

Homeostasis

Revision notes · Homeostasis and negative feedback, control of blood glucose, treating Type 1 diabetes and temperature control by the skin.

For Cambridge IGCSE Biology 0610 (and 0970, which has the same content). **Supplement** is Extended content, only examined on Papers 2 and 4.

Homeostasis Spec 14.4

Homeostasis and negative feedback Spec 14.4.1, 14.4.3

Homeostasis is the maintenance of a constant internal environment. Cells only work well when conditions around them stay steady. Two things the body keeps steady are the **body temperature** and the **blood glucose concentration**.

Homeostasis

The maintenance of a constant internal environment.

Supplement

Negative feedback

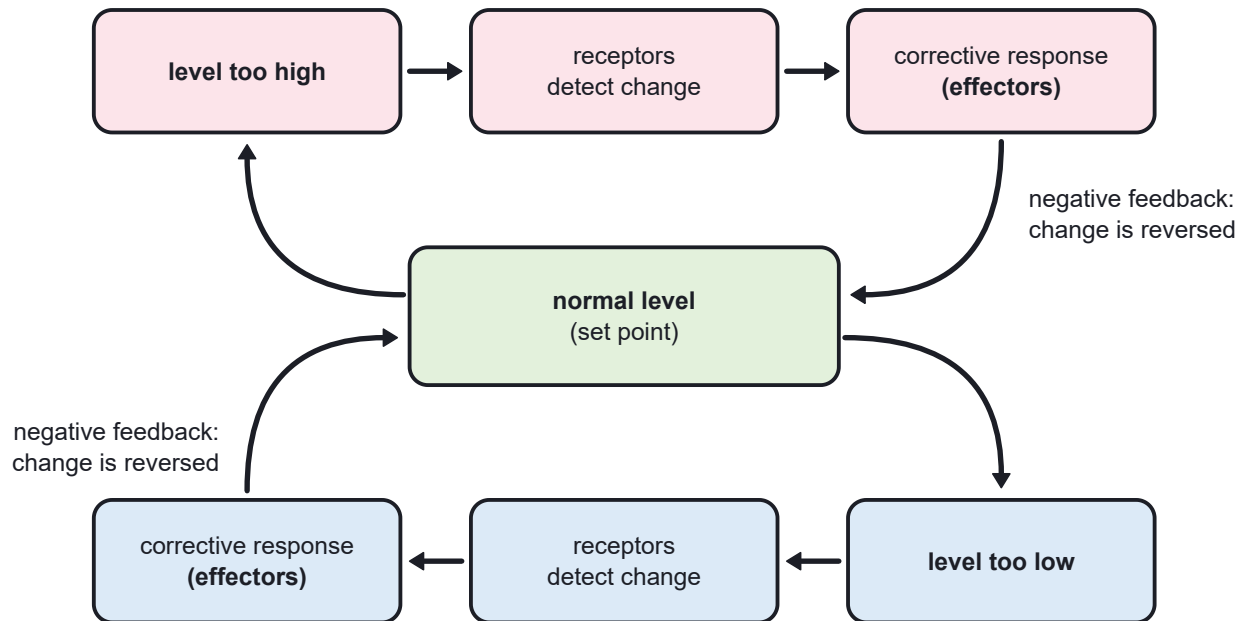
Supplement

Homeostatic control works by **negative feedback**. The body has a **set point**, which is the normal level for the factor being controlled. If the level moves away from the set point, the body responds so that the level changes back towards the set point.

Supplement

1. The level of a factor (for example blood glucose) changes away from the set point.
2. Receptors detect the change.
3. A control system (for example the brain or the pancreas) coordinates a response.
4. Effectors act to reverse the change, so the level returns towards the set point.
5. When the level is back at the set point, the response is reduced or stops.

Supplement



Negative feedback: any change away from the set point is reversed.

Supplement

Exam tip: Negative feedback does not keep a level exactly fixed. The level goes slightly above and below the set point, and the response brings it back each time.

Controlling blood glucose Spec 14.3.5, 14.4.2, 14.4.4

The pancreas secretes the hormone **insulin**. Insulin decreases blood glucose concentration.

Supplement

Insulin is secreted when the blood glucose concentration is too high, for example after a meal containing carbohydrate. The pancreas also secretes a second hormone, **glucagon**, when the blood glucose concentration is too low.

