Nervous System II

Action potential:

Important Points	Action	Consequence
The cellular membrane is selectively permeable.	Some ions pass freely through the membrane while some ions are trapped outside or inside.	There is a slight excess of negatively charged ions inside the cellular membrane and a slight excess of positively charged ions outside. This generates the *resting transmembrane potential*.
Sodium-potassium pumps on the membrane help maintain the difference in charge across the membrane.	3 sodium ions (Na^+) are moved into the extracellular fluid while 2 potassium ions (K^+) are moved into the cytoplasm.	A concentration gradient is generated for Na^+ and K^+.
A stimulus causes the transmembrane potential to increase (depolarize), reaching the threshold (10-15mV more positive than the resting transmembrane potential).	Voltage-regulated sodium channels open quickly while voltage-regulated potassium channels open more slowly	Sodium ions (Na^+) rush into the cytoplasm.
Additional voltage-regulated sodium channels are triggered to open.	As more Na^+ enter into the cytoplasm, the inner membrane surface now has more positive charges than negative.	The transmembrane potential changes from negative to positive values closer to equilibrium potential for Na^+. This is referred to as *depolarization*.

The transmembrane potential approaches 30mV.	Sodium channel close (are inactivated). Voltage-regulated potassium channels are fully opened.	Electrical and chemical gradients favour movement of K^+ out of the cell. The loss of positive charges brings the transmembrane potential back toward resting levels. This is referred to as *repolarization.*
Voltage-regulated potassium channels remain open longer than sodium channels.	More K^+ leave the cell than the amount of Na^+ that entered.	Transmembrane potential is slightly lower than the resting transmembrane potential - called *hyperpolarization*.
Sodium-potassium pumps help to re-establish correct ion concentration gradients across the membrane.	Na^+ are removed from the cytoplasm and K^+ are moved back in.	Resting transmembrane potential has been restored.

Refractory period:

Type	Period	Consequence
Absolute refractory period	From the moment the sodium channels open at the threshold until the sodium channels are inactivated.	The membrane cannot respond to an additional stimulus because the membrane cannot depolarize.
Relative refractory period	From the time sodium channels are inactivated (regain their normal resting conditions - closed) until the membrane potential stabilizes at resting levels.	Another action potential can occur if the membrane is sufficiently depolarized. This depolarization requires a larger-than-normal stimulus due to the hyperpolarization of the membrane.

Propagation of Action Potential:

Type	Type of Axon	Velocity	Propagation
Continuous	Unmyelinated	Slower propagation	The action potential begins at the initial segment. A local current develops with the movement of Na^+ towards the inside of the cell. This current depolarizes adjacent portions of the membrane. An action potential is developed at this new location. The process then continues through the cell membrane.
Saltatory	Myelinated	More rapidly	Myelin increases resistance to ions entering or leaving the axon so the internodes cannot depolarize. Only the nodes of Ranvier can respond to a depolarizing stimulus so the local current skips the internodes and depolarizes the next nearest node.

Synapses: junction that mediates information transfer from one neuron to the next one or to an effector cell

Type	Location	General characteristics	Consequence
Electrical synapses	Some areas of the brain, eye, and the ciliary ganglia.	Rarely occurs. The presynaptic and postsynaptic membranes are locked together.	Changes in the transmembrane potential of one cell produce local currents that affect the other cell. Very quick and efficient propagation.
Chemical synapses	Most communication between neurons and all communication between neurons and other types of cells.	The cells are not directly coupled. Its activity can be adjusted by many factors.	An arriving action potential may or may not release enough neurotransmitters to bring the postsynaptic neuron to the threshold.