Anatomy Team 435

Organization of The Nervous System

Done By:

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Objectives:

At the end of the lecture, the students should be able to:

- List the **parts** of the nervous system.
- List the **function** of the nervous system.
- Describe the **Structural & Functional Organizations.**
- **Define the terms**: Nervous tissue, grey matter, white matter, nucleus, ganglion, tract, nerve.
- List the **parts** of the **brain.**
- List the **structures protecting** the central nervous system.

Dr.Najeeb notes: Green

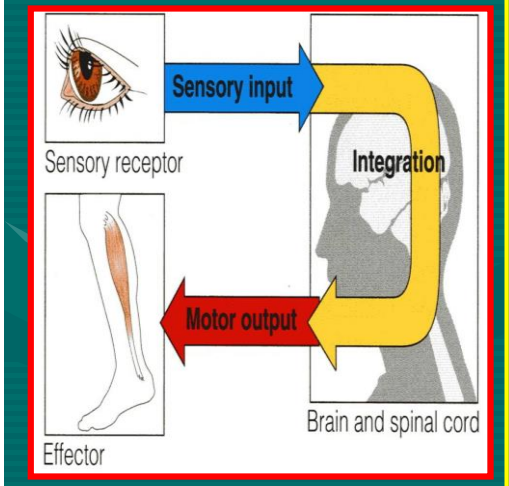
Doctors' notes: Red

Extra notes& Summaries: Blue

Editing File

INTRODUCTION

How does the nervous system work ?

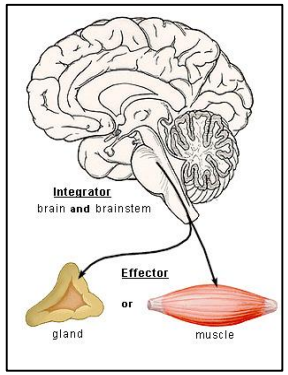


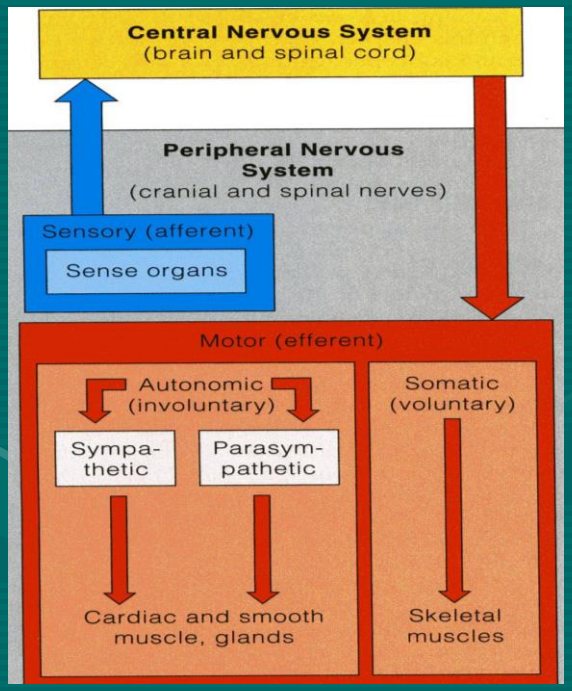
The nervous system has three functions:

- **Collection of sensory input:** Identifies changes occurring inside or outside the body by using sensory receptors. These changes are called stimuli.
- **Integration:** Processes, analyzes , and interprets these changes and makes decisions.
- **Motor output**, or response by activating muscles or glands (effectors).

Nervous system functions:

1-Collection of sensory input (Afferent) → 2-Intrgartion → 3-Motor output (Efferent)





CLASSIFICATION

I- Anatomical or Structural classification:

1- Central NS

- 2- Peripheral NS

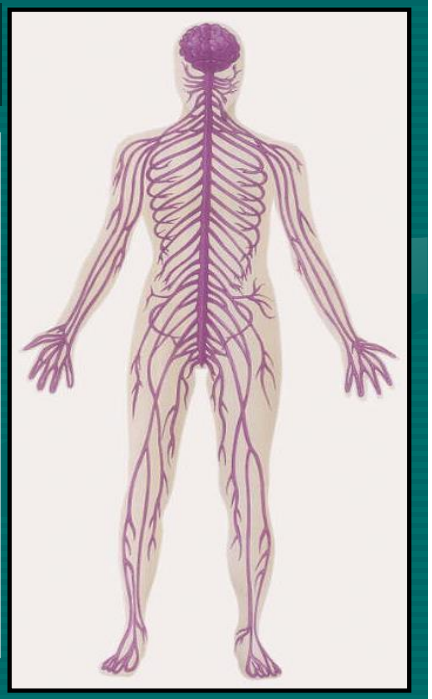
II- Physiological or Functional classification:

- **1-Sensory division (Afferent)**
- **2-Motor division (Efferent)**
  - **Autonomic**
  - **Somatic**

Classification of nervous system:

- Anatomical "structural"
  - Central nervous system
  - Priphral nervous system
- Physiological "Functional"
  - Sensory "Afferent"
    - Somatic "Voluantry"
    - Autonomic "Involuantry"
  - Motor "Efferent"
    - Somatic "Voluantry"
    - Autonomic "Involuantry"

Structural Organization



Two subdivisions:

- Central Nervous System (CNS)
  - Consists of Brain & Spinal cord
  - Occupies the dorsal body cavity
  - Acts as the integrating and command centers.
- Peripheral Nervous System (PNS)
  - Consists of nerves, ganglia, receptors.
  - It is the part of the nervous system outside the CNS.

