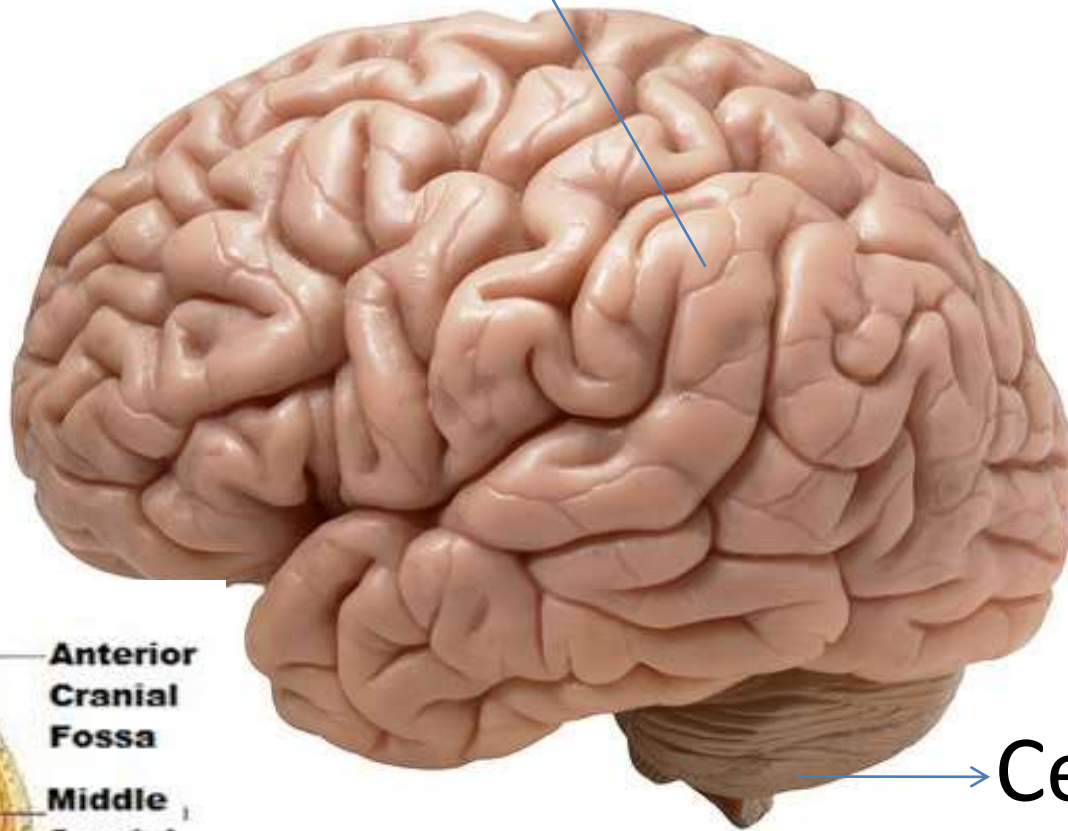


# Cerebellum

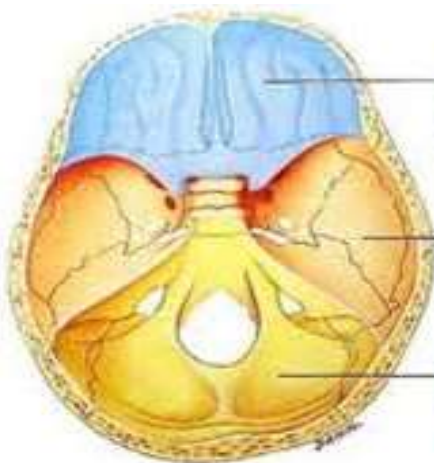
Dr. Rajeev Mukhia  
Faculty of Anatomy



# Cerebrum



# Cerebellum



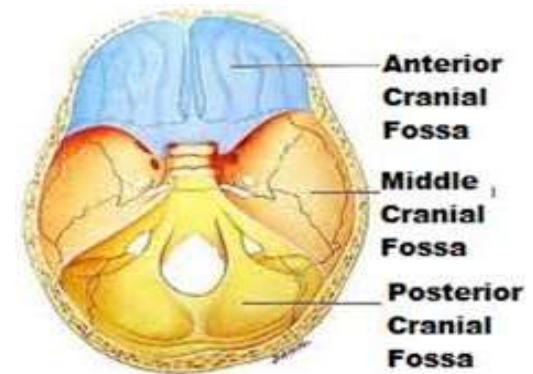
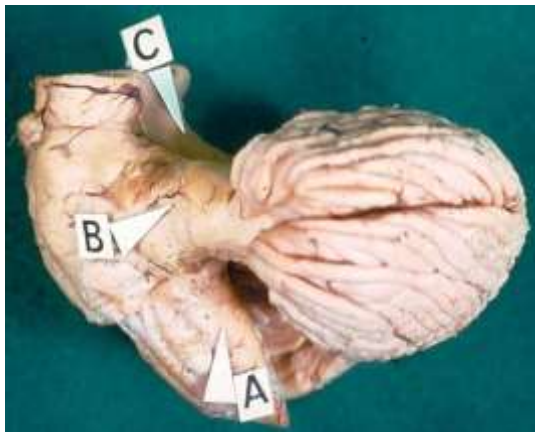
**Anterior  
Cranial  
Fossa**

**Middle  
Cranial  
Fossa**

**Posterior  
Cranial  
Fossa**

# Introduction

- It is a largest part of hind brain and second largest part of brain as a whole.
- Weight – 150 gm.
- Has 2 lobes which lie in posterior cranial fossa of skull.
- It is located underneath the tentorium cerebelli and behind the pons and medulla oblongata.
- It is separated from pons and medulla by a cavity of the fourth ventricle.
- The cerebellum is connected to medulla, pons & midbrain by inferior, middle & superior cerebellar peduncles.
- Peduncles consist of nerve fibers.

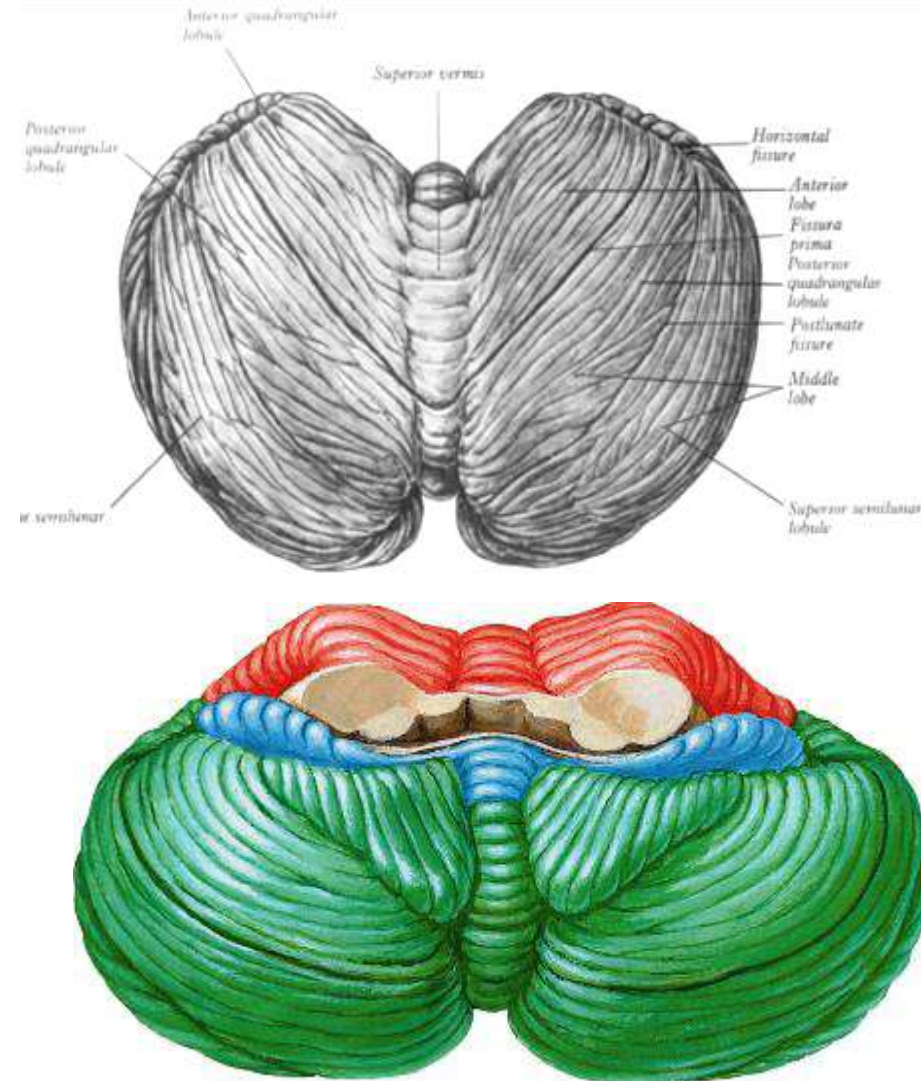


# Functions of cerebellum

- Is mainly motor in function, though it receives lot of sensory information.
- ***Maintenance of Equilibrium***
  - *balance, eye movement*
- ❖ ***Coordination movement of walking and posture maintenace***
  - It ensures that the movements occur smoothly, in the right direction & to the right extent.
- ❖ ***Maintenance of Muscle Tone***
  - Muscle coordination & locomotion control
  - Decides the proper muscle group, force, rate, range & direction & time of movement
- ❖ **Coordination of voluntary motor activity**
  - Helps in articulation & movements

- The external features of cerebellum comprise 3 parts, 2 surface, 2 notches & 3 well-marked fissures.
- **Parts:**
- The cerebellum consist of 2 large lateral hemispheres which are united to each other by a narrow worm like portion, called vermis.
- The superior and inferior aspect of vermis are termed as superior and inferior vermis respectively.
- The superior vermis is continuous on either side with the superior surface of cerebellar hemisphere.
- The inferior vermis is more clearly demarcated from the hemispheres in the floor of vallecula cerebelli.

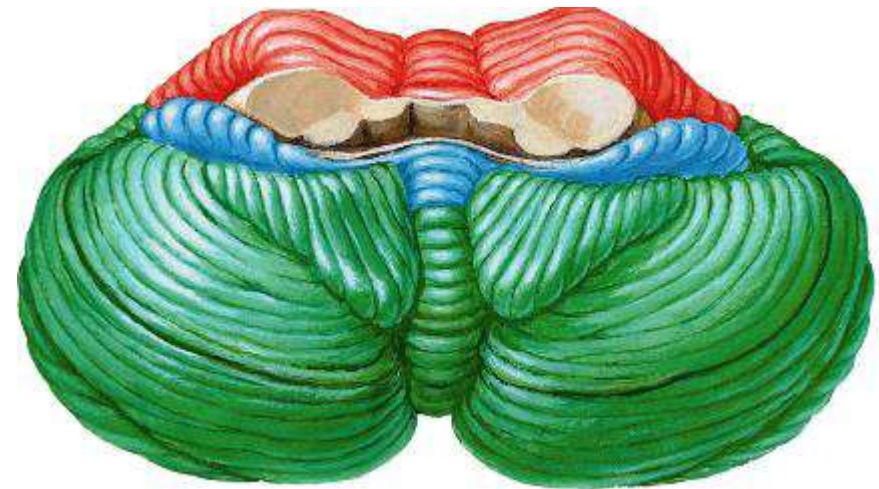
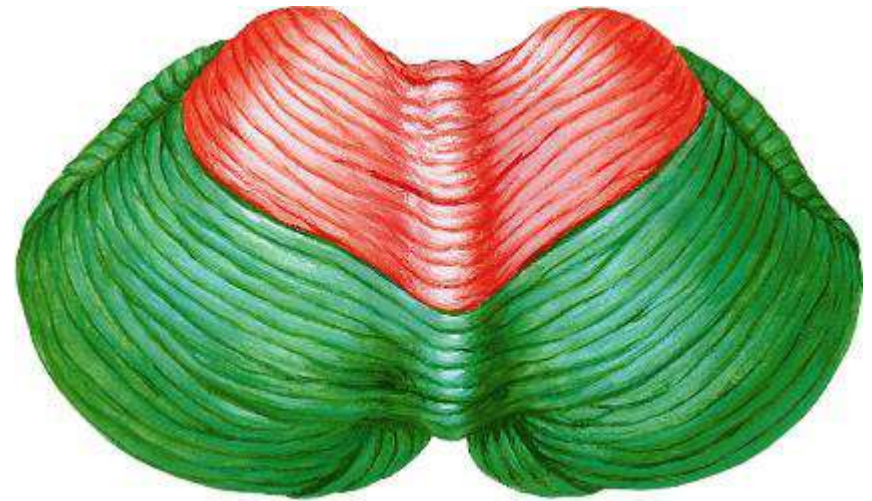
## External features





