

# INTERNAL STRUCTURE OF THE BRAIN STEM

**By**

**Dr.Sanaa Alshaarawy**

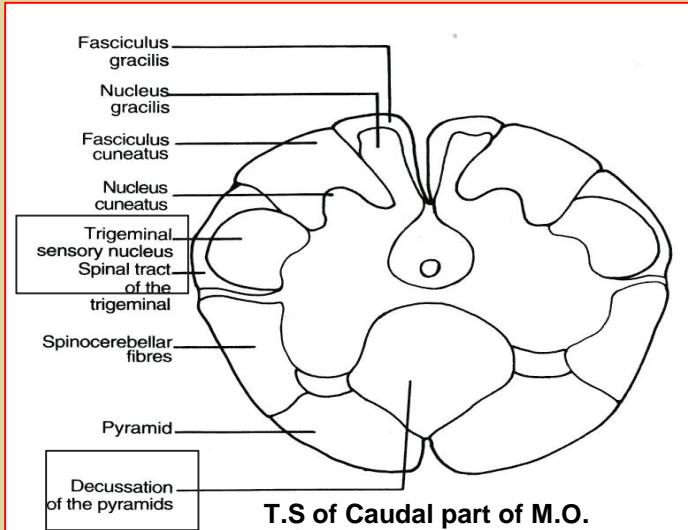
**Dr. Essam Eldin Salama**

# OBJECTIVES

*By the end of the lecture, students will be able to :*

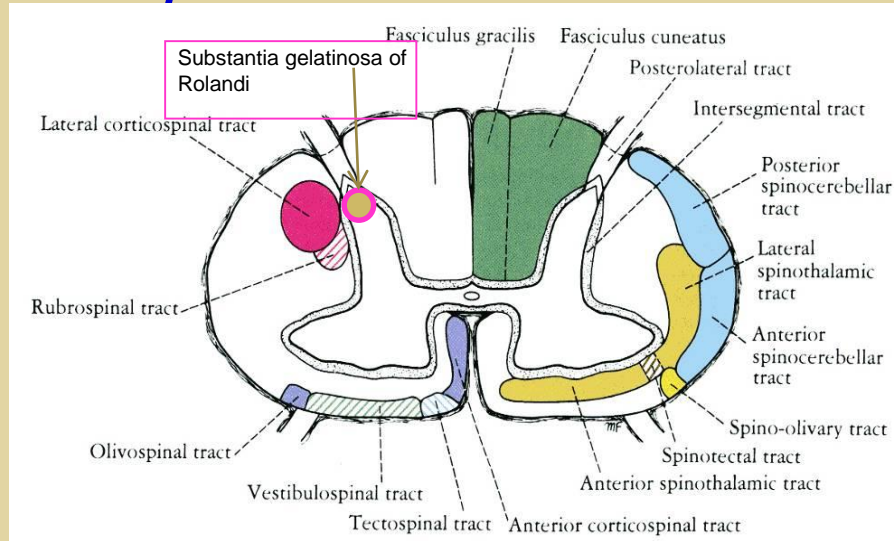
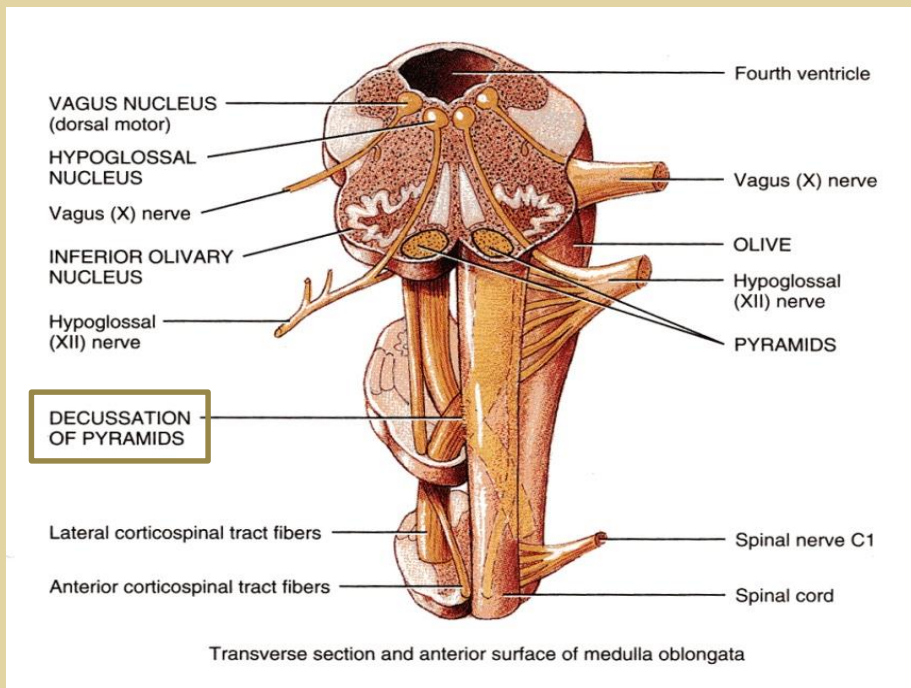
- ▣ *Distinguish the internal structure of the components of the brain stem in different levels and the specific criteria of each level.*
- ▣ *1. **Medulla oblongata** (closed, mid and open medulla)*
- ▣ *2. **Pons** (caudal and rostral).*
- ▣ *3. **Mid brain** ( superior and inferior colliculi).*

# CAUDAL (closed) MEDULLA

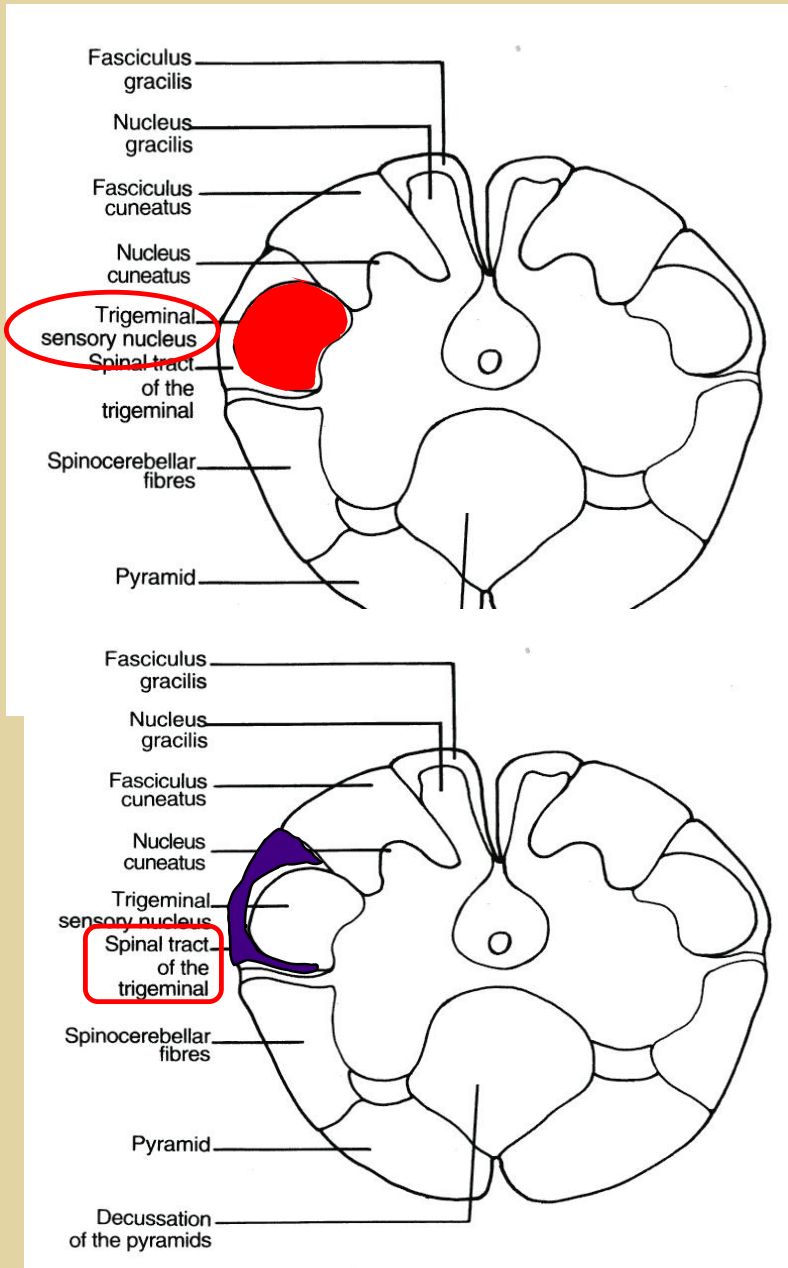


- ▣ 1. Traversed by the *Central Canal*.
- ▣ *Motor Decussation*.
- ▣ *Spinal Nucleus of Trigeminal (Trigeminal sensory nucleus)* :  
It is a larger sensory nucleus.

It is the brain stem continuation of the *Substantia Gelatinosa of spinal cord*.

