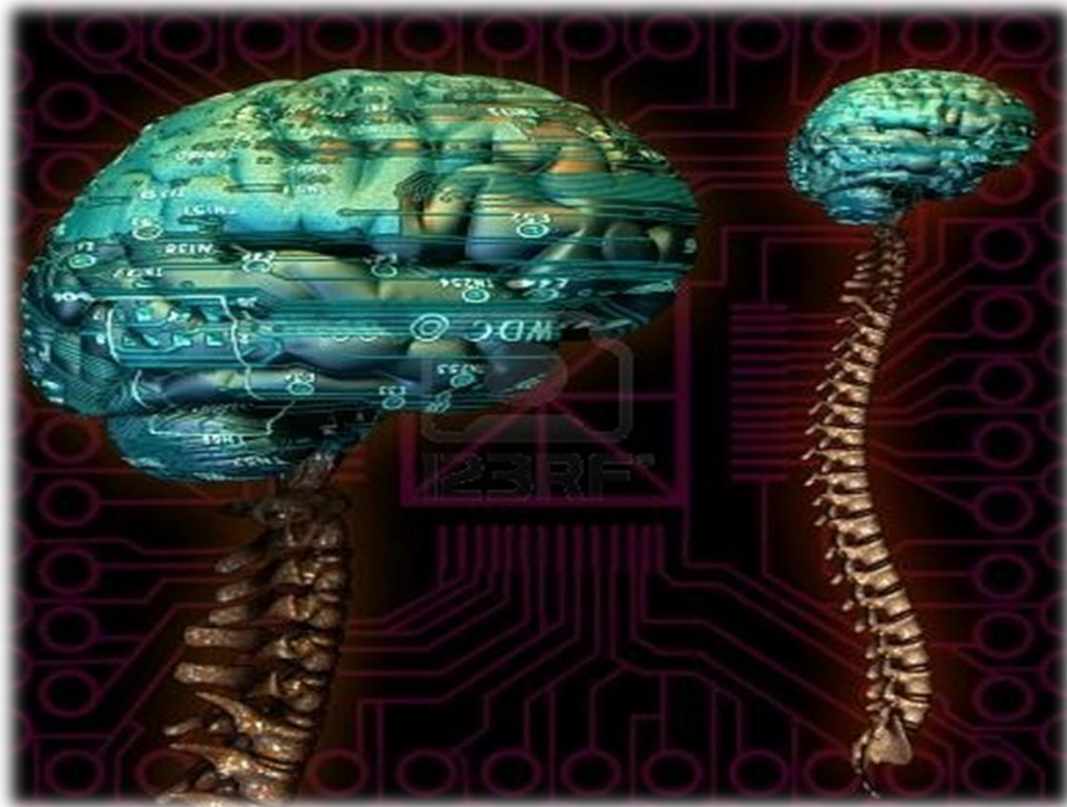




CNS Block



LECTURE (9)

Done by: Wael Al Saleh

Reviewed by: Leena alYahya

If there is any mistake please feel free to contact us:

Anatomyteam32@gmail.com

Both - Black

Male Notes - BLUE

Female Notes - GREEN

Explanation and additional notes - ORANGE

Very Important note - Red



Objectives:

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

- Describe the Reticular formation (structure, function and pathway) being an important content of the brain stem.



A) MEDULLA

1) CLOSED " Caudal " MEDULLA Components:	2) mid medulla components:	3) Open " rostral " medulla Components :
A- Tranvered by central canal	A- Tranvered by central canal	A- Its dorsal surface forms the lower part of the fourth ventricle.
B- motor pyramidal decussation	B- Large size gracile & cuneate nuclei, their axons form internal arcuate fibers.	B- The Inferior Cerebellar Peduncle is dorsolateral in position.
C- Spinal nucleus of trigeminal nerve. "Trigeminal sensory nucleus"	C- Pyramids are prominent.	C- Inferior Olivary Nucleus
	D- sensory decussation which is formed by crossed internal arcuate fibers.	D- Medial longitudinal fasciculus.



