Name: ___________________________________ Date: _______________________ Period: _____

Nervous System Worksheet

Thank you to Flinn Scientific for the original version of this assignment!

Part 1: Neuron Structure and Resting Potential

Why?

Cells are specialized for different functions in multicellular organisms. In animals, one unique kind of cell helps organisms survive by collecting information and sending messages throughout the body. The shapes and features of neurons, which are the primary cells in the nervous system, enable animals to experience all of the five senses; find food, mates, and shelter; and to survive in their diverse environments.

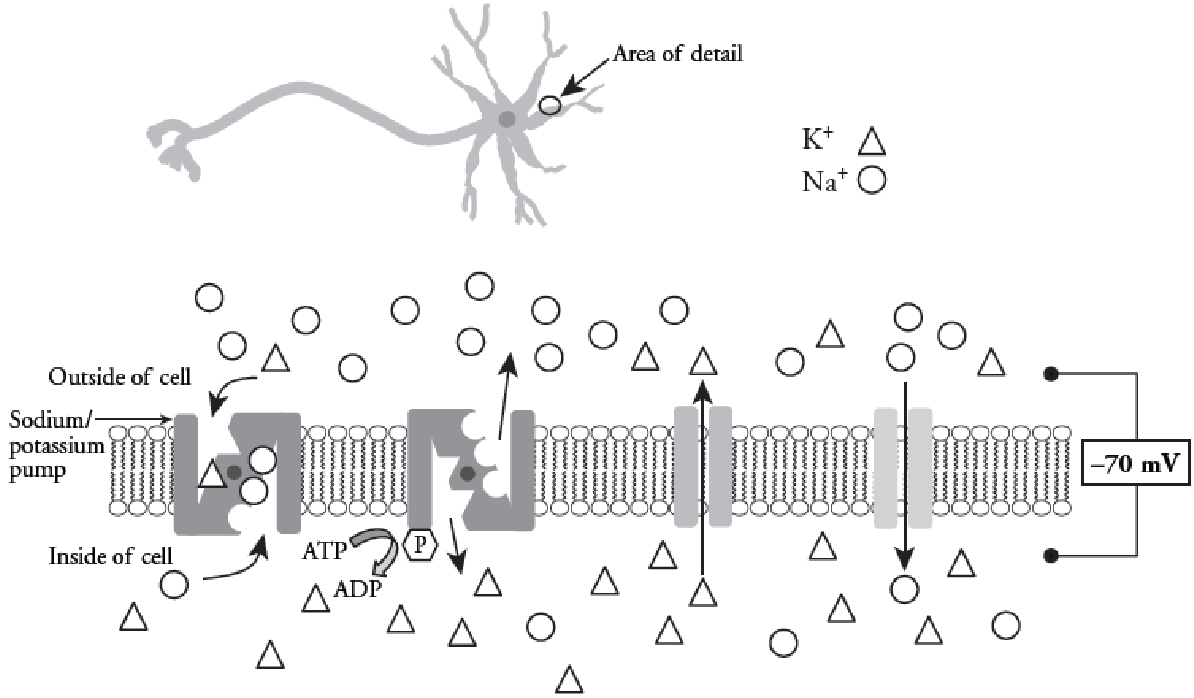
Model 1 – Parts of a Neuron

1. Model 1 is an illustration of two neurons. Label one of the neurons in the diagram with the following structures:

Cell body or soma	Axon
Cell nucleus	Synapse
Dendrites	

2. Which structure(s) on the neuron in Model 1 would receive a signal from either a sensory cell (taste bud, touch receptor, retinal cell) or from another neuron?

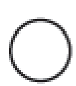
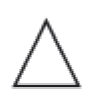
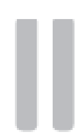
Model 2 – Membrane Potential



****Note: The two protein channels on the right side of the image are “leaky” K+ (left) and Na+ (right) channels that allow small amounts of K+ to exit the cell (left) and small amounts of Na+ to enter the cell (right) moving down their individual concentration gradients. We only discussed leaky K+ channels in class, but leaky Na+ channels exist as well. This picture shows a small amount of K+ and Na+ leaking through these channels, however, is not enough to negate the action of the Na+ / K+ pump, which establishes the resting membrane potential at -70 mV.****

3. What would you call the structure shown in detail in Model 2? (Hint: Look at the neuron at the top of the picture for reference.)

