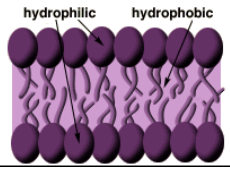
Chapter 7: Membrane Structure and Function

- We are going to cover the structure and function of the plasma membrane, including how molecules get in and out of cells.
- We are also going to cover surface modifications.

Membrane Models: Early Observations

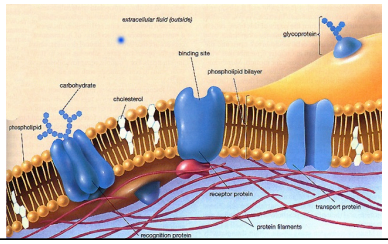
- Lipid-soluble molecules entered cells more rapidly than water-soluble molecules.
- Chemical analysis revealed the membrane contained phospholipids.
  - Nonpolar tails directed inward, polar heads outw



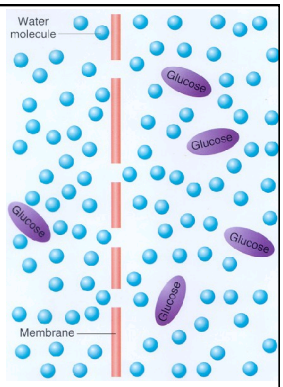
Membrane Model

- 1972, Singer and Nicolson introduced the fluid-mosaic model of membrane structure.
- 1. Plasma membrane is phospholipid bilayer in which protein molecules are partially or wholly embedded.
- 2. Embedded proteins are scattered throughout membrane in irregular pattern, depending on the membrane.

- Membrane structure has 2 components:
  - 1. Lipids
  - 2. Proteins
  - phospholipids spontaneously arrange in bilayer due to amphipathic nature.



- Plasma membrane is differentially permeable; only certain molecules can pass.
- Permeable membrane allows all molecules to pass through.
- Impermeable membrane allows none to pass
- Semipermeable membrane allows some molecules to pass through.



Types of Membranes and Transport

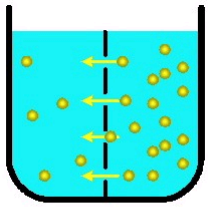
- Small non-charged lipid molecules (alcohol, oxygen) pass freely through membrane.
- Small polar molecules (CO_2, H_2O) pass through on concentration gradient.
- Macromolecules cannot cross a membrane.
- Ions and charged molecules have difficulty crossing part of bilayer.

Chapter 7: Types of Membranes and Transport

- Passive Transport moves molecules across membrane without use of energy by cell.
  - Includes diffusion and facilitated transport.
- Active Transport uses energy (ATP) to move molecules across membrane.
  - Includes exocytosis, endocytosis, and pinocytosis.

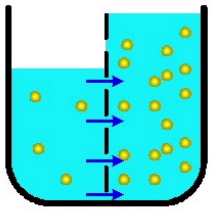
Diffusion and Osmosis

- Diffusion = molecules move from high conc. to low conc. (i.e. down concentration gradient) (show class diffusion model)
  - A solution contains a solute, usually a solid, and a solvent, usually a liquid.
- Lipid-soluble molecules (alcohol) and gases readily diffuse.



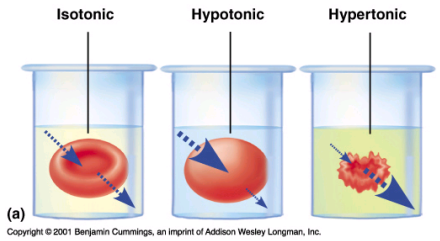
Diffusion
(Solvent moves by concentration gradient)

- Osmosis is the diffusion of water (aquaporins) across a differentially permeable membrane.
- Osmotic pressure is hydrostatic pressure, or pressure that develops in the cell due to osmosis.
- Osmosis is constant process in life.
  - Ex: water absorbed in large intestine, retained by kidneys, and taken up by blood.



