

INTERNAL STRUCTURE OF THE BRAIN STEM

By

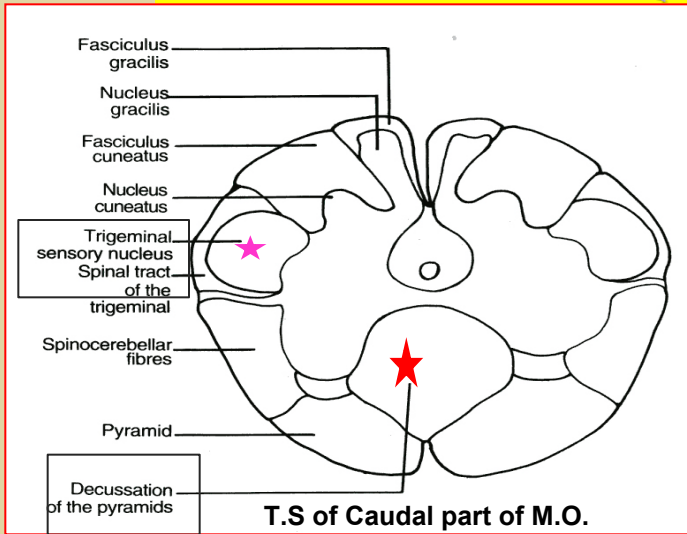
DR. Sanaa Alshaarawy

OBJECTIVES

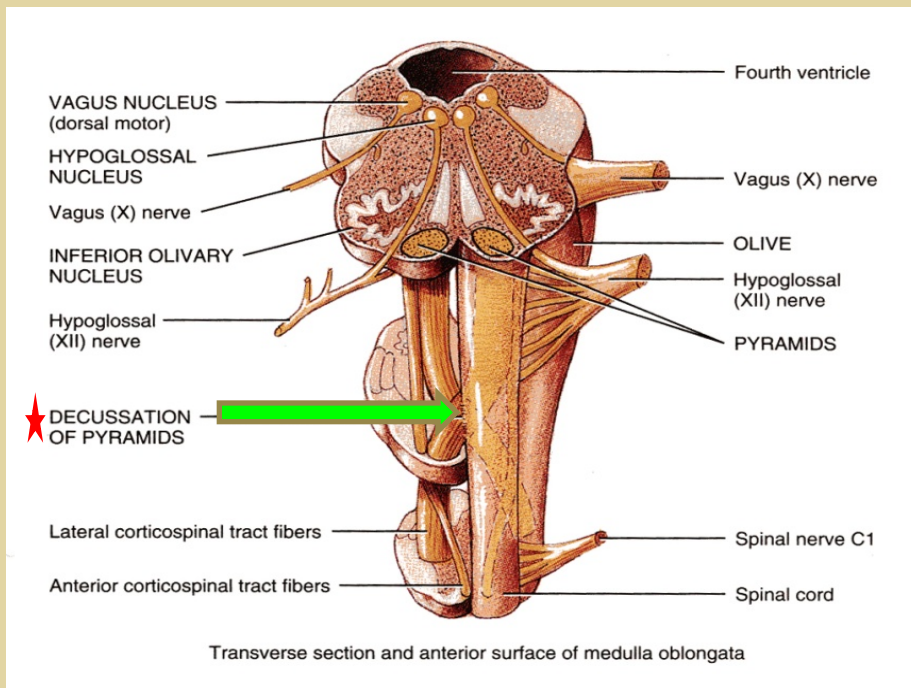
By the end of the lecture, students will be able to :

- ▣ *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 (caudal), mid and open medulla (rostral)}.*
- ▣ *2. Pons (caudal, mid “Trigeminal level” and rostral).*
- ▣ *3. Mid brain (superior and inferior colliculi).*
- ▣ *Describe in Breif the Reticular formation (structure, function and pathway).*

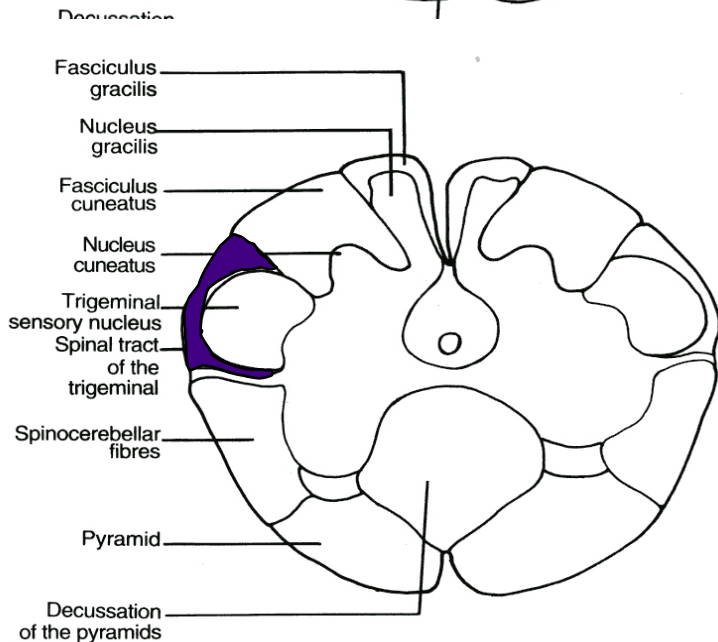
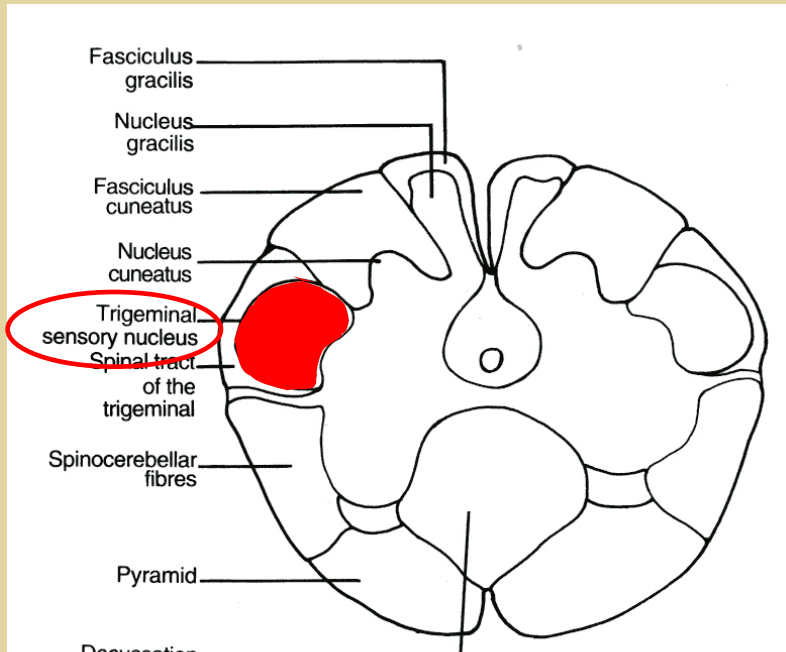
CAUDAL (closed) MEDULLA



- ▣ 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.

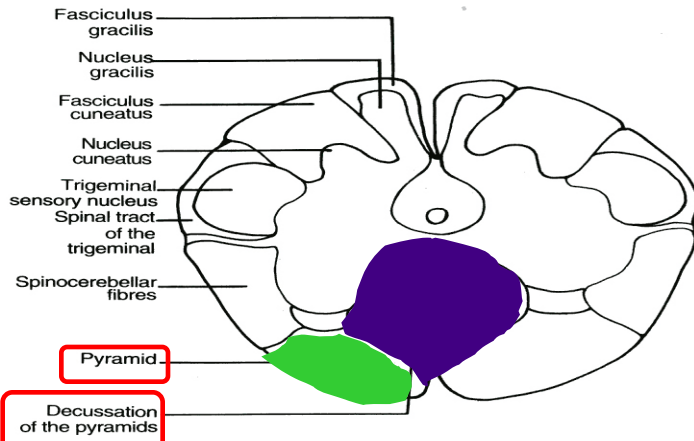
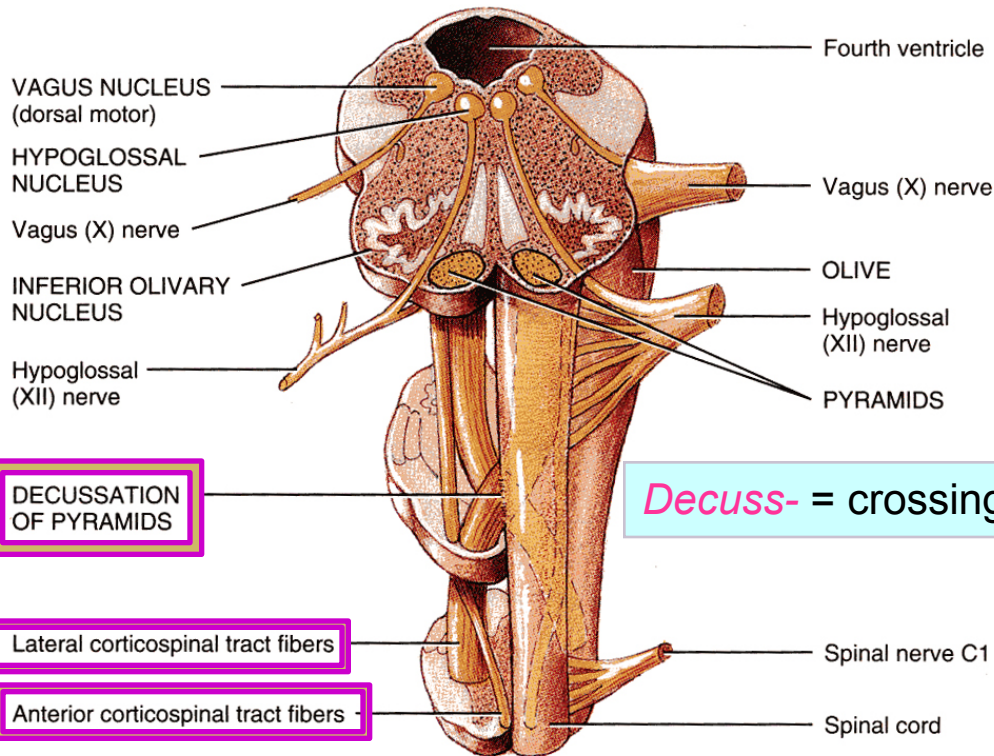


