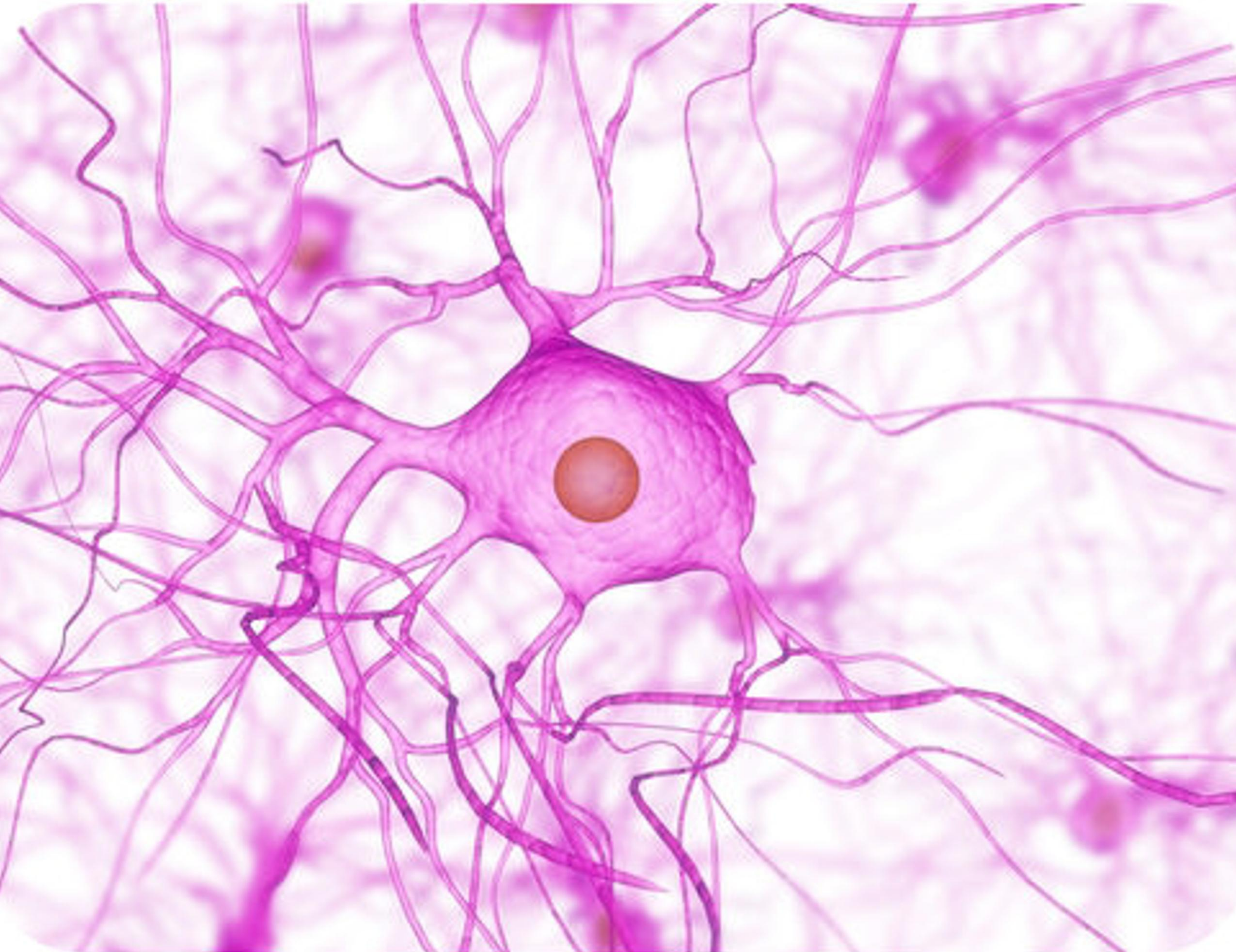
# Human Physiology 110: Nervous System



# Human Physiology 110: Nervous System

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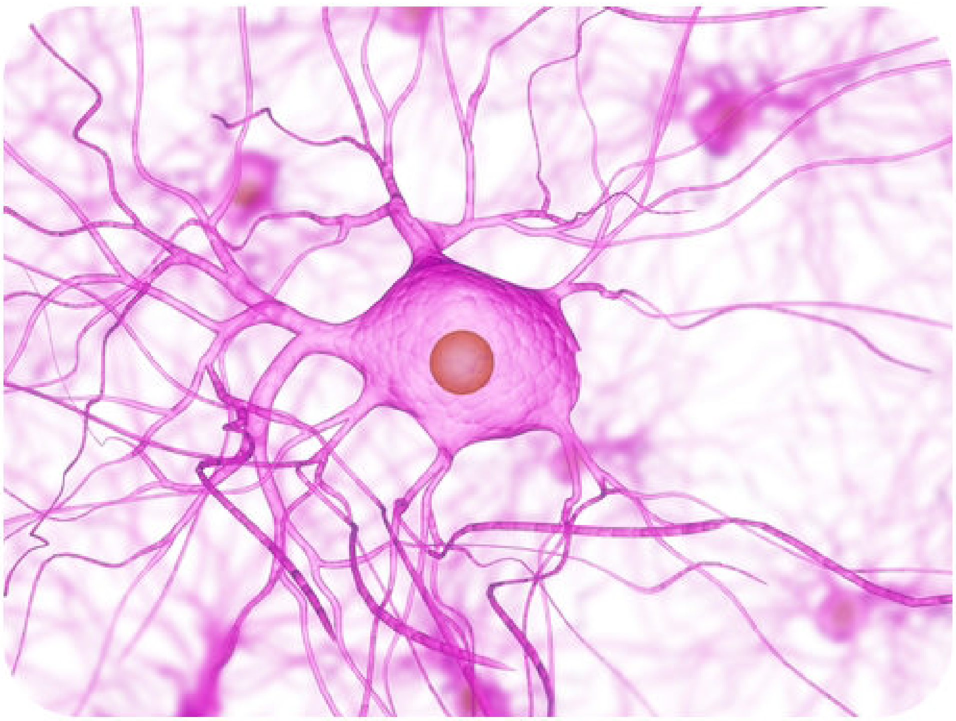
# Contents

# CONCEPT 1 Nerve Cells

## Learning Objectives

- Distinguish the central nervous system from the peripheral nervous system.
- Describe the structure of a neuron.
- Identify types of neurons.
- Explain the roles of the axon and the dendrites.



**A close-up view of a spider web? Some sort of exotic bacteria? What do you think this is?**

This is actually a nerve cell, the cell of the nervous system. This cell sends electrical "sparks" that transmit signals throughout your body.

## The Nervous System

A small child darts in front of your bike as you race down the street. You see the child and immediately react. You put on the brakes, steer away from the child, and yell out a warning, all in just a split second. How do you respond so quickly? Such rapid responses are controlled by your nervous system. The **nervous system** is a complex network of nervous tissue that carries electrical messages throughout the body. It includes the brain and spinal cord, the **central nervous system**, and nerves that run throughout the body, the **peripheral nervous system** (see **Figure** 1.1). To understand how nervous messages can travel so quickly, you need to know more about nerve cells.

