



**Anatomy Team**  
**MED 439**

Revised & Approved



**MED439**  
KING SAUD UNIVERSITY

# Organization of the Nervous System

CNS Block

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Don't forget to check the [Editing File](#)

Color index:

Content  
Male slides  
Female slides  
Important  
Doctors notes

Extra information, explanation

# Objectives

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

- List the parts of the nervous system and its functions.
- Describe the structural & functional organizations
- List the parts of the brain & structures protecting the central nervous system
- Define the terms: Nervous tissue, grey matter, white matter, nucleus, ganglion, tract, nerve.

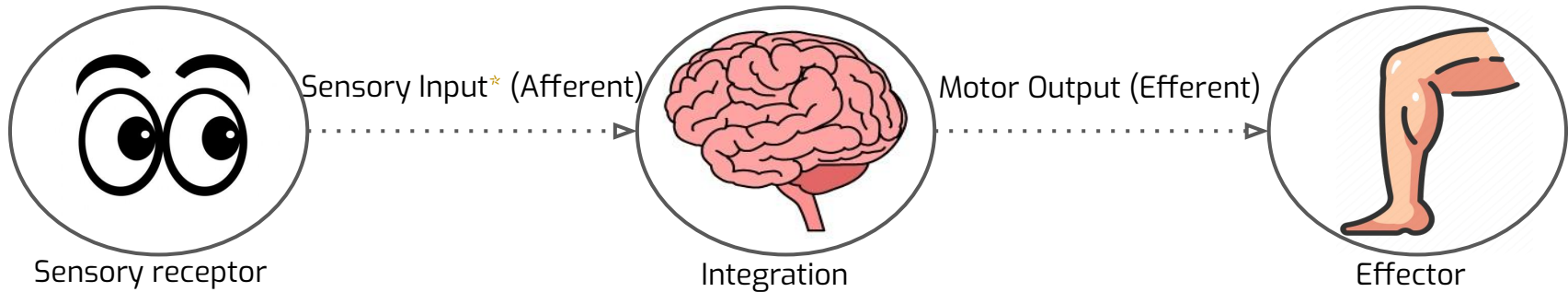
# Introduction

## The Nervous System

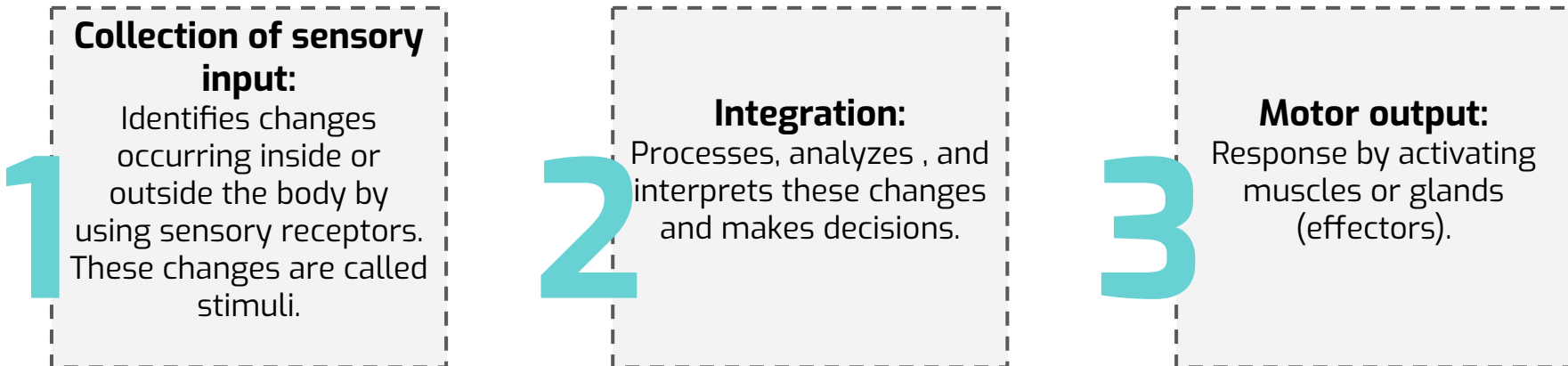
- Major controlling, regulatory & communicating system in the body.
- It is the center of all mental activity including : Thought, Learning, Behavior and Memory.
- Responsible for regulating and maintaining homeostasis together with the endocrine system.

