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**Simulation Lab**

*Action Potential Generation*

Go to the following website: <http://phet.colorado.edu/en/simulation/neuron> and click on “Run Now!” to start the simulation.

Experimental Question: *How do the ionic concentrations of sodium (Na+) and potassium (K+) and the relative permeability of these ions affect the membrane potential of the cell at rest and during an action potential?*

Take a few minutes to play around with this simulation, and then use the simulation to answer the following questions.

In your control box, click on all the boxes such that all of them are checked. This will allow you to see everything that is going on. Hit the “Stimulate Neuron” button on the upper left corner of the simulation to simulate an action potential. You can pause the simulation at any time and scroll back on the potential chart to rewind.

1. If changes in ionic concentration cause the membrane potential to change during an action potential, predict what you would observe.
2. Run the simulation and record the following:

AT REST PEAK of ACTION POTENTIAL:

Membrane potential: Membrane potential:

[Na+] Outside: [Na+] Outside:

[Na+] Inside: [Na+] Inside:

[K+] Outside: [K+] Outside:

[K+] Inside: [K+] Inside:

1. Based on the results, what can you conclude about your prediction above?

What about the role of relative permeability of the ions? Before looking at that, let’s calculate the equilibrium (Nernst) potential of the two ions.

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1. Plugging in the concentrations of sodium and potassium, calculate the equilibrium potentials for sodium and potassium.

ENa = EK =

If the cell is more permeable (easier to cross the membrane) to sodium, the membrane potential will become closer to the equilibrium potential of sodium (ENa). If the cell is more permeable to potassium, the membrane potential will become closer to the equilibrium potential of potassium (EK).

1. Based on this information, predict the relative permeability of sodium and potassium at rest, during the upstroke of the action potential, and during the down stroke of the action potential.
2. Observe the sodium and potassium ions passing across the membrane during the simulation. You might want to slow down the simulation speed and use the zoom feature to get a closer view. Do these observations agree with your prediction?
3. What type of membrane bound protein regulates the flow of sodium and potassium ions?
4. The drug ouabain inhibits the function of the sodium-potassium pump. Predict the short-term and long-term effects of ouabain on the excitability of a neuron.