Name and Block:_____

You will need a computer to access the PhET simulation for this activity. Navigate to *https://phet.colorado.edu/sims/html/neuron/latest/neuron_all.html* or click the link on the course webpage.

Background

When a nerve cell is stimulated, it triggers what is known as an action potential. An action potential is the change in electrical potential that propagates (travels) along the membrane of a nerve cell. This is how information moves through our nerves!

In this activity, you'll be investigating the changes that take place in a nerve cell during an action potential. Pay close attention to the locations and movement of ions, changes in electrical potential, and membrane proteins that are involved.

Getting Started

Open the PhET simulation. The image shown represents a cross-section of the nerve axon. (What's a cross-section? Imagine laying a nerve cell lengthwise along an x-axis and slicing through it along the y-axis: that's how you get a cross-section.) The yellow represents the plasma membrane of the axon. The myelin sheath is not shown here.

When you click "Stimulate Neuron," you'll notice a purple and yellow thing moving down the length of the axon: this represents the action potential. What you'll be observing in this activity is what happens when the action potential reaches this cross-section of axon. You are not observing the entire nerve cell, just a tiny fraction of its membrane. The changes you observe here are what happen down the entire length of the neuron.

In the box labeled **Show** start by checking all of the boxes. This will allow you to see everything that is going on. Hit the **Stimulate Neuron** button on the lower right corner of the simulation to simulate an action potential. You can pause the simulation at any time, scroll back on the potential chart to rewind, zoom in/out, and speed up or slow down the animation.

Take several minutes to play around with this simulation and get comfortable with it. What happens when you check or uncheck boxes or click different buttons? You're not going to break it, so go ahead and click everything.

After you're comfortable with the various settings, use the simulation to answer the questions below. Pro tip: You're going to need to zoom in and change the speed to really understand what's happening as you work through these questions.

When you're ready to start answering questions, check ALL of the boxes in the section labeled "Show."

1. Observe the membrane closely while the axon is at rest.
   (a) Which membrane channels are open?

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   (b) Which membrane channels are closed?

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2. Are there more open or closed channels present in the membrane when the axon is at rest?

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3. The concentrations of sodium and potassium ions are different inside and outside the membrane. Which direction will sodium ions move as a result of facilitated diffusion through the "leak" channels? Potassium ions?

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4. Which side of the neuron is negatively charged - inside the neuron or outside?

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5. This simulation only shows positively charged ions. How can one side of the membrane have a net negative charge in this scenario? What must be present but not shown in the image?

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6. On the axes provided, sketch the graph that is generated when you click **Stimulate Neuron**. Include all necessary titles, labels, and units! (This does not need to be perfect, so don't bother writing every number or filling in grid lines.)

	At Rest (0-2 ms)	Peak of Action Potential (~2.7 ms)	Immediately After Action Potential (4 ms)
Membrane potential (mV)			
Which side of the membrane has a net negative charge?	Inside / Outside	Inside / Outside	Inside / Outside
Which side of the membrane has a greater concentration of sodium ions?	Inside / Outside	Inside / Outside	Inside / Outside
Which side of the membrane has a greater concentration of potassium ions?	Inside / Outside	Inside / Outside	Inside / Outside
State of the gated channels?	Open / Closed	Open / Closed	Open / Closed / Closing

7. In your own words, summarize what happens during the action potential of a neuron. Include sketches.

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