Now we will explain in more details each part and its main components:

1- Closed medulla:

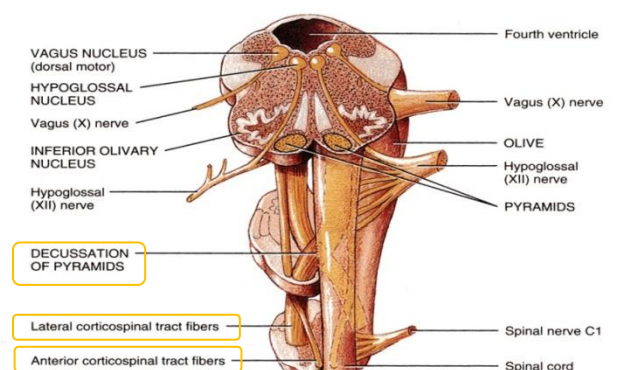
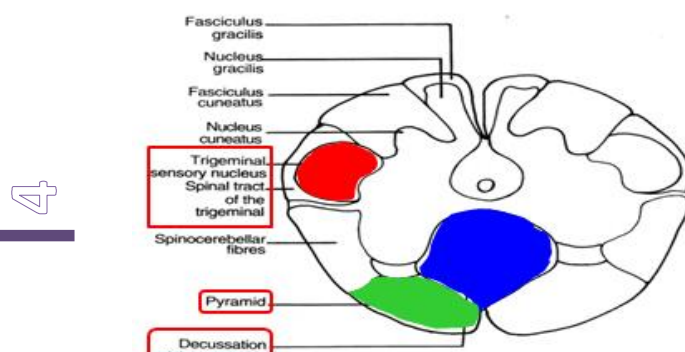
IT CONTAINS THE FOLLOWING STRUCTURE:

A) Spinal Nucleus of Trigeminal nerve:

- It is a larger sensory nucleus.
- It is the brain stem **continuation of the Substantia Gelatinosa of spinal cord**.
- It lies in all levels **Medulla Oblongata** , medial to the spinal tract of the trigeminal nerve.
- Extends through **the whole length** of the brain stem and into **upper segments** of spinal cord.
- Its tract present in **all levels of Medulla Oblongata** is formed of descending fibers that terminate in spinal nucleus of the trigeminal nerve.
- Function: It receives **pain and temperature from face, forehead**.

B) PYRAMIDAL DECUSSATION (*Decuss*- = crossing):

- It is **Motor** Decussation.
- It formed by pyramidal fibers.
- (75-90%) cross to the opposite side.
- The **crossed fibers** descend in the lateral white column of the spinal cord as **the lateral corticospinal tract**.
- The **uncrossed fibers (25-10%)** form **the ventral corticospinal tract**.





2- MID Medulla:

