




# How the Nervous System Works



-  What Is the Role of the Nervous System?
-  What Is a Neuron?
-  How Do Nerve Impulses Travel?



## my planet DiARY

### Wake Up!

Did you ever wake from a nap, only to find that your arm is “asleep”? What causes this “pins-and-needles” sensation? If you lie on your arm for a long period of time, too much pressure is placed on the nerves. The communication between your arm and brain no longer flows smoothly. A decrease in normal signals makes your arm feel odd. The pins-and-needles feeling actually happens when you remove the pressure from the nerves. They begin to send a normal flow of messages from your arm to your brain again. You slowly regain normal feeling in your arm. Remember to change your position often when you sit or lie down. If you don't, you'll end up having to wake up your arms and legs!

## FUN FACTS

Read the following questions. Then write your answers below.

1. Why would your arm feel numb if you put too much pressure on it?

---



---



---



---

2. Describe a time when one of your limbs fell asleep. How did it feel?

---




---



---



---

 **PLANET DIARY** Go to Planet Diary to learn more about the nervous system.





Do the Inquiry Warm-Up  
How Simple Is a Simple Task?

### Vocabulary


- stimulus • response • neuron • nerve impulse
- dendrite • axon • nerve • sensory neuron
- interneuron • motor neuron • synapse

### Skills

-  Reading: Compare and Contrast
-  Inquiry: Infer



## What Is the Role of the Nervous System?


You can use the Internet to chat with a friend hundreds of miles away. You can also use it to gather information from anywhere in the world. Like the Internet, your nervous system is a communications network. It includes the brain, the spinal cord, and the nerves that run throughout the body. It also includes the eyes, ears, and other sense organs.  **Your nervous system receives information about what is happening both inside and outside your body. It directs how your body responds to this information. In addition, your nervous system helps maintain homeostasis.** Without your nervous system, you could not move, think, or sense the world around you.

**Receiving Information** Your nervous system makes you aware of what is happening around you. For example, if you were at a cookout like the one shown in **Figure 1**, you would know when the wind was blowing or a fly was buzzing around your head. Your nervous system also checks conditions inside your body, such as the level of glucose in your blood and your internal body temperature.

FIGURE 1 .....

### Gathering Information

The nervous system allows people to react to their environment.

 **Describe** List four things that your nervous system would help you notice if you were enjoying a meal with these people.

---



---



---



---



---





**▶ Responding to Information** Any change or signal in the environment that an organism can recognize and react to is called a **stimulus** (STIM yoo lus; plural *stimuli*). For example, a buzzing fly is a stimulus. After your nervous system analyzes a stimulus, it causes a response. A **response** is a reaction to a stimulus. Some nervous system responses, such as swatting a fly, are voluntary, or under your control. But heart rate, breathing, sweating, and other necessary processes are involuntary responses to stimuli inside your body.

**Maintaining Homeostasis** The nervous system helps maintain homeostasis by directing your body to respond properly to information it receives. For example, when your blood's glucose level drops, your nervous system signals that you are hungry. So, you eat. This action maintains homeostasis by supplying your body with needed nutrients and energy.

## apply it!

Soccer goalies rely on their nervous systems.

**1 Infer** Read the headings in each box. Then describe how the goalie is doing each task.

**2 CHALLENGE** Suppose the goalie starts sweating. What may have caused this response?

### Receiving Information

---



---



---

### Maintaining Homeostasis

---



---



---

### Responding to Information

---



---



---



Do the Lab Investigation  
Ready or Not!

## Assess Your Understanding

got it? .....

I get it! Now I know that the nervous system

I need extra help with

Go to **my science** **COACH** online for help with this subject.

## What Is a Neuron?

Your nervous system includes various organs, tissues, and cells. For example, your brain is an organ, and the nerves running throughout your body are tissues. **Cells that carry information through your nervous system are called neurons (noo rahnz), or nerve cells.** The message that a neuron carries is called a **nerve impulse.**

**The Structure of a Neuron** A neuron's structure enables the neuron to carry nerve impulses. A neuron has a large cell body that contains the nucleus, threadlike extensions called dendrites, and an axon. Nerve impulses begin in a **dendrite**, a branchlike structure that picks up the impulses. Next, the impulses move through the neuron's cell body. They then travel to the **axon**, the long structure leading away from the cell body. The axon sends the impulses away from the cell body to the axon tips at the end of the neuron. A neuron can have many dendrites, but it has only one axon, as you can see in **Figure 2.** However, the axon can have more than one tip. Therefore, the impulse can go to more than one cell.

