

FIGURE 11-1 The nervous system can be divided into the CNS and the PNS.

The Nervous system

Human Anatomy

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Objectives of this lecture

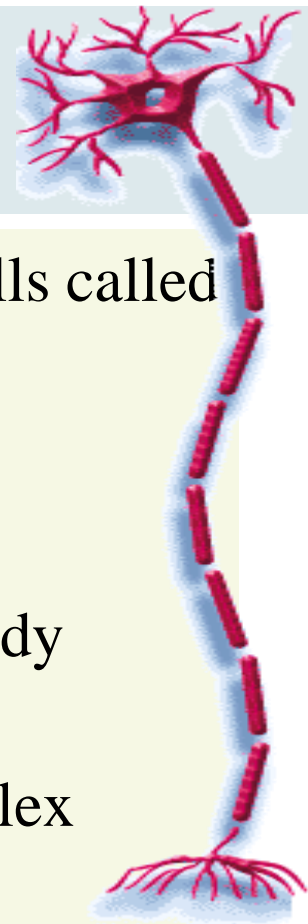
You should be able to describe the following;

- ❖ Functions of the nervous system
- ❖ Anatomical structure of the neuron
- ❖ The parts of a neuron
- ❖ The three most basic functional categories of neurons
- ❖ Subdivisions of nervous system
- ❖ Types of neurons
- ❖ Shapes of neurons

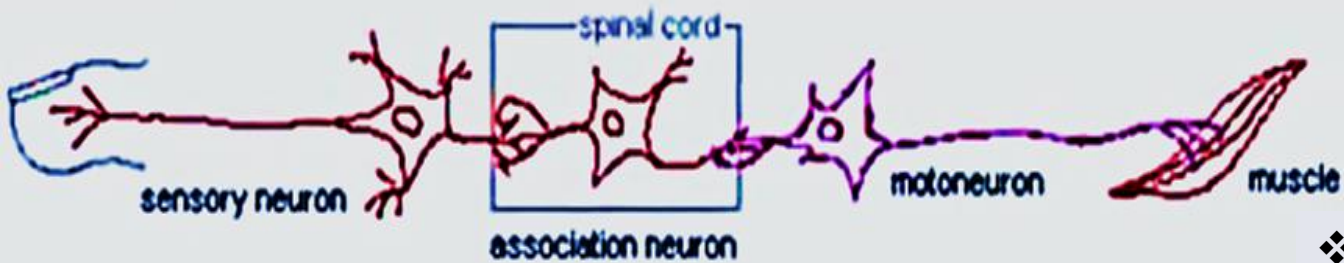


Introduction

- ❖ We respond to the environment through specialized cells called nerve cells (neurons).
- ❖ The functional unit of the NS is Neuron or nerve cell.
- ❖ Nerve cells hook together to form the nervous system.
- ❖ With a mass of only 2 kg (4.5 lb), about 3% of total body weight,
- ❖ Nervous systems is one of the smallest and most complex systems
- ❖ This complex network of billions neurons is organized into two main subdivisions
- ❖ Neurology deals with normal functioning and disorders of the nervous system



- ▶ What are the internal & external conditions that we respond to?
- ▶ How the body knows what is happening?



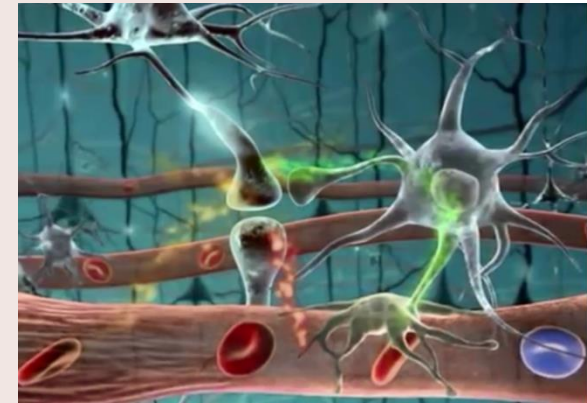
Neuron Properties

- ❖ **Excitability** respond to Stimuli
- ❖ **Conductivity** transfer signals
- ❖ **Secretion**; secretes a neurotransmitter to stimulates the next cell.



