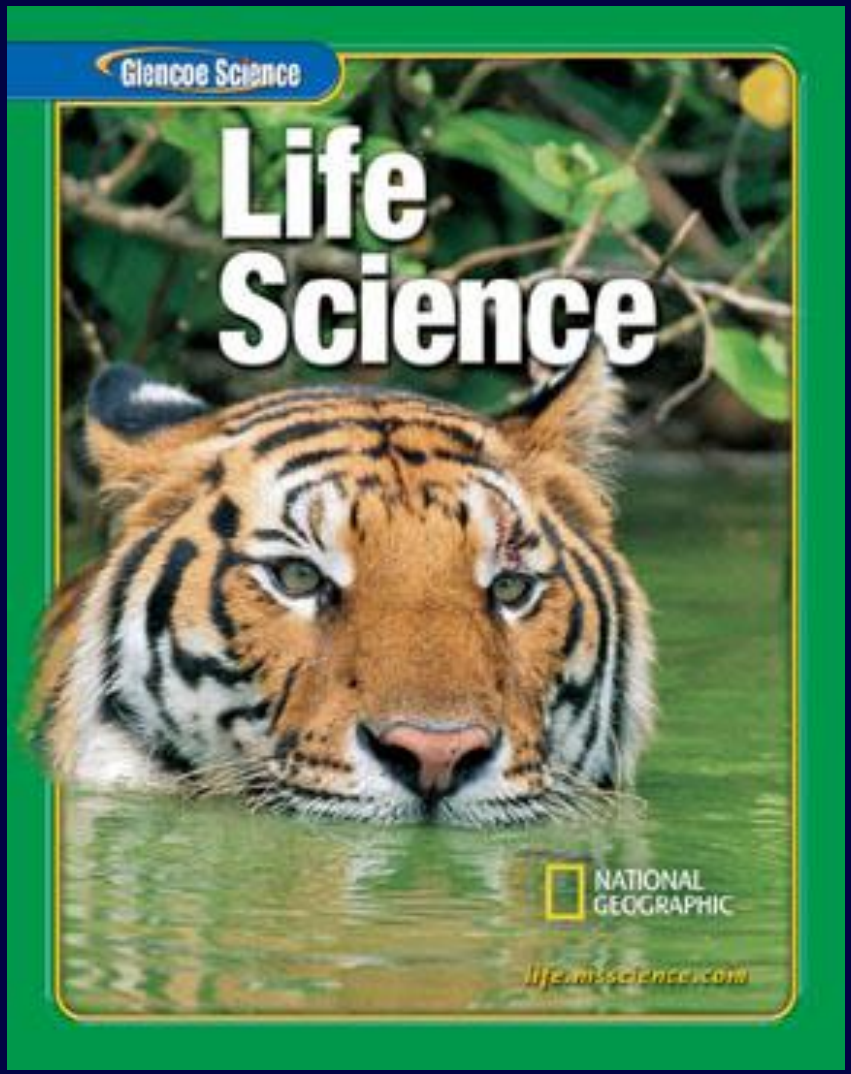
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Chapter: Control and Coordination

1

How the Nervous System Works
Responding to Stimuli

- Any internal or external change that brings about a response is called a stimulus (STIHM yuh lus).
- Noise, light, the smell of food, and the temperature of the air are all stimuli from outside your body.
- Chemical substances such as hormones are examples of stimuli from inside your body.

1

Homeostasis

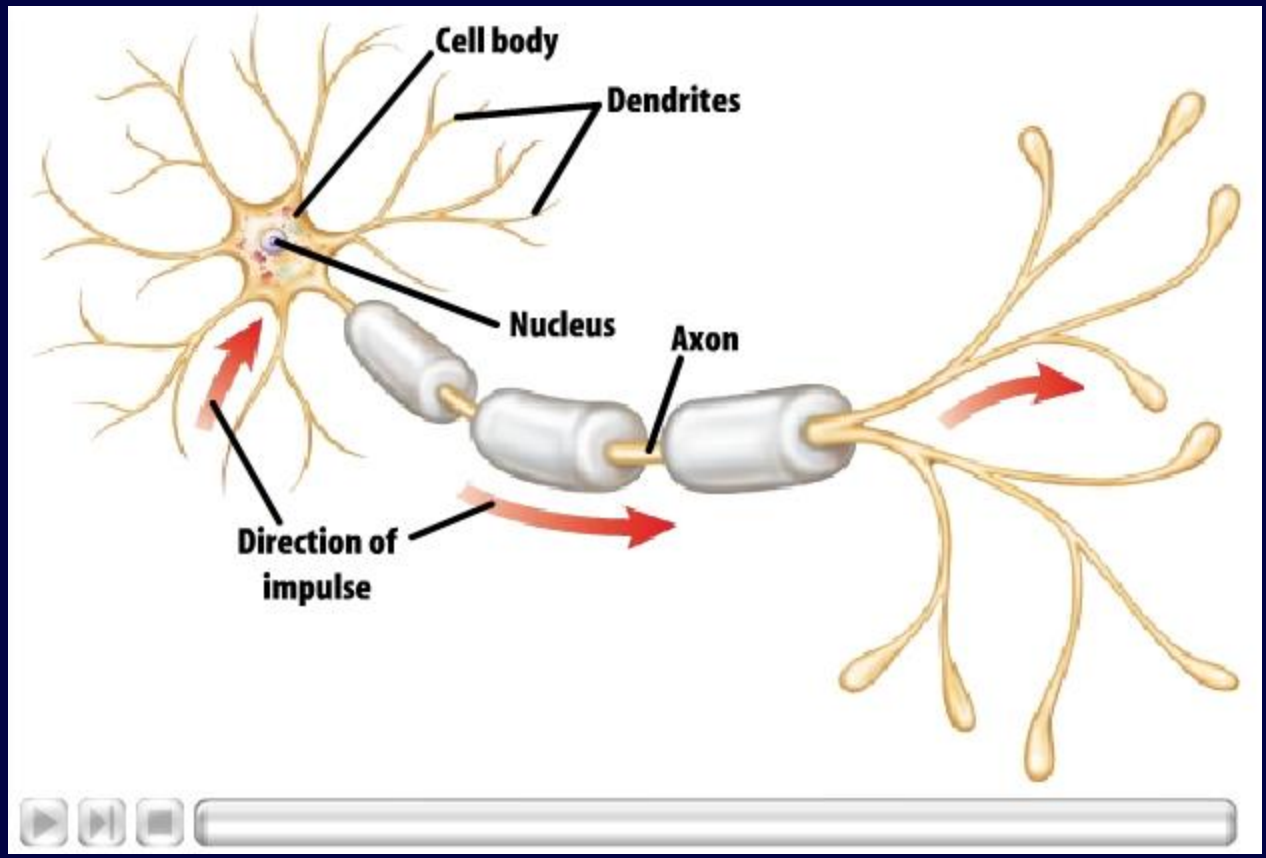
- The regulation of steady, life-maintaining conditions inside an organism, despite changes in its environment, is called **homeostasis**.

- Your nervous system is one of several control systems used by your body to maintain homeostasis.

1

Nerve Cells

- The basic functioning units of the nervous system are nerve cells, or **neurons** (NOOR ahns).



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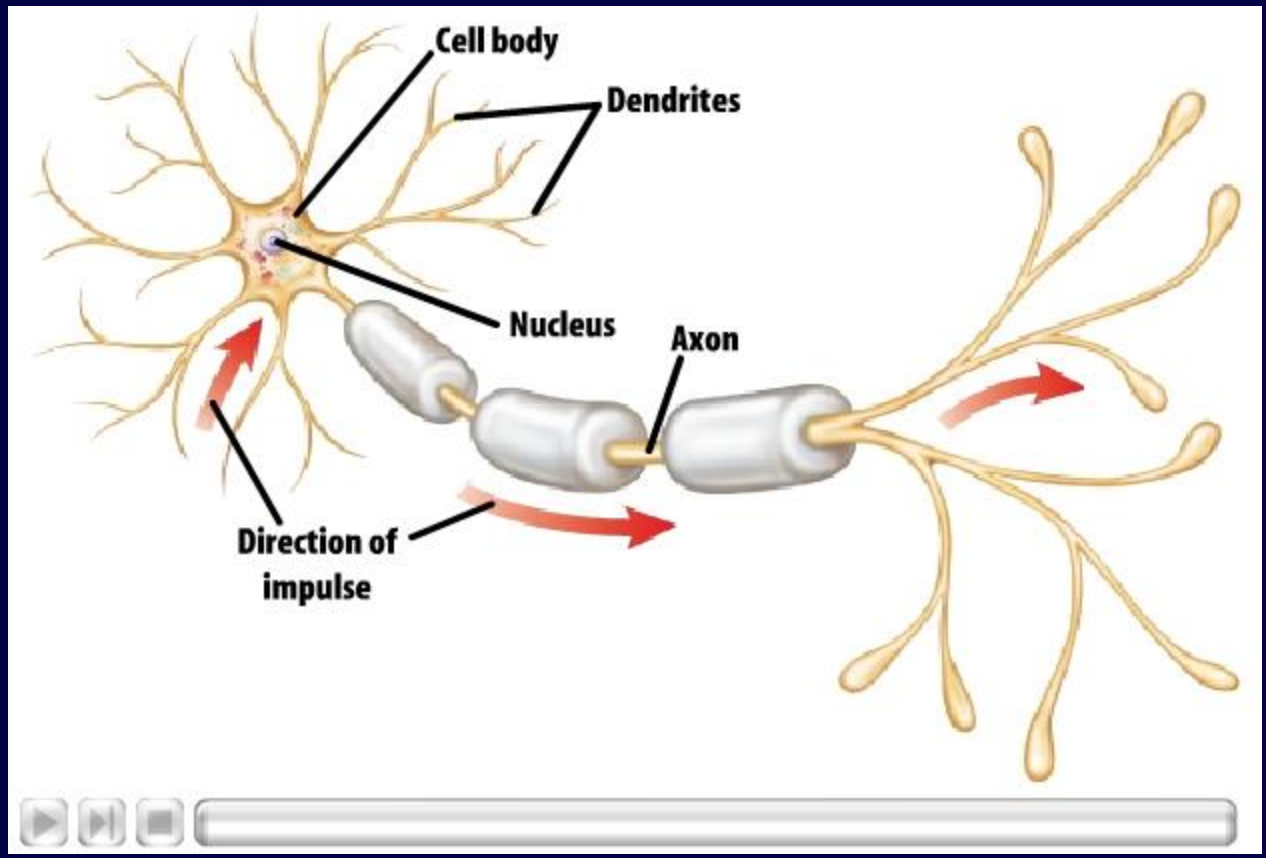
Nerve Cells

- A neuron is made up of a cell body and branches called dendrites and axons.



