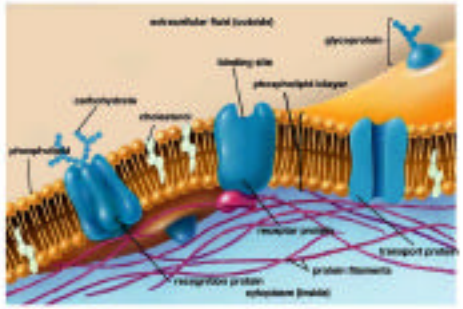
Chapter 5

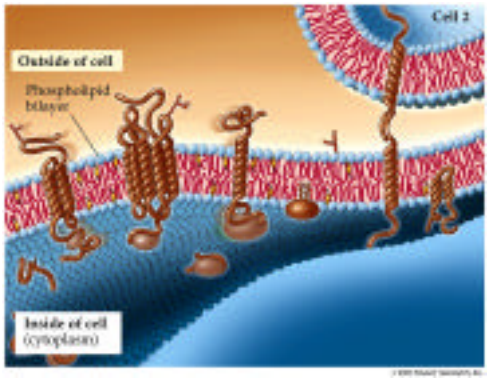
Cellular membranes

Fluid Mosaic model

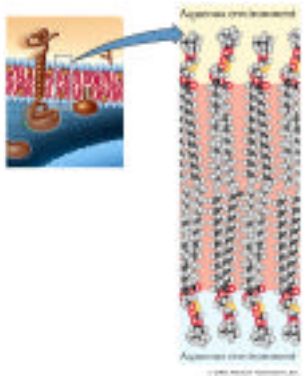


Membranes

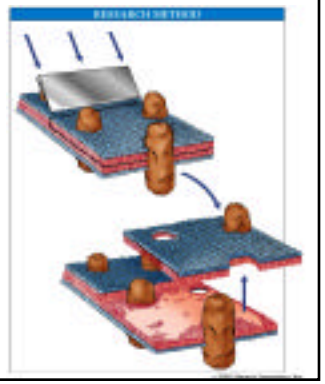
- ✓Phospholipid bilayer.
- ✓Contains proteins, glycoproteins, glycolipids.
- ✓"Fluid mosaic" structure.
  - ⇨Both protein and lipids move freely within the plane of the membrane
- ✓Serve as a hydrophobic barrier. Hydrophilic molecules are contained either outside or inside of the cell.
- ✓Membranes are selectively permeable.
  - ⇨Water will transport (diffuse) across the membrane
  - ⇨Membrane proteins help transport specific molecules across the membrane

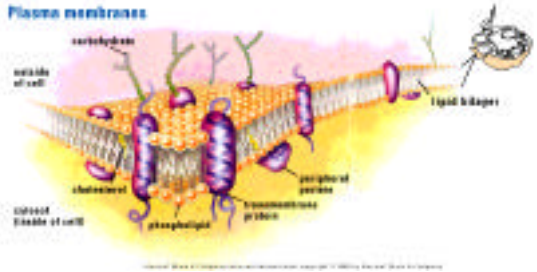


Lipid bilayer



Freeze fracture



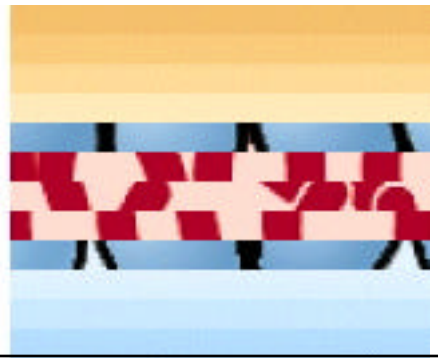


Membrane proteins

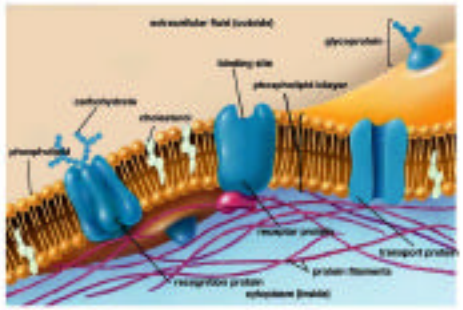
✓Integral
- ✒Hydrophobic regions
- ✒Penetrate the membrane