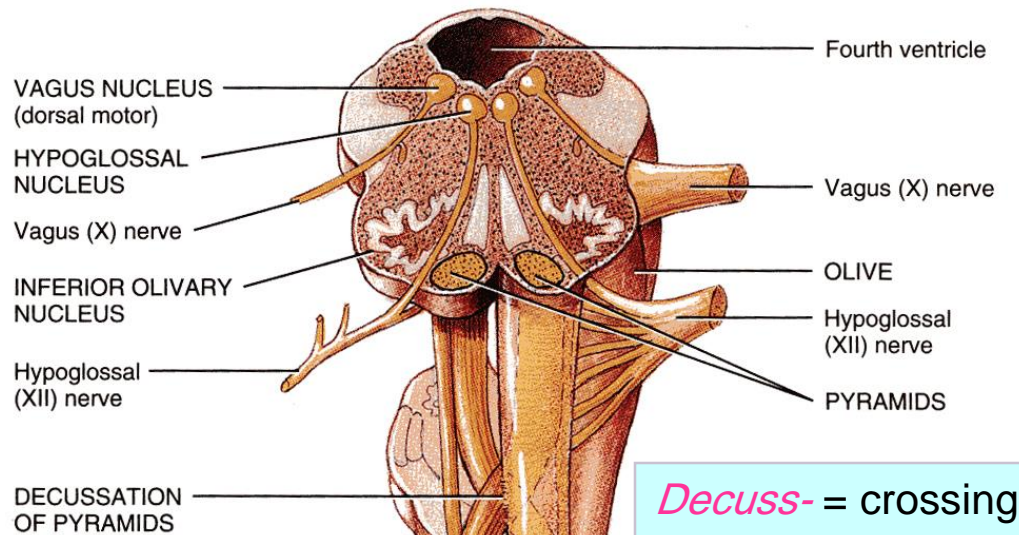


# TRIGEMINAL SENSORY NUCLEUS & TRACT

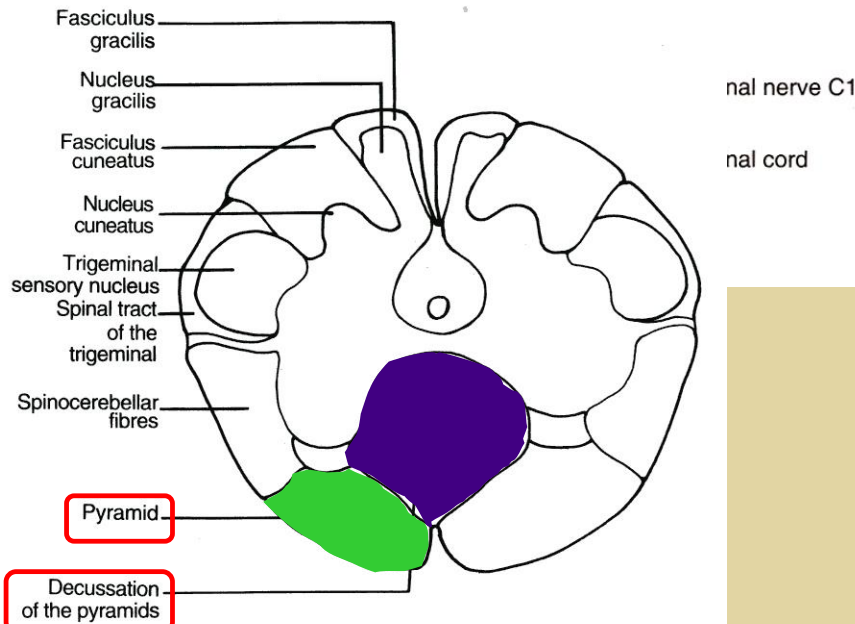


- ▣ *The Nucleus Extends :*
- ▣ *Through the whole length of the brain stem and into upper segments of spinal cord.*
- ▣ *It lies in all levels of M.O, medial to the spinal tract of the trigeminal.*
- ▣ *It receives **pain and temperature** from **face, forehead.***
- ▣ *Its **tract present in all levels of M.O.** is formed of descending fibers that terminate in the trigeminal nucleus.*

# PYRAMIDAL DECUSSATION

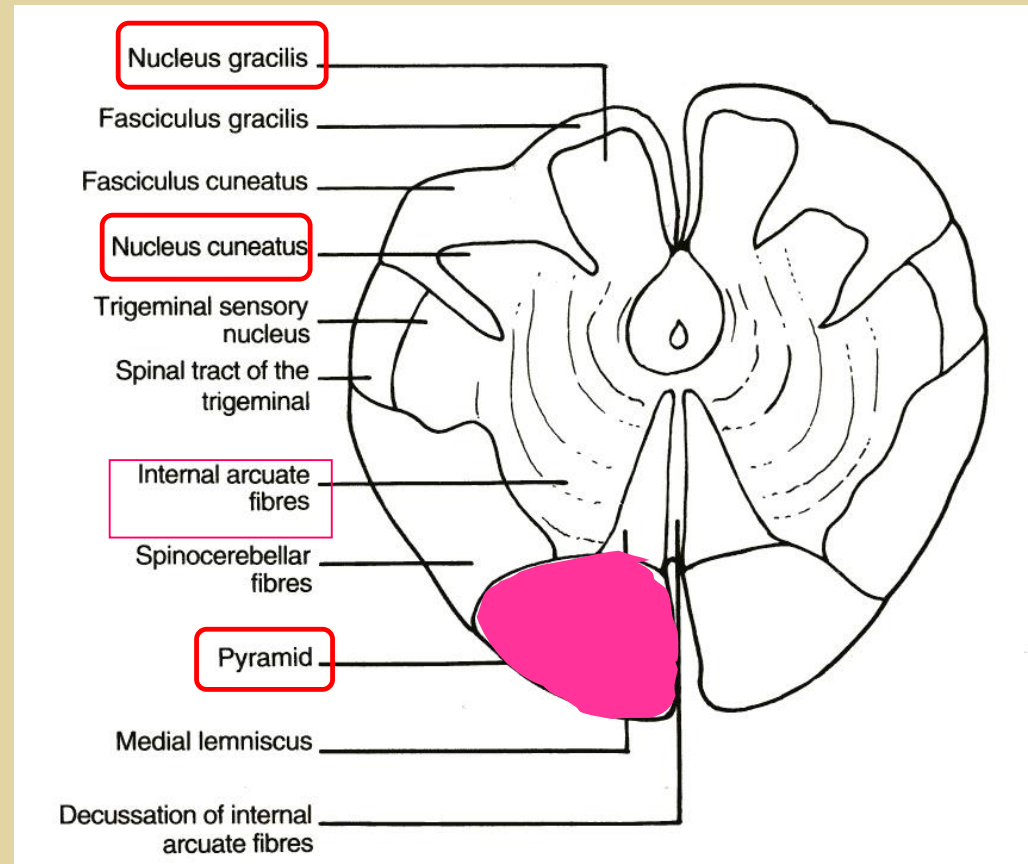


- ▣ *It is Motor Decussation*
- ▣ *Formed by pyramidal fibers, (75-90%) cross to the opposite side*
- ▣ *They descend in the lateral white column of the spinal cord as the lateral corticospinal tract.*
- ▣ *The uncrossed fibers form the ventral corticospinal tract.*

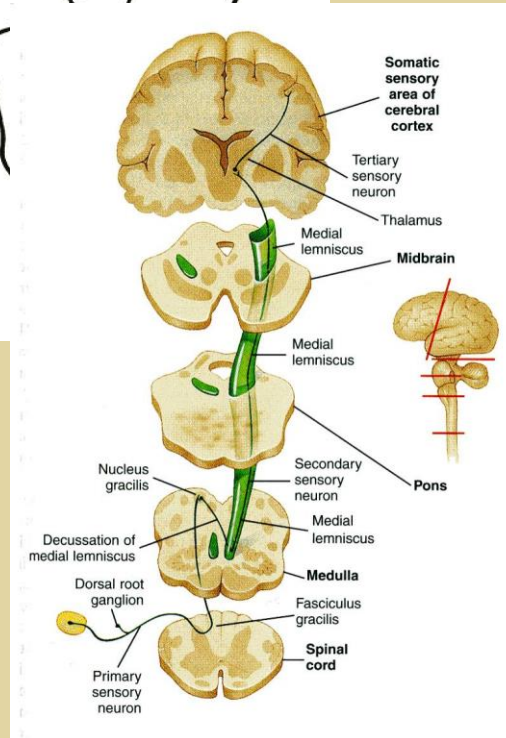
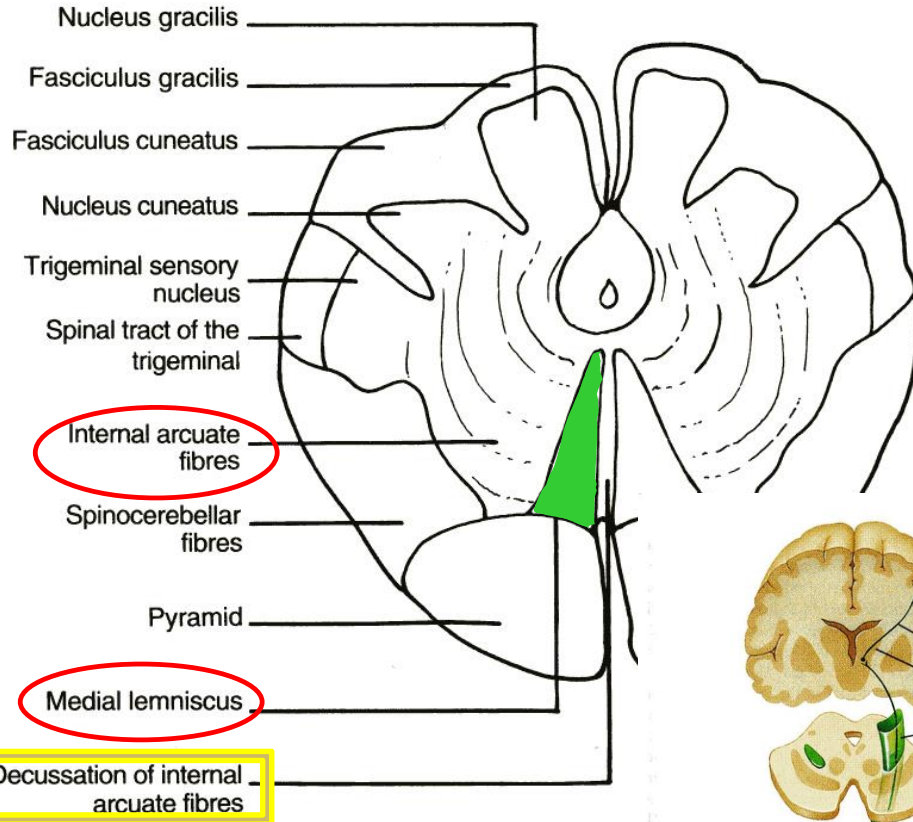


