

35-2 The Nervous System



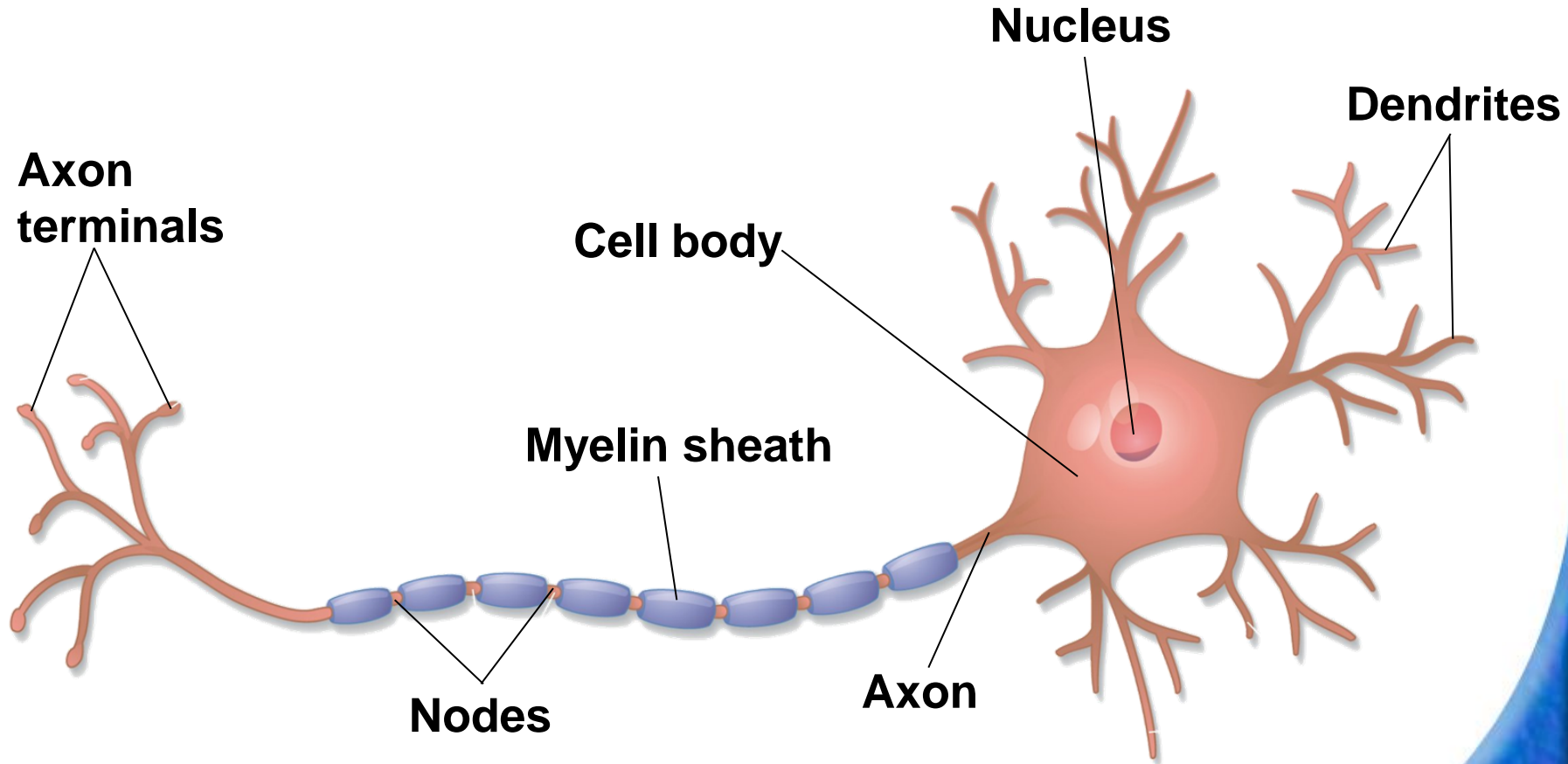


The nervous system controls and coordinates functions throughout the body and responds to internal and external stimuli.

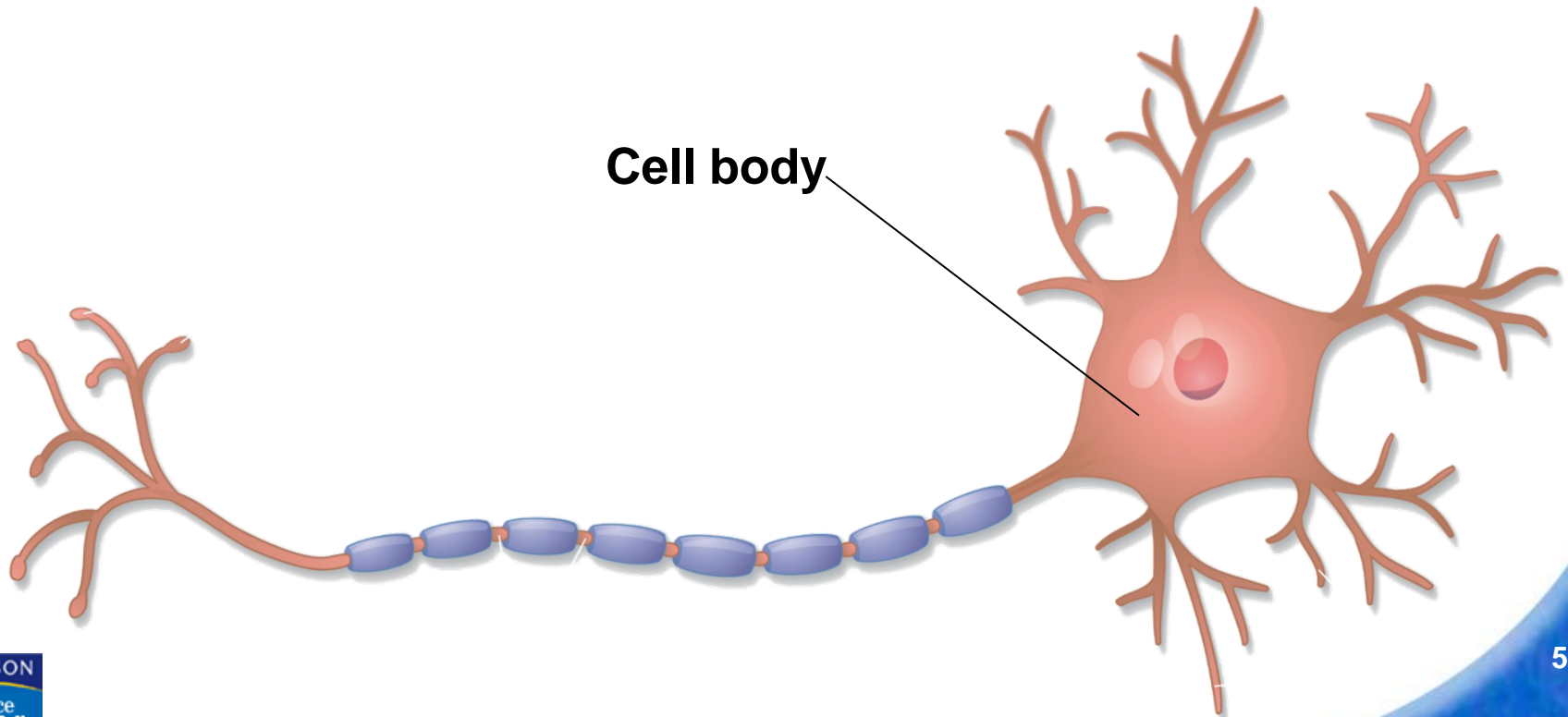
Neurons are classified according to the direction in which an impulse travels.

- Sensory neurons → from the sense organs to the spinal cord and brain.
- Motor neurons → from the brain and spinal cord to muscles and glands.
- Interneurons → connect sensory and motor neurons

