Control of body temperature

4.5.2.4 · Homeostasis and response · revision notes

How the thermoregulatory centre in the brain keeps your body temperature close to 37 °C, using sweating, changes in blood flow to the skin and shivering. Expect 'describe' and 'explain' questions, often in a context such as exercise or a cold day. This subtopic is in GCSE Biology only.

Key facts

- Thermoregulatory centre (in the brain): receptors sensitive to blood temperature
- Too hot: vasodilation + more sweating
- Vasodilation: more blood near the skin surface → more energy transferred to the environment
- Grade 7+ only Shivering: contracting muscles respire, releasing energy that warms the body
- Skin temperature receptors send nervous impulses to the thermoregulatory centre
- Too cold: vasoconstriction + sweating stops + shivering
- Sweat evaporating transfers energy away from the skin

Notes

Monitoring temperature

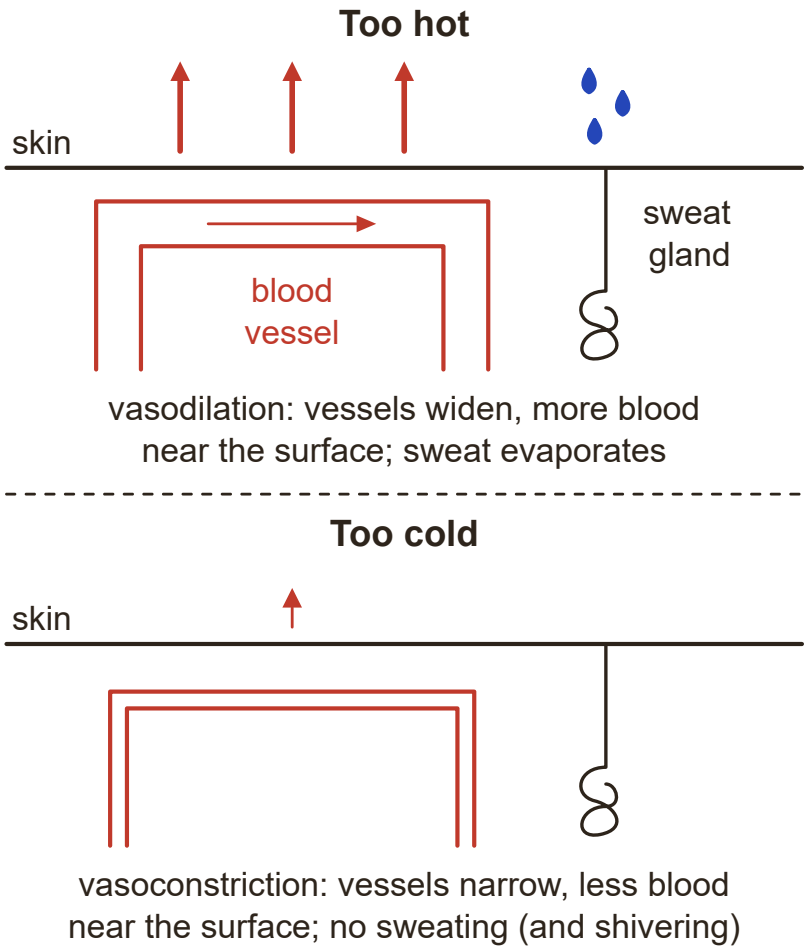
- Body temperature is monitored and controlled by the **thermoregulatory centre** in the **brain**.
- The thermoregulatory centre contains **receptors sensitive to the temperature of the blood**.
- The **skin** also contains **temperature receptors**, which send **nervous impulses** to the thermoregulatory centre.
- Keeping the core temperature near 37 °C keeps enzymes working at their optimum.

If you are too hot

- **Vasodilation**: blood vessels supplying the skin **dilate** (widen), so more blood flows through the capillaries near the skin surface.
- **Sweating**: sweat glands produce more sweat. The water in sweat **evaporates** from the skin.
- Both mechanisms transfer more **energy from the skin to the environment**, so body temperature falls.

If you are too cold

- **Vasoconstriction**: blood vessels supplying the skin **constrict** (narrow), so less blood flows near the skin surface and less energy is transferred to the environment.
- **Sweating stops**, so no energy is transferred away by evaporating sweat.
- **Shivering**: skeletal muscles contract rapidly.