4. Identify each of these symbols in Model 2.

5. Consider Model 2.
a. Which side of the membrane has more sodium ions when the neuron is at rest?

b. Briefly explain why sodium ions cannot cross the membrane without the use of a protein channel. (Use what you know about the types of particles that can and cannot pass through a lipid bilayer / cell membrane.)

c. Which direction should sodium ions flow naturally if a channel is provided?

6. Consider Model 2.
a. Which side of the membrane has more potassium ions when the neuron is at rest?

b. Which direction should potassium ions flow naturally if a channel is provided?

7. The embedded proteins in Model 2 illustrate both active and passive transport. What evidence from Model 2 supports the idea that one of the types of embedded proteins use active transport?

8. Does the sodium/potassium ion pump move sodium ions into or out of the cell when activated?

9. Does the sodium/potassium ion pump move potassium ions into or out of the cell when activated?

10. What is the ratio of sodium ions to potassium ions that are moved through the sodium/ potassium ion pump each cycle?

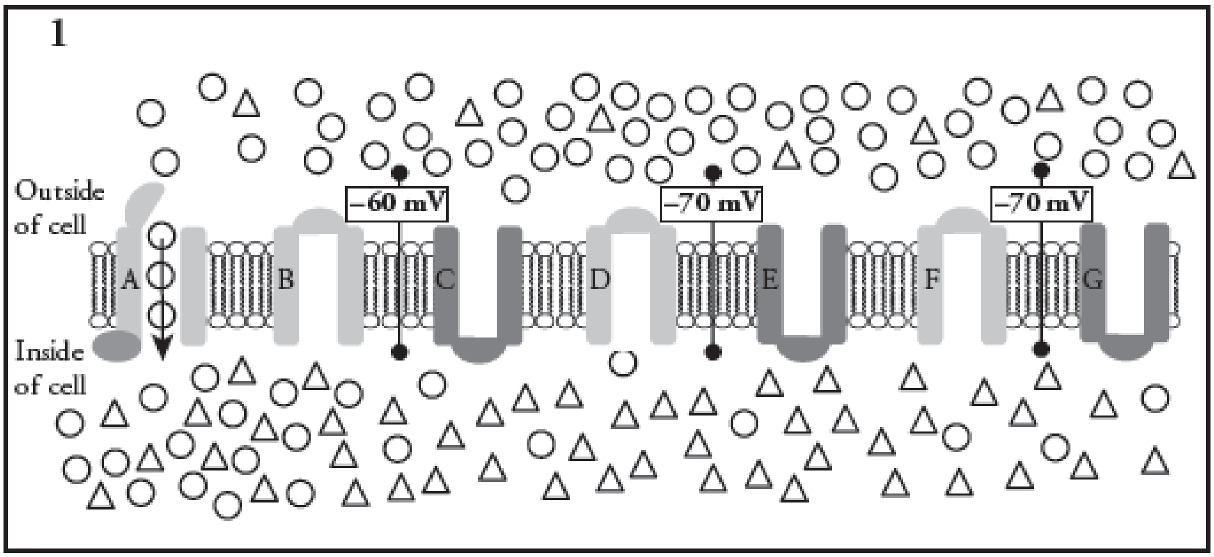
11. The diagram in Model 2 shows a voltage or potential across the membrane. What is the **resting membrane potential** of a neuron? (Be sure to include units.)

Part 2: Action Potential

Why?

Just as the coaxial cables that run down your street or through your house carry television and Internet signals, the job of a neuron is to move an electrical signal from one place to another in order to send sensory messages throughout the body. In a previous activity you saw how a membrane potential is formed at rest. In this activity you will explore how changes in membrane potentials can propagate a signal down the axon of a neuron.