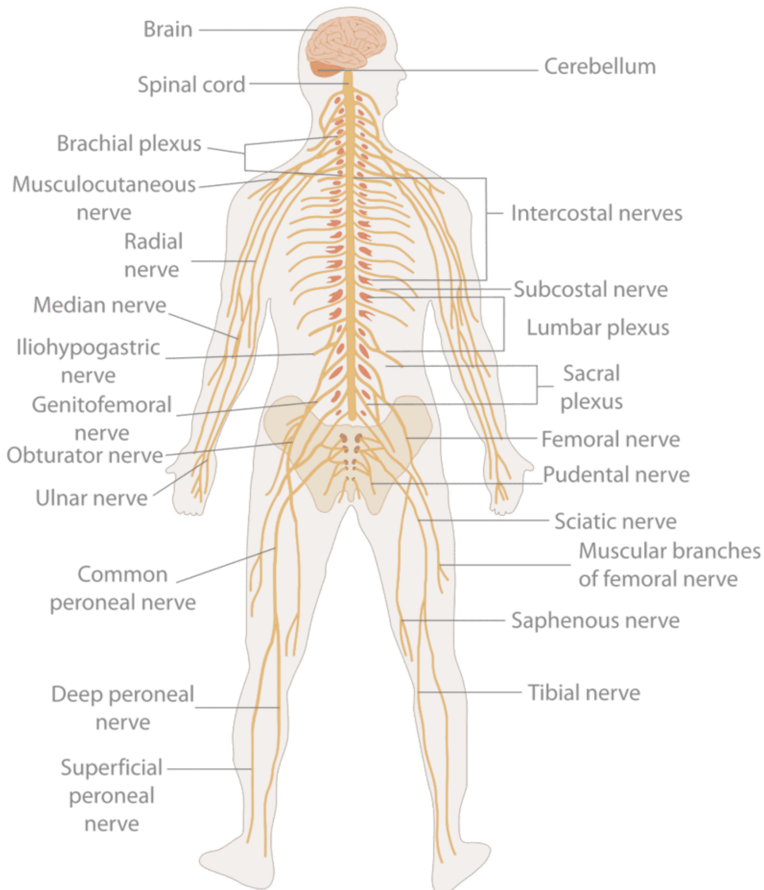



FIGURE 1.1

The human nervous system includes the brain and spinal cord (central nervous system) and nerves that run throughout the body (peripheral nervous system).

## Nerve Cells

Although the nervous system is very complex, nervous tissue consists of just two basic types of nerve cells: neurons and glial cells. **Neurons** are the structural and functional units of the nervous system. They transmit electrical signals, called **nerve impulses. Glial cells** provide support for neurons. For example, they provide neurons with nutrients and other materials.

### Neuron Structure

As shown in **Figure** 1.2, a neuron consists of three basic parts: the cell body, dendrites, and axon.

- The **cell body** contains the nucleus and other cell organelles.
- **Dendrites** extend from the cell body and receive nerve impulses from other neurons.
- The **axon** is a long extension of the cell body that transmits nerve impulses to other cells. The axon branches at the end, forming **axon terminals**. These are the points where the neuron communicates with other cells.

The axon of many neurons has an outer layer called a **myelin sheath** (see **Figure** 1.2). **Myelin** is a lipid produced by a type of a glial cell known as a **Schwann cell**. The myelin sheath acts like a layer of insulation, similar to the plastic that encases an electrical cord. Regularly spaced nodes, or gaps, in the myelin sheath allow nerve impulses to skip along the axon very rapidly.

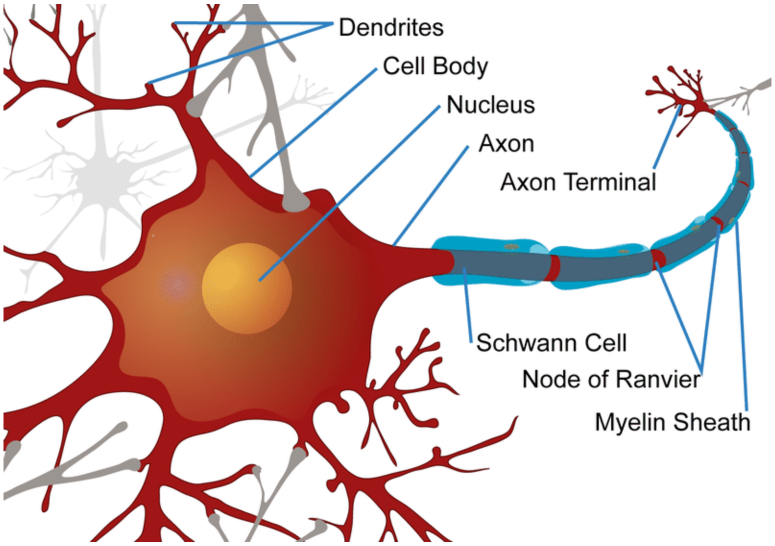



FIGURE 1.2
The structure of a neuron allows it to rapidly transmit nerve impulses to other cells.

### Types of Neurons

Neurons are classified based on the direction in which they carry nerve impulses.

- **Sensory neurons** carry nerve impulses from tissues and organs to the spinal cord and brain.
- **Motor neurons** carry nerve impulses from the brain and spinal cord to muscles and glands (see **Figure** 1.3).
- **Interneurons** carry nerve impulses back and forth between sensory and motor neurons.

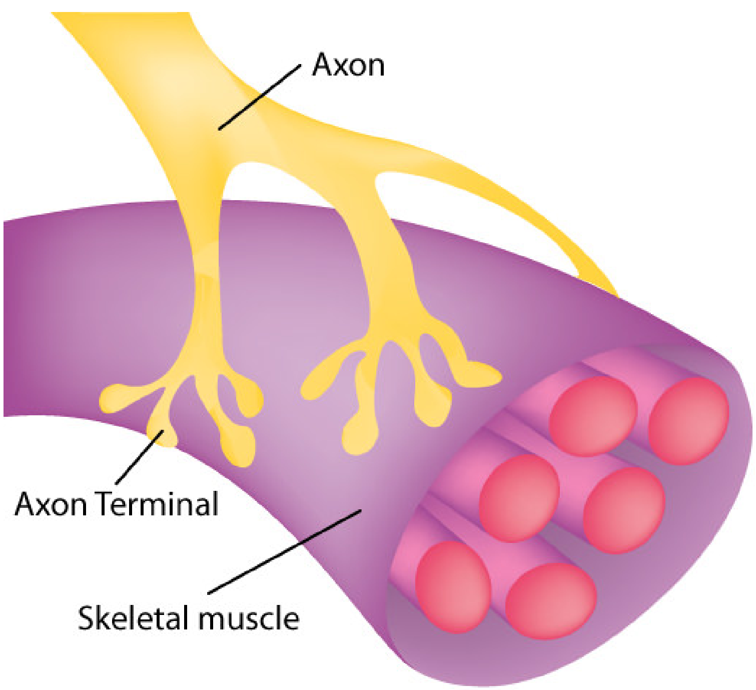



FIGURE 1.3
This axon is part of a motor neuron. It transmits nerve impulses to a skeletal muscle, causing the muscle to contract.

### Summary

- Neurons are the structural and functional units of the nervous system. They consist of a cell body, dendrites, and axon.
- Neurons transmit nerve impulses to other cells.
- Types of neurons include sensory neurons, motor neurons, and interneurons.

### Review

1. What are the two main parts of the nervous system?
2. List and describe the parts of a neuron.
3. What do motor neurons do?
4. What is myelin and the myelin sheath?