# MID MEDULLA

- ▣ *Traversed by Central Canal.*
- ▣ *Larger size Gracile & Cuneate nuclei, concerned with proprioceptive deep sensations of the body.*
- ▣ *Axons of Gracile & Cuneate nuclei form the **internal arcuate fibers**; Sensory Decussation.*
- ▣ ***Pyramids** are prominent ventrally.*

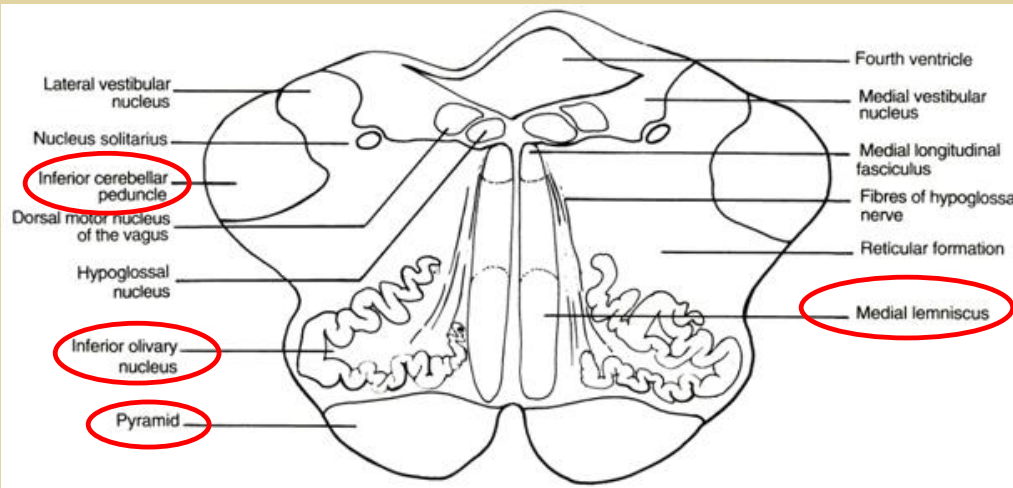


# SENSORY DECUSSATION

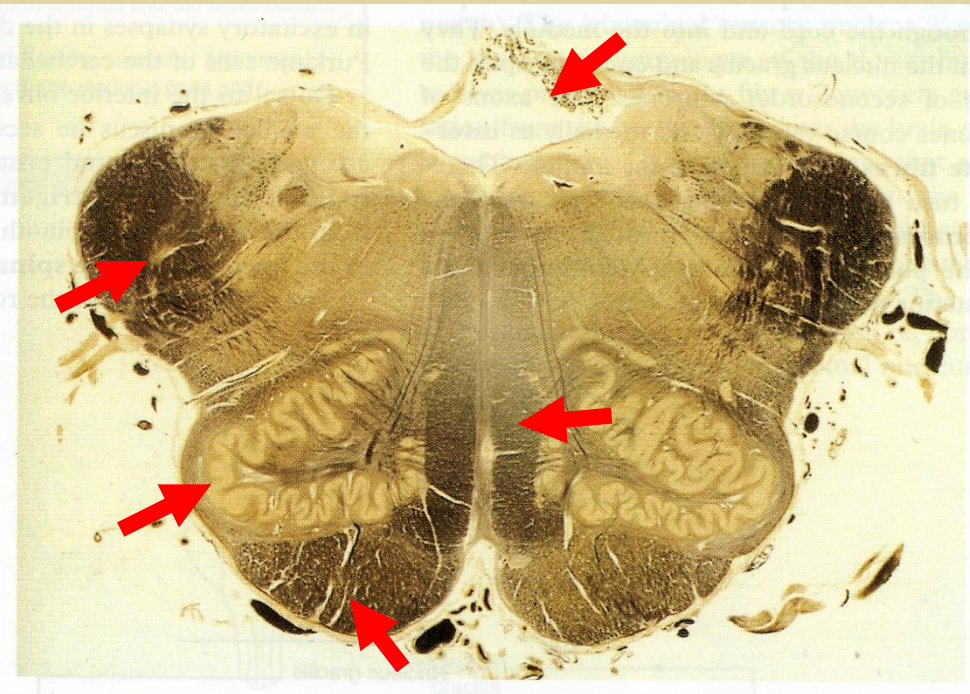


- Formed by the crossed internal arcuate fibers
- Medial Lemniscus:**
  - Composed of the ascending internal arcuate fibers after their crossing.
  - Lies adjacent to the middle line ventral to the central canal
  - Terminates in thalamus.

# ROSTRAL (open) MEDULLA



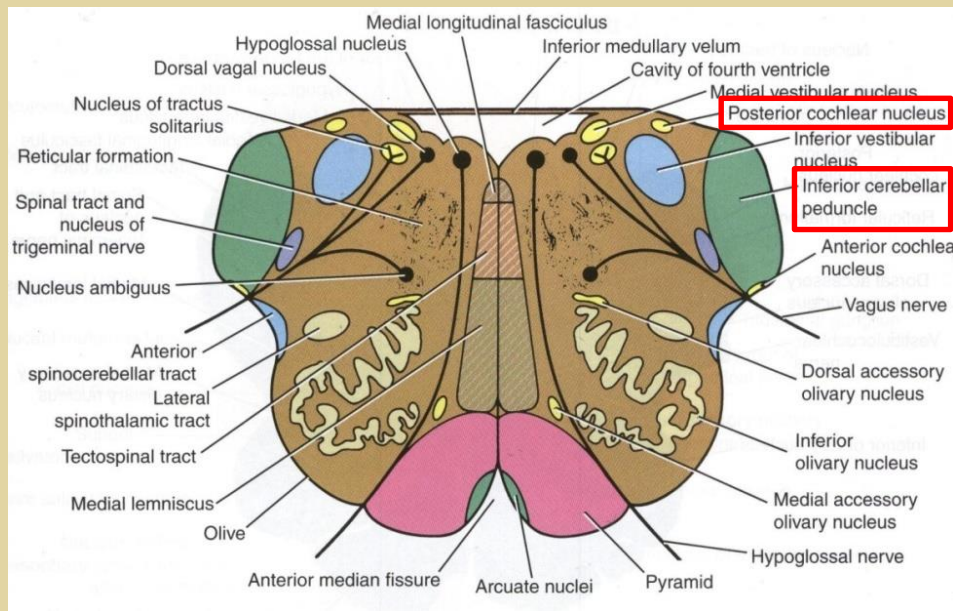
- ❑ **On the ventral aspect**
- ❑ The **pyramid** is clear, with **medial lemniscus** on either sides of middle line dorsal to the pyramid
- ❑ **Inferior Olivary Nucleus:**
  - A convoluted mass of gray matter. Has a hilum directed medially, lies posterolateral to the **pyramids** & lateral to the **medial lemniscus**.
  - It is concerned with the control of movement.