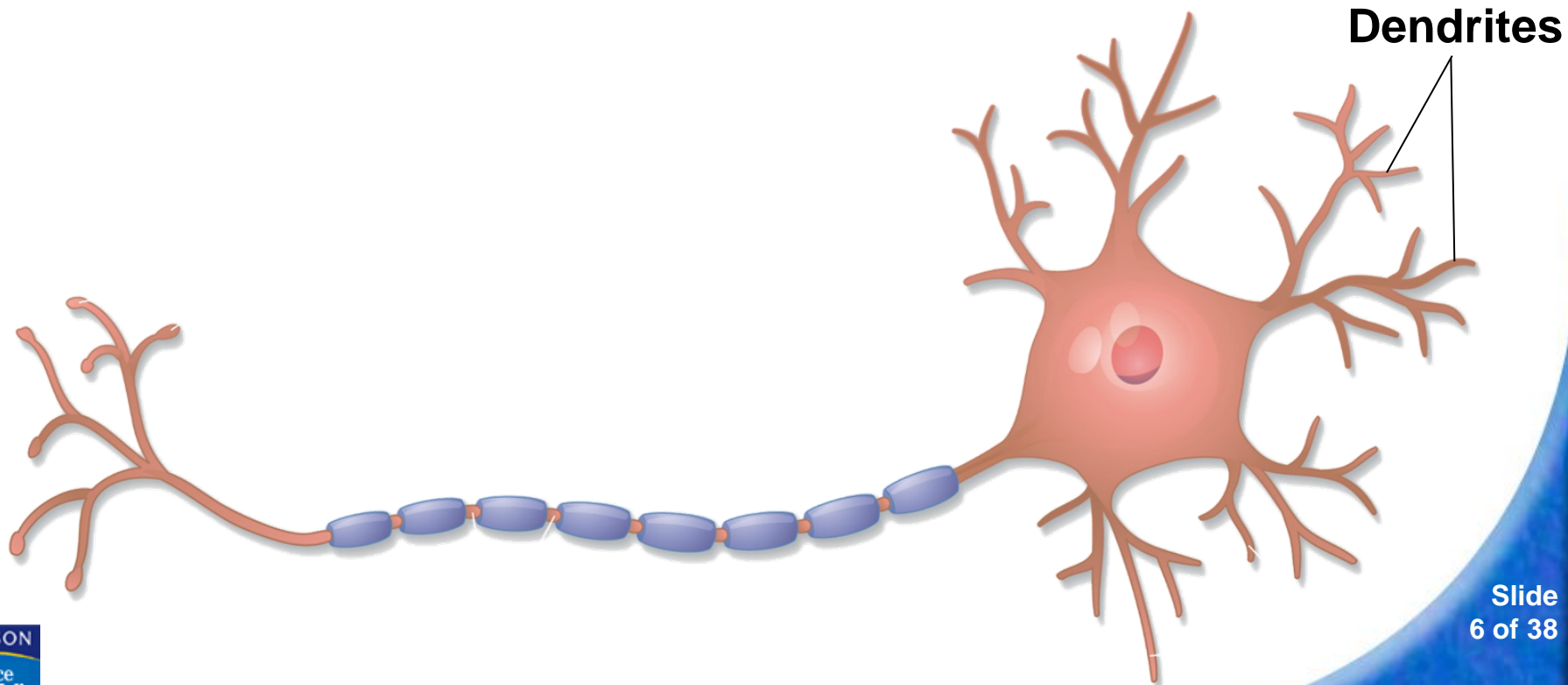
Structures of a Neuron



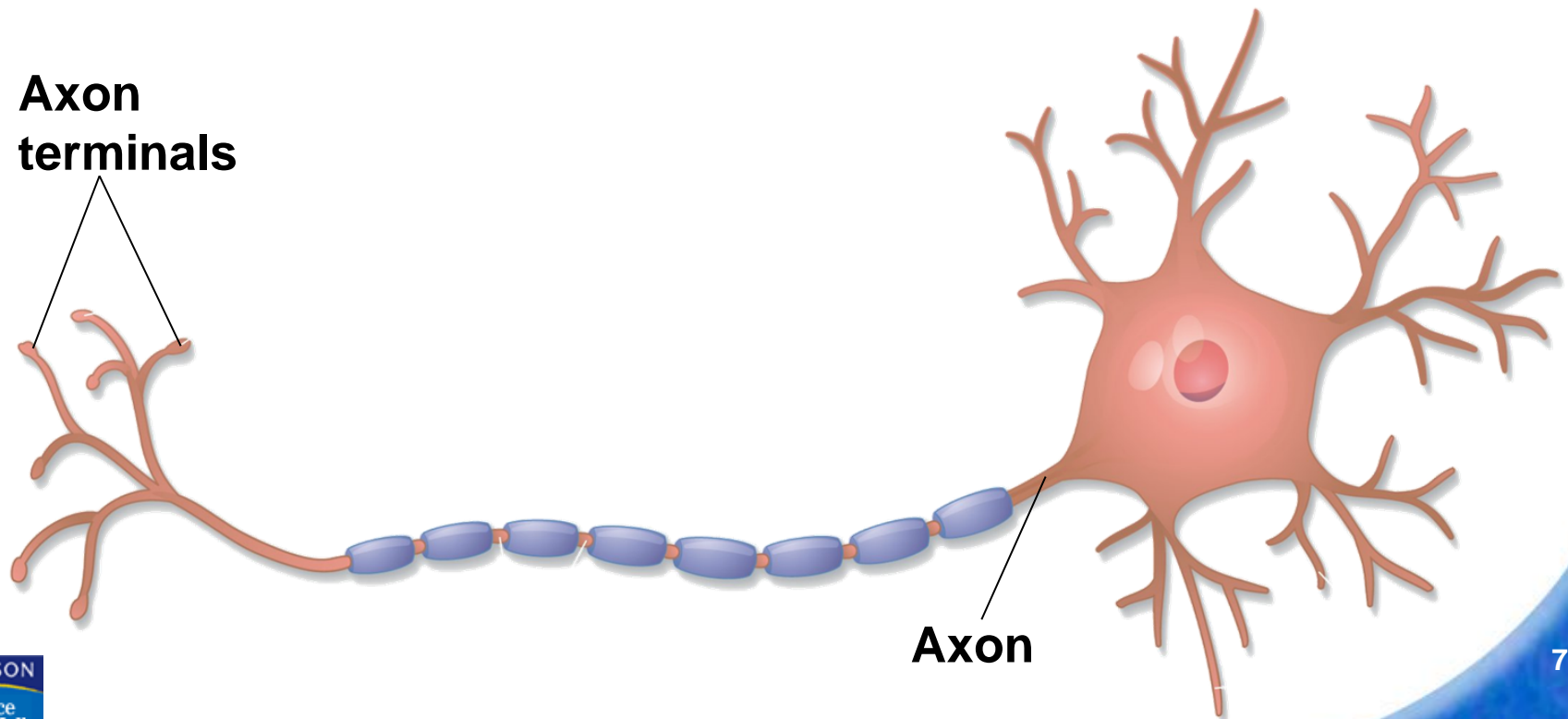
The largest part of a typical neuron is the **cell body**.
It contains the nucleus and much of the cytoplasm.



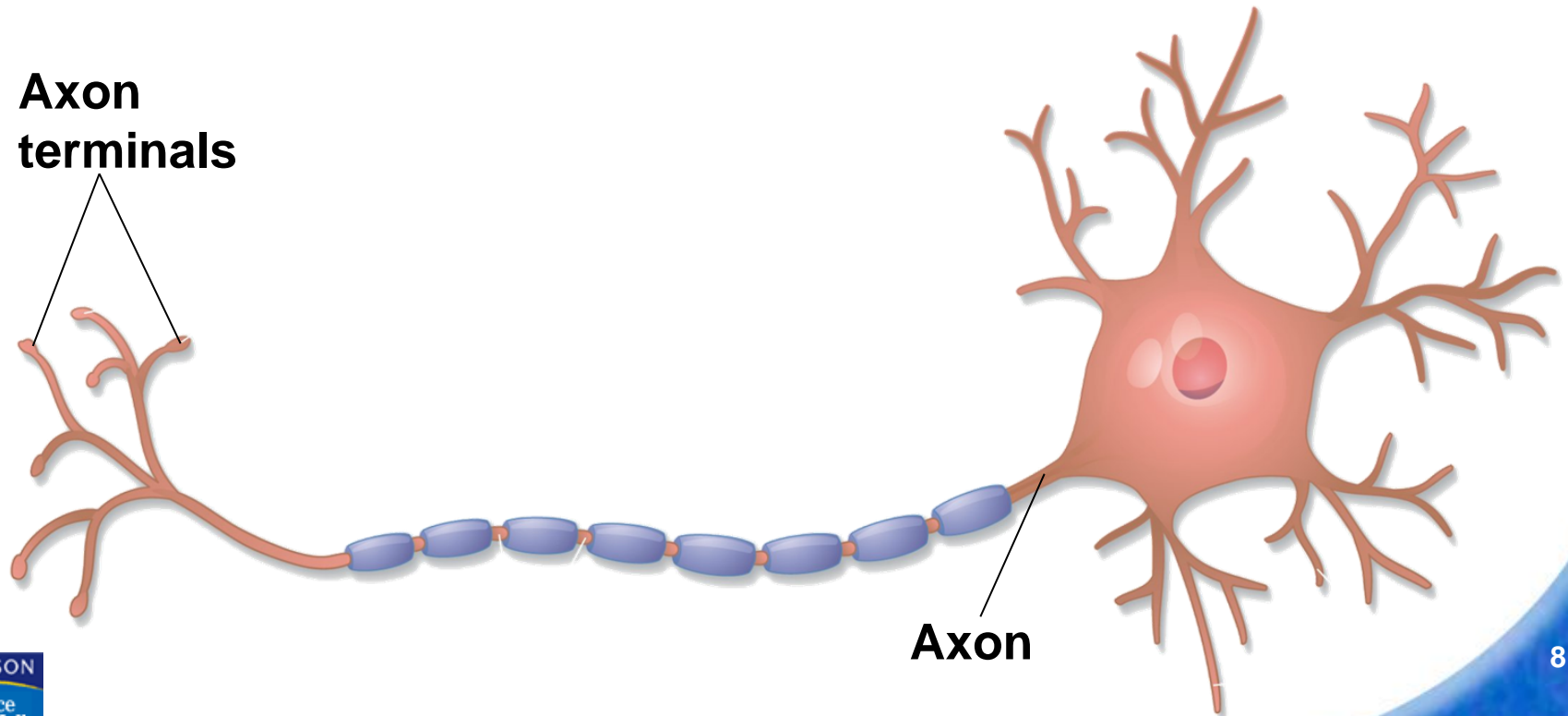
Dendrites extend from the cell body and carry impulses from the environment toward the cell body.



The **axon** is the long fiber that carries impulses away from the cell body.



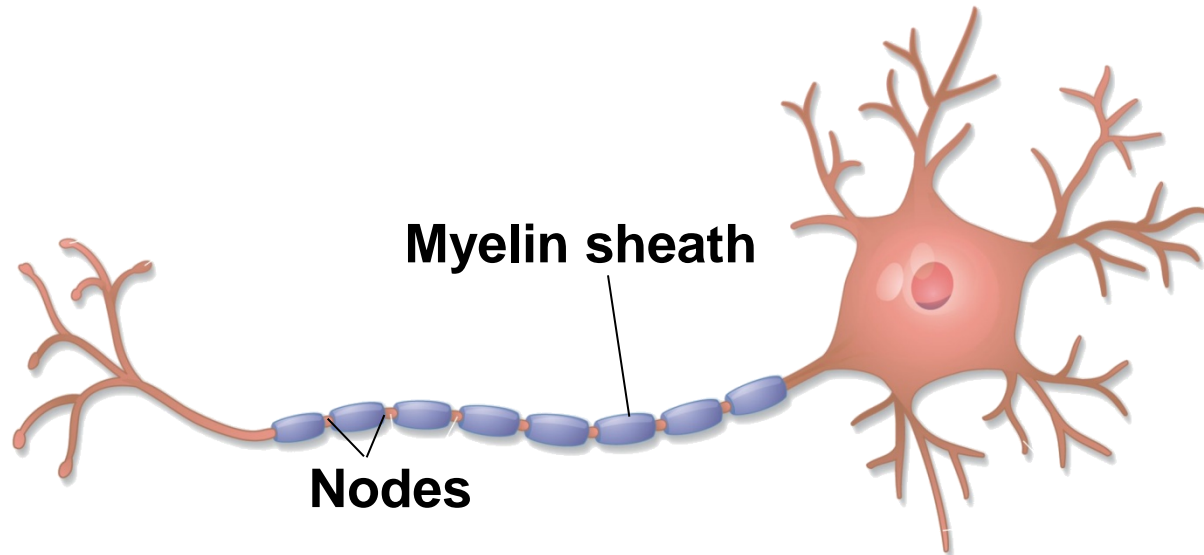
The axon ends in axon terminals.



The axon → an insulating membrane called the **myelin sheath**.

