Homeostasis

The tendency to maintain a stable, relatively constant internal environment is called h**omeostasis**. The body maintains homeostasis for many factors in addition to temperature. For instance, the concentration of various ions in your blood must be kept steady, along with pH and the concentration of glucose. If these values get too high or low, you can end up getting very sick.

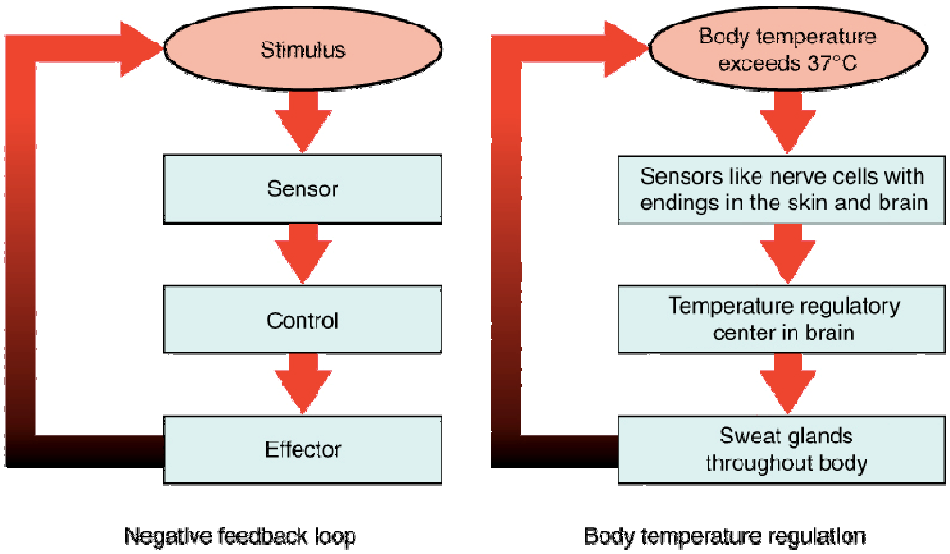
Homeostasis is maintained at many levels, not just the level of the whole body as it is for temperature. For instance, the stomach maintains a pH that's different from that of surrounding organs, and each individual cell maintains ion concentrations different from those of the surrounding fluid. Maintaining homeostasis at each level is key to maintaining the body's overall function.

So, how is homeostasis maintained? Let's answer this question by looking at some examples.

Maintaining homeostasis:

Biological systems like those of your body are constantly being pushed away from their balance points. For instance, when you exercise, your muscles increase heat production, nudging your body temperature upward. Similarly, when you drink a glass of fruit juice, your blood glucose goes up. Homeostasis depends on the ability of your body to detect and oppose these changes.

Maintenance of homeostasis usually involves **negative feedback loops**. These loops act to oppose the **stimulus**, or cue, that triggers them. First, high temperature will be detected by **sensors**—primarily nerve cells with endings in your skin and brain—and relayed to a temperature-regulatory **control center** in your brain. The control center will process the information and activate **effectors**—such as the sweat glands—whose job is to oppose the stimulus by bringing body temperature down.



(a) A negative feedback loop has four basic parts: A stimulus, sensor, control, and effector. (b) Body temperature is regulated by negative feedback. The stimulus is when the body temperature exceeds 37 degrees Celsius, the sensors are the nerve cells with endings in the skin and brain, the control is the temperature regulatory center in the brain, and the effector is the sweat glands throughout the body.

Of course, body temperature doesn't just swing above its target value—it can also drop below this value. In general, homeostatic circuits usually involve at least two negative feedback loops:

- One is activated when a parameter—like body temperature—is *above* the set point and is designed to bring it back down.
- One is activated when the parameter is *below* the set point and is designed to bring it back up.

To make this idea more concrete, let's take a closer look at the opposing feedback loops that control body temperature.

Homeostatic responses in temperature regulation

During getting either too hot or too cold, sensors in the periphery and the brain tell the temperature regulation center of brain—in a region called the hypothalamus—that temperature has strayed from its set point. For instance, if you've been exercising hard, your body temperature can rise *above* its set point, and you'll need to activate mechanisms that cool you down. Blood flow to your skin increases to speed up heat loss into your surroundings, and you might also start sweating so the evaporation of sweat from your skin can help you cool off. Heavy breathing can also increase heat loss.

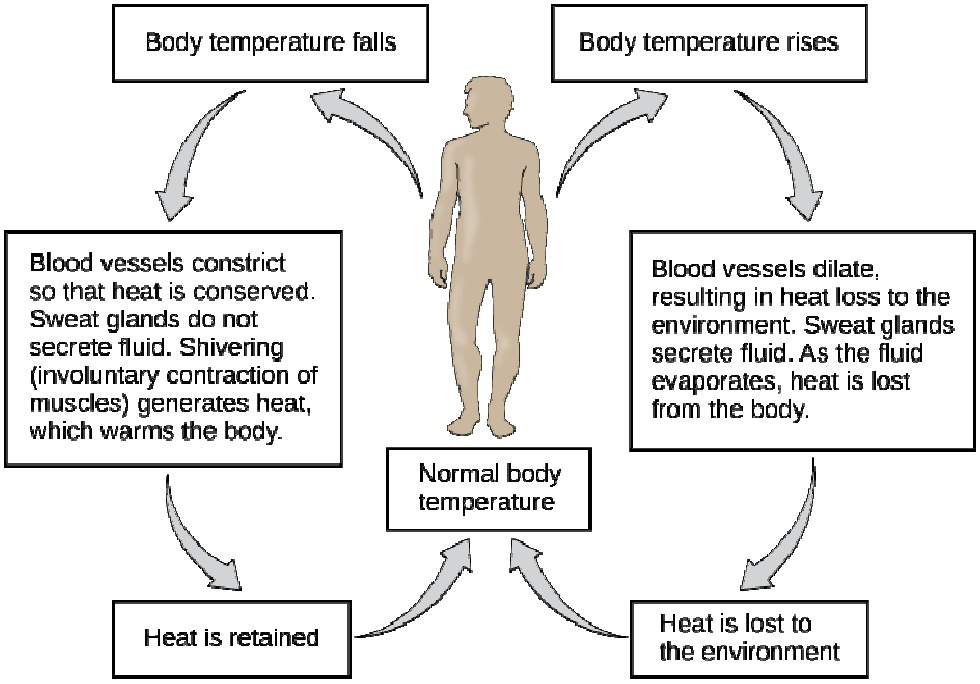


Image showing temperature regulation in response to signals from the nervous system. When the body temperature falls, the blood vessels constrict, sweat glands don't produce sweat, and shivering generates heat to warm the body. This causes heat to be retained the the body temperature to return to normal. When the body temperature is too high, the blood vessels dilate, sweat glands secrete fluid, and heat is lost from the body. As heat is lost to the environment, the body temperature returns to normal.

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