Red arrows: energy transferred from the skin to the surroundings. More when hot, less when cold.

- Muscle contraction needs **respiration**, which releases energy. Some of this energy warms the body, so body temperature rises. Grade 7+ only
- Each response brings the temperature back towards normal, which is an example of **negative feedback**. Grade 7+ only

How to answer each type of question

Describe the body's responses

2 to 3 marks | Grade 5

1. Decide whether the body is too hot or too cold.
2. Give one response per mark, using the correct terms (vasodilation, vasoconstriction, sweating, shivering).

Example. Describe how the body responds when its temperature falls below normal.

Model answer. Blood vessels supplying the skin constrict / vasoconstriction (1). Sweating stops (1). Skeletal muscles contract rapidly / shivering (1).

Explain how responses control temperature in a context

4 marks | Grade 7

1. Name each response.
2. Say what happens (e.g. more blood flows near the skin surface).
3. Link it to energy transfer from the skin to the environment.
4. Finish with the effect on body temperature.

Example. During a long run, a runner's skin becomes red and they sweat a lot.
Explain how these changes help to control the runner's body temperature.

Model answer. Blood vessels supplying the skin dilate / vasodilation (1), so more blood flows near the skin surface, making the skin look red (1). Sweat glands release more sweat, which evaporates from the skin (1). Both transfer more energy from the skin to the environment, so body temperature falls back towards normal (1).

6-mark: explain how the body detects and responds to a temperature change

6 marks **Grade 7**

1. Start with detection: skin receptors and the thermoregulatory centre in the brain.
2. Describe each response in turn.
3. Explain how each one changes energy transfer or releases energy.
4. End with the temperature returning to normal.

Example. A swimmer gets out of a cold lake on a windy day.
Explain how the swimmer's body detects and responds to the fall in body temperature.

Model answer.

Indicative content: temperature receptors in the skin detect the fall and send impulses to the thermoregulatory centre in the brain; receptors in the thermoregulatory centre detect the fall in blood temperature; blood vessels supplying the skin constrict (vasoconstriction); less blood flows near the skin surface, so less energy is transferred to the environment; sweating stops, so no energy is lost by evaporation; skeletal muscles contract rapidly (shivering); contracting muscles respire, releasing energy that warms the body; body temperature rises back towards normal.
Level 3 (5 to 6 marks): detection and all three responses, each clearly linked to how it raises body temperature.
Level 2 (3 to 4 marks): several responses with some explanation.
Level 1 (1 to 2 marks): simple statements, e.g. 'the swimmer shivers'.

Don’t lose marks

- Saying blood vessels move closer to or further from the skin. They stay where they are; they widen or narrow.
- Saying capillaries dilate or constrict. It is the blood vessels supplying the capillaries that change width.
- Writing that sweating cools you without saying the sweat evaporates, transferring energy from the skin.
- Saying shivering 'makes heat' without linking it to respiration in the muscles.
- Forgetting to name the thermoregulatory centre or saying it is in the skin. It is in the brain.

More tips

Memory tricks

- Too hot: 'dilate and sweat'. Too cold: 'constrict and shiver'.
- Vasodilation = red face when hot; vasoconstriction = pale skin when cold.
- Sweat only cools you when it evaporates.
- Shivering warms you because contracting muscles respire.

Exam technique

- Always link a response to energy transfer: 'so more (or less) energy is transferred from the skin to the environment'.
- In a context question, use the details given (red skin, sweat, shivering) and explain each one.
- For 6-mark answers, cover detection as well as the responses, and keep them in a logical order.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 — **State normal core body temperature**
About 37 °C, the optimum for the body's enzymes.

Grade 4 — **Name where temperature is monitored**
The thermoregulatory centre in the brain, which has receptors sensitive to blood temperature.

Grade 4 — **List the responses to overheating**
Vasodilation and more sweat produced by sweat glands.

Grade 5 — **List the responses to being too cold**
Vasoconstriction, sweating stops, and skeletal muscles contract (shivering).

Grade 6 — **Explain how sweating and vasodilation cool you**
Both transfer more energy from the skin to the environment.

Grade 7 — **Explain how vasoconstriction and shivering warm you**
Less blood near the skin reduces energy transfer; shivering muscles respire, releasing energy.

Grade 7 — **Apply temperature control to new contexts**
E.g. explain a runner's red skin and heavy sweating, or a swimmer's shivering.

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