Nervous System Functions

- ▶ Recognizes and response to internal and external environments changes.
- ▶ Receives stimuli from receptors & transmits information to effectors that respond to stimulation
- ▶ Mixing incoming sensory information with stored information & translating that into action.
- ▶ Storing information
- ▶ Coordinating of body function (walking, digestion, etc)



Receptor; a cell or group of cells that receives stimuli ex; sense organs

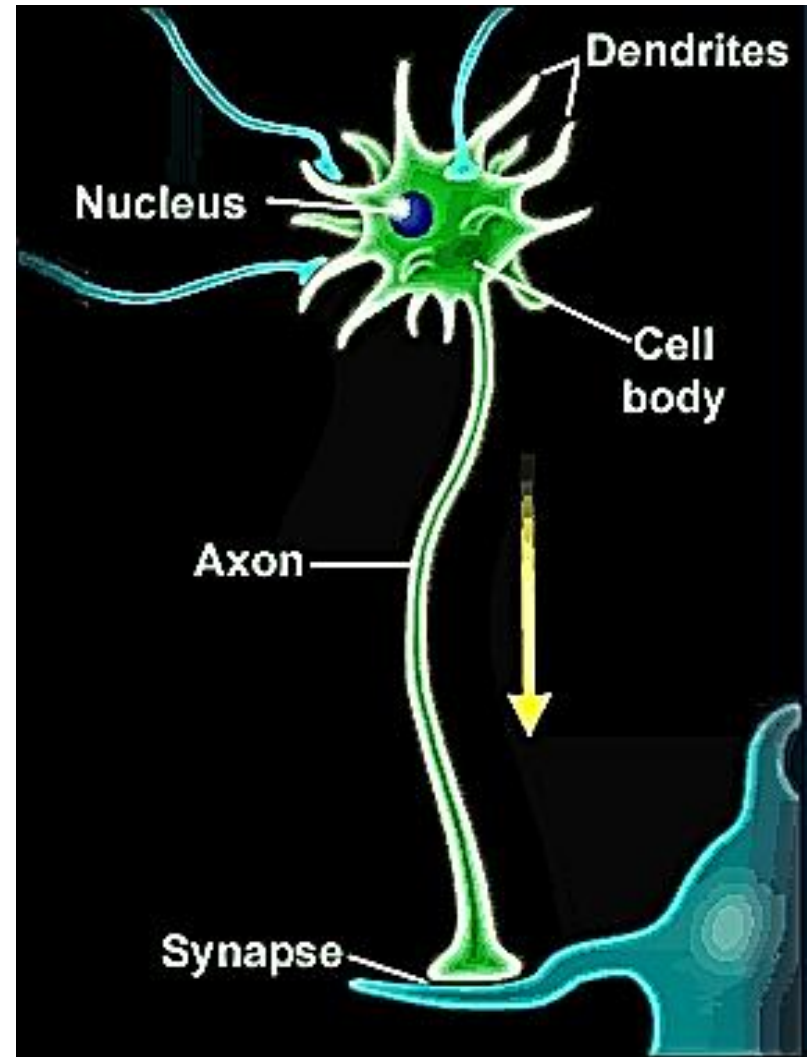
**Effectors; bodily tissue, structure, or organ (ex; gland or muscle) that response to stimulation
nerve cells (neurons)**



Anatomy of a Neuron(Nerve cell)

Each neuron consist of:

- Cell body with nucleus
 - Axons : send messages (electrical impulses) to other neurons
 - Dendrites : receive messages from other neurons
- ✓ Messages are sent across the axon to other neurons by the synapses with the help of special chemicals called neurotransmitters