TRIGEMINAL SENSORY NUCLEUS & TRACT



- ▣ *The Nucleus Extends :*
- ▣ *Through the whole length of the brain stem and 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.*

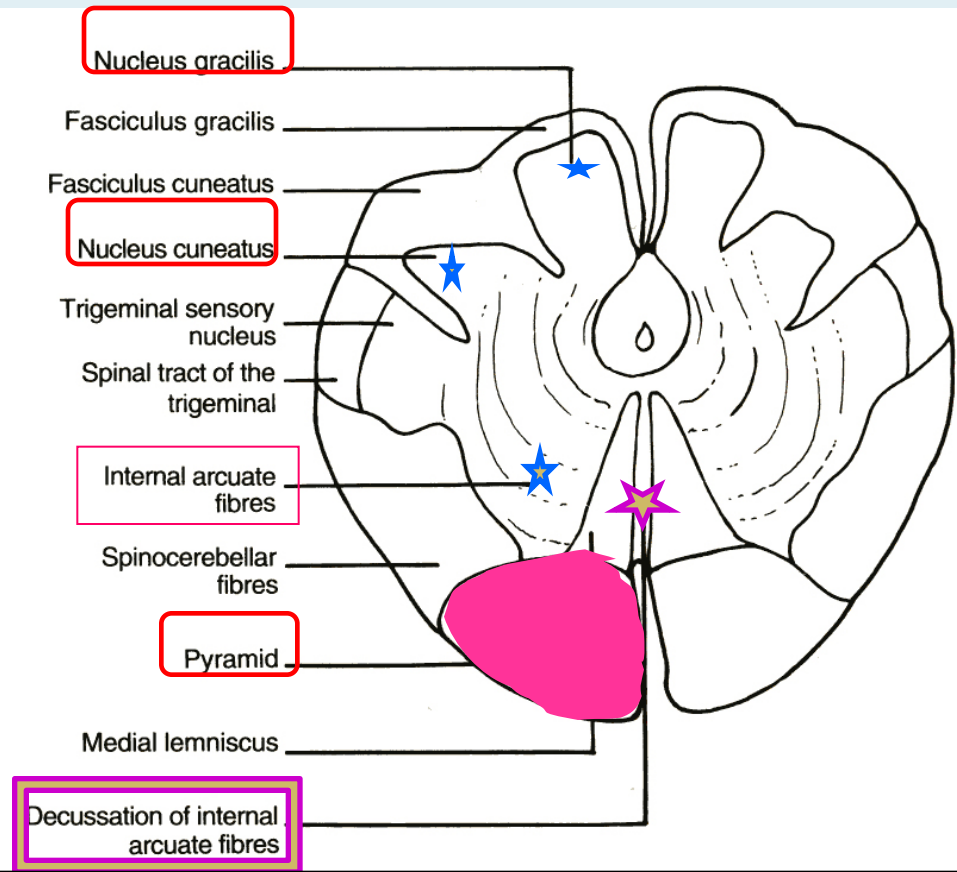
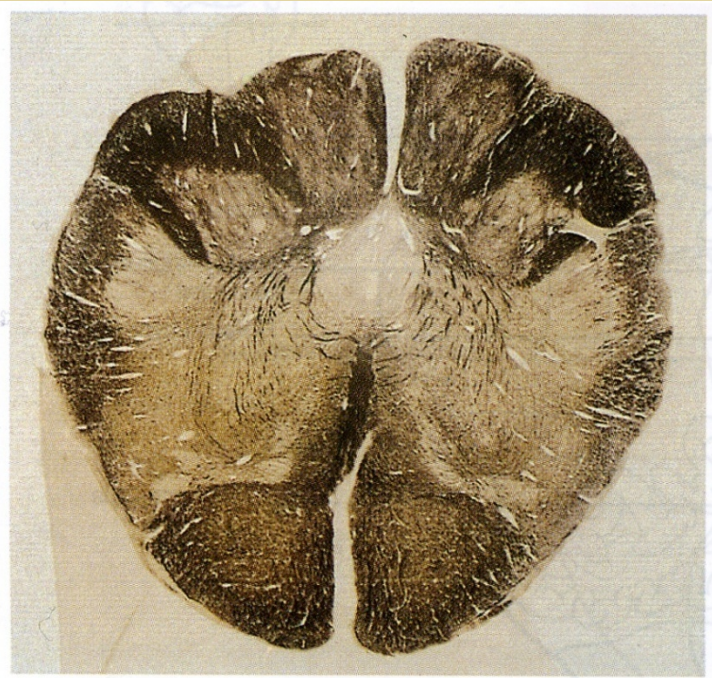
PYRAMIDAL DECUSSATION



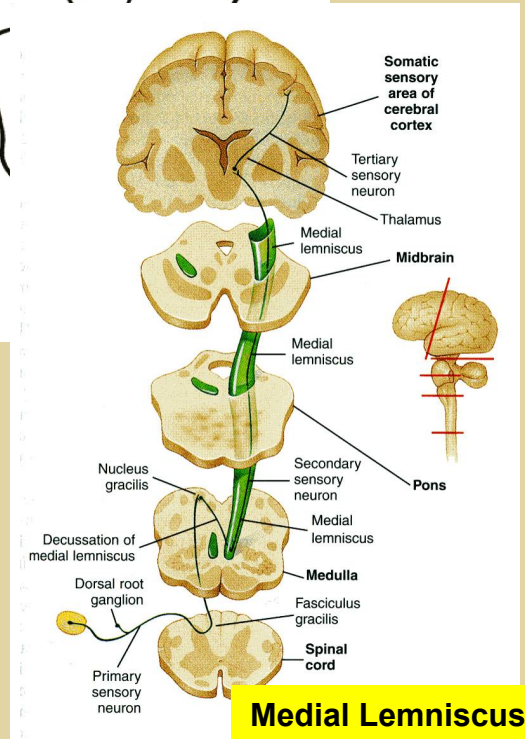
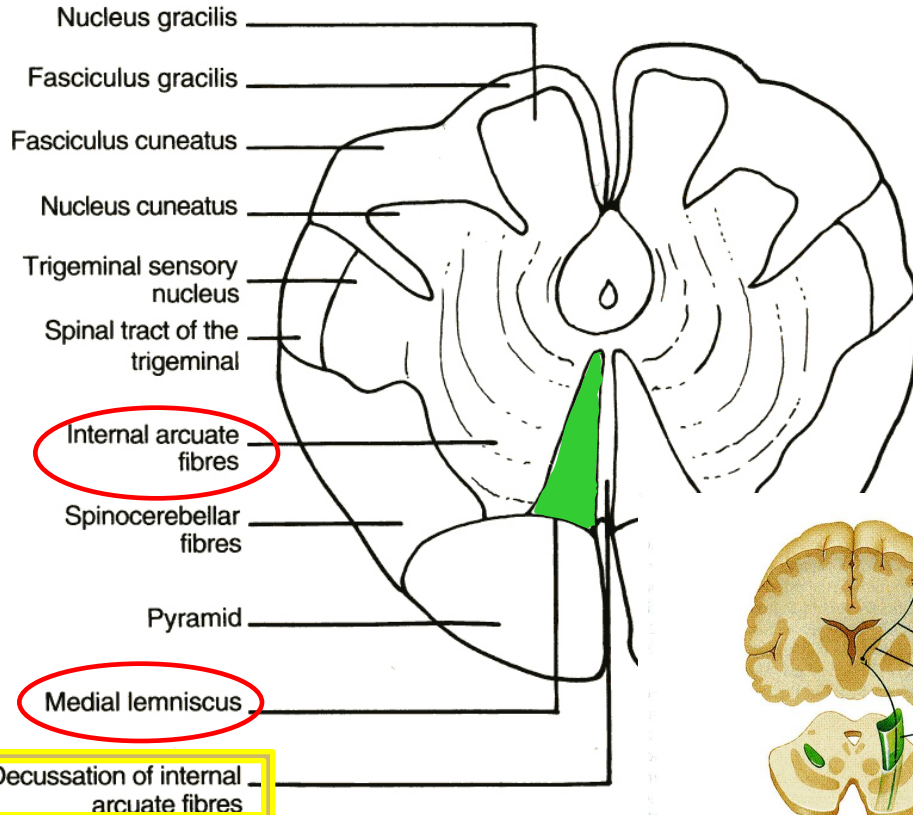
- ▣ *It is Motor Decussation.*
- ▣ *Formed by pyramidal fibers, (75-90%) cross to the opposite side*
- ▣ *They descend in the lateral white column of the spinal cord as the lateral corticospinal tract.*
- ▣ *The uncrossed fibers form the ventral corticospinal tract.*

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**; decussating forming **Sensory Decussation**.*
- ▣ ***Pyramids** are prominent ventrally.*

