Structure, Movement, and Control

**Before You Read**

**What do you think?** Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you’ve read this lesson, reread the statements to see if you have changed your mind.

<table>
<thead>
<tr>
<th>Before</th>
<th>Statement</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>All bones in the skeletal system are hollow.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>The endocrine system makes hormones.</td>
<td></td>
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</tbody>
</table>

**Read to Learn**

**Structure and Movement**

The human body can move in many different directions and do many different things. It can do things that require many parts of the body to move, such as swimming or shooting a basketball. It also can remain very still, such as when posing for a picture or balancing on one leg.

In this lesson, you will read more about two organ systems that give the body structure, help the body move, and protect other organ systems. These organ systems are the skeletal system and the muscular system.

**The Skeletal System**

The skeletal system has four major jobs. It protects internal organs, provides support, helps the body move, and stores minerals. The skeletal system is mostly bones. Adults have 206 bones. Ligaments, tendons, and cartilage are also parts of the skeletal system.

**Storage** The skeletal system stores important minerals such as calcium. Your body uses calcium in many ways. Muscles need calcium for contractions. The nervous system needs calcium for communication. Most of the calcium in the body is stored in bone. Calcium helps build stronger compact bone. Cheese and milk are good sources of calcium.

**Key Concepts**

- How does the body move?
- How does the body respond to changes in its environment?

**Sticky Notes** As you read, use sticky notes to mark information that you do not understand. Read the text carefully a second time. If you still need help, write a list of questions to ask your teacher.

**Reading Check**

1. **Identify** Which mineral is stored by the skeletal system?
Support Without a skeleton, your body would look like a beanbag. Your skeleton gives your body structure and support. Your bones help you stand, sit up, and raise your arms.

Protection Many of the bones in the body protect organs that are made of softer tissue. For example, the skull protects the soft tissue of the brain. The rib cage protects the soft tissue of the lungs and heart.

Movement The skeletal system helps the body move by working with the muscular system. Bones can move because they are attached to muscles.

Bone Types Bones are organs that contain two types of tissue. Compact bone is the hard outer layer of bone. Spongy bone is the interior region of bone that contains many tiny holes.

Spongy bone is inside compact bone. Some bones also contain bone marrow. Remember that bone marrow is a part of the lymphatic system and makes white blood cells.

The Muscular System
You might already know that your arms and legs have muscle cells. But did you know that your eyes, heart, and blood vessels have them too? Without muscle cells, you would not be able to talk, write, or run.

As shown in the figure on the next page, muscle cells are everywhere in the body. Almost one-half of your body mass is muscle cells. Muscle cells make up the muscular system. By working together, they help the body move.

The muscular system is made of three different types of muscle tissue—skeletal muscle, cardiac muscle, and smooth muscle. Skeletal muscle works with the skeletal system and helps you move. Tendons connect skeletal muscles to bones. Skeletal muscle also gives you the strength to lift heavy objects.

Another type of muscle tissue is cardiac muscle. Cardiac muscle is only in the heart. It continually contracts and relaxes and moves blood throughout your body.

Smooth muscle tissue is another type of muscle tissue. Smooth muscle tissue is in organs such as the stomach and the bladder. Blood vessels also have smooth muscle tissue.
Control and Coordination

The nervous system receives and processes information about your internal and external environments. The nervous system works with the endocrine system, which you will read about later. These two systems control many functions, including movement, communication, and growth, by working with other systems in the body. They also help your body maintain homeostasis.

The Nervous System

The nervous system is a group of organs and specialized cells that detect, process, and respond to information. The nervous system constantly receives information from your external environment and from inside your body. It can receive information, process it, and respond in less than 1 second.

Nerve Cells

The basic units of the nervous system are neurons, or nerve cells. Neurons can be many different lengths. In adults, some neurons are more than 1 m long. This is about as long as the distance between a toe and the spinal cord.

Key Concept Check

5. Explain How does the body respond to changes in its environment?

4. Recognize Which type of muscle is in your arms?

Cardiac muscle

Smooth muscle

Skeletal muscle

The Muscular System
Parts of the Nervous System

The nervous system, which is shown in the figure at right, includes the brain, the spinal cord, and nerves. The brain and the spinal cord form the central nervous system. Nerves outside the brain and the spinal cord make up the peripheral nervous system.