Dr. Najeeb's notes:

CNS

Functions:

1-Receives the sensory input from the body.

2- Compare the new information from the old informations.

3- Deciede the motor respons.

PNS

Functions:

1- transport information to the CNS.

2- Also from theCNS to the tissues.

Functional Organization

- Two subdivisions:
  - Sensory or afferent division:

    Consists of nerve fibers that convey impulses from receptors located in various parts of the body, to the CNS.
  - Motor or efferent division:

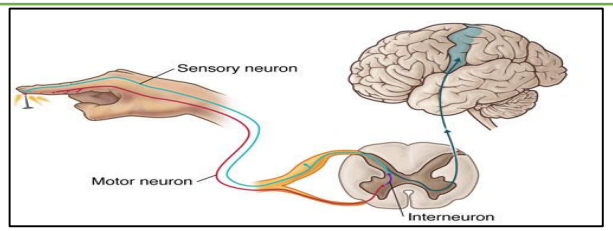
    Consists of nerve fibers that convey impulses from the CNS to the effector organs, muscles and glands.
- Both sensory and motor subdivisions are further divided into:
  - Somatic division: concerned with skin, skeletal muscles and joints.
  - Autonomic division: concerned with the visceral organs.

Dr. Najeeb's notes:

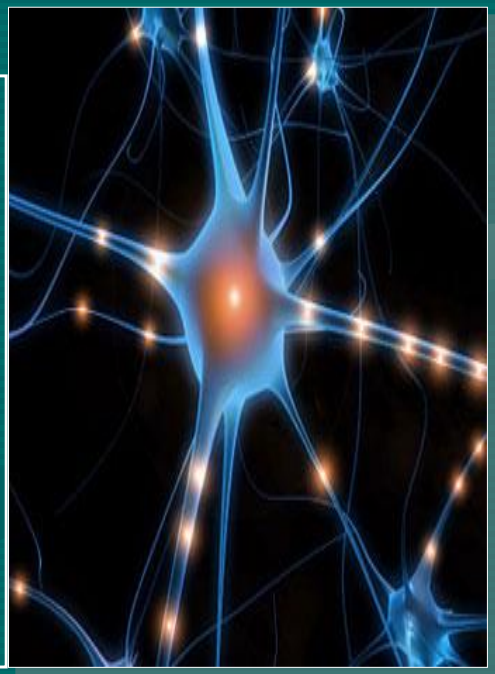
Sensory or Afferent divided into:

1- **Special senses:** are generated only from specific part of the body. E.g. (vision, smell "Olfactory", Hearing, sense of balance "equilibrium" (يعني مثلاً أنا أرى من عيني لا أستطيع النظر من أنفي)

2- **General senses:** are generated from many part of the body. E.g. (Touch) (أستطيع الإحساس باللمس من أي جزء في جسمي)



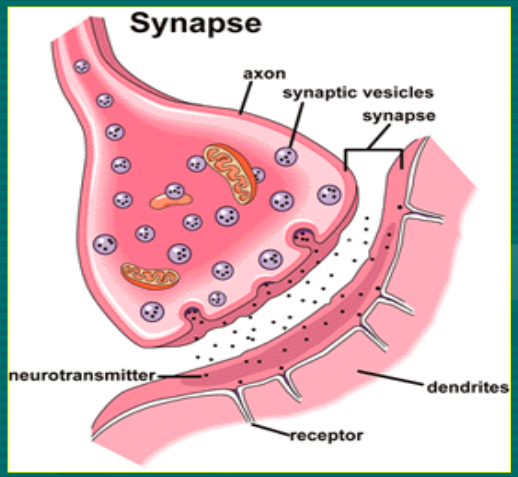
The Nervous System



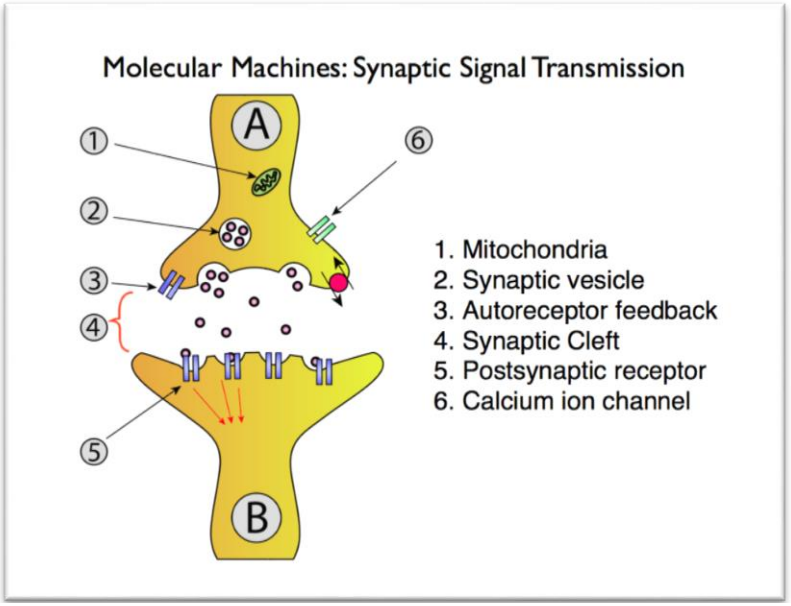
- It is the major controlling, regulatory & communicating system in the body.
- It is the center of all mental activity including:
- Thought,
- Learning,
- Behavior and
- Memory.
- Together with the endocrine system, the nervous system is responsible for **regulating** and **maintaining homeostasis.**

Nervous Tissue

- Nervous system is composed of nervous tissue, which contains two types of cells:
  1- Nerve cells or neurons
  2- Supporting cells or neuroglia (glia).
- Nervous system contains millions of neurons that vary in their shape, size, and number of processes.



