

FUNCTIONS OF THE PLASMA MEMBRANE

"Cell Transport"

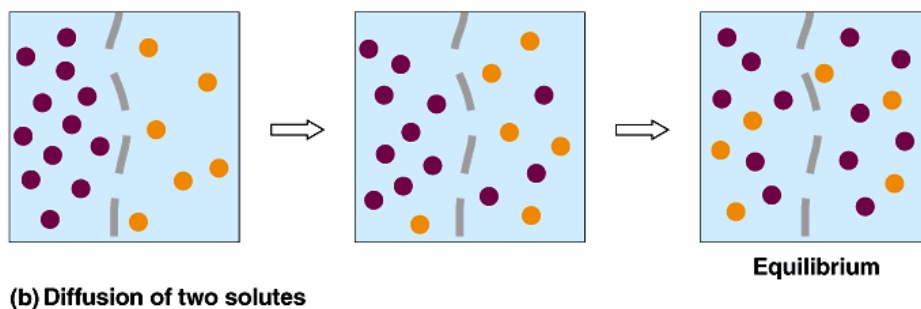
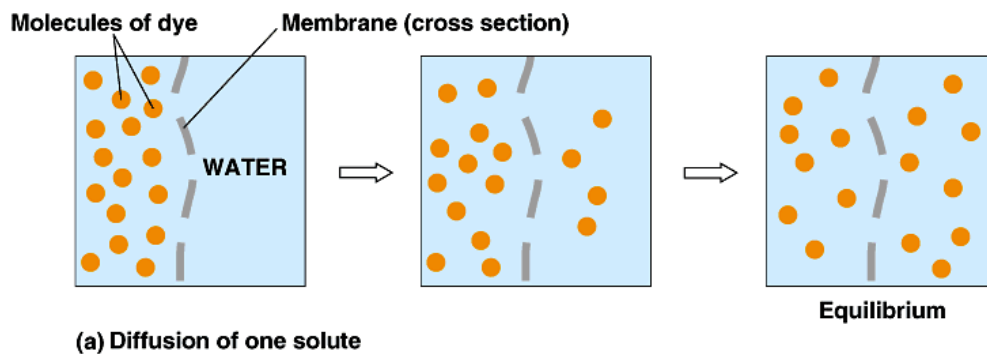
The cell's plasma membrane does not simply form a "sack" in which to keep all the cytoplasm and other cellular organelles. The plasma membrane is a very important structure which functions to allow certain substances to enter or leave the cell. It can "pump" other substance into the cell against the concentration gradient or pump other "wastes" etc. out of the cell.

Some of the transport process happens "**passively**" without the cell needing to expend any energy to make them happen. These processes are called "**passive transport processes**".

Other transport processes require energy from the cell's reserves to "power" them. These processes are called "**active transport processes**".

Passive Transport Processes

a) **Diffusion**: definition - is the movement of ions or molecules from regions of **higher** concentration **to** regions of **lower** concentration. (**Down** a concentration gradient)



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Diffusion and The Plasma Membrane

The plasma membrane will allow certain substances to cross it but not others! Such a membrane is referred to as "**selective permeable**" (or "**semipermeable**"). The plasma membrane's permeability depends on a large part on its makeup.

Both the protein portion and the phospholipid portion of the membrane are involved in the permeability.

Molecules that pass through the phospholipid bilayer easily...

Hydrophobic molecules (oil soluble)	O ₂ , N ₂
Nonpolar	benzene
Small uncharged Polar molecules	H ₂ O, Urea, glycerol, CO ₂

Molecules that don't pass through the phospholipid bilayer easily...