Dr's notes :Collection of sensory input can be either inside the body like:being hungry or outside the body touch, pain whatever  
Integration occurs in the brain or spinal cord.

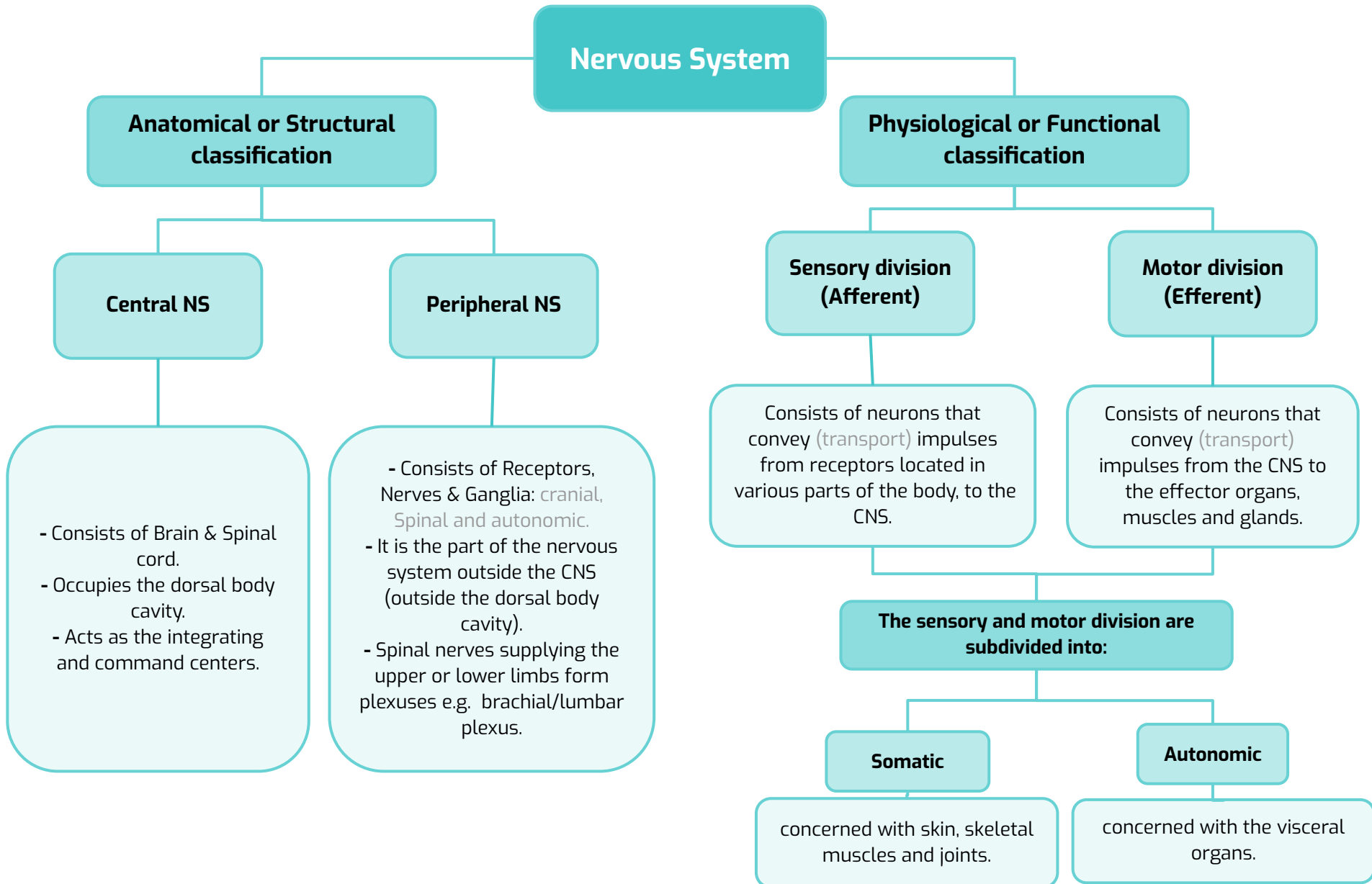
## How Does The Nervous System Work?



