Keep conditions within limits

Homeostasis is the regulation of the internal environment within narrow limits, despite changes inside or outside the organism.

1. THE ENVIRONMENT AROUND CELLS

Most body cells are surrounded by tissue fluid, which exchanges substances with blood. Regulating blood composition helps maintain suitable conditions around cells. Homeostasis controls this internal environment; it does not make the outside world constant.

2. WHY REGULATION MATTERS

Core temperature	Keeps enzyme-controlled reactions within a suitable temperature range.
Blood glucose	Maintains a supply of respiratory substrate for cells.
Blood water potential	Limits excessive water movement by osmosis, helping preserve cell volume.

3. RECOGNISE THE STIMULUS

A stimulus is a detectable change. It may be internal, such as rising blood glucose after a meal, or external, such as colder surroundings. External change can threaten internal conditions even before those conditions change greatly.

CONTROLLED DOES NOT MEAN MOTIONLESS

A set point is a target value. Small fluctuations around it are normal: monitoring and corrective responses continually maintain a dynamic steady state.

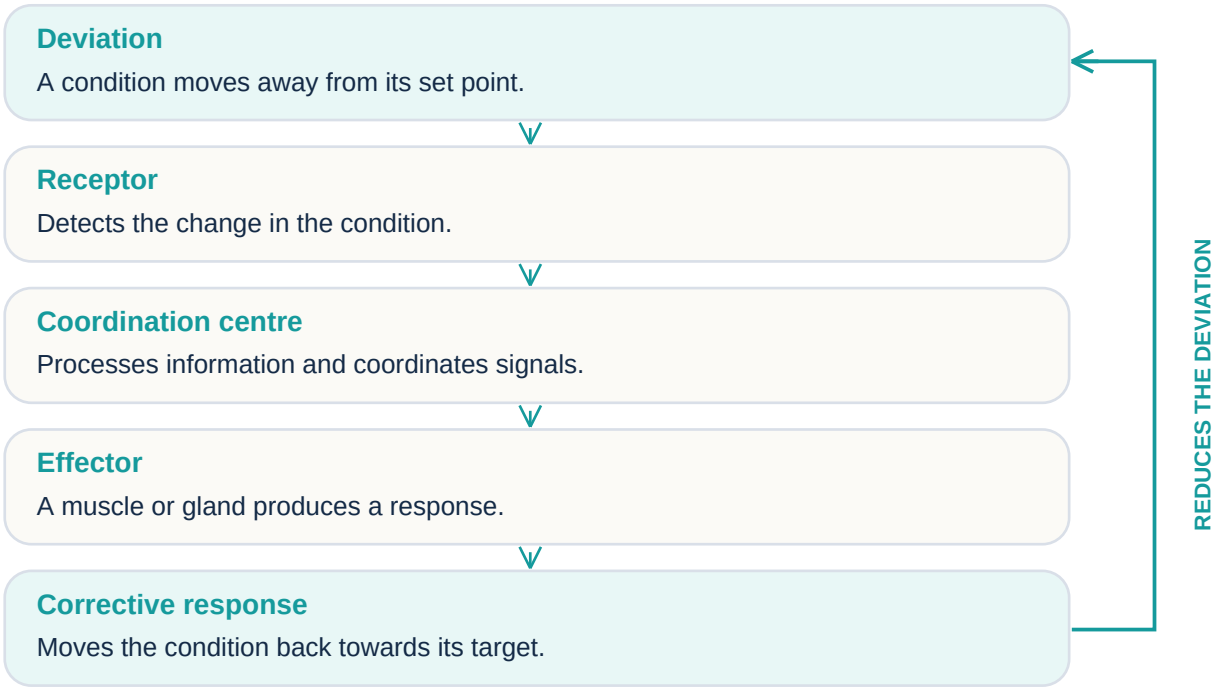
Internal environment and regulated variables: Cambridge syllabus, Topic 14.
Dynamic regulation and stimuli: OpenStax, Biology 2e 33.3.

Scope: Cambridge Biology 9700, section 14.1, outcomes 1-2, p. 37.

How negative feedback works

The response opposes the original deviation. As the condition returns towards its target, the stimulus for the corrective response becomes smaller.

1. FOLLOW THE INFORMATION AND THE RESPONSE



Feedback means the response changes the condition being monitored.

2. NERVOUS AND ENDOCRINE COORDINATION

Nervous pathways carry electrical impulses along neurones. Endocrine glands release hormones into the blood; only target cells with appropriate receptors respond. Both systems can coordinate homeostatic adjustments.

3. DISTINGUISH THE COMPONENT FROM ITS ACTION

A sweat gland is an effector; increased sweat secretion is its response. A receptor detects change, whereas an effector acts. These are functional roles: a specialised cell can combine sensing and signalling rather than requiring a separate organ for each step.

Negative-feedback components: OpenStax, Anatomy and Physiology 2e 1.5.
Nervous and endocrine signalling: OpenStax, Biology 2e 37.1.

Scope: Cambridge Biology 9700, section 14.1, outcomes 1-2, p. 37.

Correct changes in either direction

Negative feedback can increase or decrease a variable. The word negative describes opposition to the change, not a response that always lowers the value.

1. TWO ROUTES BACK TOWARDS THE TARGET

VALUE TOO HIGH	VALUE TOO LOW
↓	↓
Response lowers the value	Response raises the value
↓	↓
Deviation becomes smaller	Deviation becomes smaller

Opposite deviations need opposite corrective effects.

2. A TEMPERATURE EXAMPLE

If core temperature rises, coordinated responses can increase sweating. Evaporation removes heat. If core temperature falls, shivering involves skeletal-muscle contractions that generate heat. Each response opposes the initial change; the response weakens as the deviation decreases.

3. SMALL FLUCTUATIONS ARE EXPECTED

A reading need not sit exactly on the set point at every instant. Disturbances continue, detection and responses take time, and corrective effects may briefly overshoot. A stable range is compatible with active control, not evidence that regulation has failed.

4. NEGATIVE IS NOT THE SAME AS POSITIVE FEEDBACK

Negative feedback reduces a deviation. Positive feedback amplifies the initiating change, so it is not the usual mechanism for keeping a variable near a target. Avoid describing any response to a stimulus as negative feedback: explain how the response opposes that stimulus.

Temperature responses and feedback direction: OpenStax, Biology 2e 33.3.
Set points and contrasting feedback: OpenStax, Anatomy and Physiology 2e 1.5.

Scope: Cambridge Biology 9700, section 14.1, outcomes 1-2, p. 37.