

Skeletal, Muscular, and Nervous Systems

LESSON 3

The Nervous System

● Before You Read

Your nervous system allows you to think, move, and feel emotions. On the lines below, name as many parts of the nervous system as you can. As you read, list additional parts of the nervous system.

BIG Idea

The nervous system sends messages through the nerves to coordinate all the body's activities.

Study Coach

Outline Preview this lesson by scanning the pages. Organize the headings and subheadings into an outline. As you read, fill in the outline with important details.

I.	
A.	1.
	2.
B.	
II.	

● Read to Learn

How the Nervous System Works

Your nervous system is a network that allows communication between the brain and parts of the body. Your nervous system coordinates all the activity in your body. When you breathe, digest food, sense pain, or feel fear, your nervous system is working. The brain, spinal cord, and nerves work together. They send messages between organs, tissues, and cells.

The nervous system has two main divisions. The *central nervous system* (CNS) consists of the brain and spinal cord. The *peripheral nervous system* (PNS) includes the nerves that extend from the brain, spinal cord, and sensory receptors. Sensory receptors on your skin that tell you when something is hot are part of the PNS. This system gathers information from inside and outside your body. The nerves in the PNS send messages to the CNS. The CNS interprets the messages and sends out a response. ☑

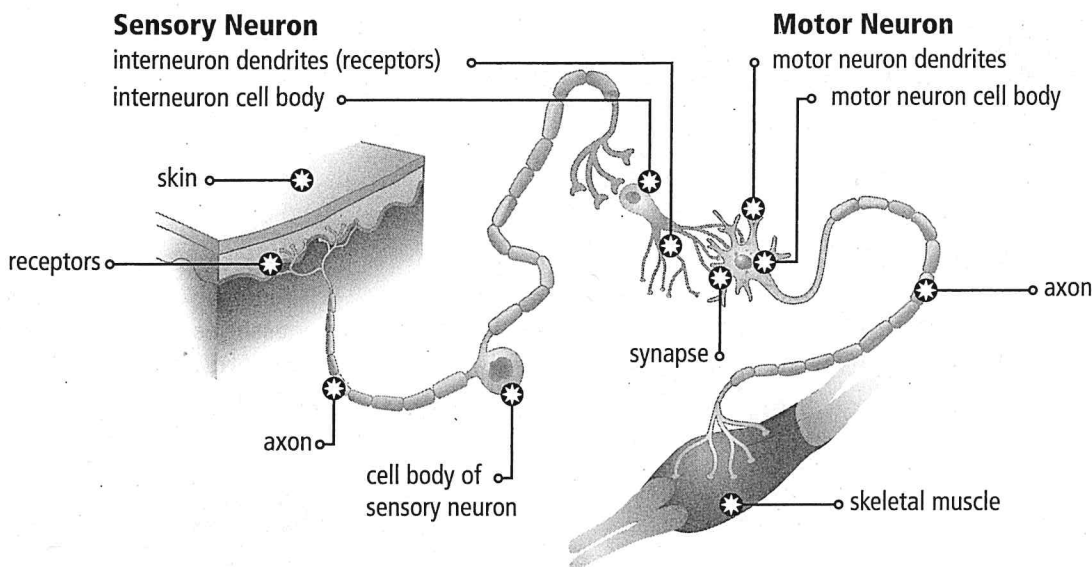


READING CHECK

1. Describe What is the function of the peripheral nervous system?

The Nerve Impulse

A nerve impulse begins when a receptor is stimulated. The impulse travels to the CNS and is interpreted with the help of an interneuron. Then an impulse is sent to a muscle cell or gland in response to the stimulus.



2. what is a neuron?

Picture This

2. Describe What happens after receptors in the skin are stimulated?

Understanding Neurons

Neurons, or nerve cells, transmit messages to and from the spinal cord and brain. There are three types of neurons. Sensory neurons carry messages from receptors in the body to the CNS. Motor neurons carry messages from the CNS back to muscles or glands. Interneurons communicate with and connect to other neurons.

A neuron consists of three main parts:

- **Cell body.** The cell body of a neuron contains the nucleus. The nucleus controls the production of proteins within the cell. Unlike other cells in the body, neurons cannot easily repair or replace damaged cells.
- **Dendrites.** Dendrites are branched structures that extend from the cell body in most neurons. Dendrites receive information from other neurons. They also transmit signals toward the cell body.
- **Axons.** Axons transmit signals away from the cell body and toward the neuron, muscle cell, or gland.



READING CHECK

3. Describe What functions do dendrites perform?

The Central Nervous System

The brain and the spinal cord make up the central nervous system. These organs send and receive impulses to and from nerves in the body.

