

Ben's Bad Day

Tab 2: Blood Pressure, Temperature, Blood pH, Water Balance & Blood Glucose

Simulation: edtechsims.com/homeostasis-bens-bad-day



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Name: _____ Class: _____ Date: _____

By the end of this activity, you should be able to:

- state the five components of a negative feedback loop and describe the role of each
- apply the negative feedback loop to blood pressure, body temperature and blood pH
- describe how ADH regulates the water potential of the blood
- describe how insulin lowers blood glucose concentration after a meal

Part A: Key Terms

On the sim: Open Tab 2 and read the Key Terms.

A1 Write the correct term next to each meaning. Choose from: Stimulus, Receptor, Control Centre, Effector, Response.

[5]

Term	What it means
	A muscle or gland that carries out the control centre's instructions.
	A change in the internal or external environment that pushes a variable away from its normal set point.
	The change the effector produces, which counteracts the original stimulus and restores the set point.
	The part of the body that receives the signal, compares it against the set point, and decides what response is needed.
	A cell, tissue, or organ that detects the stimulus and converts it into a signal — a nerve impulse or a hormone.

Table 1

Part B: Ben's Day

On the sim: Work through each scenario in Tab 2. Fill in the negative feedback loop for each one.

B1 8:00 AM · The Wake-Up Jolt

Ben fell asleep hunched over his desk after an all-nighter. A classmate slams a book down and he leaps out of his chair — the room instantly goes fuzzy and dark at the edges. He grabs the desk so he doesn't go down.

Step	Your answer
Stimulus	Blood pressure drops suddenly from standing up too fast
Receptor	
Control Centre	Cardiovascular centre in the medulla oblongata
Effector	
Response	Heart rate rises and vessels constrict, restoring blood pressure

B2 8:30 AM · Cold Walk to Lab

Still shaky, Ben steps outside into a cold morning without a jacket, rushing to Chem lab. Within a minute his teeth are chattering and his arms are covered in goosebumps.

Step	Your answer
Stimulus	
Receptor	Thermoreceptors in the skin
Control Centre	
Effector	Skeletal muscles and skin blood vessels
Response	Shivering generates heat; skin vessels constrict to cut heat loss

B3 11:50 AM · The Sprint

Ben's lab report blows off his desk and out an open door. He bolts down the hallway after it, sprinting harder than he has all semester.

Step	Your answer
Stimulus	
Receptor	Chemoreceptors sensitive to blood pH and CO ₂
Control Centre	Respiratory centre in the medulla oblongata
Effector	
Response	

B4 8:30 PM · Forgot to Drink Water

Ben's been so busy he hasn't had a sip of water since breakfast. By evening his mouth is bone dry and his blood is far more concentrated than it should be.

Step	Your answer
Stimulus	
Receptor	
Control Centre	Hypothalamus signals the pituitary gland
Effector	Kidney collecting ducts
Response	ADH release makes kidneys reabsorb more water, diluting the blood

B5 12:00 AM · Midnight Snack

Finally home, Ben devours a big bowl of pasta before bed. Half an hour later his blood glucose is climbing fast.

Step	Your answer
Stimulus	
Receptor	Beta cells in the pancreas detect high glucose
Control Centre	
Effector	Liver, muscle and fat cells
Response	

Part C: Check Your Understanding

On the sim: Circle True or False for each statement. If a statement is false, correct it. Then check your answers in the sim's Check Your Understanding section.

C1 A stimulus is the body's way of correcting an imbalance.

True / False Correction (if false):

C2 Baroreceptors in the carotid arteries and aorta detect Ben's drop in blood pressure when he stands up too fast.

True / False Correction (if false):

C3 Shivering is an effector response controlled by the thermoregulatory centre in the hypothalamus.

True / False Correction (if false):

C4 The lactic acid produced during Ben's sprint raises his blood pH.

True / False Correction (if false):

C5 When Ben is dehydrated, the pituitary gland releases ADH to make the kidneys reabsorb more water.

True / False Correction (if false):

C6 In the pancreas's response to Ben's midnight snack, the pancreas acts as both the receptor and the control centre.

True / False Correction (if false):

C7 An effector is the structure that first detects a stimulus.

True / False Correction (if false):

C8 All five of Ben's homeostatic responses in this activity are examples of positive feedback.

True / False Correction (if false):

C9 Record your score from the sim.

My score: _____ / 8

Part D: Multiple Choice Questions

On the sim: Circle the letter of the best answer. Then check your answers in the sim's Multiple Choice Questions section.

