Signals in Motion

Model how a nerve signal travels within and between neurons

HAP.5.a "Use a model to illustrate the role of action potentials in neural transmission."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where the passage describes an electrical signal moving along an axon, circle where it describes chemical signaling between neurons, and number the steps from skin to brain in order.

The Cold Bottle Signal

1. A student lifts a chilled metal water bottle. Temperature-sensitive endings in the skin respond to the cold, and a sensory neuron can produce an action potential if its membrane reaches threshold. An action potential is a brief change in voltage across the neuron's membrane. At one spot on the axon, sodium ions (Na^+) enter; afterward, potassium ions (K^+) leave as the membrane returns toward its resting state. This sequence triggers a similar change in the next stretch of membrane. The signal travels along the axon; the ions themselves do not race from fingertip to brain.

2. To model the route, represent each neuron as a separate path and each synapse as a gap between paths. The action potential travels along a sensory axon toward the central nervous system. At a synapse, its arrival can cause chemical messengers to leave the sending cell. Those messengers cross the tiny gap and may help the receiving neuron reach threshold, starting a new action potential there. An action potential does not jump through the gap as an electrical spark. In this bottle example, signals through connected neurons reach parts of the brain that process the cold sensation.

3. A model also needs to show what changes when the stimulus changes. If the bottle is colder, activated sensory neurons may fire action potentials more often. Each action potential in a given axon still has roughly the same size; a stronger stimulus does not make each spike taller. Arrows can show where signals travel, short marks can show when spikes occur, and a gap can show a synapse. Such a model leaves out many cells and chemical details, but it can still test a key claim: information moves along an axon as repeated electrical events and between neurons through chemical signaling.

2 ANSWER WITH EVIDENCE

Use the passage

1. A model labels one arrow, "Na^+ ions travel from skin to brain." How would you change that part of the model?

2. A model shows one continuous voltage spike crossing a gap between two neurons. What should the model show at the gap instead?

3. Suppose a colder bottle makes the same sensory axon fire more often. In a model that uses short marks for spikes, should the marks become taller or closer together? Explain.

4. Chemical messengers reach a receiving neuron, but it does not reach threshold. What must a model leave out on that neuron's axon?

3 YOUR TURN

Your own words

In three panels, model how hearing a sudden bell can lead you to turn your head. Show hearing receptors, a sensory neuron, brain neurons, a motor neuron, and neck muscle; label action potentials along axons and chemical signaling between neurons, and add a short caption to each panel.

Signals in Motion

PART 1 · READ AND MARK

Underline where the passage describes an electrical signal moving along an axon, circle where it describes chemical signaling between neurons, and number the steps from skin to brain in order. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A model labels one arrow, "Na^+ ions travel from skin to brain." How would you change that part of the model?	**Label the arrow as action potentials traveling along the sensory axon. Na^+ enters at successive spots; the ions do not travel from skin to brain.**
2	A model shows one continuous voltage spike crossing a gap between two neurons. What should the model show at the gap instead?	**Show chemical messengers crossing the synaptic gap, with a new action potential starting in the receiving neuron if it reaches threshold.**
3	Suppose a colder bottle makes the same sensory axon fire more often. In a model that uses short marks for spikes, should the marks become taller or closer together? Explain.	**The marks should be closer together because the action potentials occur more often, while each remains roughly the same size.**
4	Chemical messengers reach a receiving neuron, but it does not reach threshold. What must a model leave out on that neuron's axon?	**Leave out a new action potential on that axon because the receiving neuron did not reach threshold.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: Bell vibrations activate hearing receptors. Spike marks and an arrow show action potentials traveling along a sensory axon toward the brain.
Panel 2: At a synapse, chemical messengers cross from the sensory neuron to a brain neuron. Action potentials then travel along the brain neuron's axon.
Panel 3: Chemical signaling between neurons helps start action potentials in a motor neuron. They travel along its axon to the neck muscle, where signaling causes contraction and a head turn.

Accept models that show action potentials traveling along axons and chemical messengers crossing neuron-to-neuron synapses. Students may include additional brain neurons or a chemical signal from the motor neuron to the muscle.