# Action Potential Figure Caption

**Action Potential Graph with Respective K+ and Na+ Channels (Center).**

As the neuronal plasma membrane reaches the threshold potential (~55mV), the activation gates of voltage-gated sodium channels (green) open, allowing sodium (Na+) ions to move into the cell and resulting in membrane depolarization. During this period, the inside of the neuron is positive with respect to the outside due to the greater amount of positive ions present in the cytosolic side of the membrane. As more Na+ ions move into the cell, the membrane potential increases, causing more voltage-gated Na+ channels to open (positive feedback). Once the membrane potential reaches ~ +40mV, the inactivation gates of voltage-gated Na+ channels begin to close, and voltage-gated potassium channels (purple) open. Potassium (K+) ions flow out of the cell, resulting in membrane repolarization. This efflux of K+ renders the extracellular side of the membrane positive with respect to the cytosolic side. As the membrane voltage becomes more negative, more voltage-gated K+ channels open. These channels exhibit negative feedback, for their opening leads to repolarization of the membrane and thus their own closing. Voltage-gated K+ channels take longer to become inactivated than voltage-gated Na+ channels, thus resulting in more efflux of K+ ions and a drop in membrane potential below the resting potential. This is referred to as the refractory period, or undershoot, of an action potential. Once the membrane potential reaches ~ -90 mV, voltage-gated K+ channels begin to close, and the membrane potential slowly returns to its resting state. The Na+/K+ ATPase (pink) remains active in the background at every point during the action potential and helps restore the concentration gradients of Na+ and K+ ions, thus restoring the resting membrane potential.

**Movement of an Action Potential Across a Neuron (Top Right).**

After the dendrites of a postsynaptic neuron receive a strong enough stimulus that overcomes the threshold potential, an action potential travels down the axon, resulting in a change of polarity across the axonal plasma membrane. The action potential travels in only one direction until it reaches the axon terminal, where it can transfer the signal to neighboring neurons. The red arrows indicate Na+ ions entering the cell after the opening of voltage-gated Na+ channels and causing membrane depolarization in a segment of the neuron. This depolarization triggers the depolarization of the next segment via the opening of more voltage-gated Na+ channels. The opening of voltage-gated K+ channels following membrane depolarization results in the movement of K+ ions out of the cell as shown by the green arrows. Thus, as more voltage-gated Na+ channels are triggered to open further down the axon, voltage-gated K+ channels follow closely behind, repolarizing the membrane. The "movement" of the action potential down the axon is shown by the horizontal arrows in pink.

**Cross Section of a Neuron at Rest (Top Left).**
Voltage-gated K+ and Na+ channels, leak channels, and the Na+/K+ ATPase all contribute to the membrane potential of a neuron. Calcium channels and other channels found in the neuronal plasma membrane are not depicted in the figure. The resting membrane potential of a neuron is established by the selective permeability of the plasma membrane to K+ and Na+ ions, as well as the concentration gradients of these ions. In a neuron at rest, the concentration of Na+ ions is greater outside of the cell, while the concentration of K+ ions is greater inside of the cell. This unequal distribution of ions creates a concentration gradient across the membrane. Additionally, there is a higher concentration of positive charges on the outside of the cell with respect to the inside, which establishes an electrical gradient. Leak channels for K+ (red) and Na+ (teal) allow these ions to diffuse down their concentration gradients. The plasma membranes of neurons contain more K+ leak channels than Na+ leak channels, and thus the cells are more permeable to K+ ions. Due to the unequal amount of K+ to Na+ leak channels, the resting membrane potential of a neuron is closer to the potassium equilibrium potential than it is to the sodium equilibrium potential. In order to maintain the concentration gradient that is disrupted by this passive diffusion, the neurons use the Na+/K+ ATPase (pink) to pump 3 Na+ ions out of the cell for every 2 K+ ions brought into the cell. The pump actively transports Na+ and K+ ions against their electrochemical gradients, maintaining steady Na+ and K+ concentration gradients, which in turn contribute to the resting membrane potential.