Membrane Transport

Dr. Kevin Ahern
Chemical and Electrical Potential Across a Lipid Bilayer Barrier
Osmotic Pressure Across a Semipermeable Barrier
Types of Membrane Proteins
Three Types of Membrane Protein Ports

- Uniport
- Symport (Synport)
- Antiport
No Net Change in Charge

Net Change in Charge
Ion Channels
Ion Channel Features
1. General Structure
2. Opening
3. Filter
4. Effective Opening Size
5. Door
Potassium Channel

Closed

Open

Potassium Channel
Potassium Channel - Top-down View
Hydration Shell
Cellular Transport Types

Passive - Purely Diffusion Driven, Follows Concentration Gradient
Facilitated - Protein Guided, Follows Concentration Gradient
Active - Protein Guided, Energy Required to Move at Least One Molecule Against Concentration Gradient
Passive Transport - Purely Diffusion Driven
Ion Channels vs Transporters
Facilitated Diffusion
Active Transport
Sodium-Potassium ATPase

- Higher Na\(^+\) outside
- Higher K\(^+\) inside

Diagram of the sodium-potassium pump mechanism.
Sodium-Glucose Pump
Sodium/Glucose Symport

Secondary Energy Source

Diffusion

Outside

Inside

Sodium-Potassium Pump

ATP + Pi

Na+ Glucose Cotransport Protein

Sodium-Glucose Pump
Sodium/Glucose Symport
Lactose Permease
Lactose/Proton Symport
Lactose Permease
Secondary Energy Source - Protons
Nerve Cell Transmission

1. Stimulus
2. Opening of Na\(^+\) gates
3. Na\(^+\) diffuses into cell
4. Voltage change causes K\(^+\) gates to open
5. K\(^+\) diffuses out of cell
6. All gates close
7. Wave of voltage changes moves down cell
8. Neurotransmitters move signal across cells
9. Na\(^+\) K\(^+\) ATPase restores gradients in originating cell
Stimulus, Na⁺ gates open

K⁺ gates open

Na⁺K⁺ ATPase acts

Action Potential

Depolarization

Repolarization

Hyperpolarization

Membrane potential (mV)

Time
Wave of Na$^+$ in, K$^+$ out

Transmission of signal from one cell to another
Tetrodotoxin
From Puffer Fish
Bind Voltage Gated Na⁺ Channels
Saxitoxin
Shellfish Toxin From Algal Blooms
Sodium Channel Blocker