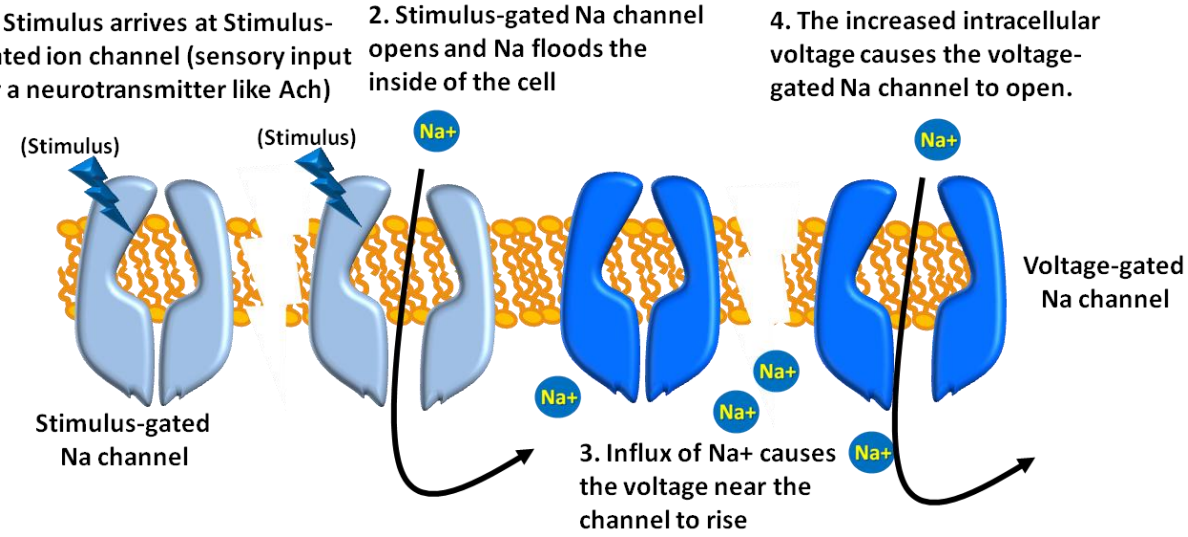
Conduction of Action Potentials and Synapses

"How does an action potential get from one cell to another?"

Model 1: There are multiple types of ion channels in excitable cells



Critical Thinking Questions

1. According to the model, what are some examples of stimuli that can cause a stimulus-gated Na channel to open?

2. According to the model, what causes the voltage-gated Na channels to open?

    a. Small increases in potential will not cause these channels to open. What do you the group) think is the term for the actual potential value that will cause these channels to open (the point of no return)?

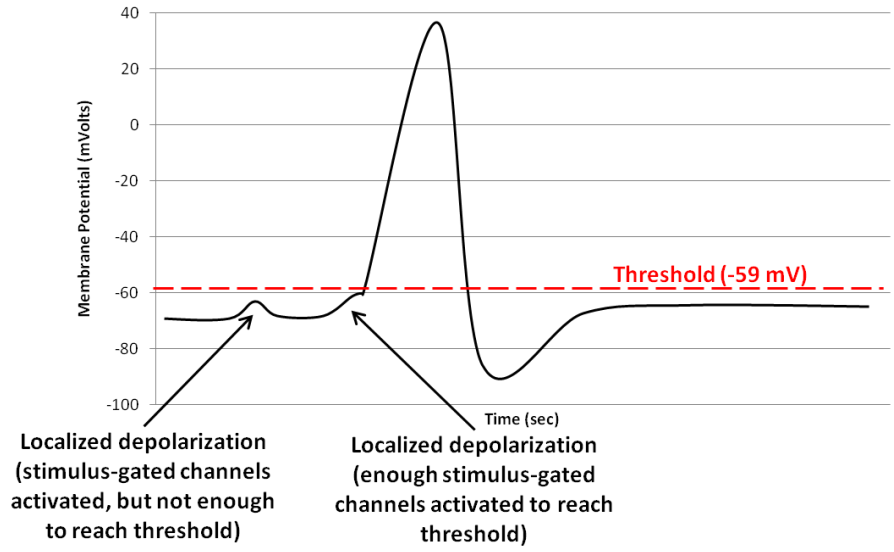
Application

3. Imagine a whole string of voltage-gated sodium channels lined up in a row on a membrane. As the first one reaches threshold and opens, what will happen to the voltage of the cell near that channel?

    a. What will that do to the voltage-gated Na channel next to it?

    b. What will that do to the voltage-gated Na channel next to that one? (do you see a pattern here?)