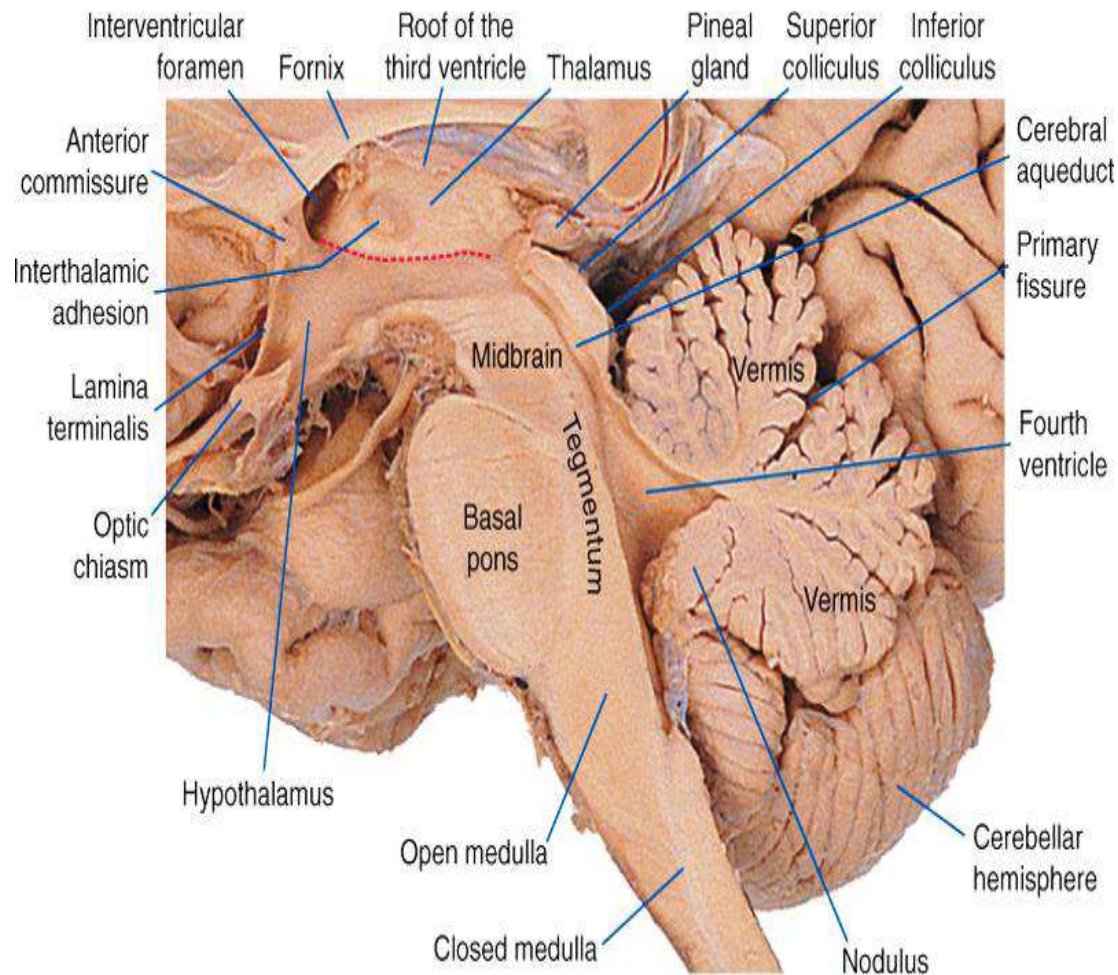
- Upper surface –the superior surface is convex. It is sloping & flat, fits under tentorium cerebelli.
- Upper midline strip is elevated & sloping called superior vermis.
- Lower surface– rounded, fits in rounded posterior cranial fossa of skull.
- Lower surface shows a deep groove in the midline called vallecula which separates the two cerebellar hemispheres.
- An elevated strip lies in it in the midline called inferior vermis.

## 2 Surfaces



# External appearance

- Gray matter is thrown in narrow gyri or folia, transversely arranged.
- On section, it looks like branches of a tree. This pattern is called "arbour vitae".
- The region in & around midline is called vermis.
- Remainder is called hemisphere



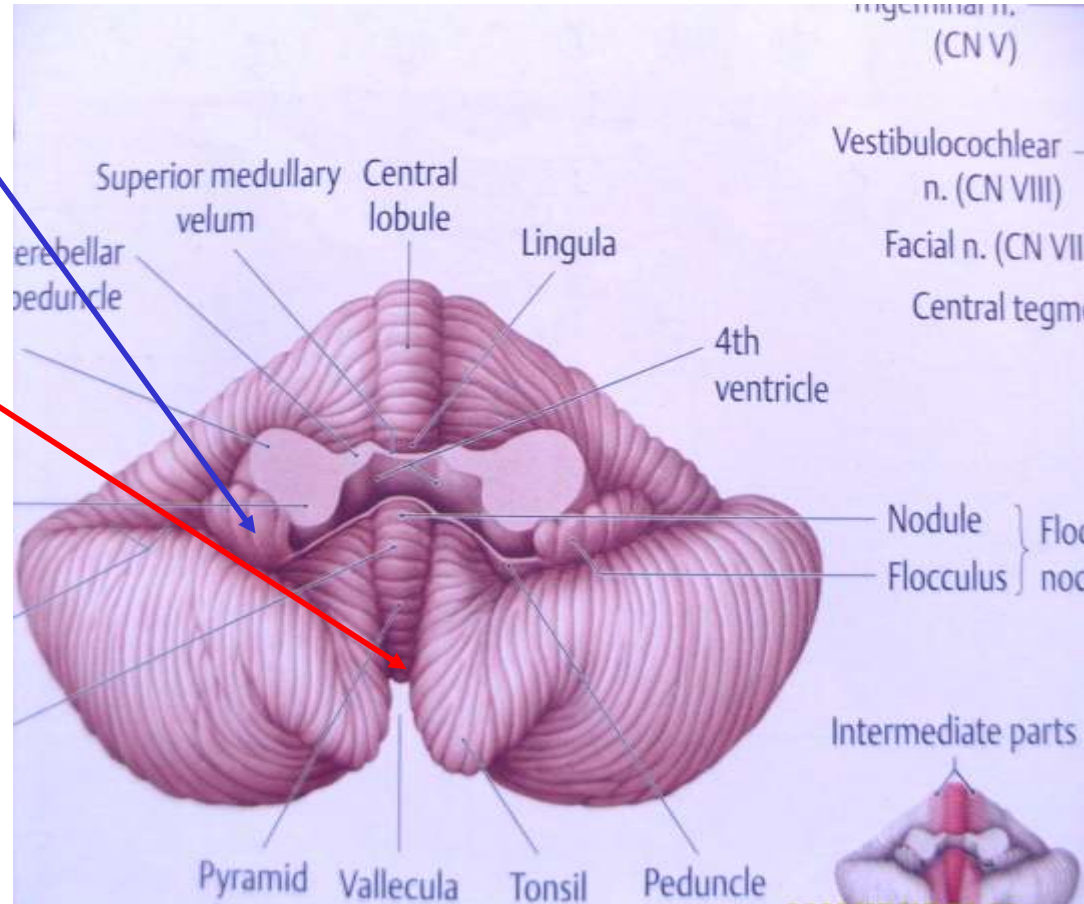
# External features

## 2 Notches:

The anterior aspect of cerebellum is marked by a wide shallow anterior cerebellar notch which accommodates pons and medulla. The posterior cerebellar notch is deep and narrow, and lodges the falx cerebelli.

Flocculus

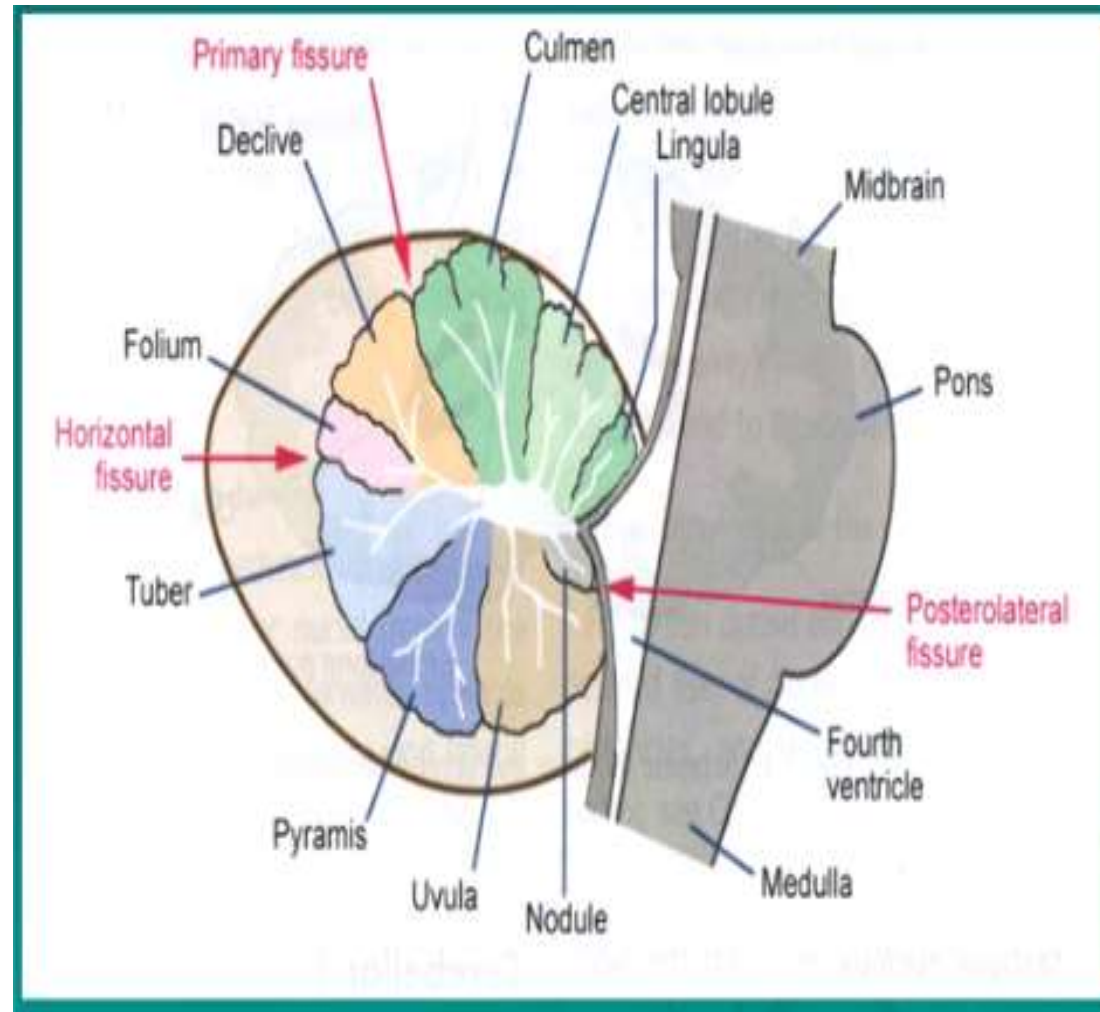
Valecula





# 3 Fissures

- **Primary fissure**— fissura prima , between culmen & declive parts of vermis. It divides the corpus cerebelli into anterior and posterior lobes.
- **Postero lateral** fissure, it lies on the inferior surface of the cerebellum. It separates the flocculo-nodular lobe from the rest of cerebellum.
- **Horizontal fissure**— between folium & tuber vermis, runs horizontally separating superior & inferior surfaces.

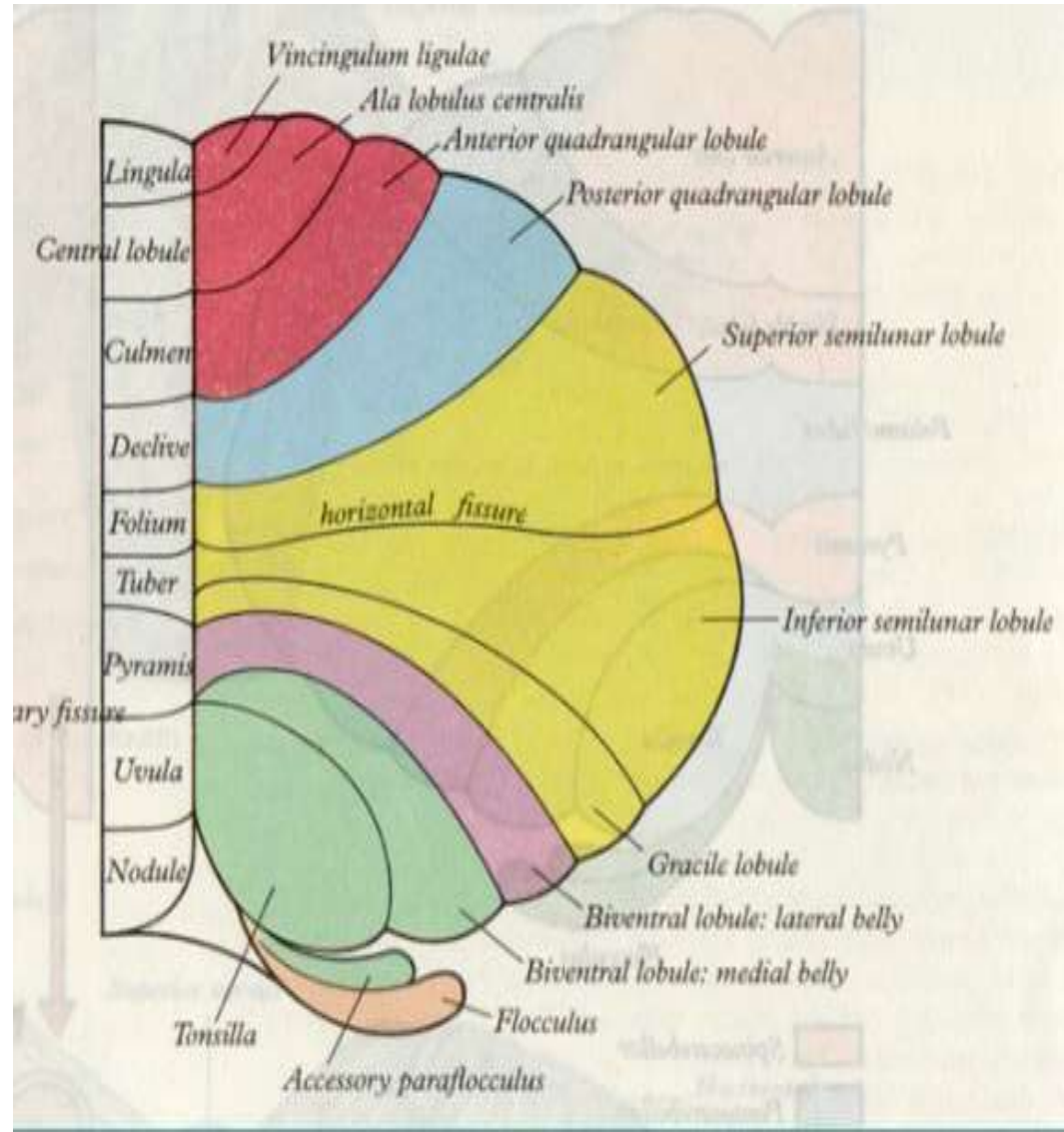


# Subdivision of Vermis

- From anterior to posterior—
- lingula,
- central lobule,
- culmen,
- declive,
- folium vermis,
- tuber vermis,
- pyramid,
- uvula &
- nodule