→ gaps in the myelin sheath, called nodes, where the membrane is exposed.

→ Impulses jump from one node to the next.



The Nerve Impulse

The Resting Neuron

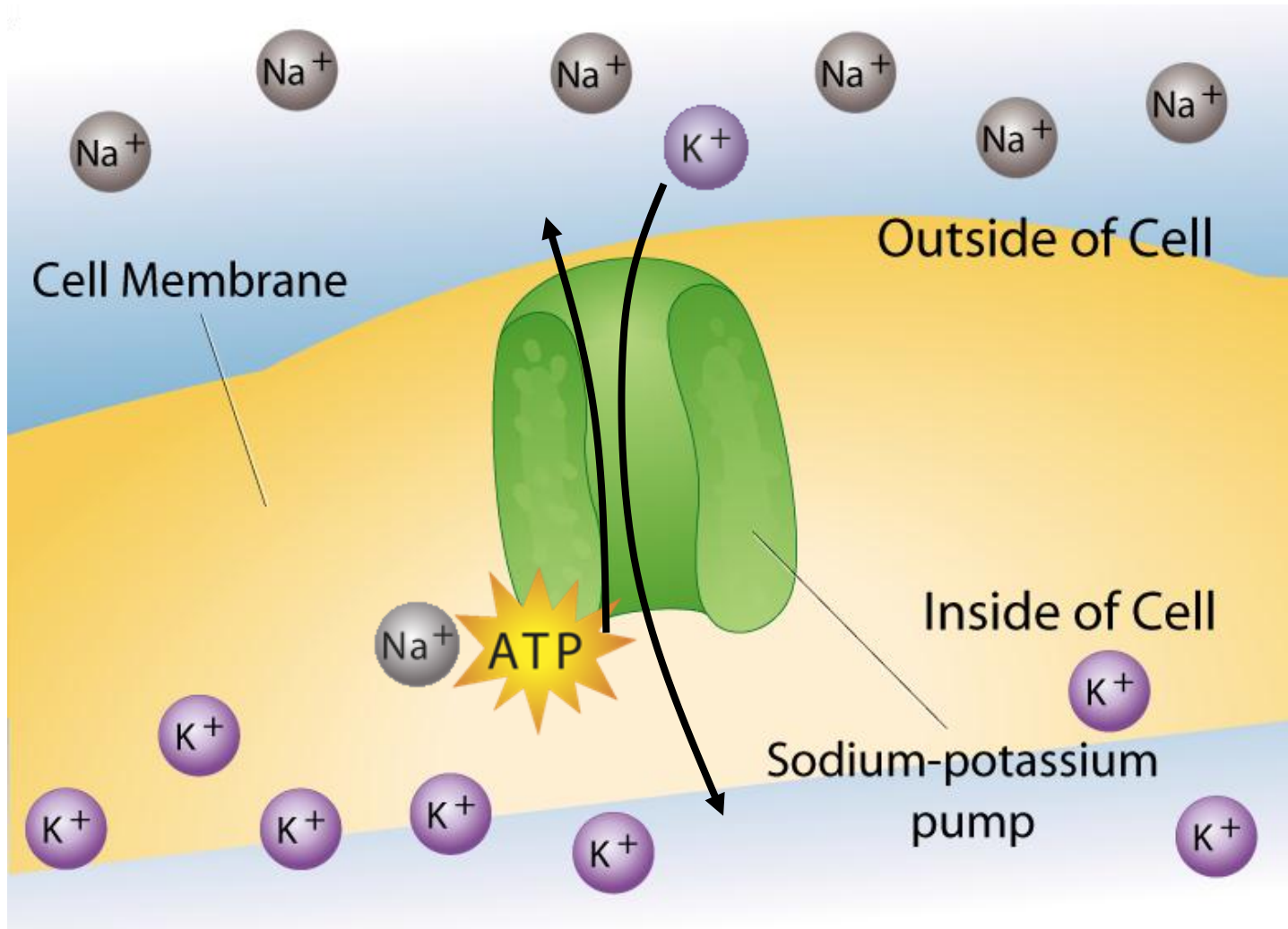
→ the outside of the neuron has a net positive charge.

→ The inside of the neuron has a net negative charge.

→ The sodium-potassium pumps sodium (Na^+) ions out of the cell and potassium (K^+) ions into the cell by means of active transport.

→ this means that the inside of the cell contains more K^+ ions and fewer Na^+ ions than the outside.

Sodium-Potassium Pump



→K⁺ ions leak across the membrane

→produces a negative charge on the inside and a positive charge on the outside.

→known as the **resting potential**.

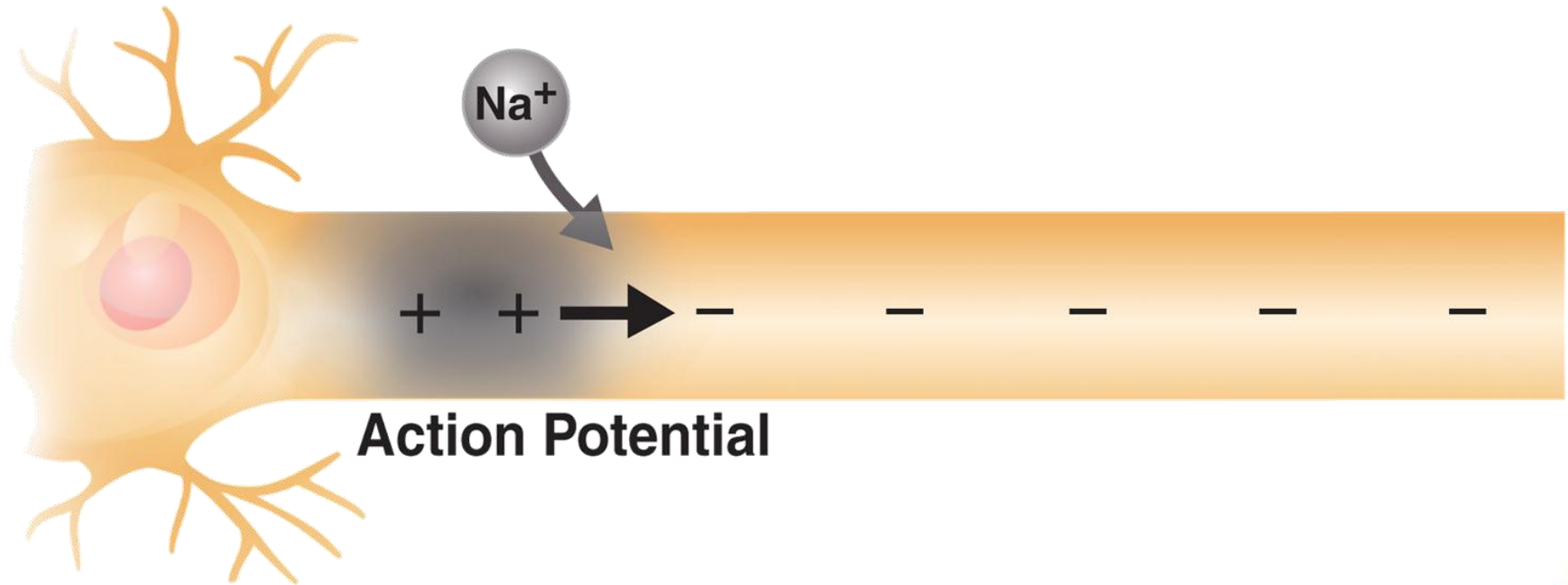


The Moving Impulse

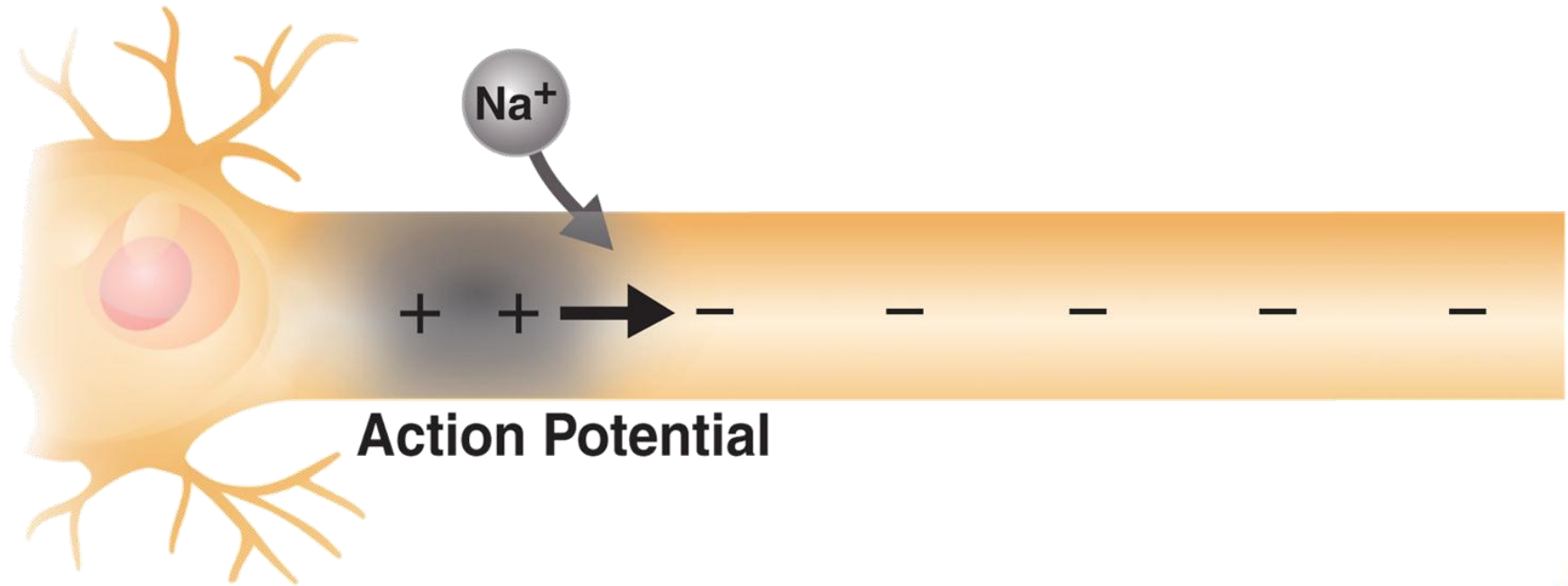


An impulse begins when a neuron is stimulated by another neuron or by the environment.