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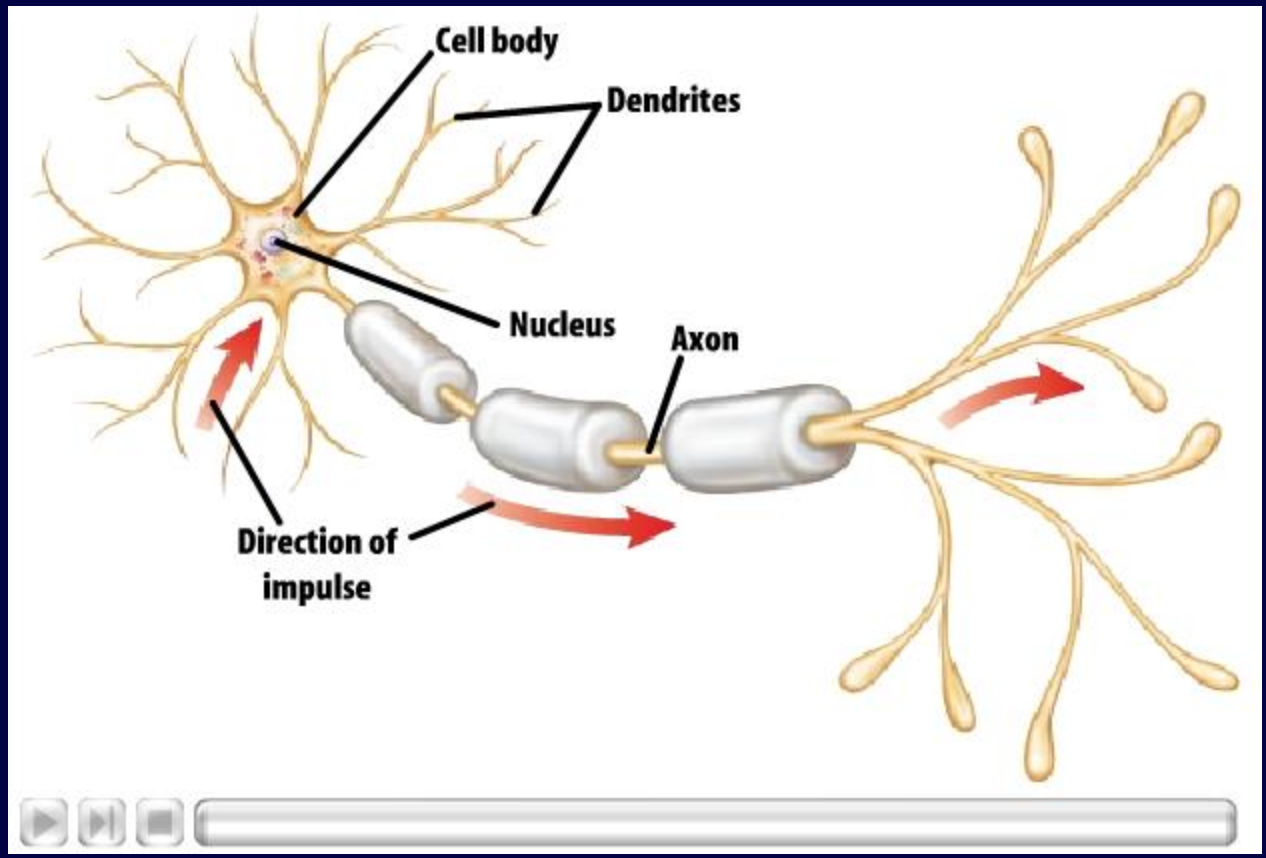
Nerve Cells

- **Dendrites** receive impulses from other neurons and send them to the cell body.



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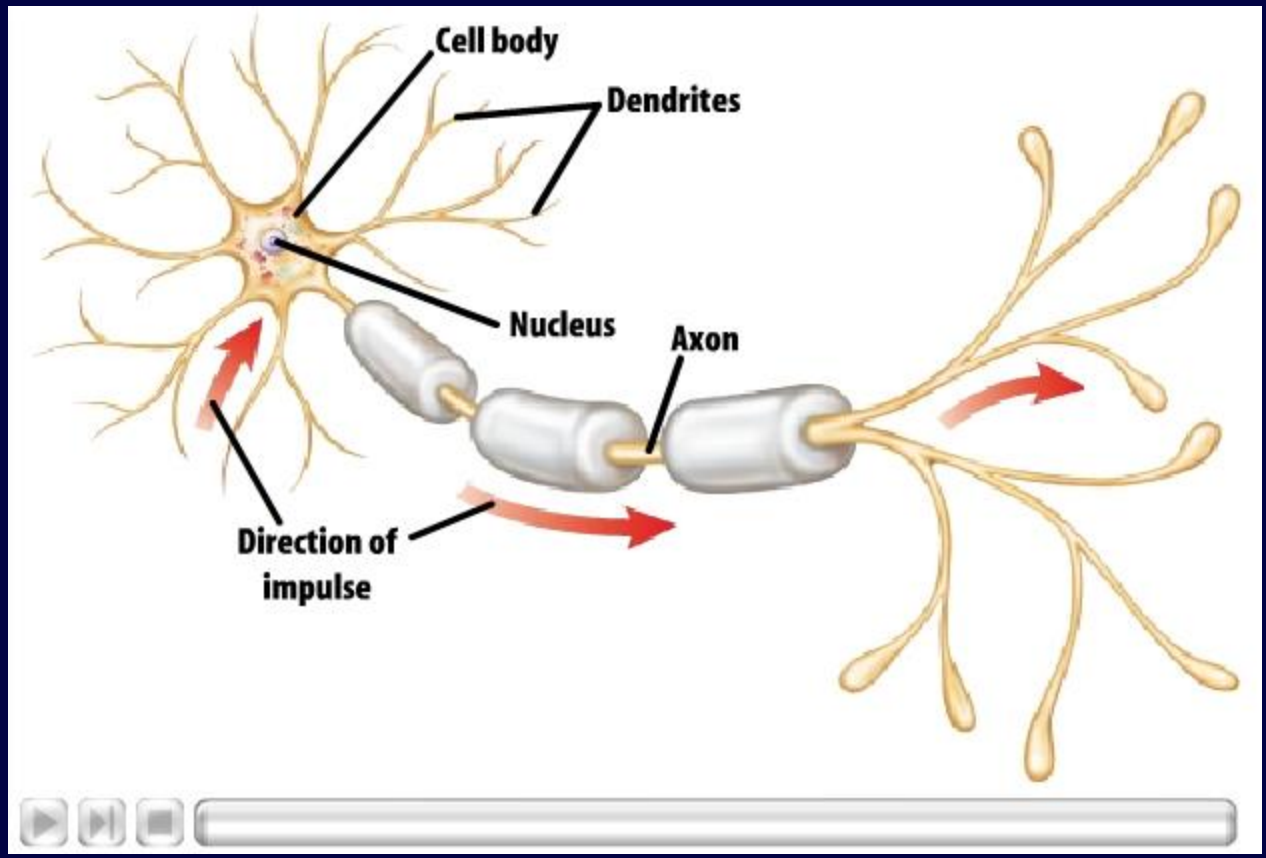
Nerve Cells

- **Axons** (AK sahns) carry impulses away from the cell body.



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Types of Nerve Cells

- Three types of neurons—sensory neurons, motor neurons, and interneurons—transport impulses.

- Sensory neurons receive information and send impulses to the brain or spinal cord.

1

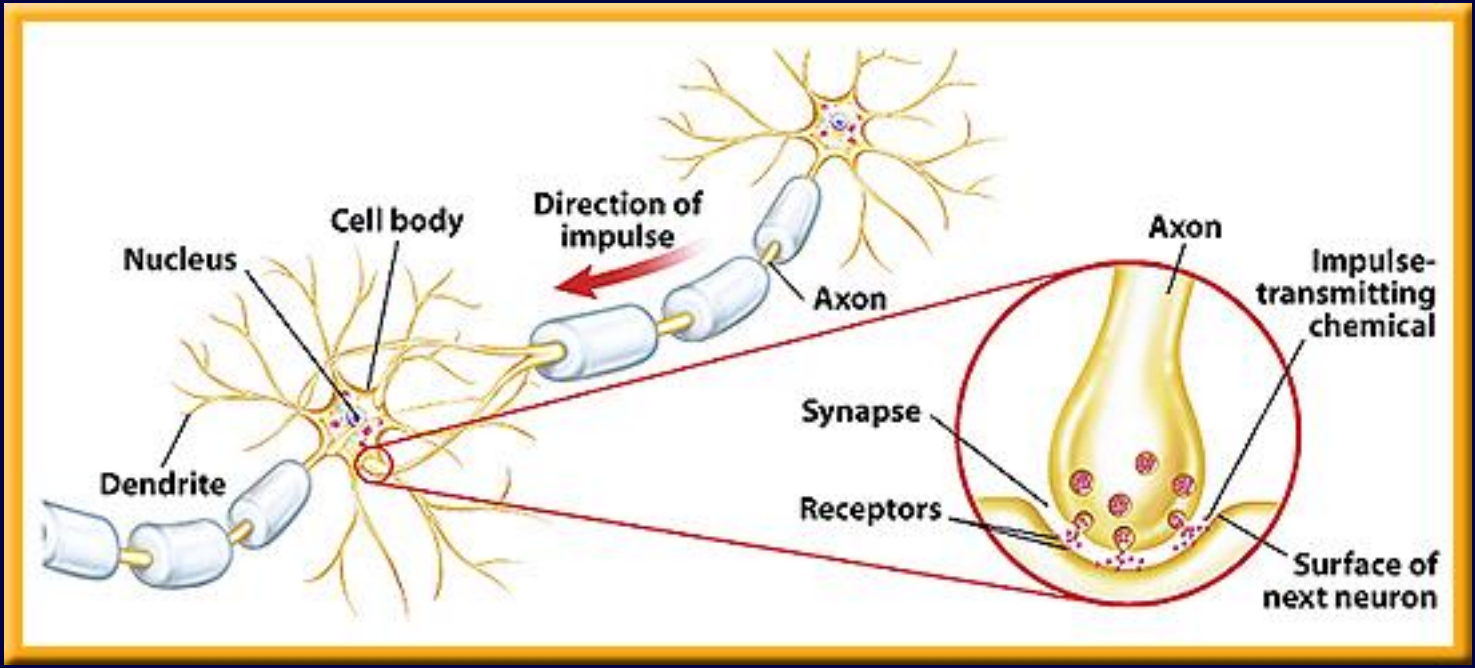
Types of Nerve Cells

- Interneurons relay these impulses to motor neurons.
- Motor neurons then conduct impulses from the brain or spinal cord to muscles or glands throughout your body.

1

Synapses

- To move from one neuron to the next, an impulse crosses a small space called a **synapse** (SIH naps).



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Synapses

- When an impulse reaches the end of an axon, the axon releases a chemical.
- This chemical flows across the synapse and stimulates the impulse in the dendrite of the next neuron.
- Your neurons are adapted in such a way that impulses move in only one direction.

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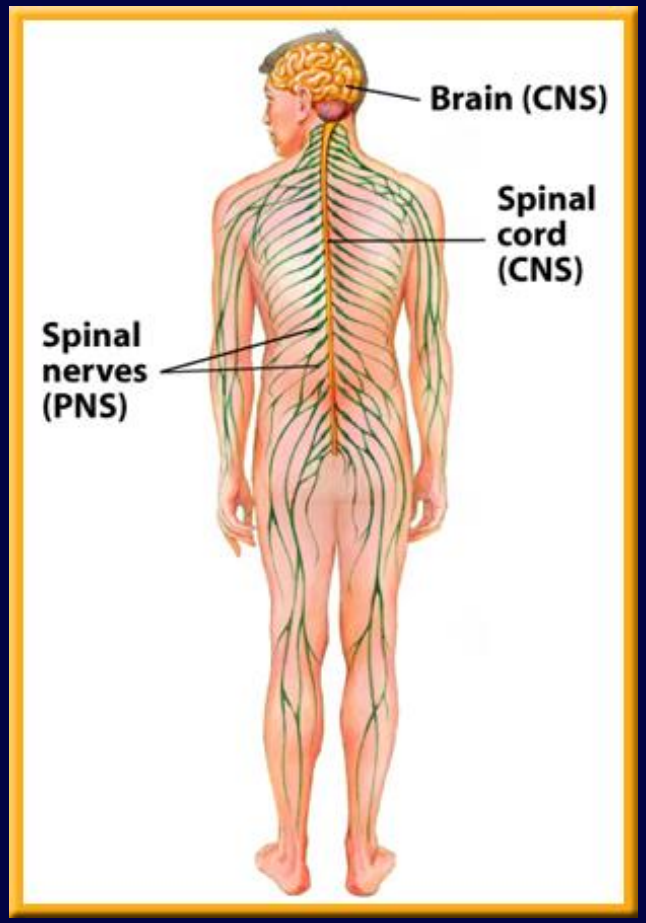
1

The Central Nervous System

- The **central nervous system** is made up of the brain and spinal cord.
- The **peripheral nervous system** is made up of all the nerves outside the CNS.