**Superior  
vermis**

**Inferior  
vermis**

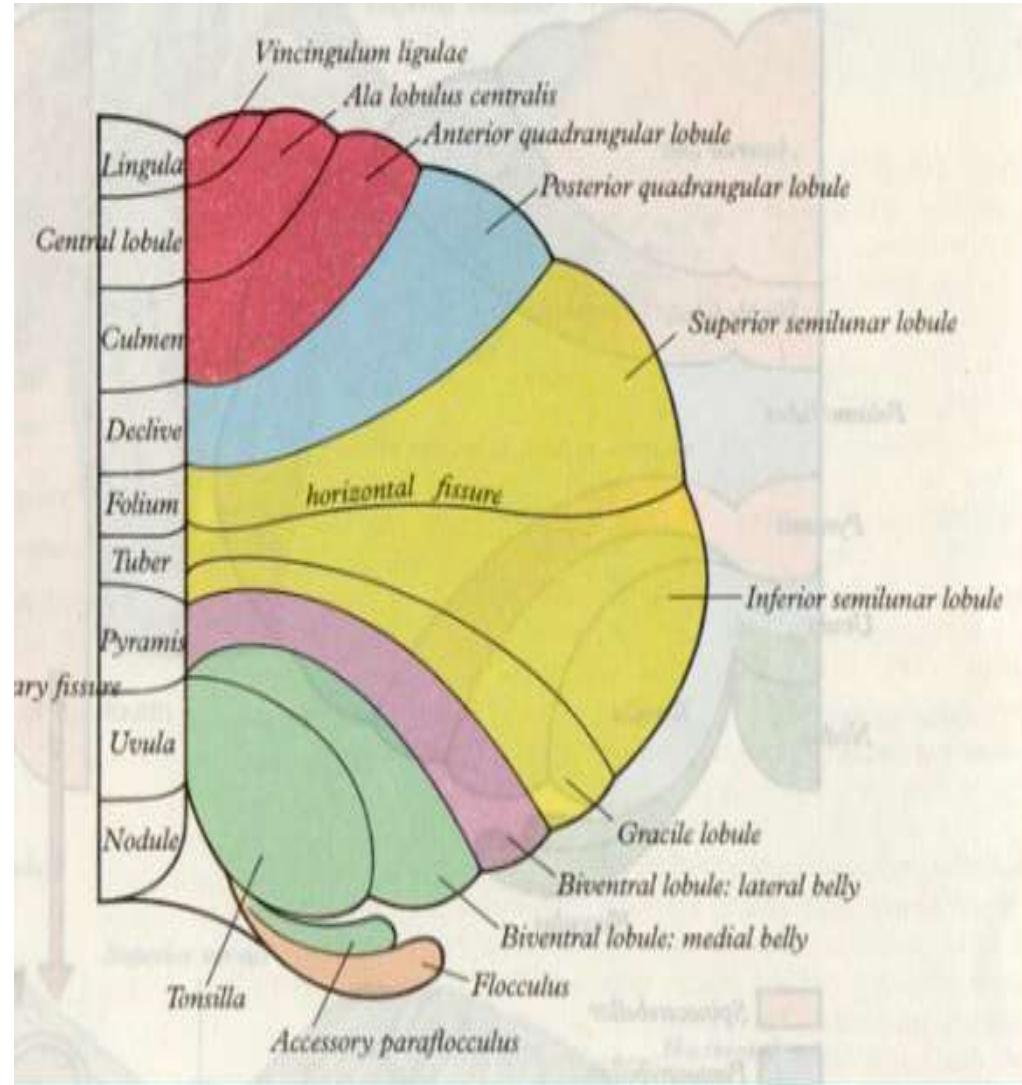


# 3 Lobes- phylogenetic, functional & anatomical

- **Phylogenetic lobes—**
  - Archicerebellum – oldest, concerned with equilibrium.
  - Paleocerebellum –oldest, concerned with muscle tone.
  - Neocerebellum-newest, concerned with muscle coordination
- **Functional lobes—**
  - Vestibulo cerebellum connected to vestibular nuclei
  - Spino cerebellum- connected to spinal cord
  - Cortico-ponto cerebellum-connected to cerebrum & pons

- **Anatomical lobes—3**
- **Flocculo nodular lobe**—made up of flocculus & nodule.
- This is the most anterior part.
- **Anterior lobe** — anterior to primary fissure. Has lingula, central lobule, culmen, uvula & lateral lobes.
- **Posterior lobe**—
- Lies posterior to primary fissure
- Is seen on both superior & inferior surfaces
- Declive, folium & tuber vermis, pyramid & lateral expansions.

# Lobes



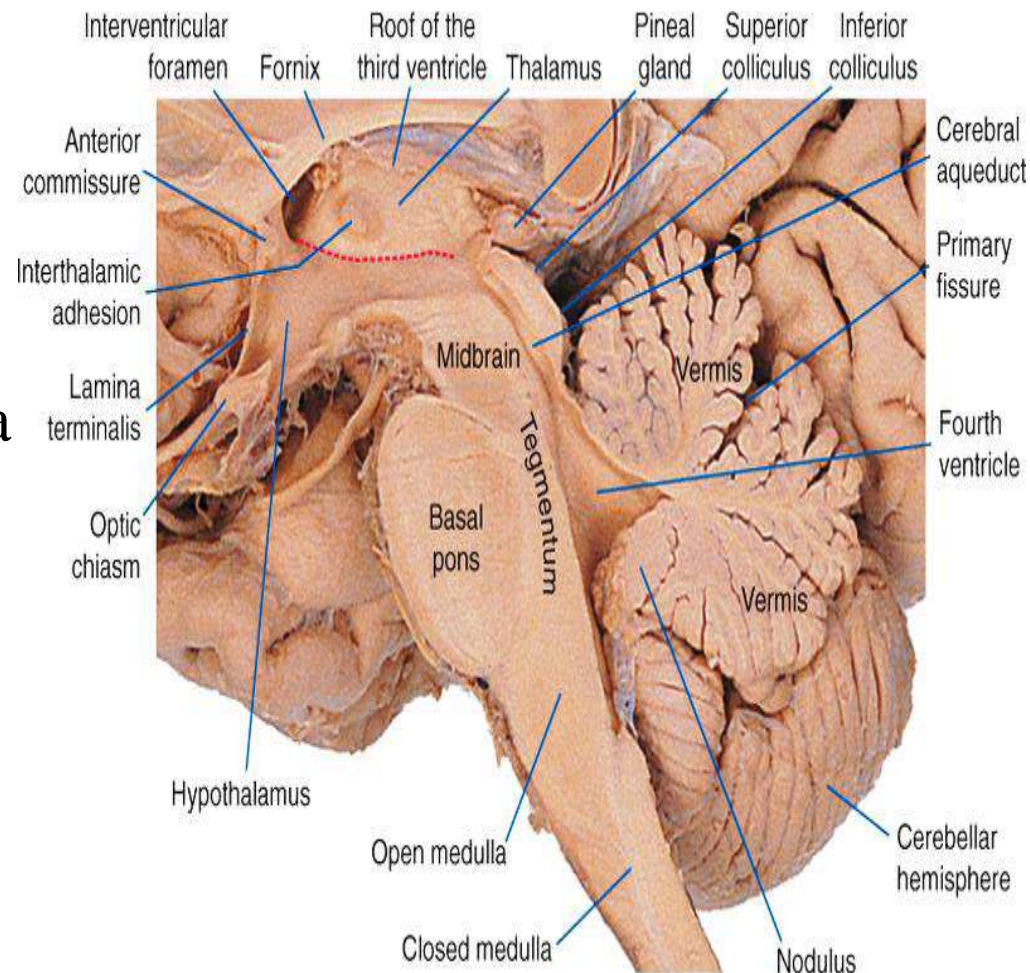


# Lobes

Anatomical lobes	Phylogenetic lobes	Functional lobes	Functions
Flocculo nodular	Archi cerebellum	Vestibulo cerebellum	Maintain equilibrium
Anterior	Paleo cerebellum	Spino cerebellum	Maintain muscle tone
Posterior	Neo cerebellum	Cortico- ponto cerebellum	Maintain muscle coordination

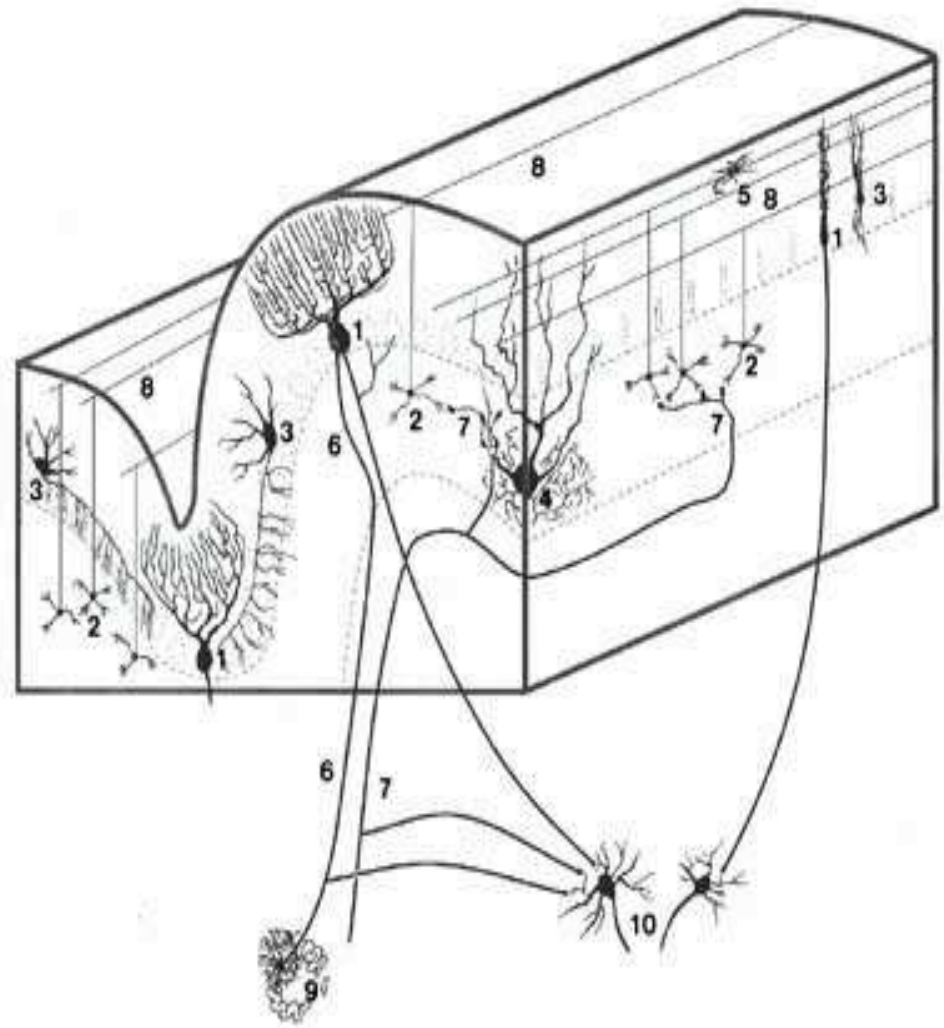
# Relations

- Superiorly, tentorium cerebelli & above that occipital lobe of cerebrum.
- Inferiorly, posterior cranial fossa
- Anteriorly, 4<sup>th</sup> ventricle & brain stem i.e. pons & medulla
- Posteriorly, transverse venous sinus in its groove



# Internal structure

- It has outer cortex made of gray matter, inner medulla made of white matter.
- Cerebellar cortex is made of neurons mostly & nerve fibers.
- Cortex has 3 layers.
  1. Outer molecular,
  2. Middle Purkinje cell layer &
  3. Deepest granular cell layer.
- Medulla or white matter has nerve fibers of mostly 2 types. They are mossy fibers & climbing fibers.
- Medulla also has 4 deep cerebellar nuclei.