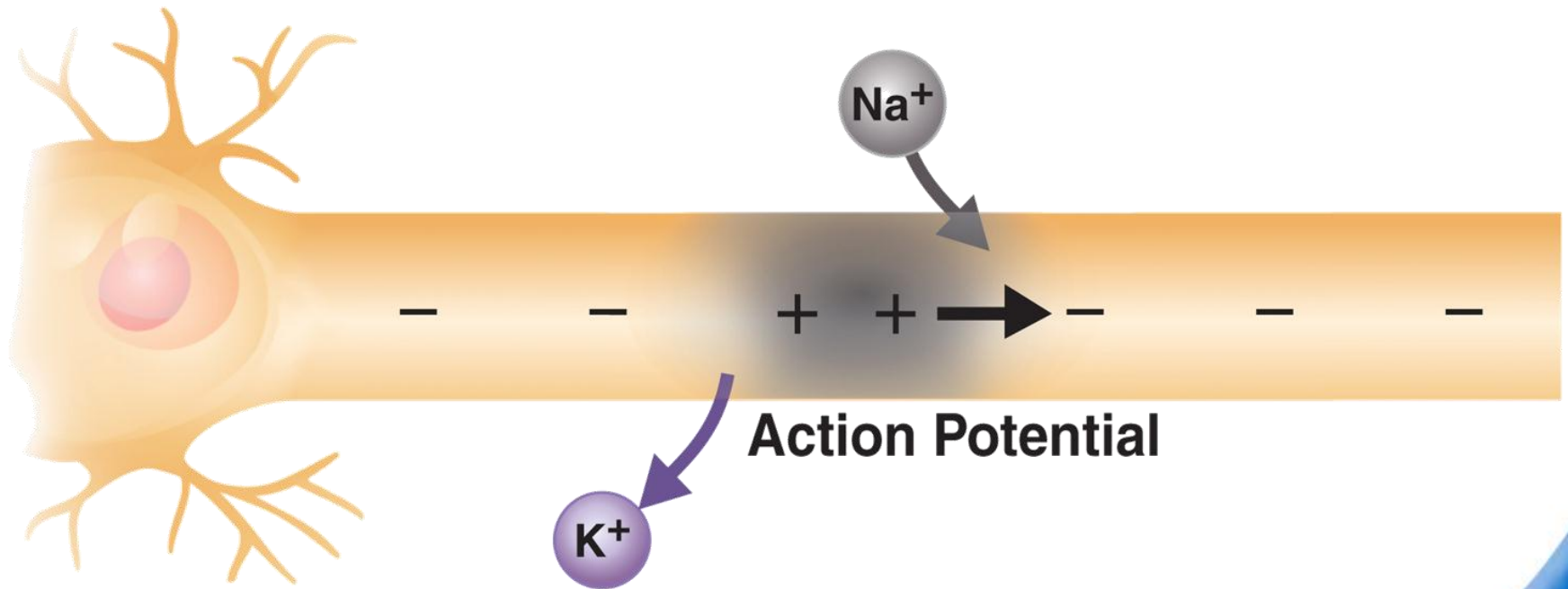
At the leading edge of the impulse, gates in the sodium channels open allowing positively charged Na^+ ions to flow inside the cell membrane.



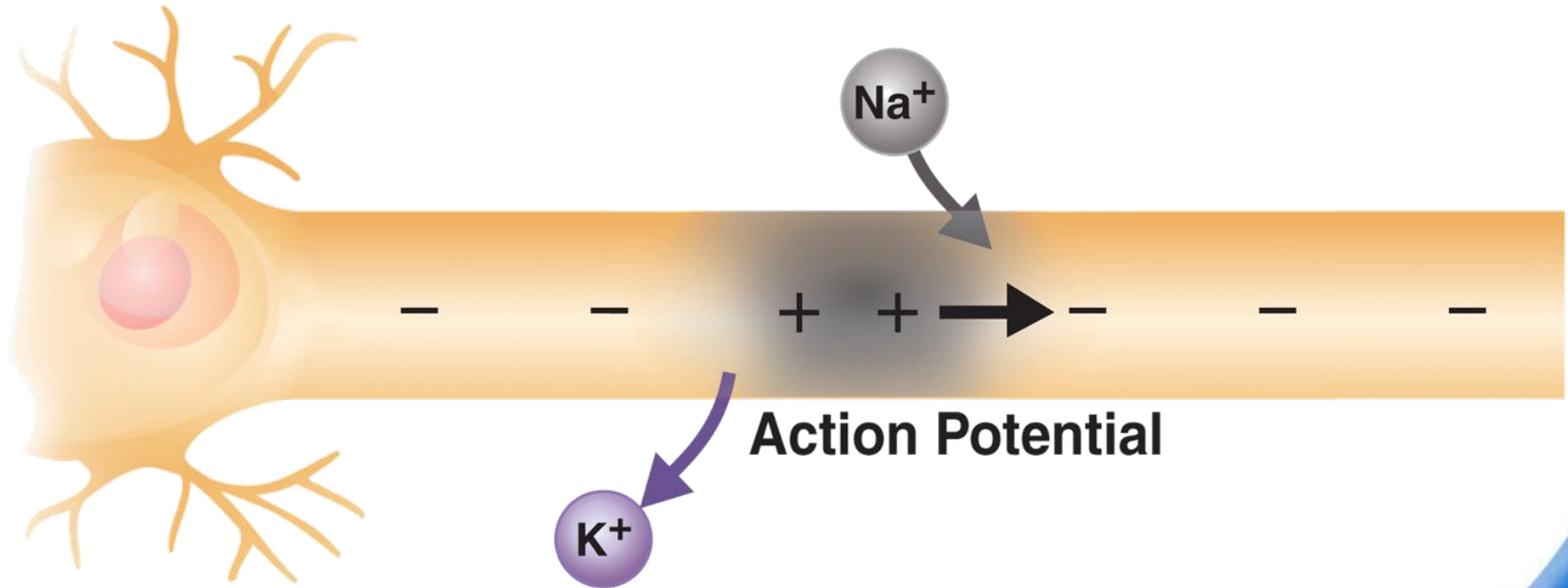
The inside of the membrane temporarily becomes more positive than the outside, reversing the resting potential.



This reversal of charges is called a nerve impulse, or an **action potential**.

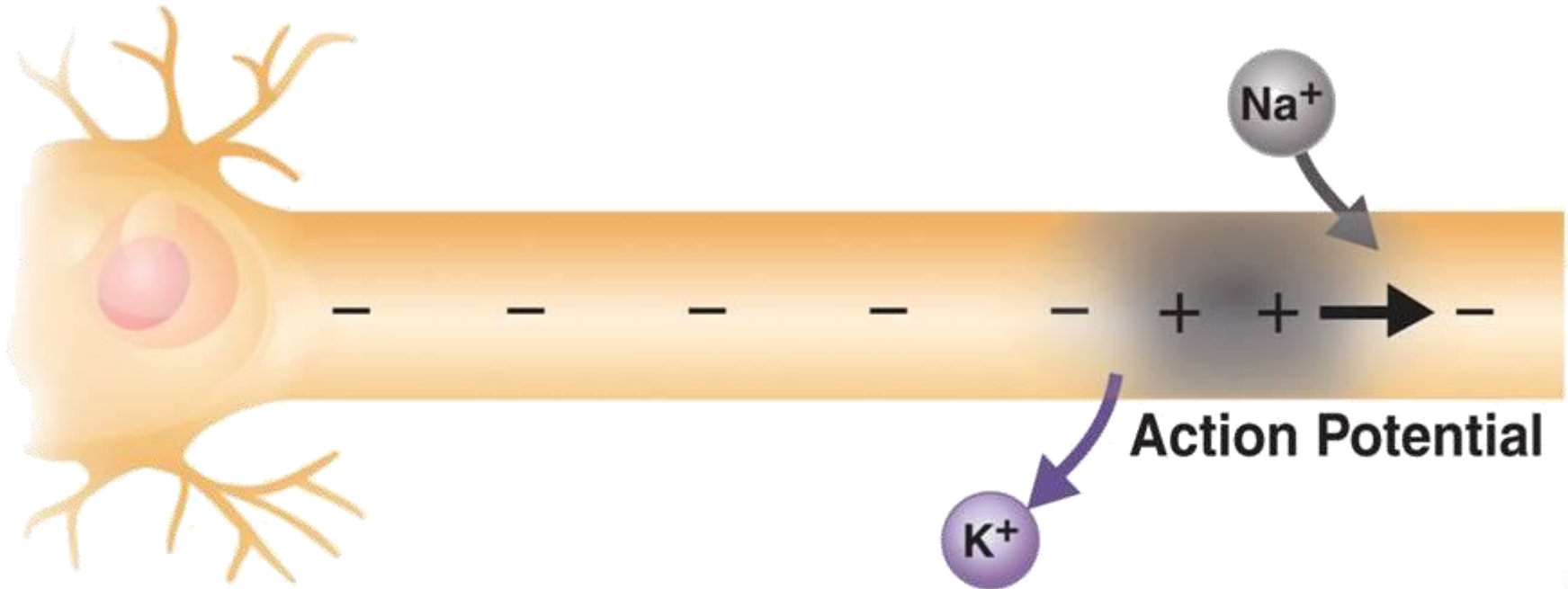


As the action potential passes, gates in the potassium channels open, allowing K^+ ions to flow out restoring the negative potential inside the axon.



The impulse continues to move along the axon.

An impulse at any point of the membrane causes an impulse at the next point along the membrane.