✓Peripheral
- ✒Lack hydrophobic regions
- ✒Polar or charges regions

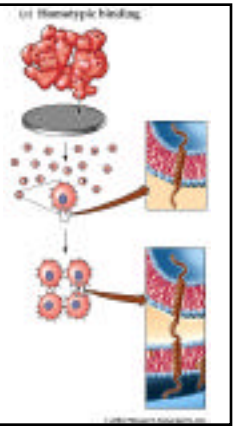
Integral protein



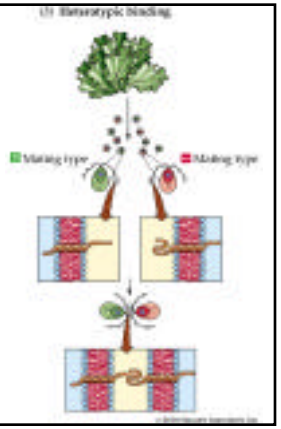
Carbohydrates act as recognition sites



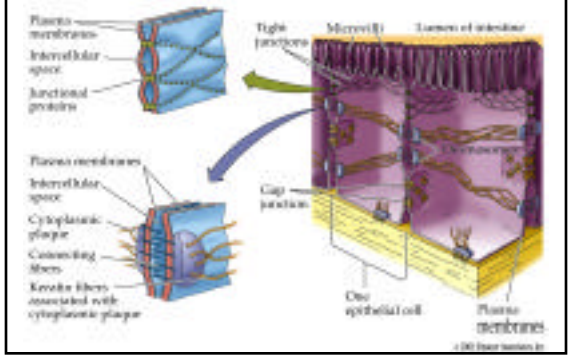
Sponge cells adhere to each other



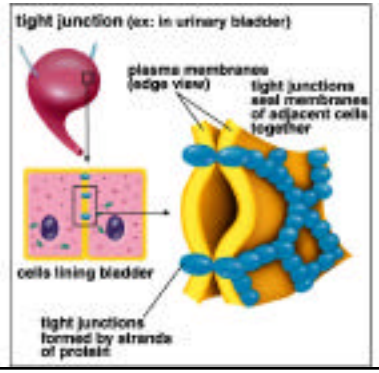
Gametes from algae adhere to each other



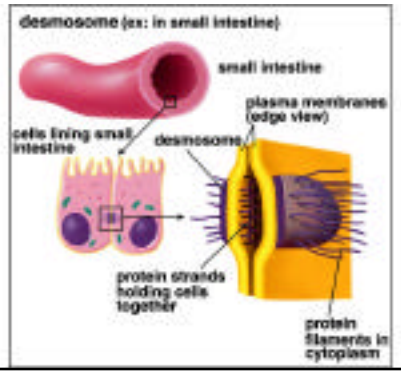
Tight junctions & Desmosomes



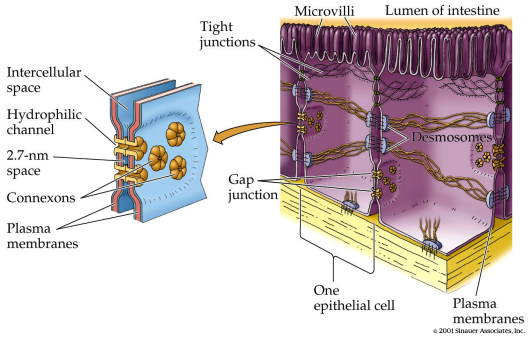
Tight junctions- Stitches



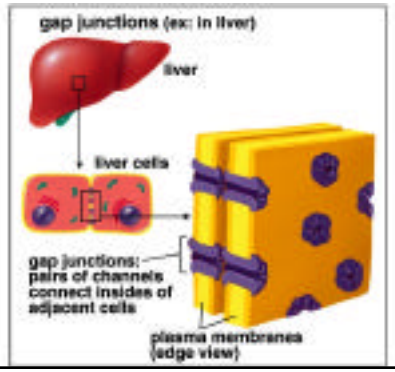
Desmosomes - Rivets



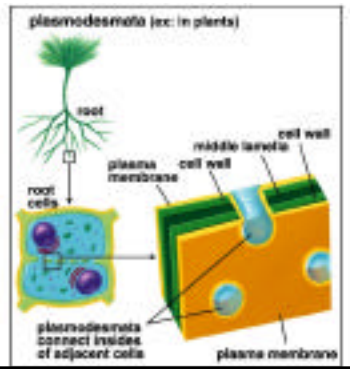
Gap junctions



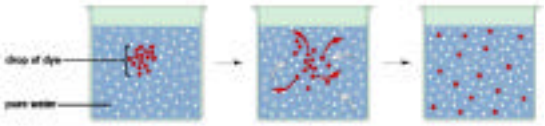
Gap junctions - cell-cell communications