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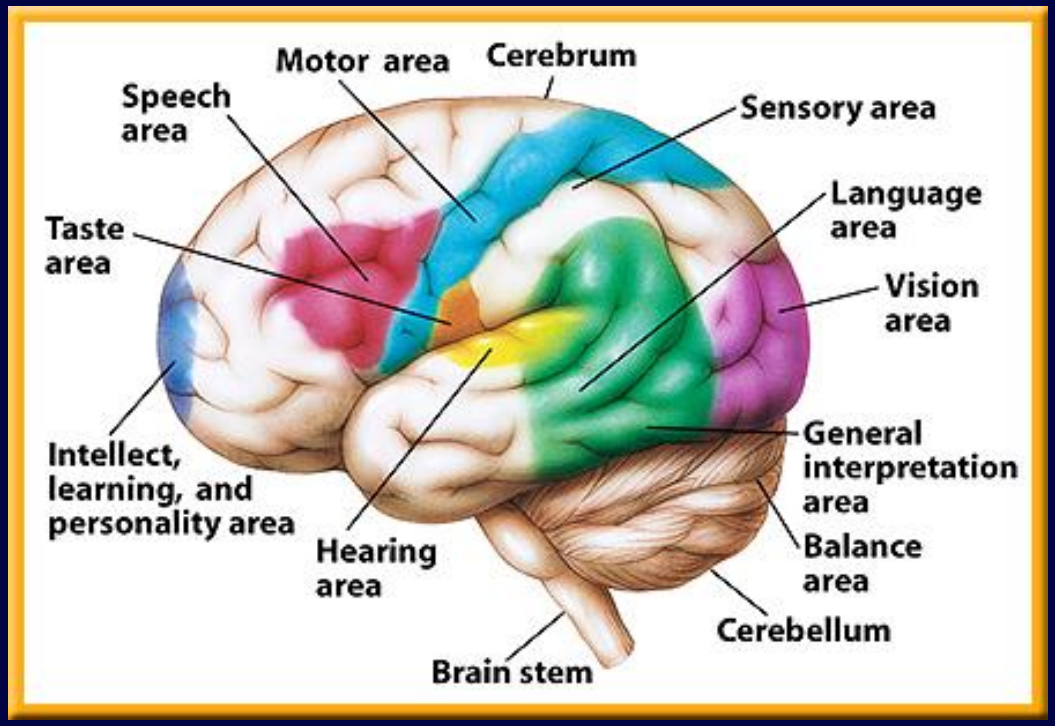
The Brain

- The brain coordinates all of your body activities.
- The brain is made up of approximately 100 billion neurons.
- Surrounding and protecting the brain are a bony skull, three membranes, and a layer of fluid.

1

The Brain

- The brain is divided into three major parts—the brain stem, the cerebellum (ser uh BE lum), and the cerebrum (suh REE brum).



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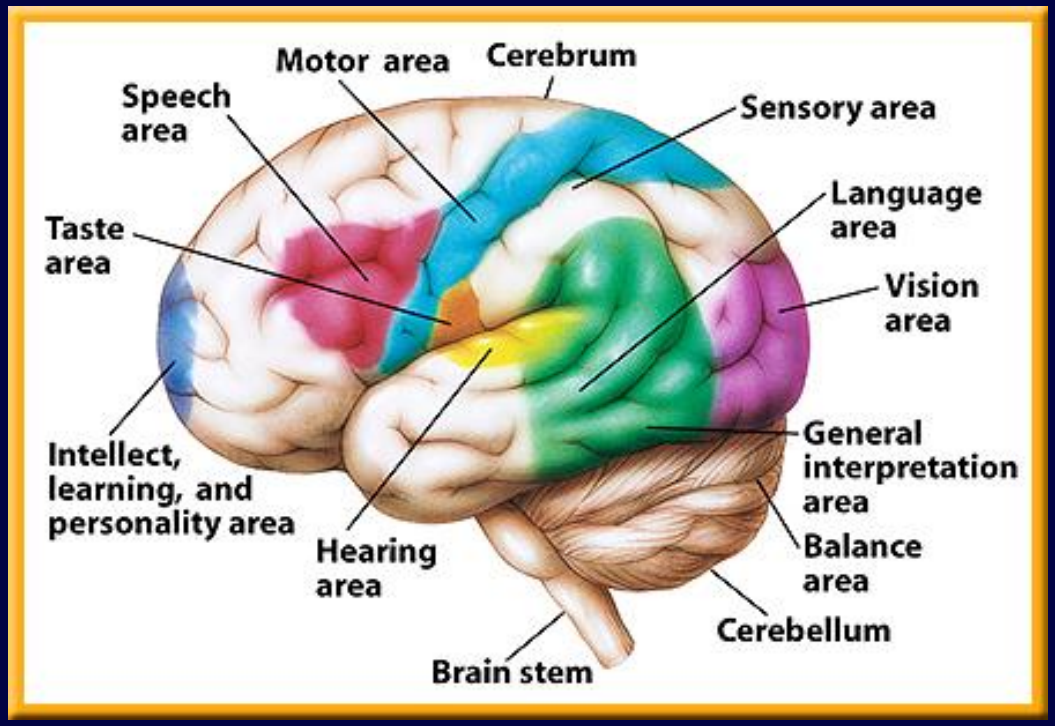
Cerebrum

- Thinking takes place in the **cerebrum**, which is the largest part of the brain.
- This also is where impulses from the senses are interpreted, memory is stored, and movements are controlled.



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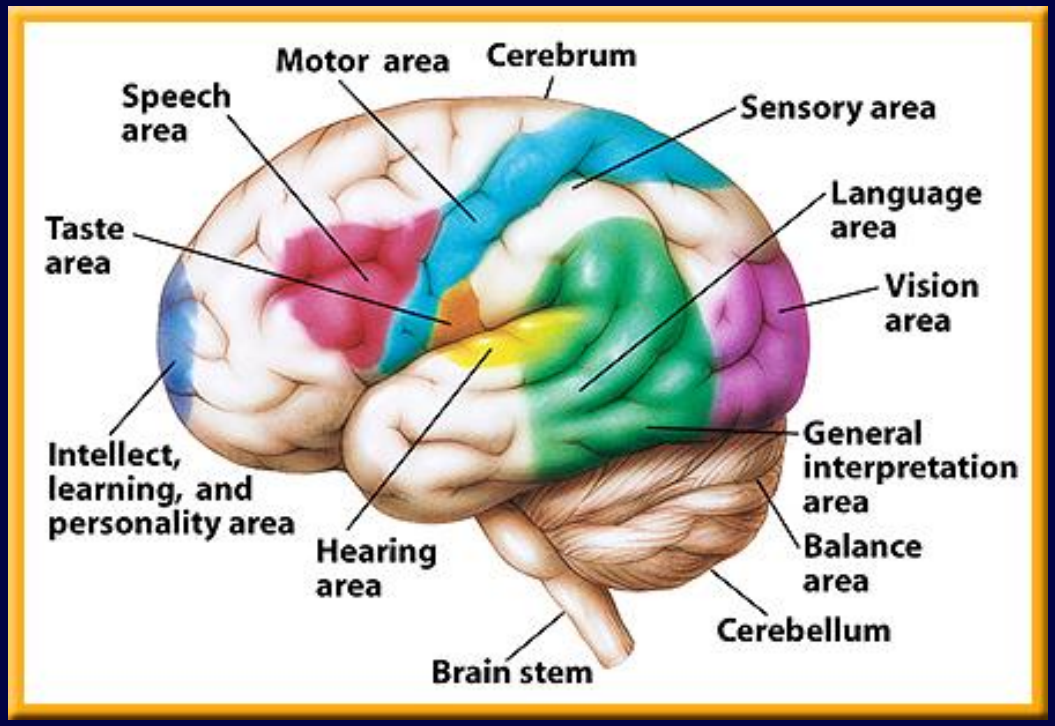
Cerebellum

- Stimuli from the eyes and ears and from muscles and tendons, which are the tissues that connect muscles to bones, are interpreted in the **cerebellum**.



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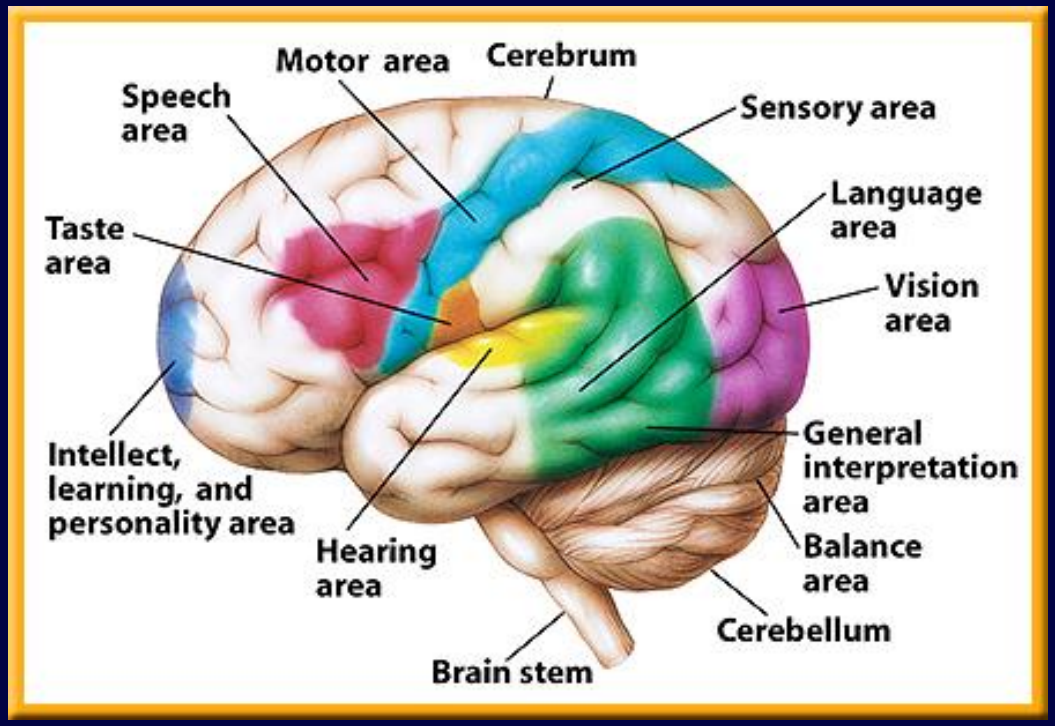
Cerebellum

- With this information, the cerebellum is able to coordinate voluntary muscle movements, maintain muscle tone, and help maintain balance.



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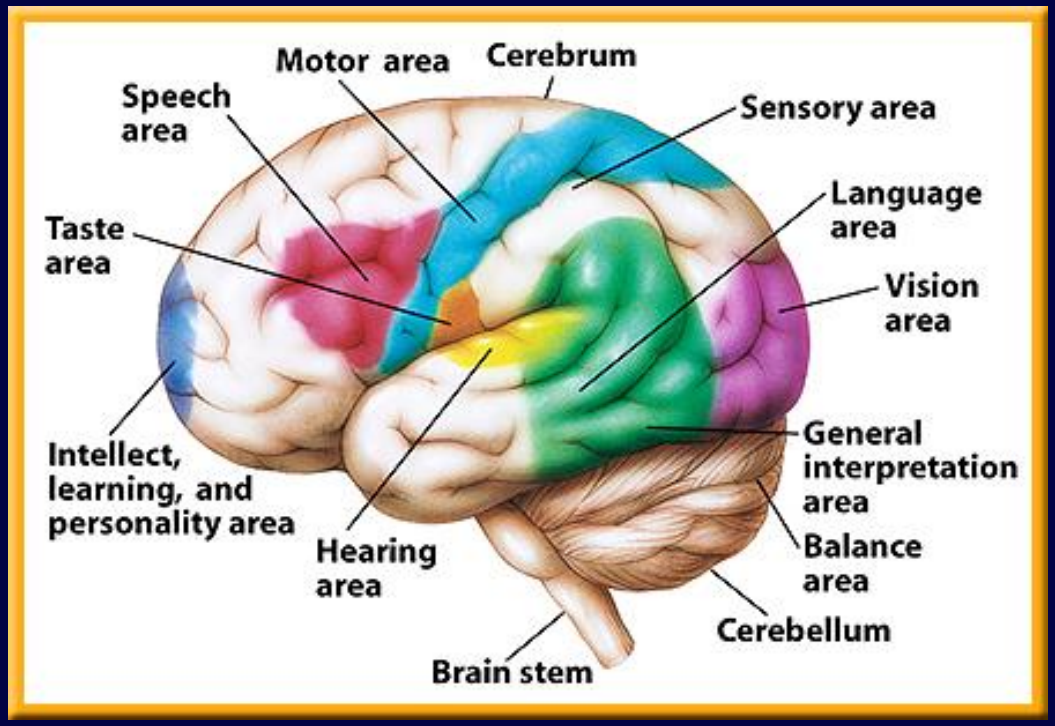
Brain Stem

- At the base of the brain is the **brain stem**.

- The brain stem is made up of the midbrain, the pons, and the medulla (muh DUH luh).



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Brain Stem

- The midbrain and pons act as pathways connecting various parts of the brain with each other.
- The medulla controls involuntary actions such as heartbeat, breathing, and blood pressure.