Threshold

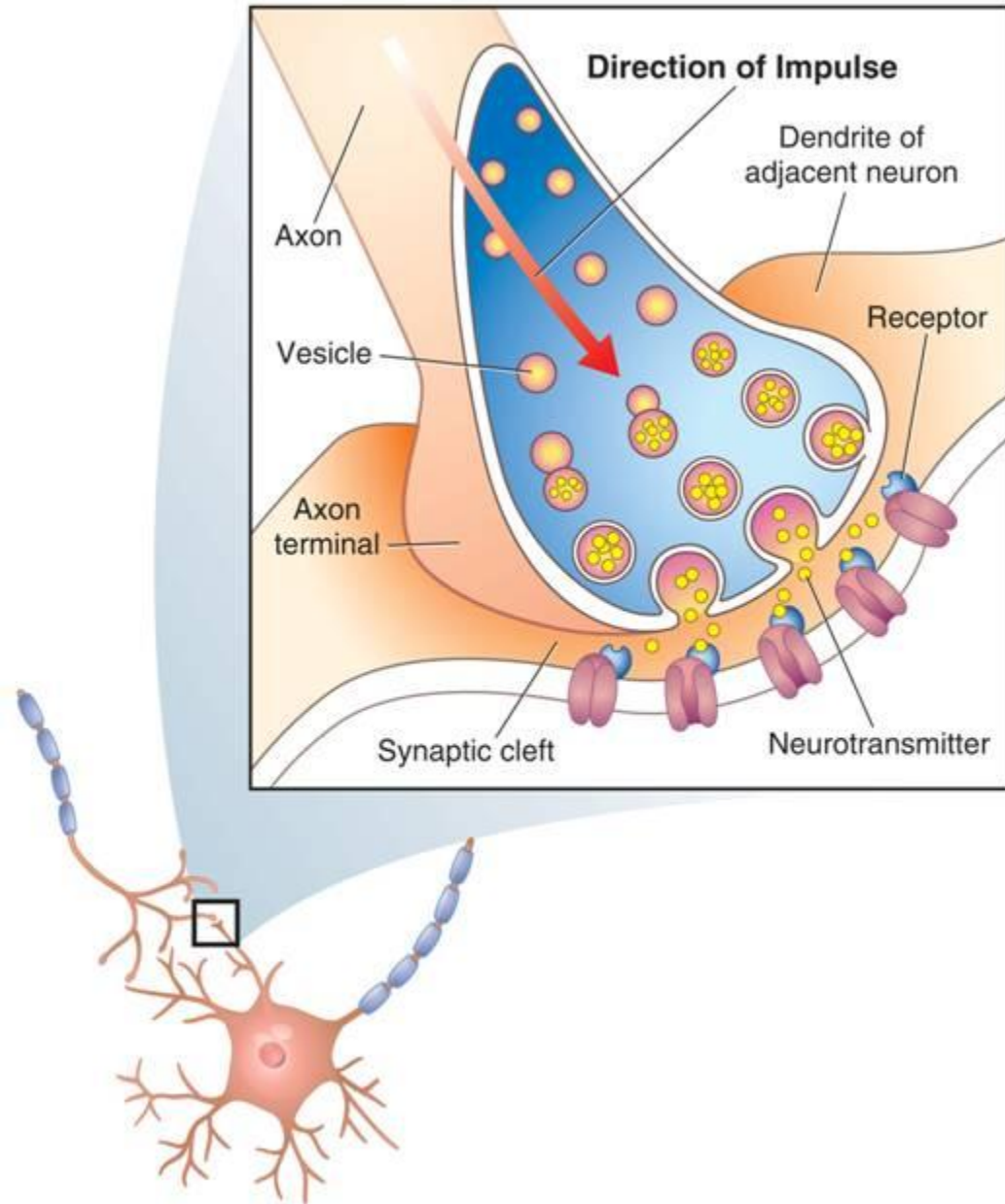
- stimulus must be of adequate strength to cause a neuron to transmit an impulse.
- minimum level required is called the **threshold**.

→ stronger than the threshold produces an impulse.

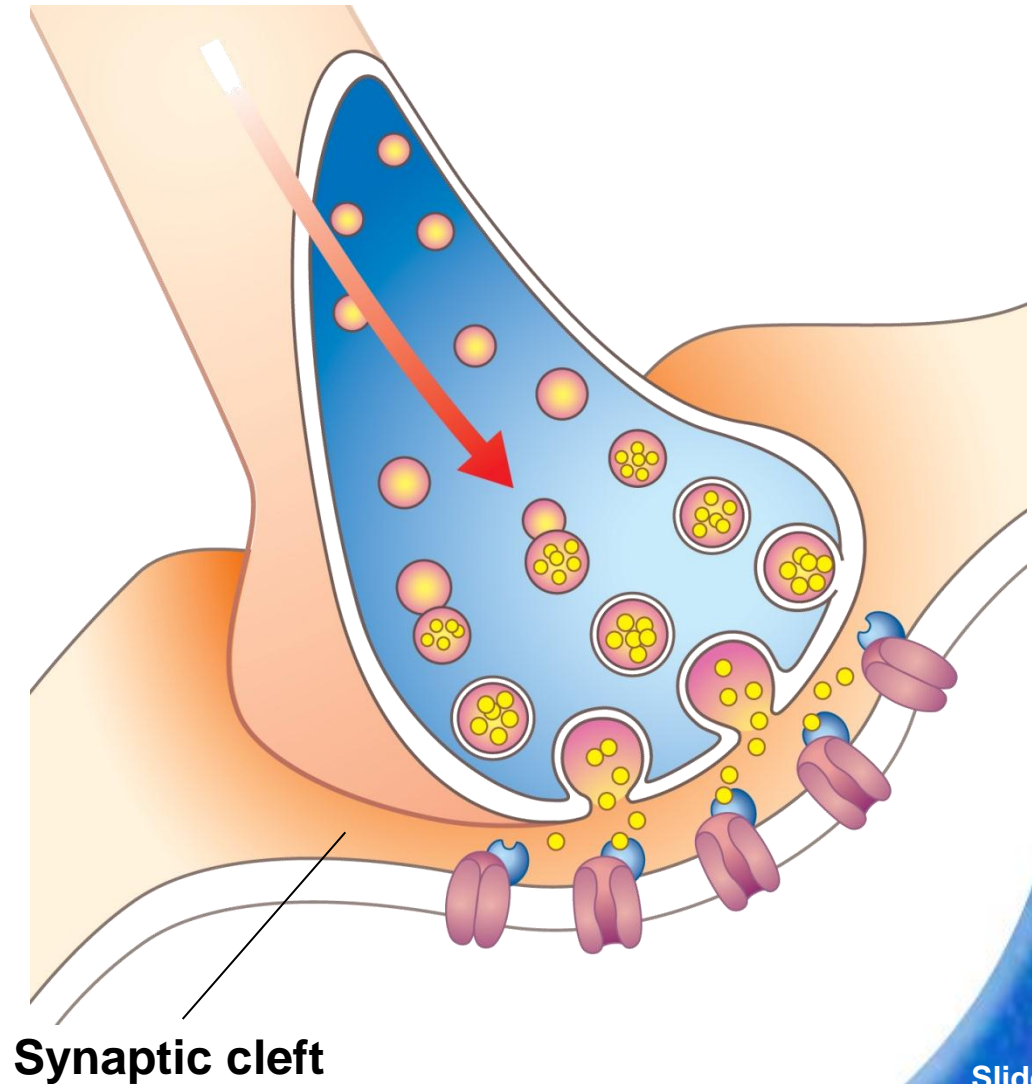
→ weaker than the threshold produces no impulse.

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A Synapse

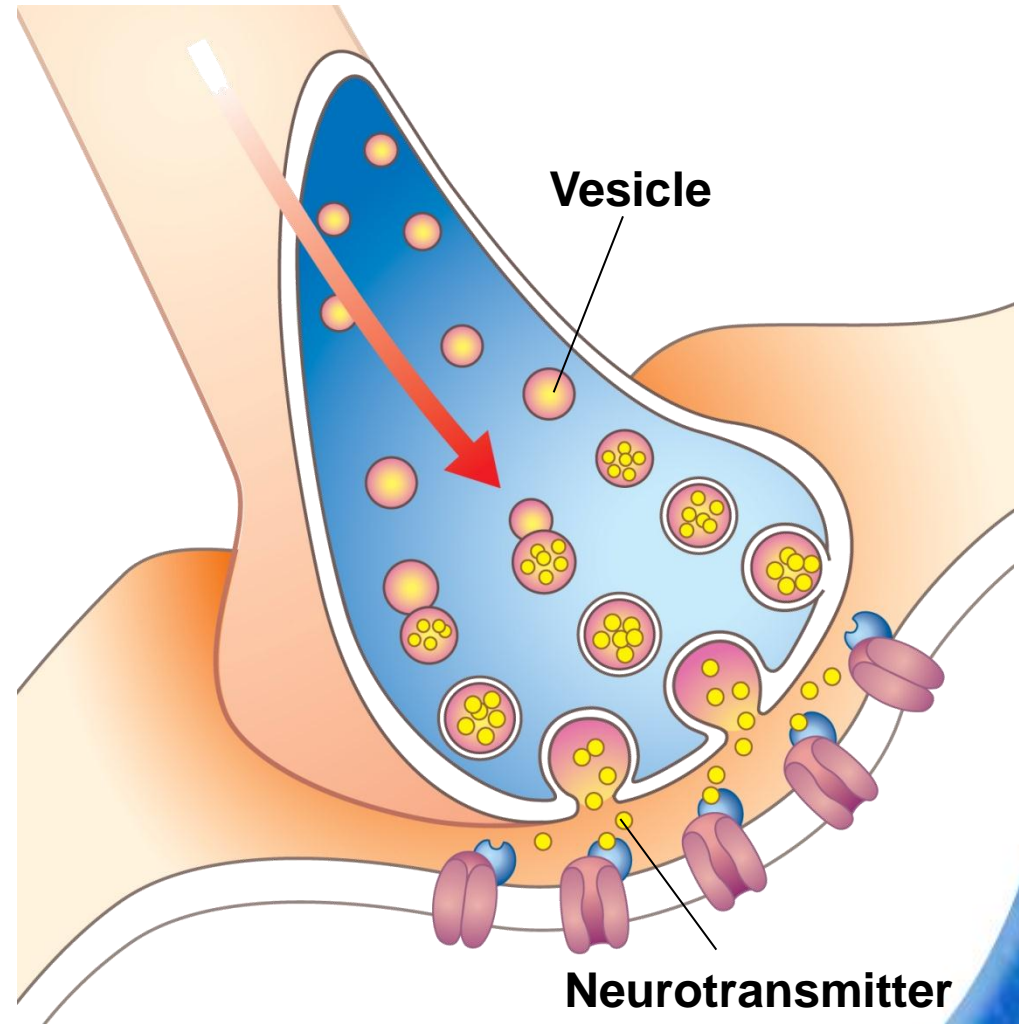


The synaptic cleft separates the axon terminal from the dendrites of the adjacent cell.