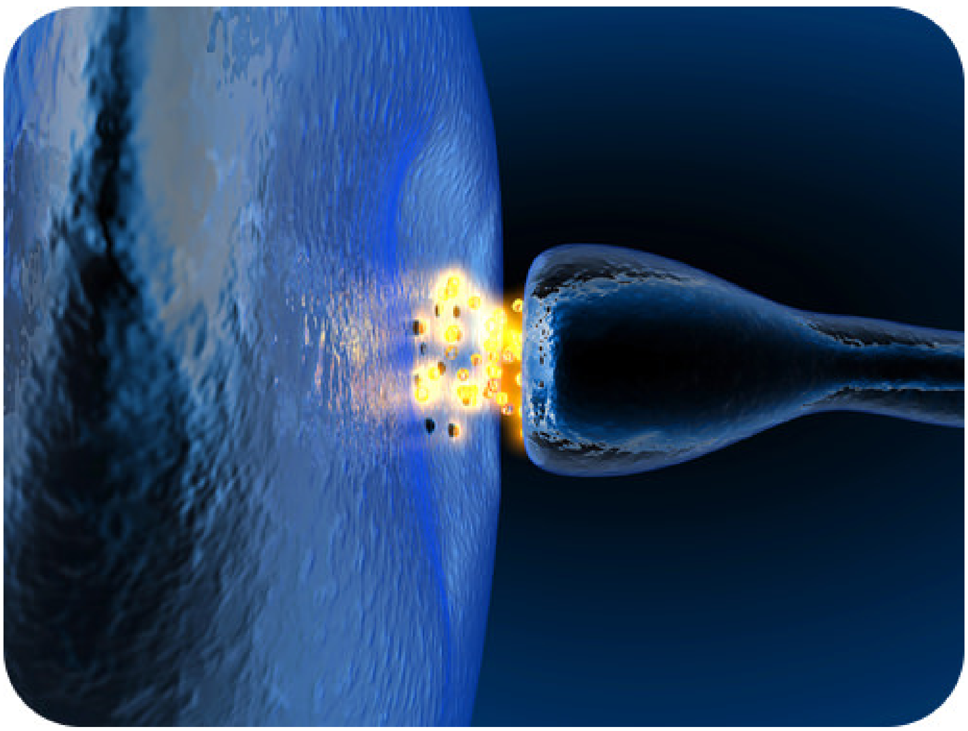
## References

1. User:The Emirr/Wikimedia Commons. Nervous system in body . CC BY 3.0
2. Zachary Wilson/CK-12 Foundation, based on image by Mariana Ruiz Villarreal (User:LadyofHats/Wikimedia Commons). Illustration of a neuron . CC BY-NC 3.0 (original image available in the public domain)
3. Zachary Wilson. Motor neuron axon . CC BY-NC 3.0

# CONCEPT 2 Nerve Impulses

## Learning Objectives

- Define nerve impulse.
- Explain how nerve impulses are transmitted.
- Compare the resting potential to an action potential.
- Explain the synapse.



**How does a nervous system signal move from one cell to the next?**

It literally jumps by way of a chemical transmitter. Notice the two cells are not connected, but separated by a small gap. The synapse. The space between a neuron and the next cell.

## Nerve Impulses

Nerve impulses are electrical in nature. They result from a difference in electrical charge across the plasma membrane of a neuron. How does this difference in electrical charge come about? The answer involves **ions**, which are electrically charged atoms or molecules.

### Resting Potential

When a neuron is not actively transmitting a nerve impulse, it is in a resting state, ready to transmit a nerve impulse. During the resting state, the **sodium-potassium pump** maintains a difference in charge across the cell membrane (see **Figure** 2.1). It uses energy in ATP to pump positive sodium ions ($Na^+$) out of the cell and potassium ions

($K^+$) into the cell. As a result, the inside of the neuron is negatively charged compared to the extracellular fluid surrounding the neuron. This is due to many more positively charged ions outside the cell compared to inside the cell. This difference in electrical charge is called the **resting potential.**

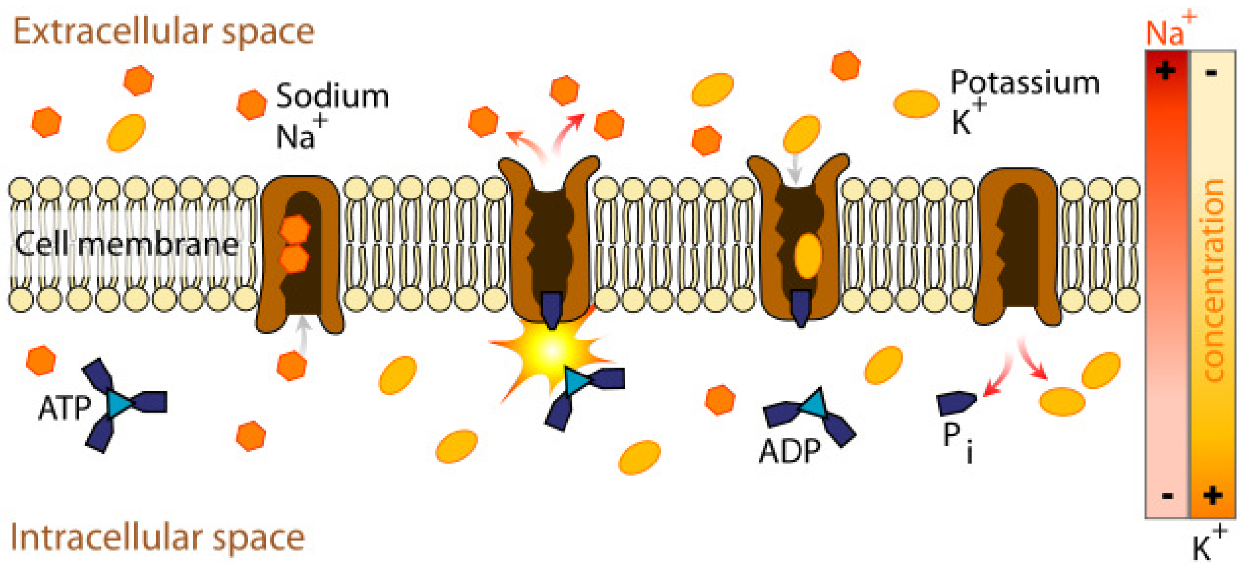



FIGURE 2.1

The sodium-potassium pump maintains the resting potential of a neuron.

### Action Potential

A **nerve impulse** is a sudden reversal of the electrical charge across the membrane of a resting neuron. The reversal of charge is called an **action potential.** It begins when the neuron receives a chemical signal from another cell. The signal causes gates in sodium ion channels to open, allowing positive sodium ions to flow back into the cell. As a result, the inside of the cell becomes positively charged compared to the outside of the cell. This reversal of charge ripples down the axon very rapidly as an electric current (see **Figure** 2.2).

In neurons with myelin sheaths, ions flow across the membrane only at the nodes between sections of myelin. As a result, the action potential jumps along the axon membrane from node to node, rather than spreading smoothly along the entire membrane. This increases the speed at which it travels.

The place where an axon terminal meets another cell is called a **synapse**. The axon terminal and other cell are separated by a narrow space known as a **synaptic cleft** (see **Figure** 2.3). When an action potential reaches the axon terminal, the axon terminal releases molecules of a chemical called a **neurotransmitter**. The neurotransmitter molecules travel across the synaptic cleft and bind to receptors on the membrane of the other cell. If the other cell is a neuron, this starts an action potential in the other cell.

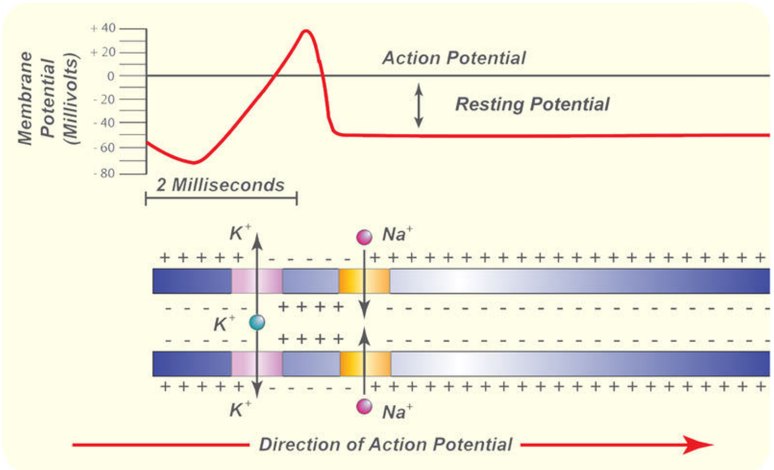



FIGURE 2.2
An action potential speeds along an axon in milliseconds.