# Cerebellar nuclei

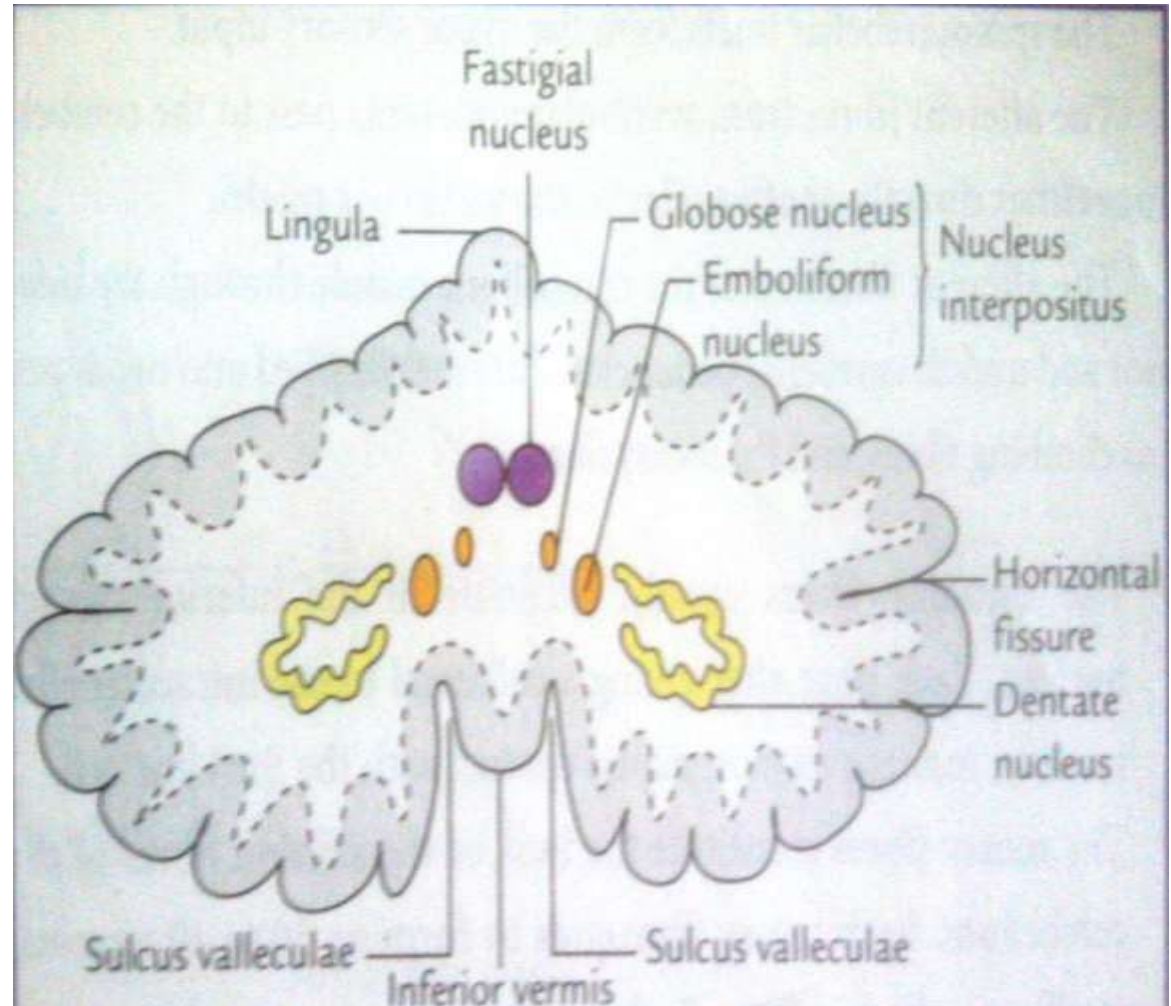
- Four nuclei in each hemisphere.
- These include from **medial to lateral side**:

1. Fastigial

2. Globos

3. Emboliform

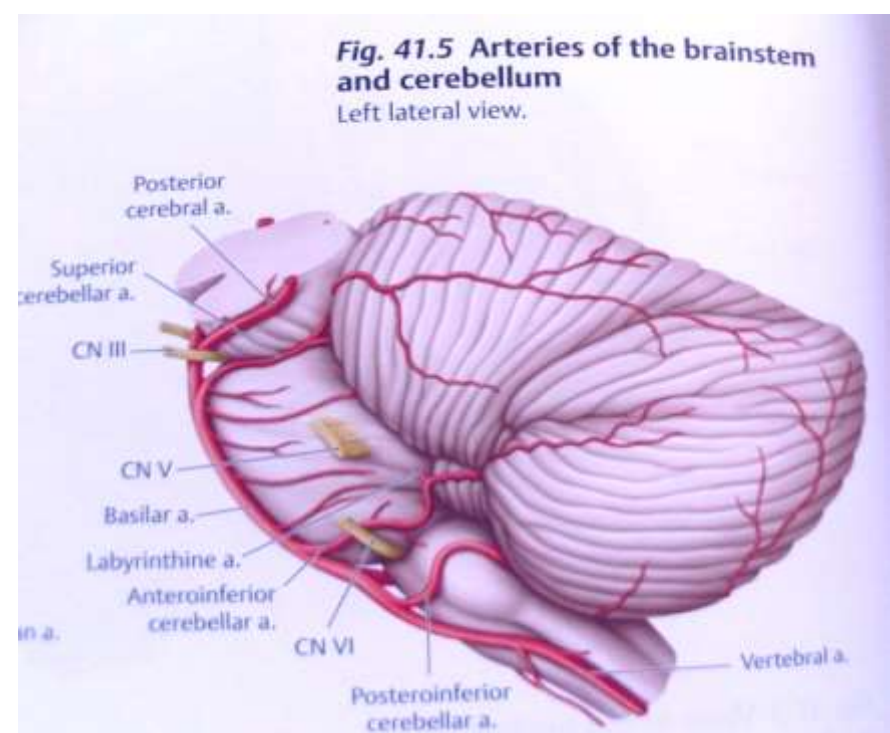
4. Dentate



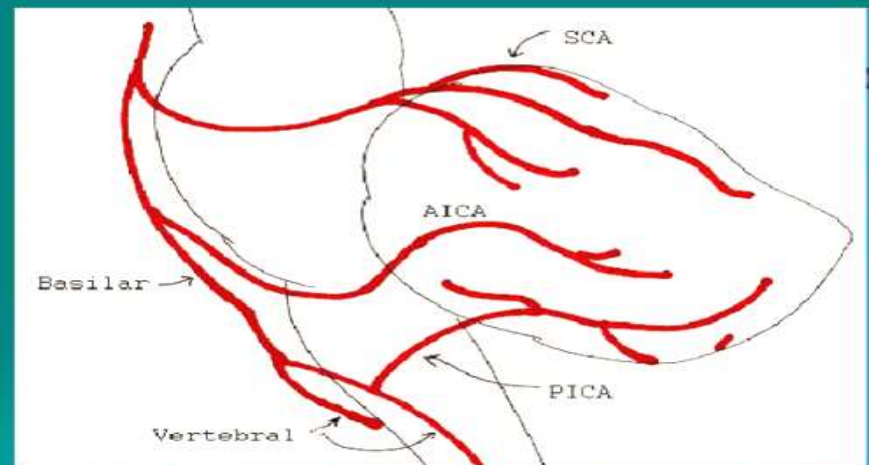


# Blood supply of Cerebellum

- superior cerebellar artery—branch of basilar artery
- 2 inferior arteries--
- Anterior inferior cerebellar artery—branch of basilar artery
- Posterior inferior cerebellar artery—branch of vertebral artery



## BLOOD SUPPLY OF THE CEREBELLUM



All major arteries are highly anastomotic

# Applied Anatomy

The cerebellar lesion due to trauma, vascular occlusion, tumours etc produce a no of signs and symptoms which together constitute the cerebellar syndrome.

The signs and symptoms are as follows:

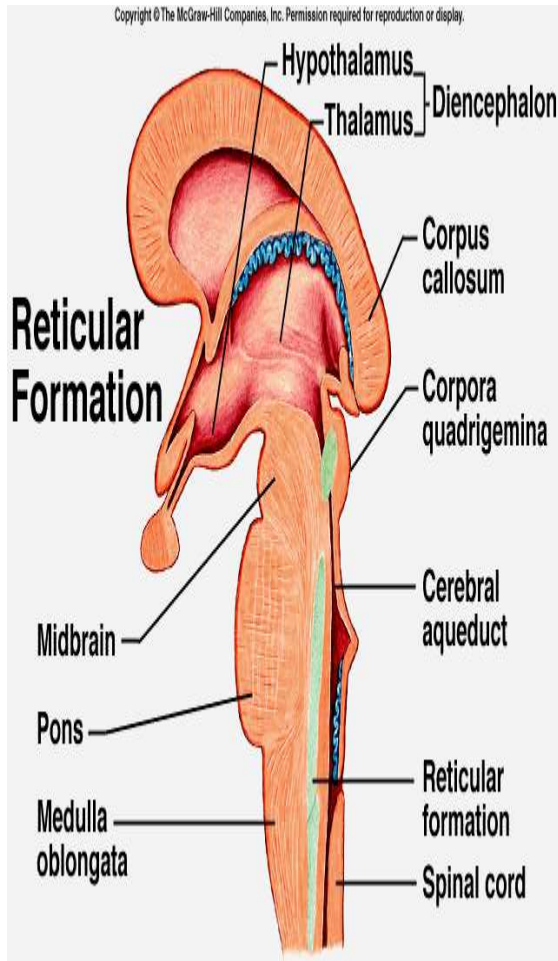
**Ataxia:** incoordination of movement

- the patient is unsteady while standing and walking.

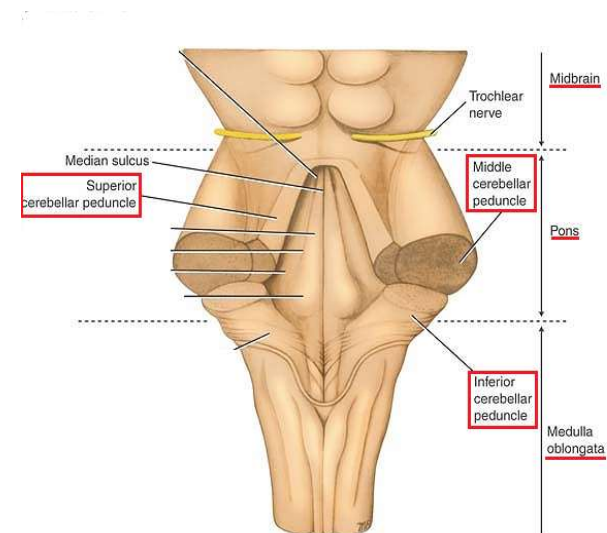
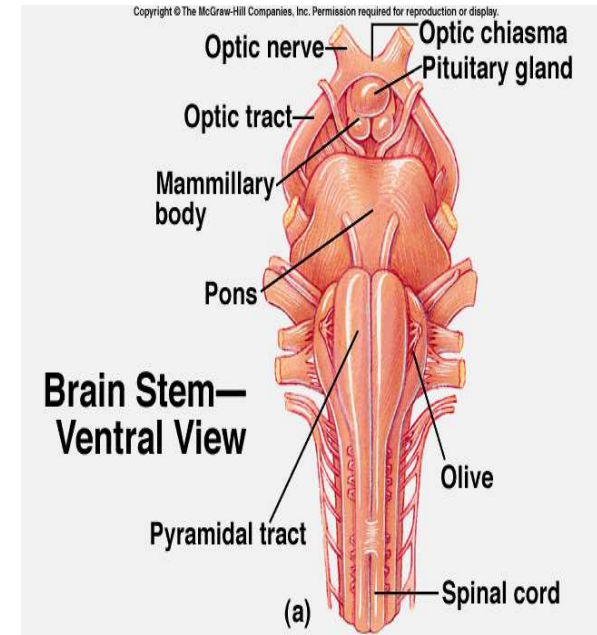
**Nystagmus:** the involuntary movements of the eyeballs while looking to either side.

- **Dysmetria:** inability to measure the distance correctly from reaching an intended target described as past-pointing.

- **Dysdiadochokinesia:** inability to execute alternate movements in rapid succession, eg: pronation and supination of the forearm.



