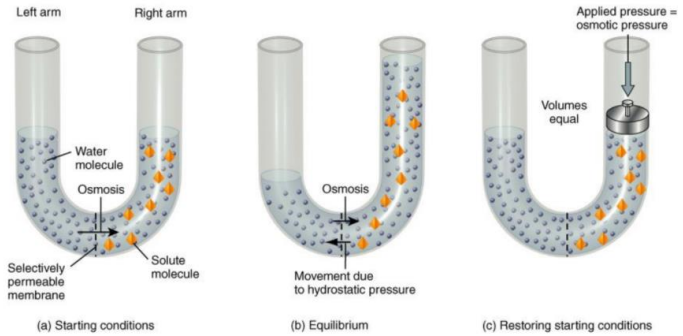
Osmosis

C) OSMOSIS



Osmosis is the spontaneous net movement or diffusion of solvent molecules through a selectively permeable membrane from a region of high water potential (low particles concentration) to a region of low water potential (high particles concentration), in the direction that tends to equalize the solute concentrations on the two sides .

The water molecules reach equilibrium when the increasing hydro-static pressure has opposed the first compartment to the second compartment another name of the Hydro-static pressure is (**osmotic pressure**).



when the a pressure is applied to a solution and the water levels becomes equal in both sides then the applied pressure = osmotic pressure

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applying more pressure than the osmotic pressure Will result in a process we call **Filtration**

[Filtration: movement of water and solutes through semipermeable membrane from region of higher hydrostatic pressure to a region of lower hydrostatic pressure.]

Osmotic pressure depends on what we call (osmolarity)

Osmolarity refers to the number of solute particle per unit liter

$$\text{Osmolarity} = g \times C$$

g = no. of particles in a solution

C = Concentration

Mol/L

the equation used to calculate the osmatic pressure is called vant's hoff's law

Van't Hoff's Law

$$\pi = RTC$$

π : osmotic Pressure
R = Gas constant
T = Absolute Temperature
C = Concentration

- **Relations regarding this requations is important to know**

Like increasing the tempreature will increase the osmotic pressure

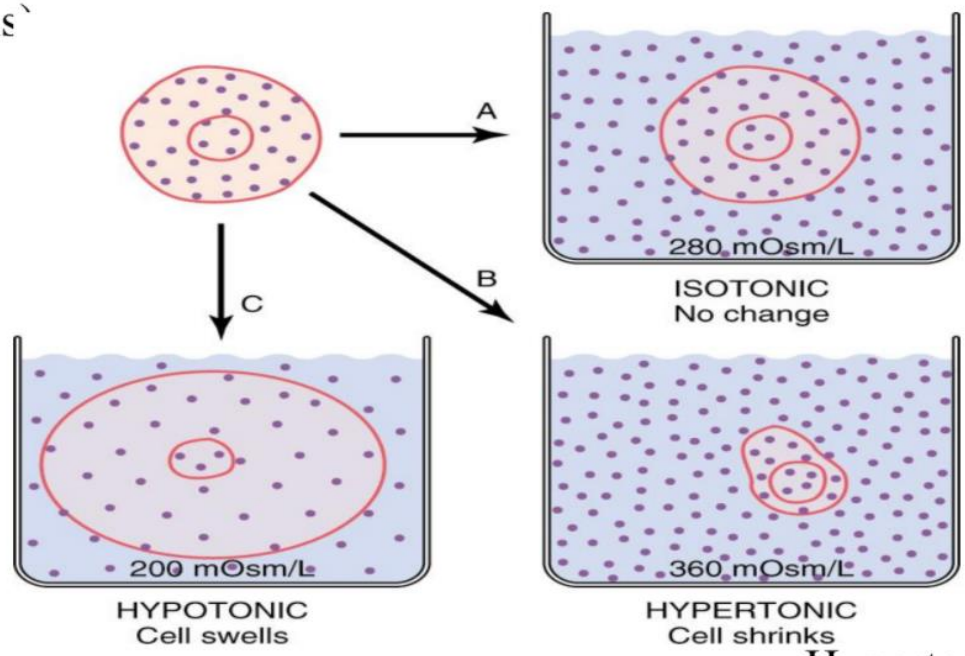
Another thing related to the osmolarity is the osmolality which is the number of solute particles per unit mass

{ Note The unit osmoles is the unit that contributes to both osmolarity [Osmol/L] , osmolality [Osmol/Kg]

-The body Cell's Osmolarity lies between 280 and 300 mOsm/L

Hypotonic (cell swells`

Isotonic (no change)



Hypertonic (cell

Figure 25-5; Guyton and Hall

Now we will Discuss The Next part of the lecture…

Active Transport

Active Transport is the movement of particles across the plasma membrane against their concentration gradient with the use of micro-energetic Molecules (ATP).