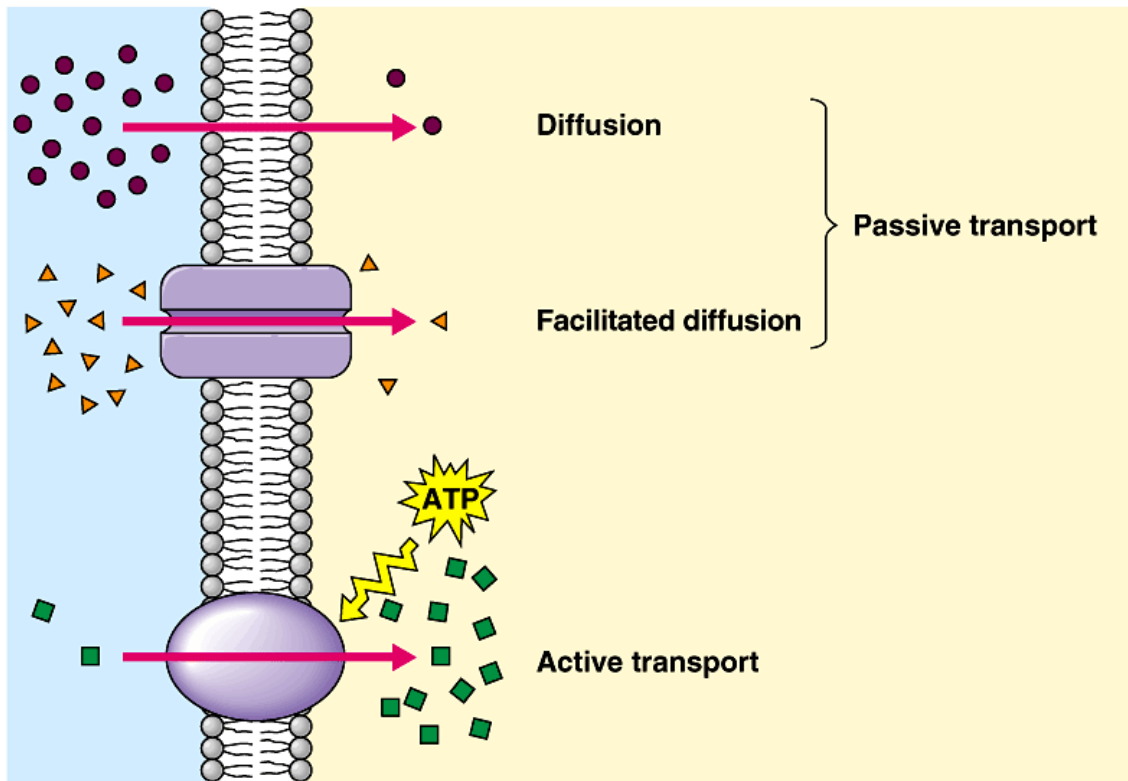
Large uncharged	Glucose
Polar molecules	Sucrose
Ions (charged)	H ⁺ , Na ⁺ , HCO ₃ ⁻ , K ⁺ , Ca ²⁺ , Cl ⁻ , Mg ²⁺

Therefore the three characteristics of a molecule that determine the permeability of the membrane to that species are . . .

- 1) polarity - (Hydrophobic vs Hydrophylic)
- 2) charge - (charged vs uncharged)
- 3) size - (large vs small)

However: some molecules which we would think (from the above) should (or should not) cross the plasma membrane do - (or don't) **because** of the presence of the **membrane proteins**.

We shall see that these proteins in the membrane are involved in both **passive** and **active transport**.



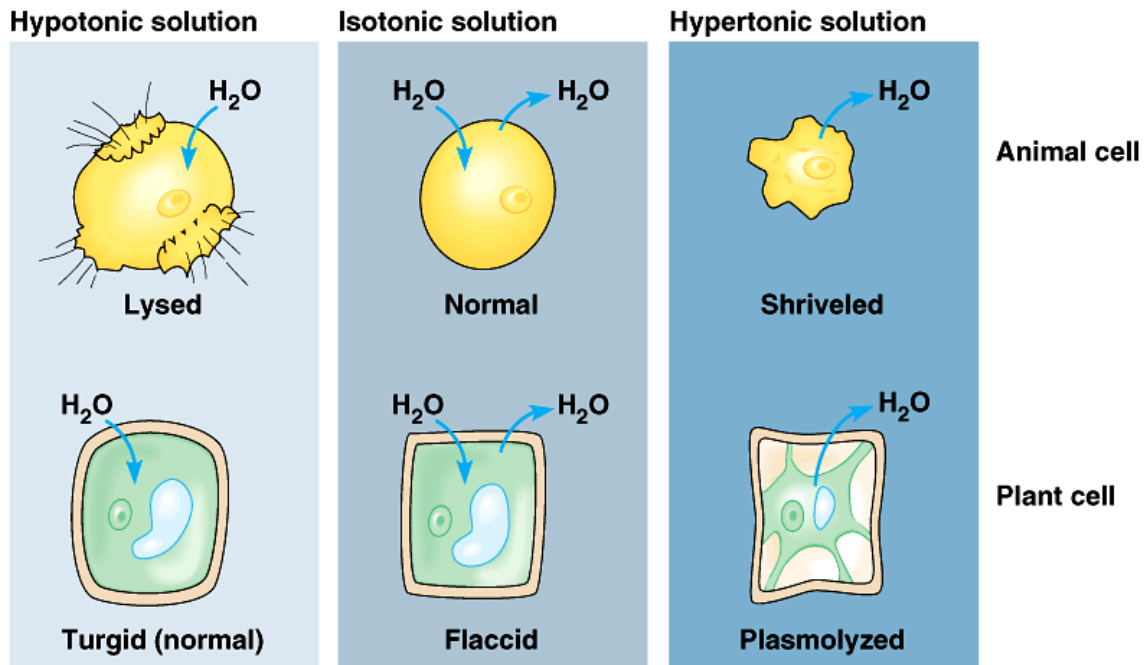
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Osmosis: A special case - the diffusion of water through a cell membrane.

