MEGA LECTURE

IB DP BIOLOGY

Theme D: Continuity and Change

D3.3 Homeostasis

Revision Notes · Standard and Higher Level

Fahad H. Ahmad

+92 323 509 4443 | Megalecture.com

Original notes prepared for the IB Diploma Programme Biology course (2025 syllabus)

What the syllabus requires

By the end of D3.3 you should be able to explain how the body keeps its internal conditions steady and to apply the idea of feedback control to real systems. Use this checklist before the exam. Rows flagged (HL) are examined at Higher Level only.

Understanding	You should be able to...
Homeostasis	Define it as the maintenance of a stable internal environment within narrow limits, and explain why this matters for enzymes and cells.
Negative feedback	Identify the set point, receptor, control centre and effector, and explain how the response returns a variable to its set point.
Positive feedback	Contrast it with negative feedback and give a biological example of each.
Thermoregulation	Describe how humans detect and correct changes in core temperature, and explain the endotherm concept.
Blood glucose	Explain the antagonistic control by insulin and glucagon, and distinguish type 1 from type 2 diabetes.
Osmoregulation	Outline nephron function (ultrafiltration, reabsorption) and the role of ADH in water balance.
Loop of Henle (HL)	Explain the counter-current multiplier, osmoreceptor detail and kidney adaptations to water availability.
Interpreting data	Read graphs that oscillate around a set point and identify feedback components from descriptions.

> **Exam note:** The command terms here are usually *explain*, *outline* and *distinguish*. Marks are earned by naming the feedback components in order and by stating the **direction** of each change, not just the fact that something is regulated.

1. What homeostasis is

Homeostasis is the maintenance of a stable internal environment within narrow limits, despite changes in the external environment or in the body's own activity. The word does not mean the internal conditions are fixed and unchanging; it means they are held close to an ideal value, oscillating within a tolerable range around it.

Variables that are regulated in humans include core body temperature, blood glucose concentration, blood pH, the water and solute (osmotic) balance of body fluids, and the concentrations of respiratory gases. Each has a normal value that the body defends.

Variable regulated	Approximate set point in humans
Core body temperature	37 °C
Blood glucose concentration	about 4–6 mmol dm^{-3} when fasting
Blood pH	about 7.4

Variable regulated	Approximate set point in humans
Blood water potential (osmotic balance)	held so cells neither swell nor shrink

Why it matters

Cells only work within a narrow band of conditions. The clearest reason is enzyme activity: enzymes are the catalysts of metabolism, and their three-dimensional shape (and therefore the shape of the active site) is sensitive to temperature and pH. If temperature rises too far the enzyme denatures and stops working; if it falls too far reactions become too slow to sustain life. A stable pH keeps enzyme and protein structures intact.

A second reason is osmotic: if the water balance of body fluids is not controlled, the water potential of the fluid surrounding cells changes, so water moves into or out of cells by osmosis. Cells then swell and may burst, or shrink and stop functioning. Steady internal conditions also mean that reaction rates, and the delivery of glucose and oxygen, remain predictable regardless of what is happening outside the body.

> **Key idea:** Homeostasis buys independence. Because the internal environment is kept constant, cells can carry on metabolising whether the organism is in the cold, has just eaten, or is exercising hard.

The internal environment

The cells of the body are not in contact with the outside world; they are bathed in **tissue fluid**, which forms from blood plasma. It is this tissue fluid, together with the blood, that makes up the **internal environment** that homeostasis defends. Blood is the transport link: it carries heat, glucose, water, salts and hormones around the body, so a change corrected in the blood is quickly passed on to the tissue fluid surrounding every cell.

Nervous and hormonal control

Homeostatic responses use two coordinating systems, and many loops combine them. It is worth being clear about how they differ.

Feature	Nervous control	Hormonal (endocrine) control
Signal	Electrical impulses along neurons	Chemical hormones carried in the blood
Speed	Very fast (fractions of a second)	Slower (seconds to minutes)
Duration	Short-lived	Often longer-lasting
Example in D3.3	Detection of temperature; triggering shivering	Insulin, glucagon and ADH acting on target organs

> **Link:** The hypothalamus is a hub for both systems: it receives nervous input about temperature and osmotic state, and it controls hormone release (for example ADH) through the pituitary gland.

