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- Membranes define the boundaries of the cell and its various internal compartments.

Functions:

- Define the boundaries of the cell and its organelles such act as permeability barriers.
- Sites for specific biochemical functions, such as electron transport during mitochondrial respiration or protein processing in the ER.
- Allow transport and have transport proteins that regulate the movement of substances into & out of the cell and its organelles.
- They provide mechanisms for cell to cell contact adhesion, & communication.
- Transport across membrane.
- Simple diffusion: direct, unaided transport of small molecules.
- Facilitated diffusion: Movement with help of channel proteins and carrier proteins.
- Active transport: Energy driven transport.

① Important Transport processes of the Erythrocyte

[a] Simple diffusion: Oxygen, carbon dioxide, and water diffuse directly across the plasma membrane is response to their relative concentrations inside and outside the cell.

[b] facilitated diffusion mediated by carrier proteins: The movement of glucose across the plasma membrane is facilitated by a specific glucose transporter called GLUT1. An anion exchange protein facilities the reciprocal transport of chloride (Cl^-) and bicarbonate (HCO_3^-)

[c] facilitated diffusion mediated by channel proteins. Aquaporin channel proteins can facilitate the rapid inward or outward movement of water molecules.

[d] Active transport:
Driven by the hydrolysis of ATP, the Na^+/K^+ pump moves three Sodium ions outward for every two potassium ions moved inward, establishing an electrochemical potential across the plasma membrane for both ions.

Properties	Simple diffusion	Facilitated diffusion
① Solutes transported.	Small polar (H_2O, glycerol) Small nonpolar (O_2, CO_2) Large nonpolar (oils, Steroids)	Small polar (H_2O, glycerol) Large polar (glucose) Ions (Na^+, K^+, Ca^{2+})

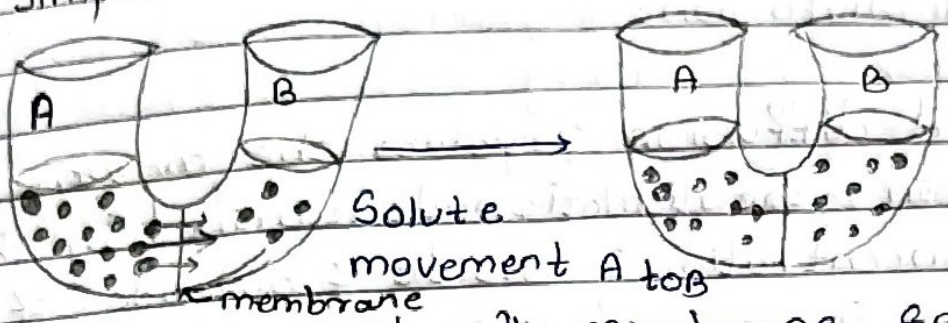
	Simple diffusion	Facilitated diffu
① Thermodynamic properties		
Direction relative to electrochemical gradient	Down	Down
Metabolic energy required	No	No
Intrinsic directionality	No	No
② Kinetic properties		
Membrane protein required	No	Yes
Saturation kinetics	No	Yes
Competitive inhibition	No	Yes

* Simple diffusion:
Simple diffusion is that the net rate of transport for a specific substance is directly proportional to the concentration difference for that substance across the membrane over a broad concentration range.

$V_{inward} = P \Delta [S]$

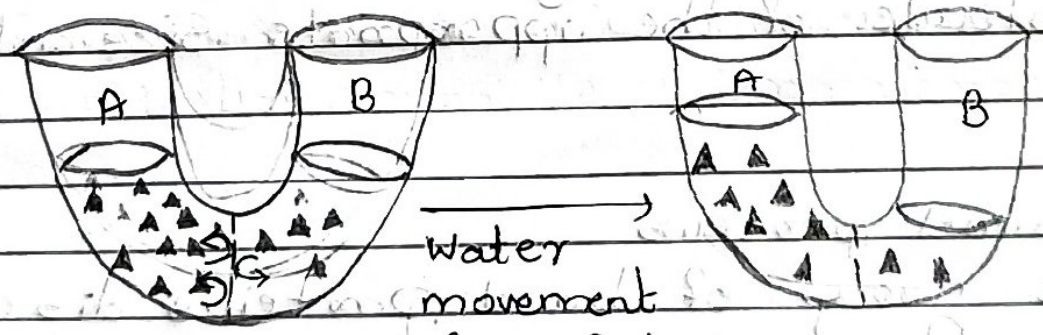
V_{inward} = inward diffusion (moles/square cm second)
ΔS = Concentration gradient of the solute.
P = Permeability coefficient.

a] Simple diffusion:



Takes place when the membrane separating chambers A & B is permeable to molecules of dissolved Solute, represented by black dots. Net movement of Solute molecules across the membrane is from chamber A to B. Equilibrium is reached when the Solute Concentration is the same in both chambers.

b] Osmosis occurs when the membrane between the two chambers is not permeable to the dissolved solute, represented by the black triangles. Bcoz solute cannot cross the membrane, water diffuses from chamber B where the solute concentration is higher. At equilibrium the solute concentration will be equal on both sides of the membrane.



③ Facilitated diffusion:

Facilitated diffusion involves the movement of molecules in the direction determined by their relative concentrations inside & outside of the cell. No external source of energy is provided, So molecules travel across the membrane in the direction determined by their concentration gradients and in the case of charged molecules.

Two classes of protein that mediate facilitated diffusion have generally been distinguished:

① Carrier protein bind specific molecules to be transported on one side of the membrane. They then undergo conformational changes that allow the molecules to pass through the membrane and be released on the other side.

② channel protein form open pores through the membrane, allowing the free diffusion of any molecule of the appropriate size and charge.

* Channel proteins

One group of chanel proteins discussed earlier is the porins, which permit the free passage of ions and small polar molecules Through the outer membranes of bacteria, mitochondria and chloroplasts. Gap junctions contain channel proteins that permit the passage of molecules b/n connected cells

① Three characteristics of ion channels protein are central to their functions.

[1] Transport through channels is extremely rapid.

[2] Ion channels are highly selective because narrow pores in the channel restrict passage to ions of the appropriate size and charge.

[3] Most ion channels are not permanently open. Instead, the opening of ion channels is regulated by "gates" the transiently open in response to specific stimuli. Some channels (ligand gated) open in response to the binding of neurotransmitters or other signaling molecules; others (voltage gated) open in response to changes in electric potential across the plasma membrane.

★ Active transport driven by ATP hydrolysis.

In active transport, energy provided by another coupled reaction is used to drive the uphill transport ~~energy provided by another~~ of molecules in the energetically unfavorable direction.

The ion pumps responsible for maintaining gradients of ions across the plasma membrane provide important examples of active transport driven directly by ATP hydrolysis.

This ion gradients are maintained by the Na-K pump, which uses energy derived from ATP hydrolysis to transport Na^+ & K^+ against their electrochemical gradients.

This process is a result of ATP-driven conformational changes in the pump.

a) Direct active transport.

Involves a transport system coupled to an exergonic chemical rxn, most commonly the hydrolysis of ATP. ATP hydrolysis drives the outward transport of protons, thereby establishing an electro-chemical potential for protons across the membrane.

b) Indirect active transport:

Involves the coupled transport of a solute S and ions - protons, in this case. The exergonic inward movement of protons provides the energy to move the transported solute S, against its concentration gradient or electrochemical potential.