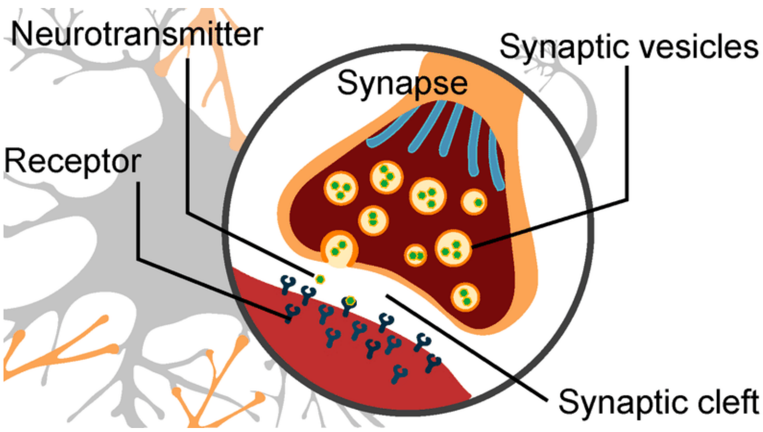
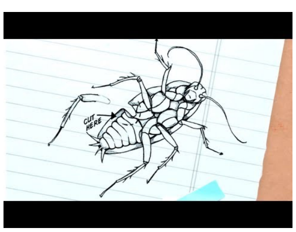



FIGURE 2.3
At a synapse, neurotransmitters are released by the axon terminal. They bind with receptors on the other cell.



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## Summary

- A nerve impulse begins when a neuron receives a chemical stimulus.
- The nerve impulse travels down the axon membrane as an electrical action potential to the axon terminal.
- The axon terminal releases neurotransmitters that carry the nerve impulse to the next cell.

## Review

1. Define resting potential and action potential.

2. Explain how resting potential is maintained
3. Describe how an action potential occurs.
4. What is a synapse?

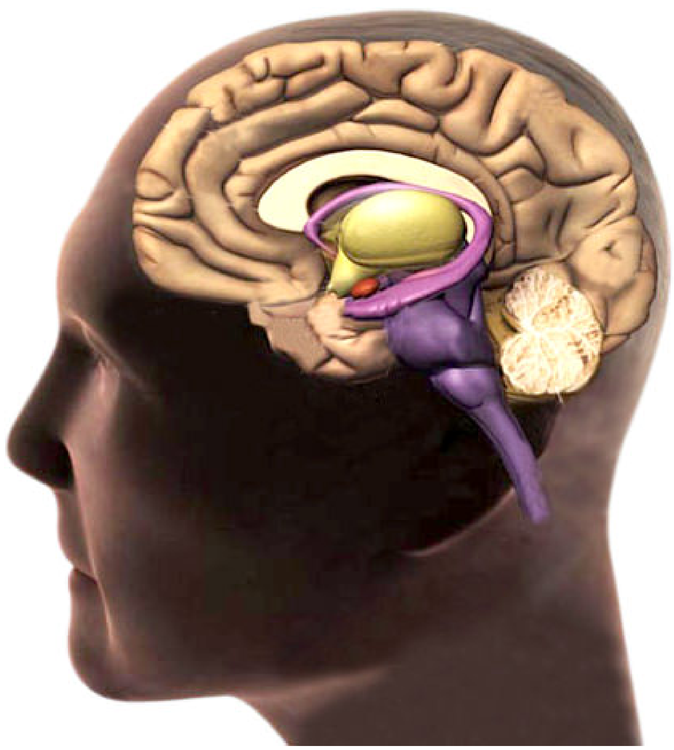
## References


1. Mariana Ruiz Villarreal (User:LadyofHats/Wikimedia Commons). Sodium Potassium pump . Public Domain
2. Rupali Raju. Action potential . CC BY-NC 3.0
3. Mariana Ruiz Villarreal (LadyofHats) for CK-12 Foundation. Closeup of synapse during signal transmission . CC BY-NC 3.0

# CONCEPT 3 Central Nervous System

## Learning Objectives

- Identify parts of the central nervous system and their functions.
- Distinguish the cerebrum from the cerebellum and the brain stem.
- Identify functions of the lobes of the cerebrum.



**The human brain. The "control center." What does it control?**

Practically everything. From breathing and heartbeat to reasoning, memory, and language. And it is the main part of the central nervous system.

## Central Nervous System

The nervous system has two main divisions: the central nervous system and the peripheral nervous system (see **Figure** 3.1). The **central nervous system (CNS)** includes the brain and spinal cord (see **Figure** 3.2). You can see an overview of the central nervous system at this link: http://vimeo.com/2024719 .

### The Brain

The **brain** is the most complex organ of the human body and the control center of the nervous system. It contains an astonishing 100 billion neurons! The brain controls such mental processes as reasoning, imagination, memory,

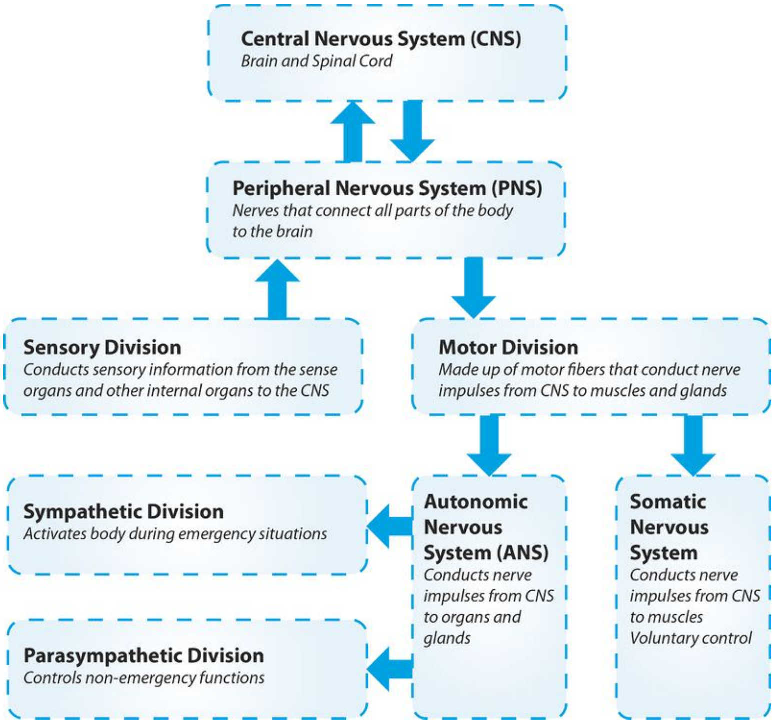



FIGURE 3.1

The two main divisions of the human nervous system are the central nervous system and the peripheral nervous system. The peripheral nervous system has additional divisions.

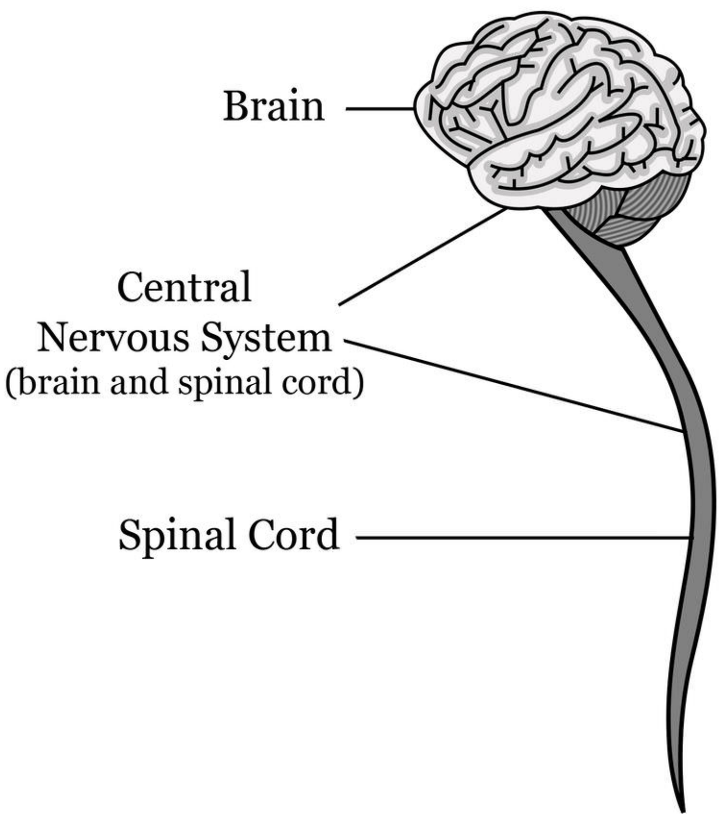



FIGURE 3.2

This diagram shows the components of the central nervous system.

and language. It also interprets information from the senses. In addition, it controls basic physical processes such as breathing and heartbeat.