2. Negative feedback control

Homeostasis is achieved mainly by **negative feedback**: a change in a variable triggers a response that reverses that change and returns the variable towards its set point. Every negative feedback loop is built from the same four parts.

Component	Role in the loop
Set point	The normal target value that the system defends (for example 37 °C).
Receptor / sensor	Detects the change and measures how far the variable has moved from the set point.
Control centre	Compares the value to the set point and coordinates a response (often the brain or an endocrine gland).
Effector	Carries out the response (a muscle or gland) that brings the variable back.

The loop closes because the corrective response itself changes the variable, so the receptor now detects a smaller deviation. As the value approaches the set point the response is switched down. The variable therefore never sits exactly on the set point; it oscillates in a small range around it.

A simple statement of the loop is:

stimulus (change) → receptor → control centre → effector → response that reverses the change

Positive feedback (the contrast)

In **positive feedback** the response amplifies the original change instead of reversing it, driving the variable further from the starting value. Positive feedback is not used for routine homeostasis because it is destabilising; it is used where the body needs a rapid, self-reinforcing change that runs to completion.

Feature	Negative feedback	Positive feedback
Effect of response	Reverses / opposes the change	Amplifies / reinforces the change
Result	Returns variable to set point; stable	Drives variable further away; self-reinforcing
Role	Maintains homeostasis	Completes a rapid process, then stops
Example	Body temperature returning to 37 °C after cooling	Oxytocin in childbirth: contractions cause more oxytocin release, causing stronger contractions until birth

> **Common misconception:** “Negative” does not mean bad or “decreasing.” It means the response acts in the **opposite** direction to the change. A drop in temperature triggers warming; a rise triggers cooling. Both are negative feedback.

3. Thermoregulation in humans

Humans are **endotherms**: they generate heat internally through metabolism and control their core temperature physiologically, keeping it close to 37 °C. This is costly in energy but lets enzymes work at a constant, optimum temperature whatever the surroundings. (Ectotherms, by contrast, rely mainly on behaviour and external heat sources.)

Detection and the control centre

Temperature is detected in two places. **Thermoreceptors in the skin** monitor the temperature of the surface and the surroundings, giving early warning. **Thermoreceptors in the hypothalamus** of the brain monitor the temperature of the blood, that is the core temperature. The **hypothalamus** acts as the control centre: it compares the blood temperature with the set point and triggers the appropriate effectors.

Responses to cold (raise temperature)

- **Vasoconstriction:** arterioles supplying the skin capillaries narrow, so less warm blood flows near the surface and less heat is lost by radiation.
- **Shivering:** skeletal muscles contract rapidly and involuntarily; the extra respiration in the muscles releases heat.
- **Hair erection:** erector muscles raise body hairs, trapping an insulating layer of still air (a small effect in humans).
- **Raised metabolic rate:** hormones such as adrenaline and thyroxine increase the rate of metabolic (heat-releasing) reactions.
- Behavioural responses (putting on clothes, curling up) also reduce heat loss.

Responses to heat (lower temperature)

- **Vasodilation:** skin arterioles widen, so more warm blood flows near the surface and more heat is lost by radiation.
- **Sweating:** sweat glands release sweat onto the skin; as the water evaporates it takes latent heat from the body, cooling it.
- Hairs lie flat and metabolic rate is not raised; behaviour (seeking shade, removing clothes) also increases heat loss.

Each response is switched off by negative feedback once core temperature returns towards 37 °C, so the two opposing sets of effectors keep the temperature oscillating narrowly around the set point.

> **Exam technique:** Vasoconstriction and vasodilation act on the **arterioles** leading to skin capillaries, not on the capillaries themselves. Do not write that “capillaries move up and down” — they do not move.

