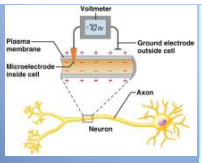
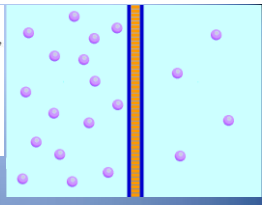
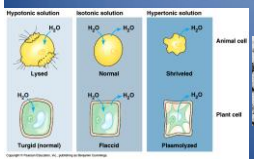
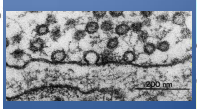
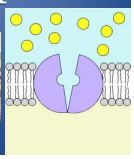




Cell Biology
1.4- Membrane Transport

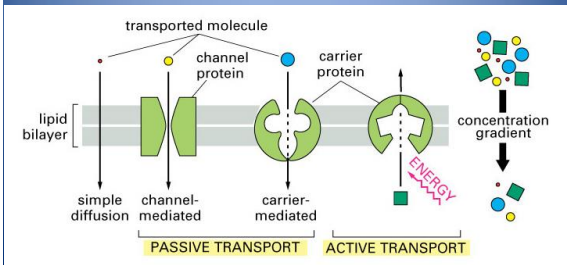






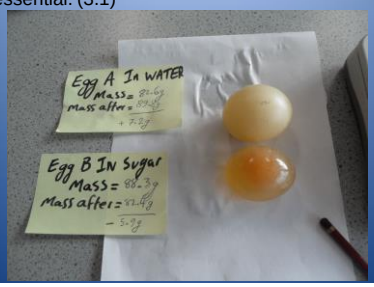
Essential idea:

- Membranes control the composition of cells by active and passive transport.



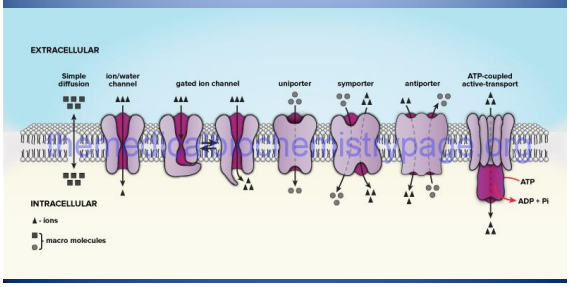
Nature of science:

- Experimental design
  - accurate quantitative measurement in osmosis experiments are essential. (3.1)



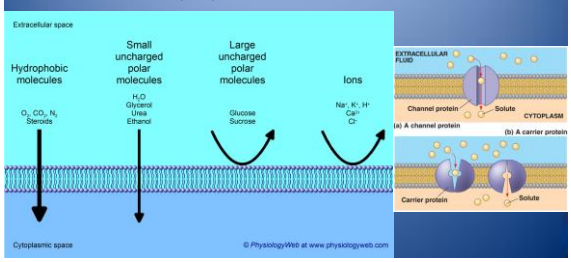
Types of Movement

- Particles move across membranes by simple diffusion, facilitated diffusion, osmosis and active transport.



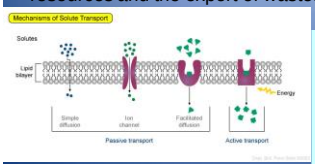
Properties of Membranes

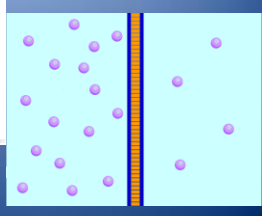
- Selectively permeable
  - Small, nonpolar molecules pass through easily (lipids, O_2, N_2).
  - Small, uncharged polar molecules pass through easily (CO_2, H_2O).
  - Hydrophilic, large polar molecules and ions move through embedded channel and transport proteins.



Passive Transport

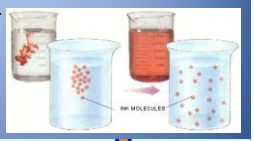
- Does not require the input of metabolic energy
- Net movement of molecules is from high concentration to low concentration.
- Passive transport plays a primary role in the import of resources and the export of wastes.



