Major Organ Systems

Introduction:

- Combinations of tissues that perform complex tasks are called organs, and organs that function together form organ systems.
- **11 Major Organ Systems** are there in a human body.
- There specific functions and associated organs/tissues are listed as:

S. No.	System	Associated Tissues and Organs	Primary Functions
1.	Integumentary	Skin, Hair, Nails, and Various Glands	Provides protection for body
2.	Endocrine	Ductless glands, e.g.: Thyroid and Adrenals	Secretes harmones that regulates many chemical actions within cells.

Cont...

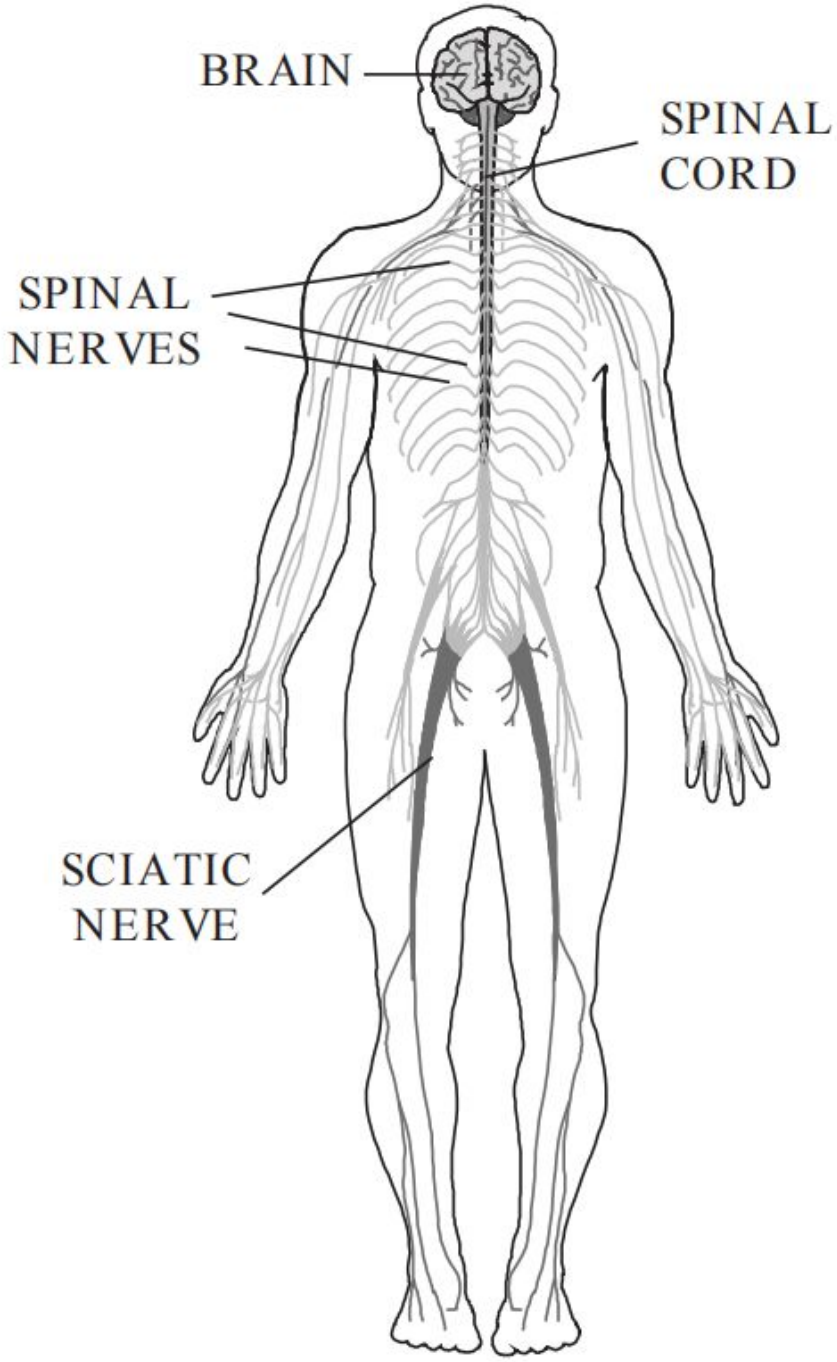
S. No.	System	Associated Tissues and Organs	Primary Functions
3.	Lymphatic	Glands, lymph nodes, lymphatic vessels	Returns excess fluid and protien to the blood and helps defending against infections and tissue damage
4.	Digestive	Stomach, Intestines, etc.	Ingests food and water, breaks food down (into small molecules) that can be absorbed and consumed by cells and removes solid wastes.
5.	Urinary	Kidneys, Ureters, Urinary Bladder, And Urethra	Maintains the fluid volume of the body, eliminates metabolic wastes, and helps regulate blood pressure and acid-base and water-salt balances
6.	Reproductive	Ovaries, Testes, Reproductive Cells, And Accessory Glands And Ducts	Produces eggs or sperm and provides a mechanism for the production and nourishment of offspring

Cont... (Listed in the Syllabus)