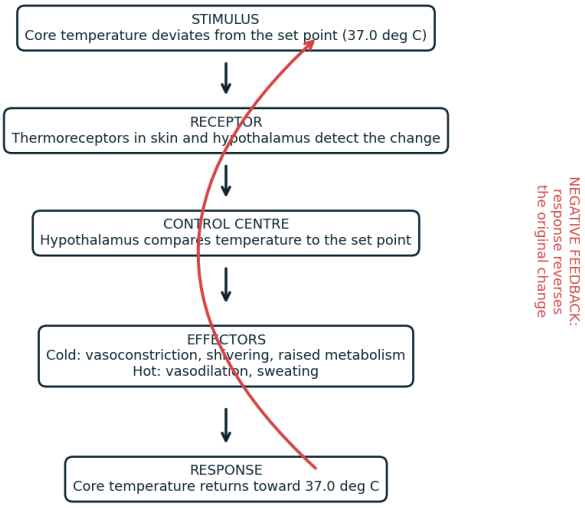

Figure 1. Negative-feedback loop for human thermoregulation. The control centre (hypothalamus) compares core temperature with the set point of 37.0°C and switches effectors on or off so the response always reverses the original deviation.

4. Regulation of blood glucose

Blood glucose must be kept near its set point because glucose is the main respiratory substrate for cells and also affects the water potential of the blood. Control is by two antagonistic hormones from the **pancreas**, secreted by cells in the **islets of Langerhans**: β **(beta) cells** release insulin, and α **(alpha) cells** release glucagon.

When blood glucose is too high (insulin)

After a meal, blood glucose rises. The β cells detect this and secrete **insulin**. Insulin lowers blood glucose by:

- increasing the **uptake of glucose** into cells (especially liver, muscle and fat cells), by increasing the number of glucose transporter proteins in their membranes;
- stimulating **glycogenesis** — the conversion of glucose to glycogen for storage in the liver and muscles;
- increasing the rate at which cells respire glucose.

As glucose is taken out of the blood, its concentration falls back to the set point and insulin secretion is reduced — negative feedback.

When blood glucose is too low (glucagon)

If blood glucose falls (for example during fasting or exercise), the α cells secrete **glucagon**. Glucagon raises blood glucose mainly by stimulating **glycogenolysis** — the breakdown of stored glycogen in the liver back to glucose, which is then released into the blood. As glucose rises to the set point, glucagon secretion falls.

insulin lowers glucose (uptake + glycogenesis) glucagon raises glucose (glycogenolysis)

Because the two hormones have opposite effects and are released by different cells, the system can correct a change in either direction, holding blood glucose in a narrow range around the set point.

Diabetes mellitus

Diabetes is a failure to control blood glucose, so it can rise dangerously high (hyperglycaemia) and glucose appears in the urine. There are two main types.

Feature	Type 1 diabetes	Type 2 diabetes
Cause	β cells destroyed (often by the person's own immune system), so little or no insulin is produced	Target cells become less responsive to insulin (insulin resistance); insulin output may also fall
Typical onset	Usually in childhood or adolescence	Usually in adulthood; linked to obesity, diet and inactivity
Treatment	Regular insulin injections; monitoring of diet and blood glucose	Managed first by diet, weight loss and exercise; sometimes drugs, occasionally insulin

> **Common misconception:** Insulin **lowers** blood glucose; it does not raise it. A quick memory aid: **i**nsulin puts glucose **i**nto cells and into storage.

Why blood glucose control matters

If blood glucose is not controlled, both extremes are harmful. Persistently high glucose (hyperglycaemia) lowers the water potential of the blood, drawing water from cells and causing glucose to be lost in the urine along with water, leading to thirst and dehydration; over years it damages blood vessels and nerves. Very low glucose (hypoglycaemia) starves cells, especially brain cells, of respiratory fuel, causing dizziness, confusion and, if severe, unconsciousness. Tight negative feedback keeps glucose safely between these limits.