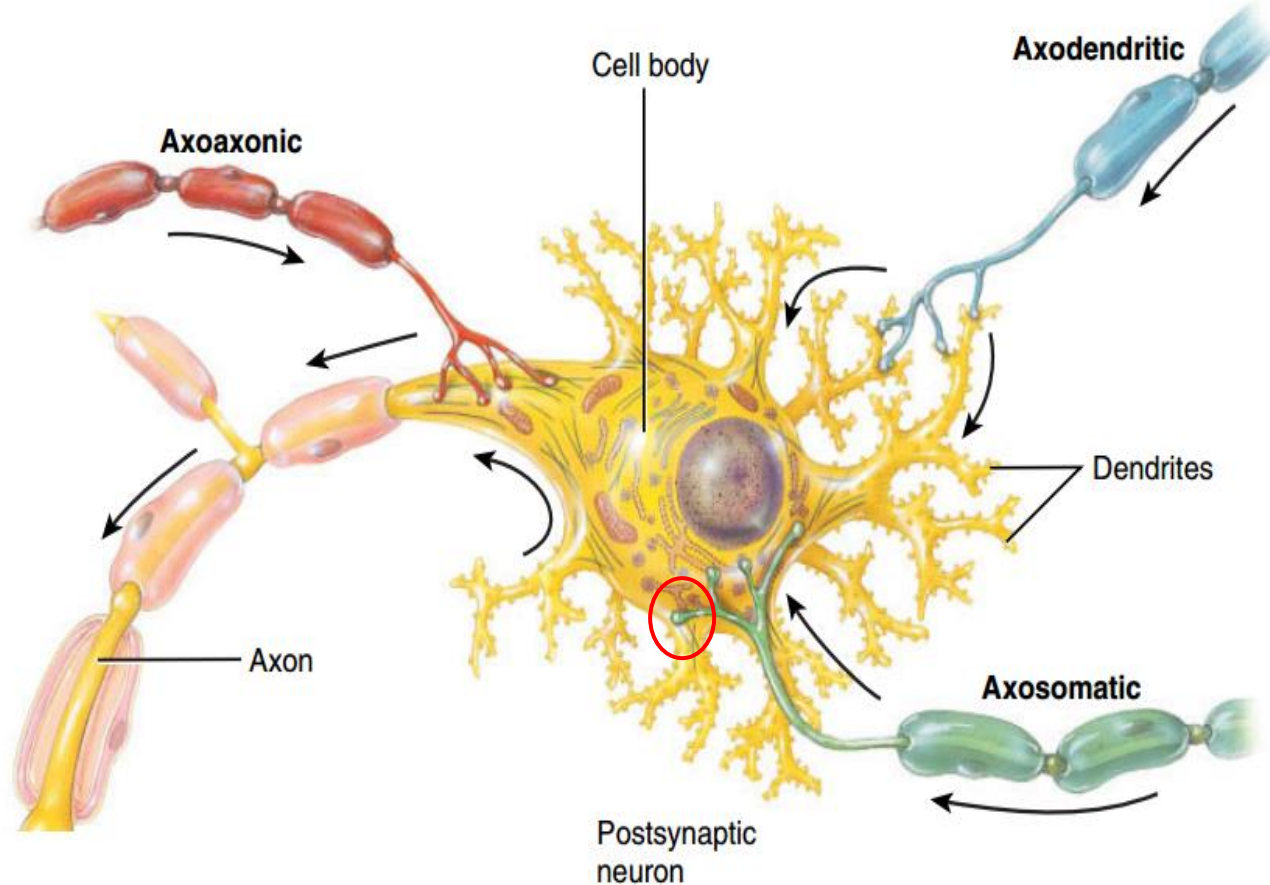


Nervous tissue consists of a mass of **neurons** (nerve cells) and is highly cellular.

Neurons are the structural and functional units of the nervous system,

Neurons have electrical excitability, the ability to respond to a stimulus and convert it into an action potential (AP)

