The Nervous System

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What does the nervous system do?
- What is the structure of the nervous system?

National Science Education Standards LS 1a, 1d, 1e, 3b, 3c

What Are the Two Main Parts of the Nervous System?

What is one thing that you have done today that did not involve your nervous system? This is a trick question! Your nervous system controls almost everything you do.

The nervous system has two basic functions. First, it collects information and decides what the information means. This information comes from inside your body and from the world outside your body. Second, the nervous system responds to the information it has collected.

The nervous system has two parts: the central nervous system and the peripheral nervous system. The **central nervous system** (CNS) includes the brain and the spinal cord. The CNS takes in and responds to information from the peripheral nervous system.

The **peripheral nervous system** (PNS) includes all the parts of the nervous system except the brain and the spinal cord. The PNS connects all parts of the body to the CNS. Special structures called nerves in the PNS carry information between the body and the CNS.

Part of the nervous system	What it includes	What it does
Central nervous system (CNS)		takes in and responds to messages from the PNS
Peripheral nervous system (PNS)		



Organize As you read, make a chart that describes different structures in the nervous system.

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V	READING	CHECK

1. Identify What are the two main parts of the nervous system?

TAKE A LOOK

2. Summarize Complete the chart to describe the main parts of the nervous system.

Math Focus

3. Calculate To calculate how long an impulse takes to travel a certain distance, you can use the following equation:

 $time = \frac{distance}{}$

If an impulse travels 100 m/s, about how long will it take the impulse to travel 10 meters?

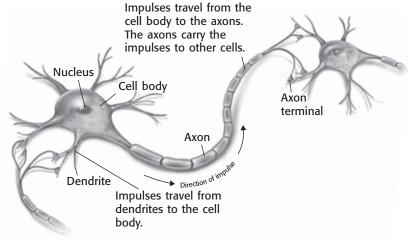
How Does Information Move Through the Nervous System?

Special cells called **neurons** carry the information that travels through your nervous system. Neurons carry information in the form of electrical energy. These electrical messages are called *impulses*. Impulses may travel up to 150 m/s!

Like any other cell in your body, a neuron has a nucleus and organelles. The nucleus and organelles are found in the *cell body* of the neuron. However, neurons also have structures called dendrites and axons that are not found in other kinds of cells.

Dendrites are parts of the neuron that branch from the cell body. Most dendrites are very short compared to the rest of the neuron. A single neuron may have many dendrites. Dendrites bring messages from other cells to the cell body.

Axons are longer than dendrites. Some axons can be as long as 1 m! Axons carry information away from the cell body to other cells. The end of an axon is called an axon terminal.



SENSORY NEURONS

Some neurons are sensory neurons. Sensory neurons carry information about what is happening in and around your body. Some sensory neurons are called receptors. Receptors can detect changes inside and outside your body. For example, receptors in your eyes can sense light. Sensory neurons carry information from the receptors to the CNS.

TAKE A LOOK

4. Identify Add an arrow to the diagram that shows the direction of impulses at the dendrites.



Identify In a small group, discuss what you think sensory receptors in your eyes, nose, ears, and finger tips respond to.

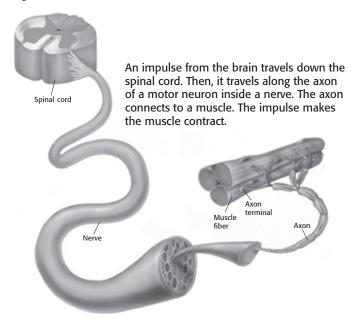
MOTOR NEURONS

Motor neurons carry impulses from the CNS to other parts of your body. Most motor neurons carry impulses to muscle cells. When muscles cells receive impulses from motor neurons, the muscle cells contract. Some motor neurons carry impulses to glands, such as sweat glands. These messages tell sweat glands when to make sweat.

NERVES

In many parts of your body, groups of axons are wrapped together with blood vessels and connective tissue to form bundles. These bundles are called **nerves**. Your central nervous system is connected to the rest of your body by nerves.

Nerves are found everywhere in your PNS. Most nerves contain axons from both sensory neurons and motor neurons. Many nerves carry impulses from your CNS to your PNS. Other nerves carry impulses from your PNS to your CNS.