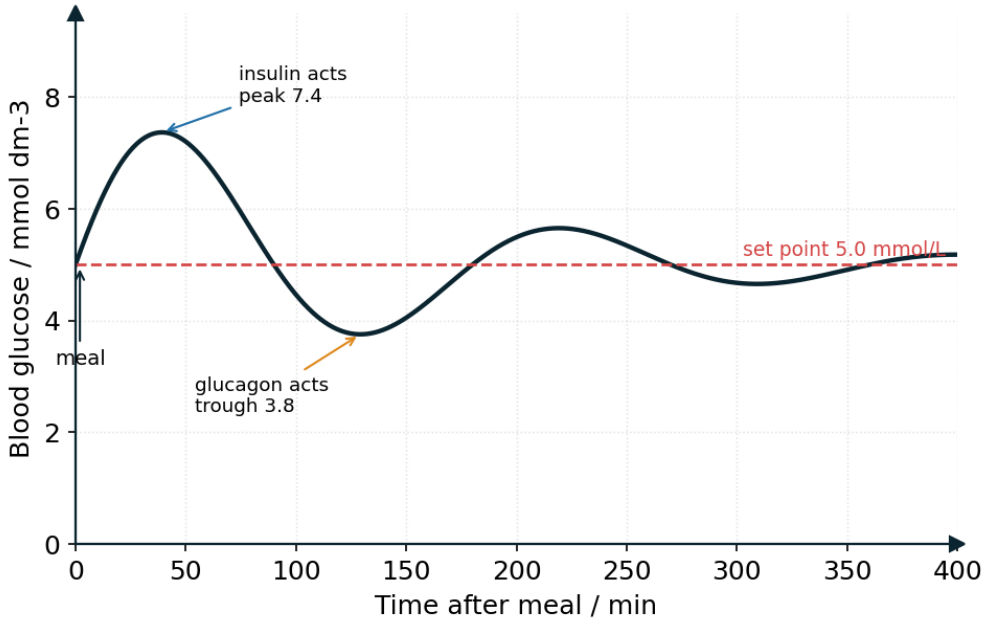

Figure 2. Blood glucose after a meal, oscillating around the set point of 5.0 mmol dm^{-3}. Insulin lowers the post-meal peak of 7.4 mmol dm^{-3} (t = 39 min) back toward the set point; the later dip to 3.8 mmol dm^{-3} triggers glucagon, which restores the set point.

5. Osmoregulation and the kidney

Osmoregulation is the control of the water and solute balance of body fluids, so that their water potential stays steady and cells neither gain nor lose water by osmosis. The kidneys carry this out while also excreting nitrogenous waste (urea). The functional unit of the kidney is the **nephron**.

Structure of the nephron

Blood enters a knot of capillaries, the **glomerulus**, which sits inside a cup-shaped **Bowman's capsule**. The fluid then flows along the **proximal convoluted tubule**, down and up the **loop of Henle**, along the **distal convoluted tubule**, and into a **collecting duct** that carries urine towards the ureter.

Region	Main process	What happens
Glomerulus + Bowman's capsule	Ultrafiltration	High blood pressure forces water, glucose, salts and urea out of the blood into the capsule; large plasma proteins and blood cells stay behind
Proximal convoluted tubule	Selective reabsorption	All glucose, most salts and much water are reabsorbed back into the blood
Loop of Henle	Sets up salt gradient	Creates a high solute concentration in the surrounding medulla tissue, allowing water to be reabsorbed later
Collecting duct	Water balance (ADH)	Water is reabsorbed from the filtrate into the blood; the amount is controlled by ADH

Ultrafiltration and selective reabsorption

In **ultrafiltration**, blood pressure in the glomerulus is high because the vessel leaving it is narrower than the one entering. This pressure forces small molecules (water, glucose, ions, urea) through the capillary and capsule walls to form the **filtrate**. Useful substances must then be recovered: in **selective reabsorption** in the proximal tubule, all the glucose and much of the water and salts are transported back into the blood, so they are not lost. Urea is mostly left in the filtrate to be excreted.

ADH and water balance

The final adjustment of water content is made in the collecting duct by **antidiuretic hormone (ADH)**, released from the pituitary gland. When the blood is too concentrated (low water potential, for example after sweating or not drinking), more ADH is released. ADH makes the collecting duct wall more permeable to water, so more water is reabsorbed into the blood; a small volume of concentrated urine is produced. When the blood is too dilute, less ADH is released, less water is reabsorbed, and a large volume of dilute urine is produced. This is a negative feedback loop that returns blood water potential to its set point.

> **Exam technique:** More ADH → more water reabsorbed → less, more concentrated urine. Do not reverse it: ADH does not make you urinate more — the name means *anti-diuretic*, i.e. against water loss.