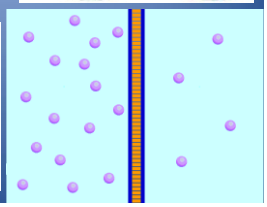


Simple Diffusion

- Molecular movement down concentration gradient.
- Due to random molecular motion.
- Factors affecting rate:
  - Tempurature
  - Surface Area
  - Concentration Gradient
  - Size of Particle
  - Diffusion Medium

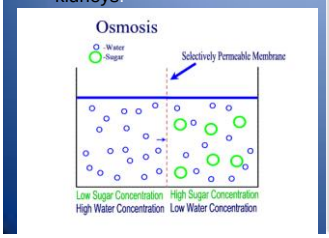


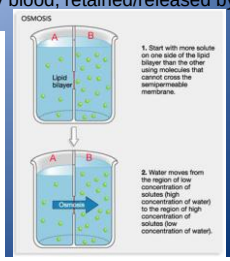
Temperature	• Higher temperature → Diffuse Faster
Surface Area	• Larger surface → Diffuse Faster
Concentration Gradient	• Higher Gradient → Diffuse faster
Size of Particles	• Smaller particles → Diffuse faster
Diffusion Medium	• Solid → Slowest • Liquid → Faster • Gas → Fastest



Osmosis

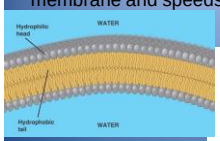
- **Diffusion** of **water** across a selectively permeable **membrane**.
  - Osmotic pressure is hydrostatic pressure.
  - Produced by water diffusing towards higher solutes.
  - Osmosis is a constant process in life: water is absorbed in large intestine, and taken up by blood, retained/released by kidneys.

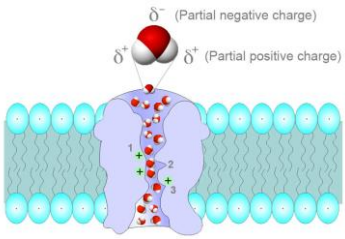




Osmosis

- How can water move across a hydrophobic structure
- Aquaporin is an integral protein that acts as a pore in the membrane and speeds the movement of water molecules



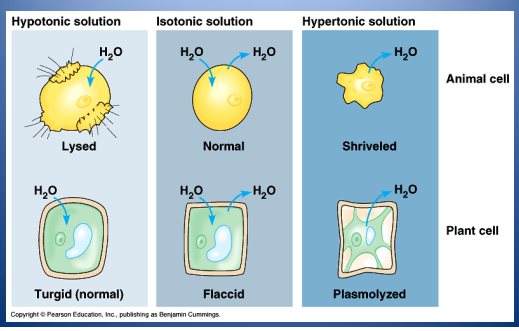


Osmosis

- External environments can be hypotonic, hypertonic or isotonic to internal environments of cells.
  - Isotonic External: relative solute concentration of two environments are equal.
  - Hypotonic External: relative solute concentration of external environment is less than internal (water moves in)
  - Hypertonic External: relative solute concentration of external environment is greater than internal (water moves out)

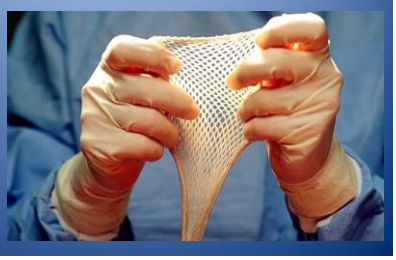
Osmotic Control

- Shape of cell is affected by osmotic pressure



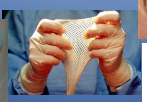
Medical Connection

- Do we use pure water in medical treatments?
- Remember: Tissues or organs to be used in medical procedures must be bathed in a solution with the same osmolarity as the cytoplasm to prevent osmosis.