Plasmodesmata - cell-cell communication



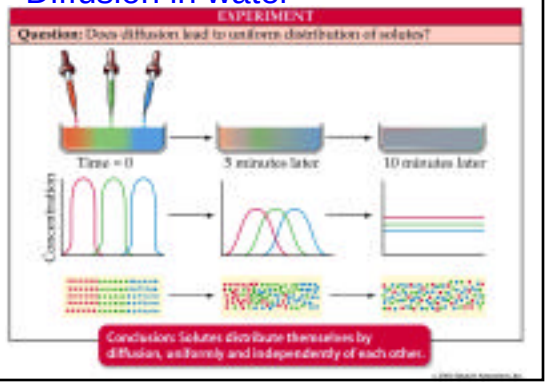
Simple diffusion



Simple diffusion

- ✓Diffusion is the random movement of molecules, ions, or atoms from an area of high concentration to an area of low concentration.
- ✓The space between the two areas is called a concentration gradient.
- ✓Eventually equilibrium is established.

Diffusion in water



Movement of molecules through the membrane

- ✓Passive Transport
  - ☛Simple diffusion
  - ☛Facilitated diffusion
- ✓Active Transport

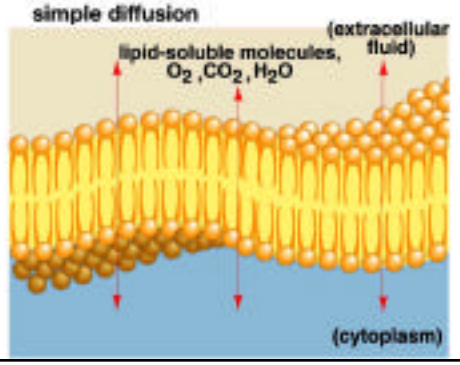
Passive transport

- ✓Spontaneous movement of molecules through the plasma membrane without the expenditure of energy.

Simple diffusion through membranes.

- ✓For most lipid-soluble molecules, diffusion occurs through the plasma membrane without help of proteins.
- ✓For large or electrically-charged molecules or ions, diffusion can be channel-mediated.

Simple diffusion



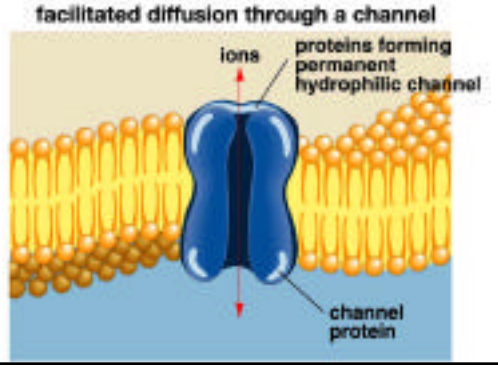
Factors influencing movement of molecules across the membrane

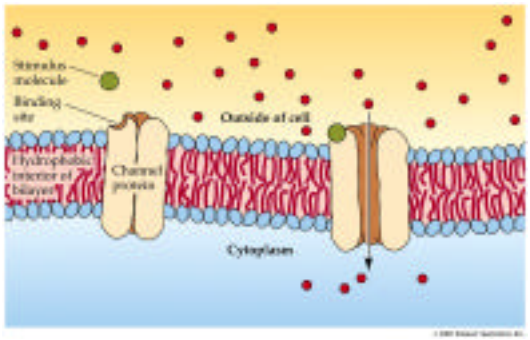
- ✓Lipid solubility (hydrophobicity)
- ✓Size of molecule.
- ✓Electrical charge of molecule.
- ✓Presence of membrane proteins that facilitate movement of large and electrically-charged molecules.

Facilitated diffusion

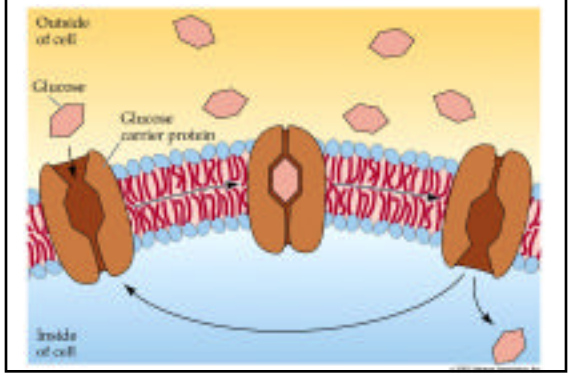
- ✓Increases the rate of passive transport.
- ✓Specific proteins within the membrane facilitate the movement of molecules into and out of the cell.
- ✓Movement is down a concentration gradient.