The junction site of two neurons is called a **"synapse or relay".**
In the synapses the membranes of adjacent cells are in close **apposition** (**contiguity**=contact, not **continuity**).



Neurons

What is neurone?

It is the **basic structural (anatomical), functional and embryological unit** of the nervous system.

The human nervous system is estimated to contain about 10^{10}.

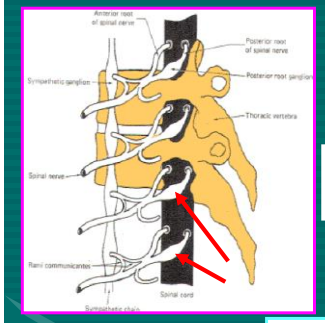
What is neuroglia or glia or glial cells?

Neuroglia, or glia cells constitute **the other major cellular component of the nervous tissue.**

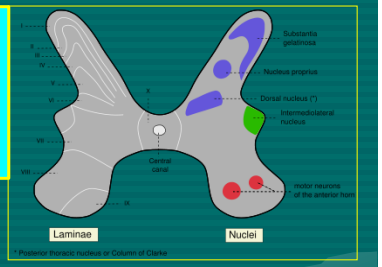
It is a **specialized connective tissue supporting framework for the nervous system.**

Unlike neurones, neuroglia do not have a direct role in information processing but they are essential for the normal functioning of the neurons, they act as supporting and nutrition for neurons.

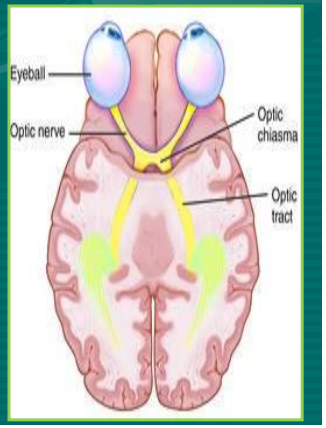
Ganglion= A group of neurons outside the CNS



Nucleus= A group of neurons within the CNS



Remember...



Nerve =A group of nerve fibers (axons) outside the CNS

Tract =A group of nerve fibers (axons) within the CNS

Neurone

Deffinition: It is the basic structural (anatomical), functional and embryological unit of the nervous system.

-**Have** a direct role in information processing.

Neuroglia

Deffinition: It is a specialized connective tissue supporting framework for the nervous system.

-**Do not Have** a direct role in information processing.

Dr. Najeeb's notes:

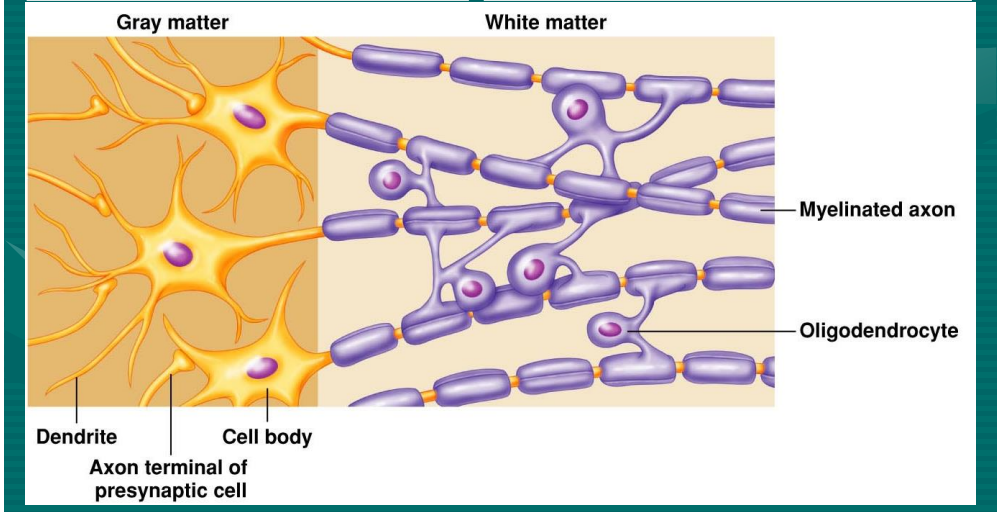
Nerve	Tract
Bundle of Axons "White matter"	Bundle of Axons "White matter"
Outside the CNS	Inside the CNS

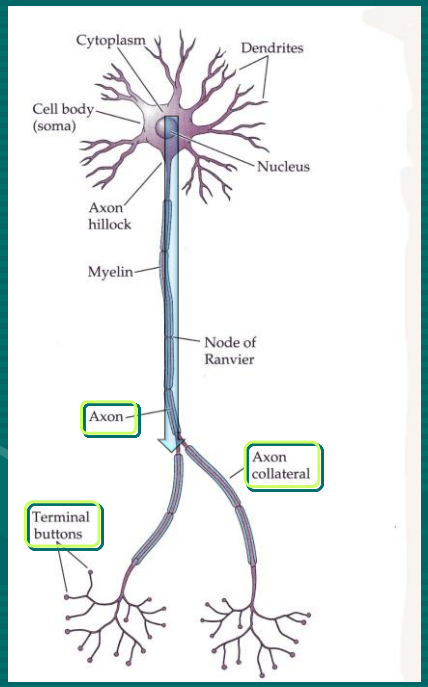
- **The Axons in CNS covered by "Oligodenrocytes"**
- **The Axons in PNS covered by "Schwann cells"**

Nervous tissue is organized as:

Grey matter, Which contains
1- **Cell bodies** &
2- Processes of the neurons,
3- Neuroglia and
4- Blood vessels.