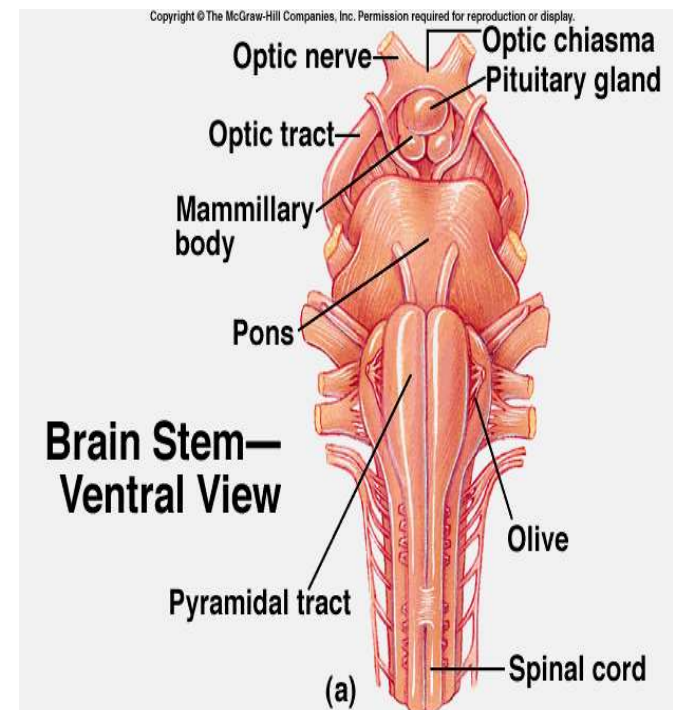
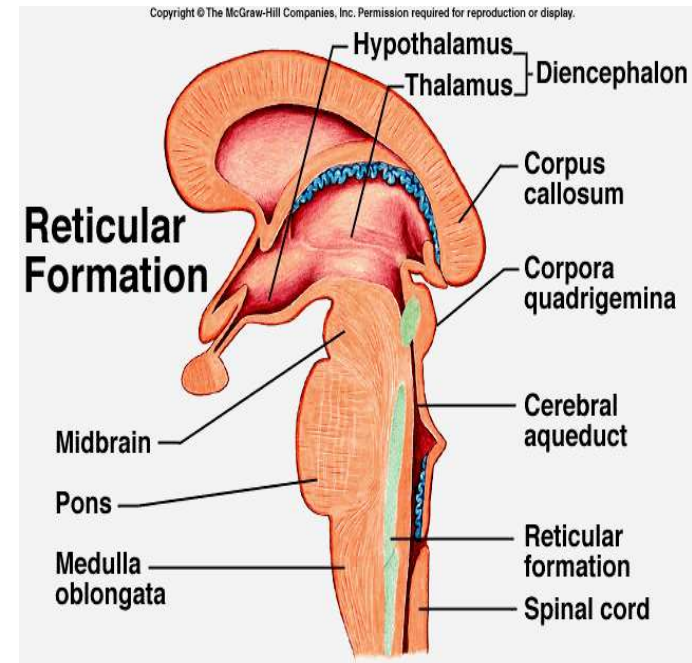
# BRAINSTEM



# Introduction

- The brainstem is the stalk-like part of the brain which connects the spinal cord with the forebrain.
- From below upwards it consists of 3 parts
  1. Medulla oblongata
  2. Pons
  3. Midbrain

The midbrain is continuous above with the cerebral hemispheres & the medulla oblongata is continuous below with the spinal cord.

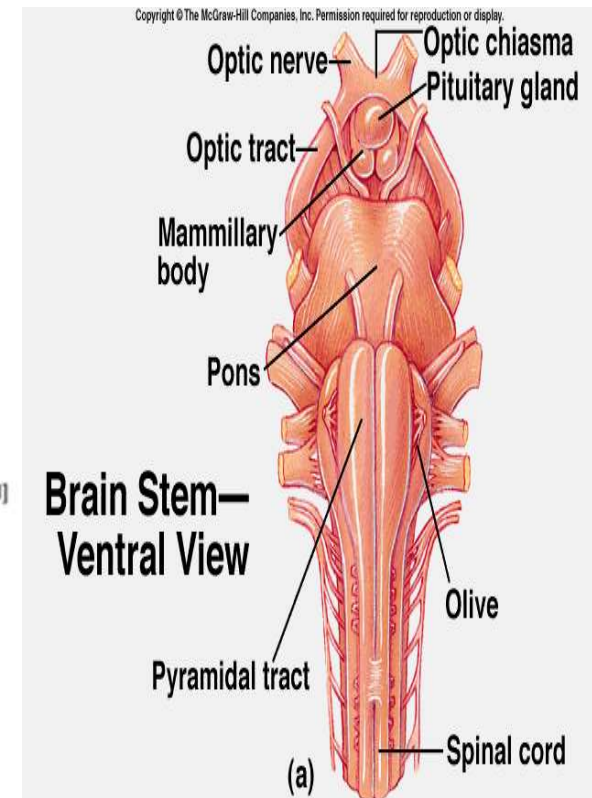
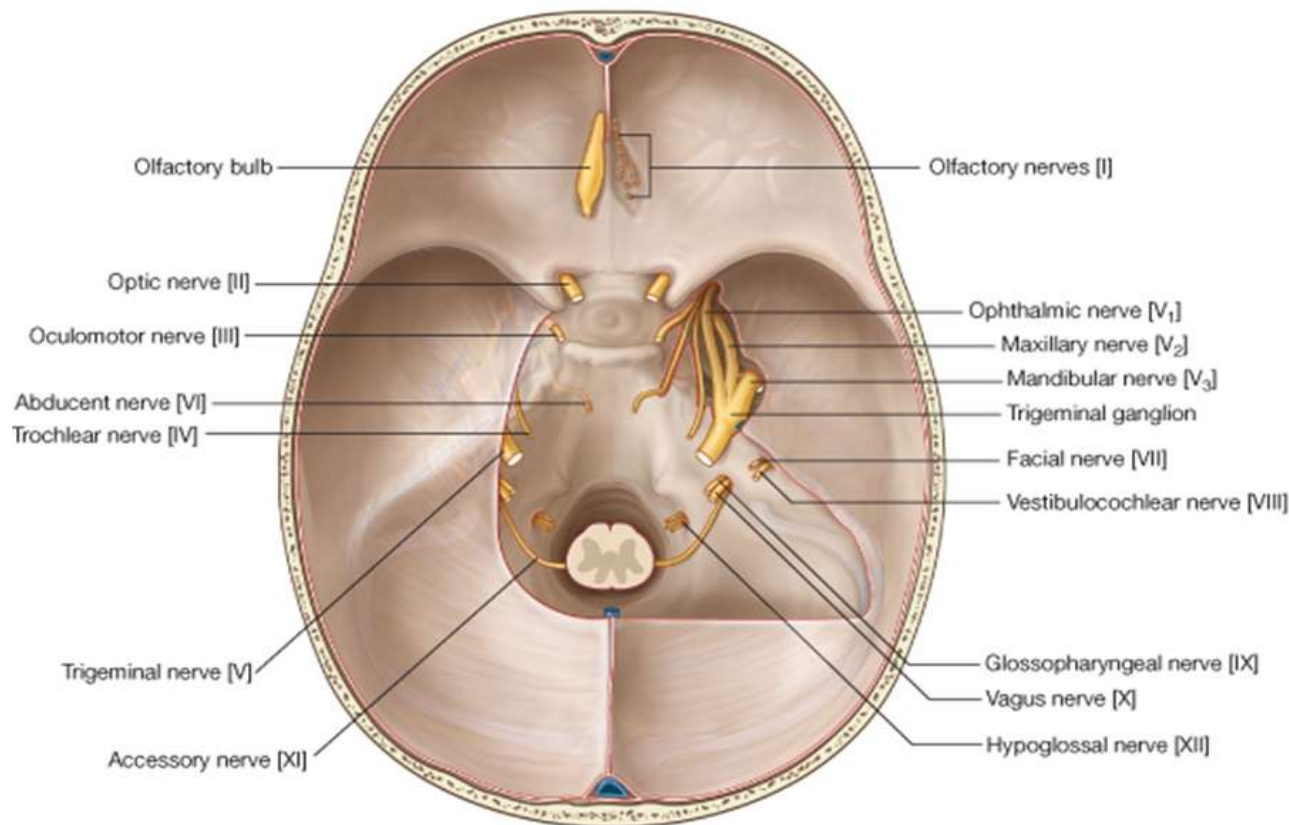




# Location of brainstem

Location – it is located in the posterior cranial fossa. Its ventral surface lies on the clivus of the skull.

Posteriorly, the pons & medulla are separated from the cerebellum by the cavity of the fourth ventricle.



# Functions

1. It provides passage to various ascending & descending tracts that connect the spinal cord to the different parts of the forebrain.
2. It contains important autonomic reflex centres (vital centres) associated with the control of respiration, heart rate & blood pressure.
3. It contains reticular activating system which controls consciousness.
4. It contains important nuclei of the last ten cranial nerves (IIIrd to XIIth).

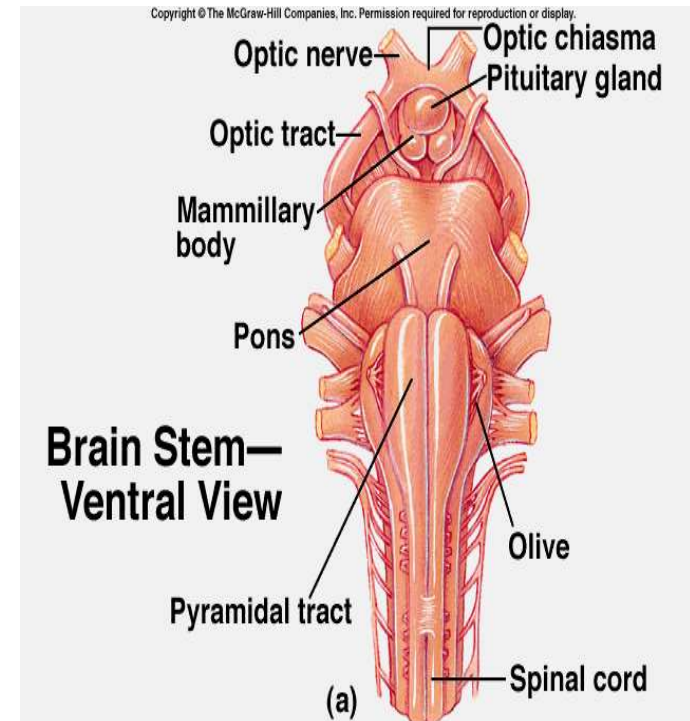
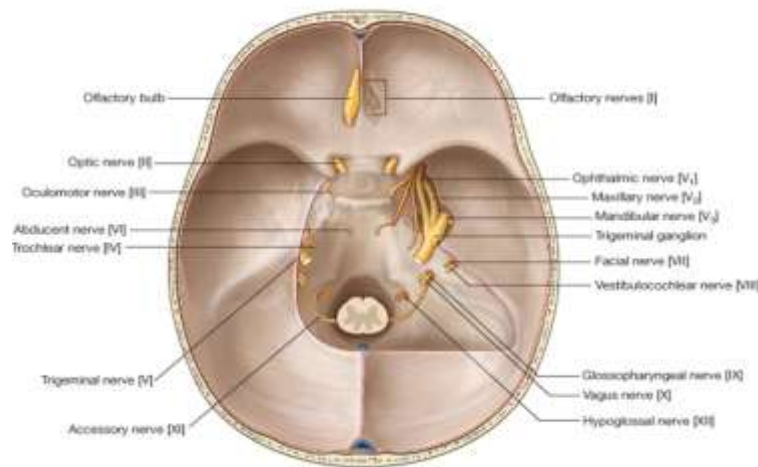
# Medulla Oblongata

The medulla oblongata is the direct upward continuation of the spinal cord, extending from foramen magnum to the lower border of pons.

It forms the lowest part of brainstem.

Location – lies almost vertically in the anterior part of the posterior cranial fossa between the clivus in front & the vallecula of the cerebellum behind.

Shape – like a truncated cone ( bulb-like)  
hence, its alternative name is bulb.

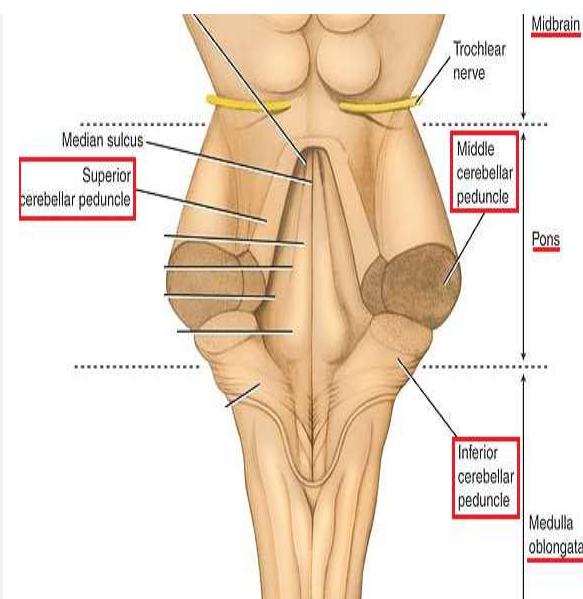
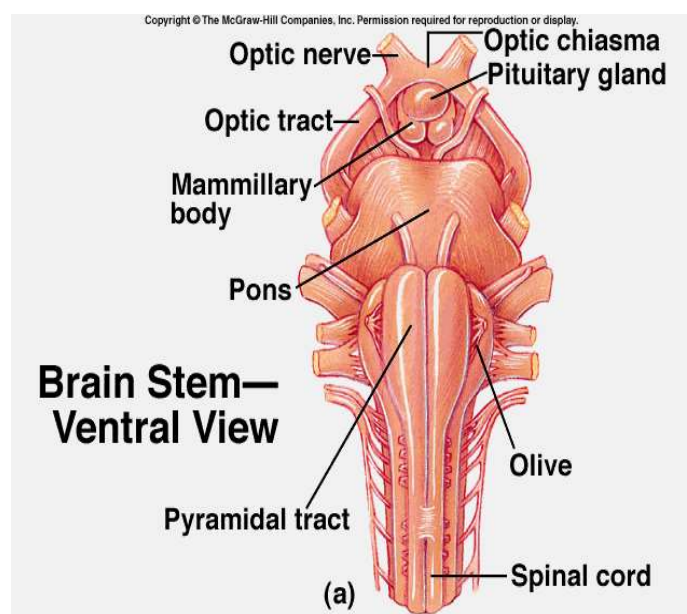


## Measurements

Length – 3cm

Breadth – 2cm

Thickness – 1.25cm



The medulla contains vital centres which are essential for life.