Axons and their tissue covering make up nerve fibers. Nerve fibers are often arranged in parallel bundles covered with more connective tissue. They look like uncooked spaghetti wrapped in thin plastic. A bundle of nerve fibers is called a **nerve.**

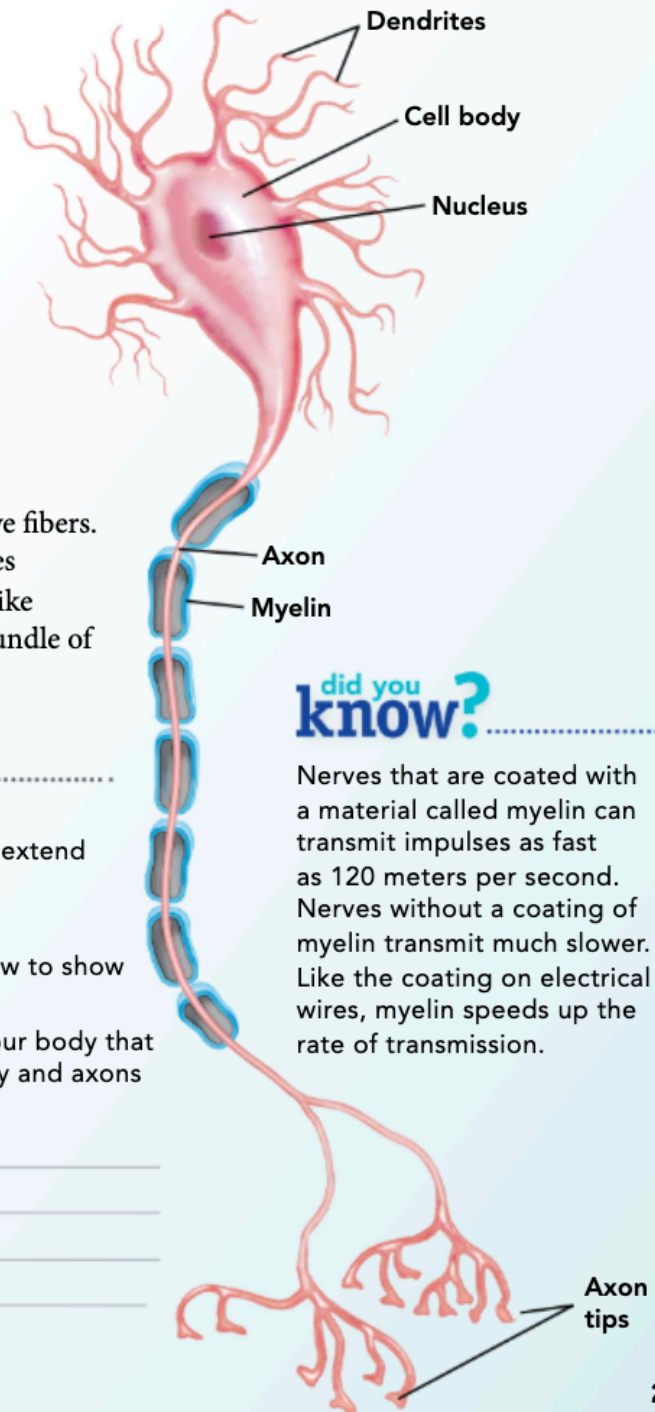


FIGURE 2 .....  
**Structure of a Neuron**

A neuron has one axon and many dendrites that extend from the cell body.

**Use the diagram to complete these tasks.**

- 1. Interpret Diagrams** Draw a line with an arrow to show the path of a nerve impulse in the neuron.
- 2. Draw Conclusions** What does it mean for your body that dendrites carry impulses toward the cell body and axons carry impulses away from the cell body?

---



---



---



---

### did you know? .....

Nerves that are coated with a material called myelin can transmit impulses as fast as 120 meters per second. Nerves without a coating of myelin transmit much slower. Like the coating on electrical wires, myelin speeds up the rate of transmission.



**Compare and Contrast**  
How is a sensory neuron similar to a motor neuron? How is it different?

---



---



---



---



---



---

**Kinds of Neurons** Your nervous system includes three kinds of neurons: sensory neurons, interneurons, and motor neurons. A **sensory neuron** picks up a stimulus and converts it into a nerve impulse. The impulse travels along sensory neurons until it reaches an interneuron, usually in the brain or spinal cord. An **interneuron** carries a nerve impulse to another interneuron or to a motor neuron. A **motor neuron** sends an impulse to a muscle or gland, enabling it to respond. Look at **Figure 3**.

FIGURE 3 .....  
**The Path of a Nerve Impulse**

To answer the phone, you use three kinds of neurons.