STANDARDS CHECK

LS 1d Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together and form larger functional units called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.

Word Help: structure a whole that is built or put together from parts

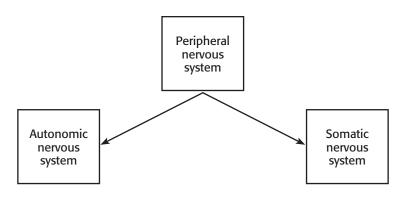
Word Help: function use or purpose

5.	Predict	What would
ha	ppen if y	our nerves
sto	pped w	orking?

What Are	e the	Parts	of the	Peripheral
Nervous	Syste	em?		-

Recall that the PNS connects the CNS to the rest of the body. Sensory neurons and motor neurons are both found in the PNS. Sensory neurons carry information to the CNS. Motor neurons carry information from the CNS to the PNS. The motor neurons in the PNS make up two groups: the somatic nervous system and the autonomic nervous system. 🗹

READING CHECK
6. Identify What are the two main groups of motor neurons in the PNS?



THE SOMATIC NERVOUS SYSTEM

The somatic nervous system is made up of motor neurons that you can control. These neurons are connected to skeletal muscles. They control voluntary movements, or movements that you have to think about. These movements include walking, writing, and talking.

THE AUTONOMIC NERVOUS SYSTEM

The autonomic nervous system controls body functions that you do not have to think about. These include digestion and the beating of your heart. The main job of the autonomic nervous system is to keep all of the body's functions in balance.

The autonomic nervous system has two divisions: the sympathetic nervous system and the parasympathetic nervous system. These two divisions work together to maintain a stable state inside your body. This stable state is called *homeostasis*. The table below shows how the sympathetic and parasympathetic nervous systems work together. 🗹

Organ	Effect of sympathetic nervous system	Effect of parasympathetic nervous system
Eye	makes pupils larger to let in more light	returns pupils to normal size
Heart	raises heart rate to increase blood flow	lowers heart rate to decrease blood flow
Lungs	makes bronchioles larger to get more oxygen into the blood	returns bronchioles to normal size
Blood vessels	makes blood vessels smaller to increase blood pressure	has little or no effect
Intestines	reduces blood flow to stomach and intestines to slow digestion	returns digestion to normal pace

Critical Thinking

7. Explain How does eating a piece of pizza involve both the somatic and autonomic nervous systems?

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8. Identify What are the two divisions of the autonomic nervous system?

What Are the Parts of the Central **Nervous System?**

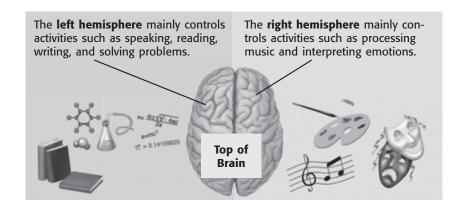
The central nervous system receives information from sensory neurons. It responds by sending messages to the body through motor neurons. The CNS is made of two important organs: the brain and the spinal cord.

The **brain** is the control center of the nervous system. It is also the largest organ in the nervous system. Many processes that the brain controls are involuntary. However, the brain also controls many voluntary processes. The brain has three main parts: the cerebrum, the cerebellum, and the medulla. Each part of the brain has its own job.

THE CEREBRUM

The *cerebrum* is the largest part of your brain. This dome-shaped area is where you think and where most memories are kept. The cerebrum controls voluntary movements. It also lets you sense touch, light, sound, odors, tastes, pain, heat, and cold. ✓

The cerebrum is made up of two halves called hemispheres. The left hemisphere controls most movements on the right side of the body. The right hemisphere controls most movements on the left side of the body. The two hemispheres also control different types of activities, as shown in the figure below. However, most brain activities use both hemispheres.





9. Identify What kind of movements does the cerebrum control?

TAKE A LOOK

10. Explain Which hemisphere of your brain are you mainly using as you read this book? Explain your answer.

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THE CEREBELLUM

The *cerebellum* is found beneath the cerebrum. The cerebellum receives and processes information from your body, such as from your skeletal muscles and joints. This information lets the brain keep track of your body's position. For example, your cerebellum lets you know when you are upside-down. Your cerebellum also sends messages to your muscles to help you keep your balance.