Supplement

The role of the liver

Supplement

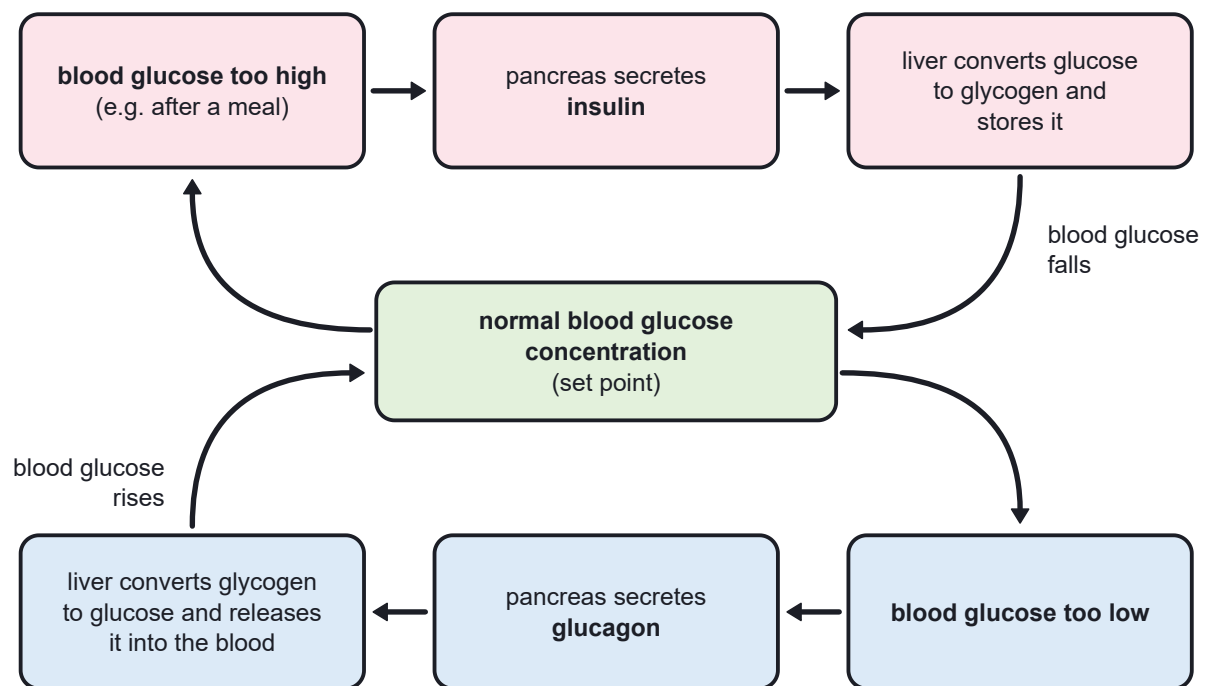
The **liver** controls blood glucose concentration by storing and releasing glucose. It stores glucose as **glycogen**. Insulin and glucagon both act on the liver.

Supplement

Control of blood glucose concentration

	Blood glucose too high	Blood glucose too low
Hormone secreted by the pancreas	Insulin	Glucagon
Response of the liver	Converts glucose to glycogen, which it stores	Converts glycogen to glucose and releases it into the blood
Effect on blood glucose	Decreases	Increases

Supplement



Control of blood glucose. **Insulin** lowers it and **glucagon** raises it, both acting on the **liver**.

Supplement

Common mistake: Insulin and glucagon are hormones. Glycogen is the storage carbohydrate. Do not mix up the three names.

Type 1 diabetes Spec 14.4.5 Supplement

In **Type 1 diabetes**, the pancreas produces little or no insulin. After a meal the blood glucose concentration rises and stays too high, because it is not brought back down.