AP is an electrical signal that propagates (travels) along the surface of the membrane of a neuron.



Q What is a synapse?

Neurons communicate with other neurons at synapses, which are junctions between one neuron and a second neuron or an effector cell.

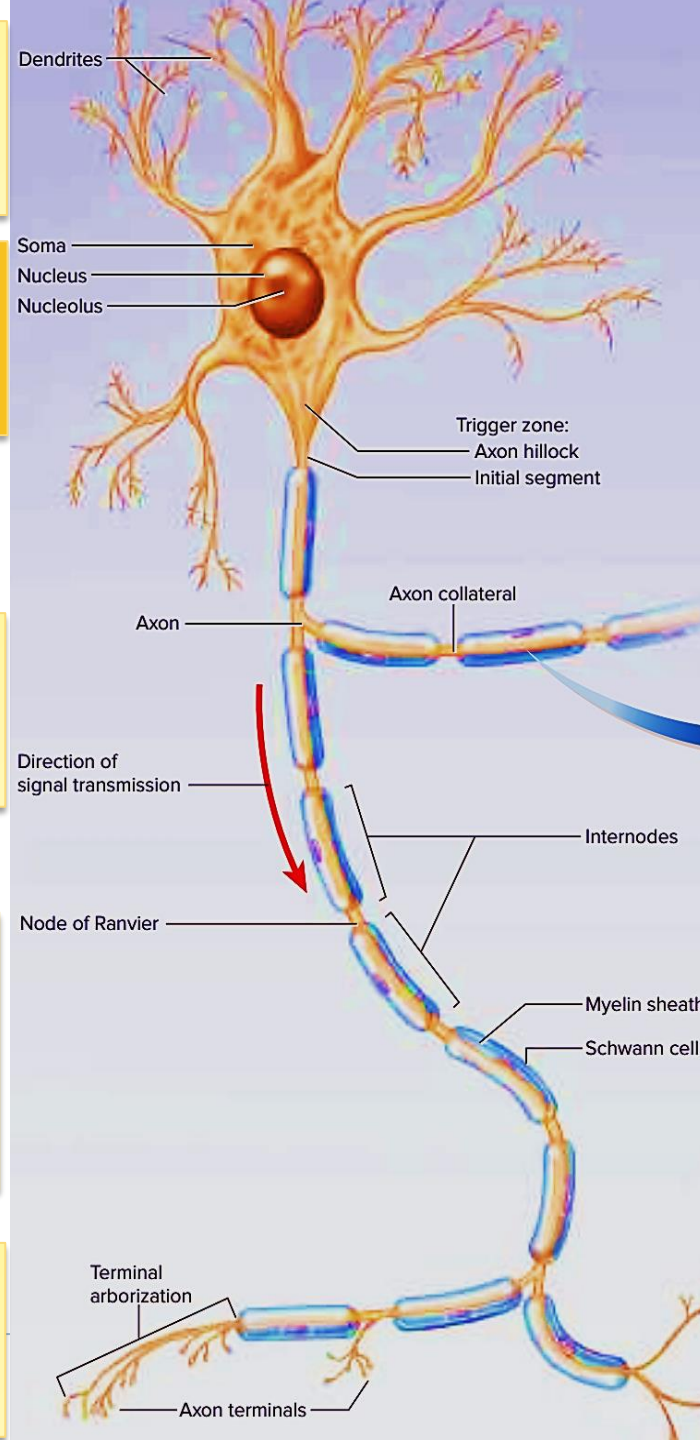
Dendrites are the primary site for receiving signals from other neurons.