How selective reabsorption works

Reabsorption in the proximal convoluted tubule is **selective** and active. Cells lining the tubule are adapted for it: they have many mitochondria to supply ATP for active transport, and their surface facing the filtrate is folded into microvilli to give a large surface area. Glucose and salts are pumped or co-transported back into

the blood, and water follows by osmosis. Because all the glucose is normally reabsorbed here, finding glucose in the urine is a sign that blood glucose was so high that reabsorption could not keep up — a classic indicator of diabetes.

> **Exam technique:** Distinguish the three ways substances cross the tubule: ultrafiltration (pressure) at the glomerulus, active transport and co-transport (using ATP) for glucose and salts, and osmosis for water.

6. Water balance in more detail (HL)

At Higher Level the ADH loop and the loop of Henle are examined in more mechanistic detail.

Osmoreceptors and the ADH pathway (HL)

Osmoreceptors in the hypothalamus monitor the water potential (solute concentration) of the blood. If the blood becomes too concentrated, the osmoreceptors are stimulated; the hypothalamus signals the **posterior pituitary gland** to release more ADH into the blood. ADH travels to the kidney and binds to receptors on the collecting-duct cells, causing water-channel proteins (aquaporins) to be inserted into the membrane so that more water is reabsorbed. As blood water potential rises back to normal, the osmoreceptors are less stimulated and ADH release falls — negative feedback.

The loop of Henle: counter-current multiplier (HL)

The loop of Henle allows mammals to make urine more concentrated than their blood. It works as a **counter-current multiplier**, because filtrate flows in opposite directions in the two limbs that lie side by side.

- The **descending limb** is permeable to water but not to salt. As filtrate descends into the increasingly salty medulla, water leaves by osmosis, so the filtrate becomes more concentrated towards the bottom of the loop.
- The **ascending limb** is impermeable to water; it actively pumps sodium and chloride ions out into the surrounding medulla tissue. This raises the solute concentration of the medulla.
- Because the two limbs run in opposite directions, a small difference in concentration at each level is multiplied along the length of the loop, building a steep **salt gradient** down the medulla — most concentrated deep in the medulla near the bottom of the loop.

This medulla salt gradient is what makes water reabsorption in the collecting duct possible: as filtrate passes down the collecting duct through the salty medulla, water is drawn out by osmosis (the more so when ADH has raised the duct's permeability), concentrating the urine.

Kidney adaptations (HL)

Mammals adapted to dry habitats have relatively **long loops of Henle** and a thick medulla. A longer loop builds a steeper salt gradient, so more water can be reabsorbed and more concentrated urine can be produced — a clear water-saving adaptation. Mammals with plentiful water tend to have shorter loops and produce more dilute urine.

> **HL link:** The counter-current arrangement is an example of how spatial organisation of a structure (limbs running in opposite directions) creates a function — a concentration gradient — that neither limb could build on its own.

7. Interpreting homeostasis graphs

Because negative feedback corrects deviations, a regulated variable plotted against time does not stay on a flat line. Instead it **oscillates** in a small range around the set point: a deviation appears, the response corrects it, the variable overshoots slightly, and the process repeats. The graph therefore looks like a gently wavering line centred on the set point.

How to read these graphs

- Find the **set point** — usually the mean value the line oscillates around (for example 37 °C or a fasting glucose level).
- Identify a **stimulus** where the line moves sharply away from the set point (a meal, exercise, entering the cold).
- Read the **correction** as the line returning towards the set point; the steeper the return, the stronger the feedback response.
- In a diabetic glucose graph, the rise after a meal is larger and the return to the set point is slower (or does not happen), because insulin control is impaired — a common comparison question.

For a glucose tolerance test, a healthy trace peaks soon after the glucose drink and returns to the fasting level within about two hours; a diabetic trace starts higher, peaks higher, and stays elevated for longer.

> **Exam technique:** When a graph shows overshoot and correction, always link it back to the components: name the receptor that detected the change and the effector whose response reversed it.

8. Worked examples and skills

Worked example 1 — identify the feedback components

In thermoregulation on a cold day, name the receptor, control centre, effector and response, and state the type of feedback.