1

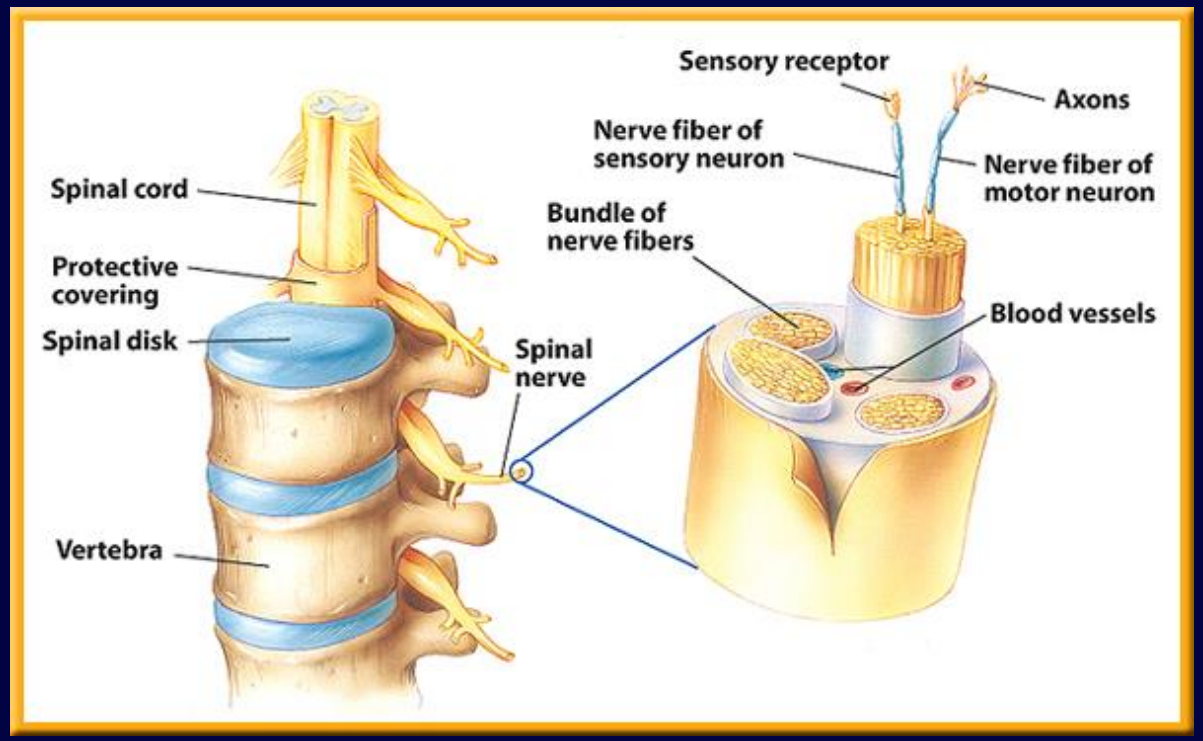
The Spinal Cord

- Your spinal cord is made up of bundle of neurons that carry impulses from all parts of the body to the brain and from the brain to all parts of your body.

1

The Spinal Cord

- A column of vertebrae, or bones, protects the spinal cord.



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The Peripheral Nervous System

- The PNS is made up of 12 pairs of nerves from your brain called cranial nerves and 31 pairs from your spinal cord called spinal nerves.
- Some nerves contain only sensory neurons, and some contain only motor neurons, but most nerves contain both types of neurons.

1

Somatic and Autonomic Systems

- The somatic system controls voluntary actions.
- It is made up of the cranial and spinal nerves that go from the central nervous system to your skeletal muscles.

1

Somatic and Autonomic Systems

- The autonomic system controls involuntary actions—those not under conscious control—such as your heart rate, breathing, digestion, and glandular functions.

1

Safety and the Nervous System

- Any injury to the brain or the spinal cord can be serious.
- A severe blow to the head can bruise the brain and cause temporary or permanent loss of mental and physical abilities.

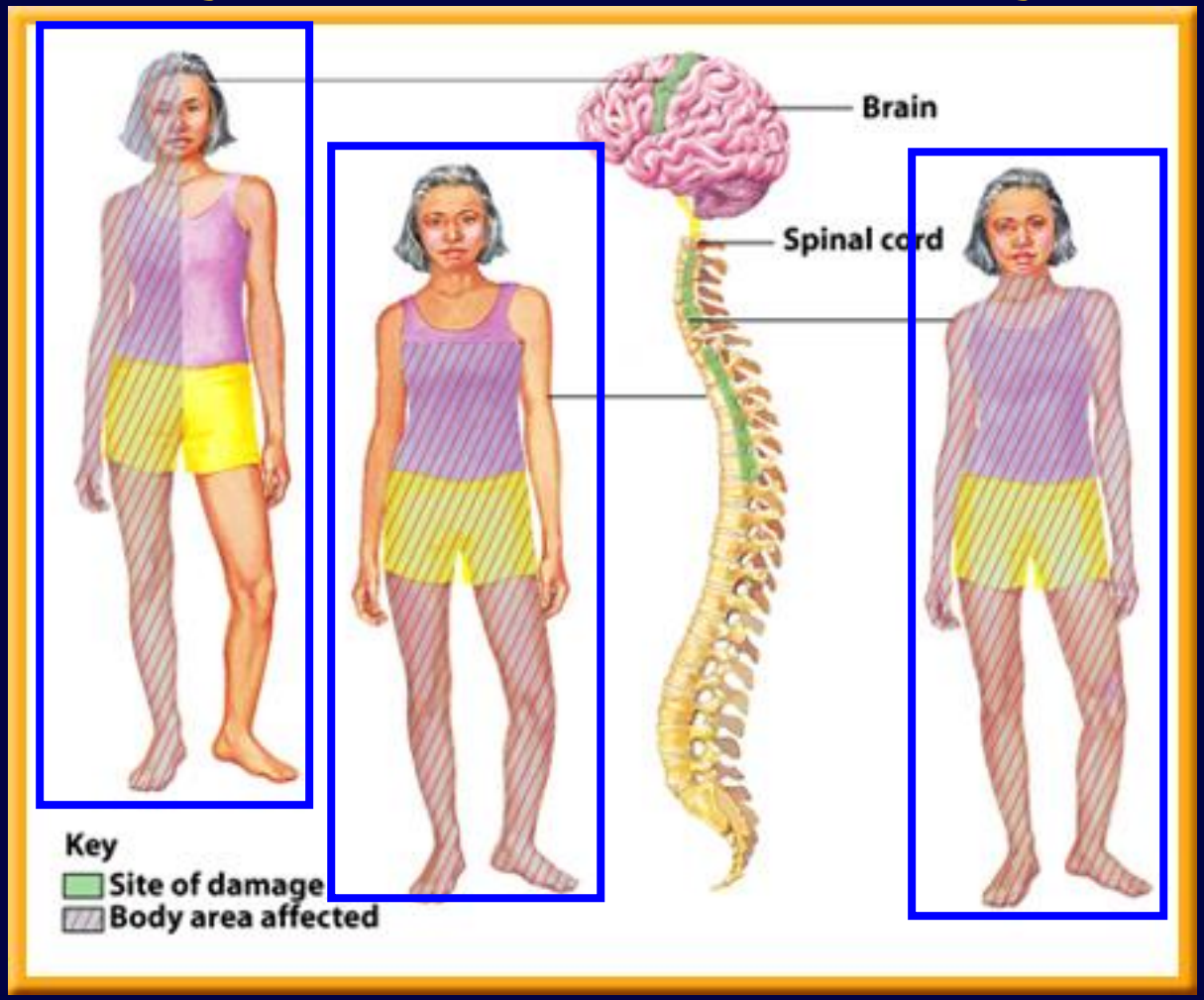
1

Safety and the Nervous System

- Spinal cord injuries can be just as dangerous as a brain injury.
- Injury to the spine can bring about damage to nerve pathways and result in paralysis (puh RA luh suhs), which is the loss of muscle movement.

1

Safety and the Nervous System



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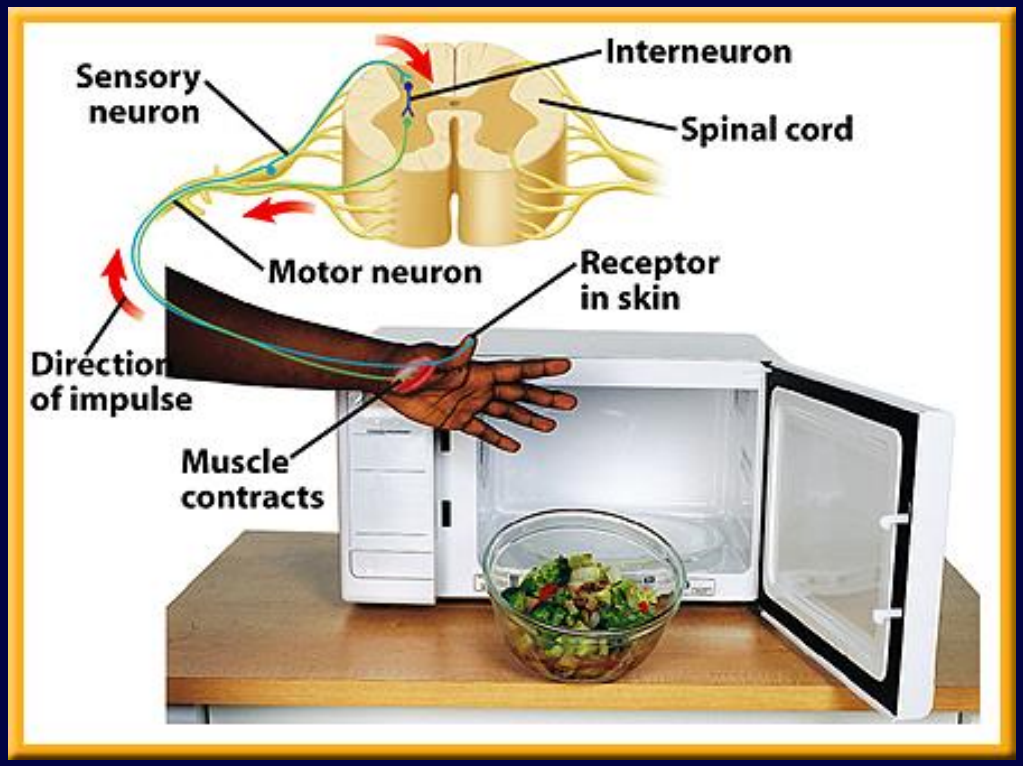
Reflexes

- A **reflex** is an involuntary, automatic response to a stimulus.
- You can't control reflexes because they occur before you know what has happened.



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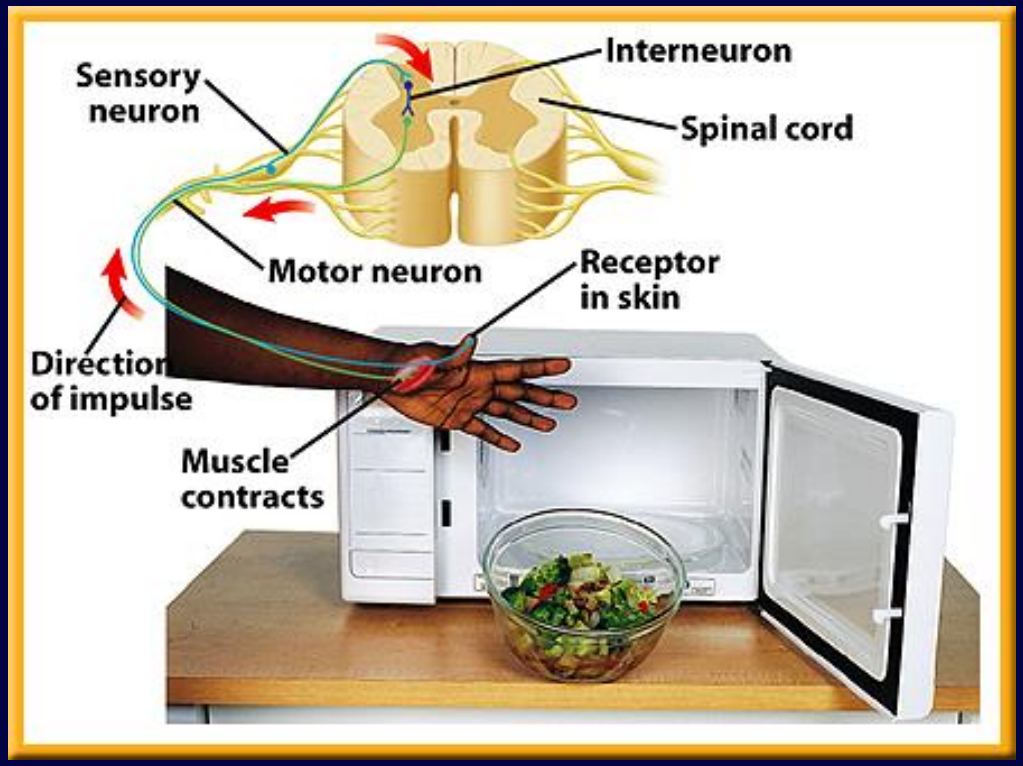
Reflexes

- A reflex involves a simple nerve pathway called a reflex arc.