These are 1. Cardiac centre 2. Vasomotor centre 3. Respiratory centre.

Medulla provides attachment to last 4 cranial nerves.

The lower part of medulla like the spinal cord contains the central canal.

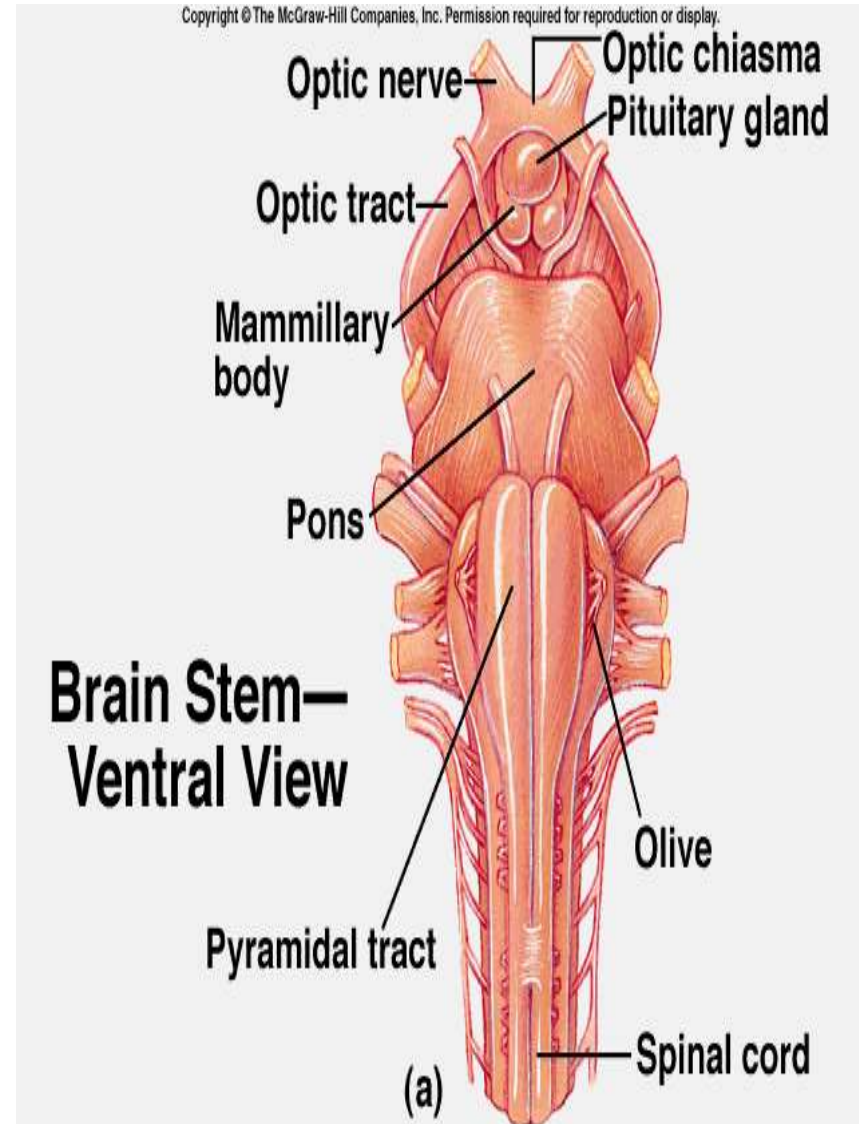
In the upper part of the medulla this canal widens & moves dorsally to form the lower part of fourth ventricle.

Thus, the medulla is divided into lower closed part & upper open part.



# External features

1. Anterior median fissure
2. Posterior median sulcus
3. Foramen caecum
4. Decussation of pyramids
5. Anterolateral sulci
6. Posterolateral sulci
7. Anterior region
8. Lateral region
9. Posterior region



# Features on the ventral aspect of medulla

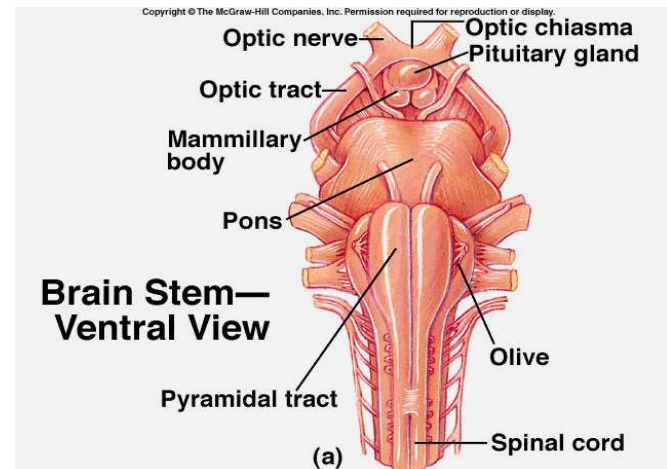
1. Pyramids – these are two elongated elevations, one on either side of anterior median fissure & are produced by the corticospinal (pyramidal) fibres.

Most of these fibres (75%) crosses to the opposite side ie. Pyramidal decussation in the lower part of medulla & then descends as lateral corticospinal tract in the lateral white column of the spinal cord.

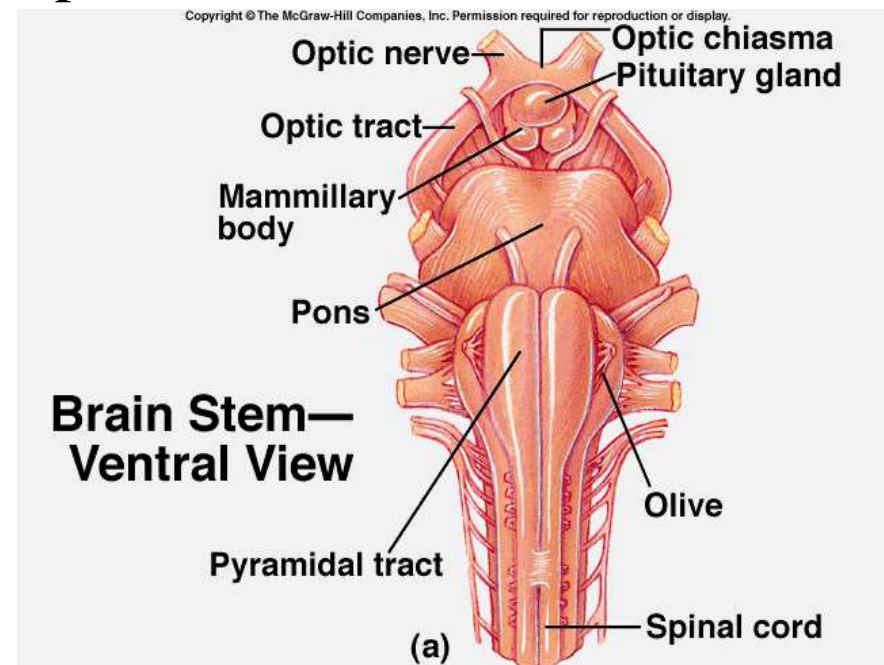
About 20% of the fibres runs downward as anterior corticospinal tract in the anterior white column of the spinal cord.

About 5% run downwards along with uncrossed fibres in the lateral white column of the spinal cord.

2. Olives – these are oval elevations, posterolateral to the pyramids & are produced by an underlying mass of gray matter called inferior olivary nucleus.



3. Rootlets of the hypoglossal nerve – they emerge from the anterolateral sulcus between the pyramid & the olive.
4. Inferior cerebellar peduncles – these are thick bundles of fibres lying posterolateral to the olive, & attach the medulla with the cerebellum.
5. Rootlets of the IXth, Xth & XIth (cranial part) cranial nerves. These emerge through the posterolateral sulcus separating the olive from the inferior cerebellar peduncle.

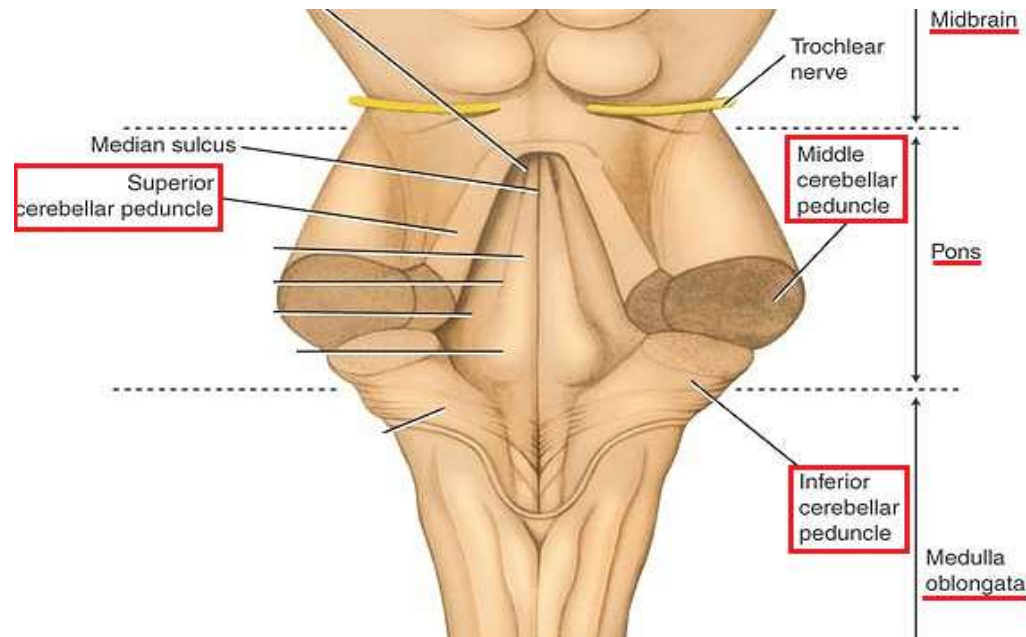


# Features on the dorsal aspect of medulla

The dorsal aspect of the medulla is well demarcated into lower closed & upper open parts.

Features of the closed part – the closed part on either side of posterior median sulcus, presents 3 longitudinal elevations. From medial to lateral these are fasciculus gracilis & fasciculus cuneatus & inferior cerebellar peduncle. The upper ends of the fasciculus gracilis & fasciculus cuneatus expand to form the gracile & cuneate tubercles respectively due to underlying nuclei of the same name.

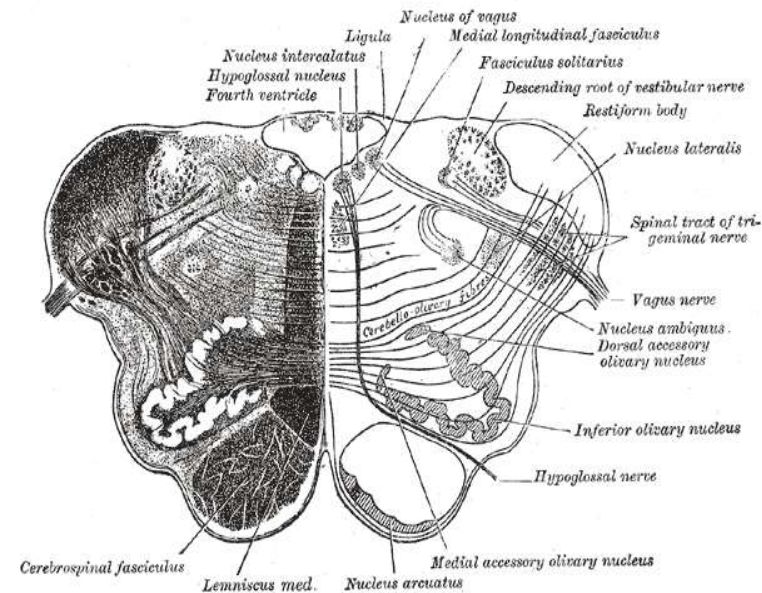
Features of the open part – the open part of the medulla forms the lower part of the floor of fourth ventricle, which presents numbers of features like median sulcus, hypoglossal triangle & vagal triangle etc.