Receptor: thermoreceptors in the skin and hypothalamus. Control centre: the hypothalamus. Effectors: skin arterioles and skeletal muscles. Response: vasoconstriction and shivering, which raise/conserve heat and return core temperature to 37 °C. Type: **negative feedback**, because the response opposes the original cooling.

Worked example 2 — predict the response to a stimulus

A person drinks a large volume of water. Predict the change in blood water potential, the change in ADH secretion, and the effect on urine.

The blood becomes more dilute, so its water potential **rises**. Osmoreceptors in the hypothalamus are less stimulated, so **less ADH** is released. The collecting duct becomes less permeable to water, so **less water is reabsorbed** and a **large volume of dilute urine** is produced — removing the excess water and restoring the set point.

Worked example 3 — explain insulin and glucagon action

Explain how the pancreas returns blood glucose to normal after a large, sugary meal, and then during the following overnight fast.

After the meal glucose rises; β cells in the islets detect this and secrete **insulin**. Insulin increases glucose uptake into cells and stimulates **glycogenesis** in the liver, so glucose falls to the set point. Overnight, glucose falls; α cells secrete **glucagon**, which stimulates **glycogenolysis** so the liver releases glucose, raising it back to the set point. The two hormones are antagonistic, giving control in both directions.

Worked example 4 — interpret a glucose graph

Two people take a glucose drink. Person A's blood glucose peaks at 8 mmol dm^{-3} and returns to 5 within 2 hours. Person B's peaks at 15 and is still 12 after 2 hours. Who is likely diabetic, and why?

Person B. The higher peak and the failure to return to the fasting level show that glucose is not being cleared from the blood effectively. This indicates too little insulin or poor response to insulin — the pattern of diabetes. Person A shows a normal, well-controlled response.

Worked example 5 — distinguish the diabetes types

A 12-year-old is diagnosed with diabetes that requires insulin injections; a 55-year-old with obesity is told to change diet and lose weight. Identify each type and justify.

The 12-year-old most likely has **type 1**: early onset and the need for injected insulin indicate that the β cells no longer produce insulin. The 55-year-old most likely has **type 2**: adult onset with obesity points to insulin resistance, which is managed first through diet, weight loss and exercise.

Worked example 6 — positive vs negative feedback

State whether each is positive or negative feedback: (a) sweating cools an overheated body; (b) oxytocin release strengthens contractions during birth.

(a) **Negative** — the response (cooling) reverses the change (overheating). (b) **Positive** — contractions cause more oxytocin, causing stronger contractions, amplifying the change until birth is complete.

Common pitfalls

- Negative feedback **reverses** a change; it does not simply decrease a value. A fall in temperature triggers warming.
- **Insulin lowers** blood glucose (uptake and glycogenesis); glucagon raises it (glycogenolysis). Do not swap them.
- **ADH increases water reabsorption** and reduces urine volume; more ADH means less, more concentrated urine.
- Vasoconstriction and vasodilation act on **arterioles**, not on capillaries, and blood vessels do not physically move up and down.
- Glycogenesis (making glycogen) and glycogenolysis (splitting glycogen) sound alike — check the ending before you write.

Quick reference

Idea	Statement
Homeostasis	Maintaining a stable internal environment within narrow limits despite external change.
Negative feedback loop	stimulus → receptor → control centre → effector → response that reverses the change
Thermoregulation (cold)	Vasoconstriction, shivering, hair erection, raised metabolism; hypothalamus is the control centre.
Thermoregulation (heat)	Vasodilation and sweating increase heat loss.
Blood glucose	Insulin lowers (uptake + glycogenesis); glucagon raises (glycogenolysis).
Diabetes	Type 1: no insulin, needs injections. Type 2: insulin resistance, managed by diet/lifestyle.
Kidney sequence	Ultrafiltration → selective reabsorption → loop of Henle salt gradient → ADH-controlled water reabsorption.
ADH	More ADH → more water reabsorbed → less, more concentrated urine.

9. Test yourself

Attempt these without notes; full answers follow. Questions marked (HL) are Higher Level only.