The brain has three major parts: the cerebrum, cerebellum, and brain stem. These parts are shown in **Figure** 3.3 and described in this section.

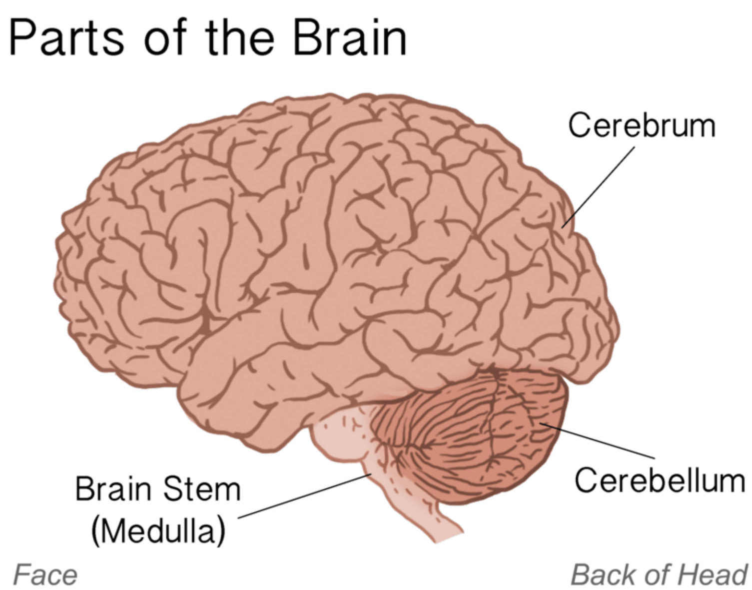



FIGURE 3.3
In this drawing, assume you are looking at the left side of the head. This is how the brain would appear if you could look underneath the skull.

- The **cerebrum** is the largest part of the brain. It controls conscious functions such as reasoning, language, sight, touch, and hearing. It is divided into two hemispheres, or halves. The hemispheres are very similar but not identical to one another. They are connected by a thick bundle of axons deep within the brain. Each hemisphere is further divided into the four lobes shown in **Figure** 3.4.
- The **cerebellum** is just below the cerebrum. It coordinates body movements. Many nerve pathways link the cerebellum with motor neurons throughout the body.
- The **brain stem** is the lowest part of the brain. It connects the rest of the brain with the spinal cord and passes nerve impulses between the brain and spinal cord. It also controls unconscious functions such as heart rate and breathing.

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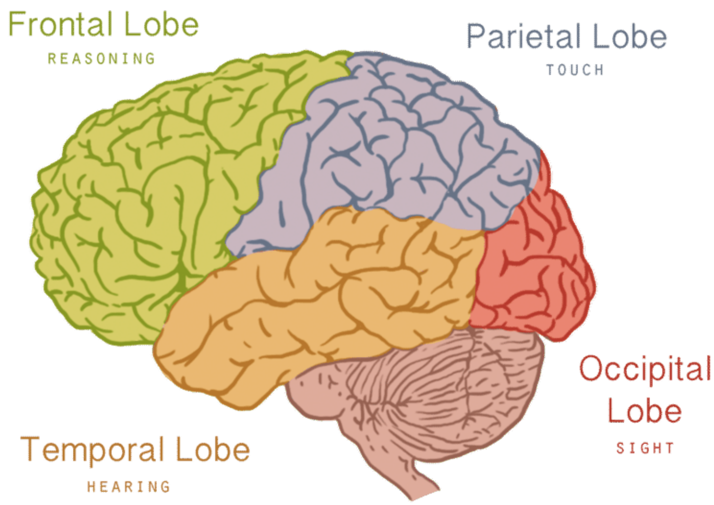


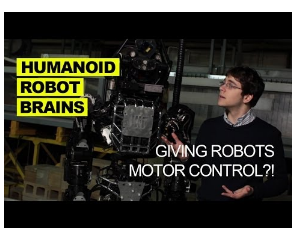

FIGURE 3.4
Each hemisphere of the cerebrum consists of four parts, called lobes. Each lobe is associated with particular brain functions. Just one function of each lobe is listed here.

### Spinal Cord

The **spinal cord** is a thin, tubular bundle of nervous tissue that extends from the brainstem and continues down the center of the back to the pelvis. It is protected by the **vertebrae**, which encase it. The spinal cord serves as an information superhighway, passing messages from the body to the brain and from the brain to the body.

### Humanoid Robot Brains

The smartest people in the world have spent millions of dollars on developing high-tech robots. But even though technology has come a long way, these humanoid robots are nowhere close to having the "brain" and motor control of a human. Why is that? Learn about the motor control processes in the human brain, and how cutting-edge research is trying to implement it in robots below.

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### Science Friday: Face Time: How quickly do you judge a face?

How fast do you judge somebody by their face? In this video by Science Friday, Dr. Jon Freeman discusses how the brain quickly creates character assessments of people and the effects these assessments may have.

**TABLE 3.1:**

| |
|---|
|  |

### Summary

- The central nervous includes the brain and spinal cord.
- The brain is the control center of the nervous system. It controls virtually all mental and physical processes.
- The spinal cord is a long, thin bundle of nervous tissue that passes messages from the body to the brain and from the brain to the body.

### Review

1. Name the organs of the central nervous system.
2. Which part of the brain controls conscious functions such as reasoning?
3. What are the roles of the brain stem?
4. Sam's dad was in a car accident in which his neck was broken. He survived the injury but is now paralyzed from the neck down. Explain why.

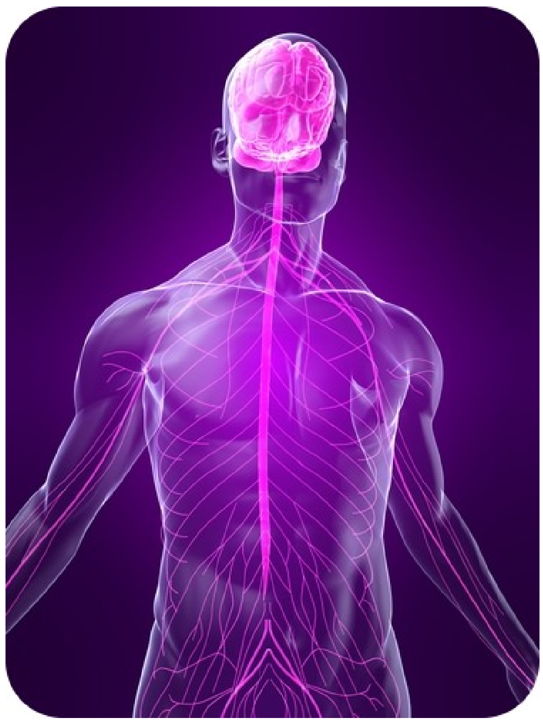
## References


1. Hana Zavadska. Divisions of the nervous system . CC BY-NC 3.0
2. User:Grm wnr/Wikimedia Commons, modified by Sam McCabe. Components of the central nervous system . Public Domain
3. Laura Guerin. Parts of the brain . CC BY-NC 3.0
4. Laura Guerin. CK-12 Foundation . CC BY-NC 3.0

# CONCEPT 4 Peripheral Nervous System

## Learning Objectives

- Describe the structure and function of the peripheral nervous system.
- Compare the sensory division to the motor division.
- Explain the role of the somatic nervous system.
- Distinguish the sympathetic division from the parasympathetic division.