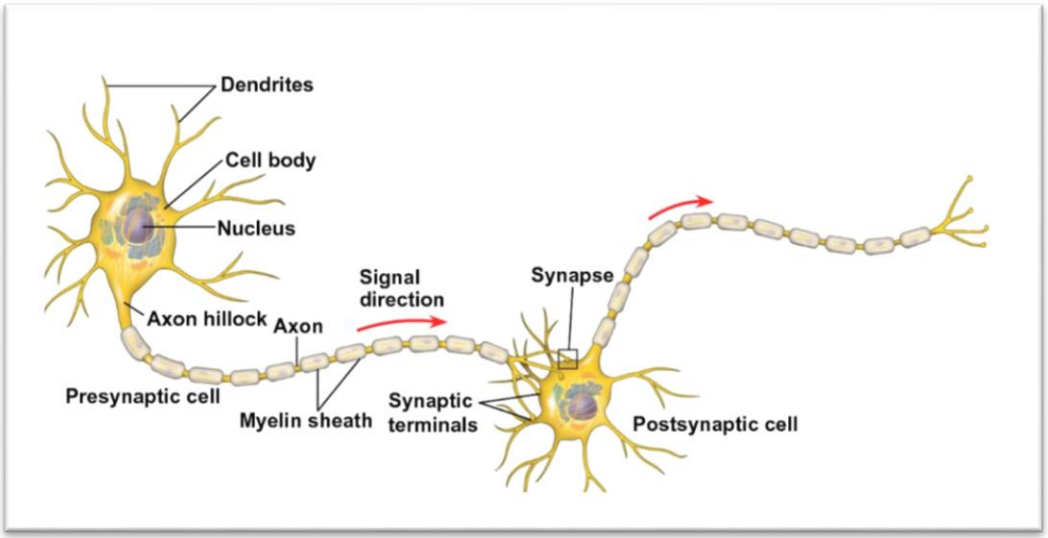
White matter, Which contains:
1- Processes of the neurons
2- Neuroglia and
3- Blood vessels
***NO cell bodies* in the white matter.**

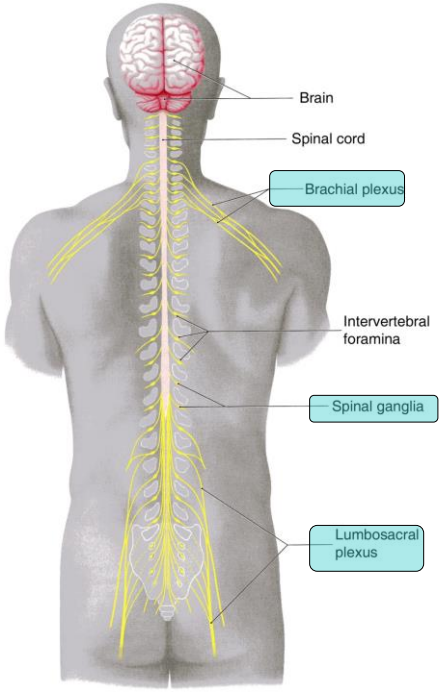




- **One** of these processes leaving the cell body is called the **axon** which **carries information away from the cell body.**
- **Axons** are highly variable in length and may **divide into** several branches or **collaterals** through which information can be distributed to a number of different destinations.
- **At the end** of the axon, specializations called **terminal buttons** occur.
- **Here information is transferred to the dendrites of other neurones.**

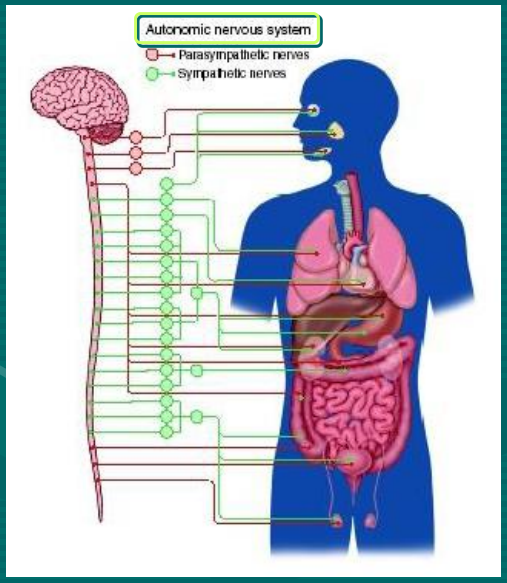
Grey matter	White matter
Cell bodies of neurones.	No cell bodies.
Processes of the neurons "Dendrites"	Processes of the neurons "Axons"
Neurogli "Supporting cells"	Neurogli "Supporting cells"
Blood vessels.	Blood vessels.