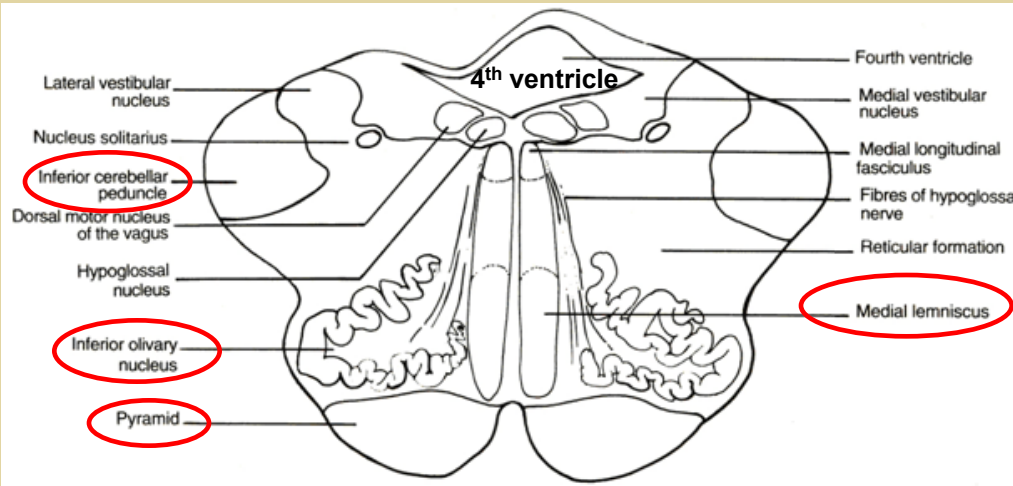


SENSORY DECUSSATION

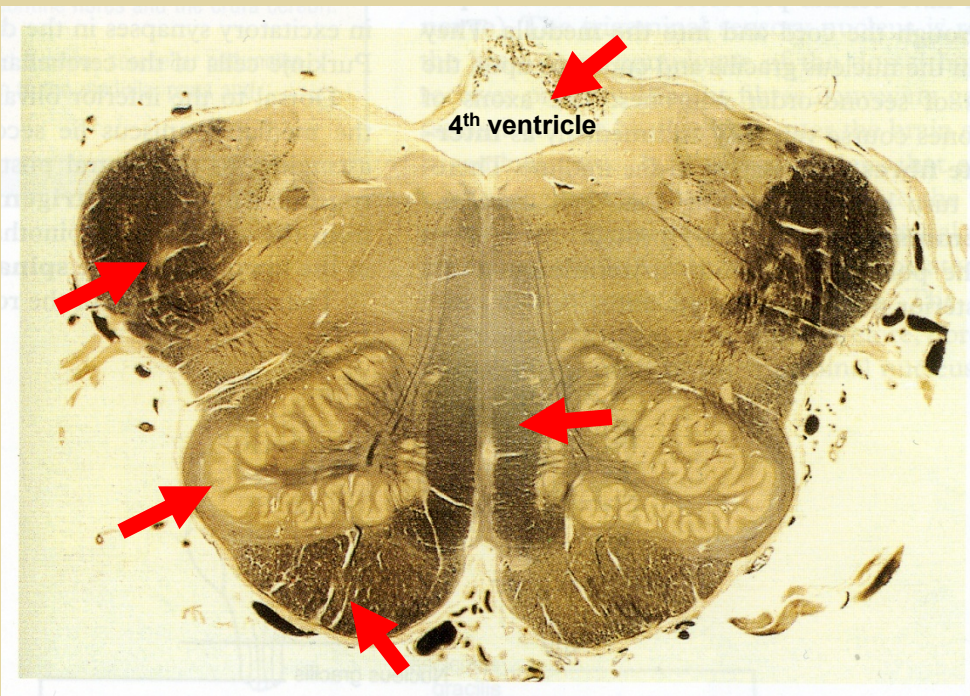


- ▣ Formed by the *crossed internal arcuate fibers*
- ▣ **Medial Lemniscus:**
 - *Composed of the ascending internal arcuate fibers after their crossing.*
 - *Lies adjacent to the middle line ventral to the central canal*
 - *Terminates in thalamus.*
 - *Concerned with proprioceptive deep sensation.*

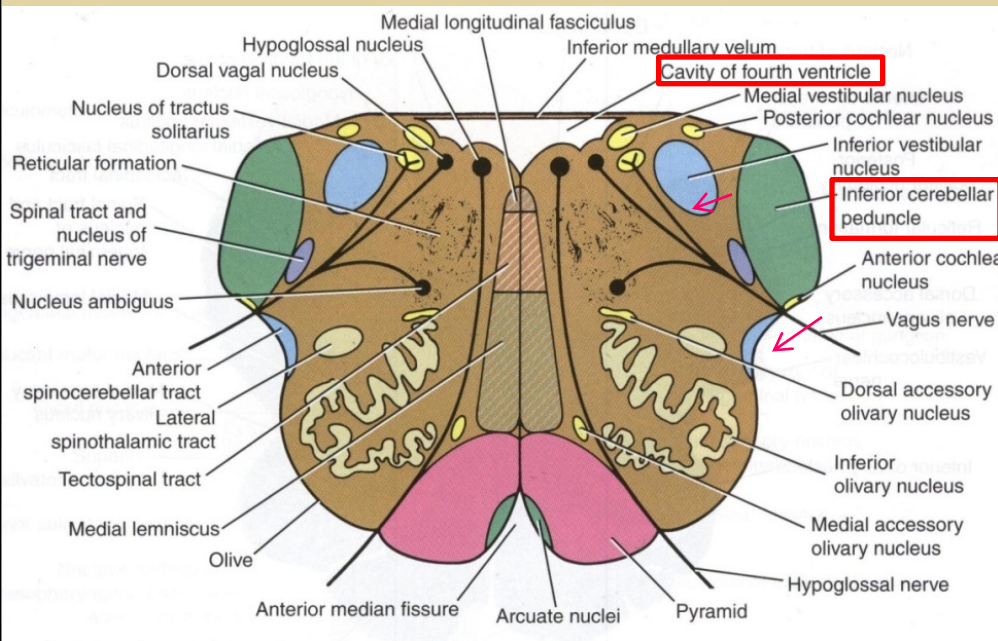
ROSTRAL (open) MEDULLA



- ❑ 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, lies posterolateral to the pyramids & lateral to the medial lemniscus.
 - It is concerned with the control of movements.

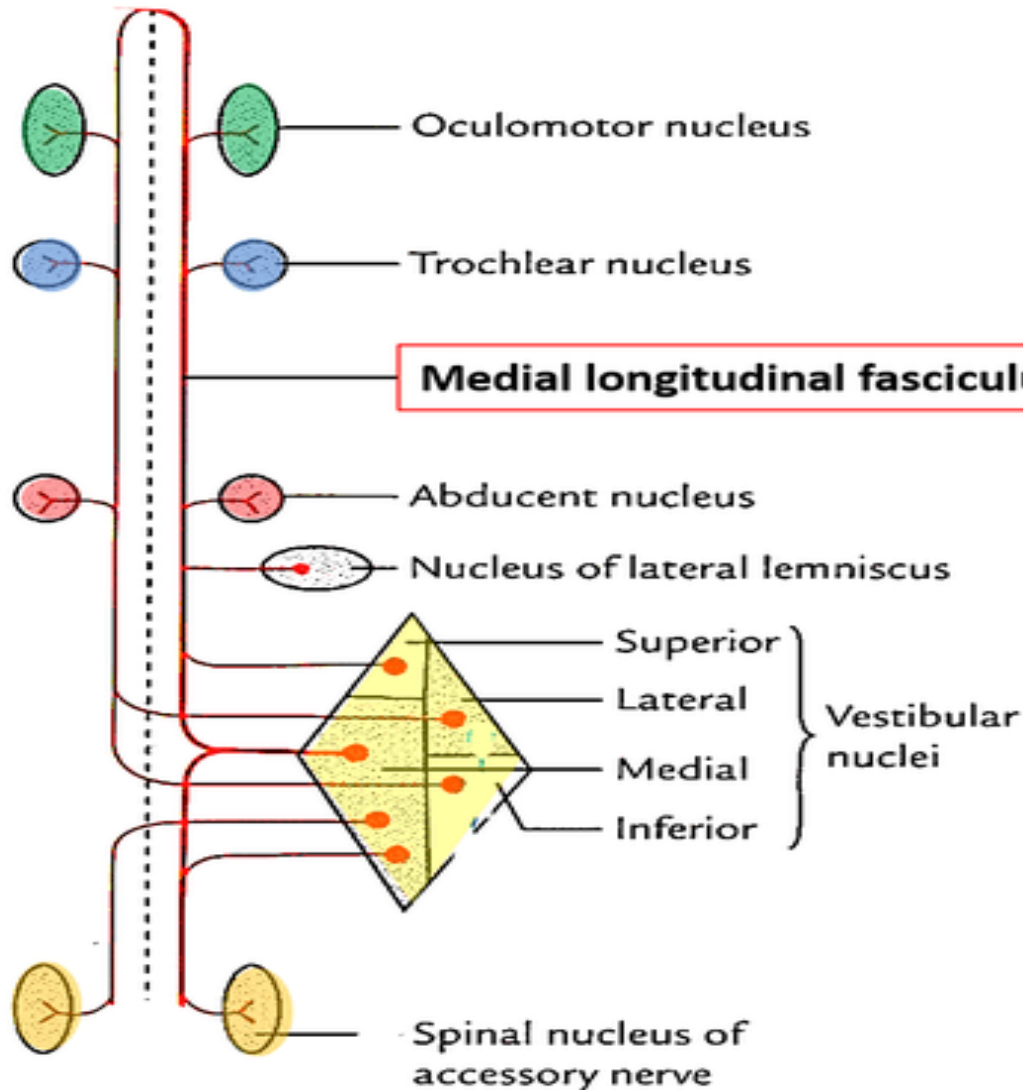


ROSTRAL (open) MEDULLA



- Its dorsal surface forms:
 - Lower part of the floor of the **4th ventricle**.
- **The Inferior Cerebellar Peduncle** is, connecting M.O. with cerebellaum.
- dorsal and lateral to the Inferior cerebellar peduncle lie the **Cochlear nuclei (dorsal and ventral)**; concerning with hearing.

