Signals Under Stress

Trace the fast and slower pathways of a stress response.

HS-AP7-4 "Construct an explanation to show the impact of stress on the hypothalamus-pituitary complex, sympathetic nervous system, and the adrenal medulla."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline signals sent by the hypothalamus, circle the adrenal medulla's action, and number the steps that lead to cortisol so you can trace how one stressful event activates two pathways.

When the Bus Brakes

1. A bus brakes sharply, and a rider lurches forward. Even before the bus stops, the rider's brain treats the sudden movement as a possible threat. The hypothalamus, a brain region that helps coordinate body responses, activates the sympathetic nervous system. Sympathetic nerves quickly signal the heart to beat faster and the airways to widen. They also signal the adrenal medulla, the inner part of each adrenal gland, to release epinephrine and norepinephrine into the blood. These hormones spread the rapid response to many organs. More blood reaches the muscles, preparing the rider to brace or move.

2. The hypothalamus also starts a slower hormone pathway through the hypothalamus-pituitary complex. It releases corticotropin-releasing hormone, or CRH, which signals the anterior pituitary gland. The pituitary releases adrenocorticotropic hormone, or ACTH, into the blood. ACTH travels to the adrenal cortex, the outer part of each adrenal gland. The cortex then releases cortisol. Cortisol helps maintain available fuel by increasing blood glucose and supporting the body's response if the stressful situation continues. Unlike a nerve signal, this hormone sequence takes more time. The medulla and cortex have different jobs: the medulla boosts the immediate response, while the cortex supports a longer response.

3. The bus comes to a stop, and the rider sees that no one is hurt. As the threat passes, sympathetic activity falls, so the heart can slow toward its usual rate. The adrenal medulla releases less epinephrine and norepinephrine. Rising cortisol also signals the hypothalamus and pituitary to reduce CRH and ACTH release, a process called negative feedback. With less ACTH, the adrenal cortex makes less cortisol. If stressful events keep occurring, however, these pathways may stay active longer. The same systems that help in an emergency can disrupt sleep or other body functions when activation persists.

2 ANSWER WITH EVIDENCE

Use the passage

1. Explain how the hypothalamus-pituitary complex causes the adrenal cortex to release cortisol after the sudden stop.

2. Explain how sympathetic nerves and the adrenal medulla together prepare the rider to move quickly.

3. Why can the rider's heart speed up before cortisol rises? Compare the two routes of stress signaling.

4. Explain how cortisol feedback reduces the hormone response after the bus stops, and what could happen if stressful events kept occurring.

3 YOUR TURN

Your own words

During a solo performance, a student hears a crash backstage and later learns that a chair fell. In five sentences, explain how the hypothalamus-pituitary complex, sympathetic nerves, adrenal medulla, and adrenal cortex could affect the student's heartbeat and available fuel before and after the student learns what happened.

ANSWER KEY

Signals Under Stress

HIGH SCHOOL · HS-AP7-4

PART 1 · READ AND MARK

Underline signals sent by the hypothalamus, circle the adrenal medulla's action, and number the steps that lead to cortisol so you can trace how one stressful event activates two pathways. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Explain how the hypothalamus-pituitary complex causes the adrenal cortex to release cortisol after the sudden stop.	**The hypothalamus releases CRH, which signals the anterior pituitary to release ACTH. ACTH travels through the blood to the adrenal cortex and prompts it to release cortisol.**
2	Explain how sympathetic nerves and the adrenal medulla together prepare the rider to move quickly.	**Sympathetic nerves speed the heartbeat, widen the airways, and signal the adrenal medulla to release epinephrine and norepinephrine. These hormones spread the rapid response, helping direct more blood to the muscles.**
3	Why can the rider's heart speed up before cortisol rises? Compare the two routes of stress signaling.	**Sympathetic nerves signal the heart quickly and activate the adrenal medulla's immediate response. Cortisol rises later because CRH must signal the pituitary, which releases ACTH to signal the adrenal cortex.**
4	Explain how cortisol feedback reduces the hormone response after the bus stops, and what could happen if stressful events kept occurring.	**Cortisol signals the hypothalamus and pituitary to release less CRH and ACTH, so the adrenal cortex makes less cortisol. Repeated stress could keep the pathways active longer and disrupt sleep or other body functions.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

When a chair crashes backstage, the student's hypothalamus activates sympathetic nerves, which speed the heartbeat and signal the adrenal medulla. The medulla releases epinephrine and norepinephrine, helping the student react quickly. The hypothalamus also releases CRH, leading the pituitary to release ACTH; ACTH prompts the adrenal cortex to release cortisol, which increases available fuel. After the student learns that a chair fell, sympathetic activity drops and the heartbeat slows. Cortisol's negative feedback reduces CRH and ACTH, so the cortex releases less cortisol.

Accept equivalent explanations that distinguish the rapid sympathetic and adrenal medulla response from the slower CRH, ACTH, and cortisol pathway. For Part 3, look for a causal explanation of both the initial response and its decline after the perceived threat passes.