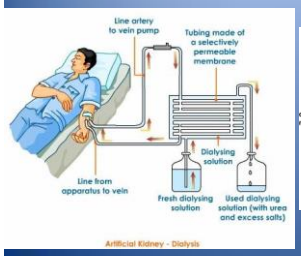
Medical Connection

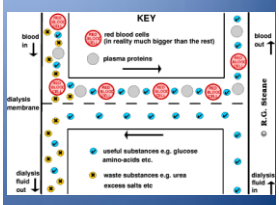
- Osmotic control is important in preventing damage to cells and tissues.
- Common medical procedures in which an isotonic saline solution is useful:
  - Fluids via an intravenous drip for rehydration or medication delivery.
  - Cleaning wounds and infected areas
  - Keep transplant organs moist
  - Eye drops
  - Sinus rinse


Medical Connection

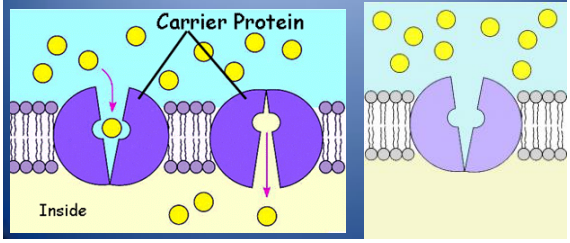
- Kidney dialysis artificially mimics the function of the human kidney by using appropriate membranes and diffusion gradients.





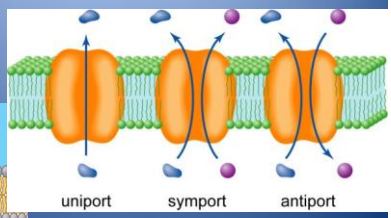
Facilitated Diffusion

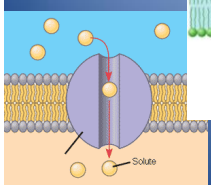
- Large, polar molecules and ions can't cross by simple diffusion.
- Carrier Proteins
  - Transport only one type of molecule.
  - Undergo a change in shape to move molecule across.
  - Movement is down the concentration gradient.



Facilitated Diffusion

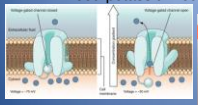
- Channel Proteins
  - Selective channels allow charged and polar molecules through a membrane.
  - May be uniport, symport, or antiport

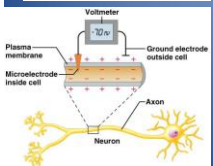


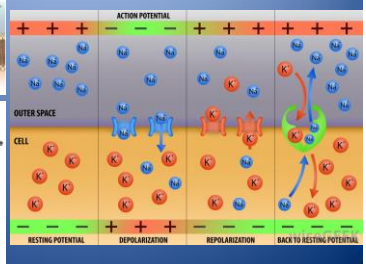


Facilitated Diffusion

- K^+ in neuron axons (IB example)
  - Potassium channels in axons are voltage gated.
  - They enable the facilitated diffusion of potassium out of the axon
  - Voltage change of environment causes protein to open
  - Flood potassium out to repolarize a cell

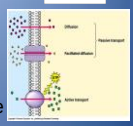


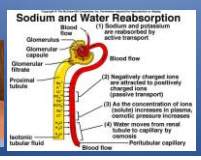




Active Transport

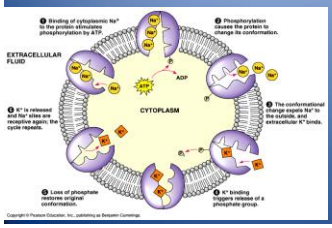
- Establishes and maintains concentration gradients.
- Movement of solutes is against the concentration gradient.
  - Iodine is concentrated in cells of thyroid gland
  - Glucose is completely absorbed into lining of digestive tract.
  - Sodium is mostly reabsorbed by kidney tubule lining.

