The Uphill Balance

Trace how body systems respond to exercise and heat.

HAP.8.c "Construct an explanation of the cardiovascular system's relationships with other organ systems, including the body's mechanisms for maintaining homeostasis."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two places where blood connects the cardiovascular system to another organ system, circle a change the body detects, and number the steps in one response that opposes that change.

What Happens on the Hill

1. On a humid afternoon, Maya pedals up a long hill. Her leg muscles use more oxygen and glucose to release energy, producing extra carbon dioxide and heat. The cardiovascular system links these working muscles to the lungs: blood picks up oxygen in lung capillaries, delivers it to muscle capillaries, and carries carbon dioxide back to the lungs to be exhaled. Rising carbon dioxide is detected by sensors that signal the brainstem. The brainstem increases breathing rate, while signals to the heart increase heart rate. Together, faster breathing and circulation help meet muscle demand and keep blood gases within a useful range.

2. As Maya climbs, heat moves from her muscles into her blood. The cardiovascular system carries that heat toward the skin, where wider skin blood vessels allow more heat to escape. Sweat glands release sweat; its evaporation cools the skin and nearby blood. Sweating also removes water from the body, which can lower blood volume. With less fluid in circulation, blood pressure may fall and delivery to organs may become harder to maintain. Her kidneys respond to signals of low fluid by returning more water to the blood instead of releasing it in urine. This response limits further water loss.

3. The body does not simply keep every response at its highest level. Pressure sensors in major arteries detect a drop in blood pressure and send signals to the brainstem. The brainstem can increase heart rate and narrow some blood vessels, helping maintain pressure and blood flow to the brain. This is negative feedback: a change triggers responses that oppose that change. At the top of the hill, Maya coasts and her muscles need less oxygen and make less heat. As carbon dioxide production and body heat decline, breathing, heart rate, skin blood flow, and sweating can gradually move back toward resting levels.

2 ANSWER WITH EVIDENCE

Use the passage

1. Explain how Maya's cardiovascular and respiratory systems work together to meet her muscles' increased oxygen demand.

2. Explain why sending more blood toward Maya's skin helps with one problem but can contribute to another problem that involves her kidneys.

3. If Maya's blood pressure drops, how do the pressure sensors, brainstem, and cardiovascular system form a negative-feedback response?

4. Why can Maya's breathing, heart rate, skin blood flow, and sweating begin to return toward resting levels when she coasts?

3 YOUR TURN

Your own words

After a person donates blood, less blood circulates and blood pressure may fall. Construct an explanation of how the nervous system and kidneys could work with the cardiovascular system to help maintain blood flow, and describe which response would take longer.

The Uphill Balance

PART 1 · READ AND MARK

Underline two places where blood connects the cardiovascular system to another organ system, circle a change the body detects, and number the steps in one response that opposes that change. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Explain how Maya's cardiovascular and respiratory systems work together to meet her muscles' increased oxygen demand.	**Faster breathing brings more oxygen into the lungs. Faster circulation carries oxygen from the lungs to the working muscles and returns their carbon dioxide to the lungs.**
2	Explain why sending more blood toward Maya's skin helps with one problem but can contribute to another problem that involves her kidneys.	**Blood carries heat to the skin, where it can escape. Sweating cools the skin but removes water, which may lower blood volume; the kidneys conserve water to limit further loss.**
3	If Maya's blood pressure drops, how do the pressure sensors, brainstem, and cardiovascular system form a negative-feedback response?	**Arterial sensors detect the drop and signal the brainstem. The brainstem can increase heart rate and narrow some blood vessels, opposing the pressure drop and helping maintain blood flow.**
4	Why can Maya's breathing, heart rate, skin blood flow, and sweating begin to return toward resting levels when she coasts?	**Her muscles need less oxygen and produce less carbon dioxide and heat. With less demand for gas exchange and cooling, those responses can gradually decrease.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

After a blood donation, reduced blood volume may lower blood pressure. Pressure sensors in arteries signal the brainstem, which can make the heart beat faster and narrow some blood vessels. These changes help maintain blood flow to the brain. Over a longer time, the kidneys can conserve water by making less urine, limiting further fluid loss from the blood. As blood pressure stabilizes, the pressure-triggered responses can ease.

Accept explanations that connect a detected change to responses that oppose it. For Your Turn, students should distinguish the quicker heart and vessel response from slower water conservation by the kidneys, without claiming that water conservation replaces the donated blood.