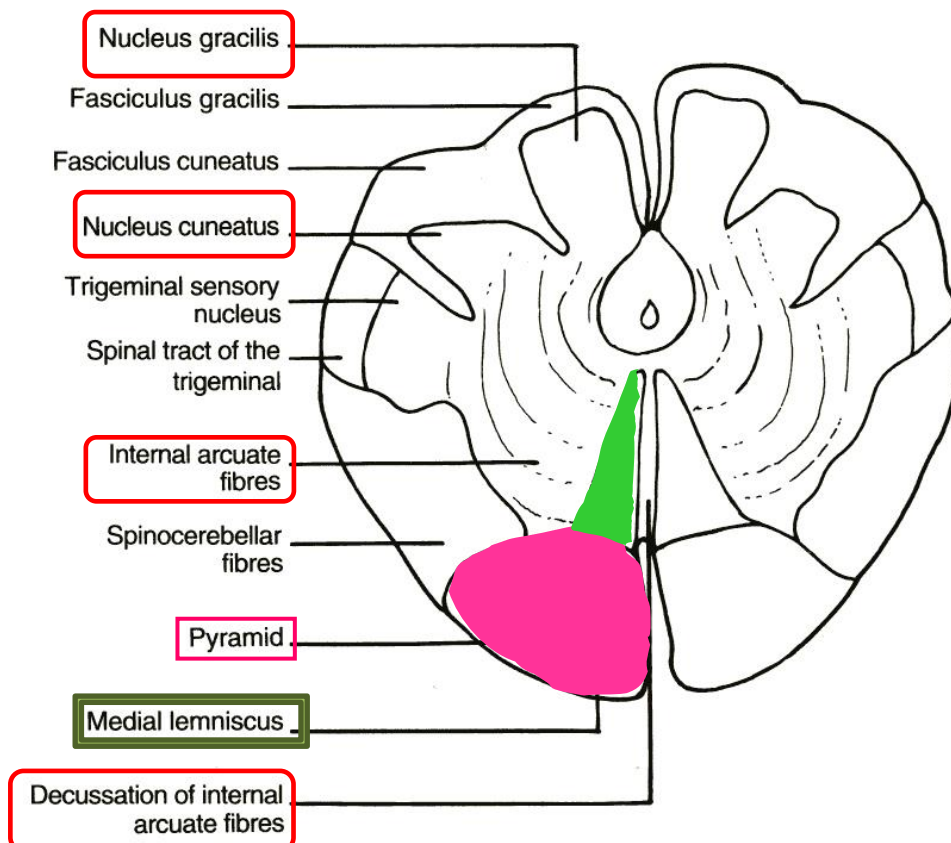
IT CONTAINS THE FOLLOWING STRUCTURE:

A) SENSORY DECUSSATION:-

- Formed by the **crossed internal arcuate fibers**.

B) Medial Lemniscus: "Lemniscus means a ribbon"

- Composed of the **ascending internal arcuate fibers** after their crossing.
- Lies adjacent to the middle line ventral to the central canal.
- Terminates in **thalamus**.
- **Function:** Responsible for **proprioceptive** pathway.