### How does the signal get to your toes?

If the brain controls practically everything, how does the signal get to your toes? Or your legs? Or arms? By way of the peripheral nervous system, or all the nerves shown here other than the brain and spinal cord. Notice how they go everywhere.

## Peripheral Nervous System

The **peripheral nervous system (PNS)** consists of all the nervous tissue that lies outside the central nervous system. It is shown in yellow in **Figure** 4.1. It is connected to the central nervous system by nerves. A **nerve** is a cable-like bundle of axons. Some nerves are very long. The longest human nerve is the sciatic nerve. It runs from the spinal cord in the lower back down the left leg all the way to the toes of the left foot. Like the nervous system as a whole, the peripheral nervous system also has two divisions: the sensory division and the motor division.

- The **sensory division** of the PNS carries sensory information from the body to the central nervous system.

- The **motor division** of the PNS carries nerve impulses from the central nervous system to muscles and glands throughout the body. The nerve impulses stimulate muscles to contract and glands to secrete hormones. The motor division of the peripheral nervous system is further divided into the somatic and autonomic nervous systems.

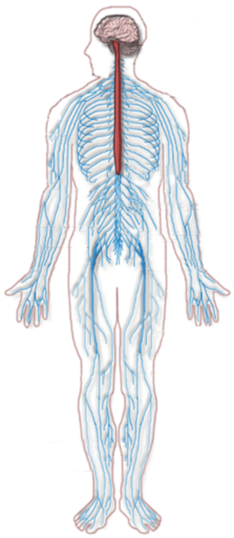


FIGURE 4.1

The nerves of the peripheral nervous system are shown in blue in this image. Can you identify the sciatic nerve?

### Somatic Nervous System

The **somatic nervous system (SNS)** controls mainly voluntary activities that are under conscious control. It is made up of nerves that are connected to skeletal muscles. Whenever you perform a conscious movement, from signing your name to riding your bike, your somatic nervous system is responsible.

The somatic nervous system also controls some unconscious movements, called reflexes. A **reflex** is a very rapid motor response that is not directed by the brain. In a reflex, nerve impulses travel to and from the spinal cord in a **reflex arc**, like the one in **Figure** 4.2. In this example, the person jerks his hand away from the flame without any conscious thought. It happens unconsciously because the nerve impulses bypass the brain.

### Autonomic Nervous System

All other involuntary activities not under conscious control are the responsibility of the **autonomic nervous system (ANS)**. Nerves of the ANS are connected to glands and internal organs. They control basic physical functions such as heart rate, breathing, digestion, and sweat production. The autonomic nervous system also has two subdivisions: the sympathetic division and the parasympathetic division.

- The **sympathetic division** deals with emergency situations. It prepares the body for "fight or flight." Do you get clammy palms or a racing heart when you have to play a solo or give a speech? Nerves of the sympathetic division control these responses.
- The **parasympathetic division** controls involuntary activities that are not emergencies. For example, it controls the organs of your digestive system so they can break down the food you eat.

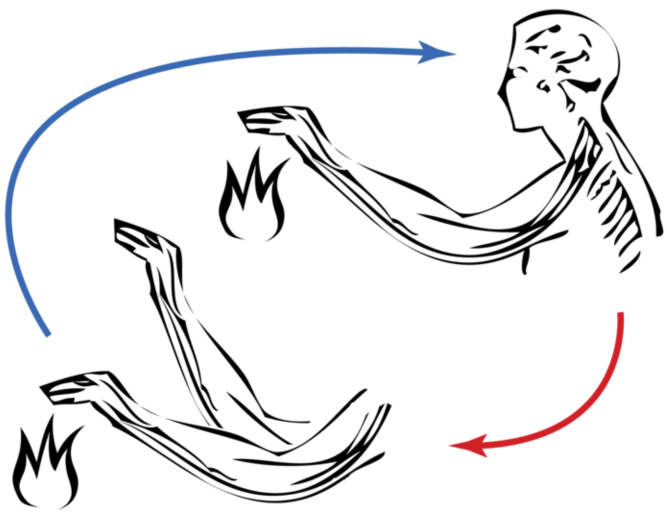
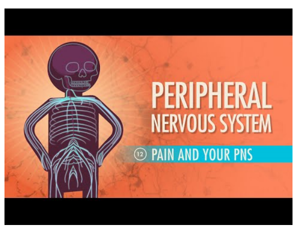


FIGURE 4.2
A reflex arc like this one enables involuntary actions. How might reflex responses be beneficial to the organism?

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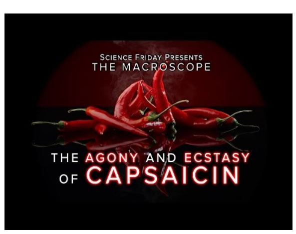
#### Science Friday: The Agony and Ecstasy of Capsaicin

Have you ever tasted something spicy? In this video by Science Friday, Dr. Marco Tizzano discusses how capsaicin creates the burning sensation that some people enjoy.

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### Summary

- The peripheral nervous system consists of all the nervous tissue that lies outside the central nervous system. It is connected to the central nervous system by nerves.

- The peripheral nervous system has several divisions and subdivisions that transmit nerve impulses between the central nervous system and the rest of the body.

### Review

1. Identify the two major divisions of the peripheral nervous system.
2. What is the role of the sensory division?
3. Compare and contrast the somatic and autonomic nervous systems.
4. What are the two divisions of the autonomic nervous system?
5. What is the role of the sympathetic division?

## References

1. User:Persian Poet Gal/Wikipedia. Detailed illustration of the nervous system . Public Domain
2. Rupali Raju. Reflex arc mechanism . CC BY-NC 3.0

# CONCEPT 5 Senses

## Learning Objectives

- Explain how sensory stimuli are perceived and interpreted.
- Summarize the roles of the cornea, lens, pupil and retina.
- Explain the role of the cochlea and semicircular canals.
- Describe the roles of taste receptors, odor receptors, and pressure receptors.

### Name the five senses.

Hearing, sight, taste, touch, and smell. But how do we hear, see, taste, touch and smell? It all has to do, obviously, with the nervous system.

## The Senses

The sensory division of the peripheral nervous system (PNS) includes several sense organs—the eyes, ears, mouth, nose, and skin. Each sense organ has special cells, called **sensory receptors**, that respond to a particular type of stimulus. For example, the nose has sensory receptors that respond to chemicals, which we perceive as odors. Sensory receptors send nerve impulses to **sensory nerves**, which carry the nerve impulses to the central nervous system. The brain then interprets the nerve impulses to form a response.

### Sight

**Sight** is the ability to sense light, and the eye is the organ that senses light. Light first passes through the **cornea** of the eye, which is a clear outer layer that protects the eye (see **Figure** 5.1). Light enters the eye through an opening called the **pupil**. The light then passes through the **lens**, which focuses it on the **retina** at the back of the eye. The retina contains light receptor cells. These cells send nerve impulses to the **optic nerve**, which carries the impulses to the brain. The brain interprets the impulses and "tells" us what we are seeing.

### Hearing

**Hearing** is the ability to sense sound waves, and the ear is the organ that senses sound. Sound waves enter the **auditory canal** and travel to the **eardrum** (see **Figure** 5.2). They strike the eardrum and make it vibrate. The vibrations then travel through several other structures inside the ear and reach the cochlea. The **cochlea** is a coiled tube filled with liquid. The liquid moves in response to the vibrations, causing tiny hair cells lining the cochlea to bend. In response, the hair cells send nerve impulses to the **auditory nerve**, which carries the impulses to the brain. The brain interprets the impulses and "tells" us what we are hearing.