## The nervous system has three functions:



# Classification



# Nervous Tissue

- Nervous system is composed of nervous tissue, **which contains two types of cells:**
  1. Nerve cells or Neurons.
  2. Neuroglia (glial cells) or Supporting cells: (**non-neural** cells don't produce electric impulse ).

Nervous system contains billions of neurons that vary in their shape, size, and number of processes.

## 1- Neurons

**What is neuron?** (neurons, nerve fibers or nerve cell all the same meaning)

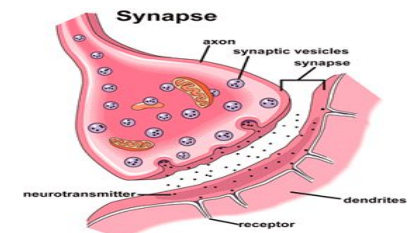
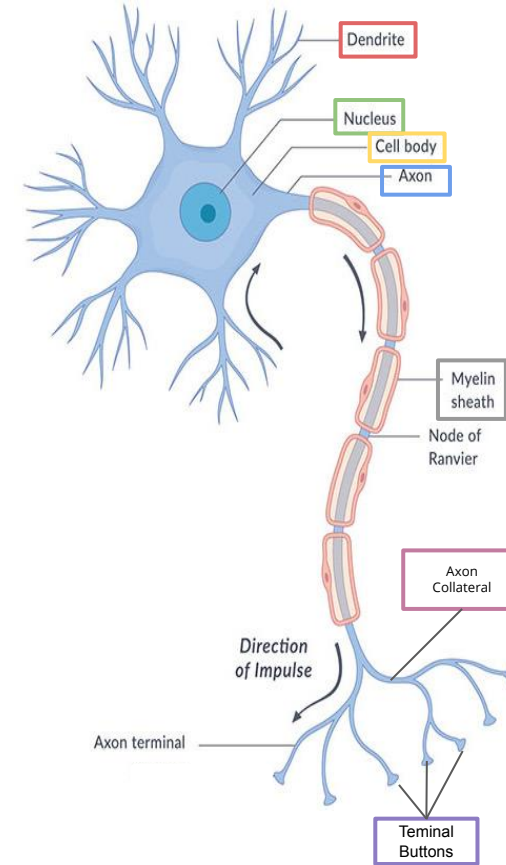
- It is the basic structural (anatomical), functional and embryological unit of the NS.
- The human nervous system is estimated to contain about  $10^{10}$  neurons.
- They shaped in long and skinny to prevent undergoing mitosis or cell division

### Neurons Contain:

- A **Cell Body** (soma) containing a **Nucleus**.
- **Dendrites:** (detect stimulus like environmental changes )
  - Short processes of the cell body with variable numbers and are receptive in function.
  - They carry impulses toward the cell body.
  - Receive signals from other neurons
- **Axon (or Nerve Fiber):** one of the processes leaving the cell body.
  - It is a single process highly variable in length and may divide into several branches or **Collaterals** through which information can be distributed to a number of different destinations.
  - when action potential reaches synaptic knobs it causes release of neurotransmitters
  - Carries information away from the cell body.
  - It send signals to other neurons
- **Terminal Buttons:** specializations occur at the end of the axon. Here information is transferred to the **Dendrites** of other neurons.
- Coverings: **Myelin, Neurilemma.**

## Synapse/Relay

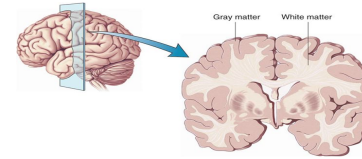
- It's the junction site of two neurons, in the synapses the membranes of adjacent cells are in close apposition (contiguity=contact, not continuity).



