Fluid-Mosaic Model of Plasma Membrane

1. plasma membrane has 2 layers (bilayers) of phospholipids (fats w/ phosphorous attached), which @ body temp. are like vegetable oil (fluid). The structure of the plasma membrane supports old saying, "Oil/water do not mix."

2. (Ea) phospholipid molecule
   - pts. toward outside ← - head is attracted to H_2O (hydrophillic)
   - form inside of bilayer ← - tail repels H_2O (hydrophobic)

3. Because cells reside in watery solution (extracellular fluid) and contain a watery solution inside of them (cytoplasm), the plasma membrane forms a circle around (ea) cell so that the water-loving heads are in contact w/ the fluid, and water-fearing tails are protected on the inside.

4. Proteins and substances such as cholesterol become embedded in the bilayer, giving the membrane the look of a <u>mosaic</u>. Because the plasma membrane has the consistency of vegetable oil @ body temp., the proteins and other substances are able to move across. That's why plasma membrane is described using the <u>fluid</u>-mosaic model.

Materials can enter cells in 4 different ways:

1. Active transport: this method requires that energy (in the form of ATP) be used to move nutrients across the plasma membrane

Sometimes molecules are too big to easily flow across plasma membranes or dissolve in water so they can be filtered through the membrane. In these cases, the cells must put out a little energy to help get molecules in or out of the cell.

Remember that embedded in plasma membranes are protein molecules – some form channels through which other molecules can pass

Some proteins act as carriers – they are "paid" in energy (ATP) to let a molecule attach to itself and then transport that molecule inside the cell.
(It is like having to pay to take Staton Island Ferry. Ferry = carrier protein, your the "big molecule" that needs help getting from bloodstream (NY Bay) to inside cell (NYC). Fee you pay is equivalent to ATP molecules expended by cell.

easier than moving molecules from a low concentration to higher concentration ←

2. Diffusion: this method relies on simple movement of molecules from where the concentration of nutrients is high (such as in the environment of bacteria in a compost heap) to an area of lower concentration of nutrients (such as into the bacteria)

means "cells eating" phago = eating cyto = cells ←

3. Phagocytosis: this method involves an organism (or a cell) engulfing solid nutrients. The cell surrounds the material that it is going to "eat", pulling the nutrients inside it and forming a food vesicle. The food vesicle connects w/a specilized cellular organelle called lysosome. The lysosome contains enzymes that can digest the solid material in the food vesicle. The nutrients are released from the solid material and then absorbed through the membrane of the food vesicle and into the rest of the cell.

"cells drinking" pino = drink cyto = cells ←

4. Pinocytosis: this method is like phagocytosis, except instead of solid material being engulfed liquid droplets are taken inside the cell, forming a pinocytotic vesicle (instead of food vesicle)

Movement Through Plasma Membrane

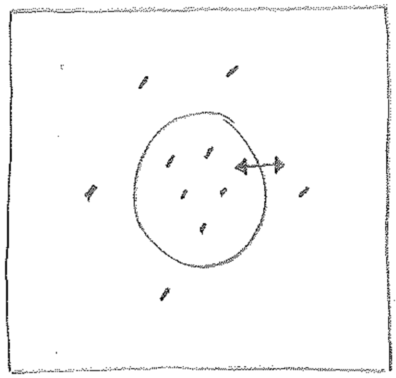
A membrane can allow molecules to be passively transported through it in 3 ways:

1. diffusion
2. osmosis
3. filtration

1. Diffusion: sometimes organisms need to move molecules (i.e. particles) from an area where they are highly concentrated to an area where the molecules are less concentrated. To go from a high concentration to a low concentration, in essence the molecules need to only "spread" themselves or diffuse, across the membrane separating the areas of concentration

2. Osmosis: describes movement of H_2O across a membrane (i.e. water molecules diffusing across a membrane). Basically, the diffusion of H_2O works as described in # 1. However, w/osmosis the concentration of substances in H_2O is taken into consideration.

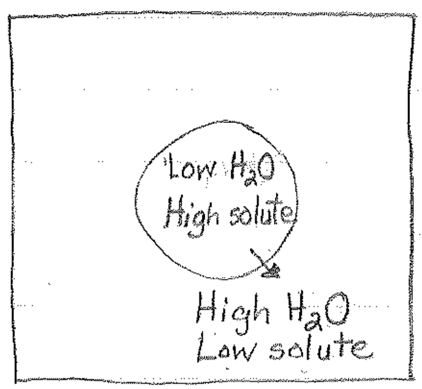
a. if a solution is isotonic: concentrations of substances (solute) and water (solvent) on both sides of membrane is =.



solvent = solute

balanced concentrations

b. if a solution is hypotonic: there is a greater concentration of solvent (H_2O) than substances (solute)