Soma is the cell body. It has a central nucleus with a large nucleolus

Axon is cylindrical and specialized for rapid conduction of nerve signals

Node of Ranvier gap in the myelin sheath on certain axon of neurons, serves to facilitate the rapid conduction of nerve impulses

Axon terminal forms a junction (synapse) with the next cell.



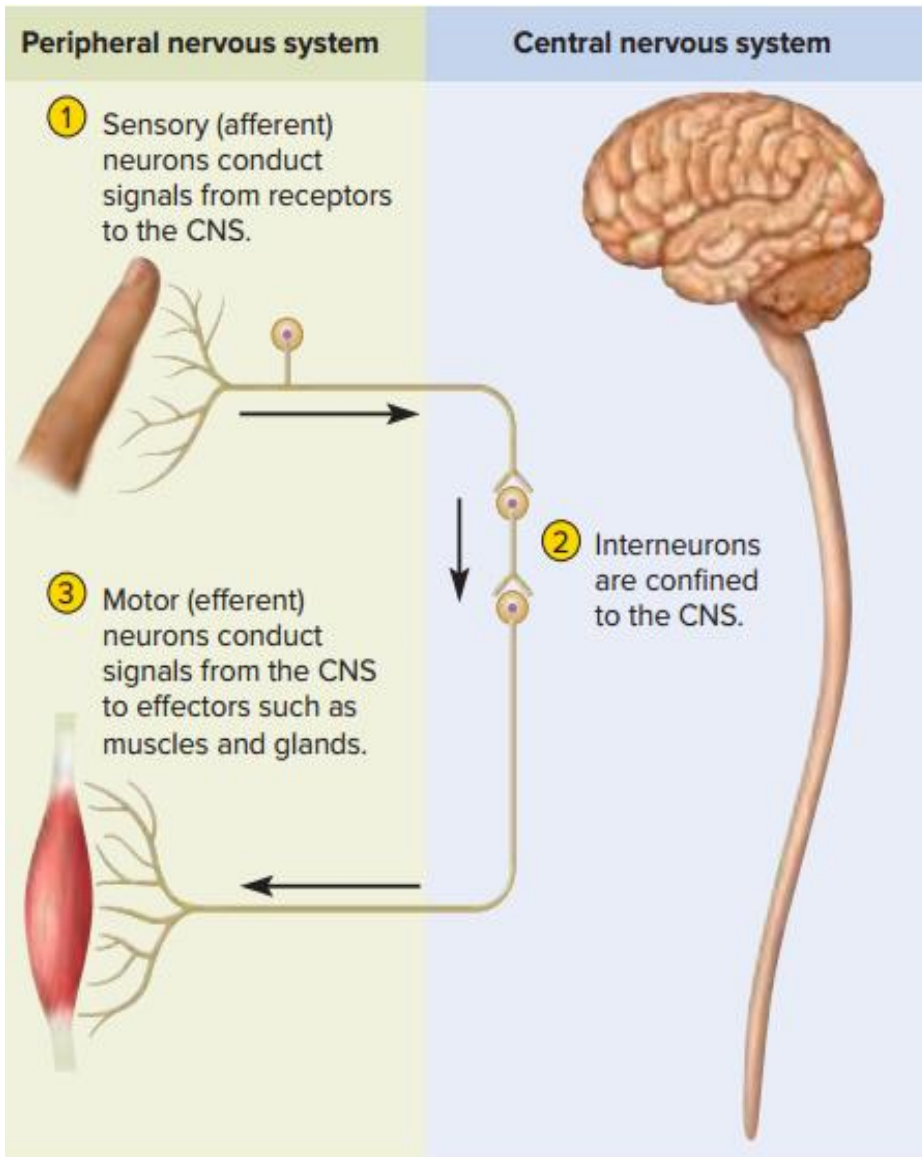
Anatomical Structure of a neuron

Internode portion of a nerve fiber between two Nodes of Ranvier.

Myelin sheath; protein-lipoid surrounds axons to insulate them and increase transmission of electrical impulses

Schwann cells encircle most axons; In myelinated axons, it form the myelin sheath; aid in regeneration of damaged nerve fibers

Functional classification of Neurons

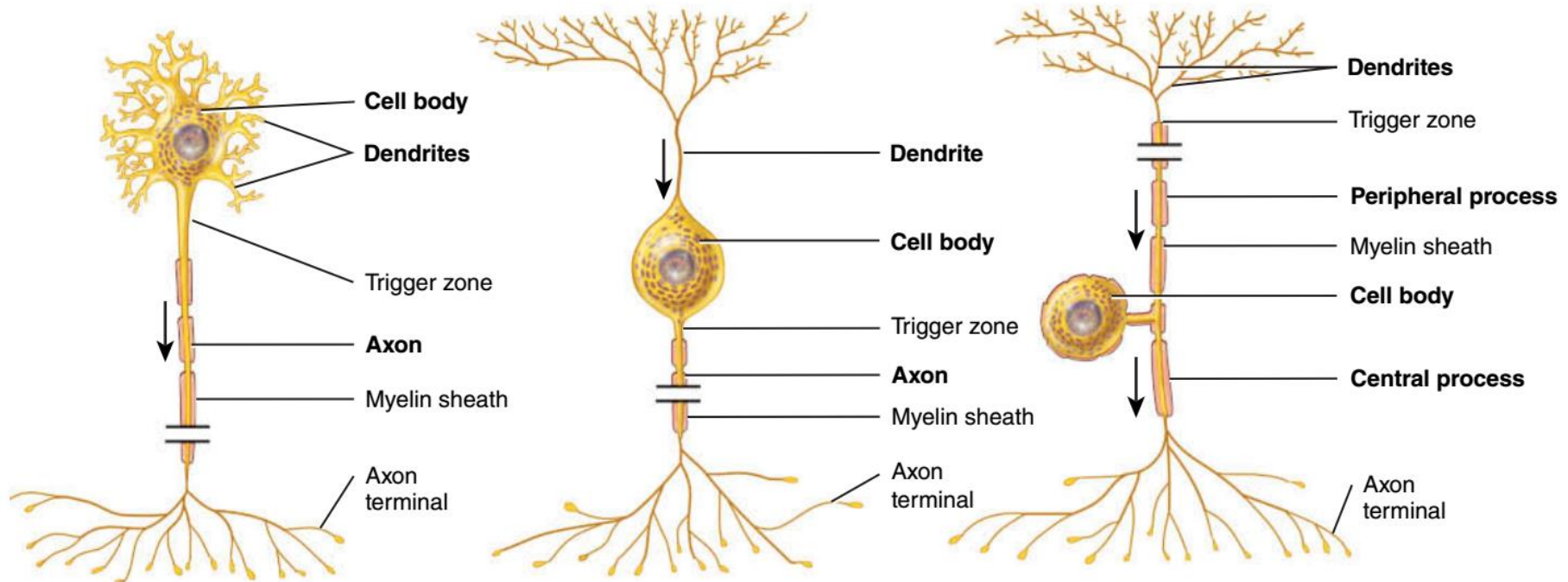


There are 3 types of Neuron based on their function

- ▶ **Afferent** (sensory neuron) conduct impulse to the CNS
- ▶ **Efferent** (Motor neuron) conduct impulse from CNS to muscles, organ, gland.
- ▶ **Association** (interneuron) occur between sensory and motor neuron.

