Homeostasis and negative feedback

60 minutes • D3.3.1, D3.3.2, D3.3.3 • Chapters 1, 2, 3

The four variables, how negative feedback works from above and from below, and how insulin and glucagon control blood glucose

BY THE END, STUDENTS CAN

- [ ] Define homeostasis and name four variables that humans keep within limits D3.3.1
- [ ] Explain how negative feedback keeps a variable at its set point, from above and from below D3.3.2
- [ ] Explain how insulin and glucagon control blood glucose D3.3.3

TIMING

0–5	5 min	**Do now: stay the same**	
5–15	10 min	**The four variables**	
15–27	12 min	**The loop**	
27–50	23 min	**Blood glucose**	
50–60	10 min	**Exit**	
	60 min	**One lesson**	

STARTER

5 min

Do now: stay the same

Ask: how does your body stay at 37 °C on a freezing morning and a hot afternoon? Take three ideas on the board and keep them for the plenary.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

01 Holding the inside steady

CHAPTER 01 IN THE SLIDES

Tap the parts of the figure in turn: Body temperature, Blood pH, Blood glucose and Blood osmotic concentration.

> **Predict box:** The air temperature drops from 20 °C to 5 °C. What happens to the temperature of the blood in a healthy person? Hands up or mini whiteboards first.
>
> **Answer B: It stays within a degree or so of 37 °C, because the body works to keep it there**

02 A change that switches itself off

CHAPTER 02 IN THE SLIDES

Step through the figure (6 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. A change pushes the variable **above** its set point.
2. A **receptor** detects the change.
3. The **control centre** compares it with the set point and sends a signal.
4. An **effector** acts on the signal.
5. The **response** opposes the change, so the level **falls back** to the set point.
6. If it falls **too low**, the same loop works the other way, and it returns to the set point.

> **Predict box:** A thermostat turns the heating on when a room is cold and off when it is warm enough. Why is this negative feedback? Hands up or mini whiteboards first.
>
> **Answer B: The response, heating, reverses the change that triggered it, a fall in temperature**

03 Two hormones, one set point

CHAPTER 03 IN THE SLIDES

Step through the figure (6 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. After a meal **glucose** in the blood is high.
2. **Beta cells** secrete **insulin** into the blood.
3. Insulin reaches the **target cells**. They take up glucose and the liver stores it as **glycogen**.
4. Blood glucose **falls back** to the set point.
5. Later the level is **low**. **Alpha cells** secrete **glucagon**.
6. Glucagon makes the liver **break down glycogen** and release glucose, so the level **rises** to the set point.

> **Predict box:** A person skips lunch and their blood glucose starts to fall. Which change comes next? Hands up or mini whiteboards first.
>
> **Answer B: Alpha cells secrete glucagon, so the liver breaks glycogen down and releases glucose**

> **Remember it:** B I T S (Beta cells, Insulin, Target cells, Store).

THE LESSON

10 min

The four variables

Chapter 1's predict box, then tap each variable on the figure. For each, ask what would go wrong if it drifted.

12 min

The loop

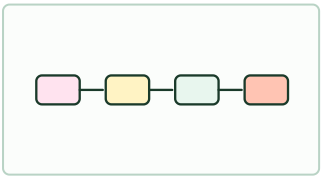
Chapter 2's predict box, then the figure step by step. Name receptor, control centre, effector and response out loud at the matching step. Practise the "In the exam" points.

23 min

Blood glucose

Chapter 3's predict box first, then the figure through all six steps. Students retell it in pairs using the BITS tiles. Then start the glucose lab: one healthy run and the water control.

ACTIVITIES



PRACTICAL

Feedback in the classroom

Give each group a card with a variable (room temperature, water level in a tank, a classmate's pulse) and a way of changing it. Groups design a negative feedback loop for it from the same four parts and act it out, with one student as the receptor, one the control centre and one the effector. The class says what the set point is and whether the response opposes the change.

Needs: cards, a thermometer or a bucket of water, paper.

PLENARY

10 min

Exit

Draw the negative feedback loop for blood glucose after a meal, labelling the receptor, control centre and effector.

WHAT STUDENTS GET WRONG

"Homeostasis keeps variables exactly constant." Variables are kept within preset limits. They fluctuate a little around the set point.

"Negative feedback is a bad thing." Negative means the response reverses the change. It is what keeps a variable steady.

STRETCH AND SUPPORT

Support: a loop diagram with four empty boxes for students to label for blood glucose.

Stretch: why is the pancreas both the receptor and the control centre for blood glucose? Compare it with temperature control.

IN THE GUIDE

1 Holding the inside steady

2 A change that switches itself off

3 Two hormones, one set point

All The whole guide, with the figures that play

PPTX This lesson's slides, in the order of this plan

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on D3.3 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=D3.3&level=HL&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on D3.3, built from its key terms and ready to print
- A pub quiz with rounds on D3.3, to present or run with no projector
- An escape room built from the question bank on D3.3

ALREADY ON THE SITE FOR D3.3

- Quiz: Homeostasis (HL)
- Quiz: Homeostasis
- Revision map: D3.3 Homeostasis, to fill in
- Exam questions: D3.3 in the exam maker, a paper with its markscheme

CARD SETS ON SPLYCR

Open a set to host it as a class game, or make a copy to edit.

- D3.3 Homeostasis

How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.