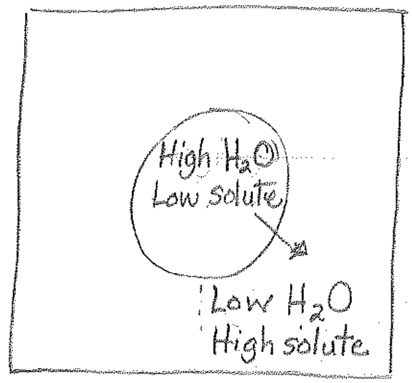


High H_2O (solvent)
Low solute

H_2O enters cell

- In animal cell, if the cell swells, it can rupture. This is called lysis.
- In plant cell, H_2O taken in by osmosis, building internal fluid pressure inside the central vacuole, called turgor pressure. This helps hold plant up.

c. if a solution is <u>hypertonic</u> : there is less concentration of H_2O (solvent) and greater concentration of substances (solute)



Low H_2O (solvent)
High solute

cell loses H_2O

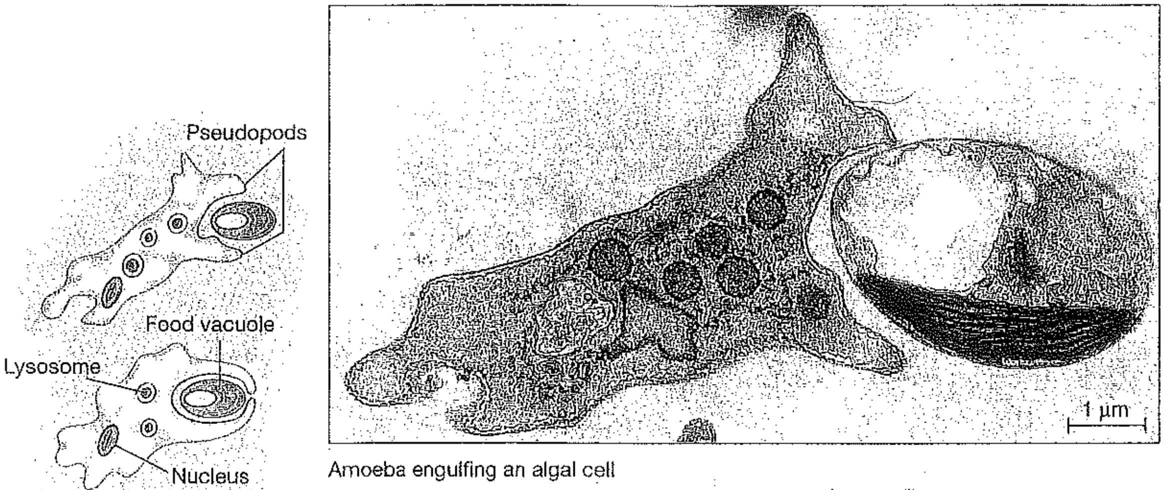
CAN pass through biological membranes by simple diffusion;

1. small lipids
2. gases like O, CO_2
3. small uncharged polar molecules
4. small nonpolar molecules

HOWEVER,

1. glucose does not cross lipid bilayer, too large to move via simple diffusion
2. lipid bilayer is relatively impermeable to <u>ions</u> and many polar molecules (this prevents H_2O from escaping)

because they become hydrated (surrounded by layer of H_2O) making them larger



Amoeba engulfing an algal cell

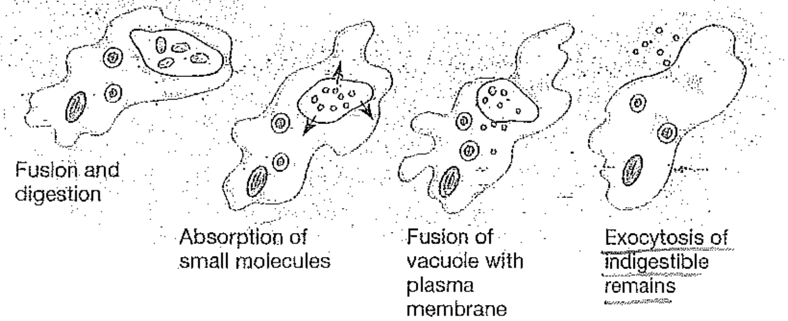


FIGURE 4–15 Phagocytosis, a form of endocytosis. (photo) An *Amoeba* extends pseudopods around a unicellular photosynthetic alga. The drawings show how the amoeba engulfs its prey and how part of the plasma membrane pinches off, forming a food vacuole inside the cell. The vacuole fuses with a lysosome, a sac of enzymes that digest the prey. The resulting small food molecules are absorbed into the cytoplasm before the indigestible remains are expelled by exocytosis. (photo, Biophoto Associates)