Structural classification (Neuron Shapes)

- ▶ There are 3 types based on shapes or structures
 - ▶ Multipolar neuron; has many processes extending from the cell body
 - ▶ Bipolar neuron has two processes
 - ▶ Unipolar neuron has one

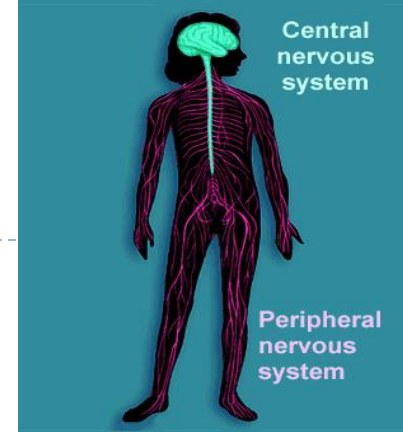


(a) Multipolar neuron

(b) Bipolar neuron

(c) Unipolar neuron

Divisions of the Nervous System



- ▶ **Central Nervous System(CNS)**; includes the brain & spinal cord
- ▶ **Peripheral Nervous System(PNS)**; includes cranial nerves, spinal nerves & all its branches.

- ▶ **PNS** divided to

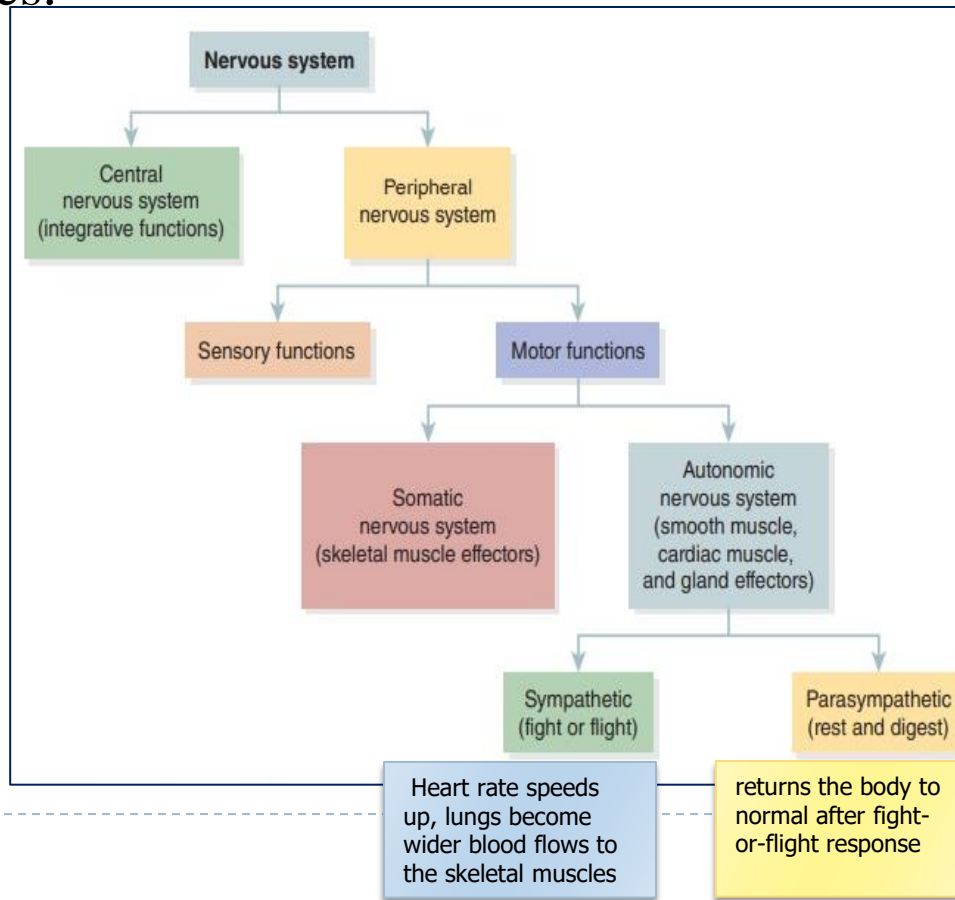
1. Sensory function includes