The spinal cord is a long column of nerve tissue about the thickness of your index finger. It starts at the base of your brain and extends about 18 inches down your back. The spinal cord is surrounded by connective tissue. This tissue is called the spinal meninges. The meninges, along with the vertebrae—the bones of the spine—help protect the spinal cord. The spinal cord is also bathed in cerebrospinal fluid. This fluid absorbs shock and nourishes the nerve tissue.

An adult human brain weighs up to three pounds. It rests in the protective cavity formed by the bones of the skull. Like the spinal cord, the brain is covered with layers of cranial meninges. It is also surrounded by cerebrospinal fluid. Both help protect the tissues of the brain from injury. Blood vessels supply the brain with the oxygen it needs to survive.

What are the parts of the brain?

The brain controls the activities of the nervous system. It receives and processes messages from the senses. The brain also controls muscle movement. The brain has three main divisions: the cerebrum, the cerebellum, and the brain stem. ✓

The Cerebrum

The **cerebrum** (seh-REE-brum) is the largest, most complex part of the brain. It is the center of conscious thought, learning, and memory. It has two sides, or hemispheres. The right hemisphere controls the left side of the body. It allows you to process music and art and comprehend spatial relationships. The left hemisphere controls the right side of the body. It is the center of language, reasoning, and critical thinking. Each hemisphere has four lobes:

- **The frontal lobe.** The frontal lobe controls voluntary movements and also has a role in the use of language. The prefrontal areas are thought to be involved with intellect and personality.
- **The parietal lobe.** The parietal lobe is involved with sensory information. This includes heat, cold, pain, touch, and body position in space.

3. What does the CNS consist of?



READING CHECK

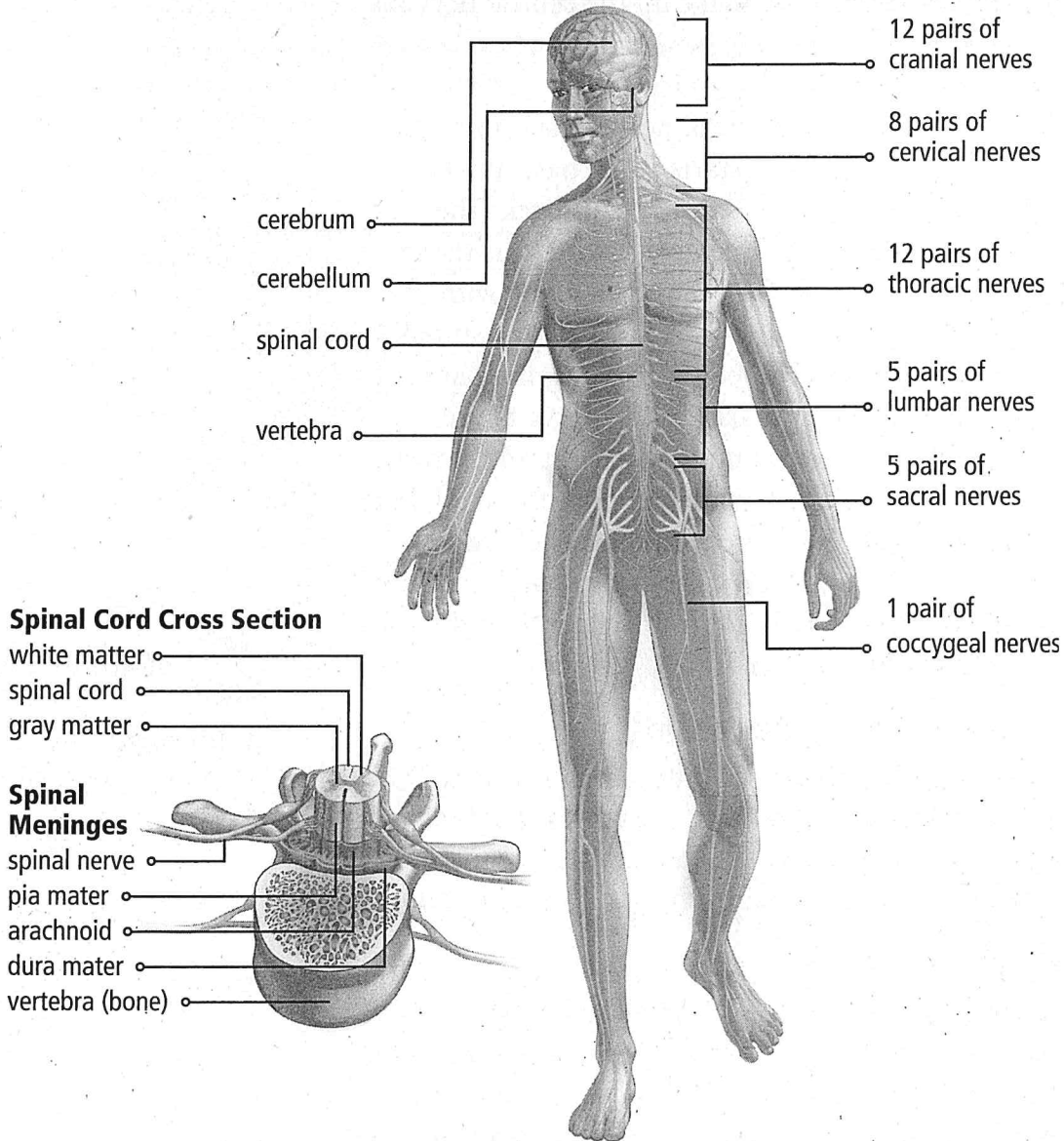
- 4. Identify** What are the three sections of the brain?
-
-