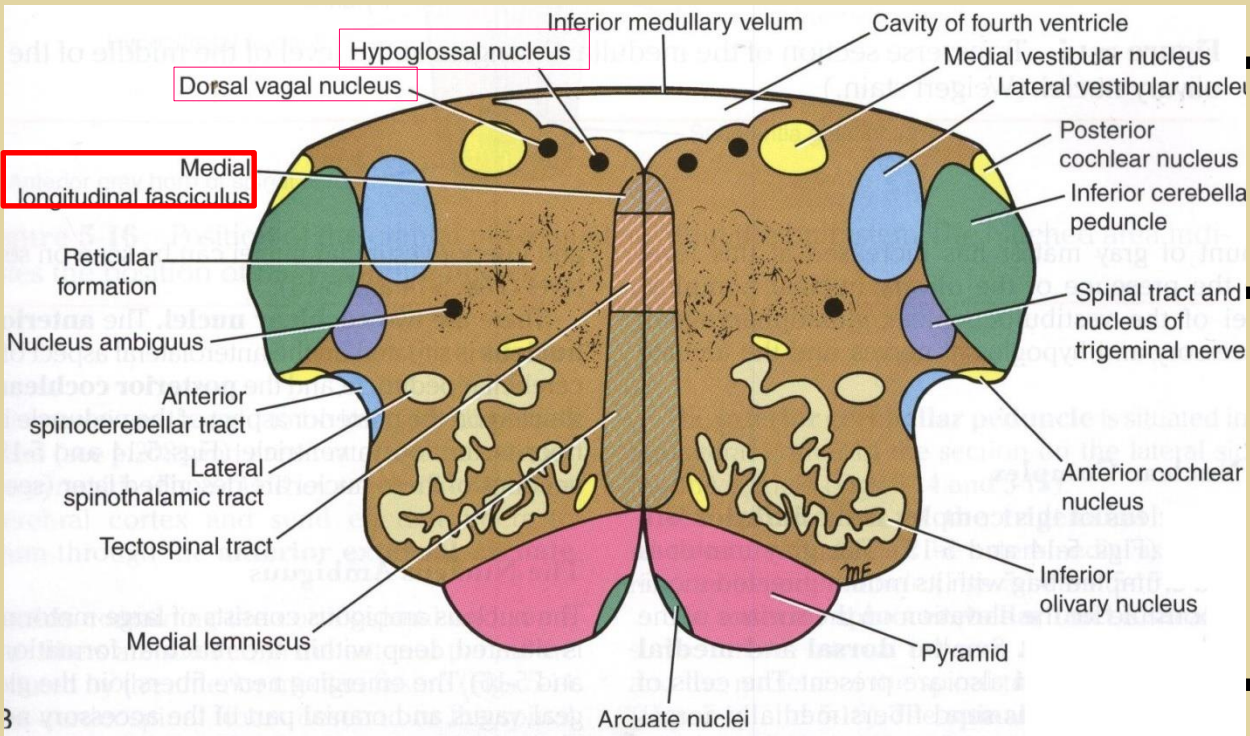




# ROSTRAL (open) MEDULLA

- ▣ **Its dorsal surface forms:**
  - Lower part of the floor of the **4<sup>th</sup> ventricle**.
- ▣ **The Inferior Cerebellar Peduncle** is dorsolateral in position, connecting M.O. with cerebellum.
- ▣ Dorsal and lateral to the Inferior cerebellar peduncle lie the **Cochlear nuclei** (dorsal and ventral).



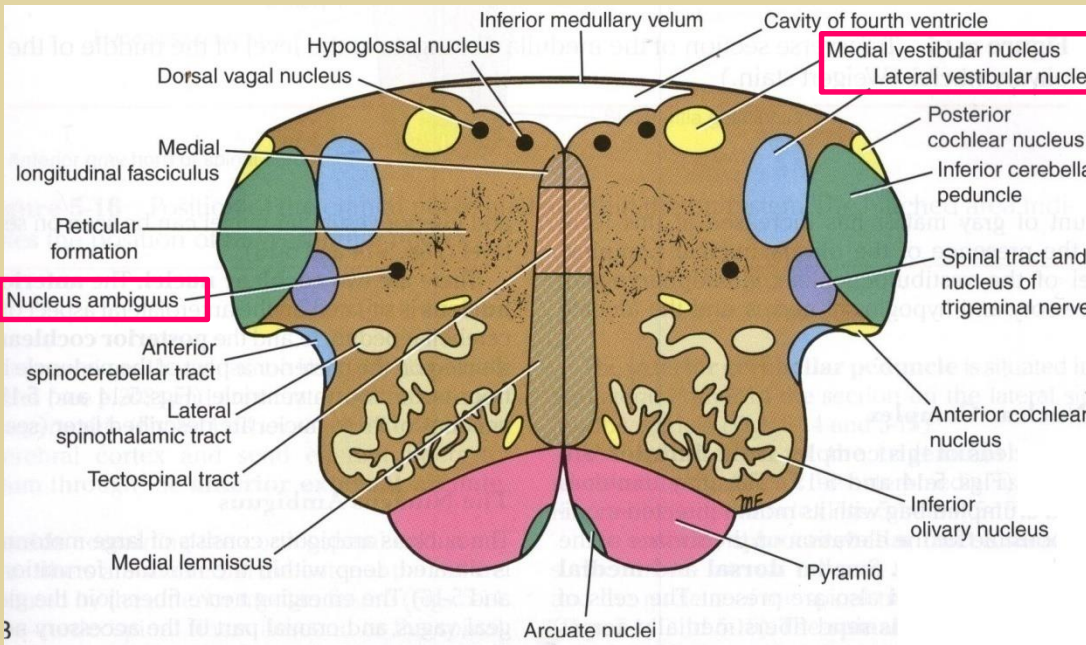


■ Beneath the floor of 4<sup>th</sup> ventricle lie;

1. *Hypoglossal Nucleus* lies just lateral to the midline

2. *Dorsal Nucleus of Vagus* lateral to the hypoglossal nucleus, contains preganglionic parasympathetic fibers.

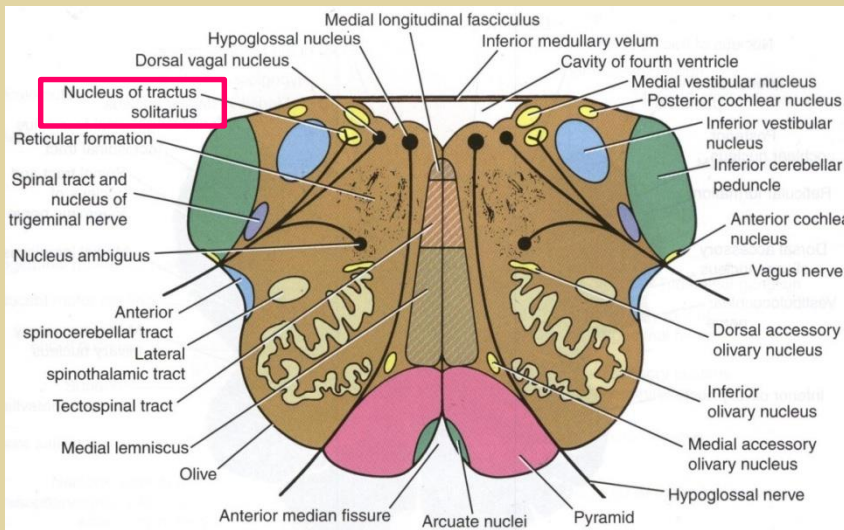
■ *Medial longitudinal fasciculus* lies close to the midline, ventromedial to the hypoglossal nucleus, dorsal to the medial lemniscus.



3. *Vestibular nuclei complex*; is composed of medial, lateral, inferior & superior nuclei, concerned with equilibrium.

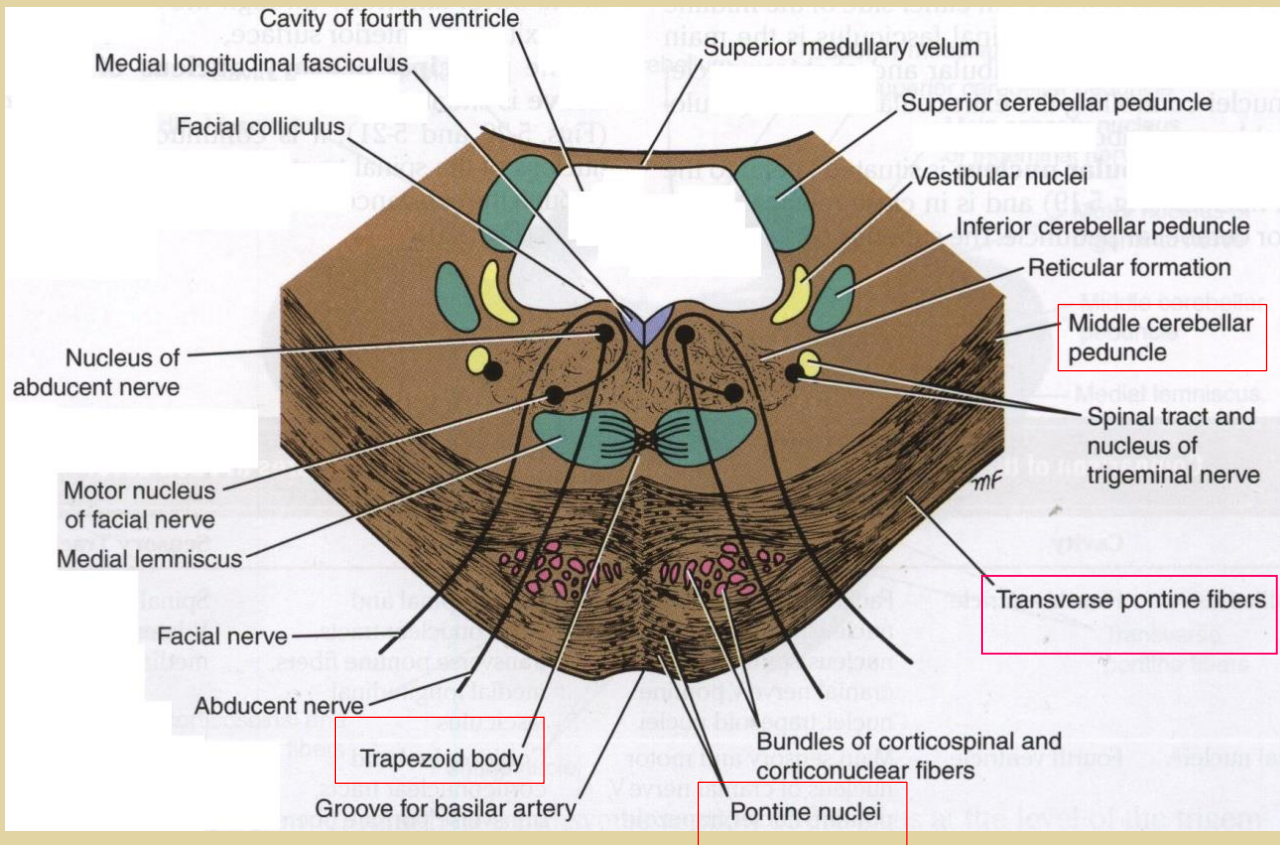
4. *Nucleus Ambiguus*: lie deep to the floor and dorsal to olivary nucleus gives motor fibers to constrictors of the pharynx & intrinsic muscles of the larynx.