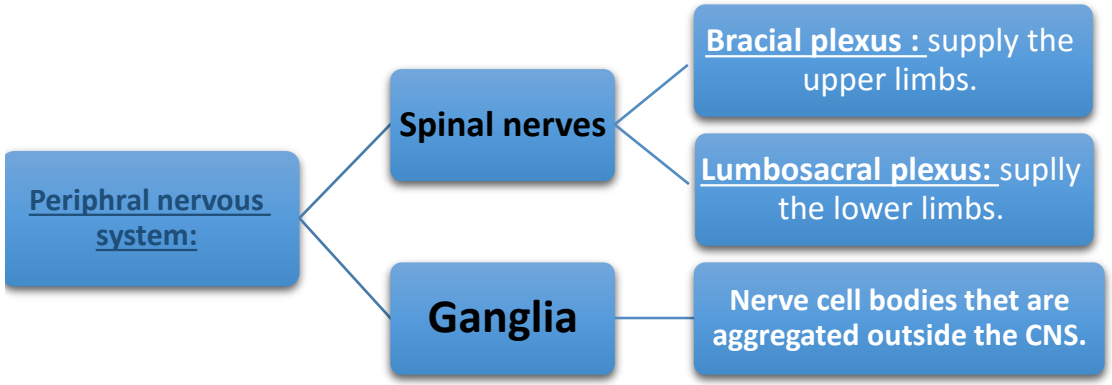
Peripheral NS

- Spinal nerves supplying the upper or lower limbs form plexuses e.g. brachial or lumbar plexus.
- Nerve cell bodies that are aggregated outside the CNS are called GANGLIA

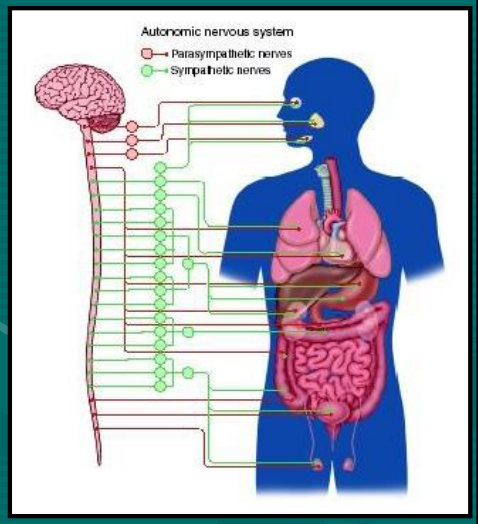


Autonomic Nervous System

- Neurones that detect changes and control the activity of the viscera are collectively referred to as the autonomic nervous system.
- Its components are present in both the central and peripheral nervous systems.



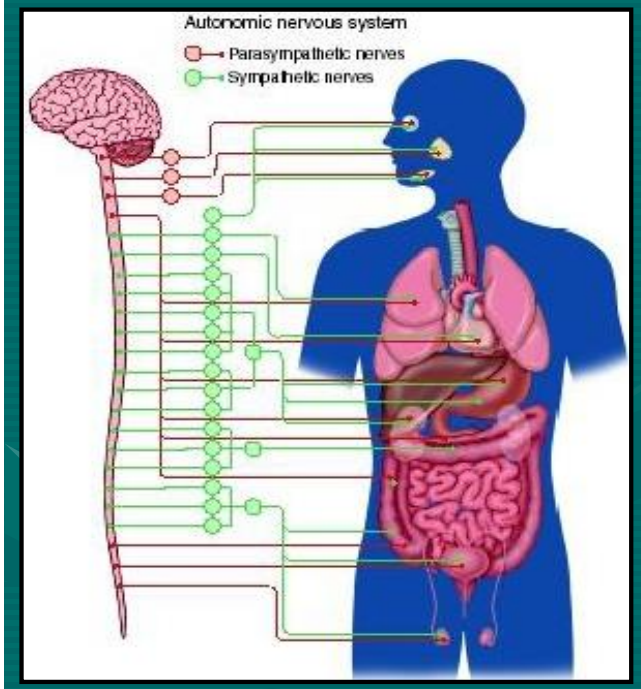
SYMPATHETIC & PARASYMPATHETIC SYSTEMS



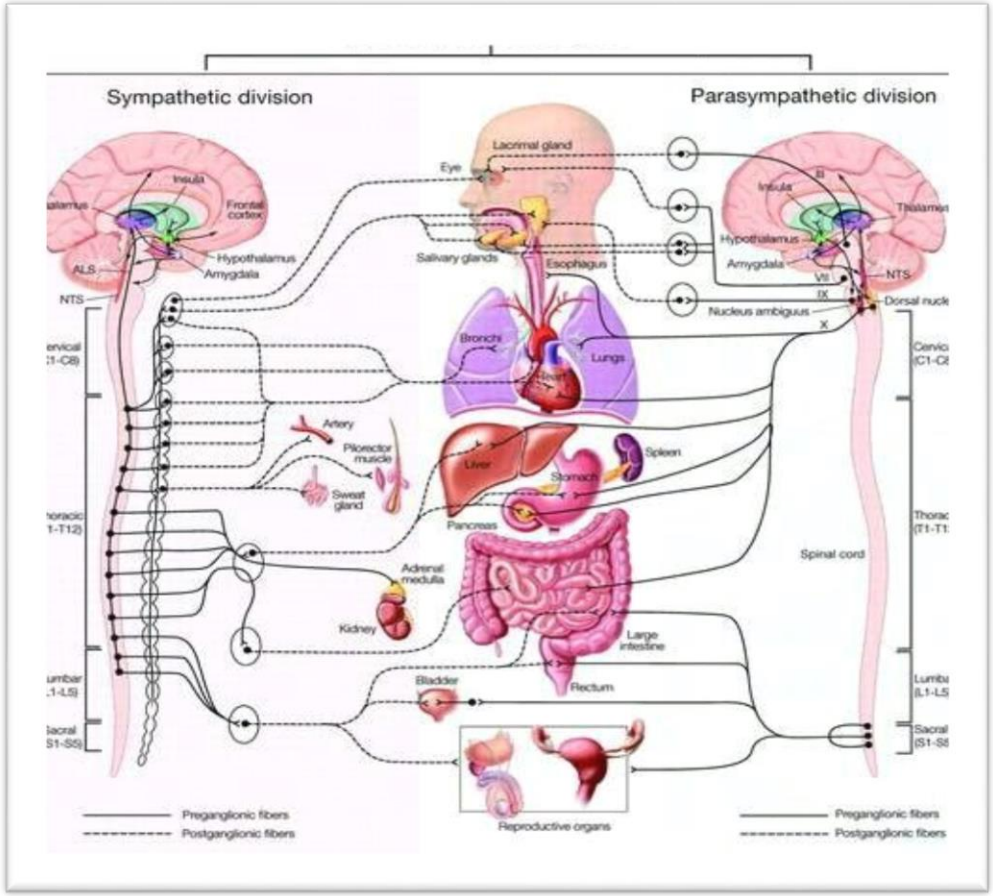
- The autonomic nervous system is divided into two anatomically and functionally distinct parts:
- **Sympathetic:** Or
- **Thoracolumbar outflow**
- **Parasympathetic**: Or
- **Craniosacral outflow.**
- **Sympathetic** and **parasympathetic** , divisions are generally have **antagonistic** effects on the structures that they innervate.
- E.g. Sympathetic increases the heart rate, while the parasympathetic decreases the heart rate.