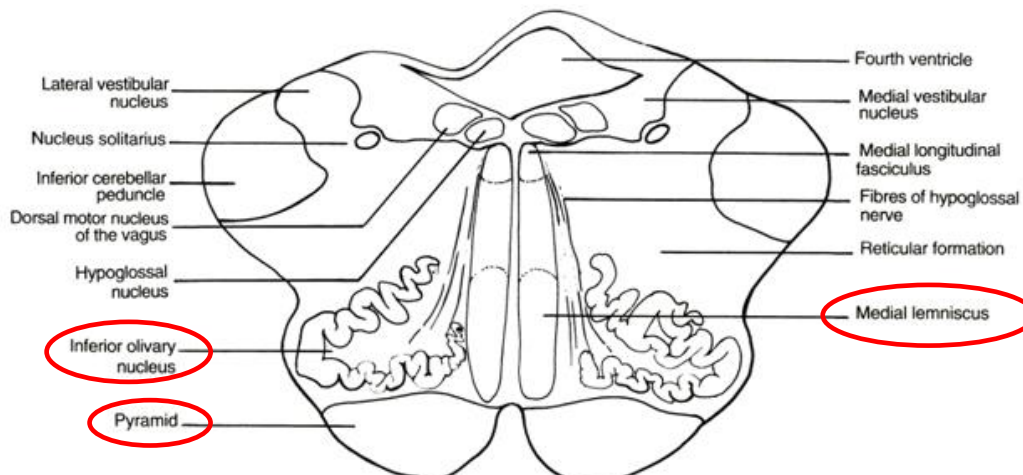




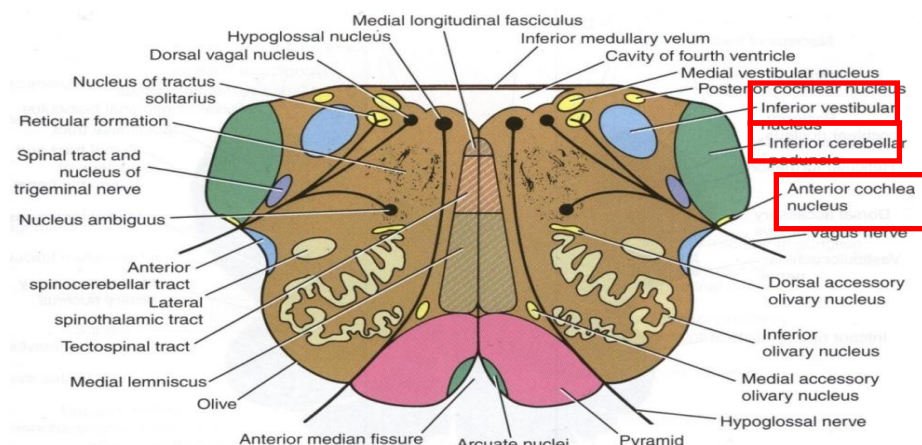
3- **ROSTRAL (open) MEDULLA:**

IT CONTAINS THE FOLLOWING STRUCTURE:

A) On the ventral aspect			
1- The pyramid is clear	2- Medial lemniscus: lies on either sides of middle line dorsal to the pyramid.	3- Inferior Olivary Nucleus: A convoluted mass of gray matter lies posterolateral to the pyramids & lateral to the medial lemniscus	Function: It is concerned with the control of movement.



B) On The dorsal aspect		
1- Lower part of the floor of the 4th ventricle	2-The Inferior Cerebellar Peduncle: connecting Medulla oblongata with cerebellum	3- the Cochlear nuclei (dorsal Cochlear nucleus & ventral Cochlear nucleus): Lie dorsal and lateral to the Inferior cerebellar peduncle.



