D.3.3 · Homeostasis

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

This handout covers selected HL/SL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: hormones and cell signalling from D.3.1–D.3.2, and percentages from mathematics.

The examples are original and fictional: they are not real measurements or real student investigations.

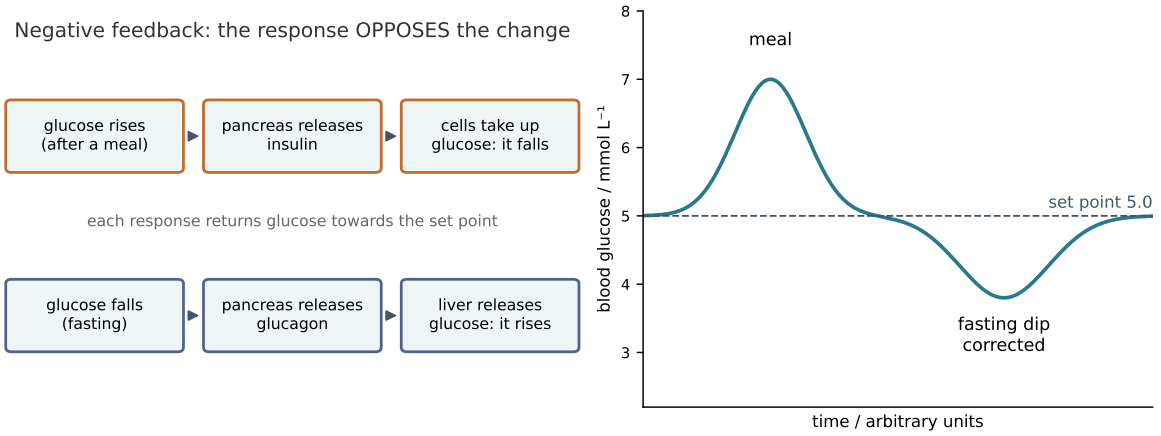
Homeostasis

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?

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. Hormone secretion adjusts through negative feedback as glucose returns towards its usual range.
- 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.



Insulin answers a rise and glucagon a fall, so blood glucose returns to the set point

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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

- 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 × 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 × 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.

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 corrective response decreases as balance returns.

■ **Write from insulin's moment**

- Blood glucose rises from 4 to 9 mmol per litre after a meal.
- Which hormone acts, and in which direction? Insulin – lowering glucose toward the set point.

■ **Write from glucagon's moment**

- Hours later glucose falls to 3 mmol per litre.
- Which hormone acts? Glucagon – raising glucose; the loop responds in both directions.

■ **Write from the corrective response decreasing**

- Insulin has worked and glucose returns to the set point.
- What happens to insulin secretion? It declines – negative feedback reduces the corrective response as balance returns.