S. No.	System	Associated Tissues and Organs	Primary Functions
7.	Circulatory	Heart, Blood, and Blood Vessels	Serves as a distribution system for the body, carries oxigen and other nutrients to the entire body and carries back the carbon dioxide and waste fluids
8.	Nervous	Brain, Spinal Cord, Peripheral Nerves, and Sensory Organs	Regulates most of the body's activities by detecting and responding to internal and external stimuli
9.	Skeletal	Bones and Cartilage	Provides protection and support as well as sites for muscle attachments, the production of blood cells, and calcium and phosphorus storage
10.	Muscular	Skeletal muscle	Moves the body and its internal parts, maintains posture, and produces heat
11.	Respiratory	Airways and Lungs	Delivers oxygen to the blood from the air and carries away carbon dioxide

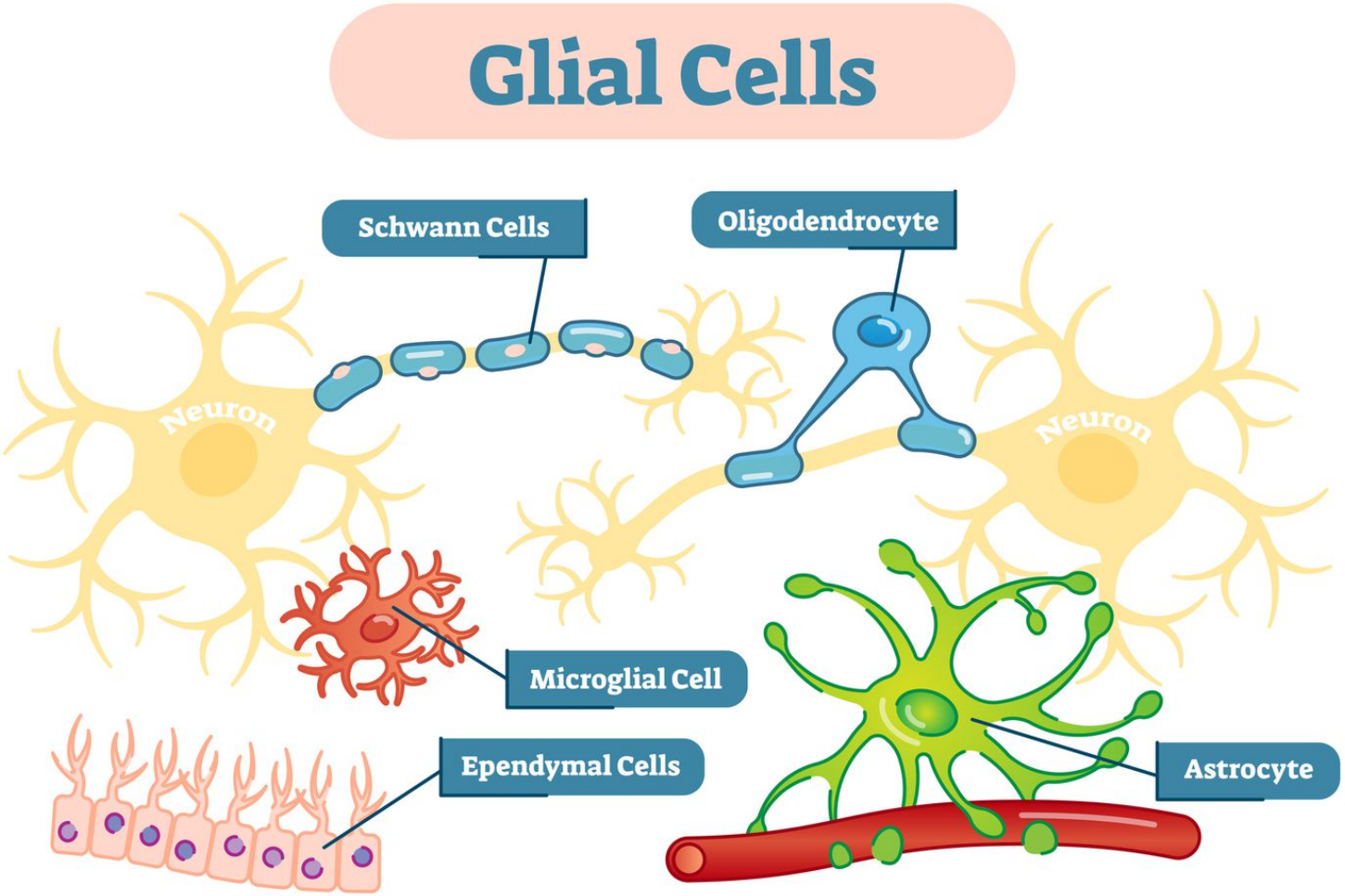
The Nervous System:

- It is one of the most exciting and mysterious part of human body.
- The fundamental element of the system is **Glial Cells** (**Glia**) and **Nerve cell** (**Neuron**)
- It comprises of **Central Nervous System** (Brain, Spinal Cord), **Peripheral Nervous System** (Peripheral Nerves, and Sensory Organs)
- Nervous system is responsible for the integration and control of all the body's functions by detecting (**sensing**) and responding (**acting or motoring**) to the intenal and external stimuli.



Glial Cells

- It play a supporting role in nervous system that outnumber the neurons by about 10 to 1 in brain and up to 50% of the brain's volume.
- Glia do not transmit or conduct electrical impulses like neurons, rather they surrounds the neurons and provides protection and nourishment.
- These can be replaced throughout life unlike neurons which cannot be replaced once died.