# Internal structure

- The medulla also contains white matter which surrounds the central mass of grey matter but in later the grey matter is broken up into nuclei that are separated by nerve fibres.
- It shows
  1. Nucleus gracilis & Nucleus cuneatus
  2. Spinal tract & nucleus of trigeminal nerve
  3. Spinal nucleus of accessory nerve
  4. Hypoglossal nucleus
  5. Dorsal nucleus of vagus
  6. Olivatory nuclei
  7. Spinocerebellar & spinothalamic tract
  8. Ascending & descending tracts



# Blood supply of the Medulla

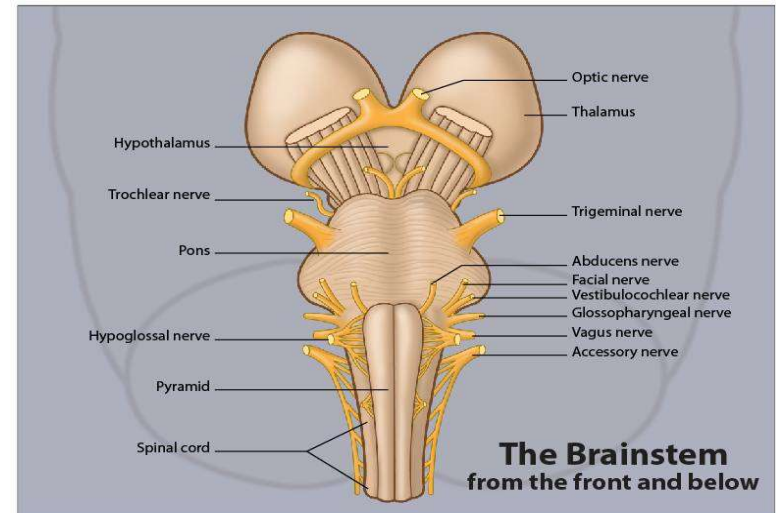
- Two vertebral arteries.
- Anterior & Posterior spinal arteries.
- Anterior & Posterior inferior cerebellar arteries.
- Basilar artery.
- **Vascular Disorders of Medulla Oblongata**
- **Lateral medullary syndrome** – the dorsolateral part of the medulla is supplied by the posterior inferior cerebellar artery. Thrombosis of posterior inferior cerebellar artery therefore, affects a wedge-shaped area on the dorsolateral aspect of medulla.
- Also known as syndrome of Wallenberg.
- **Medial medullary syndrome** – the paramedian region of the medulla is supplied by the branches of vertebral artery. The vascular involvement of this region leads to medial medullary syndrome.
- Also known as Dejerine's anterior bulbar syndrome.

# PONS

- The pons is the middle part of brainstem.
- Situated between the midbrain & the medulla.
- It lies in the posterior cranial fossa on the clivus anterior to the cerebellum.
- On either side, the pons is continuous as the middle cerebellar peduncle, thus forming a bridge between the two cerebellar hemispheres, hence its name, pons (bridge).
- It forms the upper half of the floor of fourth ventricle.
- **Measurement**

2.5cm long

3cm width



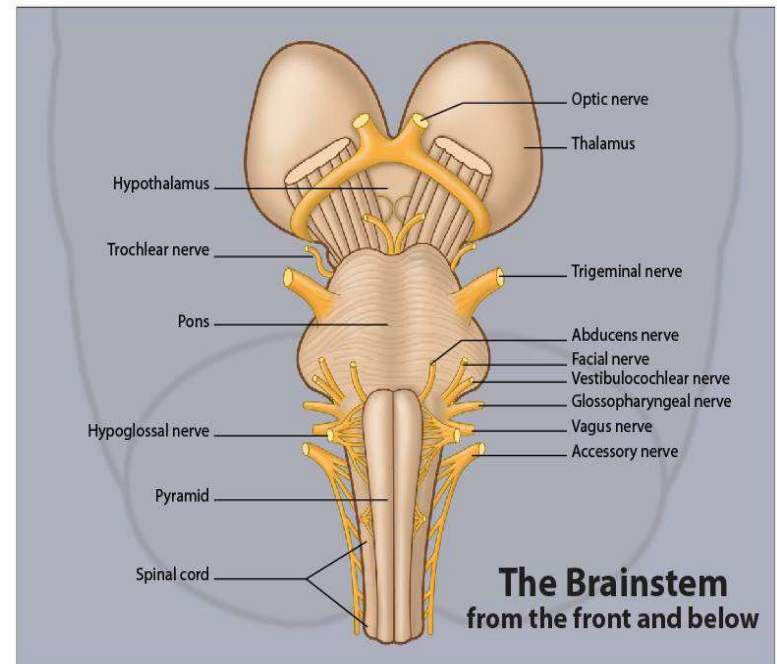
# External features

2 surface

Ventral & Dorsal

2 borders

Superior & Inferior



Anterior surface – is convex in both direction.

In the median plane it presents a vertical groove, the basilar groove, which lodges the basilar artery.

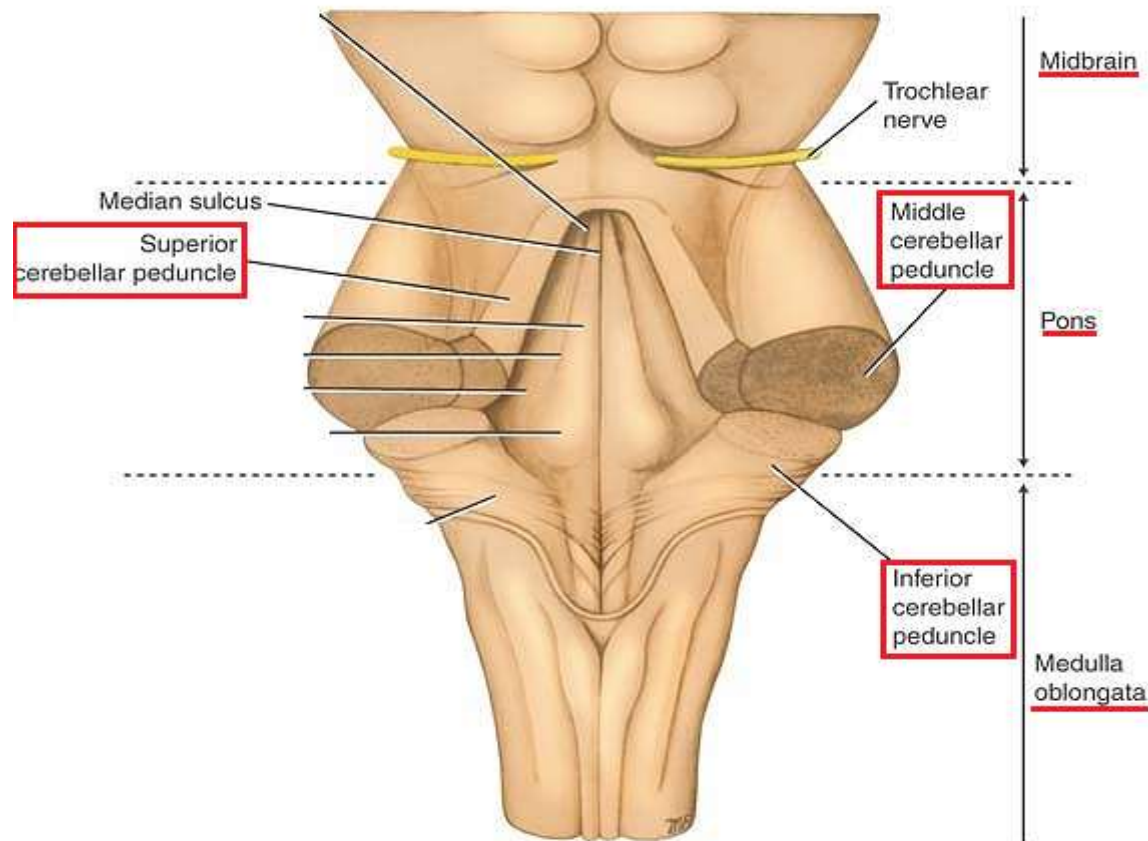
The trigeminal nerve is attached to this surface by two roots.

Small motor & Large sensory root. Motor root lies medial to the sensory root.

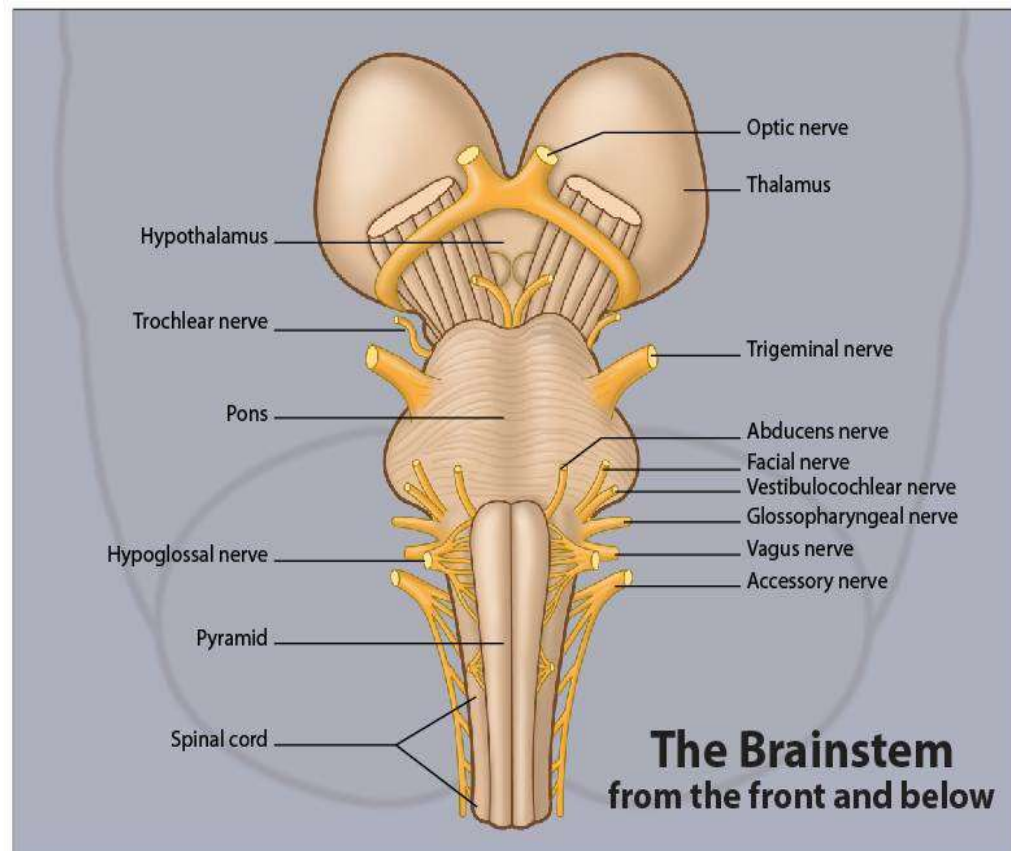
Pontomedullary junction is marked by shallow groove. In this groove from medial to lateral, the abducent, facial, & vestibulocochlear nerve emerge.



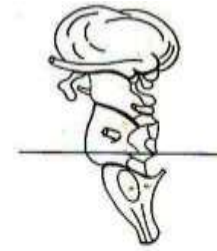
- Dorsal surface – it is covered by the cerebellum, & separated from it by the cavity of the fourth ventricle.
- The dorsal surface of the pons is triangular in shape & forms the upper part of the floor of the fourth ventricle.



- Superior border – the cerebral peduncles are attached to this border.
- The superior border provides attachment to the oculomotor & trochlear nerves.
- Inferior border – the upper end of the medulla is continuous with this border.

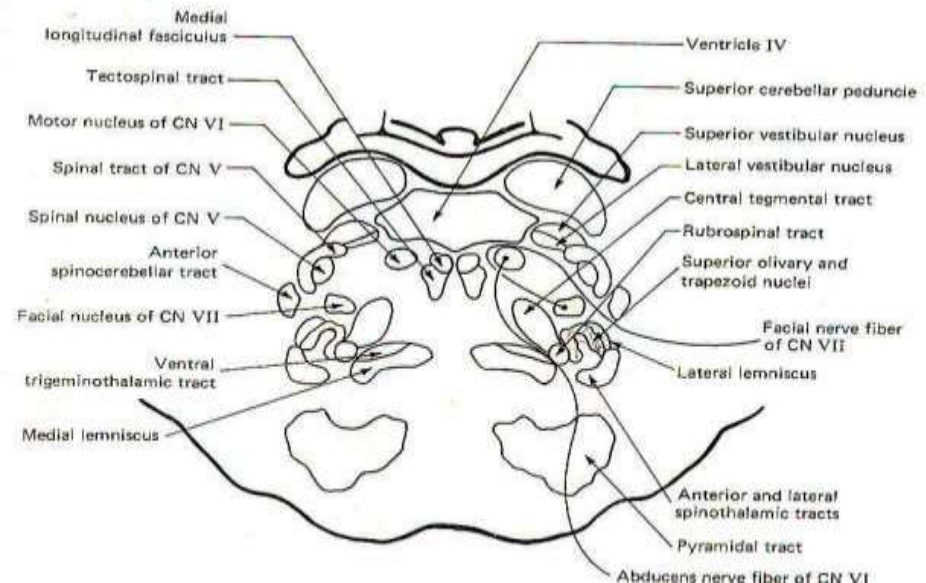


# Internal structure



It contains

1. Corticopontine fibres
2. Corticonuclear fibres
3. Corticospinal fibres
4. Pontocerebellar fibres
5. Pontine nuclei
6. Nuclei of trigeminal, abducent, facial & vestibulocochlear nerves.
7. Nucleus of spinal tract of trigeminal nerve.
8. Medial, Lateral, Trigeminal & Spinal Lemnisci.



# Blood supply of pons

- Pontine branches from the basilar artery.
- Anterior inferior cerebellar artery.

**Pontine haemorrhage** - may occur due to involvement of branches of basilar & anterior inferior cerebellar arteries.

**Millard-Gubler syndrome** - Lesion in the lower part of the pons, which includes the pyramidal tract, fibres of abducent & facial nerves.