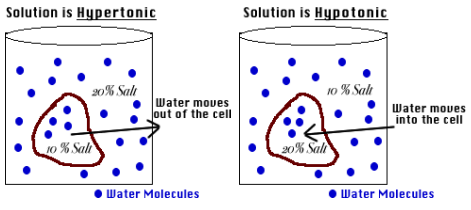
Osmosis
(Water moves by concentration gradient)

- Tonicity is strength of a solution in relationship to osmosis, determining movement of water into or out of cell.
- Isotonic - solute conc. of 2 solutions are equal.

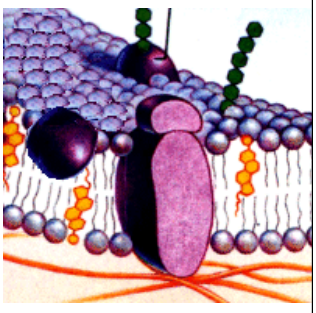


Hypertonic - solute conc. of 1 solution is greater than another solution.

Hypotonic - solute conc. of 1 solution is less than another solution.



- Cholesterol
- Glycolipids
- Glycoproteins
  - Glycolipids and proteins occur only on outside and cytoskeletal filaments attach to proteins on the inside surface.
- Plasma membrane is asymmetrical – Integral vs. Peripheral proteins



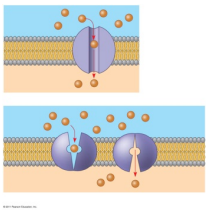
Fluidity of the Plasma Membrane

- At body temperature, the phospholipid bilayer has consistency of olive oil.
- Greater concentration of unsaturated fatty acid residues, the more fluid the bilayer.
- Evolutionary adaptations and lipid composition.
- Fluidity allows cells to be pliable.
- Some proteins are held in place by cytoskeletal filaments; most drift.

Membrane Proteins & their functions

- The membrane proteins determine most of the membranes function

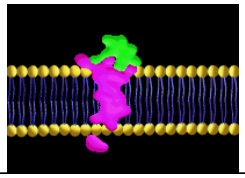
1. Transport
   - Channel Proteins: allow certain molecules to pass through.
   - Carrier Proteins: Interact with molecules so they can pass
     - Facilitated Diffusion



Membrane Proteins

2. Enzymatic proteins catalyze specific metabolic reactions.

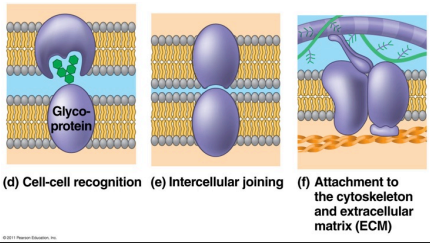
3. Signal transduction- Receptor proteins –are shaped so a specific molecule (like a hormone) can bind to it. External messenger (ligand) binds and causes shape changes relaying messages to inside of cell



4. Cell-Cell Recognition

- Membrane carbohydrate chains of glycolipids and glycoproteins identify cell.
  - Chains may vary by # of sugars.
  - Chains vary in branching.
  - Sequence of sugars in chains vary.
- In development, different type cells develop their own carbohydrate chains, allowing tissues and cells to sort themselves out in the embryo.
- Blood type

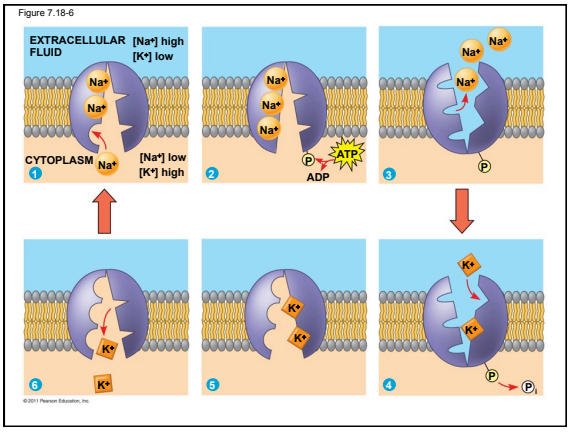
5. Intracellular joining – some proteins hook cells together (gap junctions)
6. Attachment to cytoskeleton



