

Body Organization

Key Ideas

- What two properties make stem cells different from other body cells?
- What four types of tissues can be found in the human body?
- How are tissues, organs, and organ systems related?
- How does the body maintain homeostasis?

Key Terms

stem cell
epithelial tissue
nervous tissue
connective tissue
muscle tissue

Why It Matters

For the human body to function properly, the cells, tissues, organs, and organ systems must work together.

Imagine what your body would look like if it were made up of one type of cell. Luckily, our bodies are made of many types of cells that work together.

Cells

Cells are the basic building blocks of every living organism. The human body contains more than 100 trillion cells and more than 100 types of cells. Each cell type performs a specific function in the body. Some cells produce chemicals, like the acid producing cells in the stomach. Other cells transmit nerve signals. Some cells take up the mineral calcium and become hardened to protect the body. Our health depends on each of our cells performing their function.

Stem Cells Today, **stem cells** are an important focus of research.

➤ **Stem cells are different from other cells of the body because they can divide repeatedly and can become more than one type of cell.** The stem cells used in research, like the one in **Figure 1**, are either embryonic or adult cells. Embryonic stem cells are harvested from eggs that were fertilized in the laboratory and donated for research. Adult stem cells used in research are taken from adult tissue.

The use of embryonic and adult stem cells each has advantages and disadvantages. Embryonic stem cells can become any type of cell, are grown easily in the lab, and millions of cells can be produced from one embryo. Using these cells is controversial because a human embryo is destroyed to obtain them. Research suggests, however, that embryonic stem cells might be collected from an umbilical cord, which would not result in the destruction of an embryo.

Adult stem cells may be limited in the types of cells they can become, they are relatively rare in the body, and currently cannot be grown to produce large numbers of cells in the lab. This is important because large numbers of cells are needed for stem cell therapy. The advantage of using adult stem cells is that they can be taken from a patient's own body. As a result, the transplanted cells would not be rejected by the patient's immune system.

stem cell a cell that can develop into many different types of cells

Figure 1 This adult bone marrow stem cell can typically only produce blood, bone, and cartilage cells.

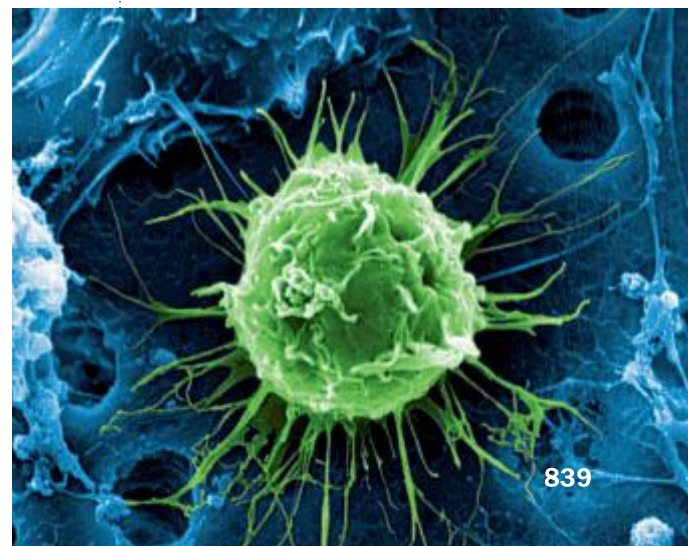
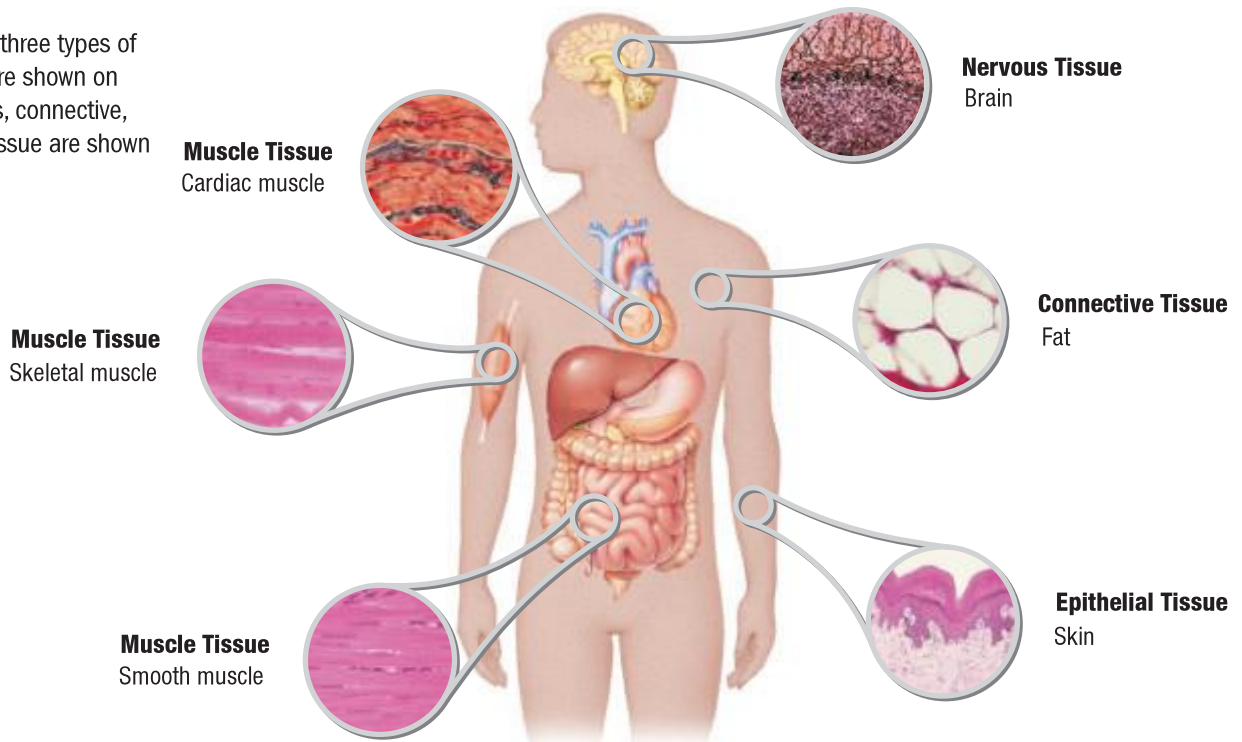