# Nervous Tissue

## 2- Neuroglia

- They make the other major cellular component of the nervous tissue.
- It is a specialized connective tissue supporting framework for the nervous system.
- Unlike neurons, 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.
- There are four types of Neuroglia found in the CNS: **astrocytes**, **microglial cells**, **ependymal cells**, and **oligodendrocytes**.



## Organization

### Grey matter

#### Which contains:

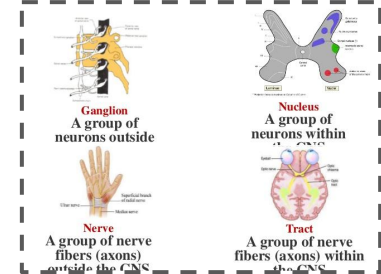
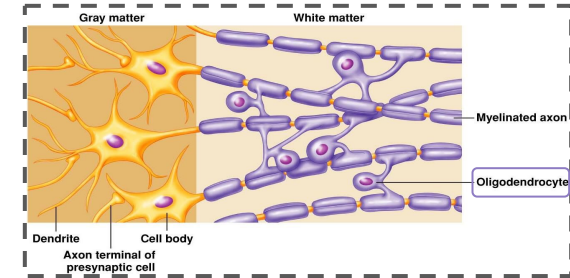
1. Processes of the neurons (axons and dendrites)
2. Neuroglia
3. Blood vessels
4. cell bodies of neurons

The nervous tissue is organized as

### White matter

#### Which contains:

1. Processes of the neurons
2. Neuroglia
3. Blood vessels
4. **NO cell bodies in the white matter.**



## Terminology

Dr's note :  
Optic tract example of axon within CNS,  
optic nerve -> outside CNS

Location	Central nervous system (CNS)		Peripheral nervous system (PNS)	
Term	Nucleus	Tract	Ganglion	Nerve
Definition	A group of neurons within the CNS	A group of nerve fibers (axons) within the CNS	A group of neurons outside the CNS	A group of nerve fibers (axons) outside the CNS
Example	Nucleus proprius	Optic tract	Dorsal root ganglion	Median nerve

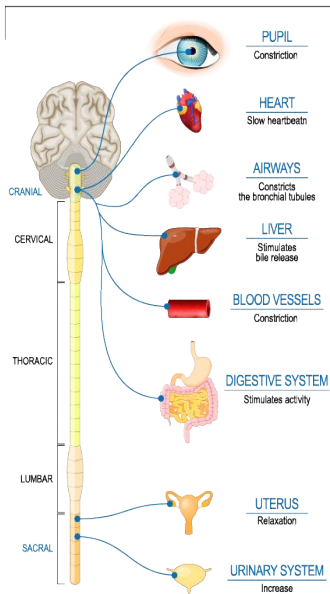
# Autonomic Nervous System

## Autonomic Nervous System

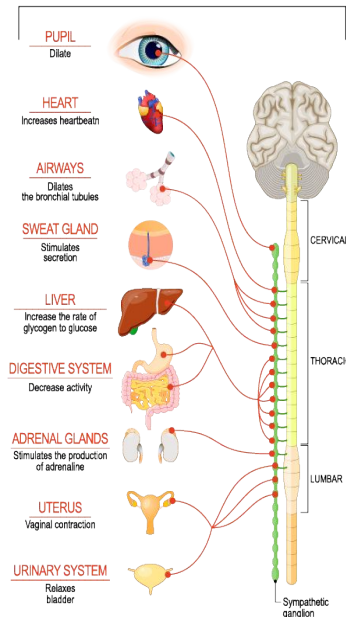
Sympathetic Nervous System  
**Thoracolumbar outflow**

Parasympathetic Nervous System  
**Craniosacral outflow**

### Parasympathetic



### Sympathetic



Divisions generally have **antagonistic** effects on the structures that they innervate. E.g. Sympathetic increases the heart rate, while the parasympathetic decreases heart rate.