Autonomic nervous system:

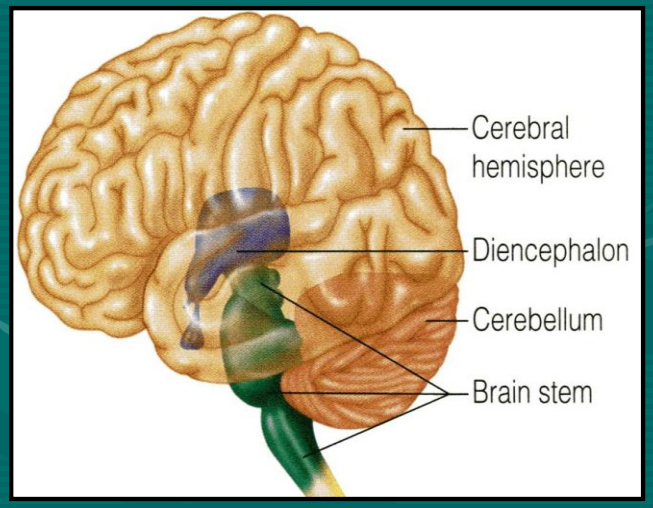
- **Sympathetic**
  "Thoracolumbar outflow"
- **Parasympathetic**
  "Craniosacral outflow"



- **The autonomic nervous system innervates:**
- **Smooth muscles,**
- **Cardiac muscle,**
- **Secretory glands.**
- It is an important part of **the homeostatic mechanisms** that control the internal environment of the body **with the endocrine system.**

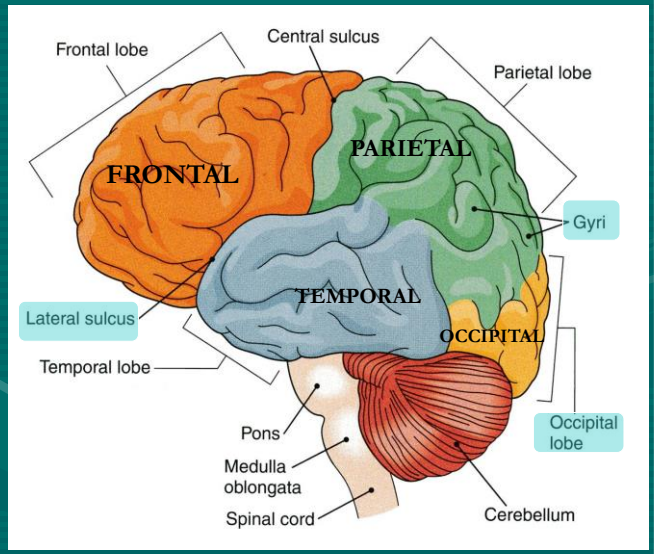


PARTS OF THE BRAIN

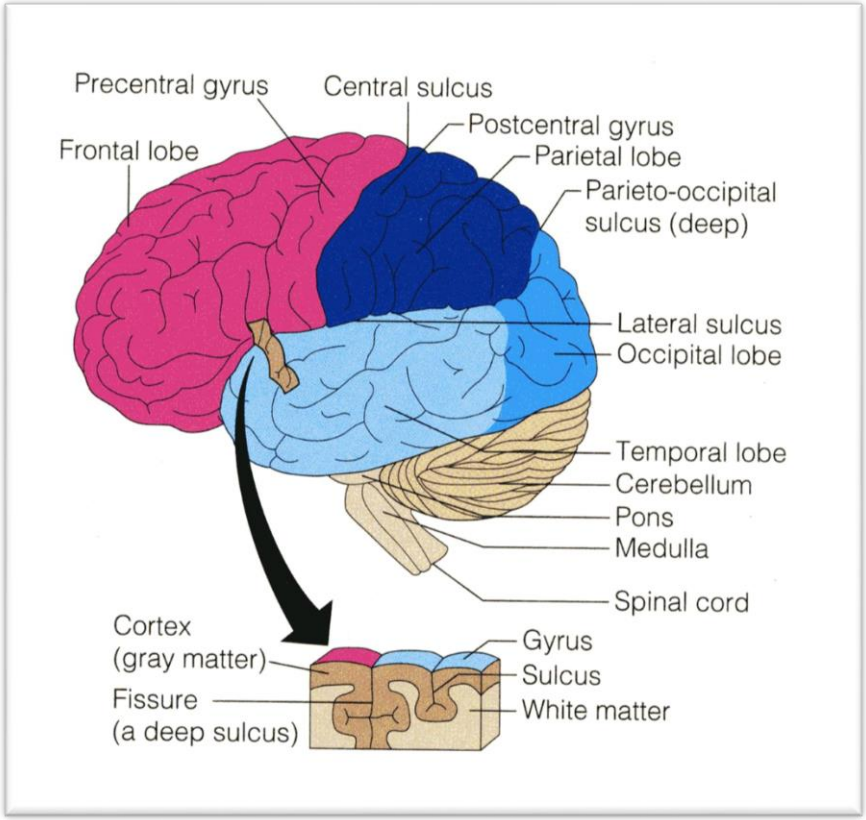


- The brain composed of 4 parts:
- Cerebral hemispheres
- Diencephalon
- Cerebellum
- Brain stem