5. *Solitary nucleus*: lie ventrolateral to dorsal nucleus of vagus, receive taste sensation from the tongue along the facial (VII), glossopharyngeal (IX) and vagus (X) cranial nerves.

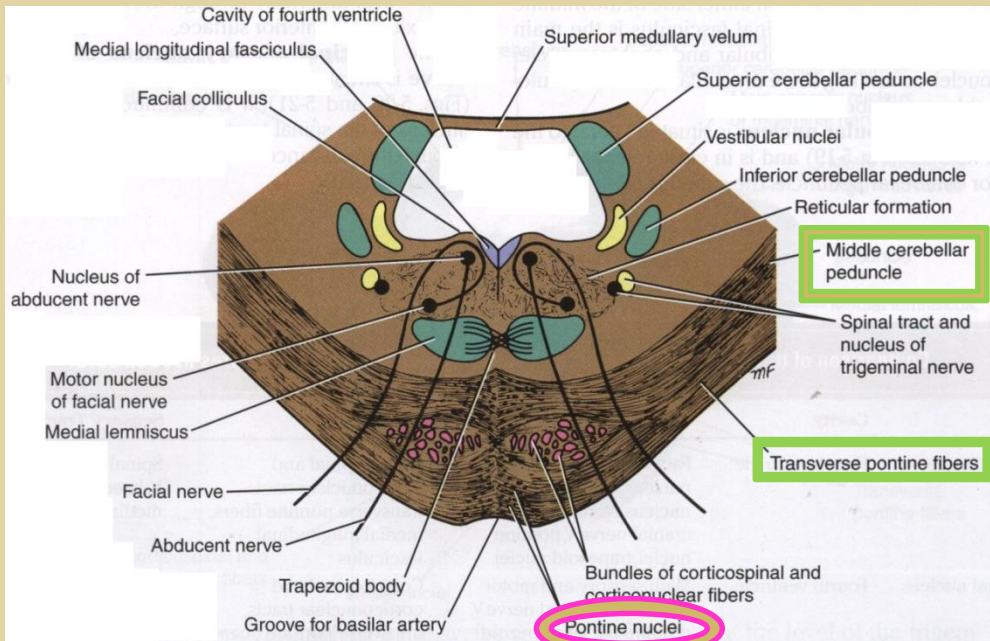


# CAUDAL PART OF THE PONS

- Divided into an anterior part (Basis Pontis) & a posterior part (Tegmentum) by the **Trapezoid Body**
- The ventral(anterior) portion is marked by numerous transversely oriented fascicles of **pontocerebellar fibres** that originate from scattered cell groups, the **pontine nuclei**, and that pass to the contralateral side of the cerebellum through the massive **middle cerebellar peduncle**.

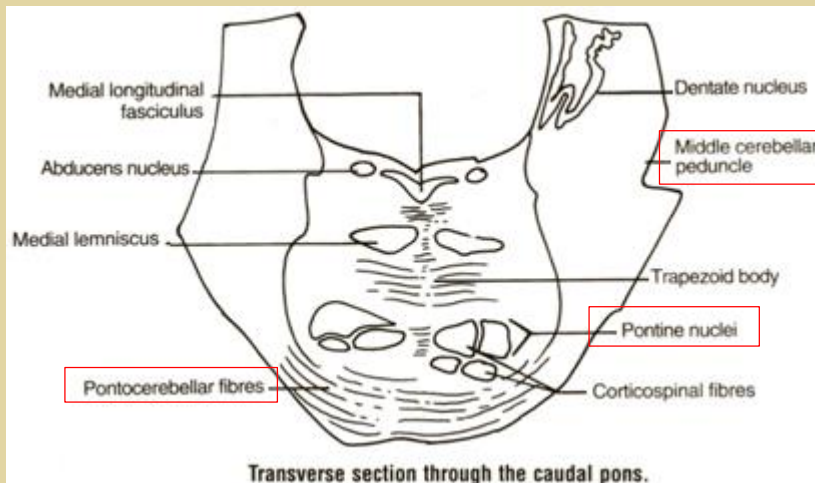


# CAUDAL PART OF THE PONS

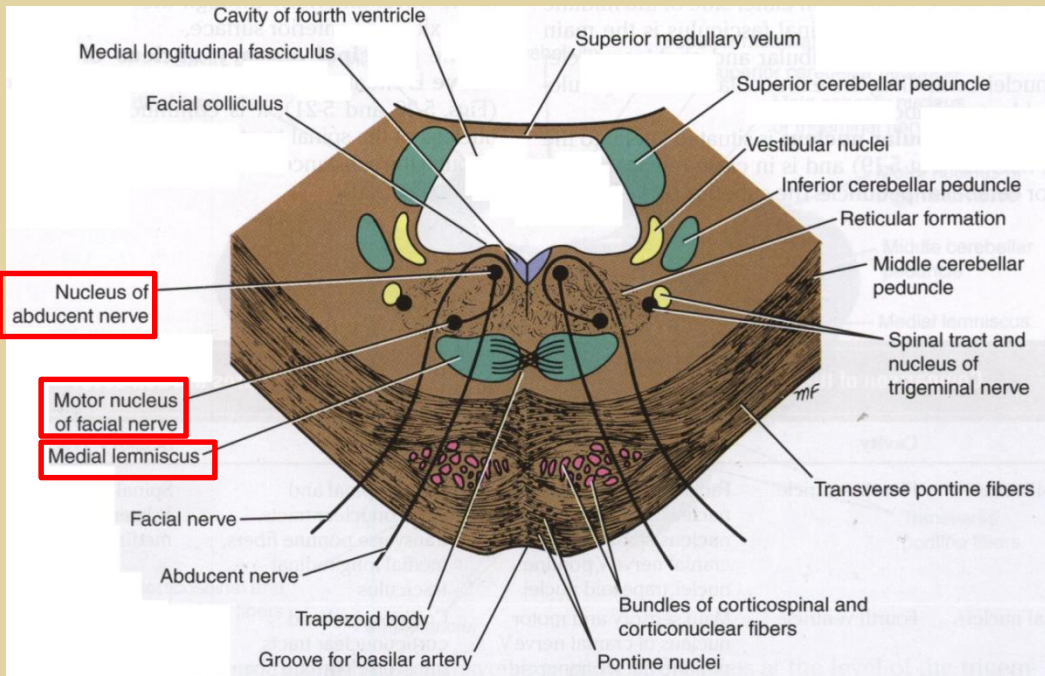


## Pontine Nuclei:

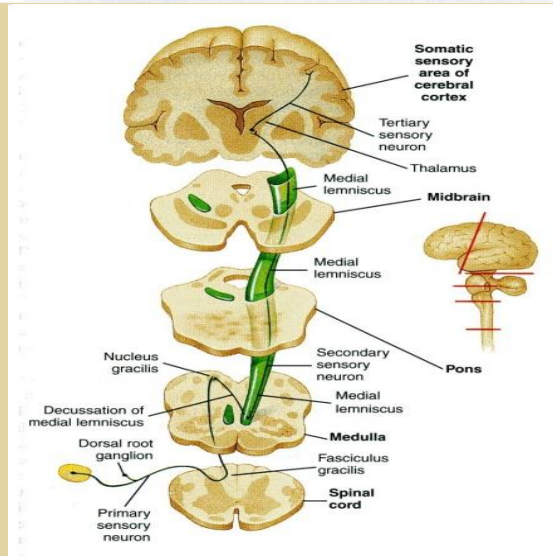
- *Are small masses of nerve cells, receive cortico pontine fibers. Their axons form the transverse pontocerebellar fibers which pass to the contra lateral side of the cerebellum through Middle Cerebellar peduncles*



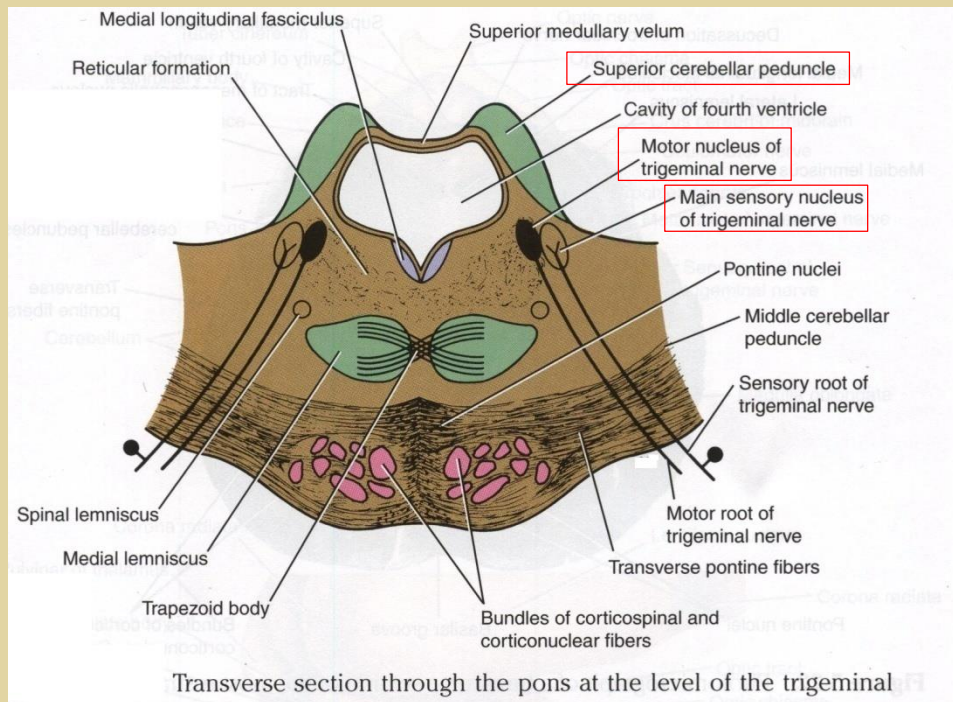
# CAUDAL PONS



- The ascending fibres of the **medial lemniscus** become separated from the pyramid and displaced dorsally
- with the **spinal lemniscus**
- *The **Medial Lemniscus** rotates 90 degrees and lies almost horizontally.*
- *The **trapezoid body** is a transverse fibers contains acoustic fibers from cochlear nuclei ascending as **lateral lemniscus***
- *Deep origin of cranial nerve nuclei:*
  - *Abducent nucleus*
  - *Facial motor nucleus*