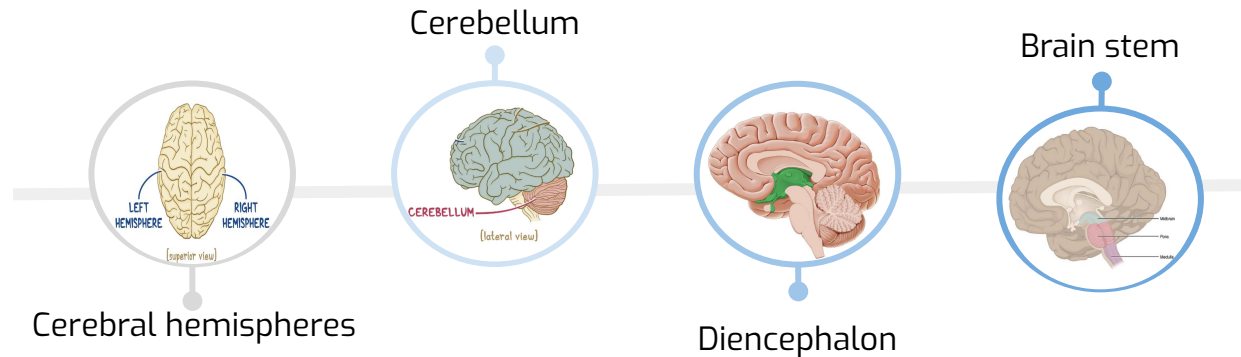
Neurons that detect changes and control the activity of the viscera.

Its components are present in both the central and peripheral nervous systems.

It innervates: smooth muscles, cardiac muscle, secretory glands.

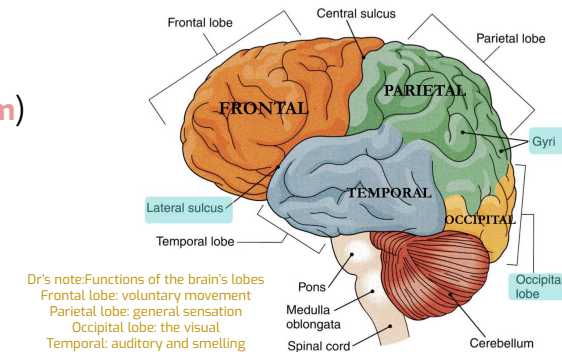
It is an important part of the homeostatic mechanisms that control the internal environment of the body with the endocrine system

# Parts of the Brain



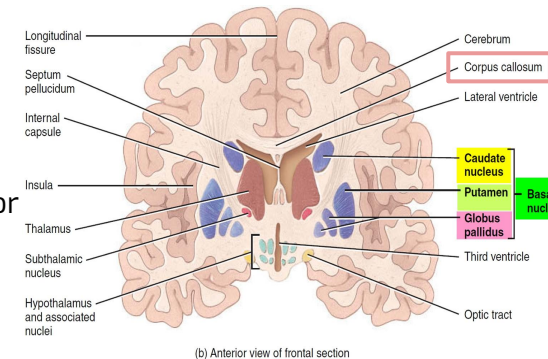
## Cerebral hemispheres

- ❖ Composed of 2 hemispheres connected by a thick bundle of nerve fibers (**corpus callosum**)
- ❖ They have elevations, called gyri that are separated by depressions called sulci.
- ❖ **Dr's note:** Gyri and sulci are important in increasing the surface area of a brain.
- ❖ Each hemisphere is divided into 4 lobes named according to the bone above.
- ❖ Lobes are separated by deeper grooves called fissures or sulci.
- ❖ The largest part of the brain.