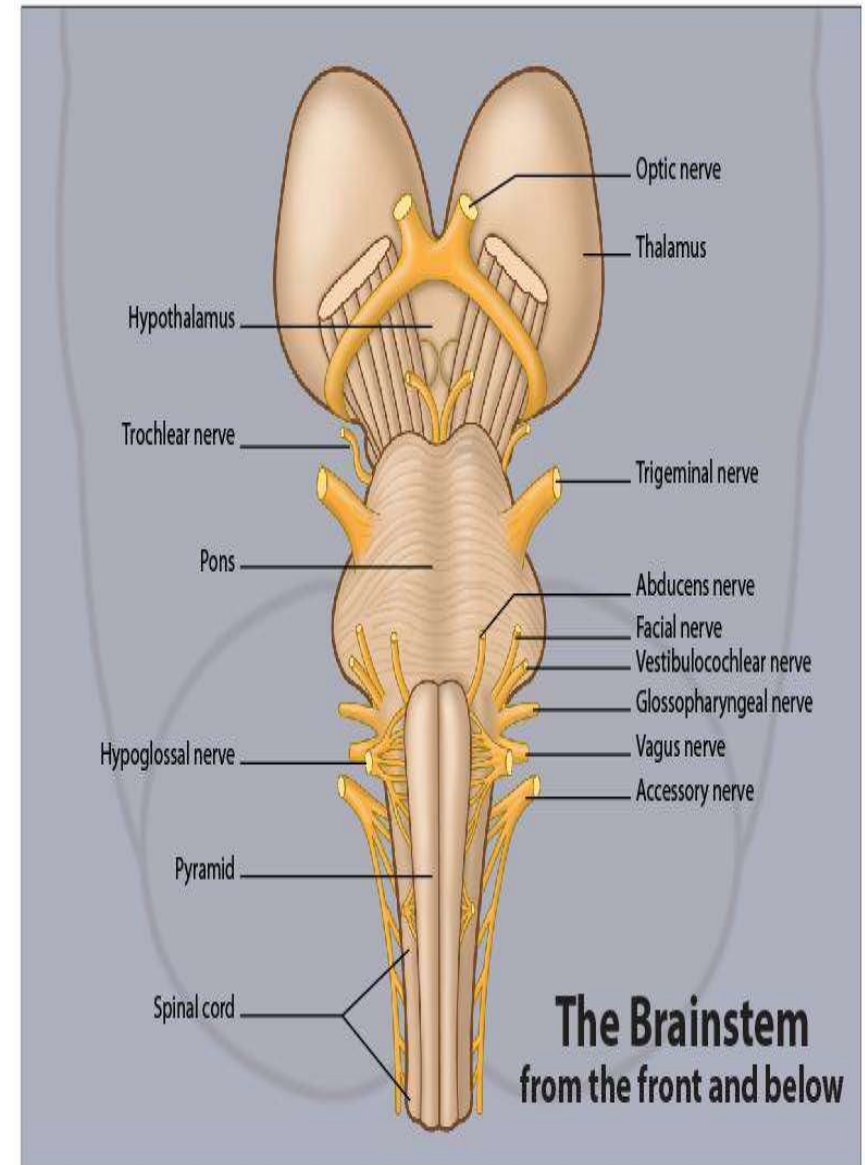


# MIDBRAIN

The midbrain is the upper & shortest part of the brain-stem. It is about 2.5 cm long & 2.5 cm wide.

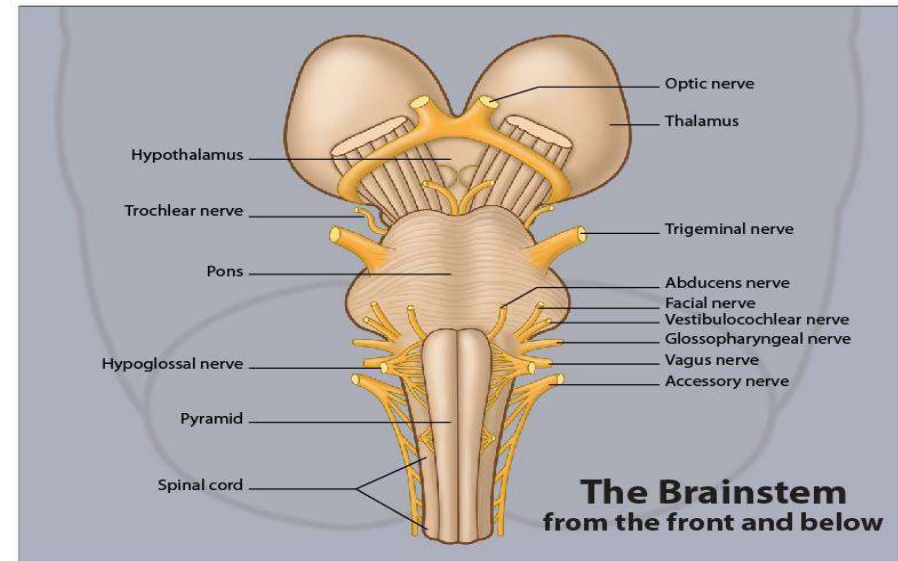
It connects the hindbrain with the forebrain.

It has a cavity called cerebral aqueduct which connects the third ventricle with the fourth ventricle.



# External Features

It has 2 surface ventral & dorsal



Ventral surface – the ventral surface of midbrain present 2 crura cerebri which emerge from the cerebral hemispheres & converge downward to enter the pons.

The oculomotor nerve emerge from a groove on the medial side of the crus cerebri.

The trochlear nerve emerge on the dorsal aspect of the midbrain & curls around the lateral aspect of the cerebral peduncle to appear on the ventral aspect of the midbrain lateral to the oculomotor nerve.

## Dorsal surface

– presents four rounded elevations

2 superior & 2 inferior colliculi

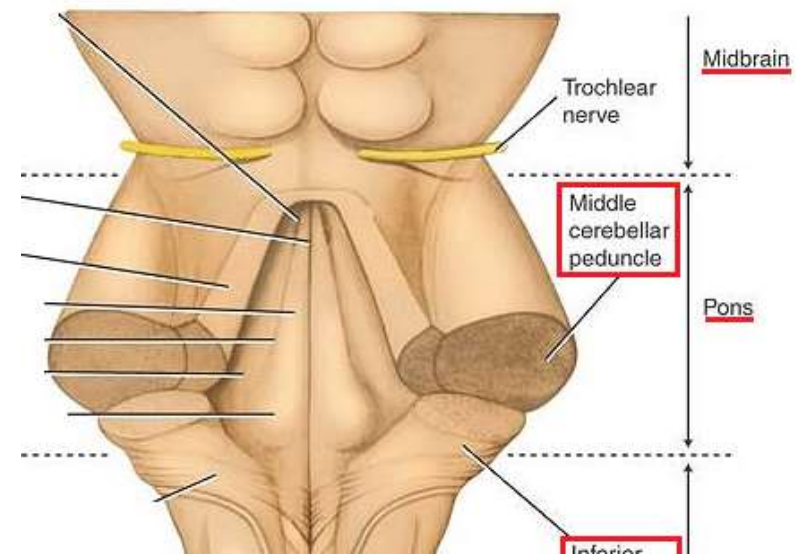
These colliculi are separated from each other by a cruciform sulcus.

Thick ridges of white matter extending from lateral side of each colliculus is known as brachia.

The superior brachium connect the superior colliculus to the lateral geniculate body & the optic tract, & is made up of optic tract fibres.

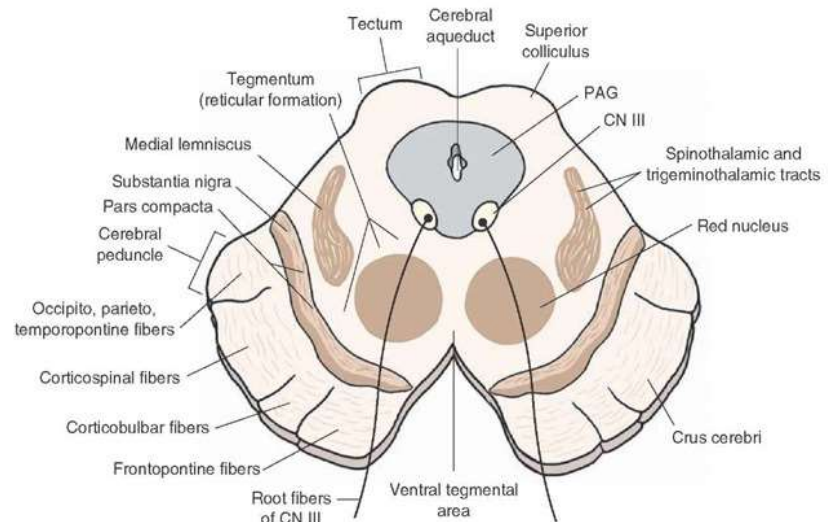
The inferior brachium connect the inferior colliculus to the medial geniculate body, & made up of auditory fibres.

The superior & inferior colliculi are concerned with reflex activities triggered by visual & auditory impulses respectively.



# Internal structure

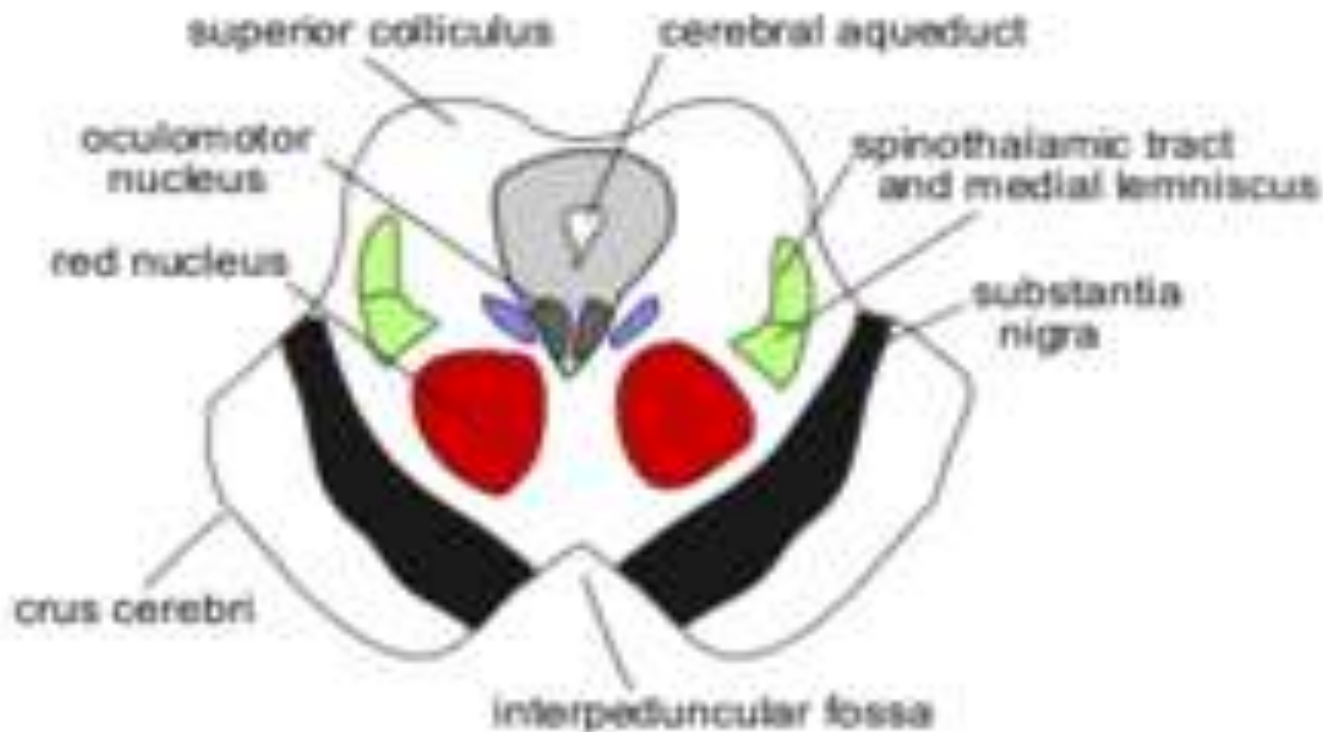
- The transverse section of midbrain shows a tiny canal, called cerebral aqueduct.
- A coronal plane passing through the aqueduct divides the midbrain into 2 parts;
- A small posterior part called tectum &
- A larger anterior part called cerebral peduncle.
- The tectum consist of four colliculi.
- The cerebral peduncle is further subdivided into 3 parts, from dorsal to ventral are
  - a. Tegmentum
  - b. Substantia nigra
  - c. Crus cerebri





It consist of

1. superior & inferior colliculi
2. Red nuclei
3. Substantia nigra
4. Nuclei of oculomotor & trochlear nerve
5. Ascending & descending tracts.



# Blood supply of midbrain

1. Basilar artery
  2. Posterior cerebral artery
  3. Superior cerebellar artery
- **Weberg's syndrome** – produced by a vascular lesion in the basal region of the cerebral peduncle due to occlusion of a branch of the posterior cerebral artery.
  - **Parkinsonism** – the degeneration or destruction of substantia nigra causes deficiency of dopamine & leads to a condition called Parkinsonism.

**THANK YOU**