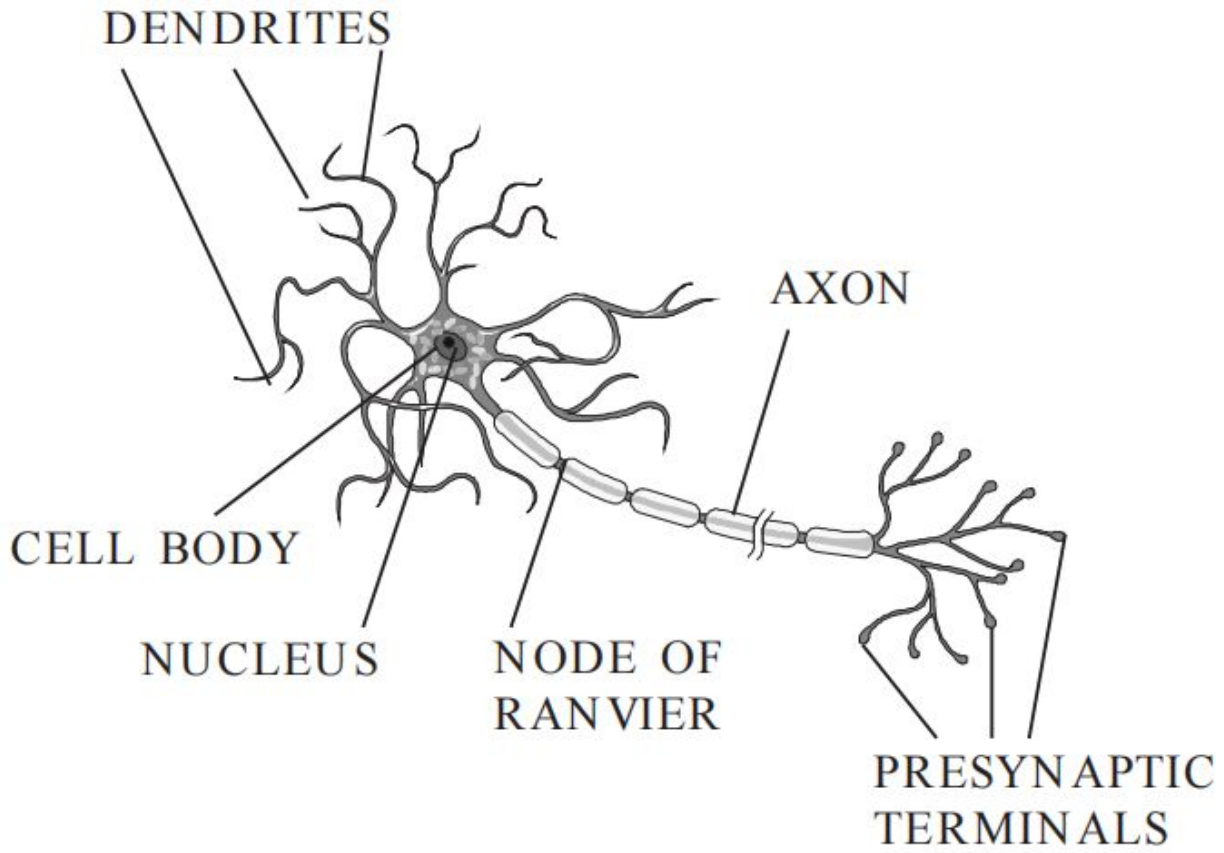


Glial Cells: Type and Function

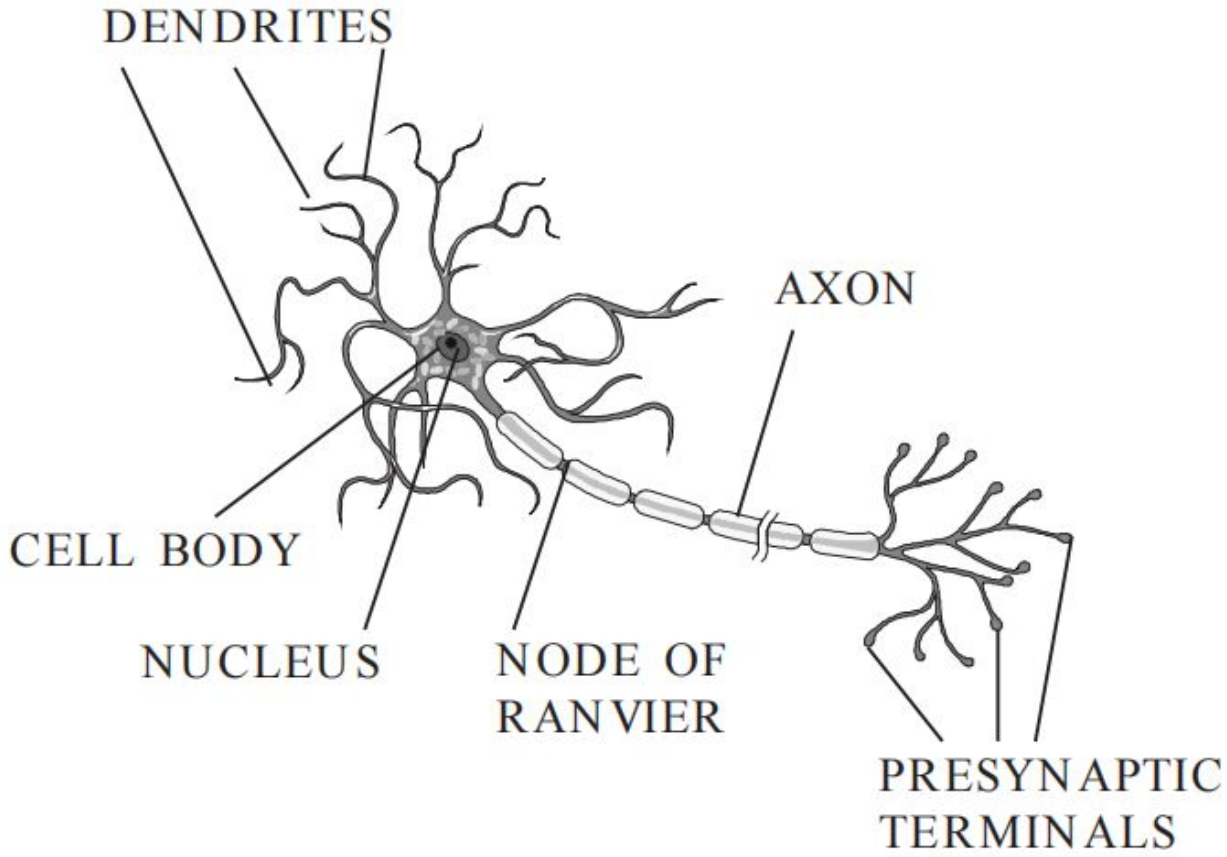
Glial cell	Location	Major functions
Oligodendrocytes	CNS	Produce myelin & provide electrical insulation
Astrocytes	CNS	Provide structural & metabolic support, participate in repair
Ependymal cells	CNS, line central canal & ventricles	Assist in production and movement of cerebral spinal fluid
Microglia	CNS	Participate in defense and immune responses
Schwann cells	PNS, peripheral nerves	Produce myelin & provide electrical insulation
Satellite cells	PNS, peripheral ganglia	Provide structural & metabolic support for cell bodies of neurons

Neurons

- Neurons are basic building block of neuronal communication network.
- It constists of three major components:
  - Cell body (Soma)
  - Recptor zone (Dendrites)
  - Long fiber (Axon)
- In a human body, these are present in different shapes and sizes that numbers approximately 20 billions.
- Its lenght may vary from a few micron to a meter.



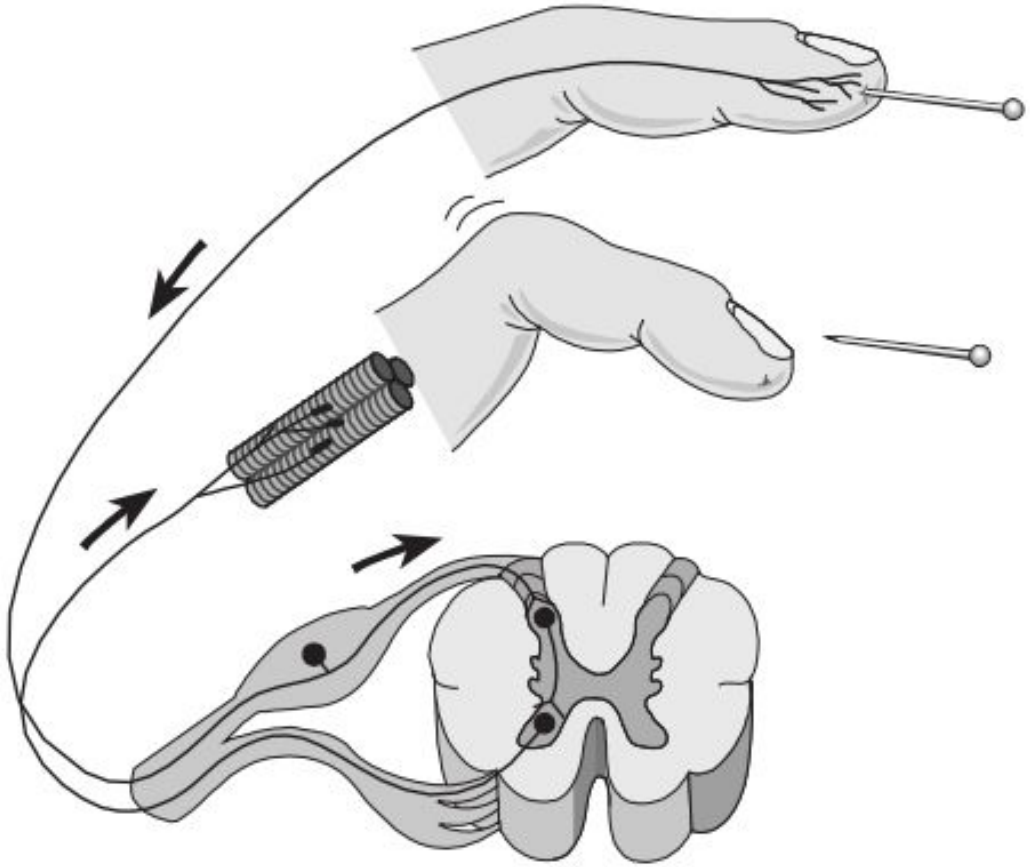
- The cell body (Soma) has an outer plasma membrane that encloses the cytoplasm containing the nucleaus and a number of organells.
- Unlike other cells, neurons do not divide or reproduce and are capable of generating electrochemical signals.
- The dendrites receive messages from the surrounding neuronal structure and move towards the cell body (Soma) for further processing and transmission through the axon, that carries the messages away from the neurons to the muscles, blood vessels, glands or other neurons.