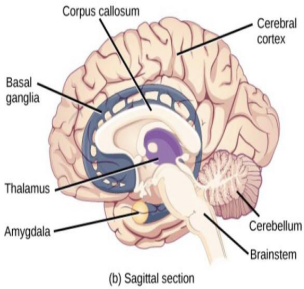
## Tissue of Cerebral hemispheres

- ❖ The outer layer is the gray matter or cortex.
- ❖ Deeper is located the white matter or medulla, composed of bundles of nerves and fibers carrying impulses to and from the cortex.
- ❖ **Basal nuclei** are gray matter that are located deep within the white matter to help the motor cortex in regulation of voluntary motor activities.
- ❖ **Dr's note:** Basal nuclei: most common gray matter in deep white matter and if there are abnormalities within basal nuclei it will affect the movement EX: Parkinson's disease





# Parts of the Brain Cont.



## Parts of the brain

### 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**.

### Brainstem

It is connected to the cerebellum with 3 paired peduncles superior, middle and inferior.

It has 3 parts:  
- Midbrain.  
- Pons.  
- Medulla oblongata.

### Diencephalon

The diencephalon is located between the 2 cerebral hemispheres and is linked to them and to the brainstem.

The major structures are:  
- Thalamus  
- Hypothalamus  
- Subthalamus  
- Epithalamus

Dr's note: Brain stem: it has the most of the central control of the heart and lungs. So if there's degeneration of the blood supply or cut off to brain stem it will lead to brain death ( brain stem death). Another function in maintaining adapt like when you go to a place have a bad smell you'll adapt to it

## Meninges

There are three connective tissue membranes invest the brain and the spinal cord, from outward to inward:

1. Dura mater.
2. Arachnoid mater.
3. Pia mater.

Dr's note: Dura matter the strongest layer and have a subdural matter, arachnoid mater also have the subarachnoid matter last layer and it sticks to the brain is pia mater and don't have sub. لانها لاصقه زي م قلت.

## 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, and it is continuous with central canal of spinal cord.

**Cerebral aqueduct:** in the midbrain connects the 3rd to the 4th ventricle.

## Cerebrospinal fluid

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

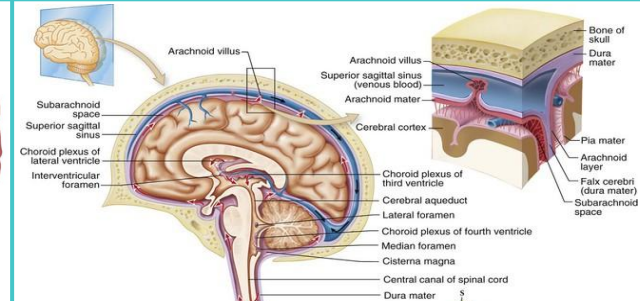
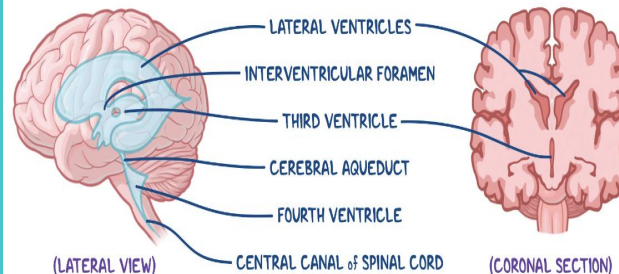
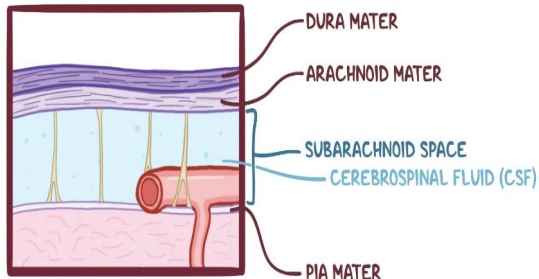
Inside the brain, CSF flows from the lateral ventricles to the 3rd and 4th ventricles

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 through the 3 apertures of the 4th ventricle to distribute in the subarachnoid space around the brain and returns to the dural venous sinuses through the arachnoid villi.

Arachnoid villi are small protrusions of the arachnoid (the second layer covering the brain) through the dura.