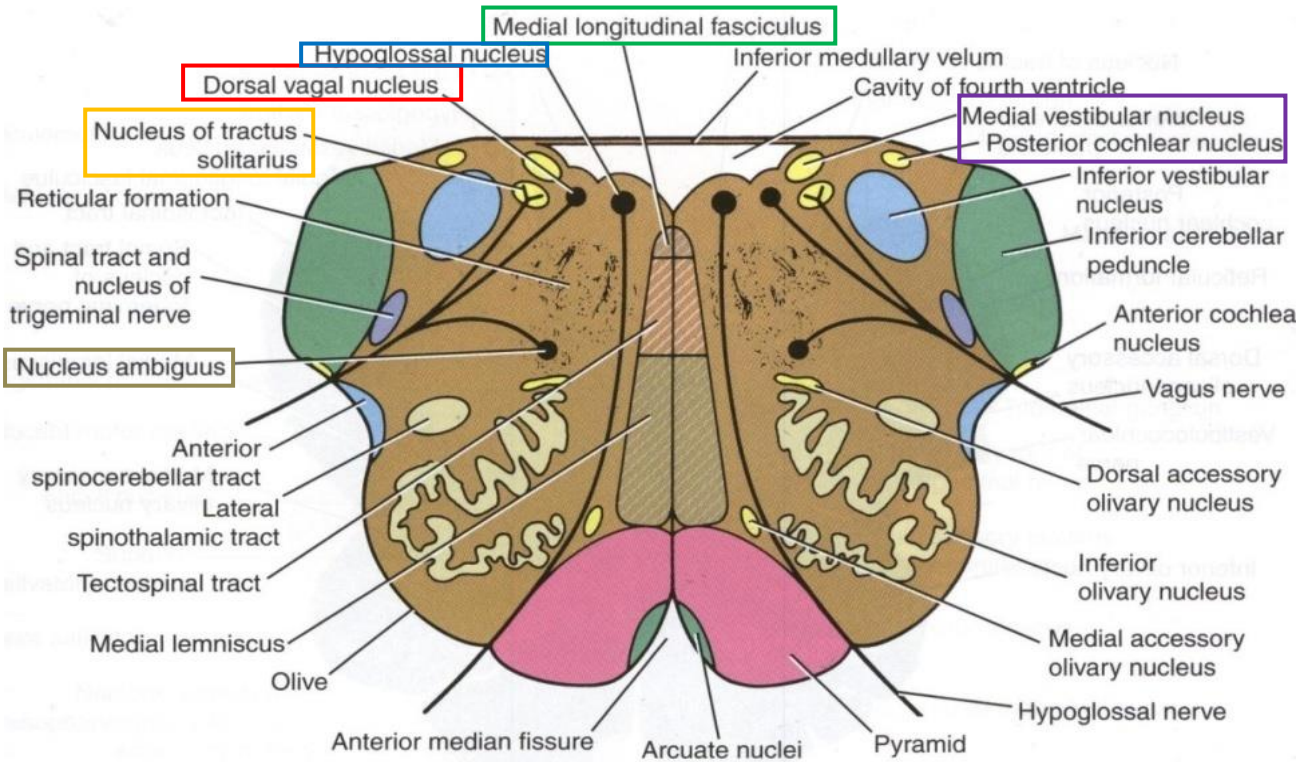


C) Beneath the floor of 4th ventricle

1- Medial longitudinal fasciculus	<ul style="list-style-type: none">▪ Site: lies close to the midline, ventromedial to the hypoglossal nucleus, dorsal to the medial lemniscus.▪ Function: It links the vestibular nuclei with nuclei of extraocular muscles (3, 4 & 6) to help coordination of head & eye movements
2-Dorsal Nucleus of Vagus	<ul style="list-style-type: none">▪ Site: lateral to the hypoglossal nucleus.▪ Function: contains preganglionic parasympathetic fibers.
3- Hypoglossal Nucleus	—
4- Vestibular nuclei complex	<ul style="list-style-type: none">▪ Function: concerned with equilibrium.
5- Nucleus Ambiguus	<ul style="list-style-type: none">▪ Site: lies dorsal to olivary nucleus.▪ Function: gives motor fibers to constrictors of the pharynx & intrinsic muscles of the larynx.
6- Solitary nucleus	<ul style="list-style-type: none">▪ Site: lies ventrolateral to dorsal nucleus of vagus▪ Function: receive taste sensation from the tongue along the facial (VII), glossopharyngeal (IX) and vagus (X) cranial nerves



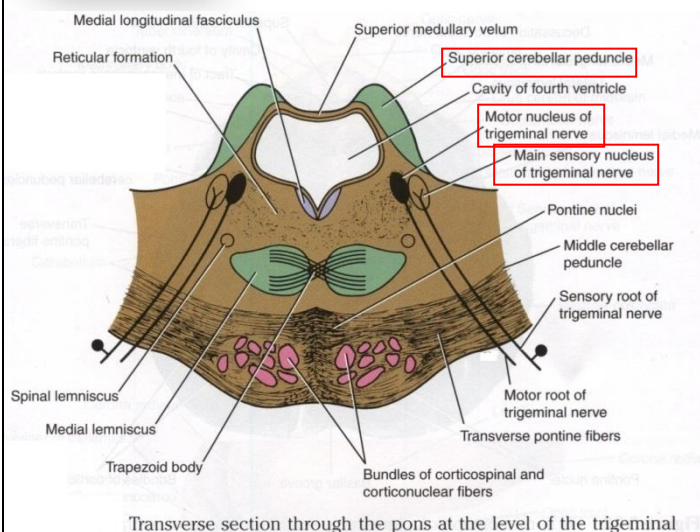
Each color from those above will be pointed at the figure:



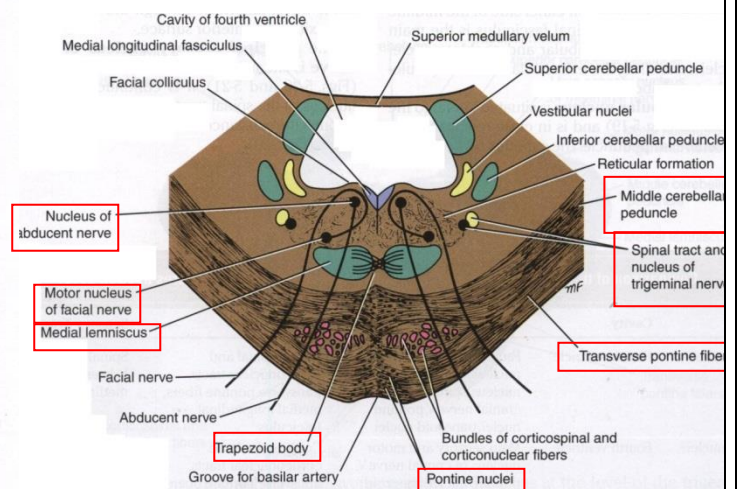


B) PONS

Site	Division	The ventral portion is marked by	Components	AT THE LEVEL OF THE TRIGEMINAL NERVE
<p>1. Caudal Pons</p>	<p>Divided into two parts:</p> <p>1) an Anterior part (Basis Pontis)</p> <p>2) a Posterior part (Tegmentum)</p> <p>by the Trapezoid Body</p> <p>(consists of acoustic fibres from cochlear nuclei to ascend into ↓ midbrain as lateral lemniscus ↓ and terminate in inferior colliculus).</p>	<p>Numerous transversely oriented fascicles of pontocerebellar fibres</p> <p>that originate from scattered cell groups, the pontine nuclei,</p> <p>and that pass to the contralateral side of the cerebellum through the massive middle cerebellar peduncle.</p>	<p>1) 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.</p> <p>2) 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. It contains spinal nucleus & tract of Trigeminal.</p> <p>3) Deep origin of cranial nerve nuclei: A- Abducent nucleus B- Facial motor nucleus</p>	<p>1) Motor nucleus of the trigeminal nerve: Lies in the lateral part of the floor of the 4th ventricle.</p> <p>2) Main sensory nucleus of the trigeminal nerve: Reaches its maximum extent in the pons and it lies lateral to the motor nucleus.</p> <p>3) Superior cerebellar peduncles: form the lateral boundary of the 4th ventricle</p>
<p>2. Rostral Pons</p>	<p>—</p>	<p>—</p>	<p>1) Superior Medullary Velum: Passes between the two superior peduncles & forms the roof of the 4th ventricle.</p> <p>2) Medial longitudinal fasciculus : Lie close to the midline beneath the floor of the 4th ventricle.</p>	<p>—</p>



Transverse section through the pons at the level of the trigeminal



At the level of trigeminal nerve

B) 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 periaqueductal (central) gray matter.
- The most ventral part of the tegmentum is the massive fibrous mass (Crus Cerebri).
- There are two sites: 1 - Inferior colliculus. 2- Superior colliculus.

	Definition	Components which are at the level of the Inferior colliculus
1- Inferior colliculus	<p>A large nucleus of gray matter that lies beneath a corresponding surface elevation.</p> <p>-It is part of the auditory pathway.</p> <p>-It receives fibers from the lateral lemniscus.</p> <p>-Its efferent fibers pass to the thalamus.</p>	<p>1) Trochlear nucleus</p> <p>2) Decussation of the superior cerebellar peduncles in the mid line.</p> <p>3) Substantia nigra</p> <p>4) CRUS CEREBRI</p>



Now we will explain in more details
each part:

1. Trochlear nucleus	<ul style="list-style-type: none">Lies in the central gray matter close to the median plane just posterior to the <u>medial longitudinal bundle</u>.The <u>fibers</u> of the <u>trochlear nerve</u> decussate in the superior medullary velum
2. Decussation of the superior cerebellar peduncles	In the mid line.
3. Substantia nigra	<ul style="list-style-type: none">Occupies the most <u>ventral part</u> of the tegmentum.It consists of pigmented, melanin containing neurones.It projects to the basal ganglia. Its degeneration is associated with Parkinson's disease
4. ASCENDING LEMINISCI	Composed Of: 1. Spinal (Lateral & anterior spinothalamic tracts) 2. Trigeminal (Lateral & medial) 3. Lateral lemniscus 4. medial lemniscus
5. Crus cerebri	<ul style="list-style-type: none">✓ It is a massive mass <u>ventral</u> to the <u>substantia nigra</u>✓ It consists entirely of descending cortical efferent fibers (corticobulbar & corticospinal fibres, Temporo-pontine, fronto-pontine) to the <u>motor cranial nerve nuclei</u> and to <u>anterior horn cells</u> . FUNCTION: Involved in the coordination of movement.