Reflex Action

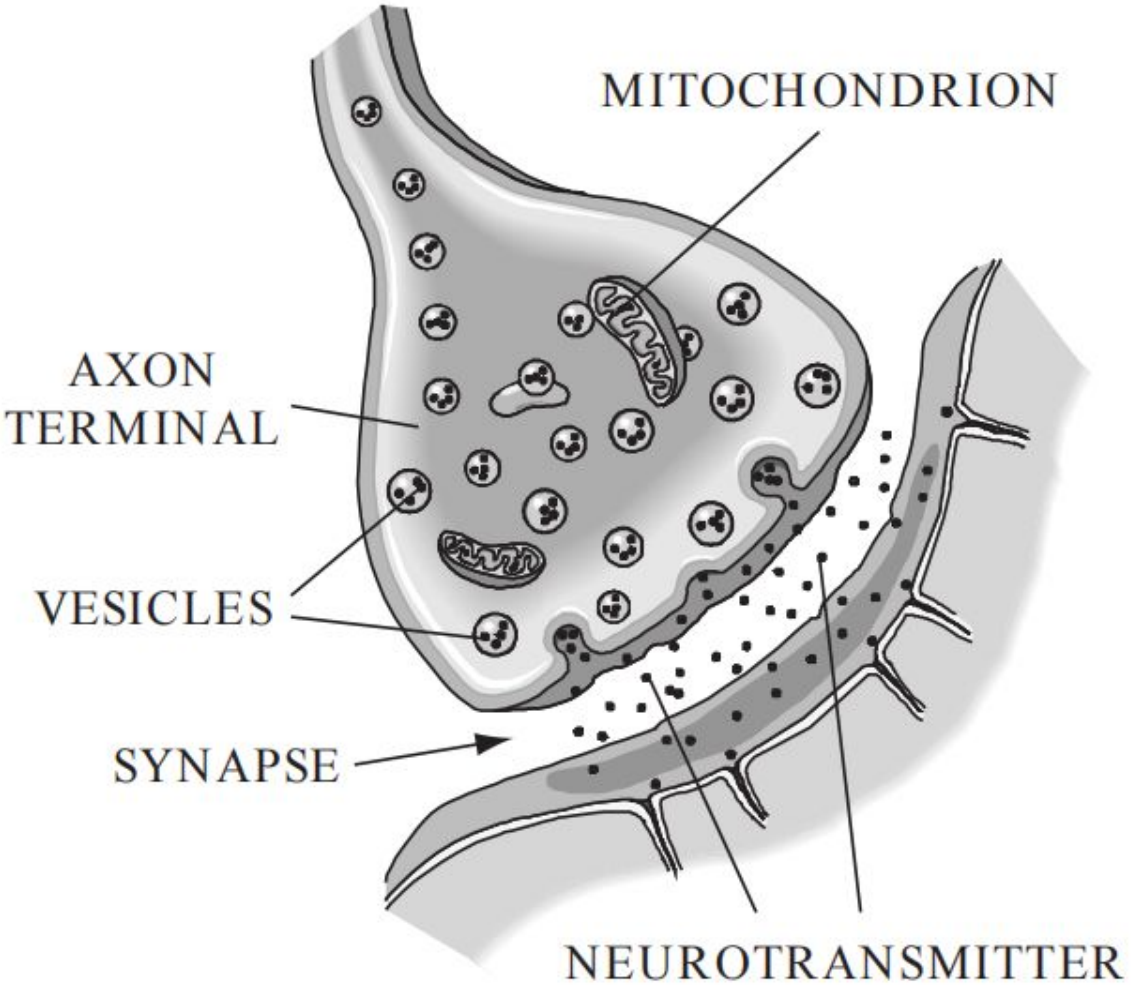
- Functional types of neurons includes:
  - **Sensory neurons (Receptor Cells)**: produces electrical impulses in response to stimuli from the internal or external environment. e.g.: touching a hot plate or pricked by nail.
  - **Motor neurons**: conveys the decisions taken by the brain via spinal cord to the muscles and glands in response to signals from sensory neurons and take suitable actions. e.g.: withdrawal of finger or hand from the hot plate etc.

This phenomena is know as **Reflex Action**.



Synapse:

- Ending terminals of the axon (called vesicles) contains neurotransmitters (chemical messengers, that are activated by electrical impulses) are responsible for generating nerve impluses, muscle contraction, and various other functions of organs and glands in the body.
- The tiny gap between two adjoining neurons measures about 100-200 Angostroms (10^{-10}m), is known as *Synaptic Cleft*, that contains a large number of submicroscopic spherical structures, (called Synaptic Vesicles).



