Signals and Choices

Trace how brain activity shapes a response

SS24.P.5 "Describe the structure, biochemistry, and circuitry of the brain and nervous system, and explain their roles in human behavior and mental processes.* 5a Describe communication between neurons and the electrochemical process..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the steps that carry or change a signal, circle named brain regions, and number the two different ways nicotine and botulinum toxin change signaling.

When a Phone Buzzes

1. A phone buzzes while Maya studies. Sensory neurons carry information from her skin toward her spinal cord and brain. Within a neuron, an electrical impulse travels down its axon. At the axon tip, the impulse triggers the release of chemical messengers called neurotransmitters into a tiny gap, the synapse. These chemicals bind to receptors on the next cell and can make it more or less likely to fire its own impulse. The signal ends when the chemicals are taken back up, broken down, or allowed to drift away. This sequence helps turn a vibration into a thought: Should I look?

2. If Maya looks at her phone, her occipital lobe processes the screen's shapes, and her temporal lobe helps process its notification sound. Her parietal lobe tracks where the phone is, while her frontal lobe helps her choose whether to answer. The left and right cerebral hemispheres communicate across connecting fibers, so these tasks are not split between two independent minds. The cerebellum helps coordinate the hand movement needed to pick up the phone. An EEG records electrical patterns using sensors on the scalp with precise timing. An fMRI detects blood oxygen changes linked to activity and helps locate active brain regions. Neither reads Maya's exact thoughts.

3. Maya's friend says nicotine helps him focus while studying. Nicotine, a psychoactive drug, binds to certain acetylcholine receptors and can increase dopamine signaling in reward circuits. Repeated use can strengthen learned links between studying and nicotine, encouraging cravings. With repeated exposure, the brain adapts, so the same amount may have less effect, called tolerance. Stopping can bring withdrawal symptoms such as irritability and difficulty concentrating. By contrast, botulinum toxin blocks acetylcholine release where motor neurons meet muscles, weakening muscle contractions. Both substances disrupt chemical signaling, but nicotine activates certain receptors and can reinforce repeated use, while botulinum toxin prevents transmitter release at this junction.

2 ANSWER WITH EVIDENCE

Use the passage

1. Trace the signal from the phone's vibration to Maya's thought. Where does electrical signaling occur, and where does chemical signaling occur?

2. If Maya picks up the phone, how do two cerebral lobes and the cerebellum contribute different parts of that response?

3. A researcher wants to know both when Maya's brain activity changes and which regions are active. Which technology in the passage is better suited to each question, and why?

4. How do nicotine and botulinum toxin change signaling in different ways? Explain how repeated nicotine use could also lead to withdrawal symptoms.

3 YOUR TURN

Your own words

Imagine a runner hears a starting whistle and begins to sprint. In four or five sentences, explain how a signal crosses a synapse, how two named brain regions work together during the start, and how repeated nicotine use could affect the runner's behavior over time.

Signals and Choices

PART 1 · READ AND MARK

Underline the steps that carry or change a signal, circle named brain regions, and number the two different ways nicotine and botulinum toxin change signaling. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Trace the signal from the phone's vibration to Maya's thought. Where does electrical signaling occur, and where does chemical signaling occur?	**Sensory neurons carry information toward the spinal cord and brain. Electrical impulses travel along axons; at synapses, released neurotransmitters bind to receptors on the next cell.**
2	If Maya picks up the phone, how do two cerebral lobes and the cerebellum contribute different parts of that response?	**For example, the occipital lobe processes the screen's shapes, the frontal lobe helps Maya choose whether to answer, and the cerebellum coordinates her hand movement.**
3	A researcher wants to know both when Maya's brain activity changes and which regions are active. Which technology in the passage is better suited to each question, and why?	**EEG is better suited to timing because it records electrical patterns with precise timing. fMRI helps locate active regions by detecting blood oxygen changes.**
4	How do nicotine and botulinum toxin change signaling in different ways? Explain how repeated nicotine use could also lead to withdrawal symptoms.	**Nicotine activates certain acetylcholine receptors and can increase dopamine signaling; botulinum toxin blocks acetylcholine release where motor neurons meet muscles. With repeated nicotine exposure, the brain adapts, so stopping can cause withdrawal symptoms such as irritability.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The runner hears the whistle, and the temporal lobe processes its sound. An electrical impulse reaches a neuron's axon tip, causing neurotransmitters to cross a synapse and bind to receptors on another cell. The frontal lobe helps the runner decide to start, and the cerebellum helps coordinate the first steps. If the runner repeatedly uses nicotine, dopamine signaling can reinforce use, tolerance may develop, and stopping could bring irritability that interferes with concentration.

Accept other accurate combinations of brain regions when their roles fit the runner's response. Responses should distinguish electrical signaling within a neuron from chemical signaling across a synapse.