Definitions

Diffusion	The process of movement of molecules under a concentration gradient
Electrical gradient	An electrostatic force caused by the separation of electrical charge
Membrane potential	A separation of opposite charges across the plasma membrane
Action Potential	Brief all or nothing reversal in membrane potential, lasting on the order of 1 millisecond
Propagation	Action potentials propagate when locally generated depolarizing current spreads to adjacent regions of membrane causing it to depolarize
Contiguous Conduction	Propagation of action potentials in unmyelinated fibers by spread of locally generated depolarizing current to adjacent regions of membrane, causing it to depolarize
Myelin	A multilayered sheath of plasma membrane that wraps around axonal fibers and acts as an insulator to the flow of current
Saltatory Conduction	Propagation of action potentials in myelinated axons by jumping from node to node

Definitions (cont)

Graded Potentials	Local changes in membrane potential that decay over short distance
Synapse	Junction between two neurons, or between a neuron and a muscle or gland that enables one cell to electrically and/or biochemically influence another cell
Electrical Synpase	Direct electrical connection between two cells, formed by a gap junction
Gap Junctions	made up of multiple proteins called connexins

Diffusion and Gradients

Diffusion is the process of movement of molecules under a concentration gradient.

There are five factors that affect the **rate of diffusion**: magnitude of the concentration gradient, permeability of the membrane, surface area of the membrane, molecular weight of the substance, and distance over which diffusion takes place

Concentration gradients are formed when there is a difference in concentration in two different areas; molecules typically move from an area of greater concentration to an area of lesser concentration. **Net diffusion** is the difference between two opposing movements.

An **electrical gradient** is when electrostatic forces are caused by the separation of electrical charges.

An **electrochemical gradient** is the combined force of concentration and electrical gradients

Membrane Potential

A **membrane potential (Vm)** is a separation of opposite charges across the plasma membrane. The cell creates this charge separation when it: 1) establishes and maintains concentration gradients for key ions 2) Ions diffuse through the membrane down their concentration gradient 3) Diffusion through the membrane results in charge separation, creating a membrane potential 4) Net diffusion continues unti lthe force exerted by the electrical gradient exactly balances the force exerted by the concentration gradient 5) This potential that would exist at this equilibrium is **"equilibrium potential"**

Equilibrium Potential for K+	1. K+ Tends to move out of the cell 2. Outside of the cell becomes more positive 3. Electrical gradient tends to move K+ into the cell 4. Electrical gradient counterbalances concentration gradient 5. No further net movement of K+ occurs 6. E(K+) = -90mV
Equilibrium Potential for Na+	1. Na+ tends to move into the cell 2. Inside of the cell becomes more positive 3. Electrical gradient tends to move Na+ out the cell 4. Electrical gradient counterbalances concentration gradient 5. No further net movement of Na+ occurs 6. E(Na+)=+60mV

Membrane Potential (cont)

Nernst equation	equation describing the equilibrium: Ei = RT/zF ln [i]o/[i]i potential for a particular ion (i)
Resting Membrane Potential	Resting membrane potential is -70mV because: the membrane is 20-30 more permeable to K+ than Na+ and there is a large net diffusion of K+. It is created due to a balance of passive leak channels and active Na+/K+ ATPase.
Action Membrane Potential	**Depolarization**: change in membrane polarization to more positive values than rest. **Repolarization**: return to resting membrane potential after depolarization. **Hyperpolarization**: change in membrane polarization to more negative values than rest. There is a **rising phase** in which Na+ moves into the cell and the **falling phase** in which K+ leaves the cell with the help of voltage-gated Na+ or K+ channels.

Types of Channels

Leak Channels	Passive channels that permit ions to flow down concentration gradients
Na/K ATPase	Active channel that establishes and maintains concentration gradients. It pumps 3 Na+ out of the cell for every 2 K+ pumped into the cell