Figure 2 The three types of muscle tissue are shown on the left. Nervous, connective, and epithelial tissue are shown on the right.



ACADEMIC VOCABULARY

similar alike, almost the same

epithelial tissue tissue that covers a body surface or lines a body cavity

nervous tissue tissue of the nervous system, including neurons and their supporting cells

connective tissue a tissue that connects and supports other tissues

muscle tissue the tissue made of cells that can contract and relax to produce movement

Tissue Types

A tissue is a group of similar cells that work together to perform a common function. ➤ The human body contains four types of tissues: epithelial, nervous, connective, and muscle tissue. The four types of tissue (including three kinds of muscle tissue) can be seen in **Figure 2**.

Epithelial Tissue Epithelial tissue lines the body surfaces and protects the body from dehydration and damage. An epithelial layer can be one or many cells thick. Epithelial tissue is constantly being replaced as old cells die. Skin and the lining of the respiratory system are examples of epithelial tissue.

Nervous Tissue Nervous tissue is made up of neurons (nerve cells) and their supporting cells. The nervous system is made mostly of nervous tissue. Neurons carry information to all parts of the body.

Connective Tissue Connective tissue supports, connects, protects, and insulates the body. Connective tissue includes fat, cartilage, bone, tendons, and blood. Some connective tissue cells, such as those in bone, are densely packed. Others, such as those found in blood, are loosely connected to each other.

Muscle Tissue Muscle tissue is made up of cells that contract and relax to produce movement. There are three types of muscle tissue: skeletal, smooth, and cardiac muscle. Skeletal muscle is attached to bone, smooth muscle makes up the walls of the intestines and blood vessels, and cardiac muscle is only found in the heart.

➤ **Reading Check** What are four types of tissues found in the body? (See the Appendix for answers to Reading Checks.)

Organs and Organ Systems

Organs are structures made of two or more types of tissue that work together to perform a specific function. Each organ belongs to at least one *organ system*. An organ system is a group of organs that work together to carry out the major processes of the body. ➤ **Tissues that work together form organs. Organs that work together form organ systems.**

The heart is an organ made of cardiac muscle tissue, connective tissue, and nervous tissue working together to pump blood. The heart, along with the blood vessels, blood, lymph nodes, lymph vessels, and lymph, make up the circulatory system. Some organs function in more than one system. The lymph nodes and vessels function in both the circulatory and the immune system. The major organ systems and their structures are listed in **Figure 3**.

