

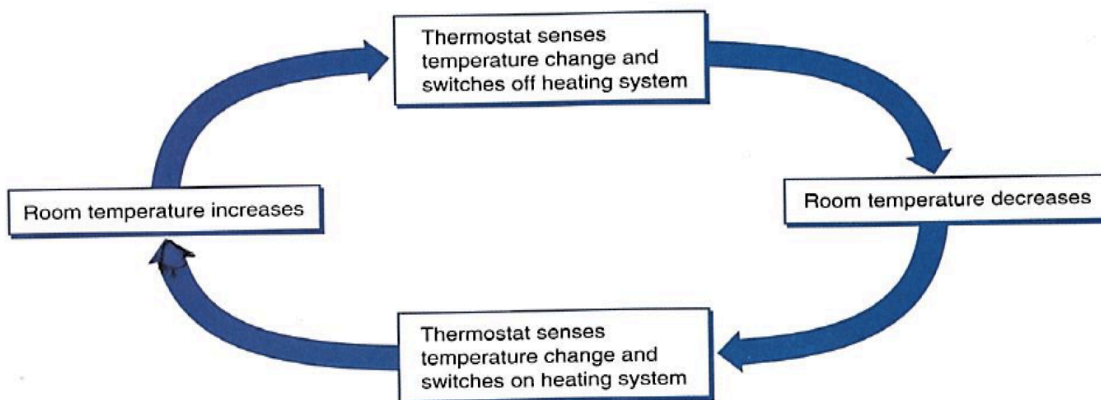
## Maintaining Homeostasis

You can get a glimpse of the interrelationship of your body systems when you breathe deeply after climbing a steep hill or when your blood clots to seal a cut. Behind the scenes, your organ systems are working constantly to do something that few people appreciate—maintain a controlled, stable environment. This process is called **homeostasis**, which means “keeping things in balance.” 🏠 **Homeostasis is the process by which organisms keep internal conditions relatively constant despite changes in external environments. Homeostasis in the body is maintained by feedback loops.**

**A Nonliving Example** One way to understand homeostasis is to look at a nonliving system that also keeps environmental conditions within a certain range. The heating system of a house is a perfect example. In most houses, heat is supplied by a furnace that burns oil or natural gas. When the temperature within the house drops below a set point, a sensor in a device called a thermostat switches the furnace on. Heat produced by the furnace warms the house. When the temperature rises above the set point, the thermostat switches the furnace off. Because the furnace runs only when it is needed, the temperature of the house is kept within a narrow range.

A heating system like the one described is said to be controlled by feedback inhibition. **Feedback inhibition**, or negative feedback, is the process in which a stimulus produces a response that opposes the original stimulus. **Figure 35-4** summarizes the feedback inhibition process in a home heating system. When the furnace is switched on, it produces a product (heat) that changes the environment of the house (by raising the air temperature). This environmental change then “feeds back” to “inhibit” the operation of the furnace. In other words, heat from the furnace eventually raises the temperature enough to send a feedback signal to switch the furnace off. Systems controlled by feedback inhibition are generally fully automated and very stable.

**Figure 35-4** 🏠 Homeostasis is the process by which organisms keep internal conditions relatively constant despite changes in external environments. A home heating system uses a feedback loop to maintain a stable, comfortable environment within a house.



## Word Origins

**Thermometer** comes from the Greek words *therme*, meaning “heat,” and *metron*, meaning “measure.” So, thermometer means an instrument used to measure heat. If *hypo-* is Greek for “under,” what does *hypothermia* mean?

**In the Body** Could biological systems achieve homeostasis through feedback inhibition? Absolutely. All that is needed is a system that regulates some aspect of the cellular environment and that can respond to feedback from its own activities by switching on or off as needed.

Maintenance of homeostasis requires the integration of all organ systems at all times. One example is the maintenance of a stable body temperature. The body regulates temperature by a mechanism that is remarkably similar to that of a home heating system. A part of the brain called the hypothalamus contains nerve cells that monitor both the temperature of the skin at the surface of the body and the temperature of organs in the body's core. The temperature of the core is generally higher than the temperature of the skin.

If the nerve cells sense that the core temperature has dropped much below 37°C, the hypothalamus produces chemicals that signal cells throughout the body to speed up their activities. Heat produced by this increase in cellular activity causes a gradual rise in body temperature, which is detected by nerve cells in the hypothalamus. This feedback inhibits the production of the chemicals that speed up cellular activity and keeps body temperature from rising to a dangerous level.

Have you ever been so cold that you began to shiver? If your body temperature drops well below its normal range, the hypothalamus releases chemicals that signal muscles just below the surface of the skin to contract involuntarily—to “shiver.” These muscle contractions release heat, which helps the body temperature to rise back toward the normal range.

If body temperature rises too far above 37°C, the hypothalamus slows down cellular activities, minimizing the production of heat. This is one of the main reasons you may feel tired and sluggish on a hot day. The body also responds to high temperatures by producing sweat, which helps to cool the body surface by evaporation. Because heat from the body's core is carried by the blood to the skin, evaporation at the body surface also helps to lower the temperature of the core. When this temperature returns to its set point, the body stops producing sweat.

## 35-1 Section Assessment

1. **Key Concept** Sequence the levels of organization in multicellular organisms.
2. **Key Concept** What is homeostasis?
3. Describe the functions of each of the eleven organ systems.
4. What are the four types of tissue?

5. **Critical Thinking Inferring** Look at the nervous tissue in **Figure 35-3**. Compare the cells of the nervous tissue to the cells of one of the other types of tissue. Which parts of an animal would contain these types of cells?

## Thinking Visually

### Making a Venn Diagram

Draw a Venn diagram to relate the four basic levels of organization in the human body. Provide at least three examples for each level included in your diagram.