Villi absorb cerebrospinal fluid and return it to the dural venous circulation (then to the veins to get rid of it.)



# MCQ

**Q1: Which of the following is NOT found in the White Matter?**

**A: Blood vessels**

**B: Axons**

**C: Cell bodies**

**D: Neuroglia**

**Q2: Which of the following are specializations that occur at the end of the axon?**

**A: Terminal buttons**

**B: Neuroglia**

**C: Dendrites**

**D: Collaterals**

**Q3: Which of the following is FALSE about Neuroglia cells?**

**A: Specialized connective tissue**

**B: Essential for the normal functioning of the neurons**

**C: Support the framework of the nervous system**

**D: They have a direct role in information processing**

**Q4: What do you call a group of neurons outside the CNS?**

**A: Neurons**

**B: Tract**

**C: Ganglion**

**D: Nerve**

**Q5: What structure carries impulses towards the cell body?**

**A: Dendrites**

**B: Terminal buttons**

**C: Axons**

**D: Collaterals**

**Q6: What consists of neurons that convey impulses from receptors located in various parts of the body to the CNS?**

**A: Efferent division**

**B: Sensory division**

**C: Motor division**

**D: Both A&C**

Answer key:  
1 (C) , 2 (A) , 3 (D) , 4 (C) , 5 (A) , 6 (B)

# MCQ

Q7: It is constantly produced by the choroid plexuses inside the ventricle:

- |          |                   |        |        |
|----------|-------------------|--------|--------|
| A: Blood | B: Lymphoid fluid | C: CSF | D: ISF |
|----------|-------------------|--------|--------|

Q8: Which of the following is the largest part of the brain?

- |               |             |                 |               |
|---------------|-------------|-----------------|---------------|
| A: Cerebellum | B: Cerebrum | C: Diencephalon | D: Brain stem |
|---------------|-------------|-----------------|---------------|

Q9: Which of the following is not correct about grey matter?

- |                               |                       |                           |                   |
|-------------------------------|-----------------------|---------------------------|-------------------|
| A: Contain Process of neurons | B: Contains Neuroglia | C: Contains Blood vessels | D: No cell bodies |
|-------------------------------|-----------------------|---------------------------|-------------------|

Q10: Which of the following nervous system functions make decisions?

- |                                |                |                 |                 |
|--------------------------------|----------------|-----------------|-----------------|
| A: Collection of sensory input | B: Integration | C: Motor output | D: Both B and C |
|--------------------------------|----------------|-----------------|-----------------|

Q11: It provides precise coordination for body movements and helps maintain equilibrium:

- |               |               |             |                |
|---------------|---------------|-------------|----------------|
| A: Brain stem | B: Cerebellum | C: Cerebrum | D: Spinal cord |
|---------------|---------------|-------------|----------------|

Q12: The 3rd ventricle is found in:

- |                 |               |                       |                             |
|-----------------|---------------|-----------------------|-----------------------------|
| A: Diencephalon | B: Cerebellum | C: In each hemisphere | D: Between pons and medulla |
|-----------------|---------------|-----------------------|-----------------------------|

Answer key:  
7 (C) , 8 (B) , 9 (D) , 10 (B) , 11 (B) , 12 (A)

# SAQ

Q1: What are the functions of the nervous system?

Q2: Enumerate the ventricles of the brain with their location:

Q3: What are the three connective tissue membranes invest the brain and the spinal cord, from outward to inward?

Q4: What is neuron?

## Answers

1:

- Collection of sensory input
- Integration
- Motor output

2:

- 2 lateral ventricles: One in each hemispheres.
- 3rd ventricle: in the Diencephalon.
- 4th ventricle: between Pons, Medulla oblongata & Cerebellum, and it is continuous with central canal of spinal cord.

3:

- Dura mater -Arachnoid mater -Pia mater

4:

It is the basic structural (anatomical), functional and embryological unit of the NS.

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## A special thanks to Mohamed Alquhidan

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