ROSTRAL (open) MEDULLA



- ▣ **Beneath the floor of 4th ventricle lie :**
 - 1. *Hypoglossal Nucleus.*
 - 2. *Dorsal vagal nucleus contains preganglionic parasympathetic fibers.*
 - 3. **Medial longitudinal fasciculus, it is important association tract;**
 - *Upwards :*
 - It links *the vestibular nuclei with nuclei of extraocular ms.(3,4&6) as (vestibulo-ocular tract) to help coordination of eye movements with head movements.*
 - *Downwards :*
 - It links *vestibular nuclei with anterior horn cells of spinal cord (cervical & upper thoracic segments) as (vestibulo-spinal tract)---so, the neck & trunk move with head movements, so maintaining balance of the body trunk and head.*

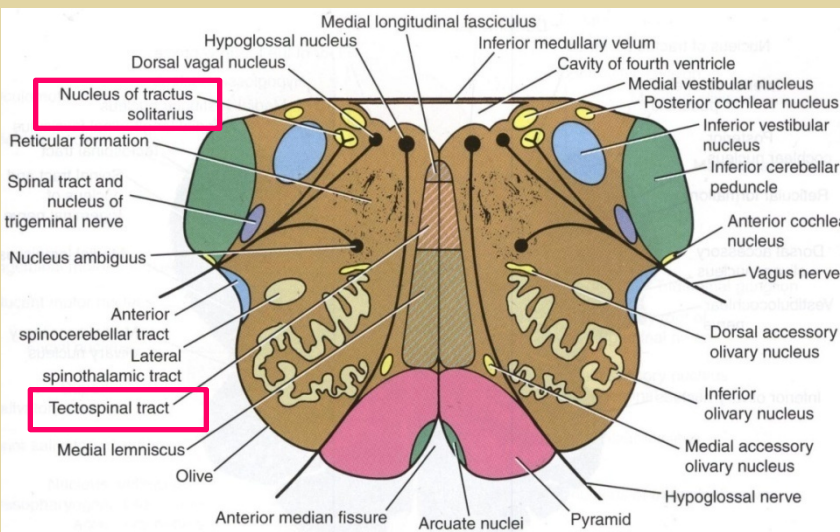
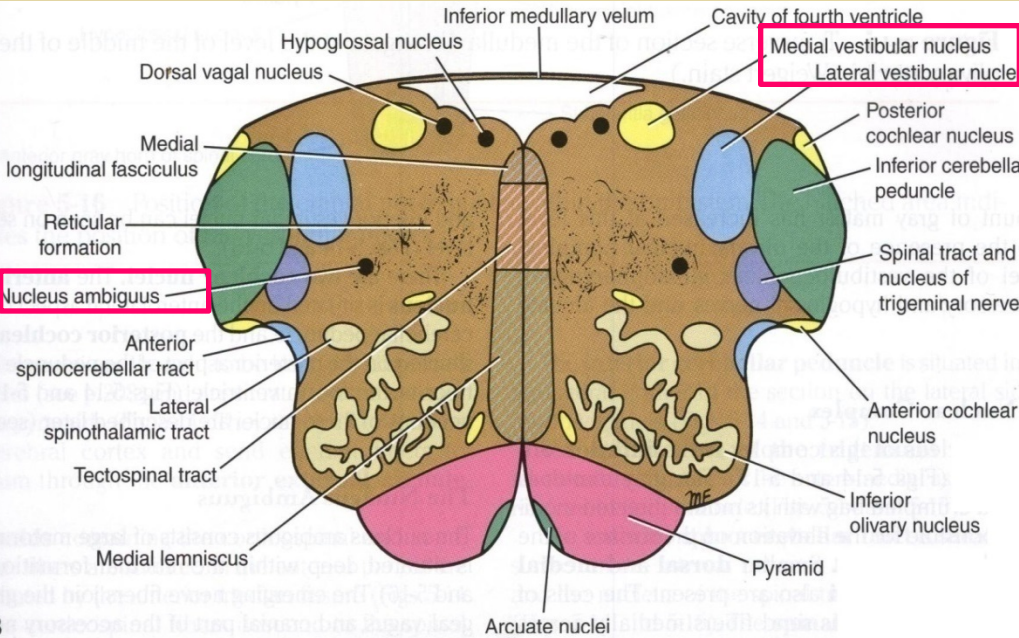
ROSTRAL (open) MEDULLA

- 4. Vestibular nuclei complex : concerned with equilibrium.

- 5. Nucleus Ambiguus: (motor nucleus) : gives motor fibers along glossopharyngeal N. & vagus N. to Ms. of the pharynx, larynx & palate.

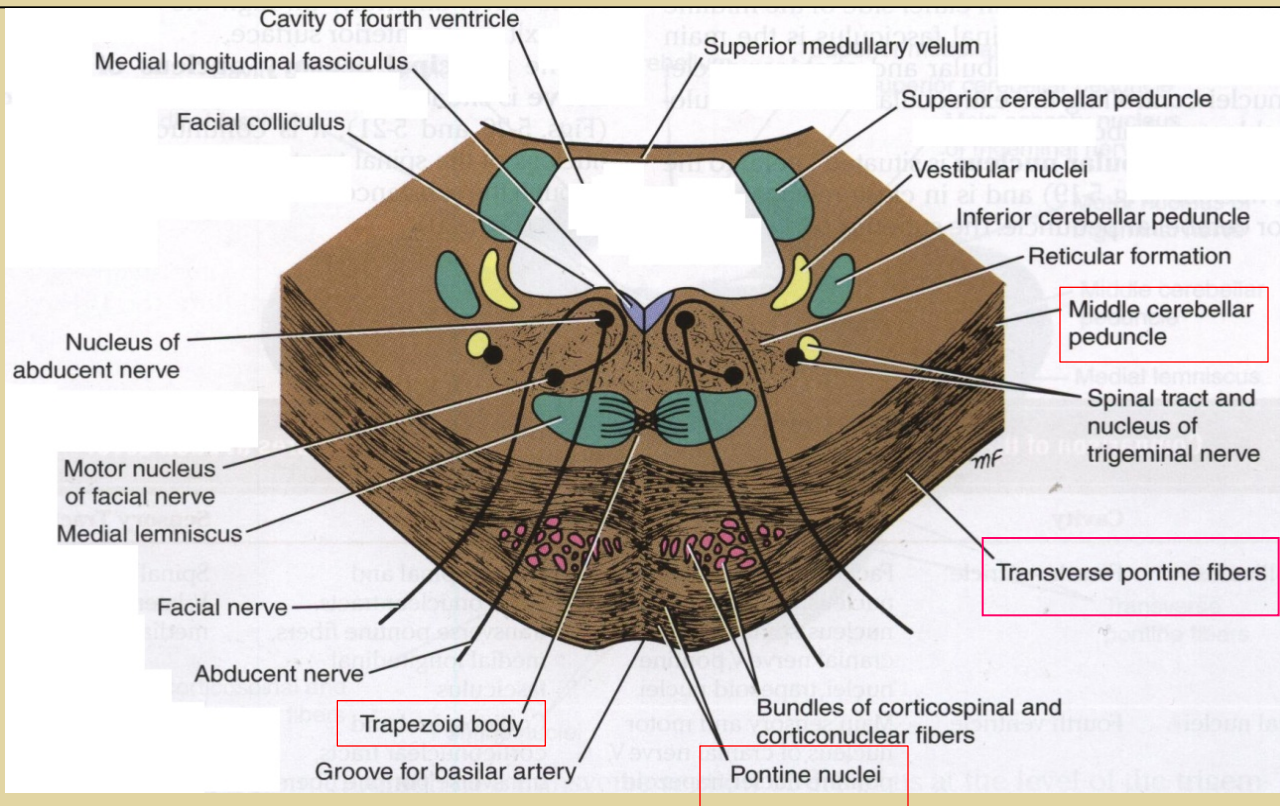
- 6. Solitary nucleus (sensory nucleus) : receives taste sensation from the tongue along the facial (VII), glossopharyngeal (IX) and vagus (X).

- 7. Tectospinal tract : between tectum of midbrain and spinal cord (involved in head movements during visual and auditory tracking).

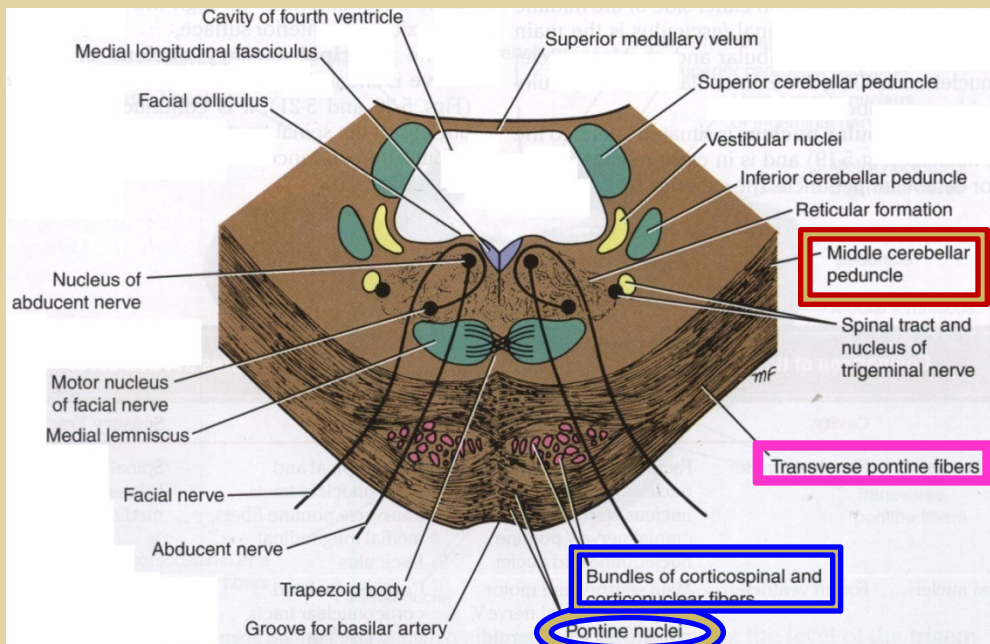


THE PONS

- It is divided into an anterior part (Basis Pontis) & a posterior part (Tegmentum) by the **Trapezoid Body** (consists of crossed acoustic fibres from cochlear nuclei to ascend into midbrain as lateral lemniscus and terminate in inferior colliculus).
- The ventral portion (In all Levels of Pons) : 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 **middle cerebellar peduncle**.



