Signals After Lunch

Trace how hormones help keep blood glucose in range.

HS-AP7-1 "Investigate the structure and function of the endocrine system and develop models showing how changes in prominent hormone levels impact homeostasis throughout the body systems."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each source of a hormone and circle each hormone named in the passage. Number the steps in one feedback loop, starting with a change in blood glucose and ending when hormone release decreases.

From Lunch to Late Afternoon

1. At a school lunch, a student eats rice, then heads to class. Digestion moves glucose from the rice into the blood, raising blood glucose above its usual range. The endocrine system helps keep this level within a workable range because body cells need a steady energy supply, especially brain cells. In the pancreas, clusters of endocrine cells called islets detect the rise. Beta cells in the islets release insulin into the bloodstream. Unlike a nerve signal sent along one pathway, this hormone travels through blood to many tissues. Only cells with the right receptors respond to its message.

2. Insulin binds to receptors on muscle and fat cells, helping those cells take up more glucose from the blood. It also signals the liver to store glucose as glycogen and reduce its release of glucose. As blood glucose returns toward its usual range, beta cells release less insulin. This is negative feedback: the change that triggered hormone release is reduced, so the signal weakens. Muscle cells can use the incoming glucose during movement or store it for later. The brain also needs glucose, but most of its glucose uptake does not require insulin. A fall in blood glucose can therefore threaten brain function.

3. Hours later, if the student skips a snack, cells still use glucose and the blood level may begin to fall. Alpha cells in the pancreatic islets respond by releasing glucagon into the blood. Glucagon binds to receptors on liver cells, prompting the liver to break down stored glycogen and release glucose into the bloodstream. As blood glucose rises toward its usual range, alpha cells release less glucagon. Together, the two hormone responses link the pancreas, blood, liver, muscle, and brain. If glucagon release fails during a long period without food, the liver releases less stored glucose, increasing the risk of low blood glucose.

2 ANSWER WITH EVIDENCE

Use the passage

1. After lunch, how does a rise in blood glucose lead to changes in muscle cells and the liver? Trace the signal from its source.

2. Trace the feedback loop that begins when blood glucose falls hours after lunch. Why does glucagon release then decrease?

3. Glucagon acts on the liver, yet it helps supply the brain with glucose. Explain this connection using the passage.

4. Suppose insulin stays unusually high even after blood glucose returns to its usual range. Predict what could happen to blood glucose and explain why that would matter to the brain.

3 YOUR TURN

Your own words

After skipping lunch, a student finishes a long bike ride. Draw two labeled arrow models: one showing the normal glucagon response and one showing what could happen if the pancreas cannot release glucagon. Include the pancreas, blood, liver, and brain, then write two sentences comparing how well the models maintain blood glucose.

ANSWER KEY

Signals After Lunch

PART 1 · READ AND MARK

Underline each source of a hormone and circle each hormone named in the passage. Number the steps in one feedback loop, starting with a change in blood glucose and ending when hormone release decreases. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	After lunch, how does a rise in blood glucose lead to changes in muscle cells and the liver? Trace the signal from its source.	**The rise prompts pancreatic beta cells to release insulin into the blood. Insulin helps muscle cells take up glucose and signals the liver to store glucose as glycogen and release less glucose.**
2	Trace the feedback loop that begins when blood glucose falls hours after lunch. Why does glucagon release then decrease?	**Pancreatic alpha cells release glucagon, which prompts the liver to release stored glucose into the blood. As blood glucose rises toward its usual range, alpha cells release less glucagon.**
3	Glucagon acts on the liver, yet it helps supply the brain with glucose. Explain this connection using the passage.	**Glucagon prompts liver cells to release glucose into the blood. The blood carries that glucose to the brain.**
4	Suppose insulin stays unusually high even after blood glucose returns to its usual range. Predict what could happen to blood glucose and explain why that would matter to the brain.	**Blood glucose could fall too low because muscle and fat cells keep taking up more glucose and the liver stores glucose and releases less of it. Low blood glucose can threaten the brain's glucose supply.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Normal response: Blood glucose falls → pancreatic alpha cells release glucagon into blood → liver releases stored glucose into blood → blood glucose rises → brain receives glucose.
No glucagon release: Blood glucose falls → pancreas releases no glucagon → liver releases less stored glucose into blood → blood glucose may remain low → brain receives less glucose.
In the normal response, rising blood glucose helps restore the usual range and reduces glucagon release. Without glucagon, the brain faces a greater risk of too little glucose.

Accept models with different layouts if their arrows show glucagon traveling through blood to the liver and liver-released glucose entering the blood. In the second panel, accept a greater risk of low blood glucose rather than requiring a claim that it will certainly occur.