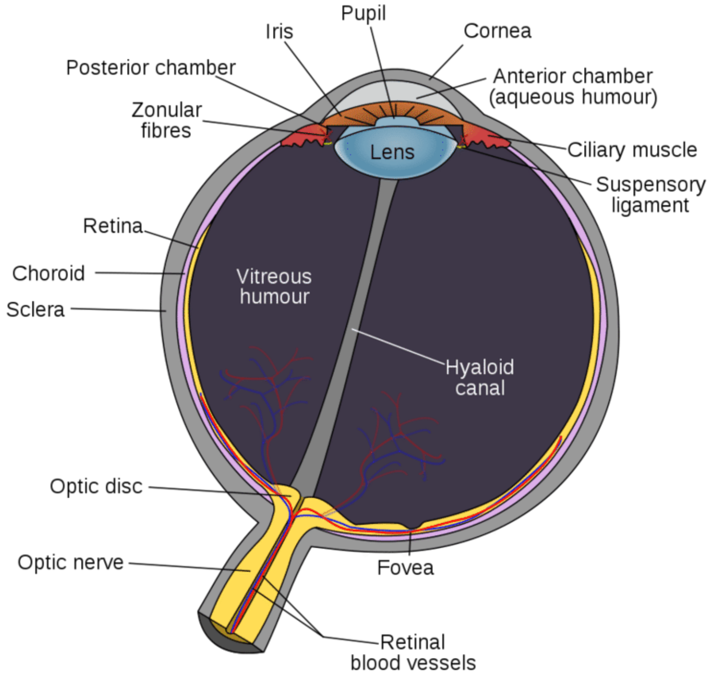


FIGURE 5.1

The eye is the organ that senses light and allows us to see.

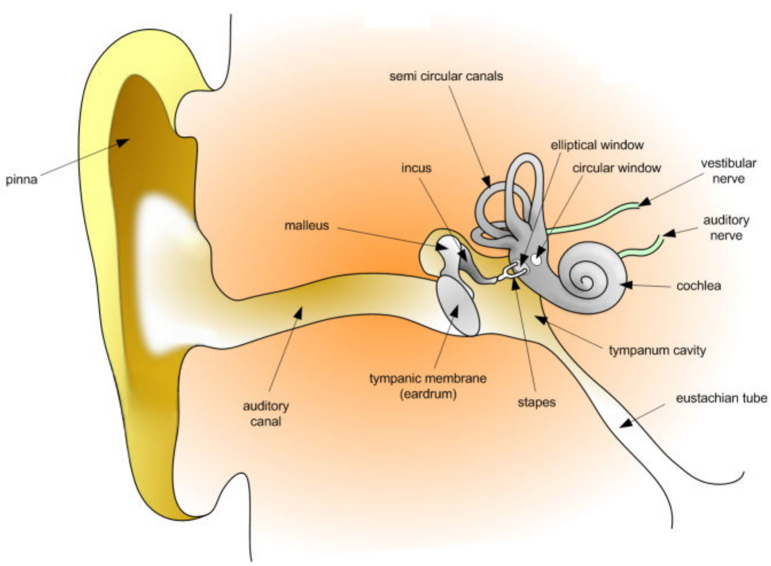


FIGURE 5.2

The ear is the organ that senses sound waves and allows us to hear. It also senses body position so we can keep our balance.


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### Balance

The ears are also responsible for the sense of balance. **Balance** is the ability to sense and maintain body position. The **semicircular canals** inside the ear (see **Figure** 5.2) contain fluid that moves when the head changes position. Tiny hairs lining the semicircular canals sense movement of the fluid. In response, they send nerve impulses to the **vestibular nerve**, which carries the impulses to the brain. The brain interprets the impulses and sends messages to the peripheral nervous system. This system maintains the body's balance by triggering contractions of skeletal muscles as needed.

### Taste and Smell

**Taste** and **smell** are both abilities to sense chemicals. Like other sense receptors, both **taste receptors** and **odor receptors** send nerve impulses to the brain, and the brain "tells" use what we are tasting or smelling.

Taste receptors are found in tiny bumps on the tongue called **taste buds** (see **Figure** 5.3). There are separate taste receptors for sweet, salty, sour, bitter, and meaty tastes. The meaty taste is called *umami*.

FIGURE 5.3
Taste buds on the tongue contain taste receptor cells.

Odor receptors line the passages of the nose (see **Figure** 5.4). They sense chemicals in the air. In fact, odor receptors can sense hundreds of different chemicals. Did you ever notice that food seems to have less taste when you have a stuffy nose? This occurs because the sense of smell contributes to the sense of taste, and a stuffy nose interferes with the ability to smell.

### Touch

**Touch** is the ability to sense pressure. **Pressure receptors** are found mainly in the skin. They are especially concentrated on the tongue, lips, face, palms of the hands, and soles of the feet. Some touch receptors sense

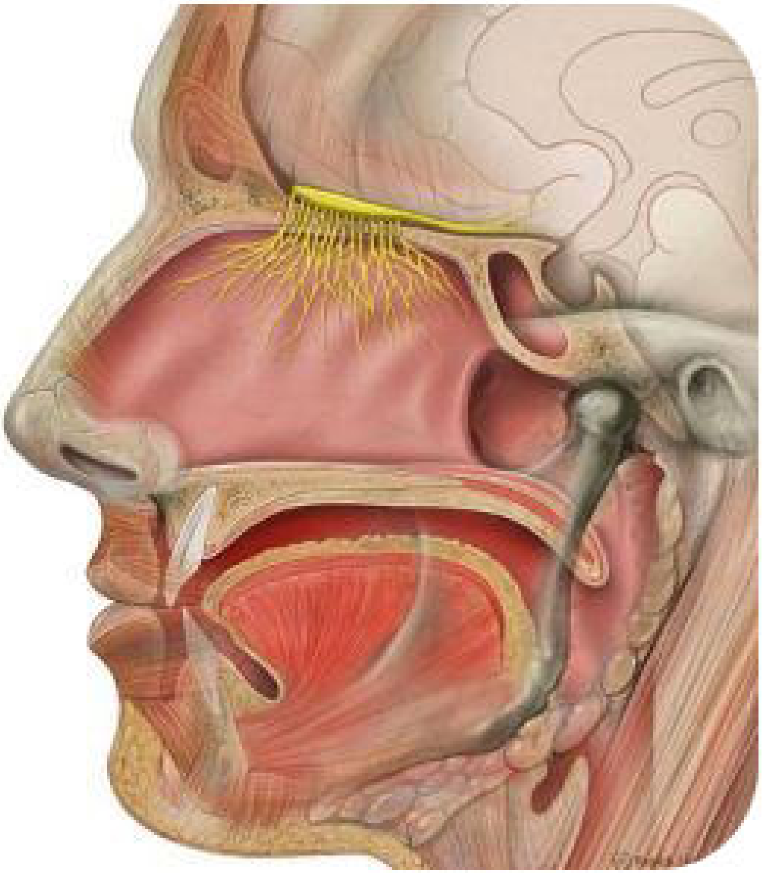
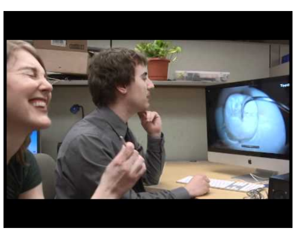


FIGURE 5.4

Odor receptors. Odor receptors and their associated nerves (in yellow) line the top of the nasal passages.

differences in temperature or pain. How do pain receptors help maintain homeostasis? (Hint: What might happen if we couldn't feel pain?)



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### Why I do Science

*If your kids don't like broccoli, it may not be their fault, it may just be their genes talking.* Dr. Danielle Reed is a geneticist working to understand the genetics of taste. Can all people detect the same tastes? No. Why not? It has to do with a person's genes. People may actually taste foods differently.

