AP BIOLOGY · UNIT 4 · TOPIC 4.4

Feedback

Learning objective 4.4.A Explain how feedback mechanisms maintain homeostasis.

Name: Date: Period:

Use the tool **Push Back, Push On**. Parts 1 and 2 use **Run the loop**, Part 3 uses **Six real loops** and Part 4 uses **Why 37 is never 37**. The two kinds of feedback differ in one thing only: the **direction** of the response relative to the change. Everything else follows from it.

Part 1 · Two loops, the same disturbance

On the Run the loop tab, leave the Response strength slider at **0.45**. Set the Starting value slider to each value in the table, and record the After 5 ticks and After 40 ticks readouts, once with **Negative feedback** selected and once with **Positive feedback**.

Starting value	Negative: after 5	Negative: after 40	Positive: after 5	Positive: after 40
43.0				
40.0				
37.0				
34.0				

1. (a) Describe the effect of the negative feedback loop on the variable.

(b) Describe the effect of the positive feedback loop on the variable.

2. (a) Identify the row of the Part 1 table in which neither loop changed the variable.

(b) Explain why neither loop changed the variable in that row.

3. With negative feedback, the variable decreased from a starting value of 43 and increased from a starting value of 34. Explain how one negative feedback loop can correct the variable in both directions.

Part 2 · What every loop is made of

Open **The parts every loop has** on the Run the loop tab and read it. Then complete the table for body temperature and for blood glucose. The Six real loops tab gives the sensor and effector for each system.

Part of the loop	For body temperature	What it would be for blood glucose
What detects the change		
What responds to it		
The set point		
Direction of the response		

4. Identify the three parts that every feedback loop needs.

5. Explain why a positive feedback loop does not have a set point.

Part 3 · Six real loops

Switch to **Six real loops**. For each system, predict the kind of feedback from what the system does, **before** you select it. Then select the system and record the Kind of feedback, Set point and What ends it readouts.

System	Your prediction	Actual	Set point?	What ends it
Body temperature				
Blood glucose				
Blood water concentration				
Childbirth				
Blood clotting				
Fruit ripening				

6. Each of the three positive feedback loops in the Part 3 table comes to an end. Describe what the events that end these three loops have in common.

7. A student claims that positive feedback is harmful and negative feedback is helpful. Using two examples from the Part 3 table, evaluate the student's claim.

Part 4 · Why 37 is never exactly 37

Switch to **Why 37 is never 37**. Move the Delay in the response slider to each value in the table, starting at 0. Record the Times it crosses the set point and Furthest overshoot readouts, and whether the swings on the graph shrink or grow.

Delay	Times it crosses the set point	Furthest overshoot (°C)	Do the swings shrink or grow?
0			
1			
2			
3			
4			

8. A healthy core body temperature is given as a range rather than a single number. Using the Part 4 table, explain why.

9. With a delay, the temperature overshoots the set point, even though the loop responds exactly as a negative feedback loop should. Explain what causes the overshoot.

10. The cells that release insulin stop working.
(a) Predict the effect on blood glucose concentration after a meal.

(b) Justify your prediction in terms of the feedback loop.

What the model simplifies

Both loops are run with a single response strength and a single variable. Real regulation uses several effectors at once, often with different strengths and different delays, and several variables are usually being regulated together.

The positive feedback curve has no ceiling, so it runs off the top of the graph. Every real positive feedback loop meets a limit (the baby is born, the clot is complete, the fruit is ripe), and the tool names that limit for each example rather than drawing it.

Time is in arbitrary ticks. A real temperature correction takes minutes and a real clotting cascade takes seconds, so the horizontal axis is a sequence of events rather than a clock.

The set points are the values usually quoted for a healthy adult at rest. They are not fixed constants: a set point can be shifted deliberately, which is what a fever is.