Division of Nervous System:

Central Nervous System (CNS)

- CNS consists of all nervous tissues enclosed by bone, i.e.
  - Brain
  - Spinal cord
- Clusters of nerves in CNS is called **Nuclei**
- Neucleons in CNS are known as **Tracts**

Peripheral Nervous System (PNS)

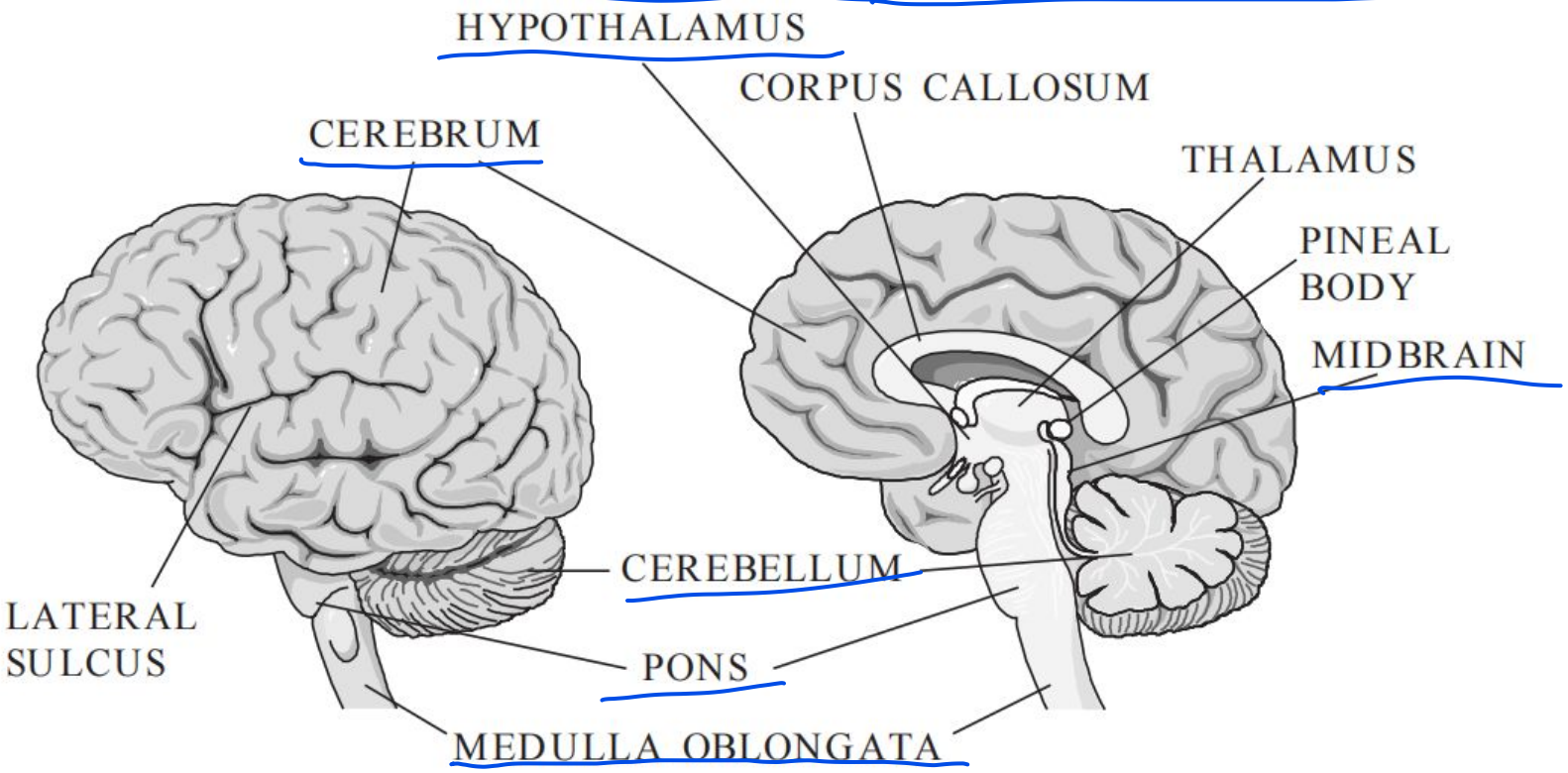
- PNS comprises of all other nervous tissues not inclosed by bone, i.e. distributed throughout the body (muscles, glands and other organs), i.e.
  - 12 pairs of cranial nerves
  - 31 pairs of spinal nerves

  All with different sensory (afferent) and motor (efferent) neurons.
- Clusters of nerves in PNS is called **Ganglion**
- Neucleons in PNS are known as **Nerves**.

- Nervous system are also divided as:
  - **Somatic PNS**:
    - Sensory neurons, which are responsible for conveying information from receptors, like pain, temperature, etc. to the CNS
    - Motor neurons, which are responsible for returning impulses from the CNS to other parts of the body for suitable reaction to the stimuli.
  - **Autonomic**: Internal regulation and regular functions of different organs and glands in the body, which is further divided as:
    - **Sympathetic:** It causes blood vessels and skin to constrict, skeletal muscles to dilate and the heart rate to increase in reaction to some fear or danger etc. Basically it prepares the body for **"Fight of Flight"**
    - **Parasympathetic:** It causes opposite effect on blood vessels and skin and decreases the heart rate. Basically it returns the body to normal operating conditions.
  - Withdrawal (protective or escape) reflexes or reflex action caused by pain or heat etc. can respond quickly to dangorous situations without interating with the brain. This is possible with the help of **Reflex Arc**.
  - It is a special type of neural circuit that begins with sensory neuron at receptor and ends with a motor neuron at the effector.

