**CONCEPT:** PRINCIPLES OF TRANSMEMBRANE TRANSPORT

Membranes and Gradients

● Cells must be able to communicate across their membrane barriers to exchange materials with the environment

□ Membranes are **semi-permeable** and only allow certain molecules to cross

- Small nonpolar molecules (oxygen, carbon dioxide) can rapidly cross

- Uncharged polar molecules can pass if small, but cannot if large

- Charged molecules and ions cannot pass

□ Cell membranes allow for internal cellular concentrations to vary from external concentrations

- **Concentration gradients**: Concentrations of molecules differ on either side of a membrane

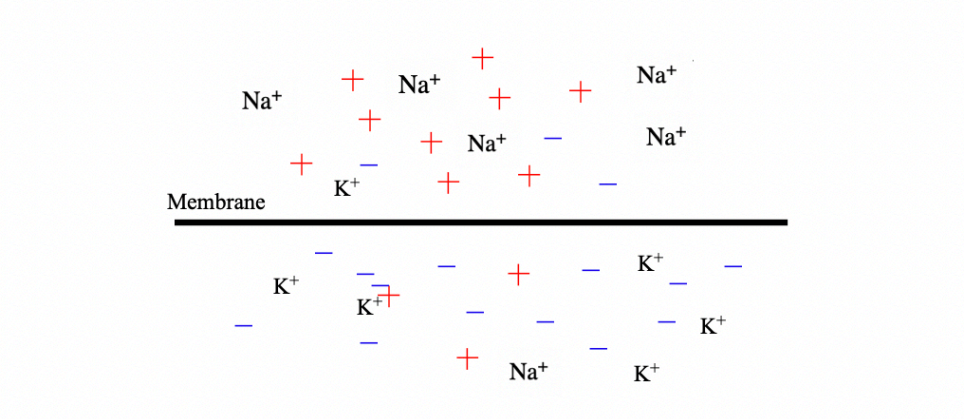
- **Electrical potentials:** Net charge of environment differ on either side of a membrane

- **Electrochemical potential:** Combined effect of concentration gradient and electrical potential

- **Membrane potential:** Difference between the concentration gradient and electrical potential

□ The overall net charge must be balanced

**EXAMPLE:** Concentration and electrical gradients across a membrane




Passive and Active Transport

● Molecules cross the membrane barrier through two ways: *passive transport* and *active transport*

□ **Passive transport** moves molecules with a gradient (high concentration to an area of low concentration)

- *Simple diffusion* can occur if the molecule needs no assistance in passing the membrane

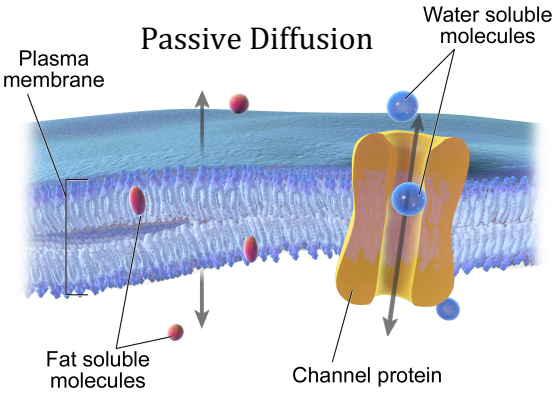
- *Facilitated diffusion* occurs if the molecule needs assistance in crossing the membrane

- Diffusion requires no energy input

□ **Active transport** moves molecules against a gradient (from low concentration to high concentration

- Active transport requires energy – usually from ATP hydrolysis

**EXAMPLE:** Simple vs. Facilitated diffusion




Facilitated Diffusion

● Three classes of transmembrane proteins transport molecules across the membrane

□ **Channels** provide a portal for molecules to pass

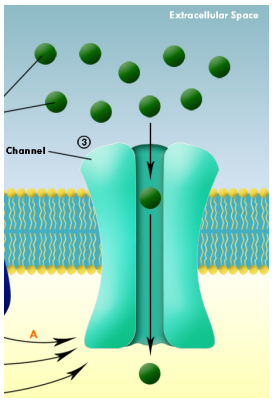
- Only let molecules of specific size or electrical charge pass the membrane

□ **Transporters** are highly selective in allowing molecules to pass

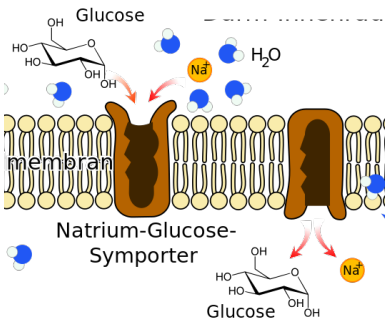
- Transfer only molecules that fit into specific binding sites

□ **ATP powered pumps** require energy from ATP to transport molecules

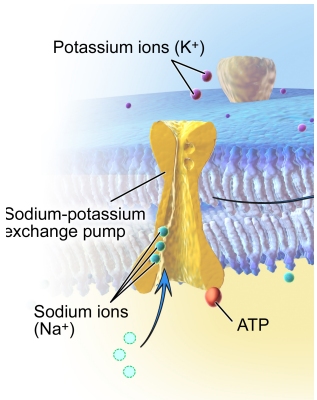
**EXAMPLE:** Examples of the three classes of transmembrane proteins




Channel




Transporter




ATP-powered pump