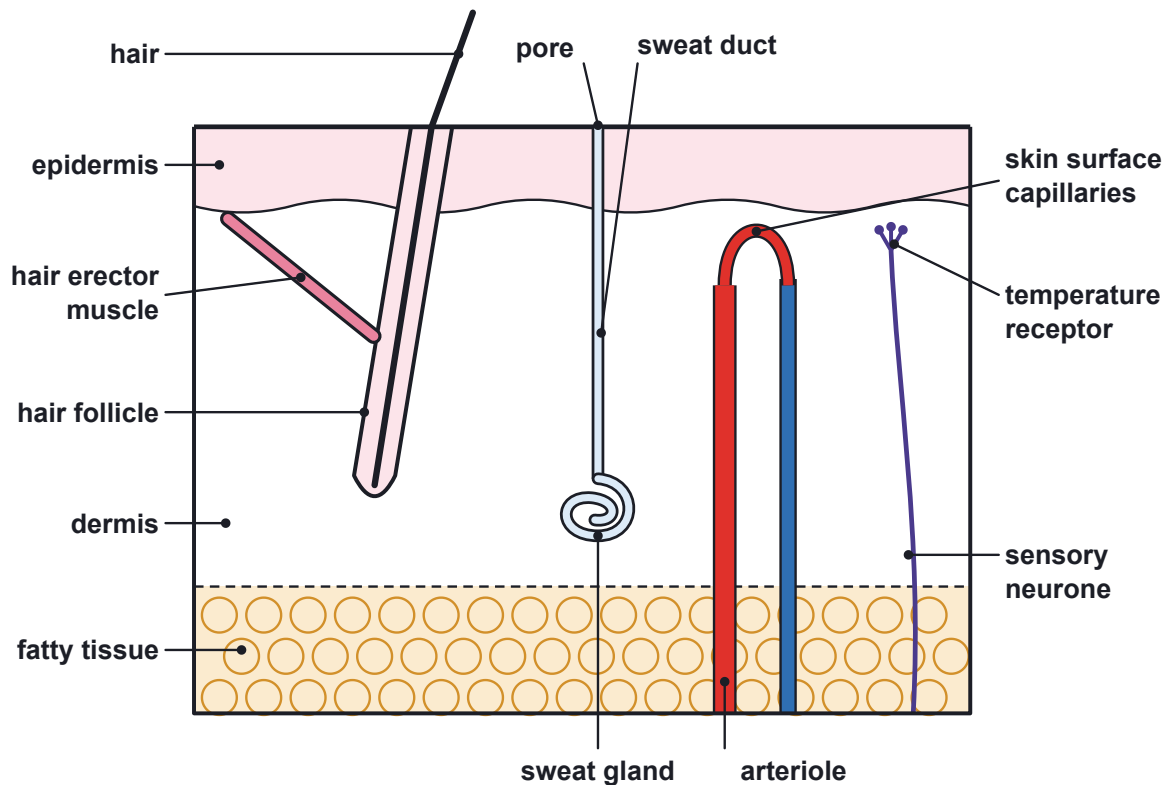
Treatment of Type 1 diabetes has three main parts.

- **Insulin injections**, usually at mealtimes, to lower the blood glucose concentration.
- **Monitoring** the blood glucose concentration, so the right dose of insulin can be given.
- Managing the **diet**, especially the amount of carbohydrate eaten, to avoid large rises in blood glucose.

Exam tip: Insulin is a protein, so it is injected. If it were swallowed it would be digested in the gut.

The skin and temperature control Spec 14.4.6, 14.4.7, 14.4.8 Supplement

Mammals keep their internal body temperature constant (about 37 °C in humans). Temperature receptors in the skin send impulses along sensory neurones to the brain, and the brain also detects the temperature of the blood. The **brain** compares the body temperature with the set point and coordinates the responses of the effectors: sweat glands, muscles, hair erector muscles and arterioles.



Structures in the skin used in temperature control.

Structures of the skin	
Structure	Role in temperature control
Hairs	Raised in the cold to trap a layer of air (insulation)
Hair erector muscles	Contract to raise the hairs; relax to lower them
Sweat glands	Release sweat onto the skin surface
Receptors	Detect temperature changes
Sensory neurones	Carry impulses from the receptors to the brain
Blood vessels	Arterioles supplying skin surface capillaries change in width
Fatty tissue	Insulation: reduces heat loss