1. Define homeostasis and give two reasons why a stable internal temperature matters for cells.

2. Name the four components of a negative feedback loop and explain, using body temperature, how the loop returns the variable to its set point.

3. Describe three responses that reduce a person's core temperature on a hot day.

4. Explain how insulin and glucagon act antagonistically to control blood glucose.

5. Distinguish between type 1 and type 2 diabetes in terms of cause and treatment.

6. Outline what happens to a molecule of water from the moment blood enters the glomerulus to the point where it is reabsorbed in the collecting duct.

7. A student runs a marathon and sweats heavily without drinking. Predict what happens to their ADH secretion and urine, and explain why.

8. (HL) Explain how the loop of Henle produces a salt gradient in the medulla, and why a longer loop allows more concentrated urine.

Answers

1. Homeostasis is the maintenance of a stable internal environment within narrow limits despite external change. A stable temperature keeps enzymes at their optimum (too hot denatures them; too cold makes reactions too slow), and keeps metabolic rates and protein structures steady so cells function reliably.

2. Set point, receptor, control centre, effector. If body temperature falls, thermoreceptors (receptor) detect it; the hypothalamus (control centre) compares it to 37 °C and signals muscles and skin arterioles (effectors) to shiver and vasoconstrict (response). This raises temperature back to the set point, at which point the response is reduced — negative feedback.

3. Any three: vasodilation of skin arterioles (more heat lost by radiation); sweating (evaporation removes latent heat); hairs lie flat; reduced metabolic rate; behaviour such as seeking shade.

4. They have opposite effects and come from different cells of the islets. When glucose is high, β cells release insulin, which increases glucose uptake into cells and glycogenesis, lowering glucose. When glucose is low, α cells release glucagon, which stimulates glycogenolysis, releasing glucose and raising it. Each correction switches off the hormone — negative feedback in both directions.

5. Type 1: the β cells are destroyed (often by the immune system) so little or no insulin is made; usually early onset; treated with insulin injections. Type 2: target cells become resistant to insulin; usually adult onset, linked to obesity and diet; treated first by diet, weight loss and exercise.

6. In the glomerulus, high blood pressure forces water out into the Bowman's capsule by ultrafiltration. In the proximal tubule much of it is reabsorbed by selective reabsorption. The loop of Henle builds a salt gradient in the medulla; as filtrate passes down the collecting duct through this salty medulla, water is drawn back into the blood by osmosis, the amount controlled by ADH.

7. Sweating and not drinking make the blood more concentrated (lower water potential). Osmoreceptors in the hypothalamus are stimulated, so **more ADH** is released. The collecting duct becomes more permeable, more water is reabsorbed, and a **small volume of concentrated urine** is produced — conserving water and restoring the set point.

8. (HL) The ascending limb pumps sodium and chloride ions into the medulla but is impermeable to water; the descending limb loses water to the medulla by osmosis. Because filtrate flows in opposite directions in the two limbs (counter-current), a small gradient at each level is multiplied into a steep salt gradient down the medulla. A longer loop builds a steeper, longer gradient, so more water can be reabsorbed from the collecting duct, producing more concentrated urine.

10. Key terms at a glance

Term	Meaning
Homeostasis	Maintaining a stable internal environment within narrow limits.
Set point	The target value a homeostatic system defends.
Negative feedback	A response that reverses a change, restoring the set point.
Positive feedback	A response that amplifies a change, driving it further.
Endotherm	An animal that generates and controls its body heat internally.
Vasoconstriction / vasodilation	Narrowing / widening of skin arterioles to conserve or lose heat.
Insulin	Pancreatic hormone that lowers blood glucose (uptake, glycogenesis).
Glucagon	Pancreatic hormone that raises blood glucose (glycogenolysis).
Glycogenesis / glycogenolysis	Making glycogen from glucose / breaking glycogen into glucose.
Osmoregulation	Control of the water and solute balance of body fluids.
Ultrafiltration	Pressure filtration of small molecules from blood into the nephron.
ADH	Hormone that increases water reabsorption in the collecting duct.

Final check: For any homeostasis question, be able to name the **variable**, its **set point**, the **receptor**, the **control centre**, the **effector**, and state the **direction** of the corrective response.