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Reflexes

- A reflex allows the body to respond without having to think about what action to take.
- Reflex responses are controlled in your spinal cord, not in your brain.
- Your brain acts after the reflex to help you figure out what to do to make the pain stop.

1

Drugs and the Nervous System

- Many drugs, such as alcohol and caffeine, directly affect your nervous system.
- When swallowed, alcohol passes directly through the walls of the stomach and small intestine into the circulatory system.

1

Drugs and the Nervous System

- This drug slows the activities of the central nervous system and is classified as a depressant.

- Heavy alcohol use destroys brain and liver cells.

1

Drugs and the Nervous System

- Caffeine is a stimulant found in coffee, tea, cocoa, and many soft drinks.

1

Drugs and the Nervous System

- Too much caffeine can increase heart rate and aggravates restlessness, tremors, and insomnia in some people.
- It also can stimulate the kidneys to produce more urine.

1

Question 1

Explain what could happen if damage occurred to the spinal cord in the lower neck area.

Answer

An injury to the spinal cord is always serious. If damage occurs to the spinal cord in the lower neck area, the body can be paralyzed from the neck down.

1

Question 2

Which helps maintain balance?

A. brain stem
B. cerebellum
C. cerebrum
D. spinal cord

1

Answer

The correct answer is B. The cerebellum also coordinates voluntary muscle movements and maintains muscle tone.

1

Question 3

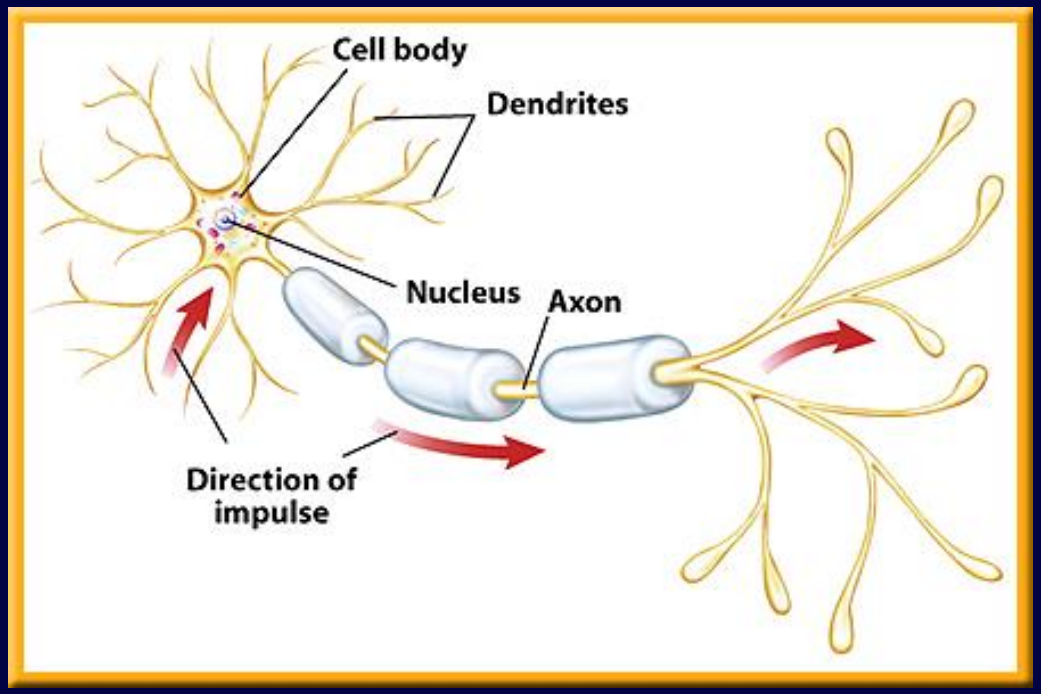
Which is NOT part of a neuron?

A. axon
B. cell body
C. dendrite
D. sensory fibers

1

Answer

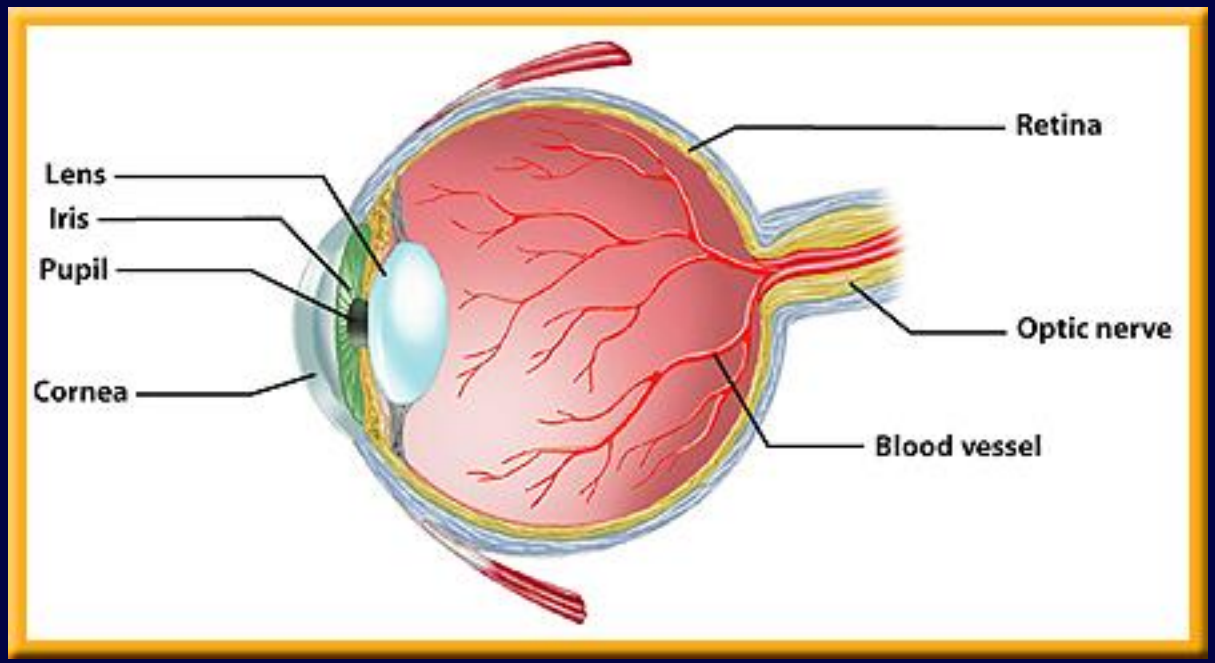
The answer is D. A neuron is made up of a cell body, dendrites, and axons.



2

The Body's Alert System

- Light rays, sound waves, heat, chemicals, or pressure that comes into your personal territory will stimulate your sense organs.



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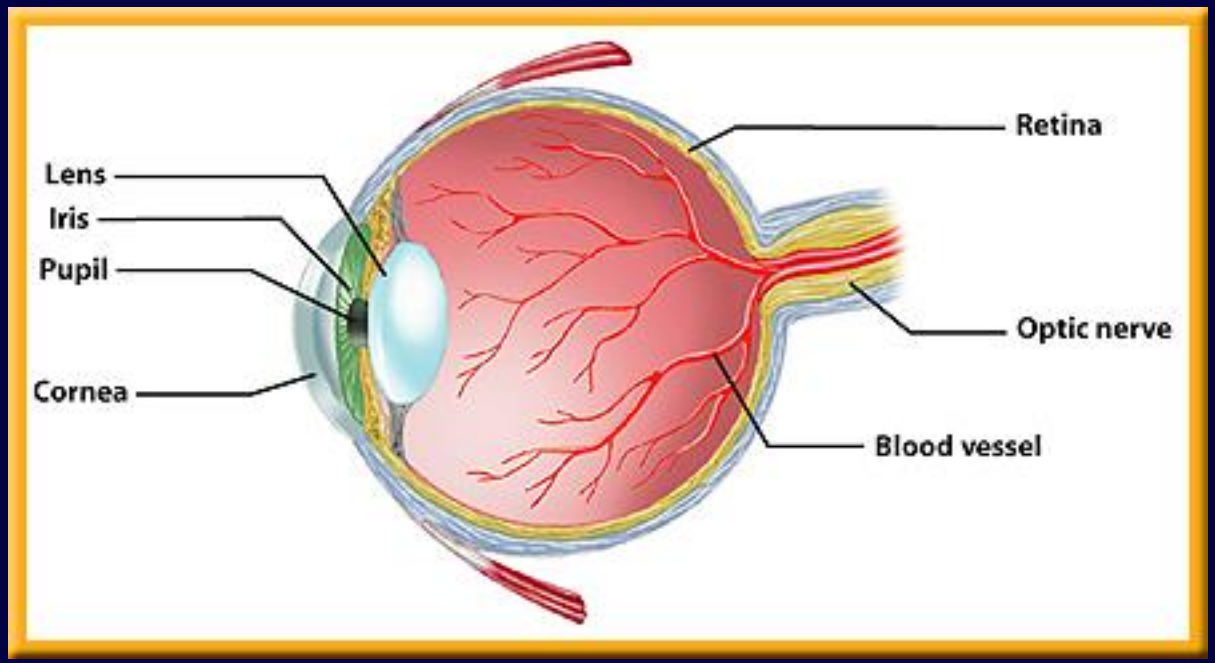
The Body's Alert System

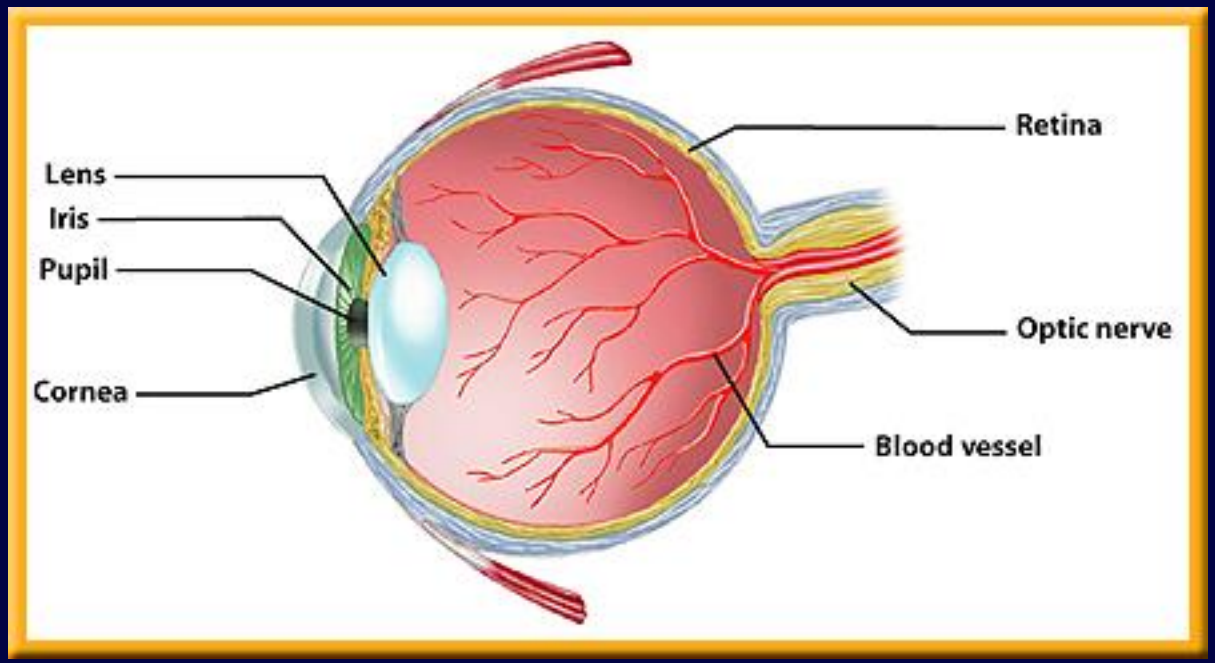
- Sense organs are adapted for intercepting these different stimuli.
- They are then converted into impulses by the nervous system.