Model 2: Action Potential



Critical Thinking Questions

4. According to the model, what causes localized depolarization that doesn't result in the cell reaching threshold?

    a. Do you think that the nerve cell is actively conducting a signal when these events occur?

5. Indicate on the graph where the **voltage-gated sodium channels** come open.

6. There are also **voltage-gated potassium channels** on these membranes. Indicate where on the graph these channels come open (hint: think about what **repolarizes** the cell).

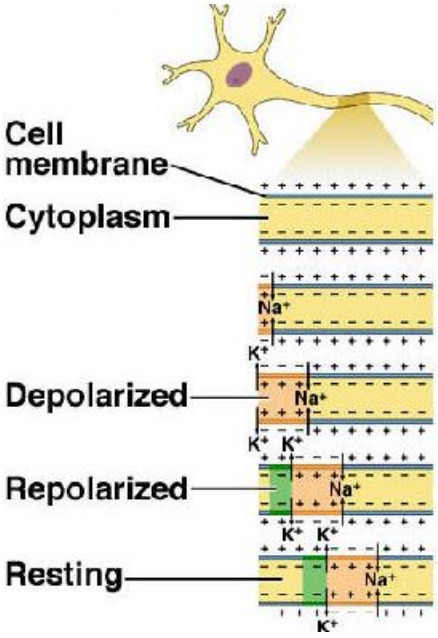
    a. Indicate on the graph where these voltage-gated potassium channels close.

Application

7. A nerve cell is like a light switch, it's either actively conducting or it's not. Using the picture to the right as a stand-in for a neuron, show which positions indicate that the neuron is at

    1. Resting membrane potential
    2. Localized depolarizations
    3. Action potential

Model 3: Action Potential Propagation



Critical Thinking Questions

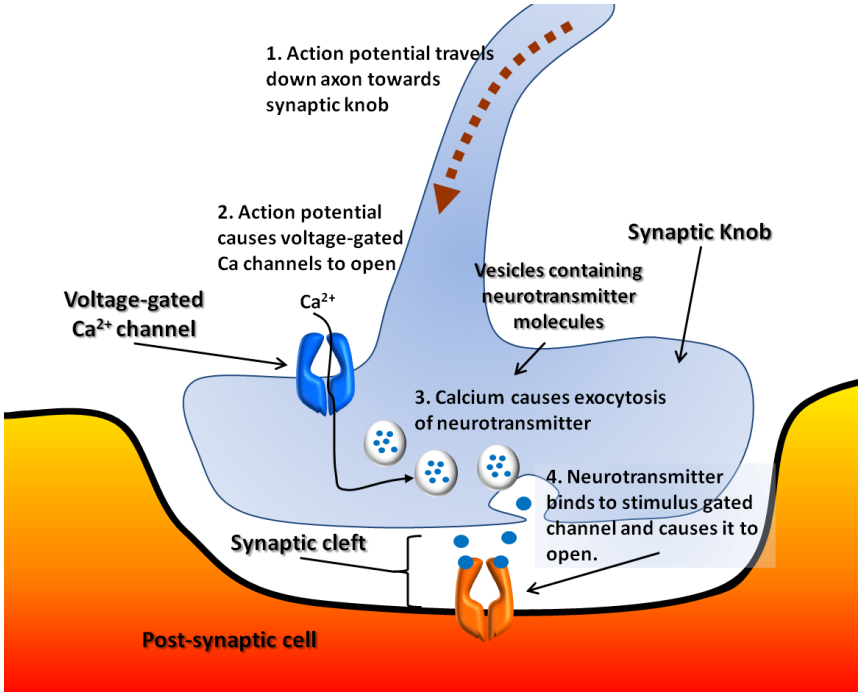
8. What portion of the neuron is being highlighted in this model?

9. Draw an arrow on the small picture of the neuron to indicate the direction the action potential is traveling.

Application

10. Based on this model and the first model, write a consensus explanation for the mechanism by which an action potential travels from the cell body (soma) down the axon.

Model 4: A Synapse



11. Based on the model, would you consider the synaptic knob to be part of the pre-synaptic or post-synaptic cell?

12. What causes the voltage-gated calcium channels to open?

13. What is the effect of calcium ions entering the cell?

14. What kind of channel opens in response to binding a neurotransmitter?

Application

15. If the channel in the post-synaptic cell were a K+ channel, would opening it stimulate or inhibit the post-synaptic cell?

Exercise

1. On a clean sheet of paper, create a flow chart that illustrates all the events involved in a cell reaching threshold, propogation of the action potential down the axon of the cell, and transmission of the signal to the next cell in the pathway (the post-synaptic cell). You may use your textbook for this.

Everyone should work individually and we will compare your flowcharts together.