- D1** Which correctly orders the components of a negative feedback loop?
- A. Stimulus → Effector → Receptor → Control Centre → Response
 - B. Stimulus → Receptor → Control Centre → Effector → Response
 - C. Receptor → Stimulus → Effector → Control Centre → Response
 - D. Control Centre → Stimulus → Receptor → Effector → Response
- D2** In Ben's cold-walk scenario, which pair of effector responses helped restore his body temperature?
- A. Sweating and vasodilation
 - B. Shivering and vasoconstriction of skin blood vessels
 - C. Increased breathing rate and heart rate
 - D. Insulin release and glucose uptake
- D3** Why does eating a meal trigger insulin release from the pancreas?
- A. To raise blood glucose levels further
 - B. To lower blood glucose by helping cells take up glucose from the blood
 - C. To break down fat stores for energy
 - D. To increase thirst and water retention
- D4** Which best describes the role of an effector in a negative feedback loop?
- A. It detects the original stimulus
 - B. It carries out the response that corrects the imbalance
 - C. It compares the change to the normal set point
 - D. It causes the imbalance to occur
- D5** In the water balance scenario, what does ADH do once released?
- A. Increases urine production to flush out excess water
 - B. Makes the kidneys reabsorb more water, producing more concentrated urine
 - C. Signals the pancreas to release more insulin
 - D. Widens blood vessels to lower blood pressure
- D6** Record your score from the sim.
- My score: _____ / 5

Part E: Applying Your Knowledge

E1 Explain the difference between negative feedback and positive feedback. Use one of Ben's scenarios as an example of negative feedback.

[3]

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E2 In the Midnight Snack scenario, the pancreas acts as both the receptor and the control centre.

(a) Explain what this means. [1]

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(b) Suggest what would happen to Ben's blood glucose after the meal if his pancreas could no longer produce insulin. Explain. [2]

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Answer Key: Ben's Bad Day (Tab 2)

Part A

A1 1. Effector 2. Stimulus 3. Response 4. Control Centre 5. Receptor

Part B

B1 8:00 AM · The Wake-Up Jolt

Step	Answer
Stimulus	Blood pressure drops suddenly from standing up too fast
Receptor	Baroreceptors in the carotid arteries and aorta
Control Centre	Cardiovascular centre in the medulla oblongata
Effector	Heart muscle and blood vessel walls
Response	Heart rate rises and vessels constrict, restoring blood pressure

B2 8:30 AM · Cold Walk to Lab

Step	Answer
Stimulus	External temperature drops
Receptor	Thermoreceptors in the skin
Control Centre	Thermoregulatory centre in the hypothalamus
Effector	Skeletal muscles and skin blood vessels
Response	Shivering generates heat; skin vessels constrict to cut heat loss

B3 11:50 AM · The Sprint

Step	Answer
Stimulus	Lactic acid builds up, lowering blood pH
Receptor	Chemoreceptors sensitive to blood pH and CO ₂
Control Centre	Respiratory centre in the medulla oblongata
Effector	Diaphragm and intercostal (rib) muscles
Response	Breathing rate rises, exhaling more CO ₂ and raising blood pH

B4 8:30 PM · Forgot to Drink Water

Step	Answer
Stimulus	Blood osmolarity rises as the body dehydrates
Receptor	Osmoreceptors in the hypothalamus
Control Centre	Hypothalamus signals the pituitary gland
Effector	Kidney collecting ducts
Response	ADH release makes kidneys reabsorb more water, diluting the blood

B5 12:00 AM · Midnight Snack

Step	Answer
Stimulus	Blood glucose level rises after eating
Receptor	Beta cells in the pancreas detect high glucose
Control Centre	Pancreas acts as its own control centre
Effector	Liver, muscle and fat cells
Response	Insulin release drives cells to take up glucose, lowering blood levels

Part C

- C1** False. A stimulus is the change that creates the imbalance; the response corrects it.
- C2** True. Baroreceptors sense the pressure drop and alert the cardiovascular centre in the medulla oblongata.
- C3** True. The hypothalamus signals skeletal muscles to contract rapidly, generating heat.
- C4** False. Lactic acid lowers blood pH, making the blood more acidic.
- C5** True. Osmoreceptors in the hypothalamus trigger ADH release from the pituitary; the kidneys reabsorb more water.
- C6** True. The beta cells detect the glucose rise and also trigger the response, so no separate control centre is needed.
- C7** False. That is the receptor's job. The effector carries out the response.
- C8** False. They are all negative feedback; each response counteracts the original change.

Part D

- D1** B. A stimulus is detected by a receptor, which signals a control centre; the control centre triggers an effector to produce the response.
- D2** B. Shivering generates heat and vasoconstriction reduces heat loss; sweating and vasodilation would cool him further.
- D3** B. Rising blood glucose is detected by the pancreas, which releases insulin so cells absorb glucose.
- D4** B. The effector, a muscle or gland, acts on the control centre's instructions to produce the response.
- D5** B. ADH increases water reabsorption in the collecting ducts, diluting the blood and concentrating the urine.

Part E

- E1** In negative feedback, the response counteracts the original change and returns the variable to its set point. In positive feedback, the response amplifies the original change. Example: in The Sprint, blood pH falls and the response (faster breathing) raises pH back to normal.
- E2(a)** The same cells (beta cells) both detect the rise in blood glucose and trigger the response by releasing insulin; no separate organ such as the brain is involved.
- E2(b)** Blood glucose would stay high (and could rise further), because without insulin the liver, muscle and fat cells would not take up glucose from the blood. (This is what happens in type 1 diabetes.)