2

Vision

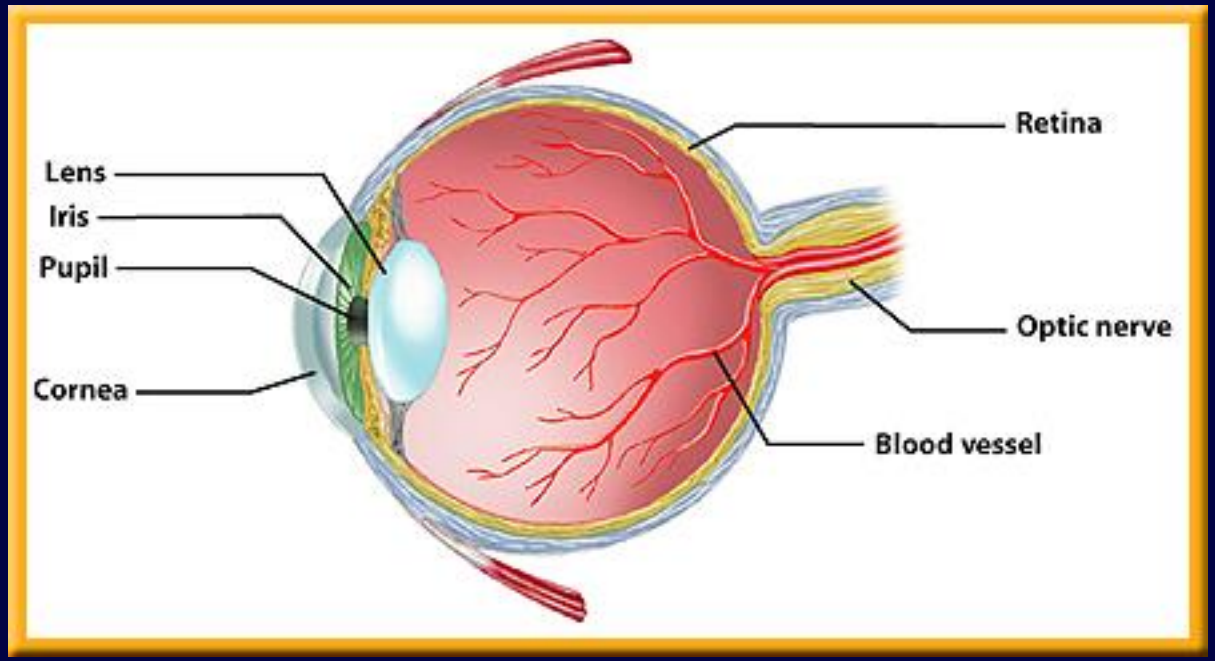
- The eye is the vision sense organ.
- Your eyes have unique adaptations that usually enable you to see shapes of objects, shadows, and color.



2

How do you see?

- Your eyes are equipped with structures that refract light.



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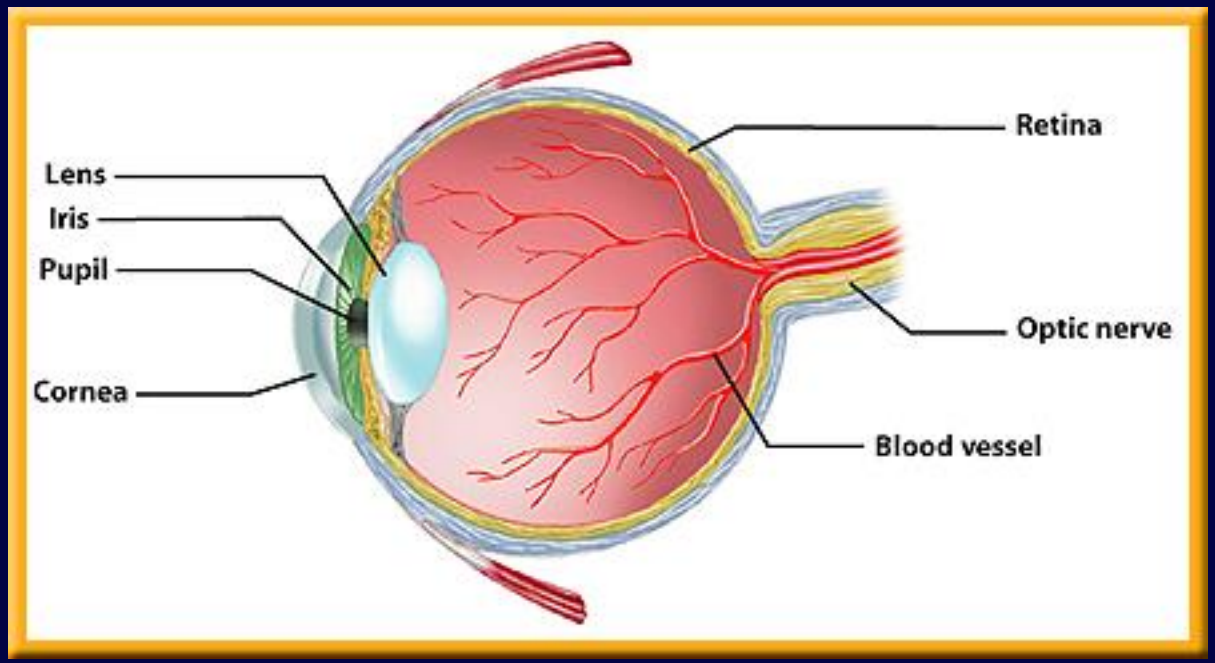
How do you see?

- As light enters the eye, it passes through the cornea—the transparent section at the front of the eye—and is refracted.



2

How do you see?

- Then light passes through a lens and is refracted again.
- The lens directs the light onto the retina (RET nuh).
- The **retina** is a tissue at the back of the eye that is sensitive to light energy.

2

How do you see?

- Two types of cells called rods and cones are found in the retina.
- They are used to help you detect shape and movement.
- The impulses pass to the optic nerve.
- This nerve carries the impulses to the vision area of the cortex, located on your brain's cerebrum.

2

How do you see?

- The image transmitted from the retina to the brain is upside down and reversed.
- The brain interprets the image correctly, and you see what you are looking at.

2

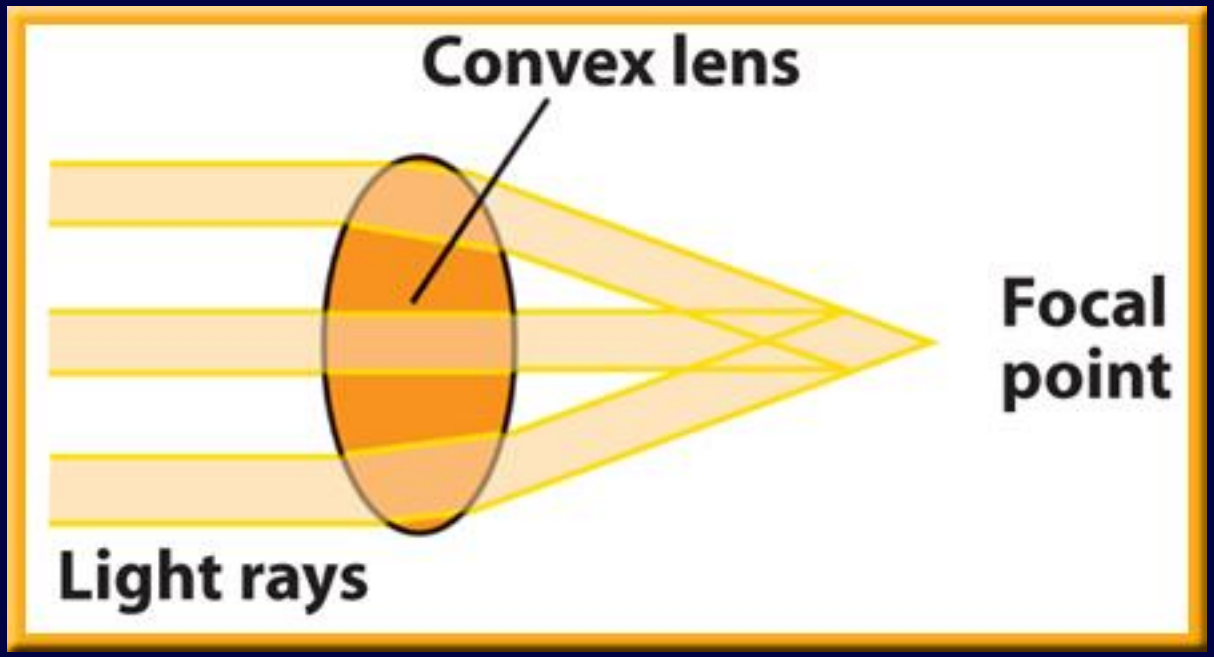
Lenses

- Light is refracted when it passes through a lens.
- The way it refracts depends on the type of lens it passes through.
- A lens that is thicker in the middle and thinner on the edges is called a convex lens.

2

Lenses

- The lens in your eye refracts light so that it passes through a point, called a focal point.



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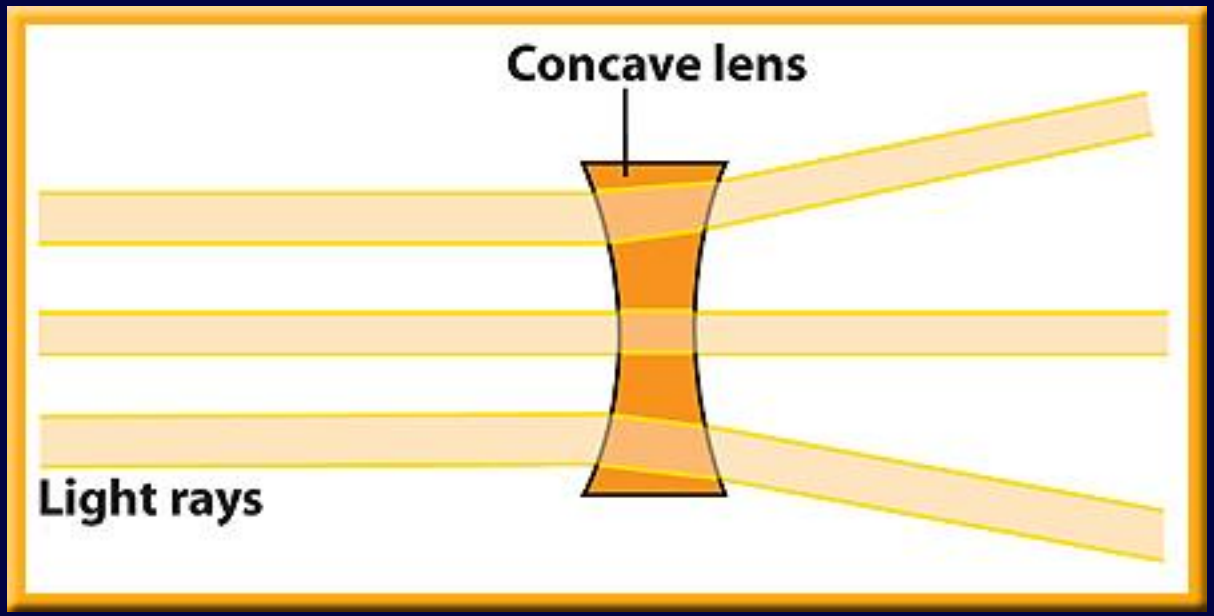
Lenses

- A lens that is thicker at its edges than in its middle is called a concave lens.
- Light that passes through a concave lens is refracted outward.