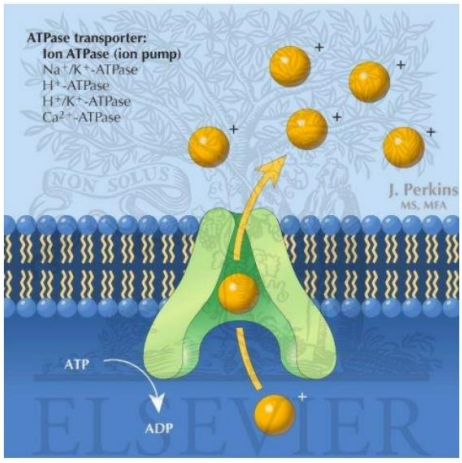
Active Transport has three Mechanisms :-

A- Primary Active Transport (ATP-ase carrier or pump)
B- Secondary active transport (Na+dependent carriers)
C- Vesicular transport ; endocytosis, phagocytosis, transcytosis, pinocytosis

Primary Active Transport

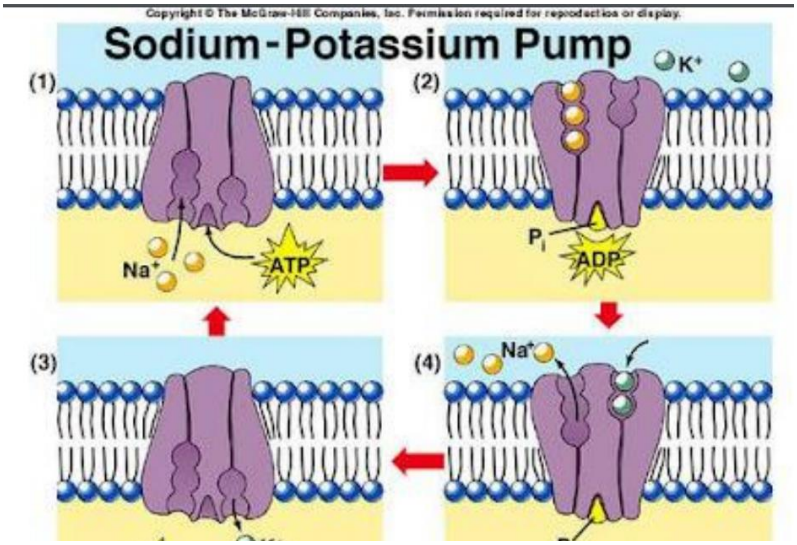
Types of Pumps

- Na+/K+ pump
- H+ pump
- H+/K+ pump
- Ca++ pump



Note : When u see the word pump that means it's a primary active transport

Sodium-potassium Pump



- 3 NA+ leaves the cell when 1 ATP Molecule phosphorylate with the Pump

- And 2 K+ enters the cell when the ATP molecule attached to the pump Dephosphorylates .

The sodium potassium pump is important for keeping the concentration of sodium and potassium levels in the range of 4-5 milliequivalents crossing that number will cause the body to die .

equivalent means the amount of substance that reacts or replaces hydrogen atoms .

PAST PAPERS QUESTIONS :-

1-Which of the following transport systems require energy?

A. Osmosis.

B. Phagocytosis.

C. Filtration through aquaporins.

D. Diffusion.

E. Facilitated diffusion.

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2- Na+ , K,+Ca+2, and Cl- permeation through their respective ion channels

represents an example of :

A. Primary active transport.

B. Secondary active transport.

C. Osmosis.

D. Pinocytosis.

E. Passive transport.

_____

3- What is the major difference between simple diffusion and facilitated diffusion?

A. Simple diffusion does not require energy but facilitated diffusion requires

energy.

B. Simple diffusion only operates across a cell membrane.

C. Simple diffusion only moves substances inside a cell.

D. Simple diffusion requires energy but facilitated diffusion does not requires

energy.

E. Facilitated transport requires a specific carrier.

4 - The rate at which diffusion takes place is determined by the following

conditions EXCEPT:

A. The size of the area of diffusion

B. The direction of the diffusion

C. The temperature

D. The concentration gradient

E. The distance for diffusion

1	**B**
2	**E**
3	**E**
4	**B**