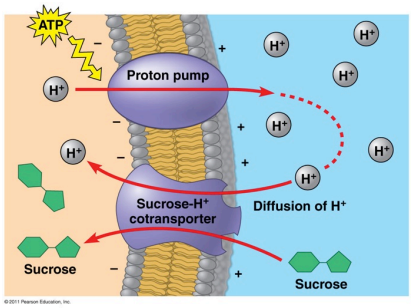
Active Transport

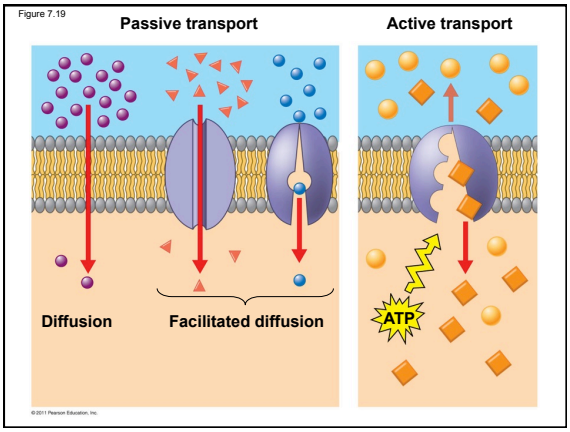
- Active transport is transport of specific solutes against conc. gradients through use of cellular energy (ATP).
- Active transport requires ATP, cells must have a high # of mitochondria near membrane.
- Proteins involved in active transport are a type of carrier protein called "pumps."
  - Ex: Sodium – potassium pump

Cotransport – Driven by one gradient



Cotransport





Transport Summary

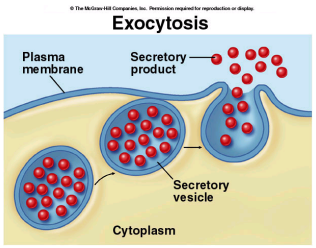
	Where does it occur in the membrane?	Does it require transport protein?	Does it require input of energy?
Simple Diffusion			
Facilitated Diffusion			
Active Transport			

Transport Summary

	Where does it occur in the membrane?	Does it require transport protein?	Does it require input of energy?
Simple Diffusion	Across the phospholipid bilayer	No	No
Facilitated Diffusion	Through membrane proteins	Yes	No
Active Transport	Through membrane proteins	Yes	Yes

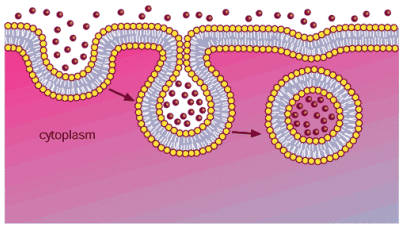
Membrane-Assisted Transport

- In exocytosis, a vesicle often formed by golgi apparatus fuses with the plasma membrane as secretion occurs.
  - Ex: method insulin leaves

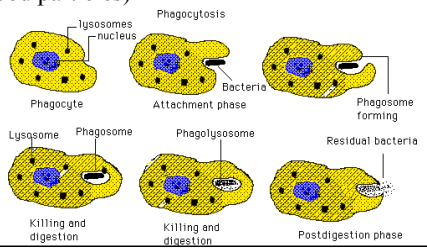


Membrane-Assisted Transport

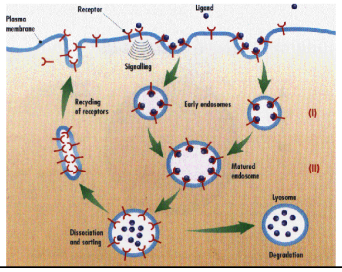
- During endocytosis, cells take in substances by vesicle formation as membrane pinches off.



- Pinocytosis occurs when vesicles form around a liquid or very small particles.
  - Ex: Blood cells and plant root cells
- Phagocytosis is used when material is too large to be taken in endocytosis (like food particles)



- Receptor-mediated endocytosis occurs when specific macromolecules bind to membrane receptors.
  - Macromolecule that binds to receptor is called a ligand.



That's right..Chapter 7 is over...