Think it Over

- 5. Analyze** If a person has trouble with language after a head injury, which part of the brain was probably affected?
-
-

The Nervous System



Picture This

6. Identify Which parts of the body protect the spinal cord from injury?

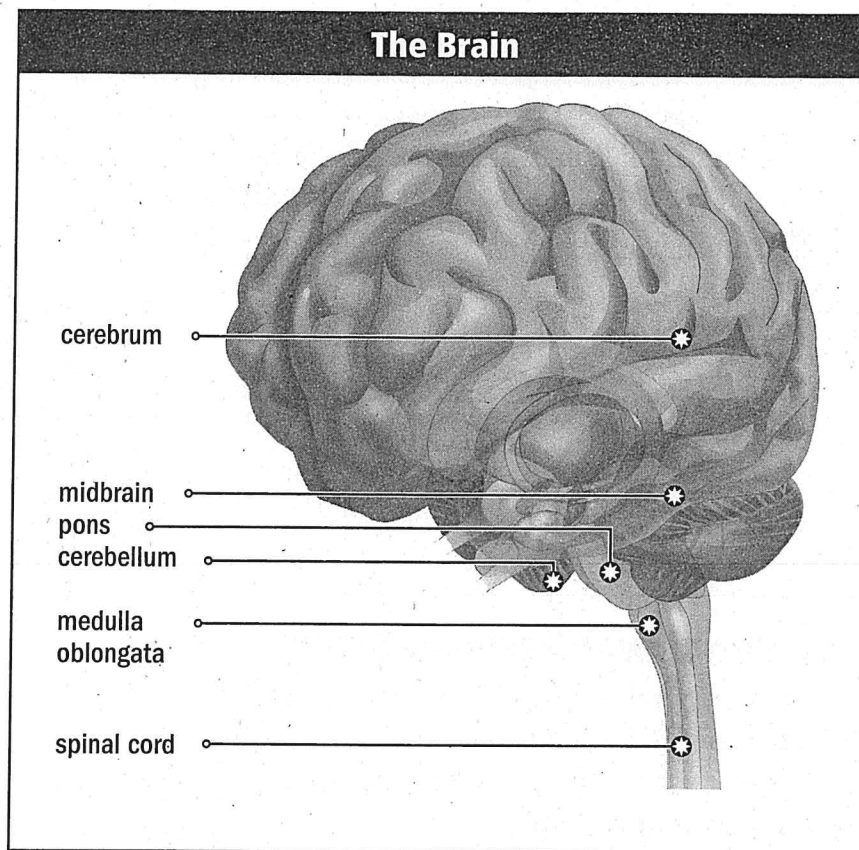
6. What does the occipital lobe control?

- **The occipital lobe.** This controls the sense of sight.
- **The temporal lobe.** This contains the senses of hearing and smell, as well as memory, thought, and judgment.

The Cerebellum

The **cerebellum** (ser-eh-BEL-um) is the second largest part of the brain. It controls the movement of skeletal muscles. This area of the brain also receives messages from neurons in the inner ear and muscles. It uses this information to maintain the body's posture and balance. The cerebellum makes it possible to play the violin and hit a tennis ball.