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#### Science Friday: The Bouba-Kiki Effect

Given two shapes, which one is Bouba and which one is Kiki? In this video by Science Friday, psychologist Kelly McCormick discusses why over 90% of tested subjects associated these made-up words with a specific shape.


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#### Science Friday: A Cure for The Colorblindness Blues

Colorblindness is the most common genetic disorder in the world. In this video by Science Friday, researchers Maureen and Jay Neitz discuss how their research has created a potential cure for this disorder.


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### Summary

- Human senses include sight, hearing, balance, taste, smell, and touch.
- Sensory organs such as the eyes contain cells called sensory receptors that respond to particular sensory stimuli.
- Sensory nerves carry nerve impulses from sensory receptors to the central nervous system.
- The brain interprets the nerve impulses to form a response.

### Review

1. List the five human senses.
2. Describe how we see.
3. Describe how we hear.
4. Why does food taste different when you have a stuffy nose?
5. What might happen if we couldn't feel pain?

## References

1. User:Rhcastilhos/Wikimedia Commons. Human eye . Public Domain
2. Dan Pickard. Ear illustration . Public Domain
3. Bruce. Taste buds . CC BY 2.0
4. Patrick J Lynch. Odor receptors . CC BY 2.5

# Concept 6 Drugs and the Nervous System

## Learning Objectives

- State how drugs affect the nervous system.
- Explain the effects of caffeine.
- Compare stimulants to depressants.
- Distinguish drug abuse from drug addiction.

### Is coffee a drug?

Maybe. But that doesn't necessarily mean it is bad for you. Looks tasty, though. Other than taste, why do many people have a cup of coffee in the morning? Does it help them wake up? For many people, it does. Why? The caffeine in the coffee stimulates the central nervous system. This drug is one of the milder drugs affecting the nervous system.

## Drugs and the Nervous System

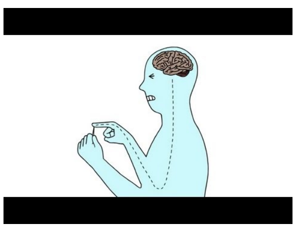
A **drug** is any chemical that affects the body's structure or function. Many drugs, including both legal and illegal drugs, are **psychoactive drugs**. This means that they affect the central nervous system, generally by influencing the transmission of nerve impulses. For example, some psychoactive drugs mimic neurotransmitters. At the link below, you can watch an animation showing how psychoactive drugs affect the brain.

### Examples of Psychoactive Drugs

**Caffeine** is an example of a psychoactive drug. It is found in coffee and many other products (see **Table** 6.1). Caffeine is a central nervous system **stimulant**. Like other stimulant drugs, it makes you feel more awake and alert. Other psychoactive drugs include alcohol, nicotine, and marijuana. Each has a different effect on the central nervous system. Alcohol, for example, is a **depressant**. It has the opposite effects of a stimulant like caffeine.

TABLE 6.1: Caffeine Content of Popular Products

| Product | Caffeine Content (mg) |
|---|---|
| Coffee (8 oz) | 130 |
| Tea (8 oz) | 55 |
| Cola (8 oz) | 25 |
| Coffee ice cream (8 oz) | 60 |
| Hot cocoa (8 oz) | 10 |
| Dark chocolate candy (1.5 oz) | 30 |



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### Drug Abuse and Addiction

Psychoactive drugs may bring about changes in mood that users find desirable, so the drugs may be abused. **Drug abuse** is use of a drug without the advice of a medical professional and for reasons not originally intended. Continued use of a psychoactive drug may lead to **drug addiction**, in which the drug user is unable to stop using the drug. Over time, a drug user may need more of the drug to get the desired effect. This can lead to drug **overdose** and death.

### Summary

- Drugs are chemicals that affect the body's structure or function.
- Psychoactive drugs, such as caffeine and alcohol, affect the central nervous system by influencing the transmission of nerve impulses in the brain.
- Psychoactive drugs may be abused and lead to drug addiction.

### Review

1. What is a psychoactive drug? Give two examples.
2. Define drug abuse. When does drug addiction occur?

# CONCEPT 7 Nervous System Disorders

## Learning Objectives

- Identify several nervous system disorders.

### Ever had a headache that just won't go away?

We all get headaches. Headaches are a relatively minor problem associated with the nervous system. But what about more serious issues of the nervous system? As you can probably imagine, these can be extremely serious.

## Disorders of the Nervous System

There are several different types of problems that can affect the nervous system.

- **Vascular disorders** involve problems with blood flow. For example, a stroke occurs when a blood clot blocks blood flow to part of the brain. Brain cells die quickly if their oxygen supply is cut off. This may cause paralysis and loss of other normal functions, depending on the part of the brain that is damaged.
- Nervous tissue may become infected by microorganisms. **Meningitis**, for example, is caused by a viral or bacterial infection of the tissues covering the brain. This may cause the brain to swell and lead to brain damage and death.
- **Encephalitis** is a brain infection most often caused by viruses. The immune system tries to fight off a brain infection, just as it tries to fight off other infections. But sometimes this can do more harm than good. The immune system's response may cause swelling in the brain. With no room to expand, the brain pushes against the skull. This may injure the brain and even cause death. Medicines can help fight some viral infections of the brain, but not all infections.
- Brain or spinal cord injuries may cause paralysis and other disabilities. Injuries to peripheral nerves can cause localized pain or numbness.

- Abnormal brain functions can occur for a variety of reasons. Examples include headaches, such as migraine headaches, and epilepsy, in which seizures occur.
- Nervous tissue may degenerate, or break down. **Alzheimer's disease** is an example of this type of disorder, as is **Amyotrophic Lateral Sclerosis**, or ALS. ALS is also known as Lou Gehrig's disease. It leads to a gradual loss of higher brain functions.
- In addition to ALS and Alzheimer's disease, other serious nervous system diseases include multiple sclerosis, Huntington's disease, and Parkinson's disease. These diseases rarely, if ever, occur in young people. Their causes and symptoms are listed below (Table below). The diseases have no known cure, but medicines may help control their symptoms.

### TABLE 7.1:

| Disease | Cause | Symptoms |
|---|---|---|
| Multiple Sclerosis | The immune system attacks and damages the central nervous system so neurons cannot function properly. | muscle weakness, difficulty moving, problems with coordination, difficulty maintaining balance |
| Huntington's Disease | An inherited gene codes for an abnormal protein that causes the death of neurons. | uncontrolled jerky movements, loss of muscle control, issues with memory and learning |
| Parkinson's Disease | An abnormally low level of a neurotransmitter affects the part of the brain that controls movement. | uncontrolled shaking, slowed movements, issues associated with speaking |
| Alzheimer's Disease | Abnormal changes in the brain cause the gradual loss of most normal brain activity. | memory loss, confusion, mood swings, gradual loss of control over mental and physical abilities |

#### Alzheimer's Disease: Is the Cure in the Genes?

By 2050, as the U.S. population ages, 15 million Americans will suffer from Alzheimer's disease — triple today's number. But genetic studies may provide information leading to a cure.

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In April 2011, an international analysis of the genes of more than 50,000 people led to the discovery of five new genes that make Alzheimer's disease more likely in the elderly and provide clues about what might start the Alzheimer's disease process and fuel its progress in a person's brain.

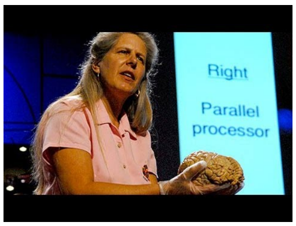
## Summary

- Disorders of the nervous system include blood flow problems such as stroke, infections such as meningitis, brain injuries, and degeneration of nervous tissue, as in Alzheimer's disease.

## Review

1. Identify three nervous system disorders.
2. Multiple sclerosis is a disease in which the myelin sheaths of neurons in the central nervous system break down. What symptoms might this cause? Why?

## Resources

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