Definition: Osmosis is the movement of water from a region of high water concentration to a region of lower water concentration through a semi permeable membrane.

Animal Cells

Imagine we take a Red Blood Cell (RBC) which has an internal solute concentration of approximately 0.9% salt (equivalent) and place it in various solutions of varying salt and concentrations.



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One can now describe the above cases using comparative terms:

"**Isotonic**"

"**Hypertonic**"

"**Hypotonic**"

Definition: the solution that loses the water is "**Hypotonic**" that solution that gains the water is "**Hypertonic**".

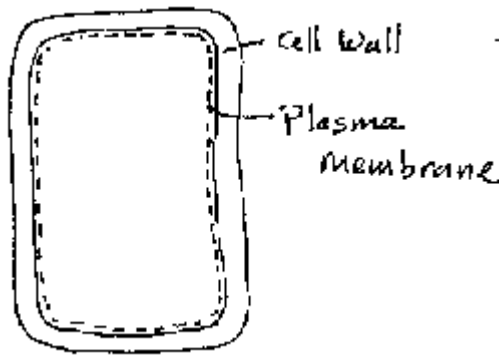
NB: One solution is **always** compared to the other solution.

i.e. the inside of the cell is "**Hypotonic**" to the outside if the cell (is cell shrinks). **Or:** the outside of the cell is "**Hypertonic**" to the inside (i.e. cell shrinks). etc.

Isotonic: Special equilibrium case where there is no net movement of water.

Plant Cell: "Turgor Pressure"

Plant cells have one extra structure surrounding it, that animal cells lack the '**cell wall**'.

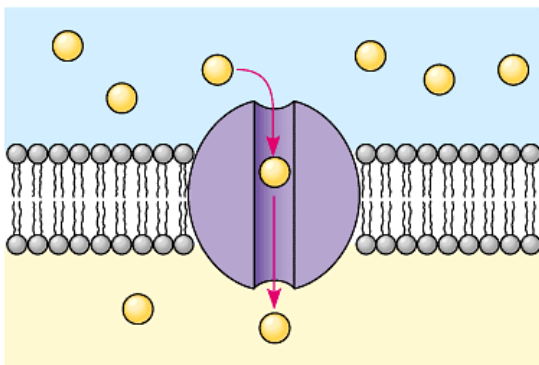


If plant cells are exposed to the same conditions as the RBC's the osmotic reactions are the same but the cell wall prevents swelling and rupture.

Facilitated Diffusion

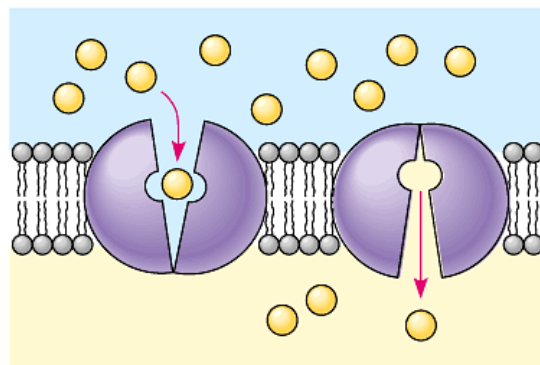
This is similar to simple diffusion in the sense that it is diffusion (across a membrane) from a high concentration to a lower concentration. **However**, this time the rate of diffusion is greatly accelerated by the action of membrane proteins that act as carrier molecules and aid in diffusion.

These "carrier proteins" are known as "**Permeases**".



