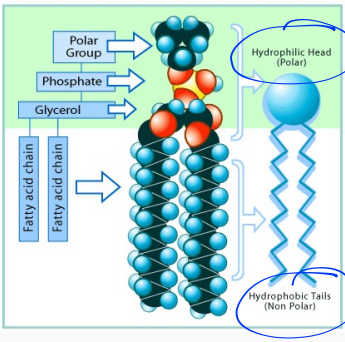
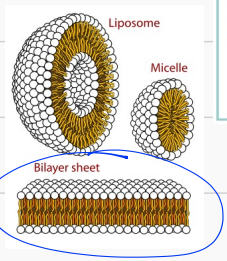
Membrane Structure and Function

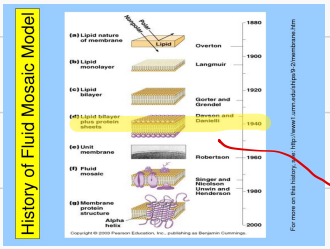
- The main unit of the dell membrane is the phospholipid
  - The phospholipid is amphipathic - it has both a polar and a non-polar region
  - Phospholipids will arrange themselves into three possible configurations:
    - The bilayer is the arrangement that functions as the cell membrane

Phospholipid structure



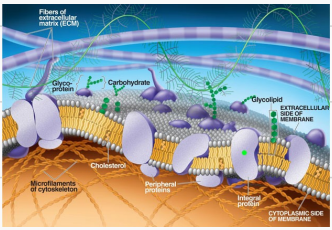


- The fluid mosaic model of the cell membrane was developed over many years

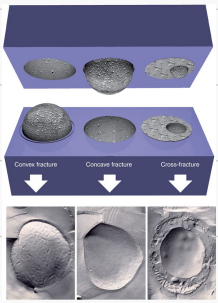


- In the lab, lipid bilayers are less attracted to water than biological membranes
  - So Davson/Danielli proposed that membranes are coated with hydrophilic proteins

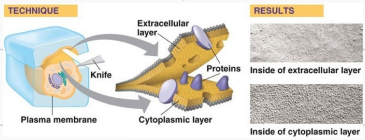
The fluid mosaic model of the cell membrane



- A cell-study method called freeze-fracture allowed scientists to see that that proteins are embedded in the phospholipid bilayer
  - The bumps and depressions from the two layers matched



Freeze-fracture technique...

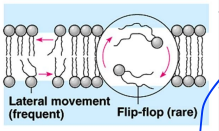


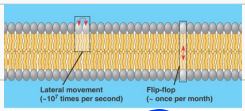
Gives these results

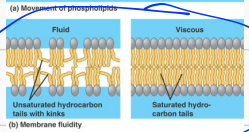
Fluidity of Membranes

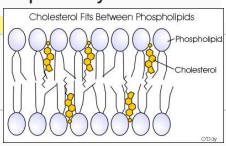
- Membranes are held together by weak hydrophobic interactions
  - Phospholipid movement is common
- Membrane fluidity decreases as temp decreases
- Cholesterol within the phospholipid bilayer decreases membrane fluidity

Movement of phospholipids

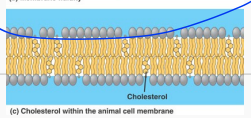








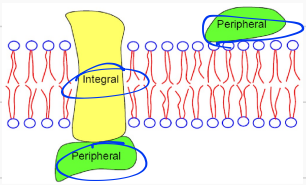
Cholesterol in the bilayer

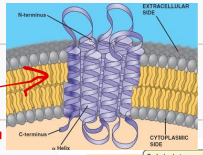


Membrane proteins and their function

- The types of proteins in the membrane depend on what type of cell it is
  - Integral proteins must have some non-polar amino acids in the region where it is in the middle of the bilayer