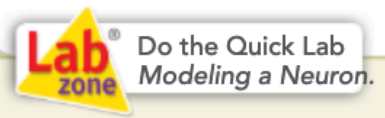
**Relate Text and Visuals** Write the kind of neuron used in each activity described in the boxes below.



**1** \_\_\_\_\_ Receptors in your ear pick up the sound of the phone ringing and trigger nerve impulses.

**2** \_\_\_\_\_ The nerve impulses move to your brain. Your brain interprets them as a ringing phone.

**3** \_\_\_\_\_ Your brain sends impulses to the muscles that you use to pick up the phone.



**Assess Your Understanding**

**1a. Name** What is another name for a nerve cell?  
\_\_\_\_\_  
\_\_\_\_\_

**b. Classify** What kind of neuron senses a mosquito on your arm?  
\_\_\_\_\_  
\_\_\_\_\_

**got it?** .....

- I get it! Now I know that a neuron contains \_\_\_\_\_, \_\_\_\_\_, and the three kinds of neurons are \_\_\_\_\_
- I need extra help with \_\_\_\_\_

Go to **my science** **COACH** online for help with this subject.



## How Do Nerve Impulses Travel?

Every day, billions of nerve impulses travel through your nervous system. Each nerve impulse begins in the dendrites of a neuron. The impulse moves rapidly toward the neuron's body and then down the axon until it reaches the axon tip. A nerve impulse travels in the form of electrical and chemical signals.

The place where a neuron transfers an impulse to another structure is called a **synapse** (SIN aps). **Figure 4** shows a gap in a synapse between the axon tip of one neuron and the dendrite of another neuron. A nerve impulse must cross the gap to continue.

**Key:** At the axon tips, electrical signals change to a chemical form, allowing the message to cross the gap in the synapse. This change is like answering a phone and then writing down the information you learn. The change from hearing information to writing it is like the change from electrical to chemical form.

FIGURE 4

### ART IN MOTION The Synapse

A synapse transfers a nerve impulse from one neuron to another.

**Sequence** Write the steps that describe how the nerve impulse crosses the gap between the axon tip of one neuron and the dendrite of the other neuron.

Step 1:

---



---



---

Step 2:

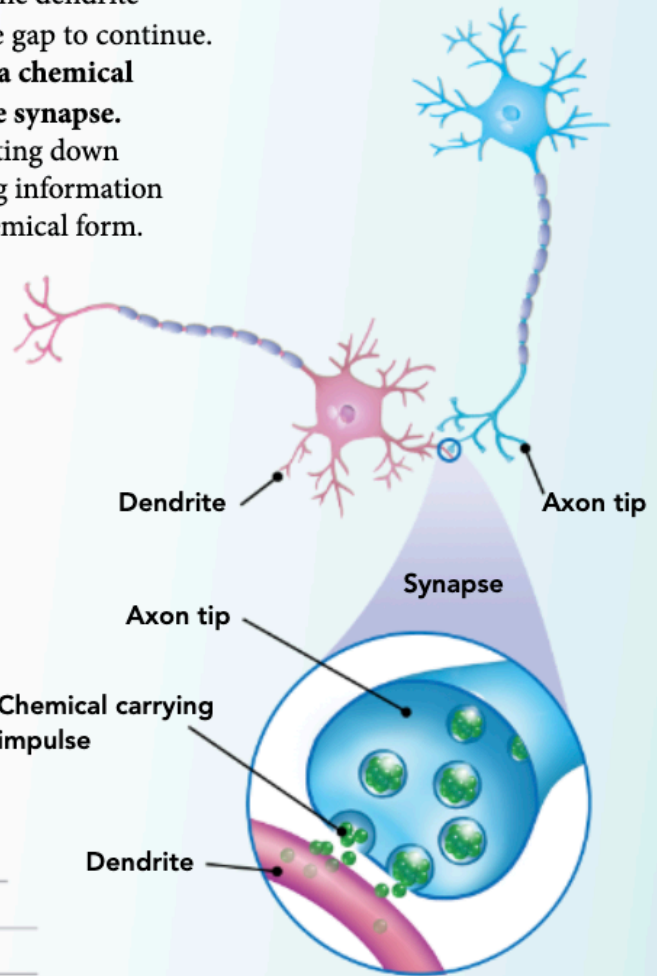
---



---



---



Do the Quick Lab Getting the Message Across.

### Assess Your Understanding

got it?

- I get it! Now I know that a nerve impulse travels from one neuron to another structure by \_\_\_\_\_
- I need extra help with \_\_\_\_\_

Go to **my science COACH** online for help with this subject.