Processing Information

The central nervous system is protected by the skeletal system. Muscles and other organs surround the peripheral nervous system. Information enters the nervous system through neurons in the peripheral nervous system. Most of the information then is sent to the central nervous system for processing. After the central nervous system processes information, it signals the peripheral nervous system to respond.

Voluntary and Involuntary Control

The body carries out many functions that depend on the nervous system. Some of these functions, such as breathing and digestion, are automatic, or involuntary. You do not have to think about them to make them happen. The nervous system automatically controls these functions and maintains homeostasis.

Most of the other functions of the nervous system are not automatic. You must think about them to make them happen. Reading, talking, and walking are voluntary functions. These tasks require input, processing, and a response.

Reflexes

Touching a hot object with your hand sends a rapid signal that your hand is in pain. The signal is so fast that you do not think about moving your hand. It just happens automatically. *Automatic movements in response to a signal are called reflexes.* The table at the top of the next page lists how the spinal cord receives and processes reflex signals. Processing information in the spinal cord instead of the brain helps the body respond faster.
Receiving and Processing Reflex Signals

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>When you touch something hot, receptors in your hand detect stimuli (the hot temperature). They send signals through nerves to your spinal cord.</td>
</tr>
<tr>
<td>2</td>
<td>Responding nerve signals travel directly from the spinal cord to muscles in your arm. This causes you to pull your hand away.</td>
</tr>
<tr>
<td>3</td>
<td>After you respond to the stimuli, nerve signals travel from the spinal cord to the brain. This causes you to feel pain.</td>
</tr>
</tbody>
</table>

**The Senses**

Humans detect their external environment with five senses—vision, hearing, smell, touch, and taste—as shown in the following table. Each of the five senses has specific neurons that receive signals from the environment.

<table>
<thead>
<tr>
<th>Senses</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision</td>
<td>The visual system receives light signals.</td>
</tr>
<tr>
<td>Hearing</td>
<td>The auditory system detects sound.</td>
</tr>
<tr>
<td>Smell</td>
<td>The olfactory system receives odor signals.</td>
</tr>
<tr>
<td>Touch</td>
<td>There are many sensory receptors for touch. Some receive signals that detect temperature.</td>
</tr>
<tr>
<td>Taste</td>
<td>Taste buds receive chemical signals.</td>
</tr>
</tbody>
</table>

Information detected by the senses is sent to the spinal cord and then to the brain for processing and a response. Responses depend on the specific signal detected. Some responses cause muscles to contract and move, such as when you touch a hot surface. The aroma of baking cookies might cause your mouth to water. It is producing saliva.

**The Endocrine System**

How tall were you in first grade? How tall are you now? From the time you were born until now, your body has changed. These changes are controlled by the endocrine system.

Like the nervous system, the endocrine system sends signals to the body. *Chemical signals released by the organs of the endocrine system are called hormones.* Hormones cause organ systems to carry out specific functions.
Why does your body need two organ systems to process information? Signals sent by the nervous system travel quickly through neurons. Hormones travel in blood through blood vessels in the circulatory system. These messages travel more slowly than nerve messages. A signal sent by the nervous system can travel from your head to your toes in less than 1 second. A hormone needs about 20 seconds to make the trip. Although hormones take longer to reach their target organ system, their effects usually last longer.

The endocrine system is shown in the figure above. Many of the hormones made by the endocrine system work with other organ systems and maintain homeostasis. Parathyroid hormone works with the skeletal system and controls calcium storage. Insulin is a hormone released from the pancreas. It signals the digestive system to control nutrient homeostasis. Other hormones, such as growth hormone, work with many organ systems to help you grow. In the next lesson, you will read about another system that the endocrine system works with.
Mini Glossary

**compact bone:** the hard outer layer of bone

**hormone:** a chemical signal released by the organs of the endocrine system

**neuron:** the basic unit of the nervous system

**reflex:** an automatic movement in response to a signal

**spongy bone:** the interior region of bone that contains many tiny holes

1. Review the terms and their definitions in the Mini Glossary. Write a sentence explaining the relationship between neurons and reflexes.

   ______________________________________________________________________

   ______________________________________________________________________

   ______________________________________________________________________

2. Fill in the graphic organizer below to show four major jobs of the skeletal system.

   ______________________________________________________________________

   ______________________________________________________________________

   ______________________________________________________________________

3. Review the information you marked with sticky notes as you read the lesson. In the space below, write the answer to one question from the list that you asked your teacher.

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What do you think **NOW?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson’s resources.