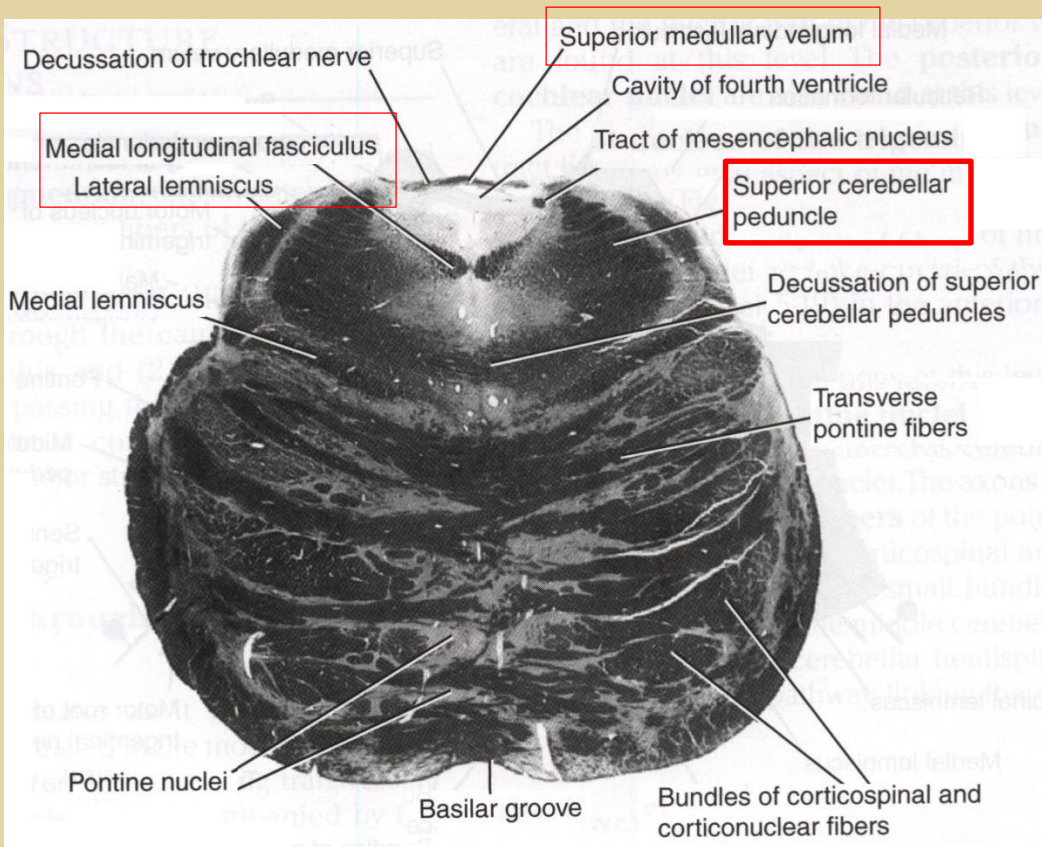


# AT THE LEVEL OF THE TRIGEMINAL NERVE



- **Motor nucleus of the trigeminal nerve:** Lies in the lateral part of the floor of the 4<sup>th</sup> ventricle.
- **Main sensory nucleus of the trigeminal nerve:** Reaches its maximum extent in the pons and it lies lateral to the motor nucleus.

# ROSTRAL PONS



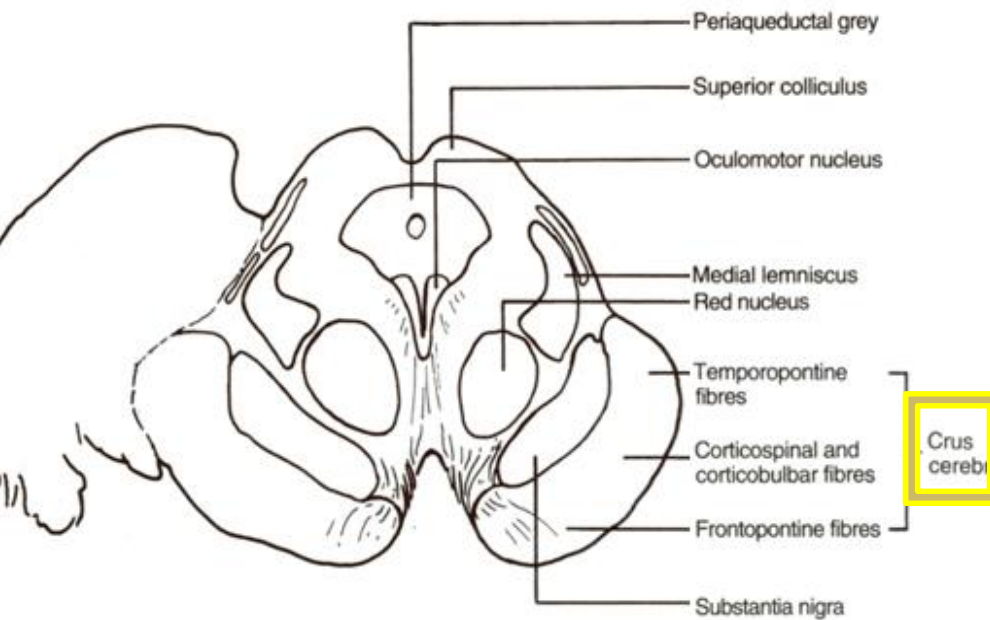
- *Superior cerebellar peduncles; form the lateral boundary of the 4<sup>th</sup> ventricle.*
- *Superior Medullary Velum; passes between the two peduncles & forms the roof of the 4<sup>th</sup> ventricle.*
- *Medial longitudinal fasciculus; lie close to the midline beneath the floor of the 4<sup>th</sup> ventricle.*



# MIDBRAIN

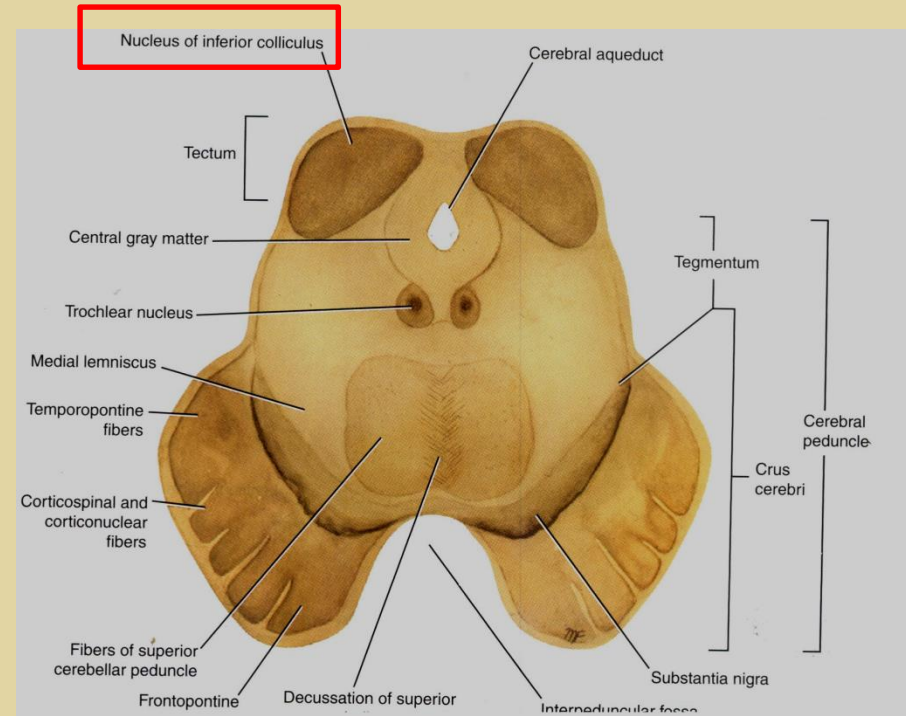


- It is divided into a dorsal part (**Tectum**) and a ventral part (**Tegmentum**) at the level of the cerebral aqueduct.
- The **cerebral aqueduct** is surrounded by a pear shaped peri aqueductal (central) gray matter.
- The most ventral part of the tegmentum is the massive fibrous mass (**Crus Cerebri**).