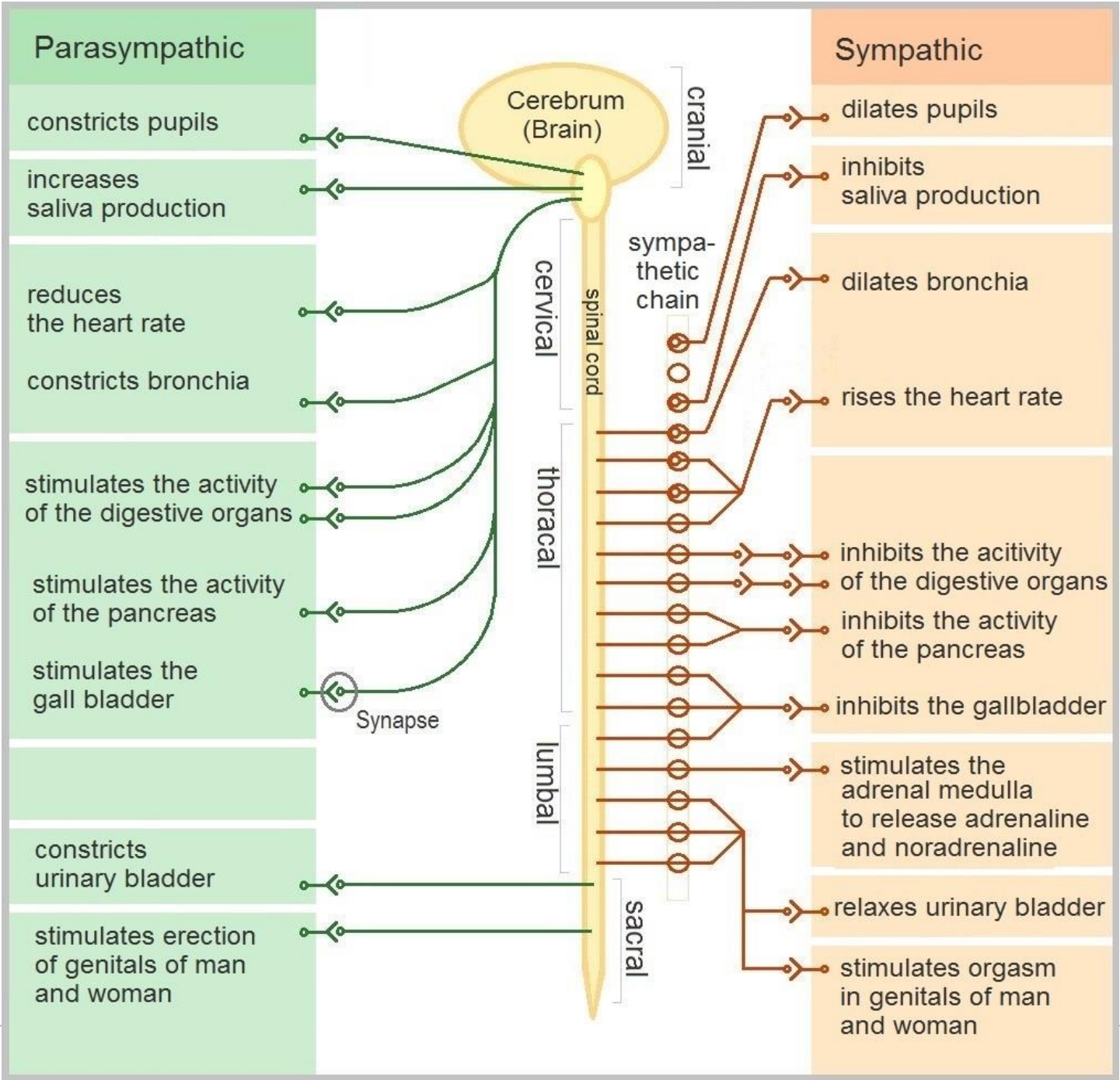
- ▶ Somatic sensory fibres transmit impulses from the joints, skeletal muscles, and skin. Visceral sensory fibers transmit impulses from the visceral organs of the ventral body cavity.

- ▶ **2. Motor** divided to

Somatic NS & Autonomic NS

- ▶ ANS control subconscious activities





Central nervous system

➤ Brain

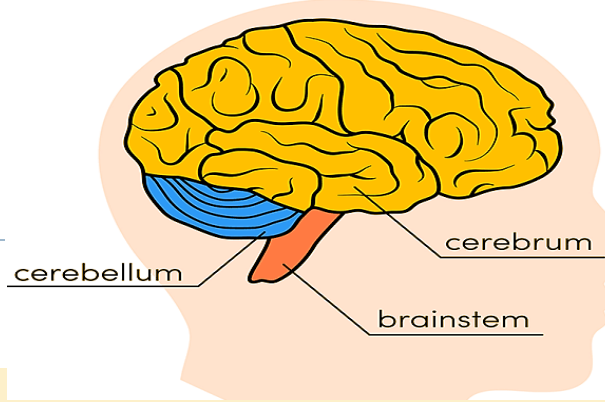
- Control center of the Nervous System.
- Communications network consisting of billions of neurons
- Process the received information and translate it into action.
- Controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger and every process that regulates our body.