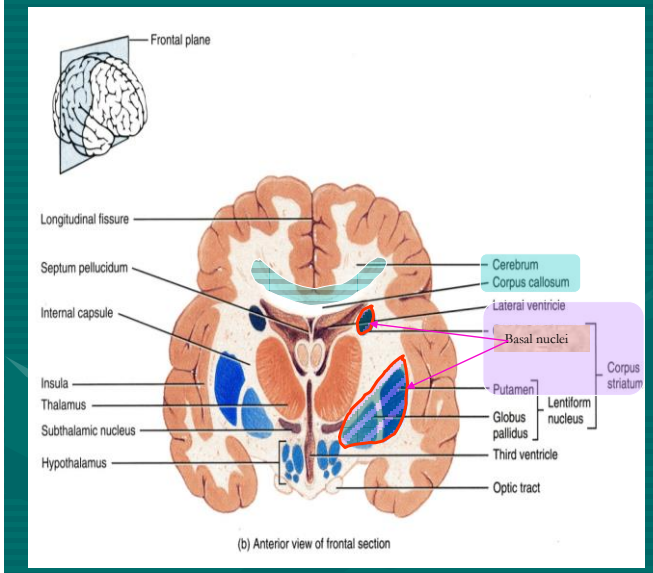
CEREBRAL HEMISPHERES



- The largest part of the brain.
- They have elevations, called gyri.
- Gyri are separated by depressions called sulci.
- Each hemisphere is divided into 4 lobes named according to the bone above.
- Lobes are separated by deeper grooves called fissures or sulci.



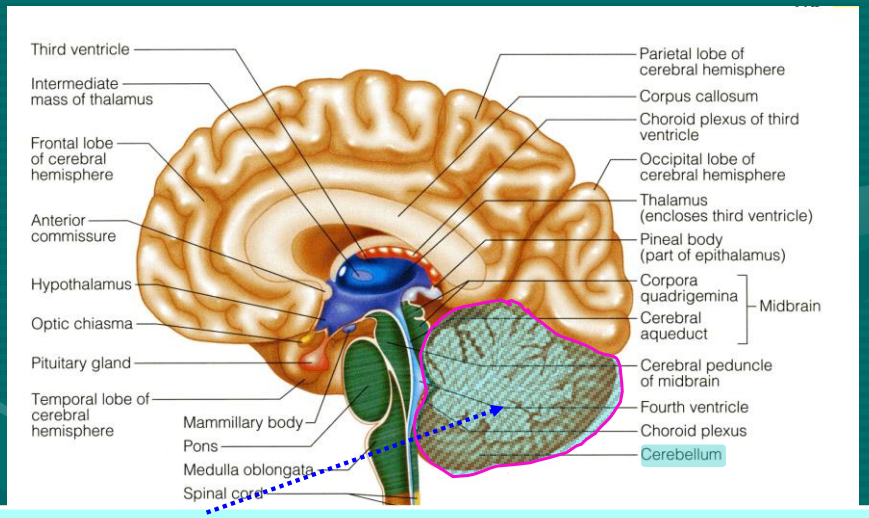
TISSUE OF THE CEREBRAL HEMISPHERES



(b) Anterior view of frontal section

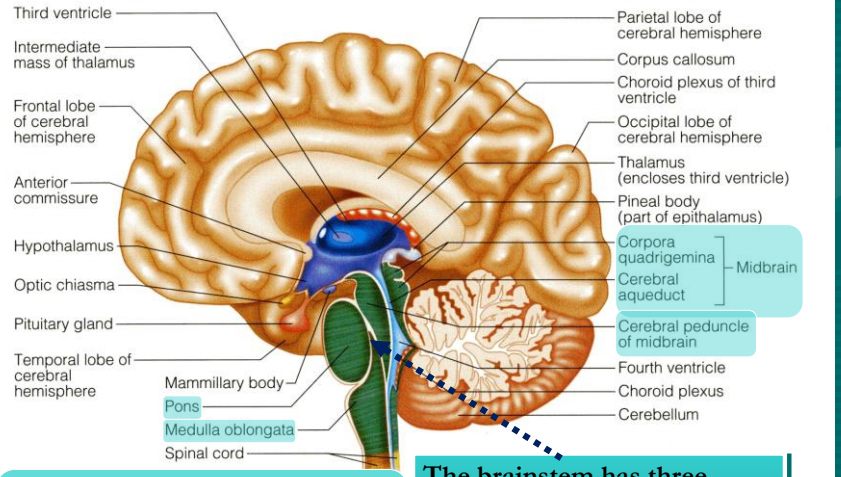
- **The outer layer** is the gray matter or cortex
- **Deeper** is located the **white matter, or medulla**, composed of bundles of nerve fibers, carrying impulses **to and from** the cortex
- **Basal nuclei** are **gray matter** that are located deep within the white matter
- They help the motor cortex in regulation of ***voluntary motor activities.***

CEREBELLUM



Cerebellum has 2 cerebellar hemispheres with convoluted surface.
It has an **outer cortex of gray matter** and an **inner region of white matter.**
It provides precise coordination for body movements and helps maintain equilibrium.