CAUDAL PART OF THE PONS

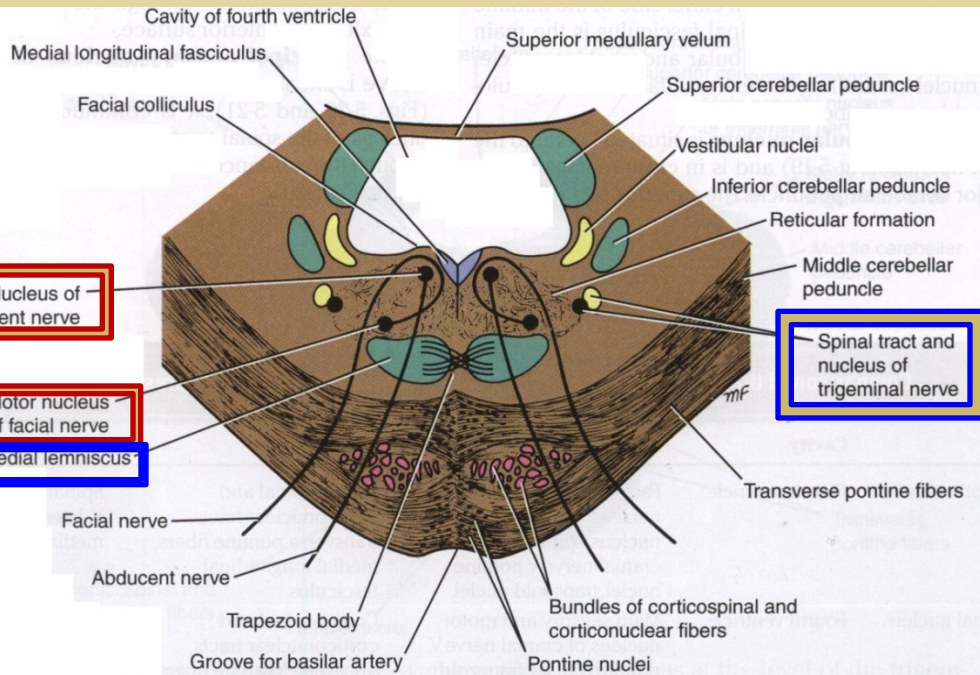


1. Pontine Nuclei:

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

2. Bundles of corticospinal & corticonuclear fibres (Pyramidal fibres)

CAUDAL PART OF THE PONS



3. The ascending fibres of the **Medial lemniscus**

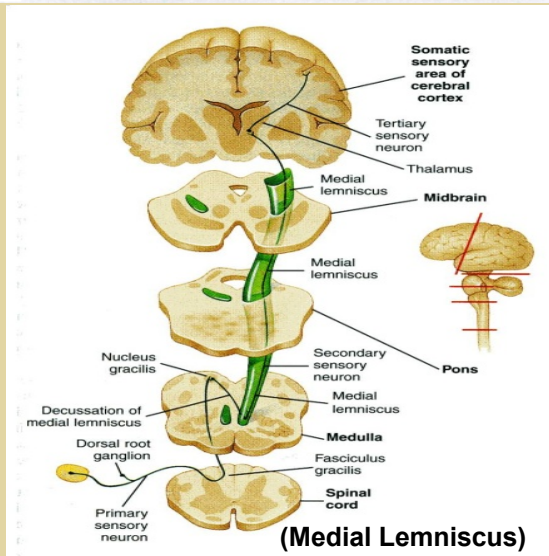
- become separated from the pyramid and displaced dorsally.

- The **Medial Lemniscus** rotates 90 degrees and lies almost horizontally.*

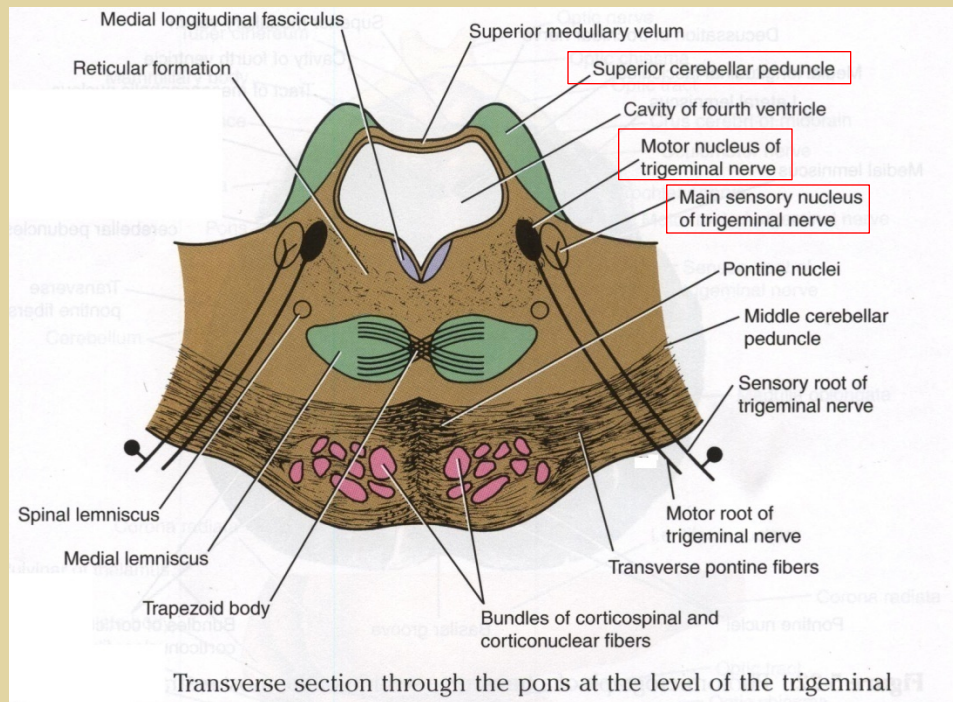
4. Spinal tract & nucleus of Trigeminal.