(a)

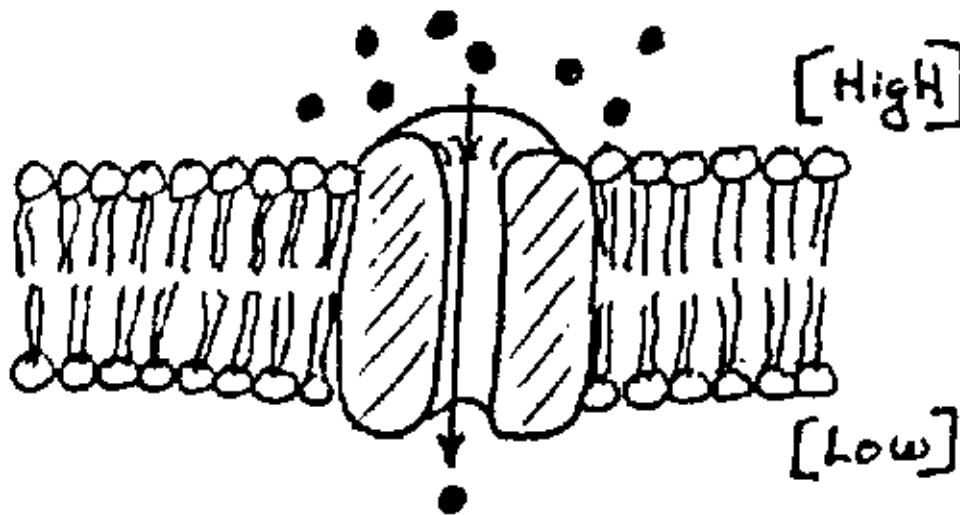
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(b)

Protein Channels

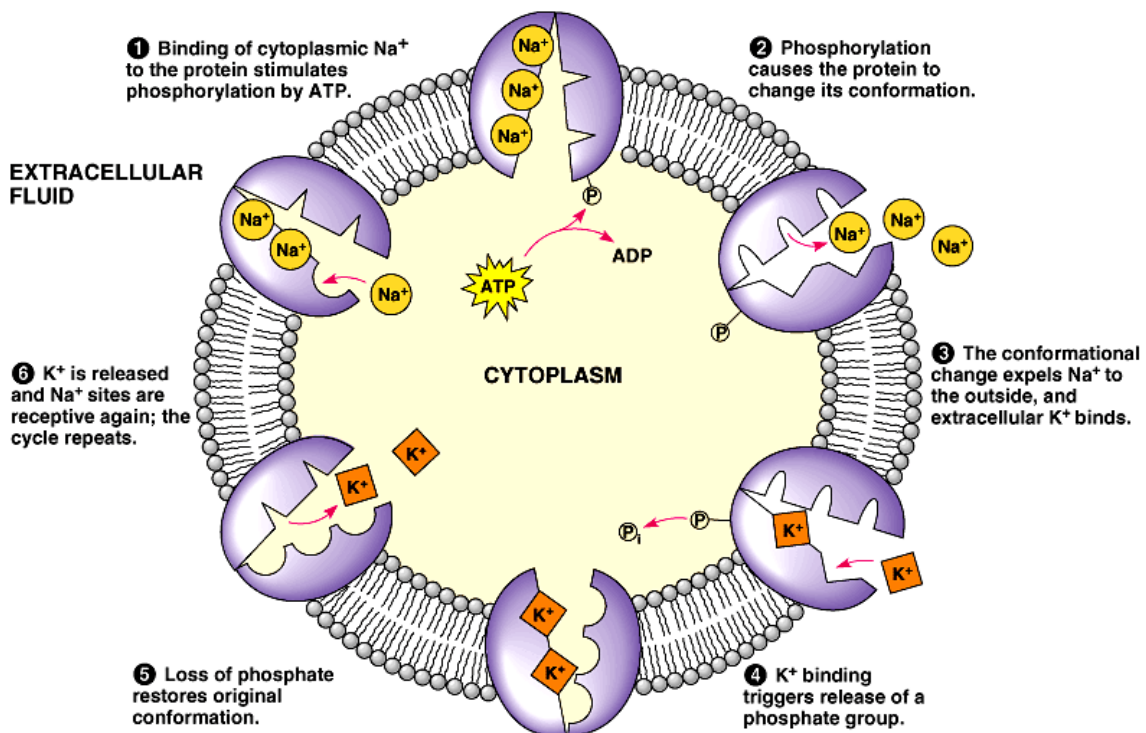
Simple diffusion can also be accomplished by the passage of solutes through "tunnel-like" transmembrane proteins called channel proteins.



