Signals at the Stove

Trace a quick response and evaluate what brain research can show.

HAP.5 "Obtain, evaluate, and communicate information explaining the relationship between the structures and functions of the central nervous system and the peripheral nervous system. a..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each named CNS or PNS structure, circle the electrical and chemical signals that carry information, and number the steps from the skin receptor to the muscle.

A Split-Second Response

1. While making soup, you brush a hot pot handle with a fingertip. Heat-sensitive receptors in the skin convert the stimulus into electrical signals. In each sensory neuron, an action potential is a brief change in membrane voltage that travels along the axon. At a synapse, arrival of the impulse triggers the release of chemical messengers called neurotransmitters. These bind to receptors on the next cell, changing its chance of firing. Sensory neurons belong to the peripheral nervous system (PNS), which connects the body to the central nervous system (CNS), the brain and spinal cord. The signals reach your spinal cord before you have time to think.

2. In the spinal cord, a sensory neuron activates interneurons that signal motor neurons. Those motor neurons carry signals through the PNS to muscles that pull your hand away. This reflex arc protects tissue rapidly, without waiting for a conscious choice by the brain. Meanwhile, signals also travel to the brain, where you become aware of pain. Seeing steam rise from the pot uses a special sense, vision, to help you judge where to place your hand next. The brain combines this visual input with touch and directs a slower, deliberate movement toward a towel instead of the handle.

3. Afterward, the smell of soup may bring the incident back to mind. Research using brain scans and studies of patients with brain injuries links the hippocampus to forming new memories and the amygdala to processing the emotional importance of events, including threats. Neither region works alone: networks across the brain shape what you remember and feel. These findings show associations, but a scan showing activity does not prove that one brain region creates an emotion by itself. Neurotransmitters help neurons communicate within these networks, so changes in their signaling can affect attention, memory, and behavior. Your next choice around the stove reflects both past experience and current sensory input.

2 ANSWER WITH EVIDENCE

Use the passage

1. Trace the signal from the hot-handle receptor to the muscle. Where does it travel as an action potential, and what carries it across a synapse?

2. Why can your hand move before you consciously feel pain? Explain how the brain becomes involved afterward.

3. How do vision and the CNS help you make a different movement after the reflex?

4. A classmate says, “A brain scan proves the amygdala alone creates fear.” Use two details from the passage to evaluate this claim.

3 YOUR TURN

Your own words

A cyclist hears a horn and steers away. In four to five sentences, explain how hearing, the PNS, the CNS, action potentials, and neurotransmitters guide this response, then explain how a past near-collision might affect the cyclist’s choice.

Signals at the Stove

PART 1 · READ AND MARK

Underline each named CNS or PNS structure, circle the electrical and chemical signals that carry information, and number the steps from the skin receptor to the muscle. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Trace the signal from the hot-handle receptor to the muscle. Where does it travel as an action potential, and what carries it across a synapse?	**Action potentials travel along sensory neuron axons toward the spinal cord. Neurotransmitters carry signals across synapses to other neurons; motor neurons then carry signals through the PNS to the muscle.**
2	Why can your hand move before you consciously feel pain? Explain how the brain becomes involved afterward.	**A reflex arc in the spinal cord signals the muscles without waiting for a conscious choice. Signals also reach the brain, where you become aware of pain.**
3	How do vision and the CNS help you make a different movement after the reflex?	**The brain combines the sight of steam with touch information and directs a deliberate movement toward a towel instead of the handle.**
4	A classmate says, "A brain scan proves the amygdala alone creates fear." Use two details from the passage to evaluate this claim.	**The claim is too strong. Scans showing activity do not prove that one region creates an emotion, and networks across the brain shape emotions rather than the amygdala acting alone.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Sound receptors in the cyclist's ears turn the horn's vibrations into signals carried by sensory neurons in the PNS. Action potentials travel along their axons to the CNS, where neurotransmitters help pass signals across synapses. The brain uses the sound to judge the danger and sends motor commands through the PNS to muscles that steer the bicycle. The hippocampus helps form memories, while the amygdala processes the emotional importance of threats. A remembered near-collision could make the cyclist more alert and influence the choice to steer sooner.

For the open task, accept other plausible effects of a past near-collision if the response connects memory to behavior. Do not require students to describe steering away as a reflex.