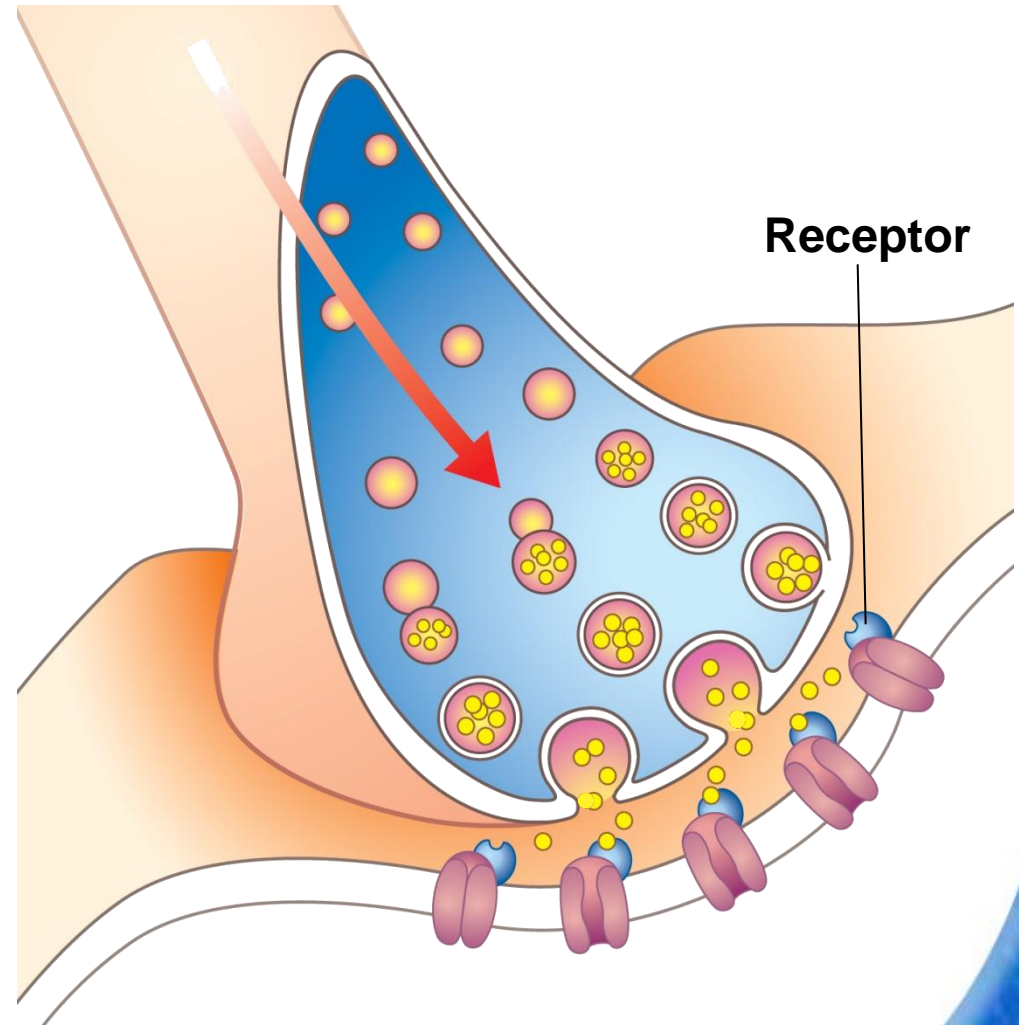
Terminals contain vesicles filled with neurotransmitters.

Neurotransmitters are chemicals used by a neuron to transmit an impulse across a synapse to another cell.



As an impulse reaches a terminal, vesicles send neurotransmitters into the synaptic cleft.

These diffuse across the cleft and attach to membrane receptors on the next cell.



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35-2 Section QUIZ

1

Neurons that carry impulses from the brain and spinal cord to the muscles are

- a. interneurons.
- b. sensory neurons.
- c. resting neurons.

A

d. motor neurons.

35-2 Section QUIZ

2 The part of the neuron that carries impulses toward the cell body is the

- a. axon.
- b. myelin sheath.

A c. dendrite.

d. nodes.

35-2 Section QUIZ

3 The minimum level of a stimulus that is required to activate a neuron is called its

- a. action potential.
- b. resting potential.

A c. threshold.

d. synapse.

35-2 Section QUIZ

4 Chemicals that are used by a neuron to transmit impulses are called

A a. neurotransmitters.

b. synapses.

c. axons.

d. inhibitors.

35-2 Section QUIZ

5 An action potential begins when

- A**
- a. sodium ions flow into the neuron.
 - b. potassium ions flow into the neuron.
 - c. sodium and potassium ions flow into the neuron.
 - d. sodium and potassium ions flow out of the neuron.

35-3 Divisions of the Nervous System



35-3 Divisions of the Nervous System

The human nervous system has two major divisions:

- central nervous system
- peripheral nervous system



The central nervous system relays messages, processes information, and analyzes information.

The central nervous system consists of the brain and the spinal cord.

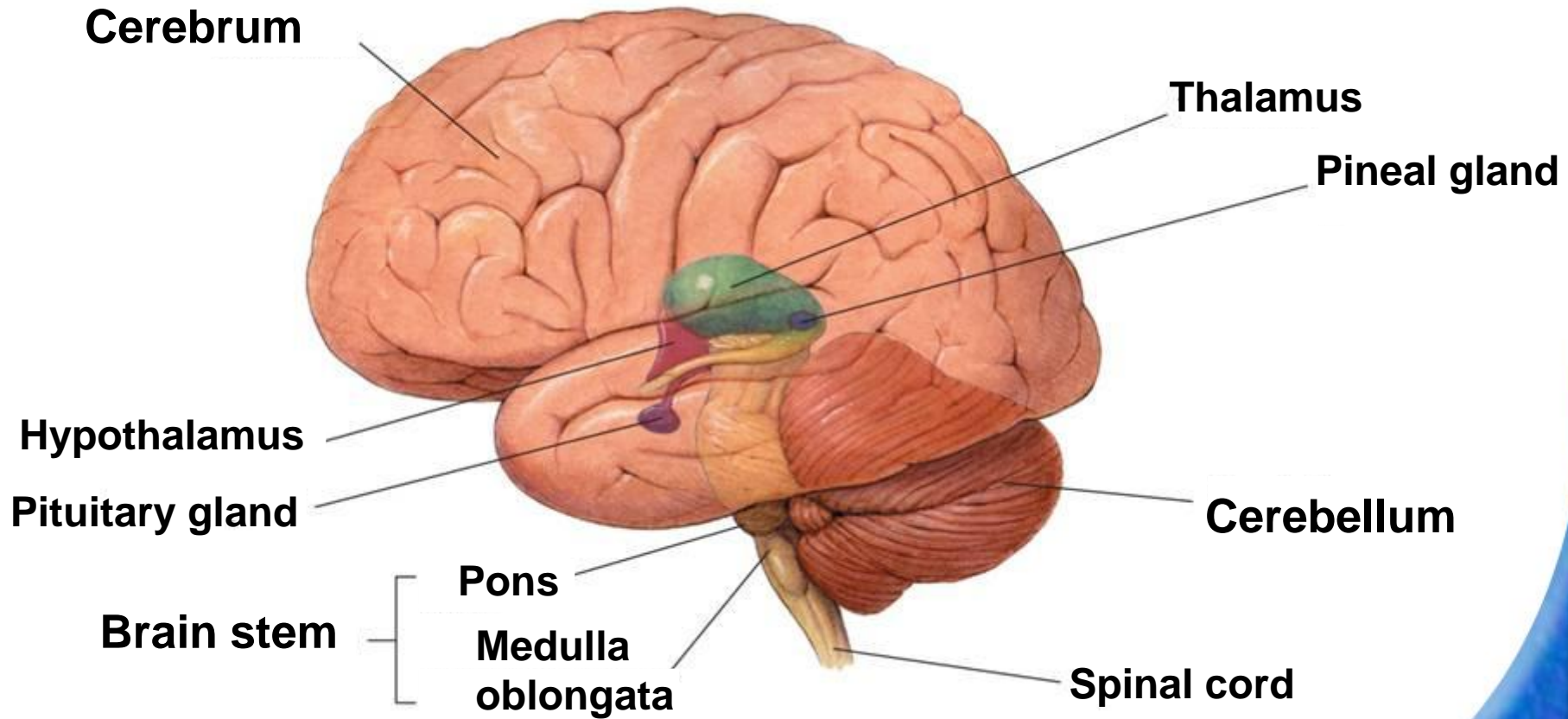
Both the brain and spinal cord are wrapped in three layers of connective tissue known as **meninges**.

Between the meninges and the central nervous system tissue is a space filled with cerebrospinal fluid.

Cerebrospinal fluid acts as a shock absorber that protects the central nervous system.

Cerebrospinal fluid also permits exchange of nutrients and waste products between blood and nervous tissue.

Parts of The Human Brain



The Cerebrum

The largest and most prominent region of the human brain is the **cerebrum**.

It controls the voluntary, or conscious, activities of the body.