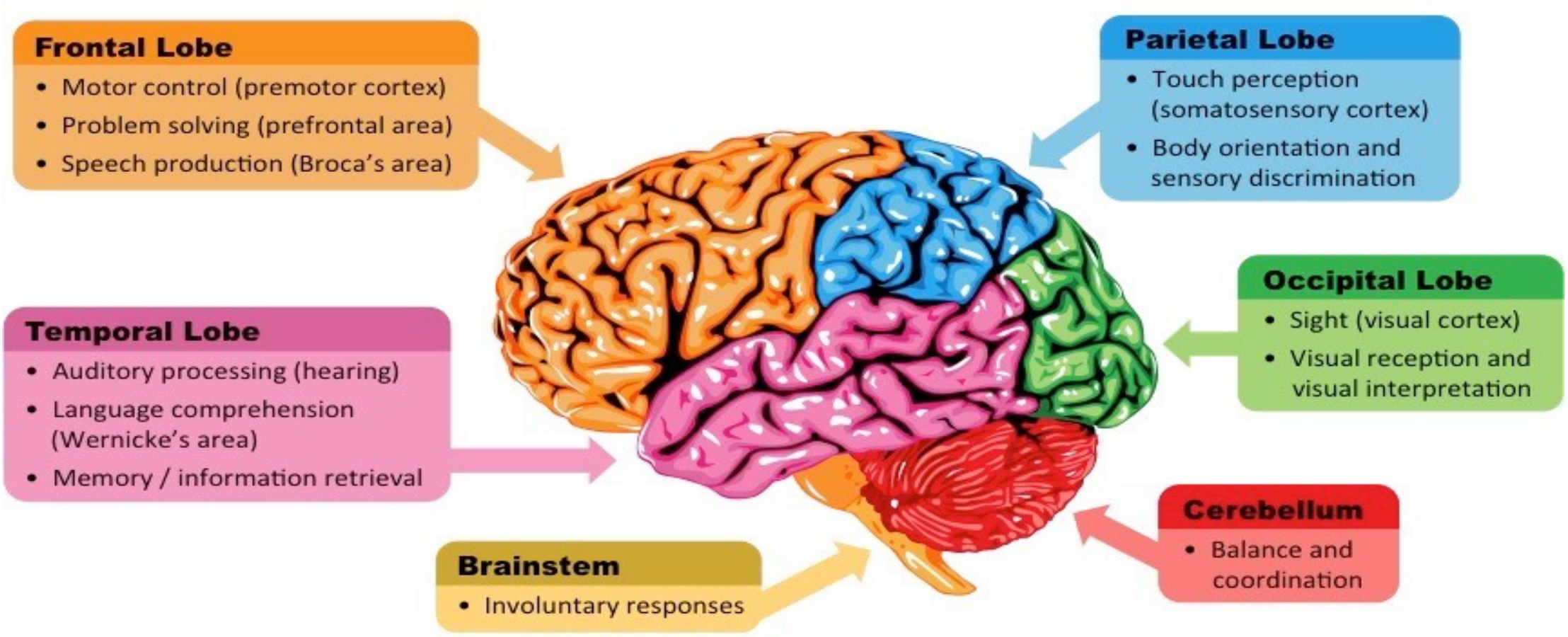
Brain:

- The most complicated organ in human body, that weights around 3.5 pounds and is located within the skulls.
- It is large and soft mass of nervous tissues that conists of cerebrum, diencephalon, mesencephalon (midbrain), brain stem and celebellum.