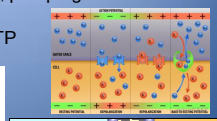


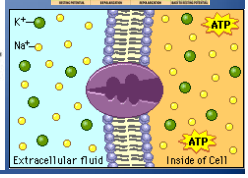


Sodium-potassium Pump

- An important carrier system in nerve and muscle cells.
- Major electrogenic pump in animal cells.
- Transport Protein changes shape, pumping three Na+ out for every two K+ pumped in.
- Caused by phosphorylation by ATP

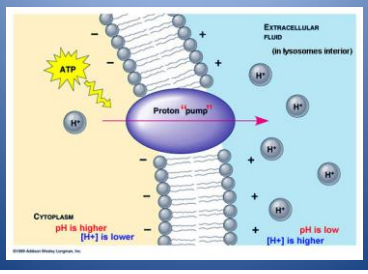






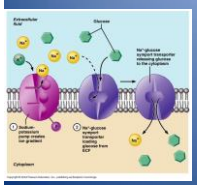
Proton Pump

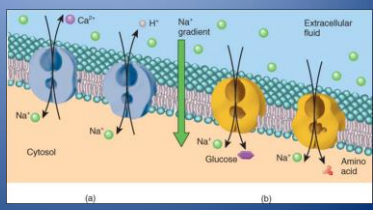
- Major electrogenetic pump in plants, bacteria, and fungi.
- Drives ATP synthesis in mitochondria and chloroplasts.
- Hydrogen ions pumped out against its gradient.



Secondary Active Transport

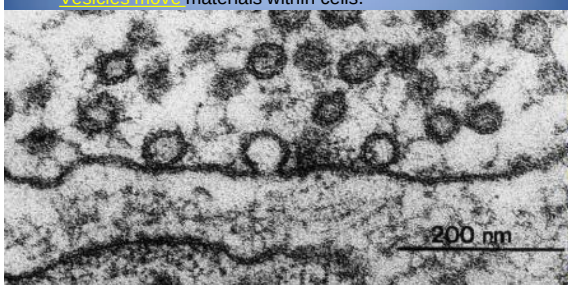
- Energy is derived from energy stored in the form of concentration differences in a second solute (often Na^+).
  - Concentration gradient of the second solute was created by primary active transport
  - Diffusion of the second solute across the membrane drives secondary active transport





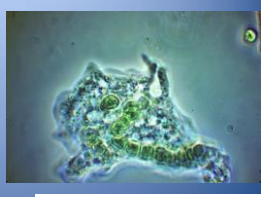
Fluidity of Membranes

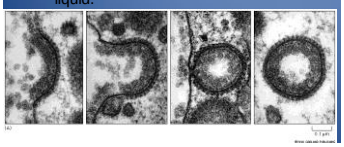
- Allows materials to be taken into cells by endocytosis or released by exocytosis.
- Vesicles move materials within cells.

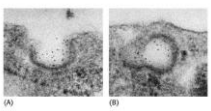


Endocytosis

- Take in macromolecules
- Vesicle formation as plasma membrane pinches inwards.
  - Phagocytosis(cell eating)
    - Cells engulf large particles forming a food vacuole.
    - Vacuole fuses with a lysosome, digestion occurs.
  - Pinocytosis- vesicles form around a liquid.



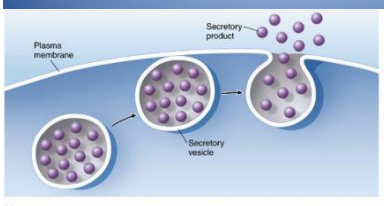


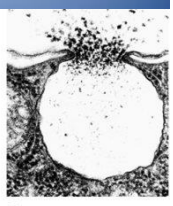


Exocytosis

End

- Export macromolecules
- A vesicle often formed by ER or Golgi fuses with the plasma membrane.
- Method by which proteins and hormones are secreted by cells (keratin,insulin).





Remember from 1.2 Notes

Back

Vesicles

- A single membrane with fluid inside
- Very small in size
- Used to transport materials inside of a cell