D.3.3 · Homeostasis · supported focus

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

Supported HL/SL core focus. First assessment 2025; current subject brief acquired; full Biology guide not acquired. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: hormones and cell signalling from D.3.1–D.3.2, and percentages from mathematics. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

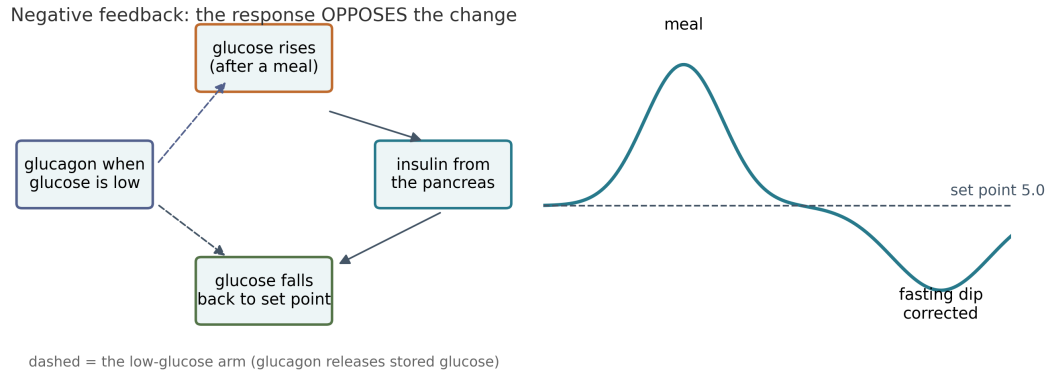
Homeostasis

■ What would explain this observation?

- After a large meal your blood glucose jumps, yet within an hour it returns to near where it started – and after a night without food it still does not collapse. What keeps it steady?
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Homeostasis** is the maintenance of a nearly constant internal environment around a set point. It runs on **negative feedback**: a detector notices the change, a control centre compares it with the set point, and an effector produces a response that OPPOSES the change.
- For blood glucose: when it rises, the pancreas releases **insulin**, which makes liver and muscle cells take up glucose and store it as glycogen, so glucose falls. When glucose falls too low, **glucagon** triggers the liver to convert glycogen back to glucose, so it rises. Each hormone switches off as the level returns to the set point.
- homeostasis: Maintaining a nearly constant internal environment around a set point; negative feedback: A control loop whose response opposes the original change; insulin: The hormone that lowers blood glucose by promoting uptake and storage; glucagon: The hormone that raises blood glucose by releasing stored glucose.



■ Choose evidence that can test it

- Measure blood glucose at intervals after a meal: the model predicts a rise, a peak, and a return towards the set point as insulin acts – and the same record shows insulin rising before glucose falls, the cause arriving before the correction.
- Compare a person whose pancreas cannot make insulin: glucose stays high after a meal, direct evidence that insulin is the link between the detector and the response.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a person's blood glucose rises from a set point of 5.0 to 7.0 mmol/L after a meal. Change = final − initial = 7.0 − 5.0 = 2.0 mmol/L. Percentage deviation = $2.0/5.0 \times 100 = 40\%$ above the set point. Negative feedback acts until the value returns close to 5.0 mmol/L.

Example:

During a fast, blood glucose falls from 5.0 to 4.2 mmol/L. Find the percentage deviation from the set point and name the responding hormone, using the same sequence: known quantities → model → relation → substitution → unit and interpretation. (Answer: change = 4.2 − 5.0 = −0.8 mmol/L; deviation = $-0.8/5.0 \times 100 = -16\%$; glucagon responds to raise it.)

■ Check the conclusion and its limits

- Homeostasis is NEAR-constant, not fixed: the value oscillates around the set point because each response takes time. This model covers blood glucose; temperature, water and carbon dioxide each have their own detectors and effectors with the same logic.

- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Negative feedback makes the measured value negative. This claim is false: "negative" means the response OPPOSES the change – a rise triggers a fall and a fall triggers a rise. The measured value stays positive and close to the set point.

Key:

Homeostasis: detector → control centre → effector loops keep internal conditions near a set point by negative feedback. Insulin lowers raised blood glucose; glucagon raises lowered blood glucose; the loop switches off as balance returns.