BRAIN STEM

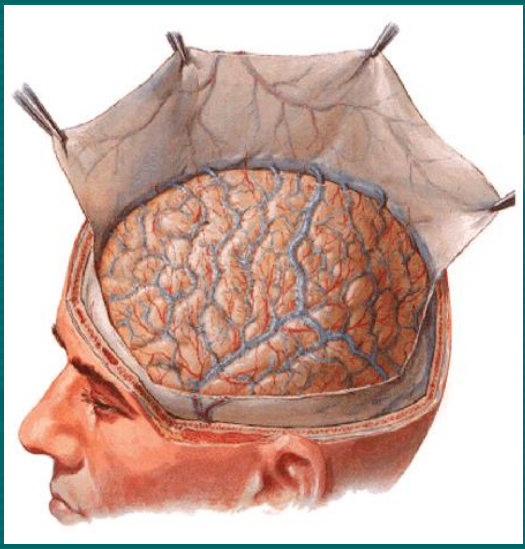


It is connected to the cerebellum with 3 paired **peduncles**
Superior, middle and inferior

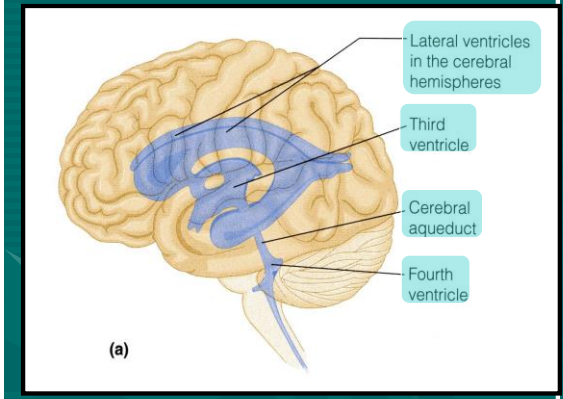
The brainstem has three parts: midbrain, Pons and medulla oblongata.

MENINGES

- There are three connective tissue membranes invest the brain and the spinal cord.
- These are from outward to inward are:
- **1- Dura mater.**
- **2- Arachnoid mater.**
- **3- Pia mater.**



BRAIN VENTRICLES



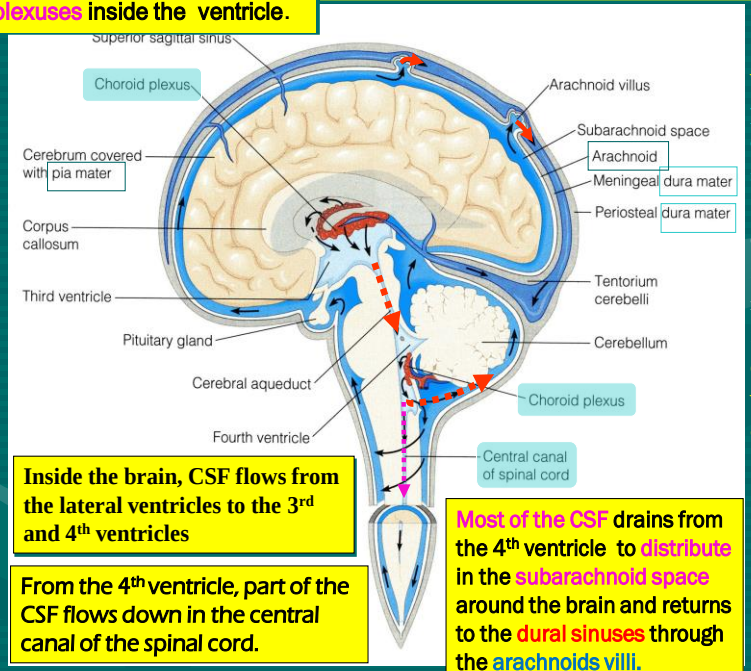
- Brain is bathed by the cerebrospinal fluid (CSF).
- Inside the brain, there are 4 ventricles filled with CSF.
- The 4 ventricles are:
  - 2 lateral ventricles:
    One in each hemispheres.
  - 3rd ventricle:
    in the Diencephalon.
  - 4th ventricle:
    between Pons, Medulla oblongata & Cerebellum.

N.B. Cerebral aqueduct: connects the 3rd to the 4th ventricle.

YouTube Ventricular system

CEREBROSPINAL FLUID

CSF is constantly produced by the choroid plexuses inside the ventricle.



•Arachnoid villi are small protrusions of the arachnoid.
•Villi absorb cerebrospinal fluid and return it finally to the dural venous circulation.

Inside the brain, CSF flows from the lateral ventricles to the 3rd and 4th ventricles

From the 4th ventricle, part of the CSF flows down in the central canal of the spinal cord.

Most of the CSF drains from the 4th ventricle to distribute in the subarachnoid space around the brain and returns to the dural sinuses through the arachnoids villi.

Doctors notes:

Cerebrospinal fluid:

Production: Choroid plexuses "Clusters of capillaries" inside the ventricle.

Distribution: From the lateral ventricles to the 3rd ventricle then to the 4th ventricle through "cerebral aqueduct". Then, part of the CSF flows down in the central canal of the spinal cord.

Final drainage: Most of the CSF drains in the "subarachnoid space" around the brain and returns to the "Dural sinuses" through the "Arachnoid villi"

Revised by

هشام الغفيلي & خولة العماري