Signals and Substances

How chemical signals shape behavior

SS24.P.5b "Explain the effect of neurotransmitters on human behavior and compare the effects of drugs and toxins on the brain."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline links between brain signals and behavior, then circle the different ways the drug and toxin change signaling.

Before the Presentation

1. Before a class presentation, Maya feels alert, then relaxes when it ends. Neurons help shape these shifts by releasing neurotransmitters, chemical messengers that cross tiny gaps and bind to receptors on other cells. Glutamate generally increases the chance that a neuron will send a signal, supporting learning and attention. GABA generally decreases that chance, helping limit activity. No single messenger controls a behavior alone; its effect depends on the brain circuit and the receptors involved.

2. Before speaking, Maya drinks coffee. Its caffeine blocks receptors for adenosine, a messenger that normally helps slow neural activity and promotes sleepiness. With that brake reduced, she may feel more awake and find it easier to stay attentive. Caffeine does not create energy or guarantee a better speech; too much can cause restlessness and make sleep harder. This drug changes behavior by altering how a brain signal is received, rather than by adding a new skill.

3. Later, Maya reads about organophosphate pesticides, toxins that can enter the body through exposure. They block an enzyme that normally breaks down acetylcholine, a neurotransmitter involved in muscle movement. Acetylcholine then builds up, and nerve signals can keep stimulating muscles. Severe poisoning may cause twitching and dangerous breathing problems. Caffeine and this toxin both disrupt chemical signaling, but caffeine blocks a messenger's receptors, while organophosphates prevent a different messenger from being cleared. Their effects and risks differ greatly.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do glutamate and GABA differ in their effects on neuron signaling and behavior?

2. Why might caffeine make Maya feel more awake?

3. How can an organophosphate toxin lead to twitching?

4. Compare how caffeine and organophosphates change brain signaling and their possible effects.

3 YOUR TURN

Your own words

Imagine a drug that strengthens GABA signaling in brain circuits involved in alertness. Predict a possible effect on behavior, explain why, and compare its action with caffeine's.

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PART 1 · READ AND MARK

Underline links between brain signals and behavior, then circle the different ways the drug and toxin change signaling. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do glutamate and GABA differ in their effects on neuron signaling and behavior?	**Glutamate generally makes signaling more likely, supporting attention and learning. GABA generally makes signaling less likely, helping limit activity.**
2	Why might caffeine make Maya feel more awake?	**Caffeine blocks receptors for adenosine, which normally helps slow neural activity and promotes sleepiness.**
3	How can an organophosphate toxin lead to twitching?	**It blocks the enzyme that breaks down acetylcholine. The buildup can keep stimulating muscles, causing twitching.**
4	Compare how caffeine and organophosphates change brain signaling and their possible effects.	**Caffeine blocks adenosine receptors and may increase wakefulness. Organophosphates prevent acetylcholine from being cleared and can cause twitching or dangerous breathing problems.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The drug might make a person less alert because stronger GABA signaling would decrease the chance that neurons in those circuits send signals. Caffeine acts differently: it blocks adenosine receptors and may make a person feel more awake.

Accept other reasonable predictions that connect stronger GABA signaling to reduced activity in the specified circuits. Do not require students to claim that either substance has the same effect in every brain circuit.