Spinal cord:

- Bundle of nerves from brain to tailbone protected by vertebrae or spine
 - Conducting impulses between the brain and the rest of the body
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Brain is about 60% fat, the remaining 40% is a combination of water, protein, carbohydrates and salts. The brain itself is not a muscle. It contains blood vessels and nerves, including neurons and glial cells.

Cerebrum

- ▶ The cerebrum (front of brain) comprises gray matter (the cerebral cortex) and white matter at its center.
- ▶ The largest part of the brain, initiates and coordinates movement and regulates temperature, speech, judgment, thinking and reasoning, problem-solving, emotions and learning, vision, hearing, touch and other senses.

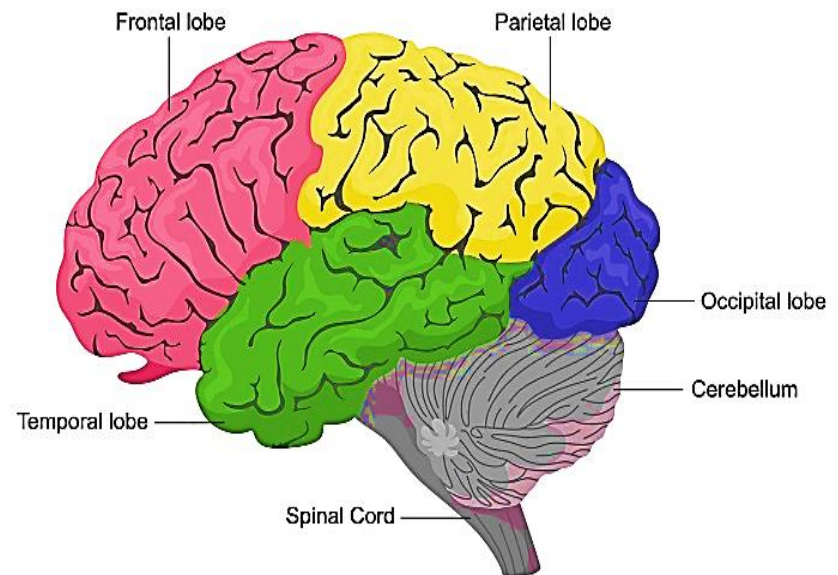
Cerebral Cortex

The outer grey matter covering of the cerebrum, has a large surface area due to its folds, and comprises about half of the brain's weight.

Brainstem

The brainstem (middle of brain) connects the cerebrum with the spinal cord

Human Brain Anatomy



Peripheral nervous system

- ❑ The PNS consists of the peripheral **nerves** connecting the CNS to other parts of the body
- ❑ It is made up of nerves extending from the brain and spinal cord to the rest of the body.

- ▶ **Cranial Nervous**
 - ▶ The cranial nerves transmit impulses to and from the brain.
 - ▶ Twelve nerves that originate in the brain. Each has a different function for sense or movement. The functions of the cranial nerves are sensory, motor, or both: Sensory cranial nerves help a person to see, smell, and hear.

- ▶ **Spinal nerves**
 - ▶ All the nerves that transmit impulses to and from the spinal cord.



Q&A

- ▶ What is a receptor? Give two examples of effectors.
- ▶ Distinguish between the central and peripheral nervous systems
- ▶ What are the components and functions of the CNS and PNS?
- ▶ Sketch a multipolar neuron and label its neurosoma, dendrites, axon, terminal arborization, axon terminals, myelin sheath, and nodes of Ranvier.
- ▶ Explain the differences between a sensory neuron, motor neuron, and interneuron.
- ▶ What is the functional difference between a dendrite and an axon?
- ▶ What properties do a nerve cell and a muscle cell have in common?
- ▶ Describe the structures of neurons, dendrites, and axons.
- ▶ Identify the differences between sensory and motor neurons.
- ▶ What are the three major structural categories of neurons?
- ▶ Differentiate between multipolar and bipolar neurons.



References

- ▶ **For further reading please see:**
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 - ▶ **Atlas of Human Anatomy (Netter Basic Science). Elsevier; 7th edition. Charles K. Weichert (2017).**
 - ▶ **Human Anatomy Atlas; Comprehensive 3D reference and study platform for anatomy, physiology and pathology; <https://www.visiblebody.com/anatomy-and-physiology-apps/human-anatomy-atlas>**
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