5. Deep origin of cranial nerve nuclei :

- Abducent nucleus**
- Facial motor nucleus**

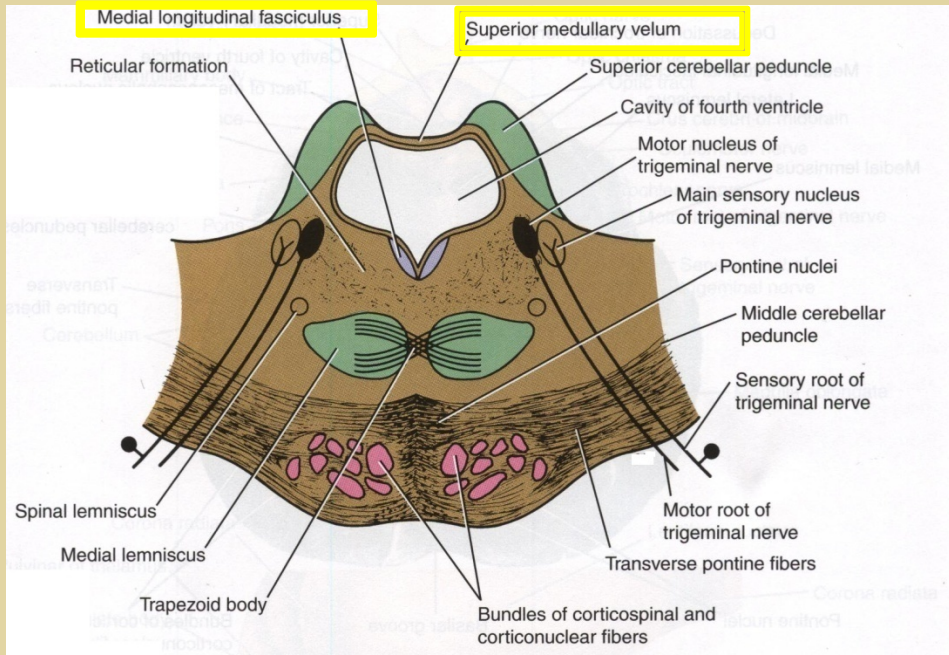


AT THE LEVEL OF THE TRIGEMINAL NERVE



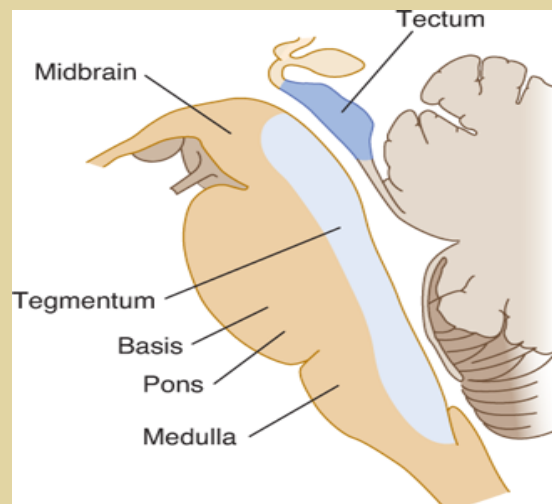
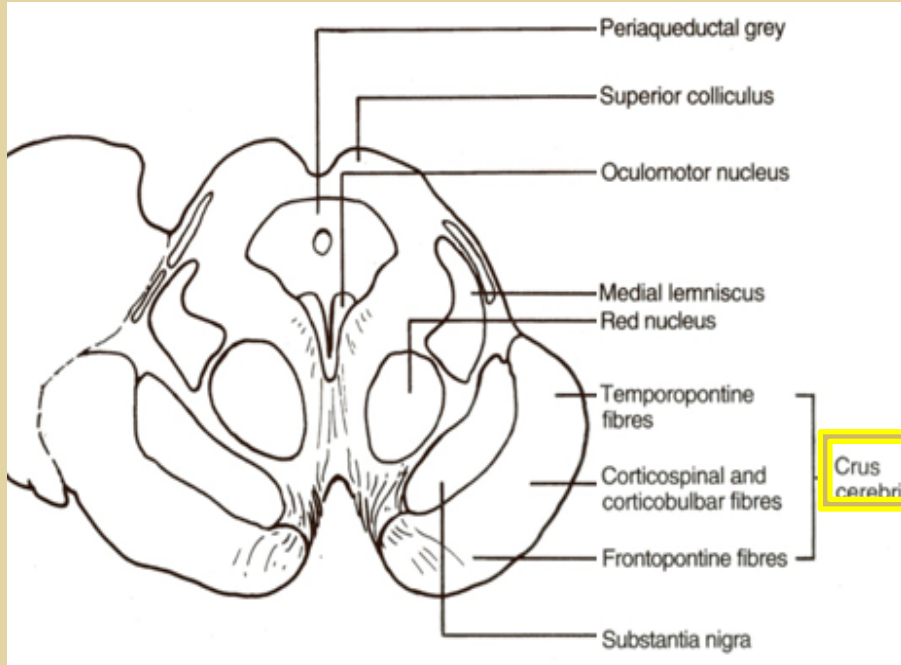
- **Motor nucleus of the trigeminal nerve:** Lies in the lateral part of the floor of the 4th ventricle.
- **Main sensory nucleus of the trigeminal nerve:** it lies lateral to the motor nucleus.
- **Superior cerebellar peduncles** form the lateral boundary of the 4th ventricle

ROSTRAL PONS



- **Superior Medullary Velum:**
 - *Passes between the two peduncles & forms the roof of the 4th ventricle.*
- **Medial longitudinal fasciculus:**
 - *Lies close to the midline beneath the floor of the 4th ventricle.*

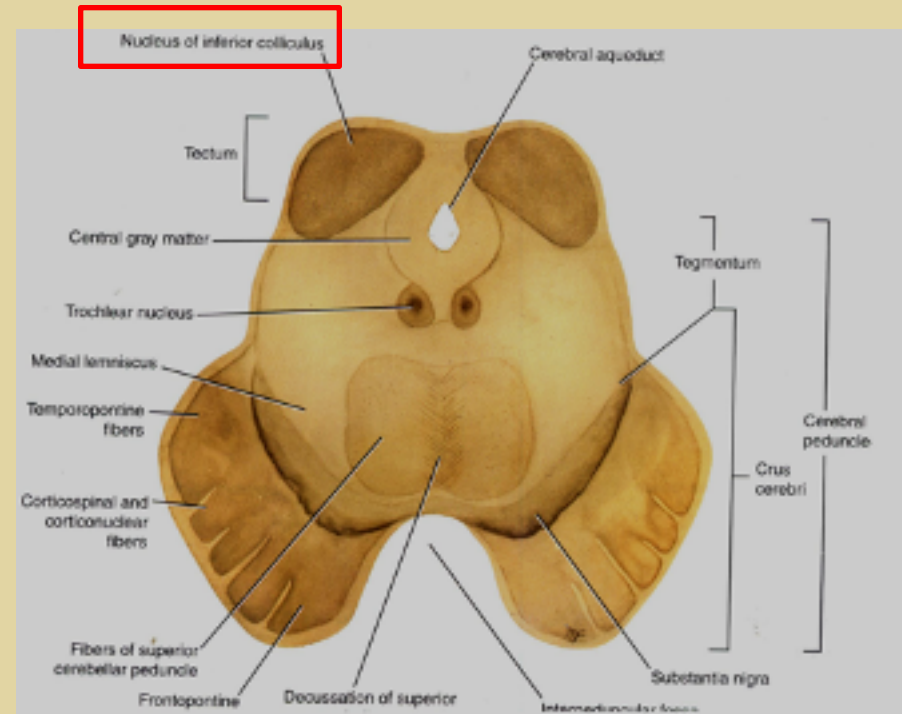
MIDBRAIN



- It is divided into :
- a dorsal part (Tectum) of 4 colliculi; and
- a ventral part (Tegmentum) at the level of the cerebral aqueduct.
- The cerebral aqueduct is surrounded by a pear shaped periaqueductal (central) gray matter.
- The most ventral part to the tegmentum is the massive fibrous mass (Crus Cerebri); Present in both levels of colliculi.

INFERIOR COLLICULUS Level

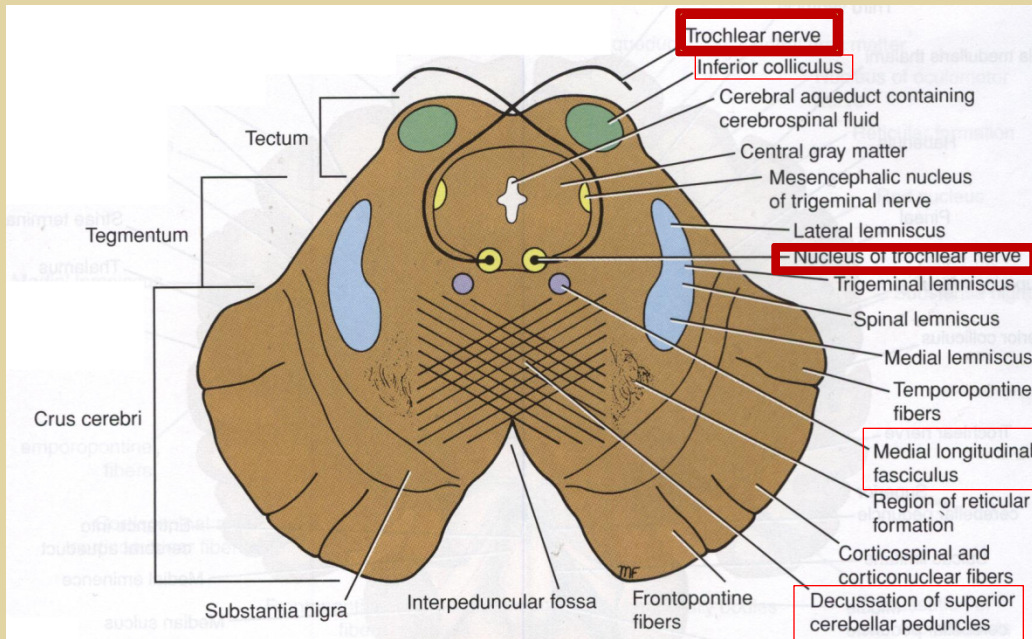
- ▣ *Inferior colliculus is a large nucleus of gray matter that lies beneath a corresponding surface elevation.*
- ▣ *It is part of the auditory pathway.*
- ▣ *It receives fibers from the lateral lemniscus.*
- ▣ *Its efferent fibers pass to the thalamus*



INFERIOR COLLICULUS Level

1. Trochlear nucleus:

- *lies in the central gray matter close to the median plane.*
- *The fibers of the trochlear nerve decussate in the superior medullary velum and emerge from posterior surface of midbrain.*