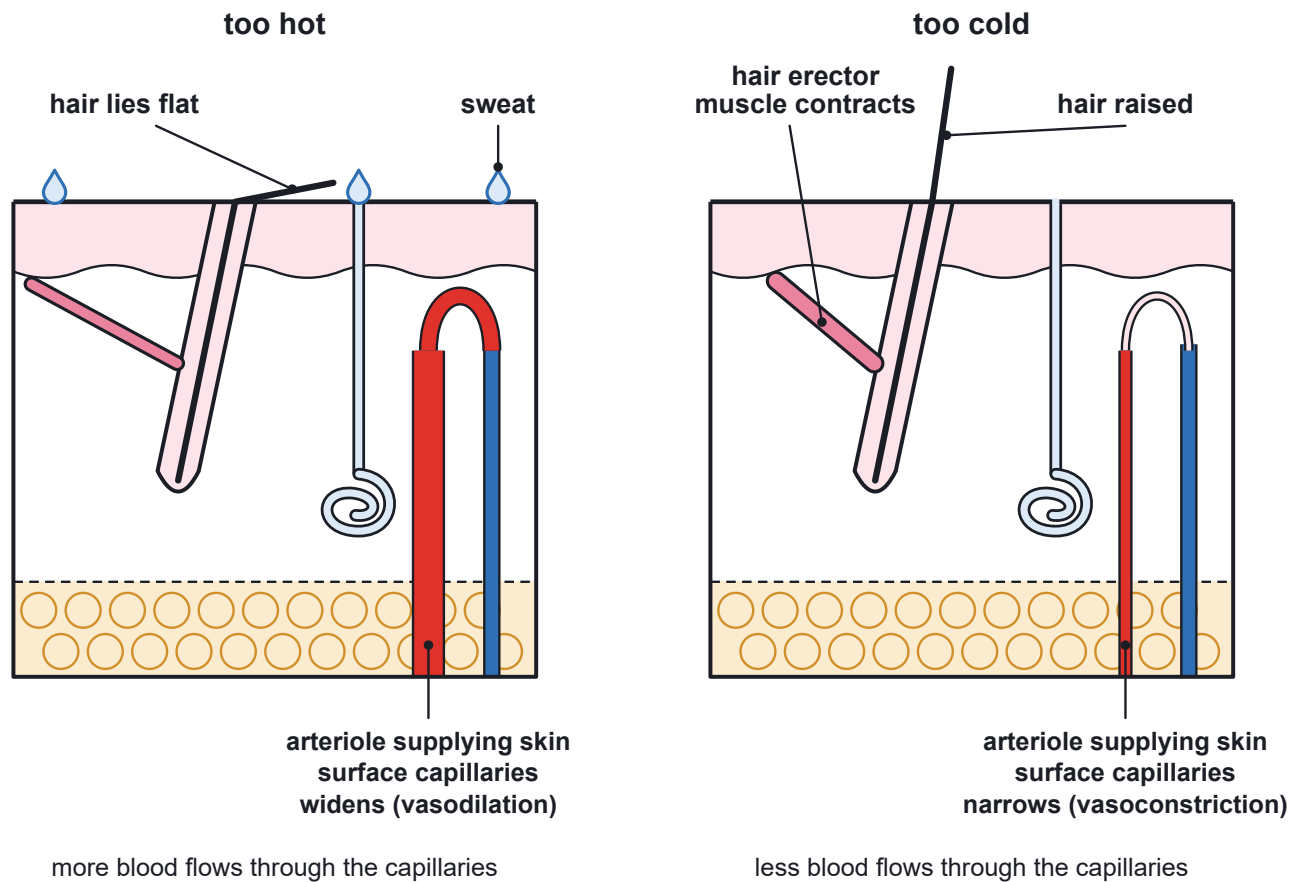
When the body is too hot

- **Sweating**: sweat evaporates from the skin and takes heat from the body.
- **Vasodilation**: the arterioles supplying the skin surface capillaries widen, so more blood flows through the capillaries and more heat is lost.

When the body is too cold

- **Shivering**: muscles contract rapidly, and respiration in them releases heat.

- **Vasoconstriction**: the arterioles supplying the skin surface capillaries narrow, so less blood flows near the surface and less heat is lost.
- **Insulation**: hairs are raised by the hair erector muscles to trap air, and fatty tissue under the skin reduces heat loss.



Vasodilation when too hot; **vasoconstriction** when too cold. The arterioles change width; they do not move.

Supplement

Common mistake: Blood vessels do not move up and down towards the skin surface. The arterioles get wider (vasodilation) or narrower (vasoconstriction).

Quick check

1. What is homeostasis?
2. What does insulin do to blood glucose concentration?
3. **Supplement** What is a set point?
4. **Supplement** What does the liver do with glucose when insulin is secreted?
5. **Supplement** What happens to the arterioles supplying the skin surface capillaries when the body is too cold?

Quick check answers

Homeostasis

1. The maintenance of a constant internal environment.
2. It decreases it.
3. The normal level of a factor that the body keeps steady by negative feedback.
4. Converts it to glycogen for storage.
5. They narrow (vasoconstriction).