Endocytosis: process where cell takes in material from their surroundings

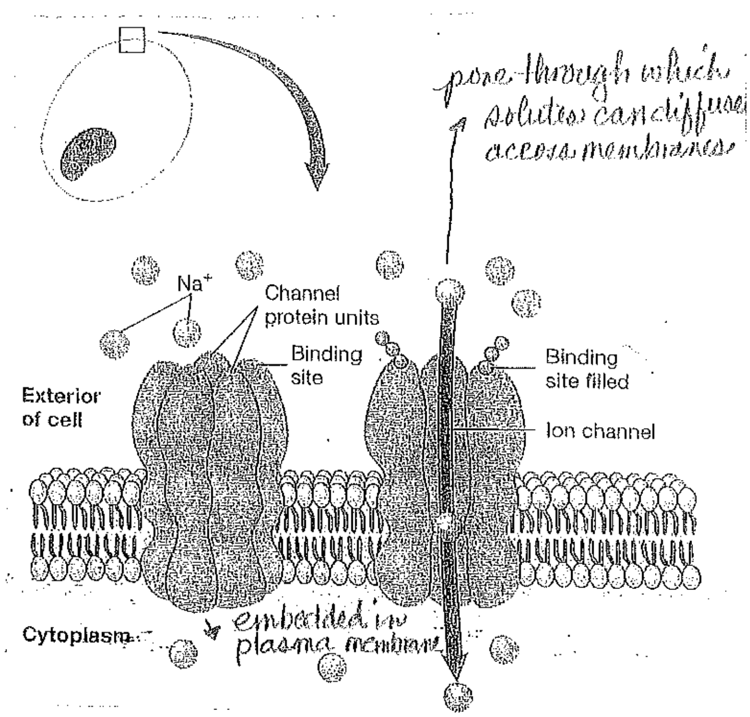
(cell eating)
Phagocytosis: process by which a cell will engulf large particles (i.e. bacteria)

1. major feeding method of unicellular organisms and simple multicellular animals
2. plays a part in defense against disease

Exocytosis: internal vesicle (or vacuole) fuses with plasma membrane which then opens allowing vesicle's contents to escape (be discharged) from cell

Channel Proteins

(transport polar molecules/ions) provides a pore through which solutes can diffuse across membranes.



low to high: is active transport

only going against gradient

certain size & electrical charge

↑

Protein molecules:

1. some form channels through which molecules can pass, they are recognized by a receptor (a protein molecule) w/in cell membrane or they attach
2. to a carrier molecule - they are paid in "energy" to let a molecule attach to itself and then transport the molecule inside the cell

** transport proteins structural configuration is alpha-helical

** cystic fibrosis - genetic disorder characterized by defective chloride channel proteins

Facilitated Diffusion (by a protein - channel/carrier) - provides a way in which a particular solute can move through the membrane down its diffusion gradient (hi to low concentrations)

AGAIN,

1. can utilize carrier proteins for transport
2. can utilize channel proteins for transport
3. usually move substances down their concentration gradient

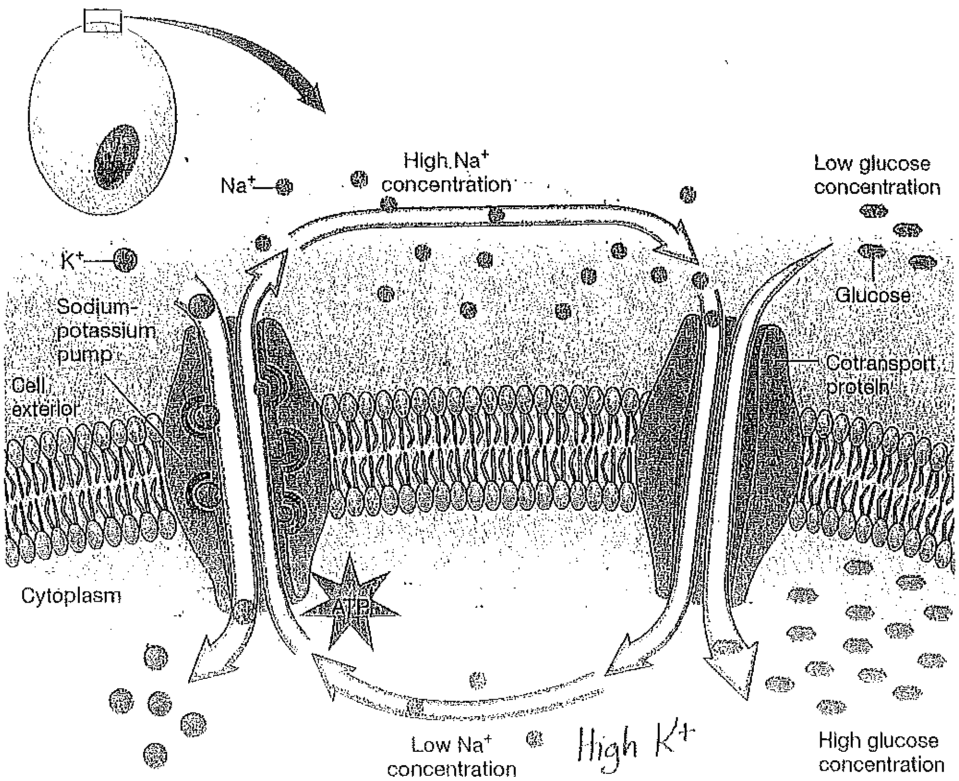


FIGURE 4–14 Active transport of glucose indirectly powered by the sodium-potassium pump. Using energy from ATP, the pump maintains a high concentration of sodium outside the cell by active transport. In some types of cells, the flow of sodium ions down this steep gradient into the cell then supplies the energy for the active cotransport of glucose into the cell, against the glucose gradient.