READING CHECK

11. Identify What are two functions of the cerebellum?

THE MEDULLA

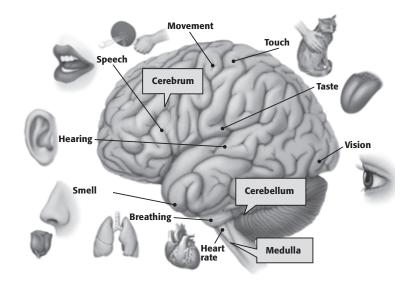
The *medulla* is the part of your brain that connects to your spinal cord. It is only about 3 cm long, but you cannot live without it. It controls involuntary processes, such as breathing and regulating heart rate.

Your medulla is always receiving sensory impulses from receptors in your blood vessels. It uses this information to control your blood pressure. If your blood pressure gets too low, your medulla sends impulses that cause blood vessels to tighten. This makes your blood pressure rise. The medulla also sends impulses to the heart to make it beat faster or slower.

TAKE A LOOK

12. Identify Which part of the brain controls breathing?

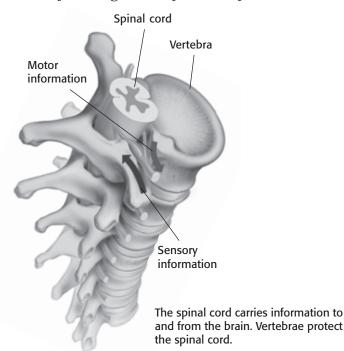
13. Identify Which part of the brain senses smells?



THE SPINAL CORD

Your spinal cord is part of your central nervous system. It is made up of neurons and bundles of axons that send impulses to and from the brain. The spinal cord is surrounded by bones called *vertebrae* (singular, *vertebra*) to protect it.

The axons in your spinal cord let your brain communicate with your PNS. The axons of sensory neurons carry impulses from your skin and muscles to your spinal cord. The impulses travel through the spinal cord to your brain. The brain then processes the impulses and sends signals back through the spinal cord. The impulses travel from the spinal cord to motor neurons. The axons of motor neurons carry the signals to your body.



Critical Thinking

14.	Explain	What is	one
way	your nei	rvous sys	stem
and	skeletal	system v	vork
toge	ther?		

SPINAL CORD INJURIES

A spinal cord injury may block the messages to and from the brain. For example, a spinal cord injury might block signals to and from the feet and legs. People with such an injury cannot sense pain, touch, or temperature in their feet or legs. They may not be able to move their legs.

Each year, thousands of people are paralyzed by spinal cord injuries. Most spinal cord injuries in young people happen during sports. You can help prevent such injuries by using proper safety equipment.

<u>√</u>	READING CHECK
nelį	Identify How can you p prevent spinal cord ries while playing sports?

Name Class Date

Section 1 Review

NSES LS 1a, 1d, 1e, 3b, 3c

SECTION VOCABULARY

brain the mass of nerve tissue that is the main control center of the nervous system

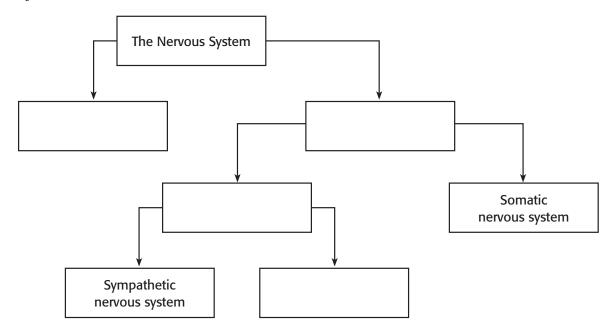
central nervous system the brain and the spinal cord

nerve a collection of nerve fibers through which impulses travel between the central nervous system and other parts of the body

neuron a nerve cell that is specialized to receive and conduct electrical impulses

peripheral nervous system all of the parts of the nervous system except for the brain and the spinal cord

- **1. Compare** How do the functions of the CNS and the PNS differ?
- **2. Summarize** Complete the diagram below to show the structure of the nervous system.



- **3. Compare** How do the functions of dendrites and axons differ?
- **4. Explain** What can happen to someone with a spinal cord injury?