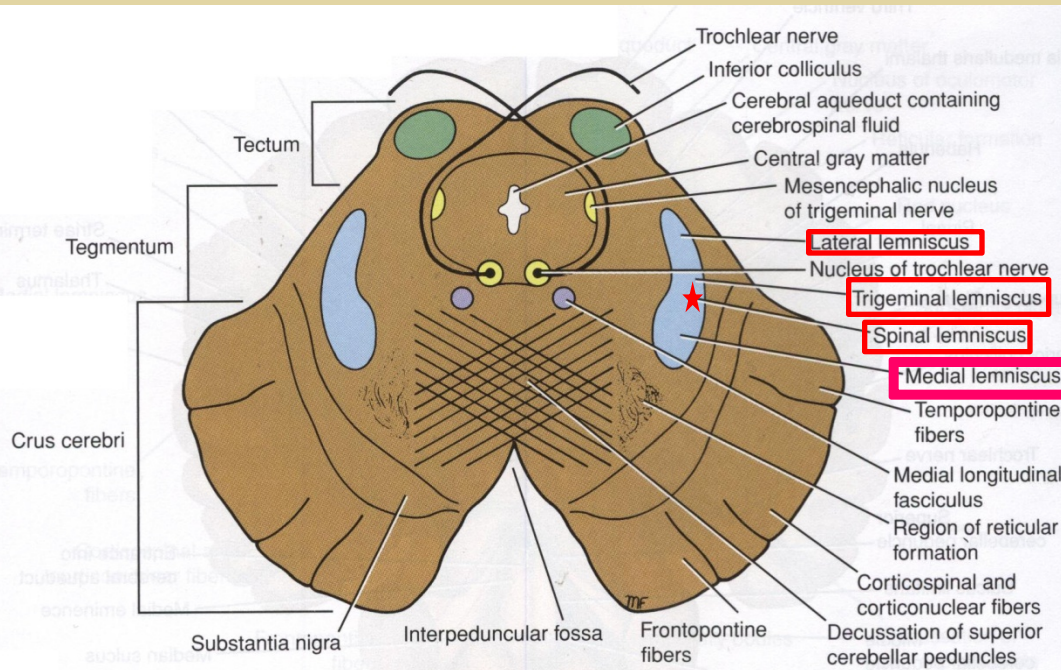


2. Decussation of the superior cerebellar peduncles in the mid line.

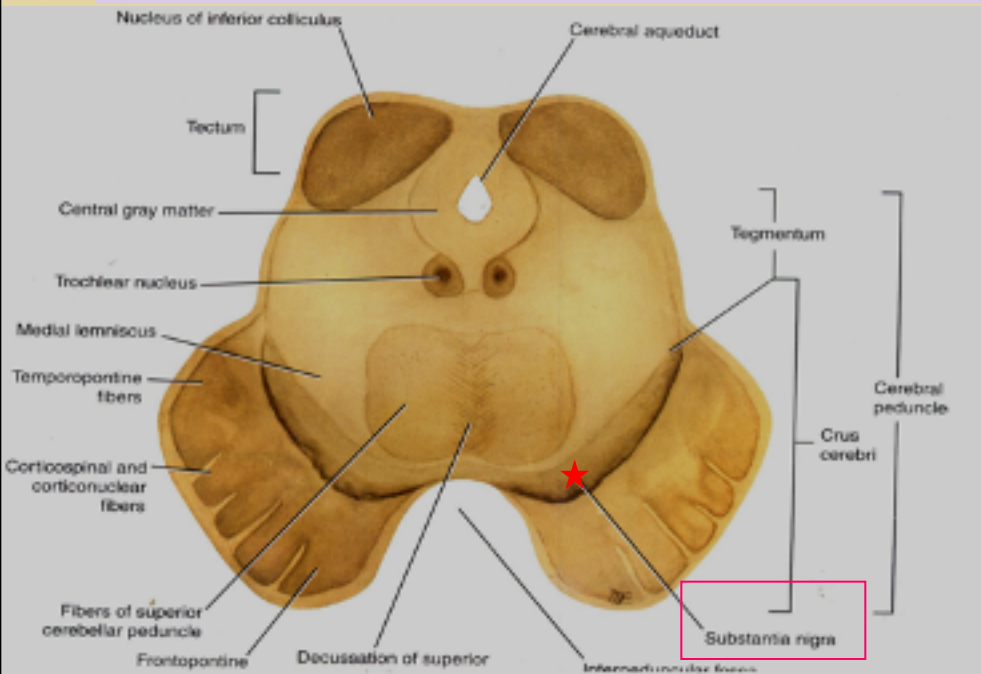
3. ASCENDING LEMNISCUS :

■ *Composed Of:*

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

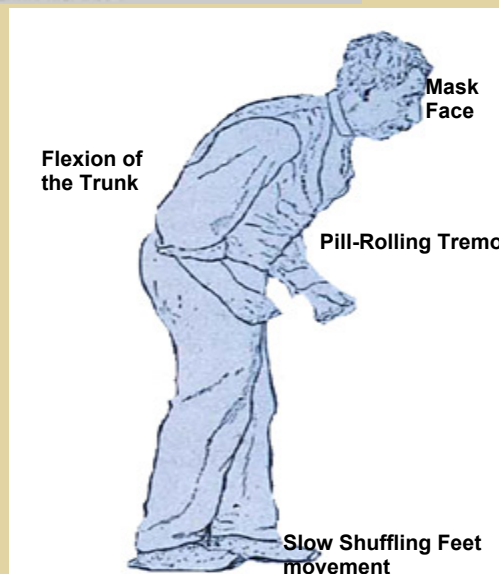


INFERIOR COLLICULUS Level

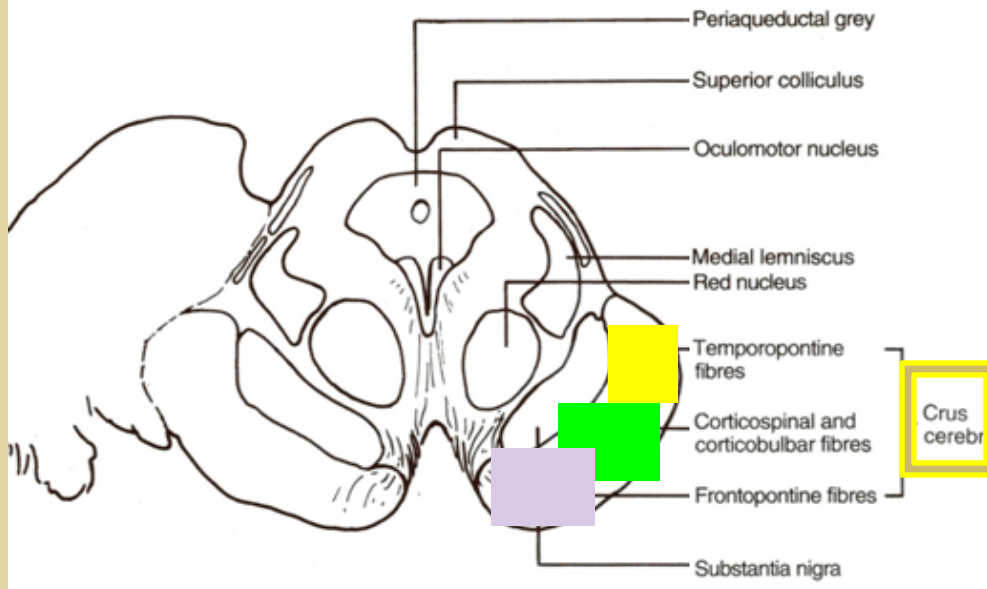
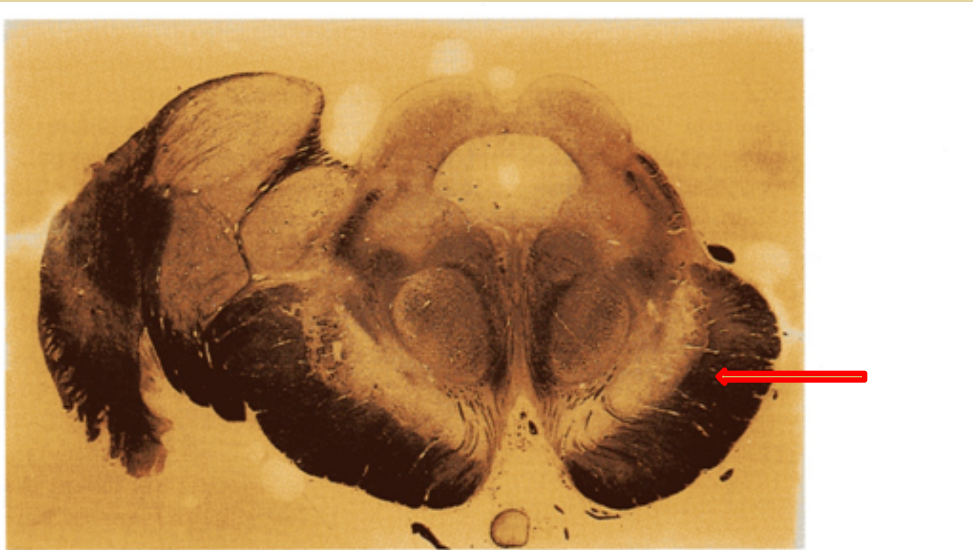


4. Substantia nigra^{*}:

- ▣ 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.*

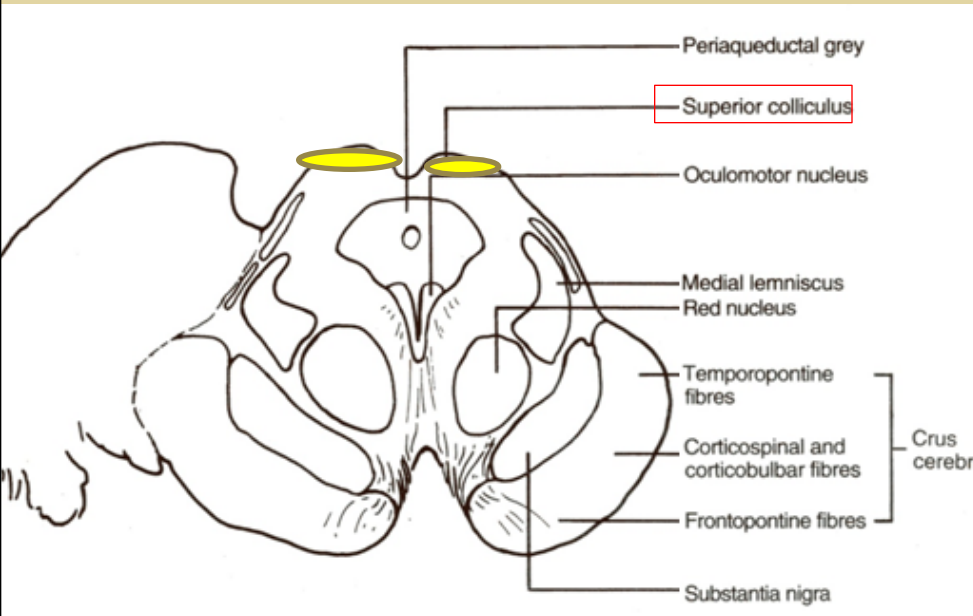


CRUS CEREBRI



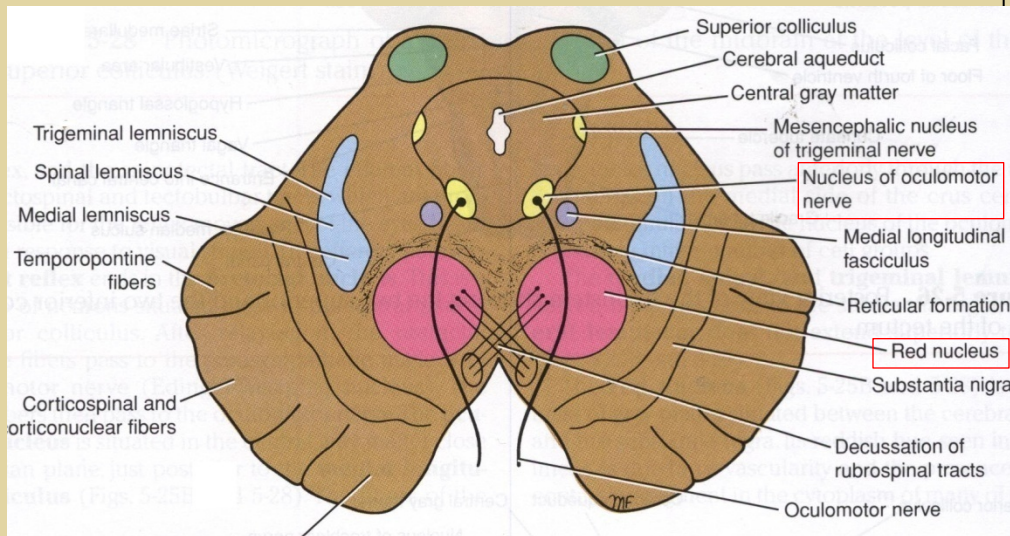
- It is a massive mass ventral to the substantia nigra.
- It consists entirely of **descending cortical efferent fibers** (Frontopontine, Corticospinal & corticobulbar and Temporopontine Fibres) to the motor cranial nerve nuclei and to anterior horn cells of spinal cord.
- Involved in the coordination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