Facilitated diffusion





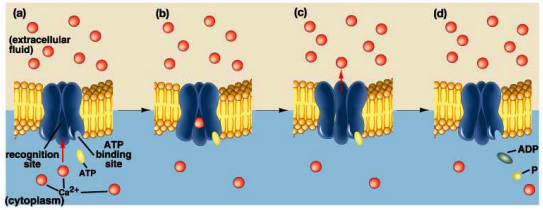
Facilitated diffusion



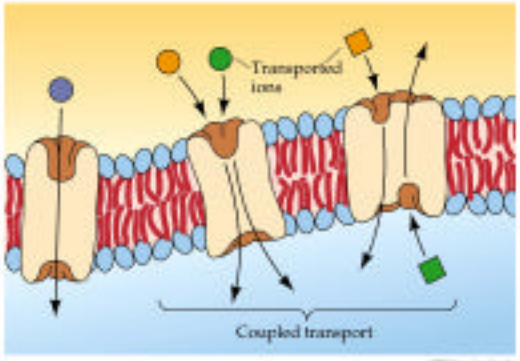
Active transport

- ✓A pump mechanism that moves molecules and ions through the membrane
- ✓Requires energy.

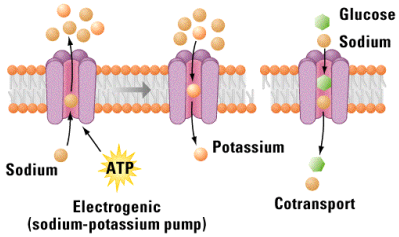
Active transport-against the gradiant



Active transport-uniport, symport, and antiport



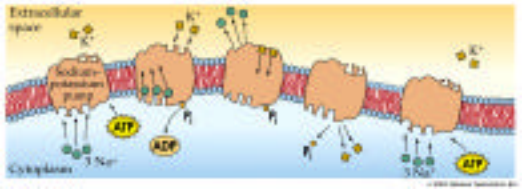
Sodium-Potassium Pump



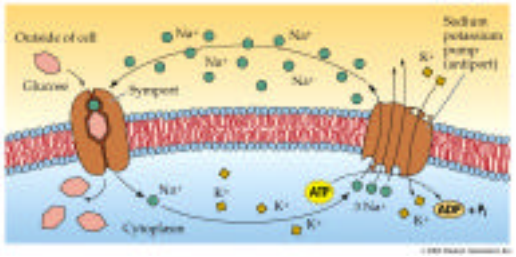
5.2 Concentration of Major Ions Inside and Outside the Nerve Cell of a Squid

ION	CONCENTRATION (MOLAR) INSIDE	OUTSIDE
K^+	0.400	0.020
Na^+	0.050	0.440
Cl^-	0.120	0.560

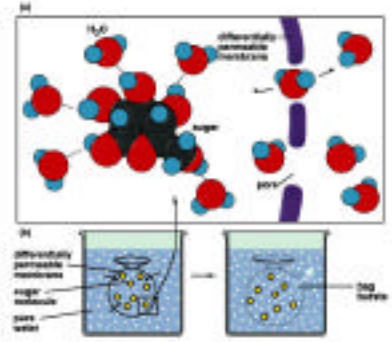
Primary active-Na^+-K^+ pump



Primary vs secondary active transport



Osmosis



Osmosis

- ✓ Movement of water across a selectively permeable membrane in response to a concentration gradient.
- ✓ Movement of water is towards the zone of high solute concentration.
- ✓ The pressure associated with the movement of water is called osmotic pressure.

Isotonic

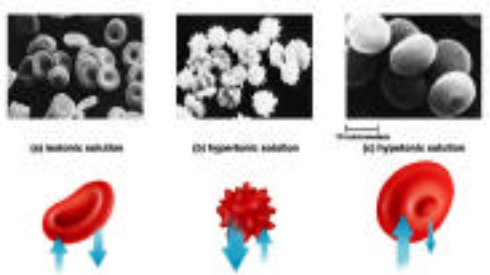
- ✓ Solute concentration is the same on both sides of the plasma membrane.
- ✓ Movement of water is equal in both directions.

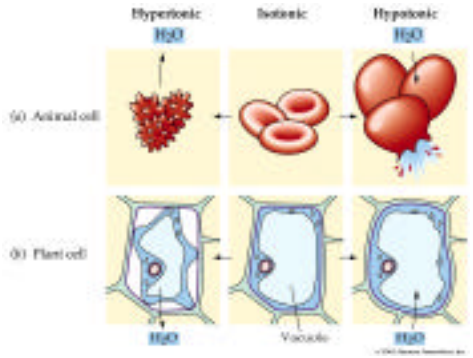
Hypertonic

- ✓ Solute concentration is greater on the outside of cell.
- ✓ Movement of water is towards the greater solute concentration.
- ✓ Water moves OUT of the cell.