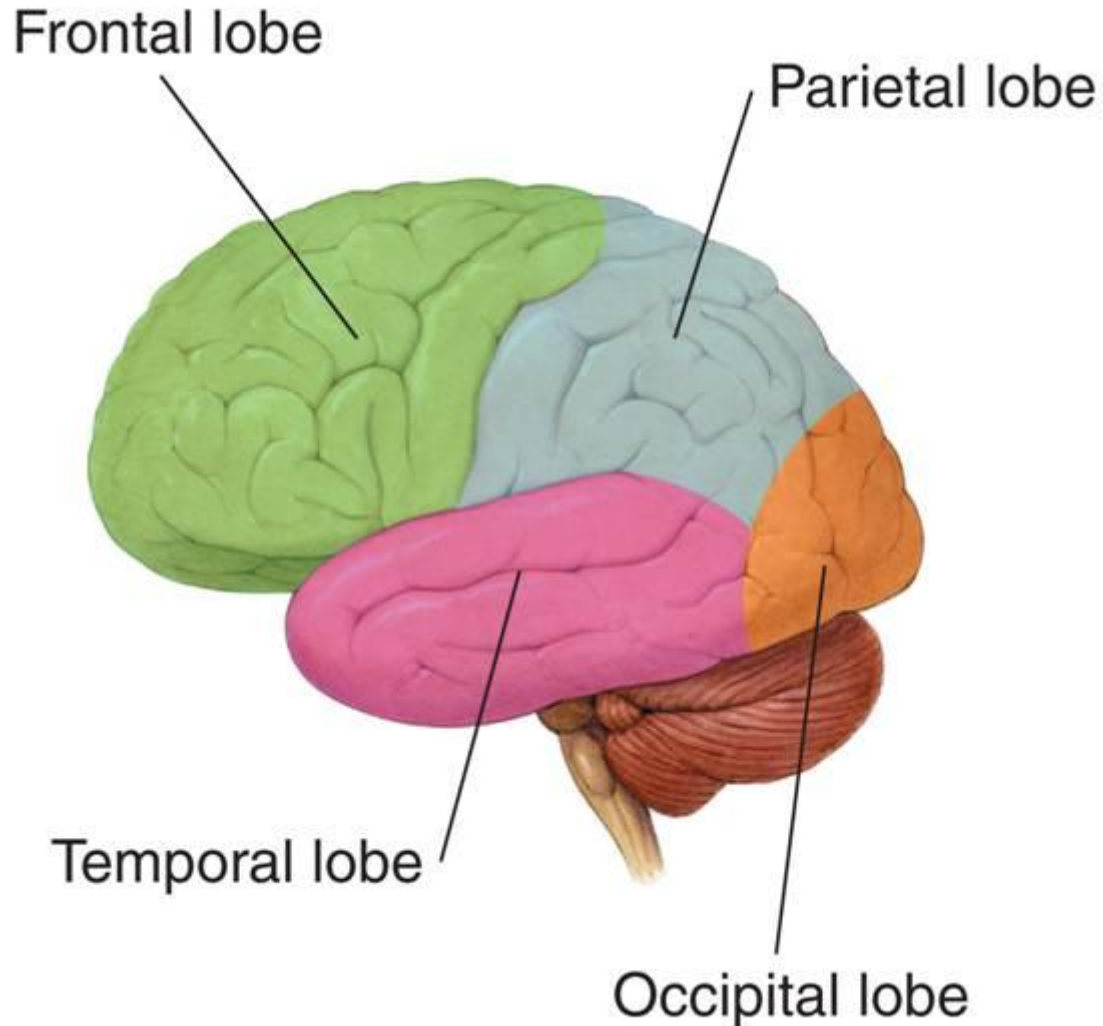
It is the site of intelligence, learning, and judgment.

35-3 Divisions of the Nervous System → The Brain

A deep groove divides the cerebrum into hemispheres, which are connected by a band of tissue called the corpus callosum.

Each hemisphere is divided into regions called lobes.

Lobes of the Cerebrum



35-3 Divisions of the Nervous System → The Brain

The outer layer of the cerebrum is called the cerebral cortex and consists of gray matter.

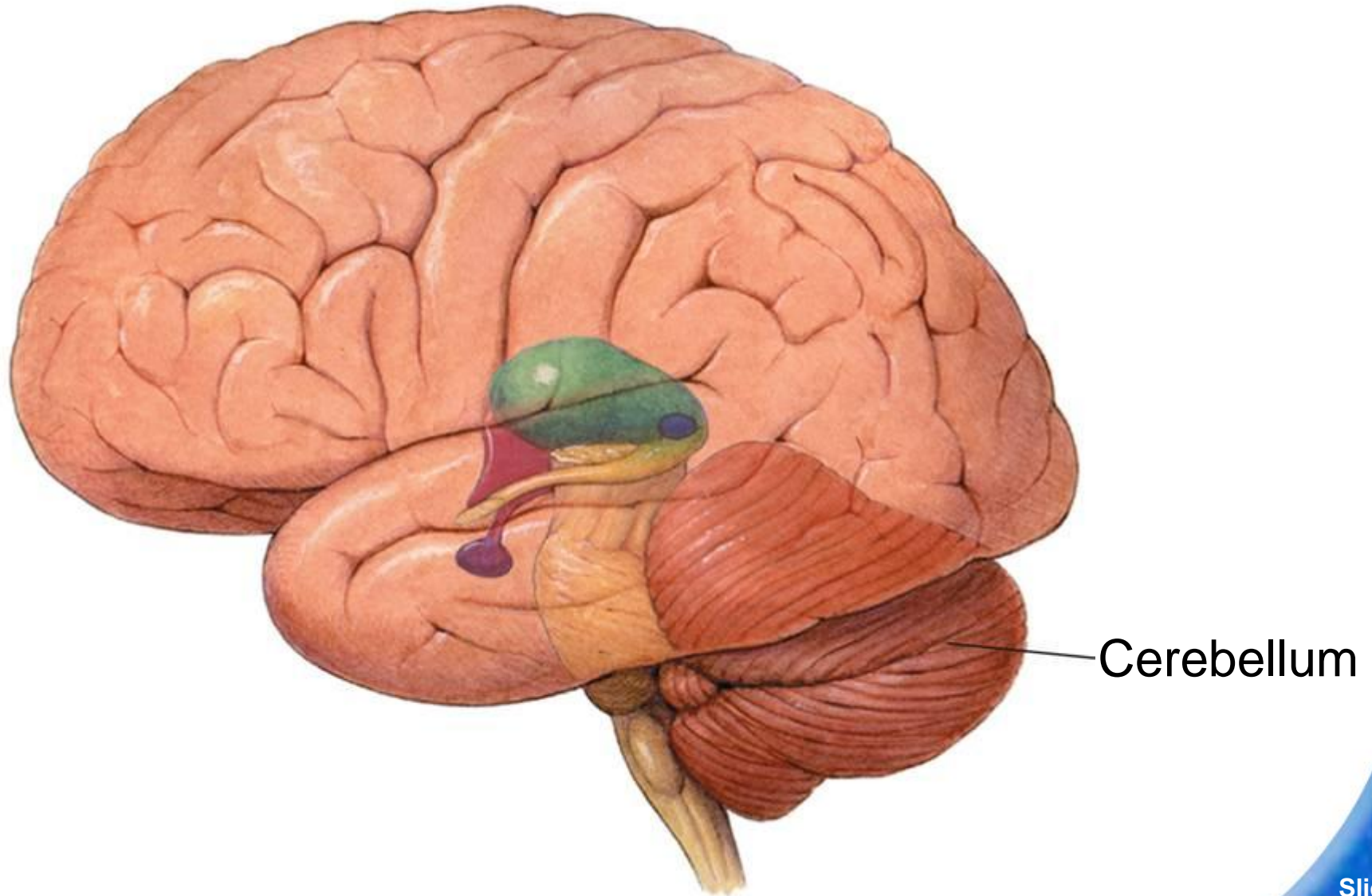
The inner layer of the cerebrum consists of white matter, which is made up of bundles of axons with myelin sheaths.

The Cerebellum

The second largest region of the brain is the **cerebellum**.

It coordinates and balances the actions of the muscles so that the body can move gracefully and efficiently.

35-3 Divisions of the Nervous System → The Brain System



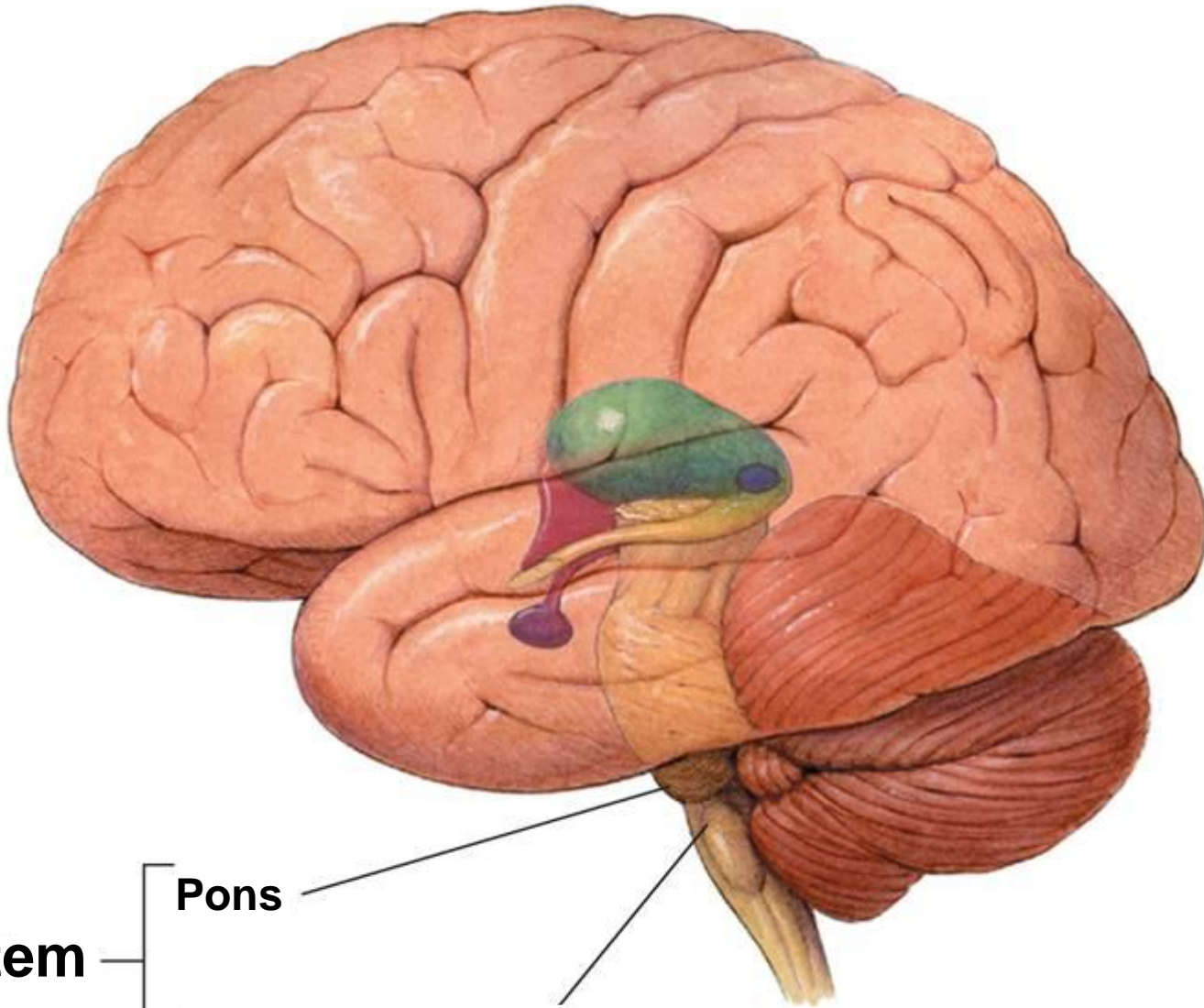
The Brain Stem

The **brain stem** connects the brain and spinal cord.

It has two regions: the pons and the medulla oblongata. Each region regulates information flow between the brain and the rest of the body.

Blood pressure, heart rate, breathing, and swallowing are controlled in the brain stem.

