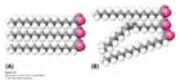
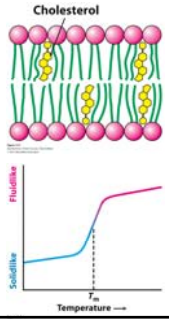
Membrane Structure and Function

Ch 12, Stryer Short Course

Introduction to Membranes

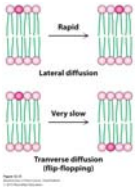
- Lipid structure makes a bilayer
  - Hydrophobic effect
  - Non-covalent structure
- Fluidity of membrane: liquid crystal
- Fluidity controlled by cholesterol, tail packing

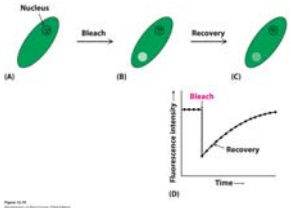




Fluidity

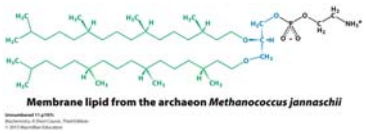
- Transverse vs lateral diffusion
- Bleaching experiment
- Fluid Mosaic Model





Extremophiles

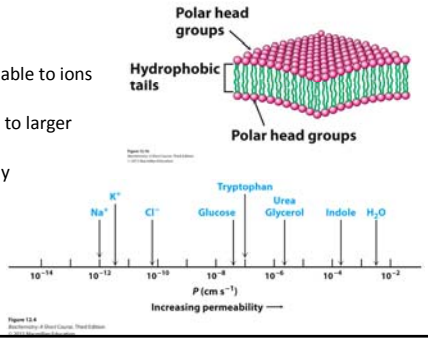
- Archea: branched tails, ether linkages
  - Increased range of temperature
  - Stable to hydrolysis
  - Stable to oxidation



Membrane lipid from the archaeon *Methanococcus jannaschii*

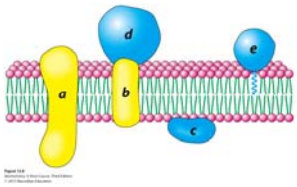
Permeability

- Membrane impermeable to ions (water shell)
- Mainly impermeable to larger polar molecules
- Water can flow slowly



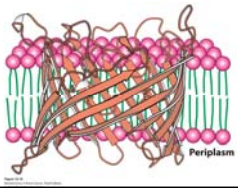
Introduction to Membrane Proteins

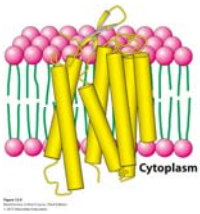
- Proteins carry out membrane function
  - Diversity of membranes based on protein content
- Types of proteins
  - Integral proteins
  - Peripheral proteins
  - Anchored proteins



Integral Proteins

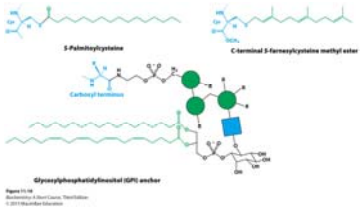
- Common motifs
  - 7-transmembrane helix
  - β-barrel





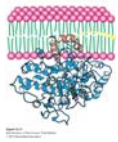
Anchored proteins

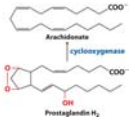
- Reversible Anchoring directs proteins to membrane
- Patholgy
  - Cancer
  - Hutchinson-Guilford Progeria syndrome



Effect of Aspirin

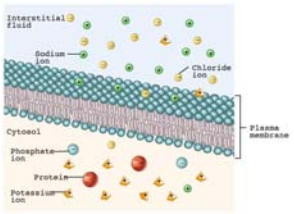
- Arachidonate from membrane, travels through cavity in Prostaglandin H_2 synthase
- Aspirin covalently modifies Serine in cyclooxygenase active site
- COX-1 and COX-2 inhibitors



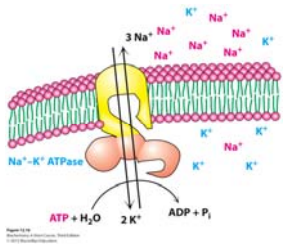


Transporter Proteins

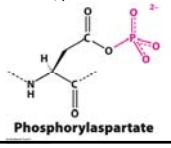
- Thermodynamic gradients
  - Concentration gradient
  - Ion gradient
- Pumps, channels, transporters
- Diffusion
  - Simple diffusion
  - Facilitated diffusion (passive transport)
  - Active Transport



Sodium-Potassium ATPase

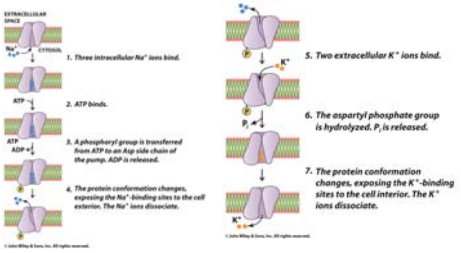


- Up to a third of ATP is used to create ion gradient
  - Maintain structure and function of cell
- ATP phosphorylates the pump
  - Change in conformation used to drive sodium/potassium exchange



Phosphorylaspartate

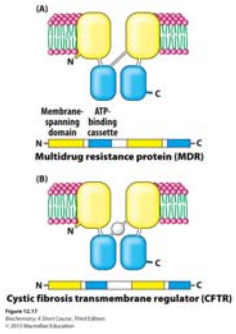
Mechanism



Digitalis blocks dephosphorylation, leading to low sodium ion gradient. This changes the calcium ion gradient, making the heart beat harder.

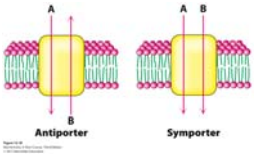
ABC transporters

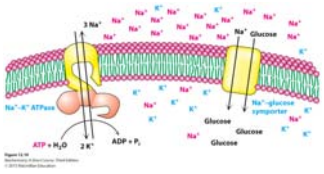
- ATP-binding cassette domain
  - Large superfamily includes
- Multidrug Resistance Pump
- Cystic Fibrosis Transmembrane Regulator
  - ATP-regulated chloride channel
  - Mutation causes less fluid/salt to be pumped out of cell



Secondary Transport

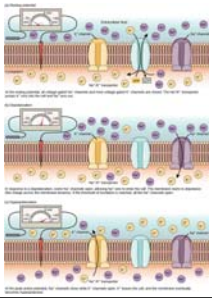
- Use energy of active transport to make a gradient
  - This gradient drives active transport of another compound





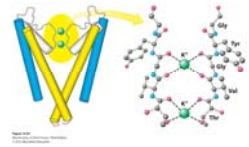
Facilitated transport: K+ channel

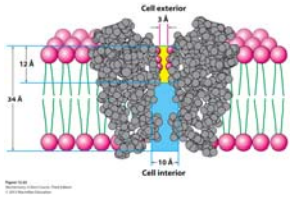
- Channels can allow specific compounds to transverse the membrane rapidly
- Nerve Impulse
- Controlled systems
  - Voltage gated
  - Ligand gated
  - mechanicoselective



Structure explains specificity

- How do you block a smaller sodium ion from going through a hole that fits a larger potassium ion?
- Make up for desolvation with strong binding





Structure explains speed

- Four binding sites in the narrow channel
- Repulsion of neighboring ions pushes potassium through