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.**

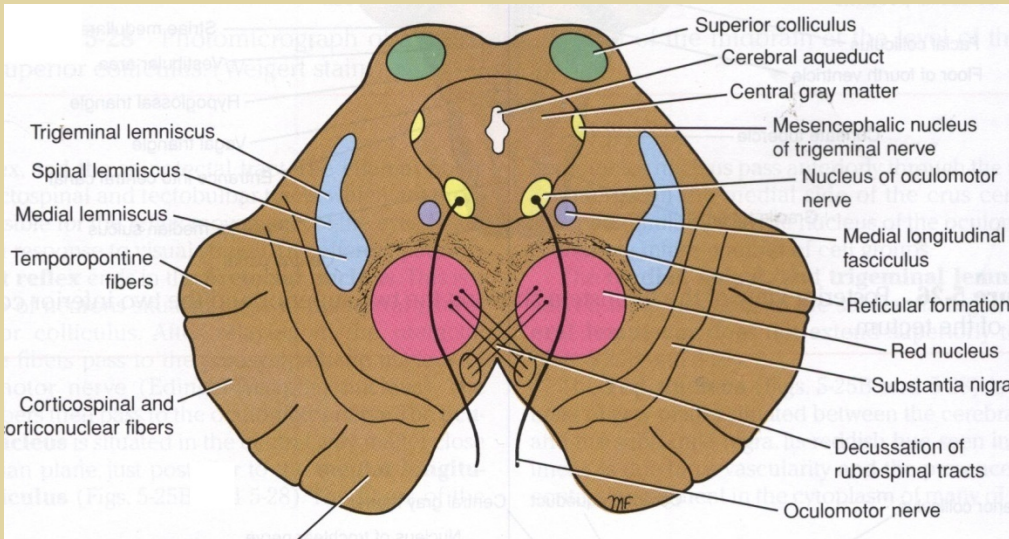
SUPERIOR COLLICULUS Level



1. Oculomotor nucleus:

- ▣ *Situated in the central gray matter.*
- ▣ *The fibers of the oculomotor nerve passes anteriorly through the red nucleus to emerge on the medial side of the crus cerebri (In interpeduncular fossa).*

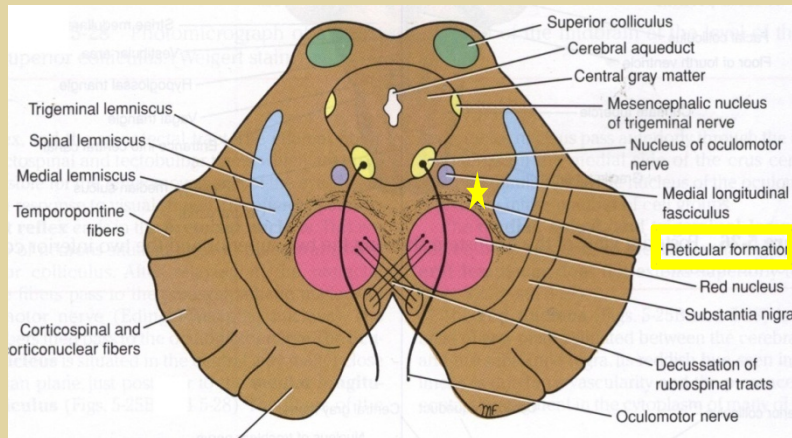
SUPERIOR COLLICULUS Level



2. Red nucleus :

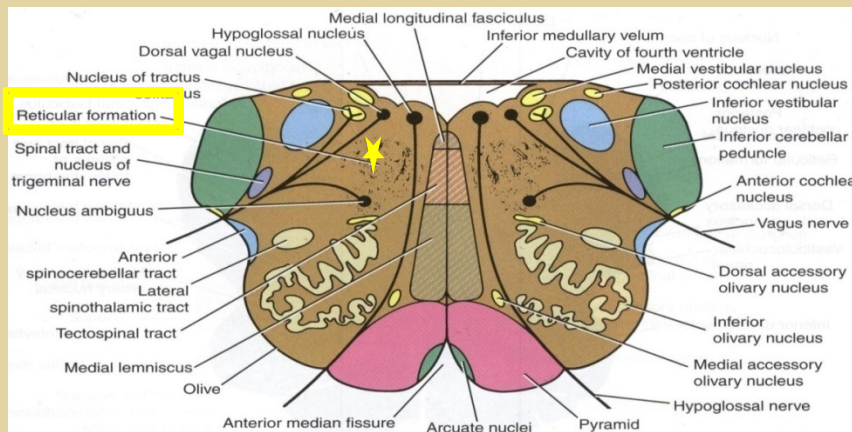
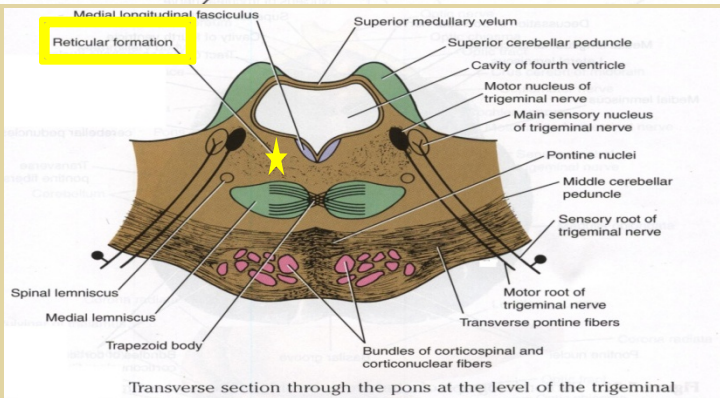
- ▣ A rounded mass of gray matter that lies in the central portion of the tegmentum.
- ▣ Its red coloration is **due to its vascularity** and the presence of an iron containing pigment in the cytoplasm of its neurons.
- ▣ It is involved in **motor control**.

RETICULAR FORMATION

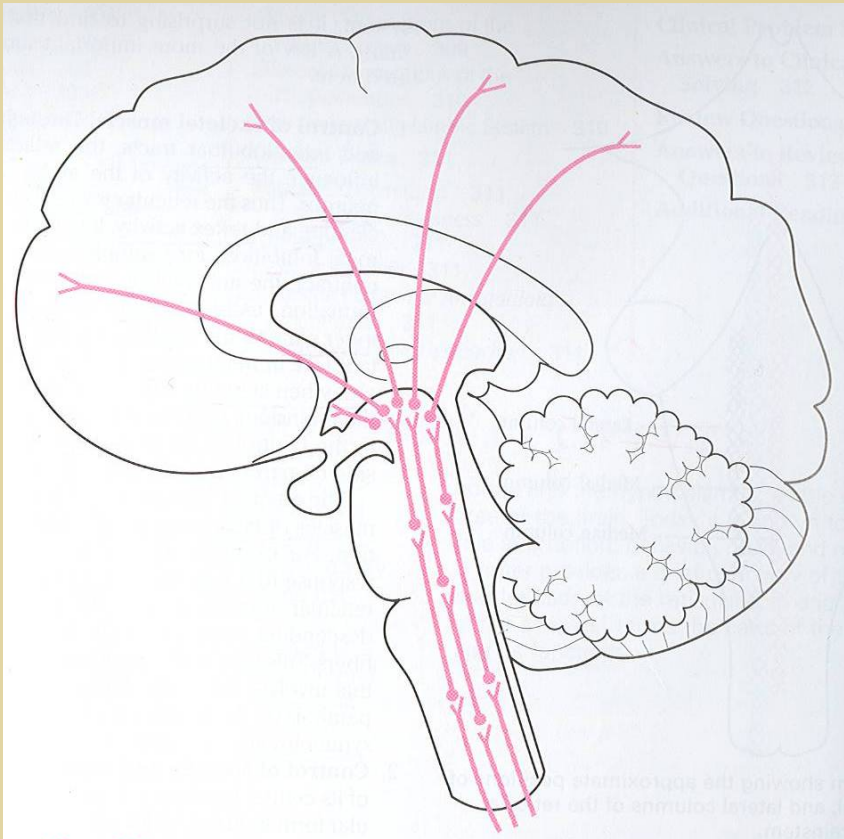


It is a complex matrix of nerve fibers & groups of nerve cells that extends throughout the brain stem.

It has a number of important functions i.e. Respiratory and Cardio-vascular centers.



RETICULAR TRACTS



- ▣ **Reticulo spinal tracts:**
 - **Descending fibres**
Influence a muscle tone & posture
- ▣ **Reticular Activating system:**
 - **Ascending fibers activate the cerebral cortex through the thalamus.**

THANK YOU