Main classes of membrane proteins

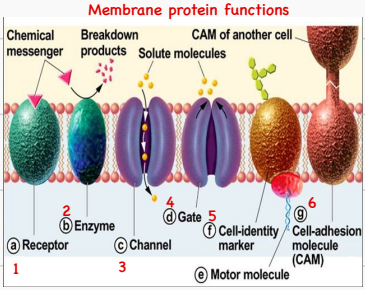


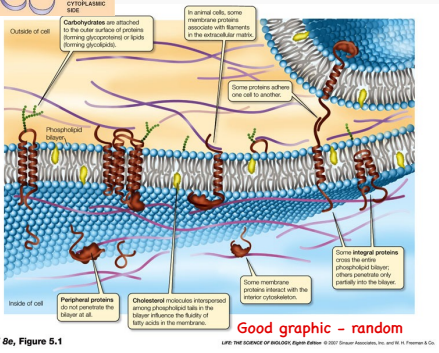


Integral Protein

- Membrane protein functions (x6)

Membrane protein functions

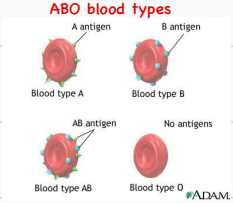




Good graphic - random

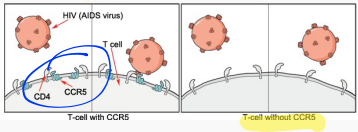
- ABO blood antigens are an example of proteins as cell identity markers

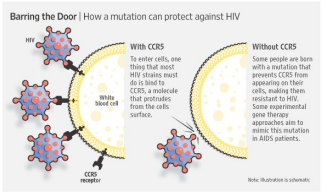
ABO blood types



Cell ID

- The HIV virus infects host cells by attaching to protein receptors CD4 and CCR5
- A mutation that prevents CCR5 from being made renders cells resistant to HIV



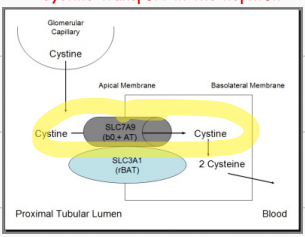


Attachment

- A transport membrane protein in the nephrons is responsible for the reabsorption of the amino acid cystine into the blood

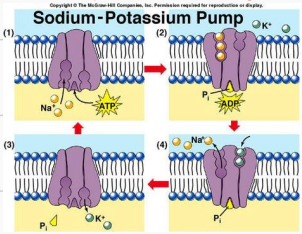
Transport

Cystine transport in the nephron



- A mutation in the gene that codes for this protein will result in inefficient reabsorption of cystine, which will cause it to become concentrated in the urine, ultimately resulting in kidney stones

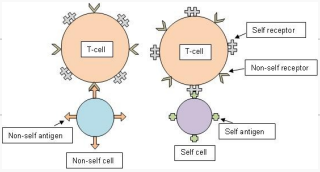
Membrane proteins as channels/gates



- The Na/K pump protein helps regulate membrane voltage potential by exchanging sodium for potassium

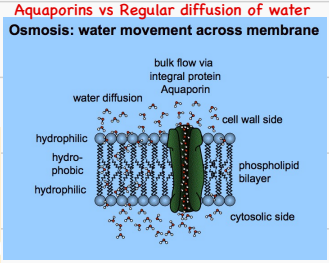
Gates / Channels

- Role of glycoproteins and glycolipids
  - Carbohydrates attached to phospholipids and membrane proteins function in cell recognition
    - Example: surface antigens in the immune system



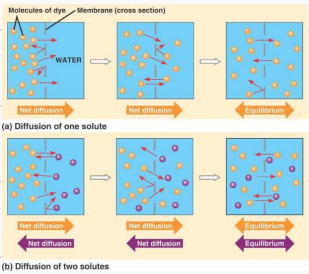
- Cell membranes are selectively permeable
  - Nonpolar molecules can dissolve readily into the bilayer, ions and polar molecules, not so much
  - Polar molecules and ions can avoid hydrophobic regions by passing through protein channels (Like H_2O)

Aquaporins vs Regular diffusion of water

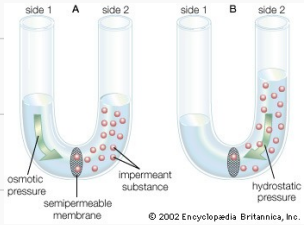


- Passive transport = no energy (diffusion)
  - Diffusion: movement along a concentration gradient = Spontaneous
  - Osmosis (diffusion of water) is a form of passive transport