The Brain



Picture This

7. Identify Which part of the brain regulates heartbeat and breathing rate?

[Handwritten scribbles]

The Brain Stem

The **brain stem** is a three-inch long stalk of nerve cells and fibers. It connects the spinal cord to the rest of the brain. Incoming sensory impulses and outgoing motor impulses pass through the brain stem. It has five parts:

- **The medulla oblongata.** The medulla oblongata controls heartbeat, breathing rate, and reflexes such as coughing and sneezing.
- **The pons.** This helps regulate breathing and controls the eye and face muscles.
- **The midbrain.** The midbrain controls eyeball movement, pupil size and the reflexive response of turning your head when you hear a loud noise.
- **The thalamus.** This processes input from the eyes and the ears and receives messages about touch and pressure from receptors in the skin.
- **The hypothalamus.** The hypothalamus helps control body temperature, appetite, and sleep. It also controls the pituitary gland. This gland affects metabolism, sexual development, and emotions.



READING CHECK

8. Describe What does the pituitary gland control?

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How Your Reflexes Work

1. Stimulus:
the hand touches
a hot stove.



2. The sensory
neuron contacts
a connecting
neuron in the
spinal cord.



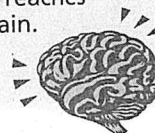
3. The connecting
neuron contacts a
motor neuron that
sends an impulse
to the muscles.



5. Reflex: the muscles
respond by pulling
the hand away
from the
stove.



4. The nerve impulse
finally reaches
the brain.



Picture This

9. Explain How does a
reflex differ from a regular
nervous system response?



READING CHECK

10. Describe What happens
during the "fight or flight"
response?

The Peripheral Nervous System

The peripheral nervous system (PNS) carries messages between the CNS and parts of the body. It signals change. The PNS is made up of the autonomic nervous system and the somatic nervous system.

What is the autonomic nervous system?

The *autonomic nervous system* controls involuntary functions such as digestion and heart rate. It is a network of nerves divided into two parts:

- **The sympathetic nervous system.** The sympathetic nervous system kicks in when you are startled. Messages from this system cause your heart rate to increase. Blood vessels in your muscles dilate, allowing greater blood flow. This is the "fight-or-flight" response that prepares you to react in a dangerous situation. This reaction is a *reflex*, a spontaneous response to a stimulus.
- **The parasympathetic nervous system.** The parasympathetic nervous system does the opposite job of the sympathetic nervous system. It slows heartbeat, relaxes blood vessels, and lowers blood pressure. ✓

What is the somatic nervous system?

The *somatic nervous system* involves responses that are under your control. Sensory neurons relay messages from receptors in the eyes, ears, nose, tongue, and skin to the central nervous system (CNS). Motor neurons carry impulses from the CNS to skeletal muscles.

Caring for Your Nervous System

Making healthful choices can protect your nervous system from injury. Always wear a safety belt when driving or riding in a motor vehicle. Wear a helmet and protective gear for certain sports like skateboarding. Never dive head first into shallow water or into an area where you cannot see the bottom. Finally, avoid drugs and alcohol. ✓

What are some possible problems of the nervous system?

The following problems can affect the nervous system:

- **Headaches.** Headaches can be caused by muscle tension, eyestrain, exposure to fumes, infections, dehydration, or food allergies. A migraine is a more serious type of headache. Sensitivity to light is one common symptom of a migraine.
- **Head injuries.** One type of head injury, a concussion, can occur after a blow to the head. It can result in loss of consciousness. A contusion is a bruising of the brain tissues. Contusions can result in dangerous swelling in the brain. Major trauma to the head can sometimes result in a coma, a prolonged state of unconsciousness.
- **Spinal injuries.** Swelling of the spinal cord or tissue can result in loss of nerve function. Without treatment, this can lead to permanent nerve damage. If the spinal cord has been severed, paralysis results.
- **Meningitis.** Meningitis is a swelling of the spinal and cranial meninges. It is caused by a bacterial or viral infection. Meningitis is very serious and can result in death. Symptoms include fever, headache, light and sound sensitivity, and neck stiffness.

Some diseases of the nervous system occur over time as tissues and cells break down. These are known as degenerative diseases. Examples include multiple sclerosis, Parkinson's disease, and Alzheimer's. Other disorders result from injury or brain damage, such as:

- **Epilepsy.** This is a disorder of the nervous system characterized by seizures. Seizures are sudden episodes of uncontrolled electrical activity in the brain. Epilepsy can be caused by brain damage at birth, infections, head injury, or exposure to toxins.
- **Cerebral palsy.** Cerebral palsy refers to a group of disorders that are the result of damage to the brain before, during, or just after birth. ✓



READING CHECK

- 11. Describe** What are some ways to protect your nervous system?



READING CHECK

- 12. Identify** Which nervous system diseases can result from brain damage?