Model 1 – An Action Potential



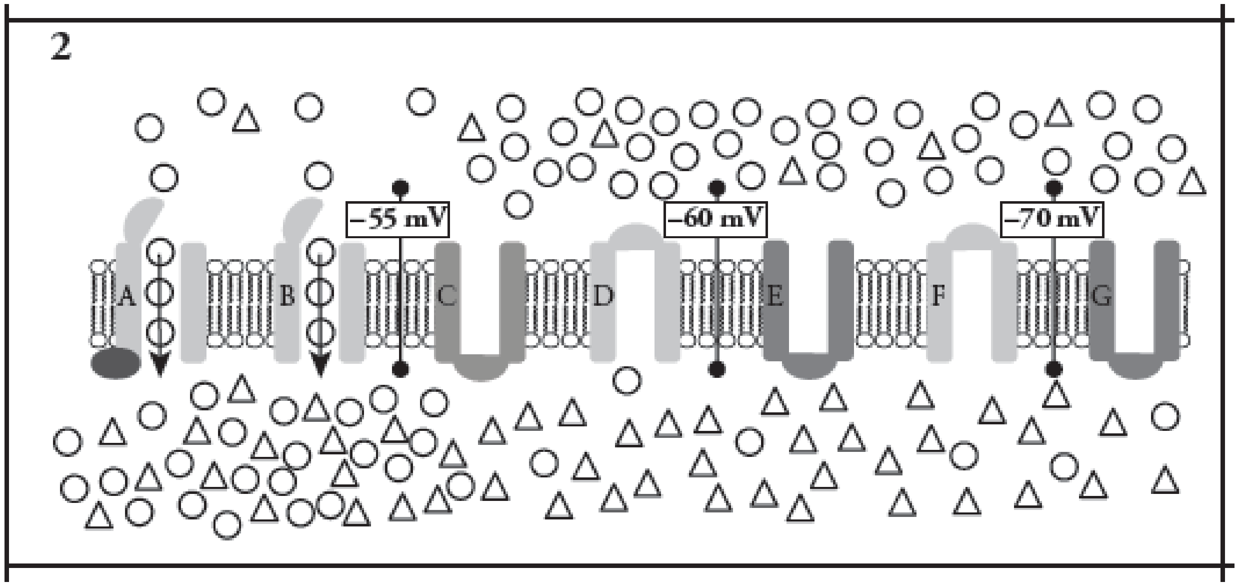
12.

a. What type of channel is opening in Image 1 of Model 1? (Note: I am referring to Channel A… and a signal molecule is binding to Channel A to get it to open.)

Your options are… voltage-gated K+ channel, voltage-gated Na+ channel, and ligand-gated Na+ channel.

b. What types of ions (Na+ or K+) are flowing through the channel and in what direction (into or out of the cell)?

c. How does this affect the membrane potential in the nearby area?



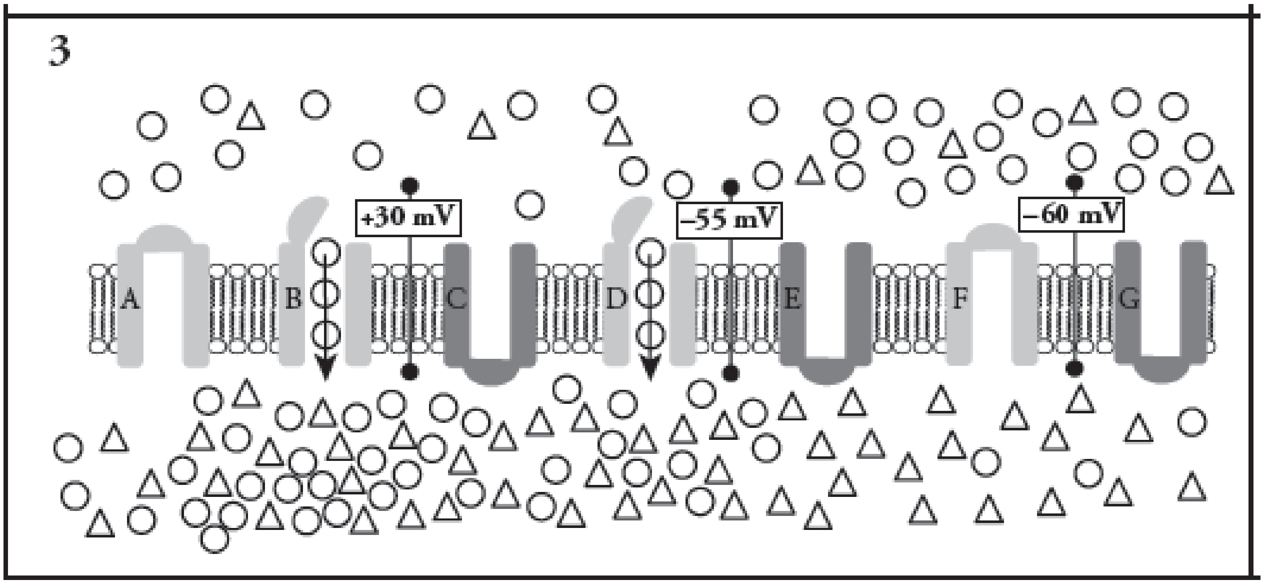
13.

a. What type of channel is opening in Image 2? (Note: I am referring to Channel B)
Your options are… voltage-gated K+ channel, voltage-gated Na+ channel, and ligand-gated Na+ channel.