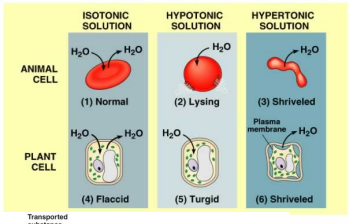
Diffusion



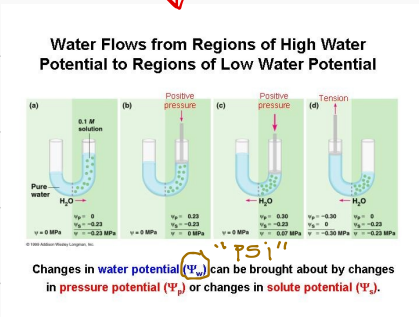
Osmosis

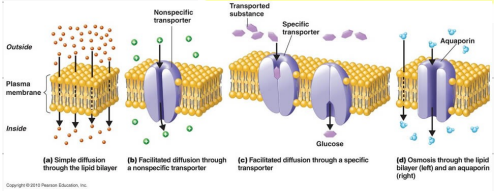


- Tonicity: the ability of surrounding solution to cause a cell to gain or lose water
  - Prefix refers to concentration of solute



- Water potential is the measurement of the "desire" of water to move down a gradient

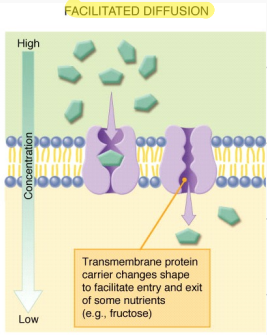




Simple Diffusion	Facilitated Diffusion
• Through the phospholipid bilayer • Happens to the small and non-polar particles	• Through the transport protein • Happens to large or polar particles

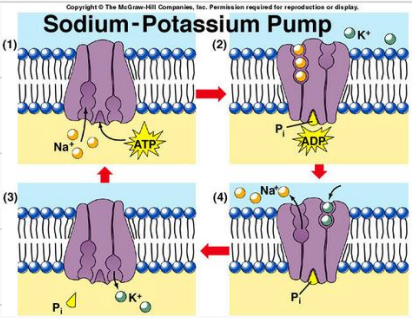
A comparison of simple and facilitated diffusion

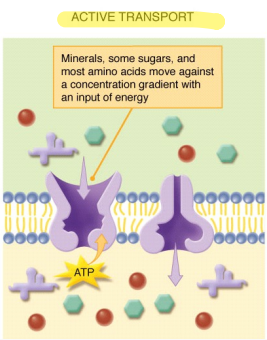
- Facilitated diffusion uses membrane proteins as pores or channels
  - Increase in solute concentration increases solute interaction with membrane proteins, which cause the protein to change shape and "open" the "gate"



Active transport requires expenditure of energy - ATP

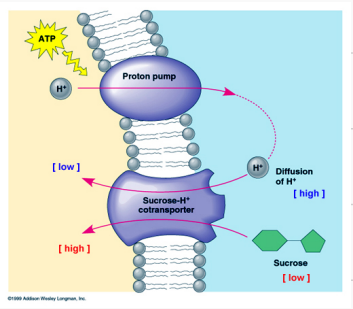
- The sodium/potassium pump is the cells way to maintain a voltage gradient across the membrane
- This is called primary active transport
- Sometimes the movement of a solute along its concentration gradient can drive the transport of another solute against its gradient



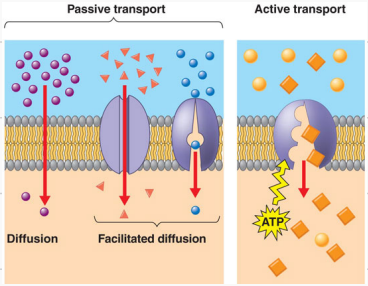


- This is called co-transport, or secondary transport

Co-transport of sucrose and protons



A comparison of passive and active transport



Materials can also be transported across the membrane by exo- and endocytosis