2

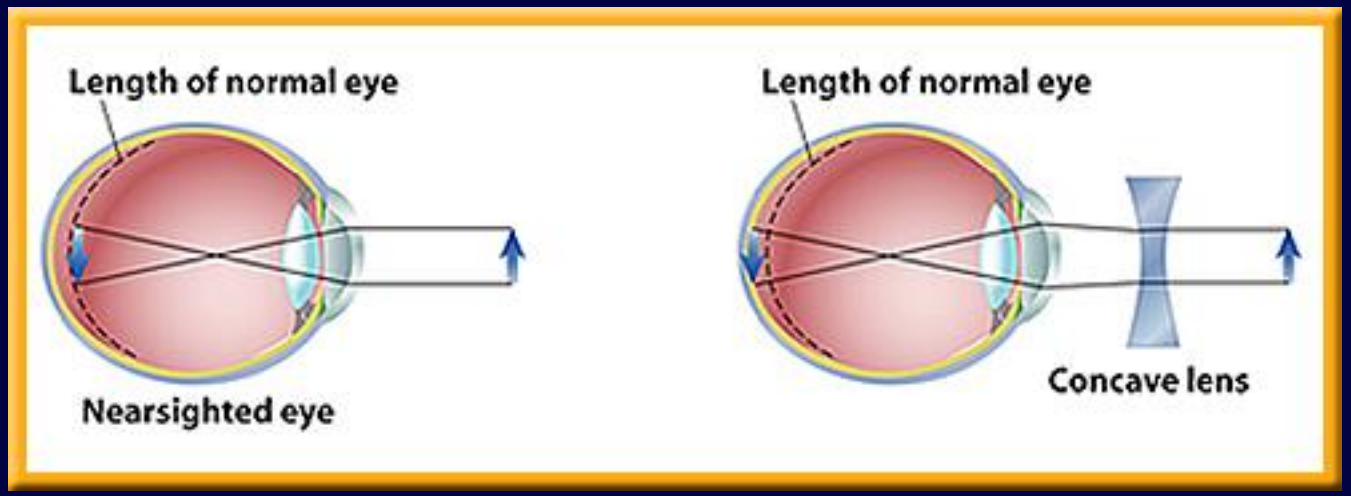
Correcting Vision Problems

- In an eye with normal vision, light rays are focused onto the retina by the coordinated actions of the eye muscles, the cornea, and the lens.
- The image formed on the retina is interpreted by the brain as being sharp and clear.

2

Correcting Vision Problems

- A nearsighted person cannot see distant objects because the image is focused in front of the retina.
- A concave lens corrects nearsightedness.



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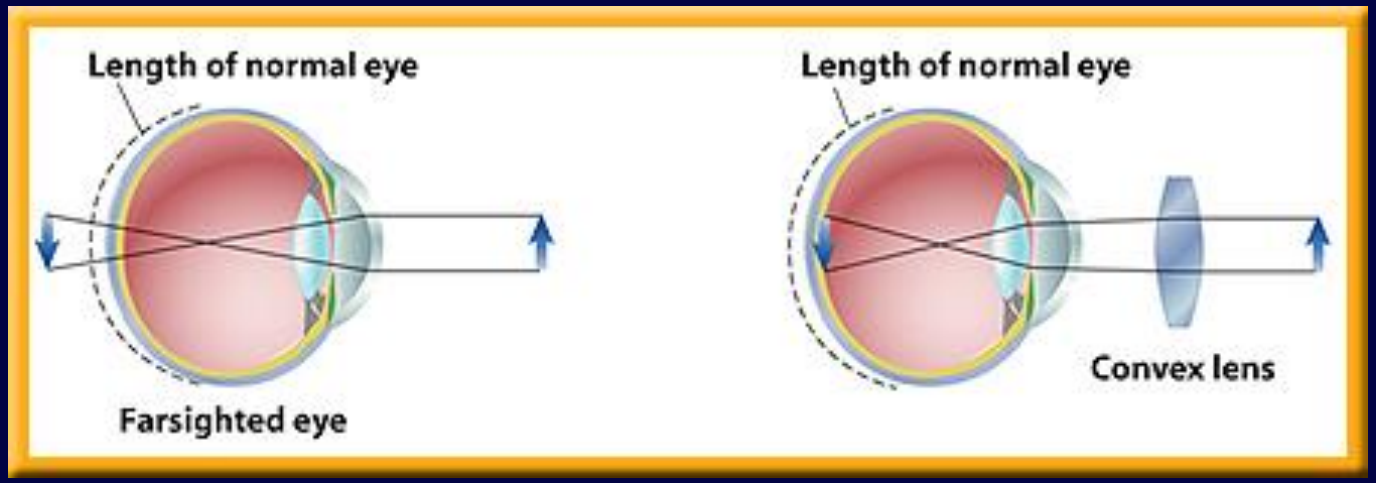
Correcting Vision Problems

- A farsighted person cannot see close objects because the image is focused behind the retina.
- A convex lens corrects farsightedness.



2

Hearing

- Sound waves are necessary for hearing sound.
- When an object vibrates, sound waves are produced.
- These waves can travel through solids, liquids, and gases.

2

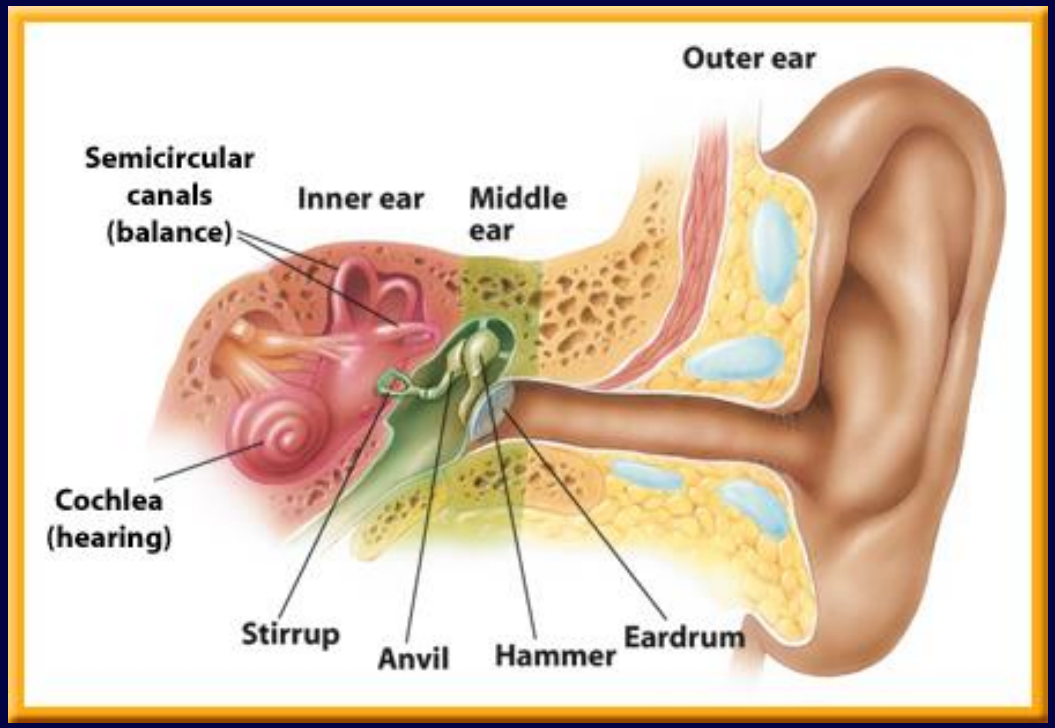
Hearing

- When the waves reach your ear, they usually stimulate nerve cells deep within your ear.
- Impulses are sent to the brain.
- When the sound impulse reaches the hearing area of the cortex, it responds and you hear a sound.

2

The Outer Ear and Middle Ear

- Your outer ear intercepts sound waves and funnels them down the ear canal to the middle ear.
- The sound waves cause the eardrum to vibrate.



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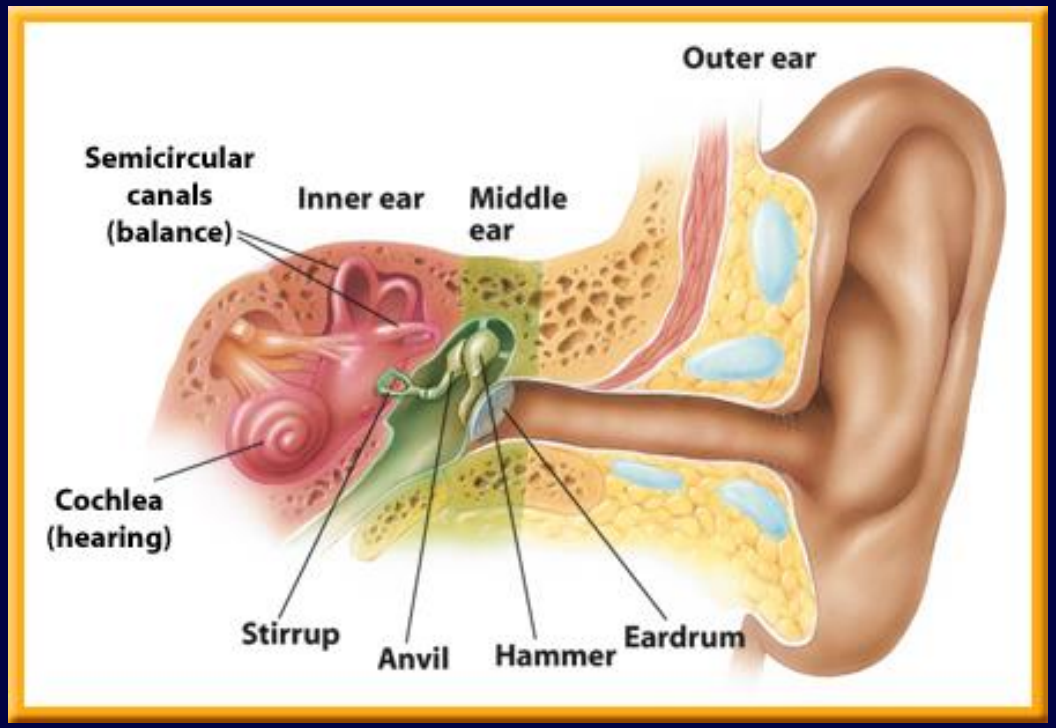
The Outer Ear and Middle Ear

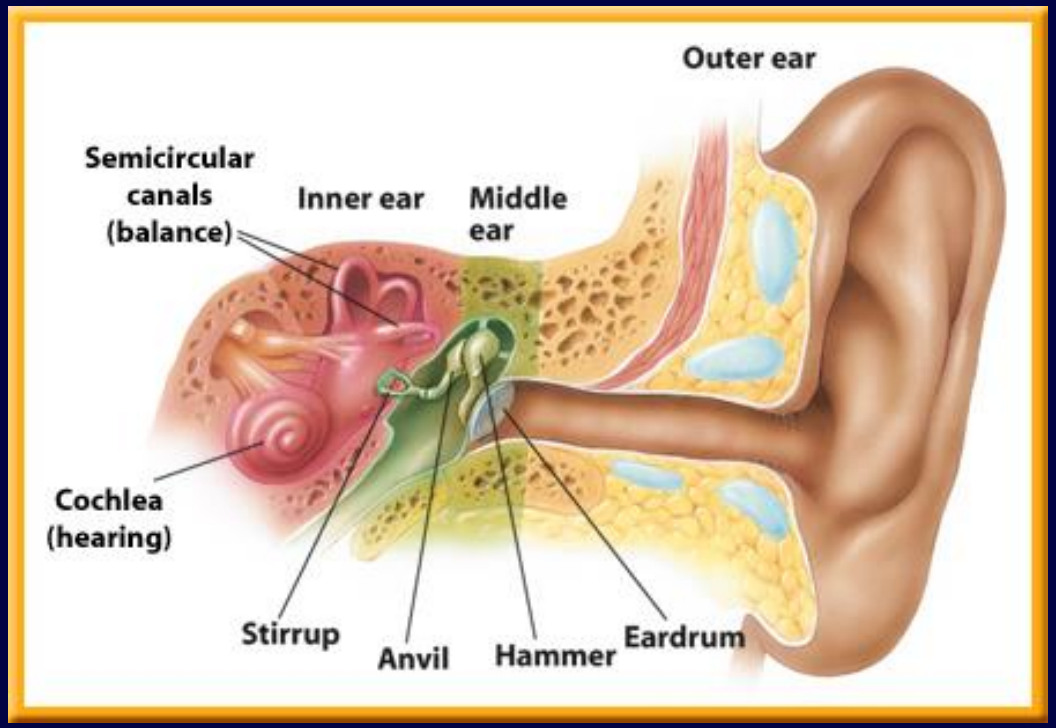
- These vibrations then move through three tiny bones called the hammer, anvil, and stirrup.



2

The Inner Ear

- The **cochlea** (KOH klee uh) is a fluid-filled structure shaped like a snail's shell.
- When the stirrup vibrates, fluids in the cochlea begin to vibrate.