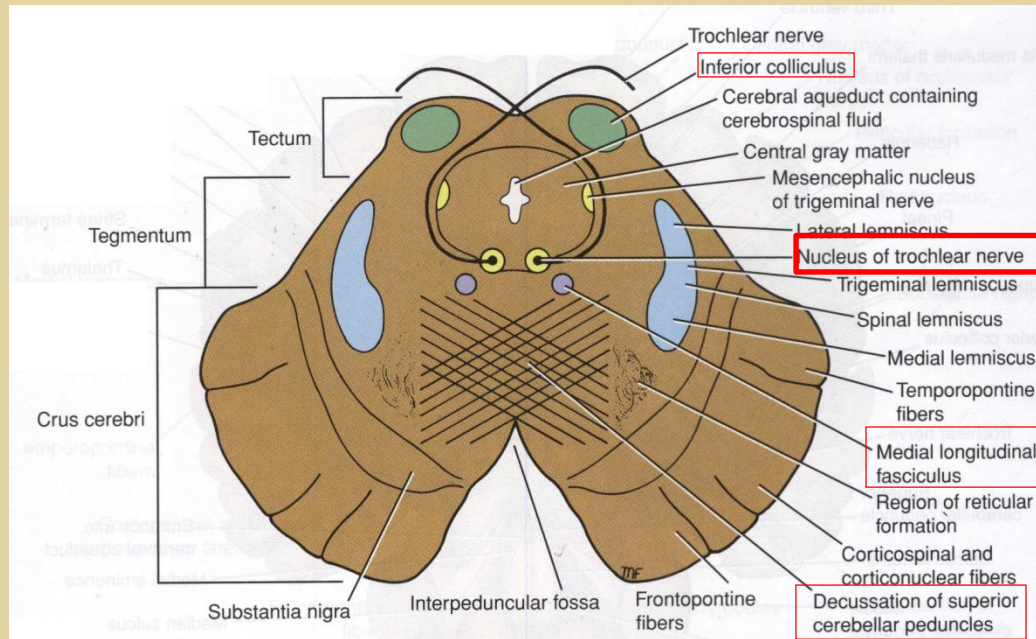


# INFERIOR COLLICULUS Level

- ❑ *Inferior colliculus is a large nucleus of gray matter that lies beneath a corresponding surface elevation*
- ❑ *It is part of the auditory pathway.*
- ❑ *It receives fibers from the lateral lemniscus.*
- ❑ *Its efferent fibers pass to the thalamus.*



# INFERIOR COLLICULUS Level

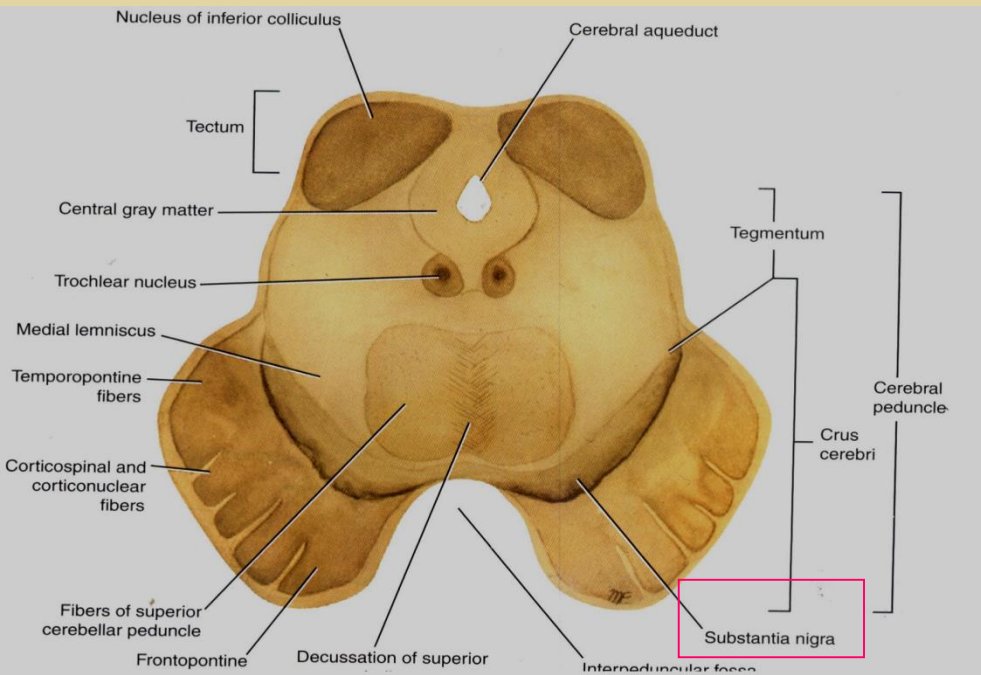


## 1. Trochlear nucleus:

- *lies in the central gray matter close to the median plane just posterior to the medial longitudinal bundle.*
- *The fibers of the trochlear nerve decussate in the superior medullary velum.*

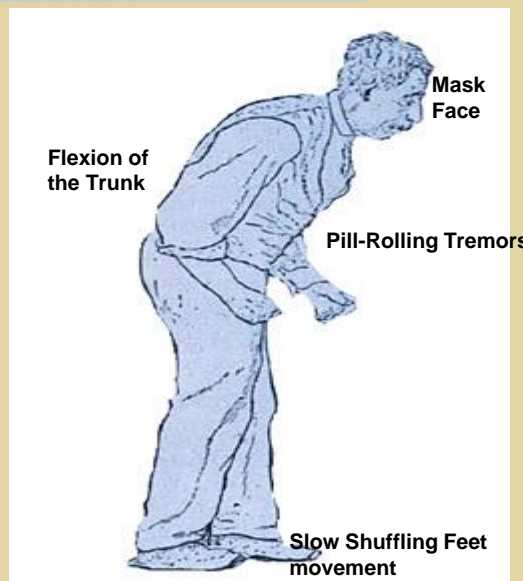
## 2. Decussation of the superior cerebellar peduncles in the midline.

# INFERIOR COLLICULUS Level

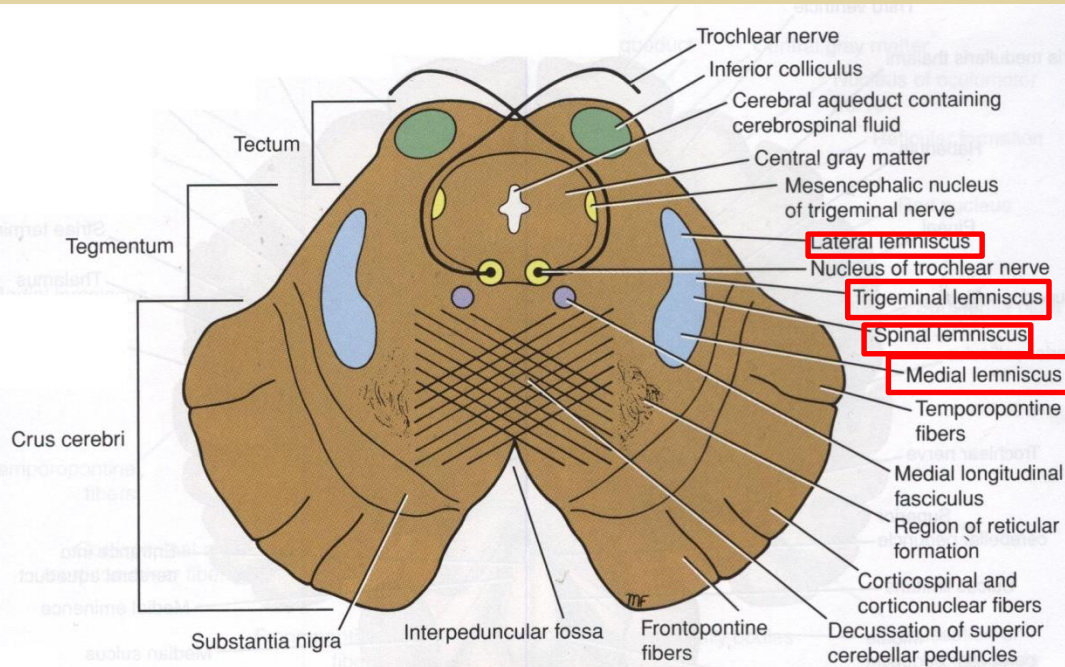


## 3. Substantia nigra:

- ▣ Occupies the most ventral part of the tegmentum.
- ▣ It consists of pigmented, melanin containing neurones.
- ▣ It projects to the basal ganglia. **Its degeneration is associated with Parkinson's disease**



# ASCENDING LEMNISCI



## Composed Of:

- *Spinal lemniscus.*(Lateral & anterior spinothalamic tracts)
- *Trigeminal lemniscus.*(Lateral & medial).
- *Lateral lemniscus.*
- *Media lemniscus.*

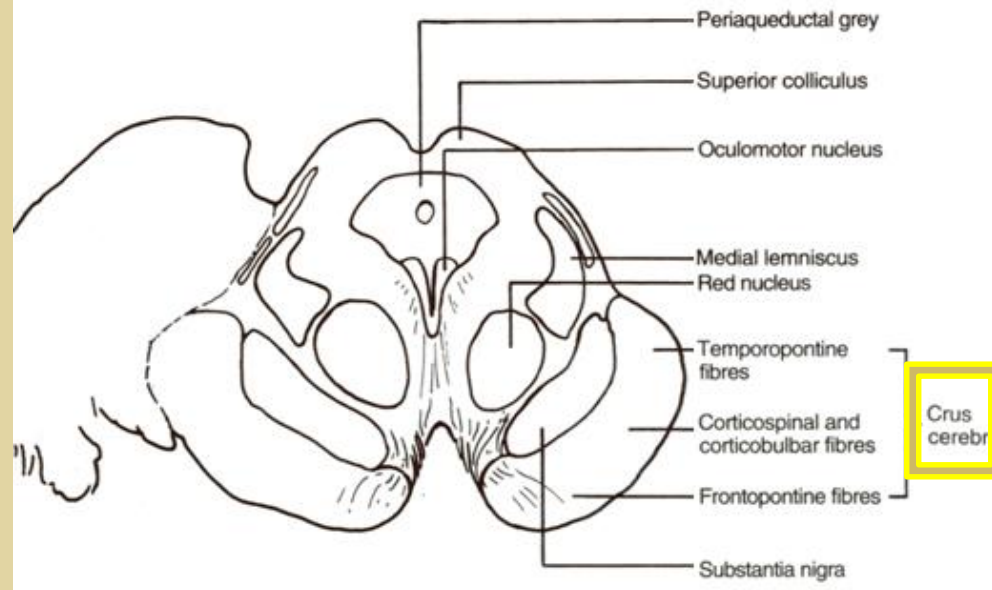
## Position:

- *Deeply placed lateral to the medial longitudinal fasciculus.*

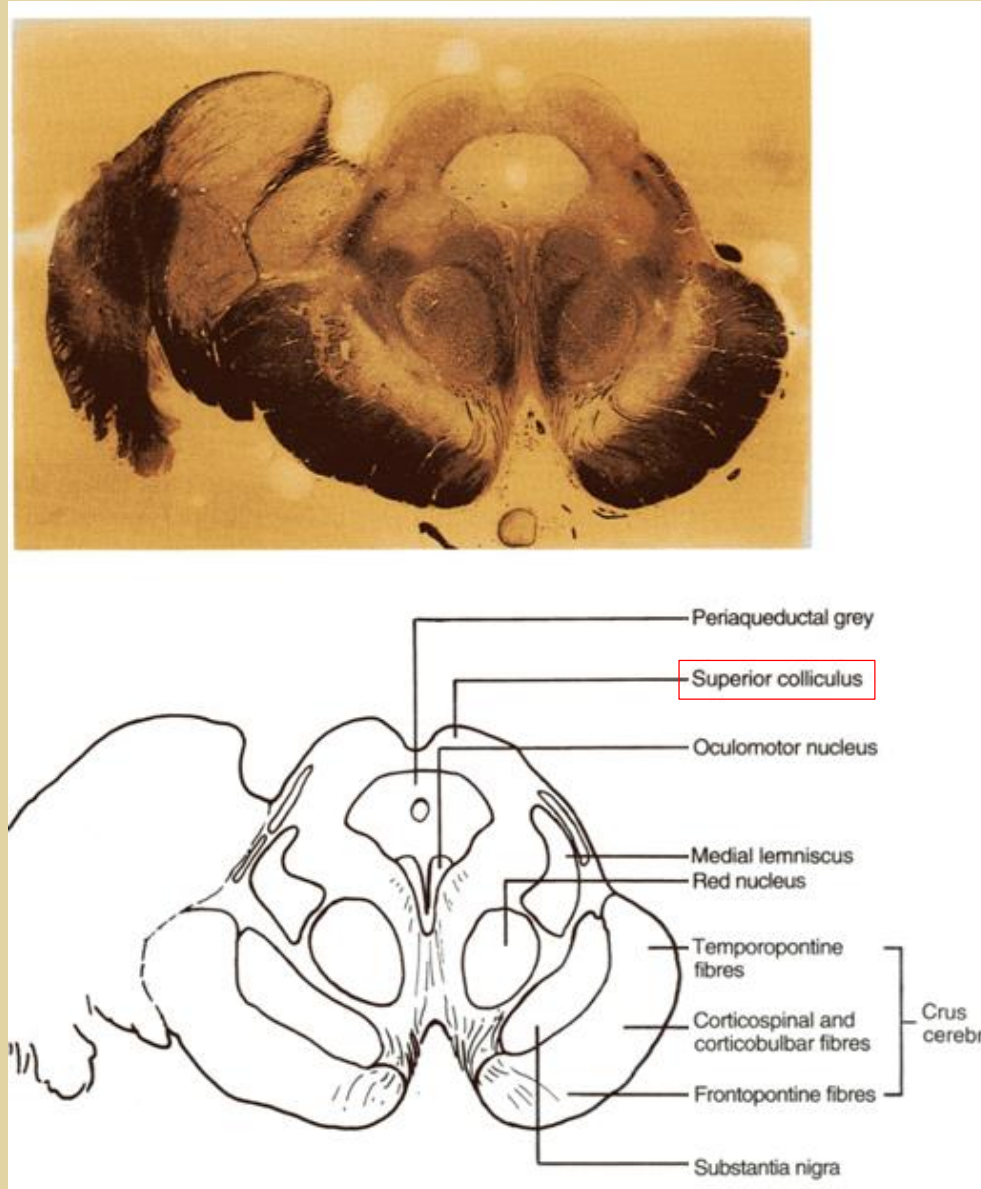
# CRUS CEREBRI



- It is a massive mass ventral to the substantia nigra.
- It consists entirely of descending cortical efferent fibers (Frontopontine, Corticospinal & Corticobulbar and Temporopontine Fibres) to the motor cranial nerve nuclei and to anterior horn cells.
- Involved in the coordination of movement.



# SUPERIOR COLLICULUS Level



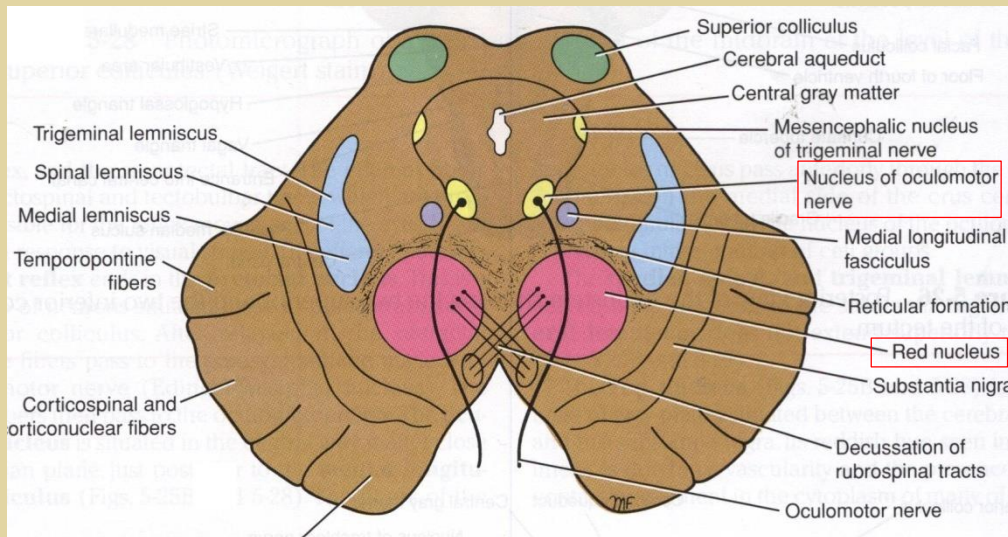
- A large nucleus of gray matter that lies beneath corresponding elevation.
- It forms part of the visual reflexes.
- Its efferent fibers go to the anterior horn cells & to cranial nuclei 3, 4, 6, 7 & 11).
- It is responsible for the reflex movements of the eyes, head and neck in response to visual stimuli, as in following a moving object or altering the direction of the gaze.

# SUPERIOR COLLICULUS Level

## 1. Oculomotor nucleus:

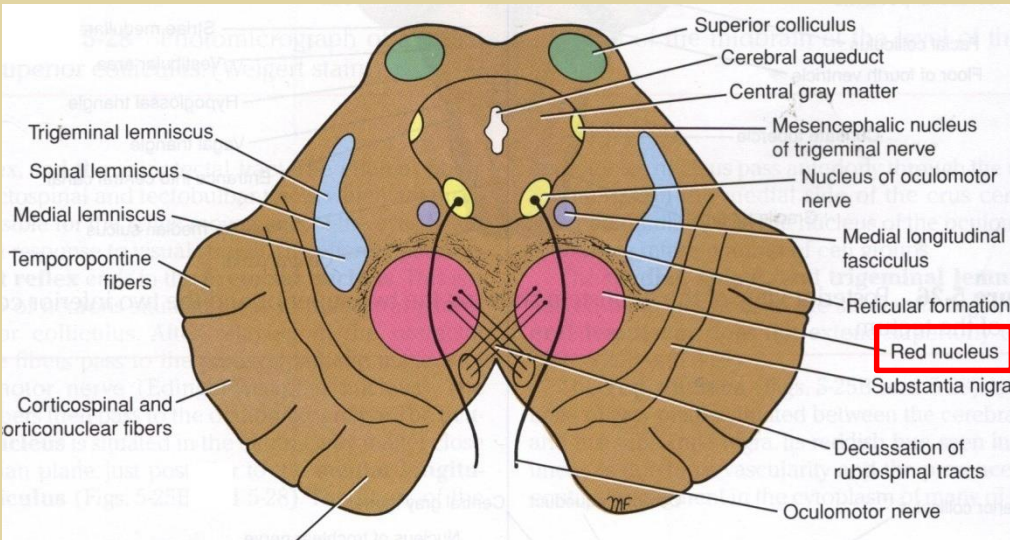
▣ *Situated in the central gray matter close to the median plane.*

▣ *The fibers of the oculomotor nerve passes anteriorly through the red nucleus to emerge on the medial side of the crus cerebri.*





# SUPERIOR COLLICULUS Level



## 2. Red nucleus :

- ▣ A rounded mass of gray matter that lies between the substantia nigra and the cerebral aqueduct in the central portion of the tegmentum.
- ▣ Its red coloration is due to its vascularity and the presence of an iron containing pigment in the cytoplasm of its neurons.
- ▣ It is involved in **motor control**.

THANK YOU