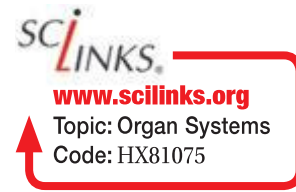
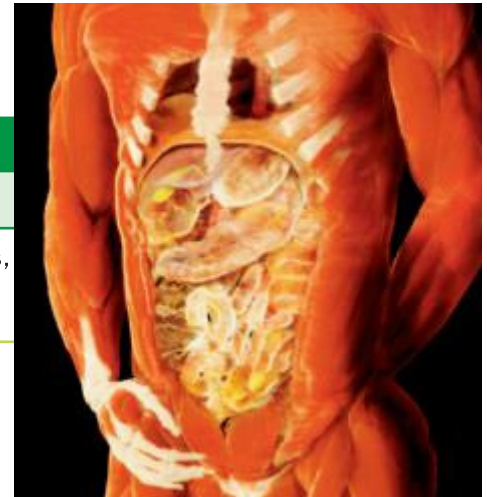


Figure 3 The table below lists the major structures and functions of the organ systems of the body. ➤ **Which organs function in more than one system?**



Major Organ Systems of the Body		
System	Major structures	Functions
Circulatory system	heart, blood vessels, blood, lymph nodes and vessels, and lymph	to transport nutrients, wastes, hormones, and gases
Digestive system	mouth, throat, esophagus, stomach, liver, pancreas, and small and large intestines	to absorb nutrients from food; to remove wastes; to maintain water and chemical balances
Endocrine system	hypothalamus, pituitary gland, pancreas, testis, ovaries, and many other glands	to regulate body temperature, metabolism, development, and reproduction; to maintain homeostasis; to regulate other organ systems
Urinary system	kidneys, urinary bladder, ureters, and urethra	to remove wastes from blood; to regulate concentration of body fluids
Immune system	white blood cells, lymph nodes and vessels, and skin	to defend against pathogens and disease
Integumentary system	skin, nails, and hair	to protect against injury, infection, and fluid loss; to help regulate body temperature
Muscular system	skeletal, smooth, and cardiac muscle tissues; tendons	to move limbs and trunk; to move substances through the body; to provide structure and support
Nervous system	brain, spinal cord, nerves, and sense organs	to regulate behavior; to maintain homeostasis; to regulate all other organ systems; to control senses and movement
Reproductive system	testes, penis, ovaries, uterus, and breasts	to produce gametes (eggs and sperm) and offspring
Respiratory system	nose, mouth, trachea, bronchi, and lungs	to move air into and out of lungs; to control gas exchange between blood and lungs
Skeletal system	bones, ligaments, and cartilage	to protect and support the body and organs; to work with skeletal muscles; to produce red blood cells, white blood cells, and platelets



Investigation of Homeostasis

The human body maintains a fairly constant internal temperature of about 37 °C (98.6 °F). You can test this fact by taking your temperature in a variety of conditions.

Procedure

- 1 Use a **thermometer** to record the air temperature inside your classroom. Use an **oral thermometer** to take your temperature, and record it.
- 2 Move to a location that is warmer or colder than your classroom. Record the air temperature. After 10 min, take your temperature and record it.

Analysis

1. **Explain** what happened to your body temperature when you went from your classroom to a warmer or colder place.
2. **CRITICAL THINKING Recognizing Relationships** The body produces heat through metabolism. So, why can people freeze to death?



Homeostasis

Homeostasis is the steady internal environment that your body maintains, despite changes in the external environment. ➤ **The body maintains homeostasis by sensing and responding to changes in the internal environment.**

Negative Feedback Almost all body processes use a system called *negative feedback* to maintain homeostasis. Negative feedback is a system in which the results of a process provide the signal for the process to stop. One example of this is the regulation of body temperature.

Body Temperature Despite temperature changes in the environment, our bodies maintain a fairly constant internal temperature of about 37 °C. The body regulates its internal temperature using negative feedback, in much the same way that a thermostat works. When the body senses that its internal temperature has dropped below normal, a chemical signal causes the body to produce heat. The result is shivering, a process you are probably familiar with. When your body

temperature returns to normal, the chemical signal is turned off, and you stop shivering. If your body temperature rises above normal, another chemical signal is sent. This signal tells the body to begin cooling itself through the evaporation of sweat and by increasing blood flow to small vessels below the skin. This releases heat and cools the body. Temperatures that are too high cause proteins to *denature* (change shape) and stop functioning. Temperatures too far below the normal range cause cellular processes to stop.

Section

1

Review

➤ KEY IDEAS

1. **Identify** the two characteristics that make stem cells different from other cells of the body.
2. **List** the four types of body tissue, and give an example of each type.
3. **Explain** the relationship between cells, tissues, organs, and organ systems.

4. **Describe** the system used to maintain homeostasis in most of the body's processes.

CRITICAL THINKING

5. **Inferring Relationships** How might developing a fever during illness be beneficial to the body?
6. **Forming Reasoned Opinions** Would you recommend that embryonic stem cell research be regulated by law? Explain your answer.

MAKING CONNECTIONS

7. **Predict** Recall that cytoplasm is the region inside a cell that includes the cell's fluid. Based on this information, would you expect the cells that form the surface of the skin to have more or less cytoplasm than fat cells have? Why or why not?