Hypotonic

- ✓ Solute concentration is greater on the inside of cell.
- ✓ Movement of water is towards the greater solute concentration.
- ✓ Water moves INTO the cell.

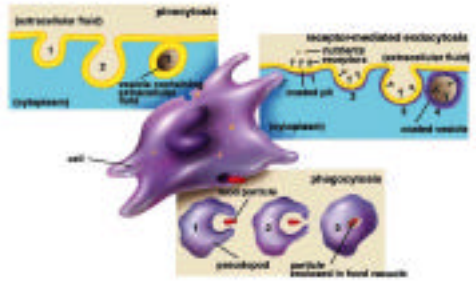




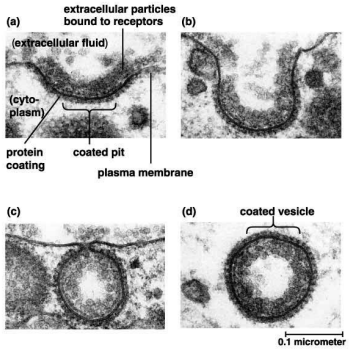
Other mechanisms

- ✓ Membrane fusion
  - ✒ Endocytosis
    - ☞ pinocytosis
    - ☞ receptor mediated pinocytosis
  - ✒ Exocytosis

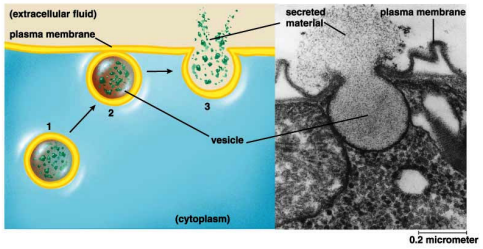
Endocytosis



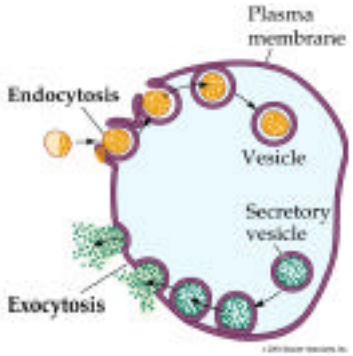
Clathrin coated pits



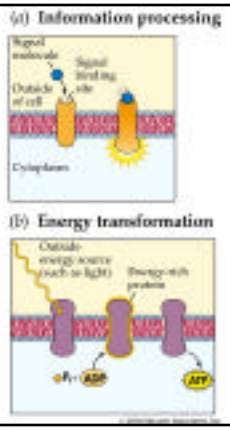
Exocytosis



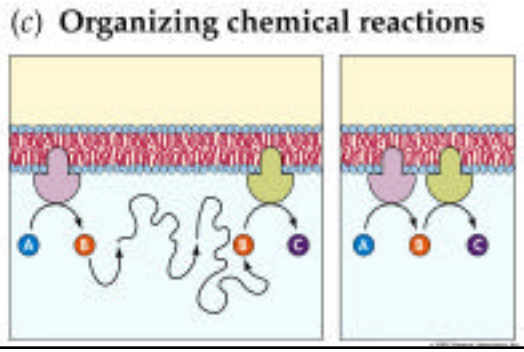
Overview



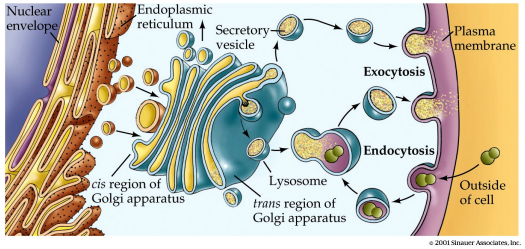
Information processing & energy transforming

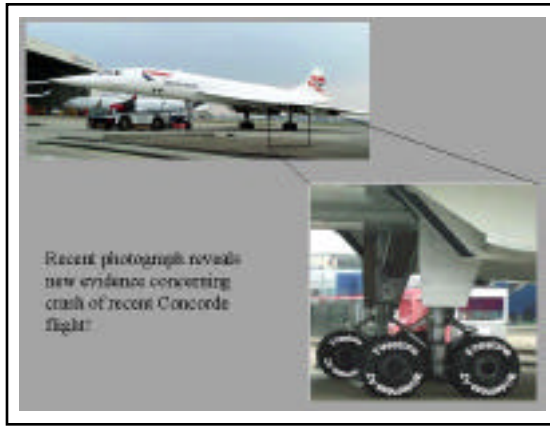


Chemical reactions



Ever-changing membranes





Recent photograph reveals new evidence concerning crash of recent Concorde flight