2

The Inner Ear

- These vibrations bend hair cells in the cochlea, which causes electrical impulses to be sent to the brain by a nerve.
- Depending on how the nerve endings are stimulated, you hear a different type of sound.

2

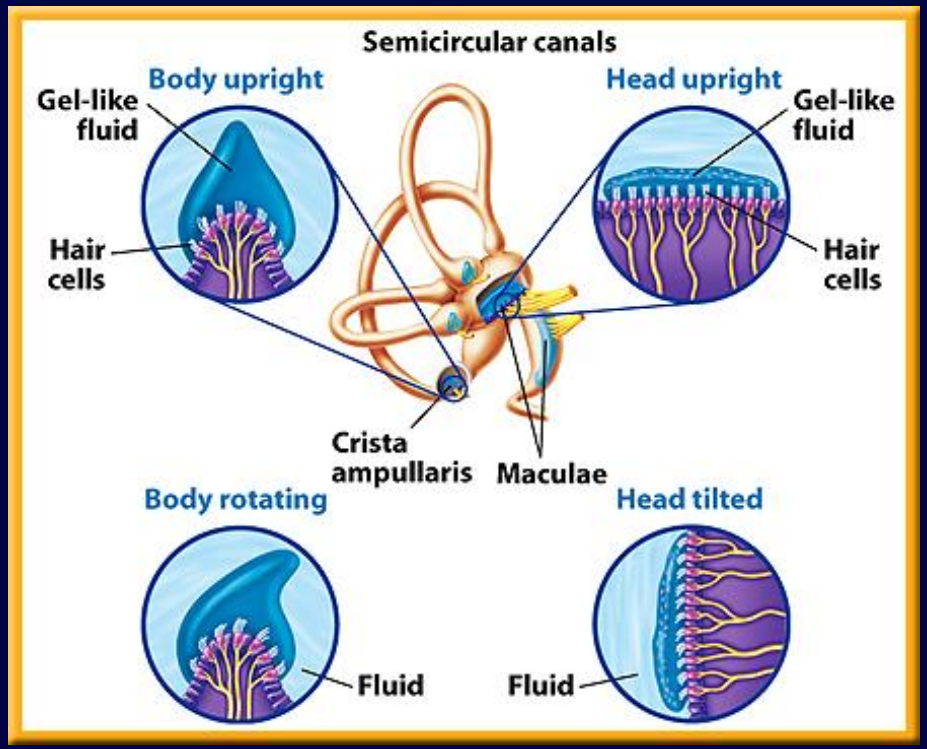
Balance

- Structures in your inner ear also control your body's balance.
- Structures called the cristae ampullaris (KRIHS tee am pyew LEER his) and the maculae (MA kyah lee) sense different types of body movement.

2

Balance

- In your inner ear, the cristae ampullaris react to rotating movements of your body, and the maculae check the position of your head with respect to the ground.



2

Smell

- You smell food because it gives off molecules into the air.
- These molecules stimulate sensitive nerve cells, called **olfactory** (ohl FAK tree) **cells**, in your nasal passages.
- Olfactory cells are kept moist by mucus.

2

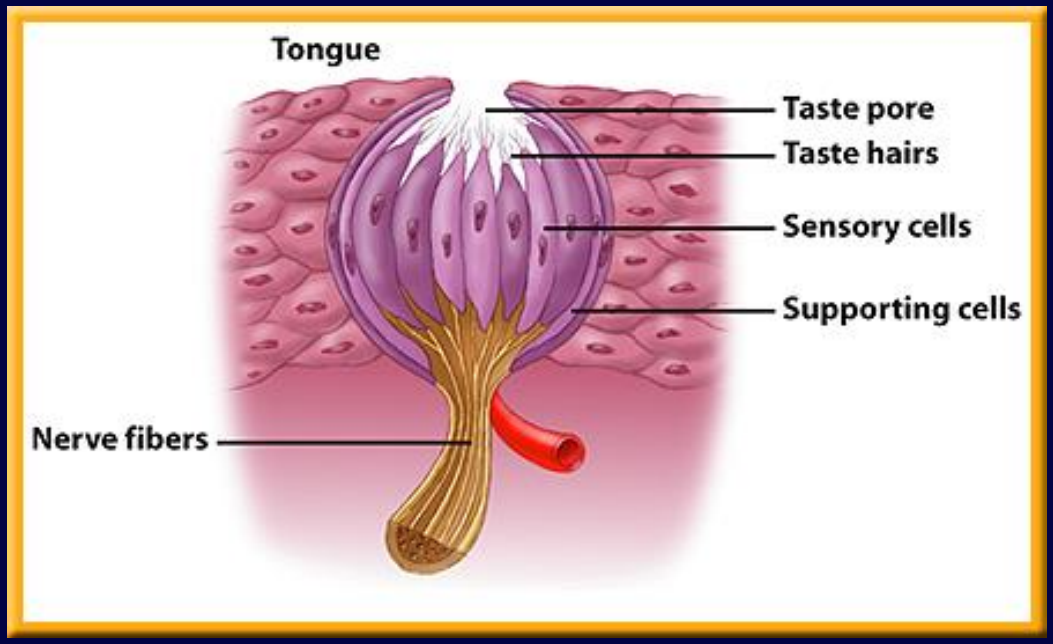
Smell

- When molecules in the air dissolve in this moisture, the cells become stimulated.
- If enough molecules are present, an impulse starts in these cells, then travels to the brain where the stimulus is interpreted.

2

Taste

- **Taste buds** on your tongue are the major sensory receptors for taste.
- About 10,000 taste buds are found all over your tongue, enabling you to tell one taste from another.



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Tasting Food

- Most taste buds respond to several taste sensations.
- The five taste sensations on the tongue are sweet, salty, sour, bitter, and the taste of MSG (monosodium glutamate).

2

Tasting Food

- In order to taste something, it has to be dissolved in water.
- Saliva begins this process.
- This solution of saliva and food washes over the taste buds, and impulses are sent to your brain.
- The brain interprets the impulses, and you identify tastes.

2

Smell and Taste

- Smell and taste are related.
- The sense of smell is needed to identify some foods such as chocolate.
- When saliva in your mouth mixes with the chocolate, odors travel up the nasal passage in the back of your throat.
- The olfactory cells are stimulated, and the taste and smell of chocolate are sensed.

2

Other Sensory Receptors in the Body

- Your internal organs have several kinds of sensory receptors.
- These receptors respond to touch, pressure, pain, and temperature.
- In turn, your body responds to this new information.

2

Other Sensory Receptors in the Body

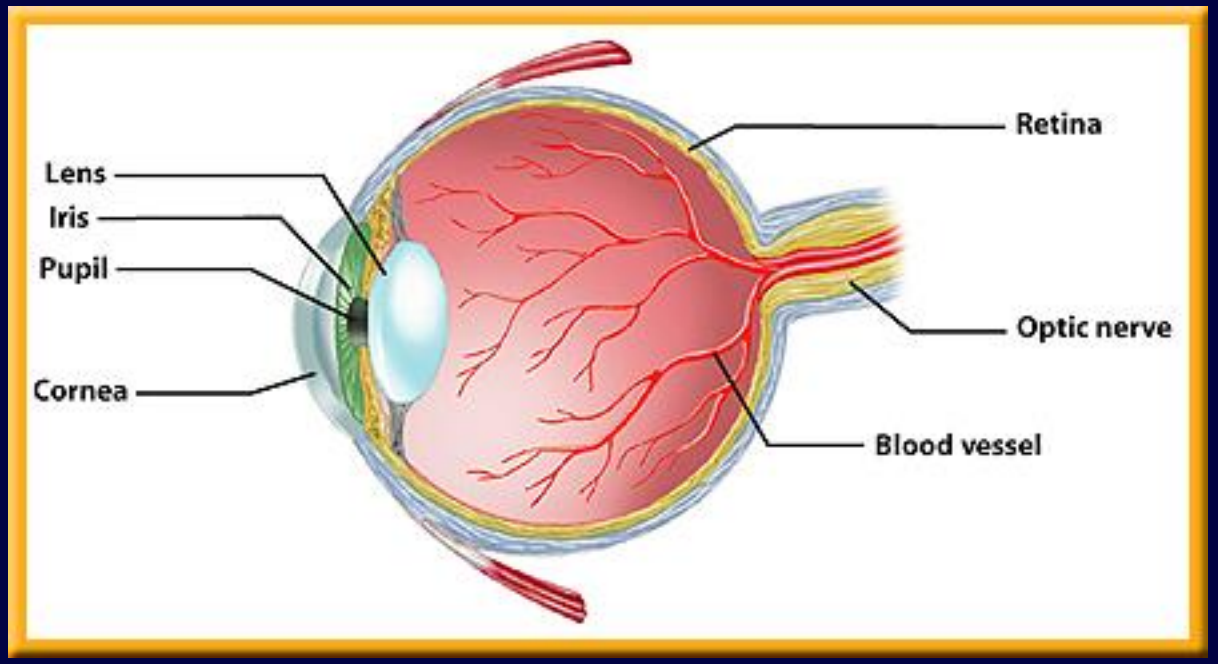
- Sensory receptors also are located throughout your skin.
- Your fingertips have many different types of receptors for touch.
- As a result, you can tell whether an object is rough or smooth, hot or cold, and hard or soft.

2

Question 1

Which does light pass through first?

A. cornea
B. lens
C. pupil
D. retina



2

Answer

The answer is A. As light enters the eye, it passes through the cornea.

2

Question 2

Which is used to correct nearsightedness?

A. concave lens
B. convex lens
C. concave mirror
D. convex mirror

2

Answer

The correct answer is A. A nearsighted person cannot see distant objects because the image is focused in front of the retina.

2

Question 3

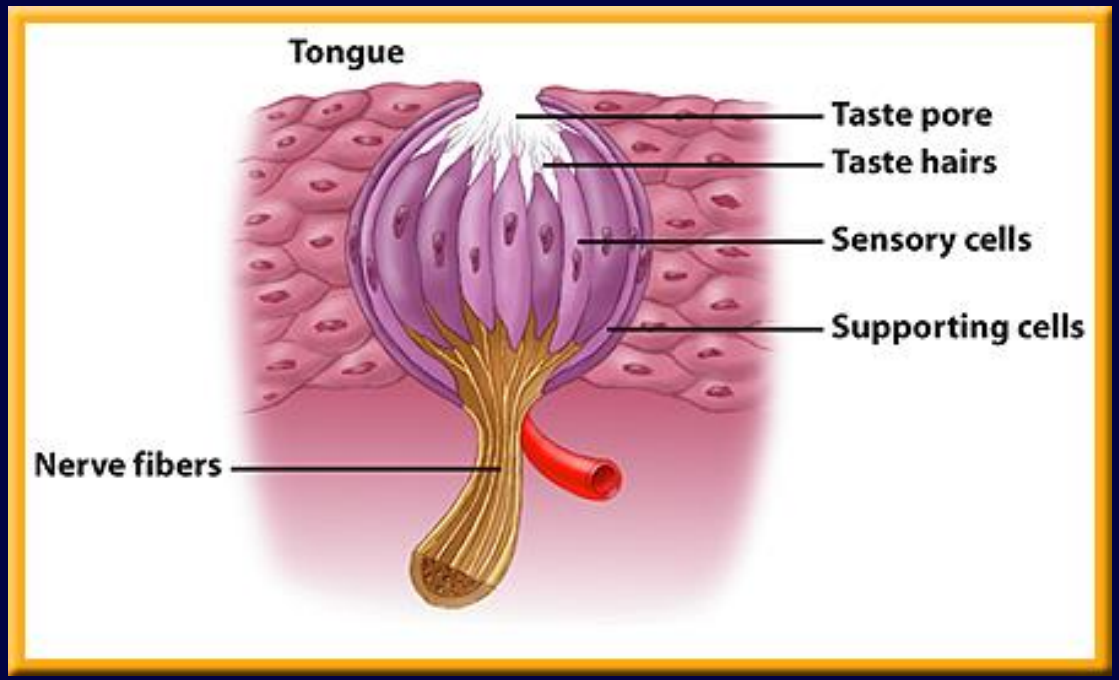
Which are the sensory receptors for taste?

A. cochlea
B. olfactory cells
C. semicircular canals
D. taste buds

2

Answer

The correct answer is D. About 10,000 taste buds are found all over your tongue, enabling you to tell one taste from another.



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End of Chapter Summary File