From Bell to Step

Trace how electrical and chemical signals shape a response.

SS24.P.5a "Describe communication between neurons and the electrochemical process, including the role of neurotransmitters in behavior.*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline electrical steps within a neuron, circle chemical steps between cells, and number three events in the order they help Maya move her foot.

A Bell in the Bike Lane

1. A bicycle bell sounds as Maya starts to step into a bike lane. Her ears turn sound vibrations into signals in sensory neurons. Neurons do not pass a continuous current directly from cell to cell. Within one neuron, charged particles called ions move across its membrane. If incoming signals push the neuron past a threshold, it produces an action potential, a brief electrical change that travels down its axon. This is an all-or-none event: a stronger input can increase how often action potentials occur, not make each one larger. The signal can then reach a junction with another cell.

2. At the axon's end, an action potential opens channels for Ca^{2+}. The movement of these ions helps trigger the release of chemical messengers called neurotransmitters. They cross a tiny gap, the synapse, and bind to receptors on the next neuron. Receptor activity can make that neuron more likely or less likely to reach its own threshold. For example, glutamate usually increases the chance of firing, while GABA usually decreases it. If the next neuron reaches threshold, its own action potential begins. The first neuron's electrical signal has not simply jumped across the gap. Reuptake into cells or chemical breakdown helps end a neurotransmitter's effect.

3. In Maya's brain, networks process the bell and her position near the lane. Some synapses make particular neurons more likely to fire, while others make them less likely to fire. Those combined effects help shape which signals continue through the network. Messages eventually reach motor neurons, whose activity helps Maya pull her foot back. Acetylcholine released by motor neurons at their connections with muscle fibers helps trigger muscle contraction. No single neurotransmitter commands the whole choice to move: behavior depends on patterns of activity across many cells, the situation, and past learning.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does a signal become an action potential and travel within one neuron?

2. How can an action potential in one neuron lead to an action potential in the next neuron?

3. How might glutamate and GABA have different effects on which signals continue through Maya's brain?

4. What role does acetylcholine play when Maya pulls her foot back, and why does it not explain the whole behavior?

3 YOUR TURN

Your own words

Imagine you feel a mug starting to slip and tighten your grip. In four or five sentences, trace a possible path from sensing the slip to moving your muscles, including an electrical event, a chemical step at a synapse, and why no single neurotransmitter determines your action.

From Bell to Step

PART 1 · READ AND MARK

Underline electrical steps within a neuron, circle chemical steps between cells, and number three events in the order they help Maya move her foot. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does a signal become an action potential and travel within one neuron?	**Incoming signals bring the neuron past threshold. Ions move across its membrane, producing an action potential that travels down the axon.**
2	How can an action potential in one neuron lead to an action potential in the next neuron?	**At the axon's end, the action potential opens Ca^{2+} channels, helping trigger neurotransmitter release. Neurotransmitters cross the synapse and bind to receptors. If the next neuron reaches threshold, it produces its own action potential.**
3	How might glutamate and GABA have different effects on which signals continue through Maya's brain?	**Glutamate usually makes a receiving neuron more likely to fire, while GABA usually makes it less likely to fire. Their effects help shape which signals continue through the network.**
4	What role does acetylcholine play when Maya pulls her foot back, and why does it not explain the whole behavior?	**Motor neurons release acetylcholine at muscle fibers to help trigger contraction. Pulling her foot back also depends on activity across many cells, the situation, and past learning.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Touch receptors in my fingers detect the mug slipping, and incoming signals can bring a sensory neuron to threshold. Ion movement across its membrane produces an action potential that travels along its axon. At a synapse, the signal triggers neurotransmitter release, and receptors on the next neuron affect whether it reaches threshold. Some synapses increase firing while others reduce it, so activity across a network helps guide my response. Motor neurons release acetylcholine at muscles to help tighten my grip; no single neurotransmitter alone determines that movement.

Accept other accurate paths that distinguish electrical signaling within neurons from chemical signaling across synapses. Students should connect neurotransmitter effects to the likelihood of further firing without treating one chemical as the sole cause of behavior.