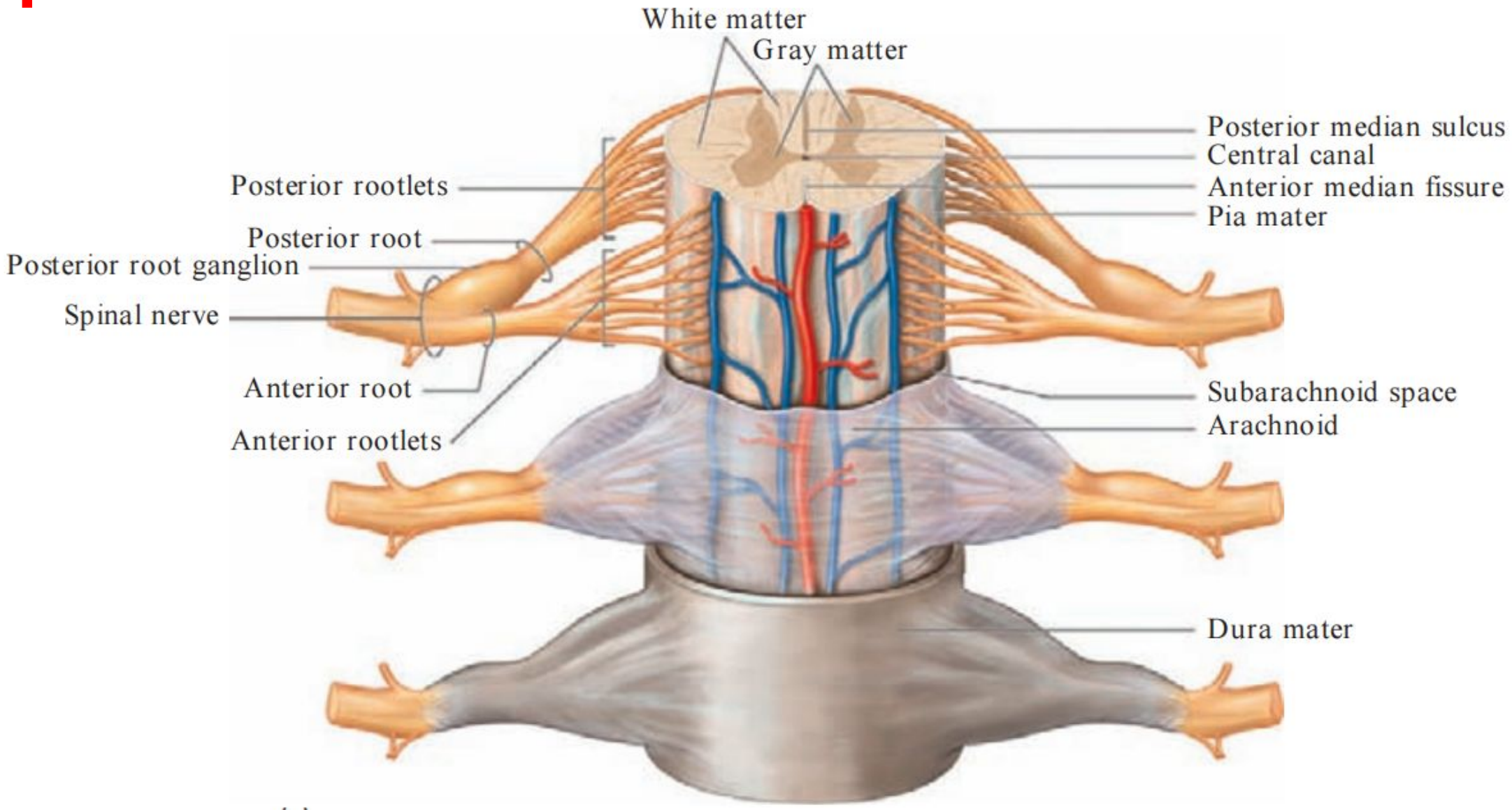
- The cerebrum is the largest portion of the brain, which is divided into two hemispheres and consists of many convoluted ridges (gyri) and narrow grooves (sulci) and deep fissures.
- Its outer layer is known as cerebral cortex, which is composed of gray matter (neurons with unmyelinated axons), while the thicker inner layer is the white matter (interconnecting groups of myelinated axons).
- The interconnection between the two cerebrum hemispheres is known as, corpus callosum.
- The left side of cortex controls motor and sensory functions from the right side of the body and vice versa.
- The fissures divides each cerebral hemisphere into a series of lobes, i.e.
  - Frontal lobe:
  - Parietal lobe:
  - Temporal lobe:
  - Occipital lobe:

Division of Brain and Their Functions



- The **brain stem** connects the brain with spinal cord and automatically controls vital functions such as breathing and includes:
  - **Midbrain:** Connects the pons and celebellum with the cerebrum and is responsible for visual reflexes, such as movement of eyes and focusing lenses
  - **Pons:** Connects medulla oblongata and midbrain and is responsible for controlling respiratory functions.
  - **Medulla:** Connects pons to the spinal cord and is responsible for regulating heart rate, respiration rate, coughing, sneezing, swallowing, vomiting etc.
- **Celebellum** is located behind the pns and is the 2nd largest part of the brain. It processes sensory information that is used by the motor systems and is involved in coordinating balance, body positions and precision and timing of movements.

Spinal Cord


White matter
Gray matter
Posterior median sulcus
Central canal
Anterior median fissure
Pia mater
Posterior rootlets
Posterior root
Posterior root ganglion
Spinal nerve
Anterior root
Anterior rootlets
Subarachnoid space
Arachnoid
Dura mater

- It is an important part of CNS, that provides a crucial link between the brain and the body.
- It helps in relaying information from periphery (sensory inputs) to the brain and carrying commands from the brain (motor output) to the peripheral parts of the body.
- The gray matter of the spinal cord is divided into the **dorsal** and **ventral** horns. In a human, standing upright, the “dorsal” horn is posterior and the “ventral” horn is anterior.
- Dorsal horn neurons receive and process sensory information from the skin, while ventral horn neurons participate in the control of skeletal muscle contraction.
- The gray matter is surrounded by columns (funiculi) of white matter containing ascending and descending axons.
- Dorsal root fibers bring information to the spinal cord, and ventral root fibers carry information away from the spinal cord

Diseases of the Nervous Systems:

- Aging and environmental factors may cause different types of diseases and disorders of nervous system.
- Viruses, toxins, genetic factors and drugs may induce movement dissorders, such as,
- **Parkinson's Disease:** Humans of age group 50-60 years are mostly affected. Due to the environmental toxins, body cells and neurons stops producing sufficient neurotransmitters, dopamine etc. which results in slowness in body movements and tremors of hands and head.
- **Dementia:** Affected age group of 60 years, caused by changes in brain tissues resulting in loss of memory (**Alzheimer**), inability to learn, irritation, etc.
- **Bell's Palsy:** Any age group may get affected. It may be caused by cold, or viral infections, stress, and high blood pressure. In this, one or both sides of muscles stops working, resulting in poor control over facial expressions, eating/drinking, speaking etc. This is also known as **facial paralysis**.