35-3 Divisions of the Nervous System → The Brain System



Brain stem

Pons

Medulla oblongata

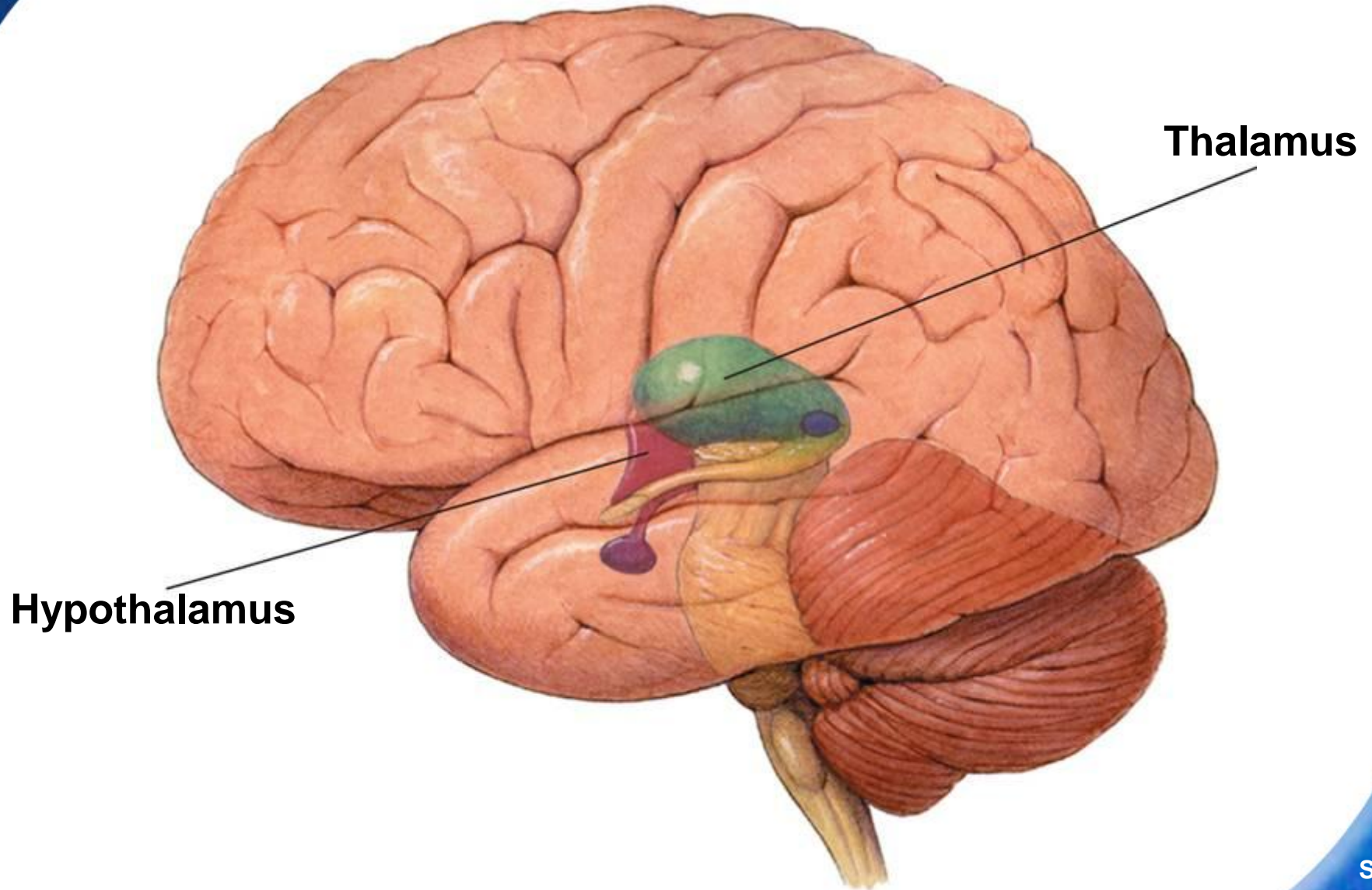
The Thalamus and Hypothalamus

The **thalamus** receives messages from all sensory receptors throughout the body and relays the information to the proper region of the cerebrum for further processing.

The **hypothalamus** controls recognition and analysis of hunger, thirst, fatigue, anger, and body temperature.

It controls coordination of the nervous and endocrine systems.

35-3 Divisions of the Nervous System → The Brain System



The Spinal Cord

The spinal cord is the main communications link between the brain and the rest of the body.

Certain information, including some kinds of reflexes, are processed directly in the spinal cord.

A **reflex** is a quick, automatic response to a stimulus.

The Peripheral Nervous System

The peripheral nervous system is all of the nerves and associated cells that are not part of the brain and the spinal cord.

The peripheral nervous system includes cranial nerves, spinal nerves, and ganglia.

Ganglia are collections of nerve cell bodies.



The sensory division of the peripheral nervous system transmits impulses from sense organs to the central nervous system.

The motor division transmits impulses from the central nervous system to the muscles or glands.

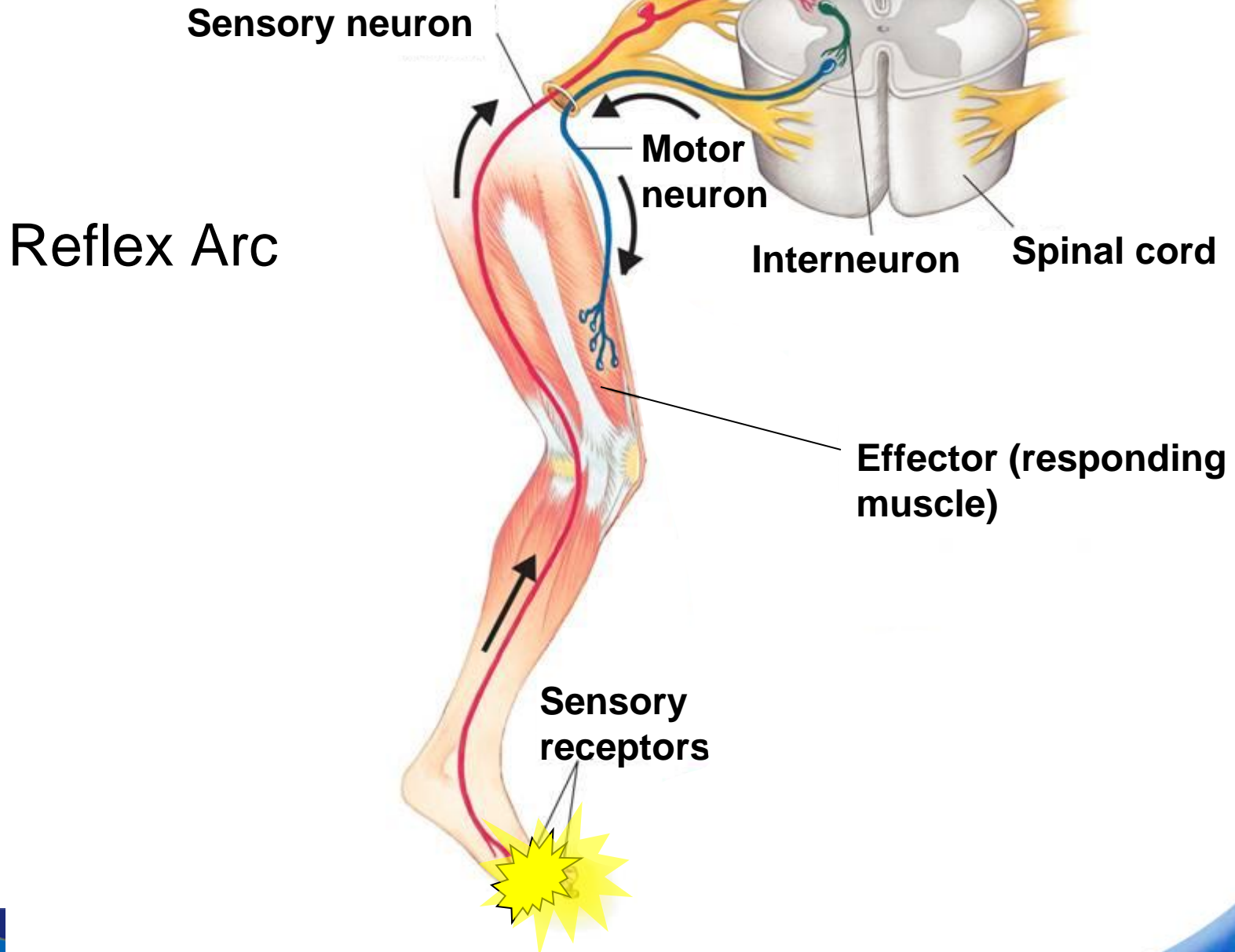
The Somatic Nervous System

The somatic nervous system regulates activities that are under conscious control, such as the movement of skeletal muscles.

Some somatic nerves are involved with reflexes.

A **reflex arc** includes a sensory receptor, sensory neuron, motor neuron, and effector that are involved in a quick response to a stimulus.

35-3 Divisions of the Nervous System → The Peripheral Nervous System



The Autonomic Nervous System

The autonomic nervous system regulates involuntary activities.

The autonomic nervous system is subdivided into two parts:

- sympathetic nervous system
- parasympathetic nervous system

The sympathetic and parasympathetic nervous systems have opposite effects on the same organ system.

These opposing effects help maintain homeostasis.

35-3 Section QUIZ

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35-3 Section QUIZ

- 1 The brain stem functions as
- a. a location for memory and learning.
 - A b. the control site responsible for heart rate, blood pressure, and breathing.
 - c. the location where all sensory information is processed and delivered to the cerebrum.
 - d. an area that recognizes hunger, thirst, and body temperature.

35-3 Section QUIZ

- 2** The left half of the cerebrum largely controls
- a. the left side of the body.
 - b. both the right and left sides of the body.
 - A** c. the right side of the body.
 - d. the right half of the brain.

35-3 Section QUIZ

3 The part of the brain that is responsible for coordination and balance is the

A a. cerebellum.

b. cerebrum.

c. brain stem.

d. thalamus.

35-3 Section QUIZ

4 Reflex arcs are actions that are a part of the peripheral nervous system's

a. sensory division.

A b. somatic system.

c. autonomic system.

d. motor division.

35-3 Section QUIZ

5 Which of the following is NOT under the control of the autonomic nervous system?

- a. heartbeat
- b. digestion

A c. walking

d. sweating

END OF SECTION