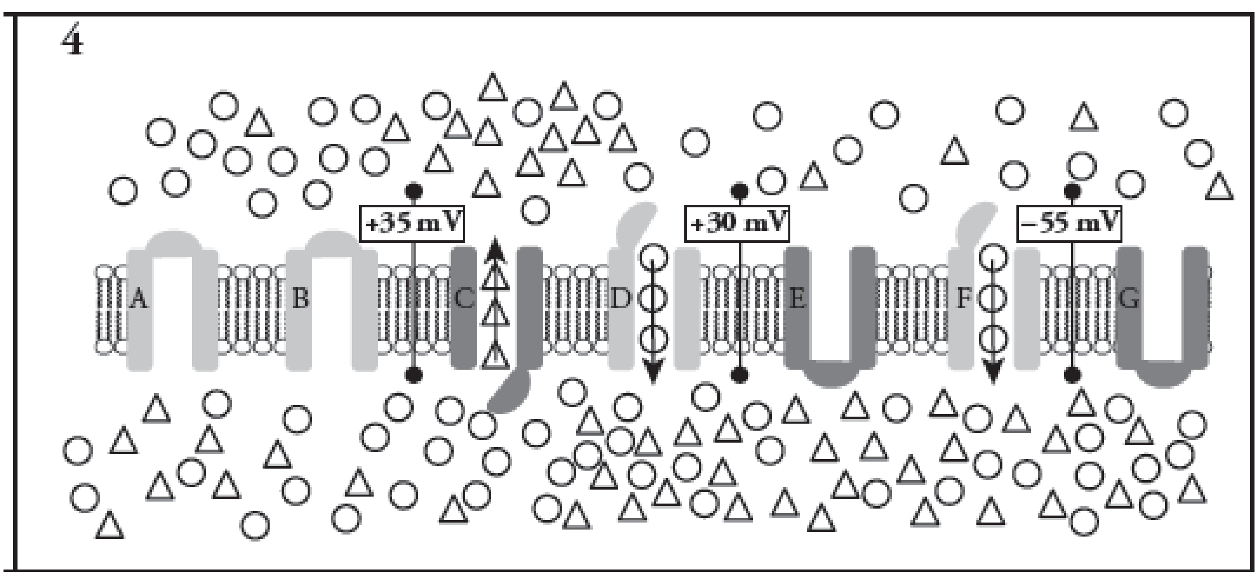
b. What types of ions (Na+ or K+) are flowing through the channel and in what direction?

c. How will this affect the membrane potential in the nearby area?

d. What stages of the action potential (i.e. threshold, depolarization, repolarization, hyperpolarization) are shown near Channels A and B in the picture? Hint: There are two! Explain your answer.



14. How is the signal (aka action potential) moving down the neuron in Image 3? You should discuss what is happening at Channel D in your response! (Hint: Channel D is the same type of channel as channel B.)



15.
a. What type of channel is opening in Image 4? (Note: I am referring to Channel C, which is the same type of channel as Channels E and G)
Your options are… voltage-gated K+ channel, voltage-gated Na+ channel, and ligand-gated Na+ channel.

b. What types of ions (Na+ or K+) are flowing through the channel and in what direction?
c. How will this ultimately affect the membrane potential in the nearby area?

d. What stages of the action potential (i.e. threshold, depolarization, repolarization, hyperpolarization) are happening (or will happen) near Channel C in the picture? Hint: There are two! Explain your answer.

16. How is the signal moving down the neuron in Image 4 of Model 1? You should discuss what is happening at Channel F in your response! (Hint: Channel F is the same type of channel as channel B and channel D.)

17. Examine the graph of a membrane potential below. Did the voltage-gated Na+ channel in this section of the membrane open? Explain your answer using information from the graph and the term "threshold."