Active Transport

These are cell membrane processes that require energy. These processes are also (as far as we can tell) mediated by **membrane carrier molecule**. (Proteins)

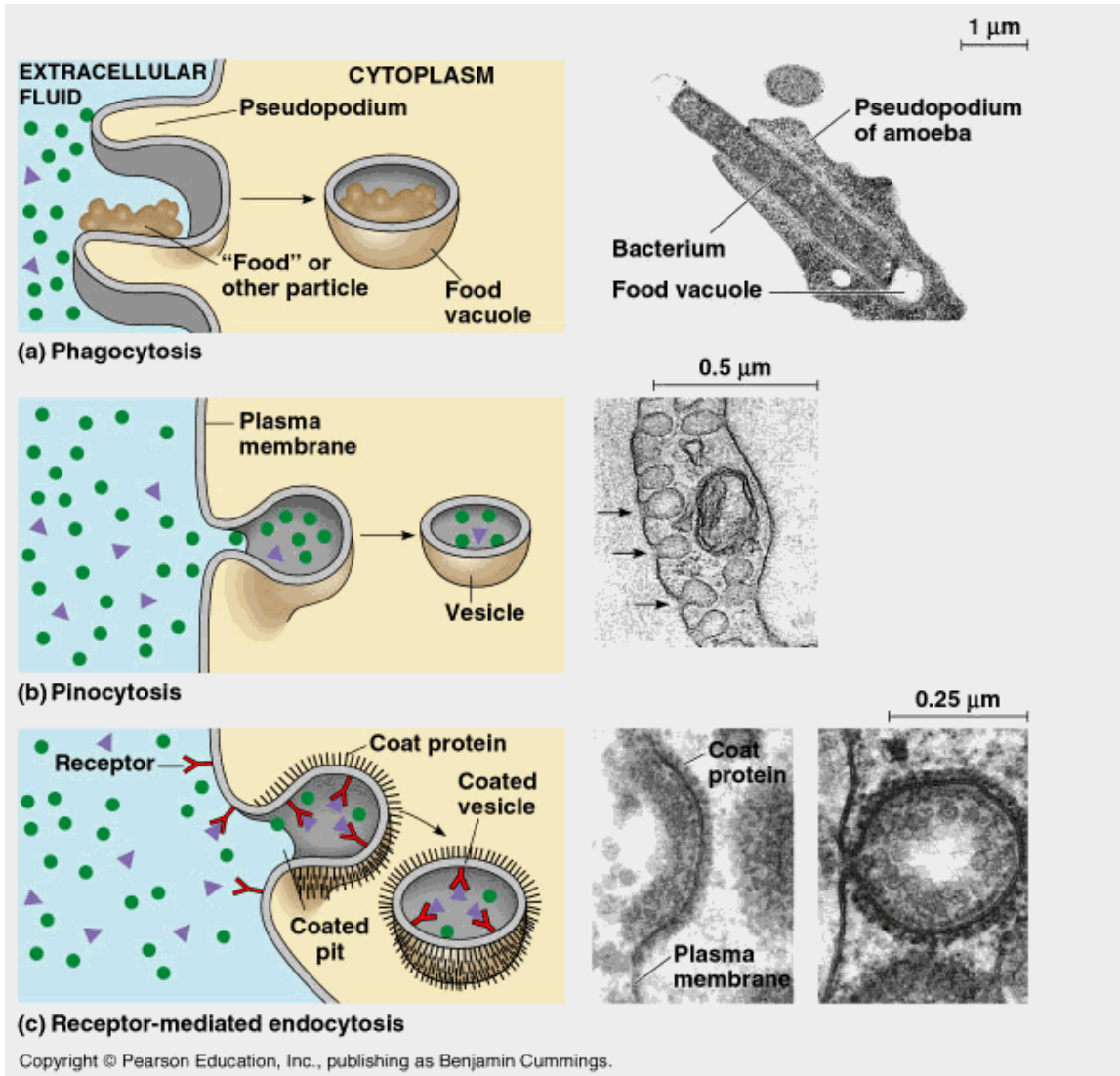
"**Active Transport**" "pumps" materials across the membrane **against** the concentration gradient. I.e. **from low concentration to high concentration** therefore requires energy.



Other Energy Requiring Process

A. **Endocytosis:** Large materials transported into the cell.

Endocytosis includes three slightly different processes.



B. **Exocytosis:** Material (wastes etc.) are expelled from the cell (recall golgi vesicles).