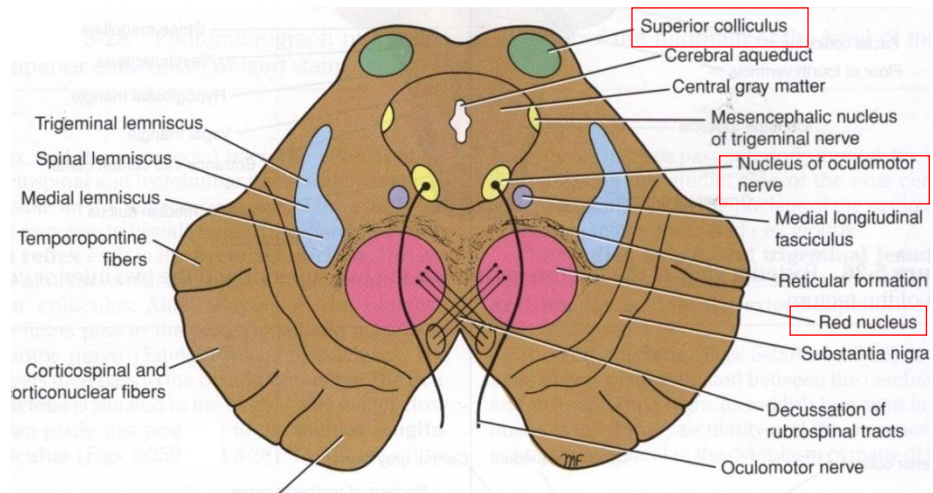


Midbrain..

	Definition	Components at the level of the Superior colliculus
2. Superior colliculus	<p>-large <u>nucleus of gray matter</u> that lies beneath corresponding elevation.</p> <p>-It forms part of the visual reflexes.</p> <p>-Its <u>efferent fibers</u> go to the <u>anterior horn cells</u> & to <u>cranial nuclei (3, 4, 6, 7 & 11)</u>.</p> <p>-Function: It is responsible for the reflex movements of the eyes, head and neck in response to visual stimuli, as in following a moving object <u>or</u> altering the direction of the gaze.</p>	<p>1. Oculomotor nucleus</p> <p>2. Red nucleus</p>

*** Now we will explain in more details each part:**

1. Oculomotor nucleus	<ul style="list-style-type: none">▶ 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 <u>the medial side of the crus cerebri</u>.
2. Red nucleus	<ul style="list-style-type: none">▶ A rounded mass of gray matter that lies <u>in the central portion of the tegmentum</u>.▶ 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

Definition:

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

Functions:

It has a number of important functions i.e. **Respiratory and Cardio-vascular centers** are located in the **medullary** and caudal **pontine reticular** formation.

Reticular Tracts

Reticulo spinal tracts:

Influence a muscle tone & posture

Reticular Activating system:

- Formed of some of the **ascending fibers** of the reticular formation.
- They **activate the cerebral cortex** through the **thalamus**.



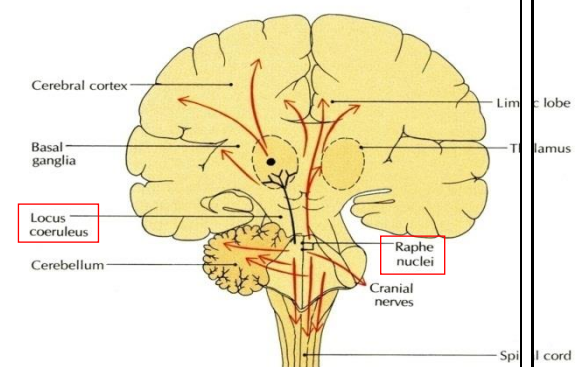
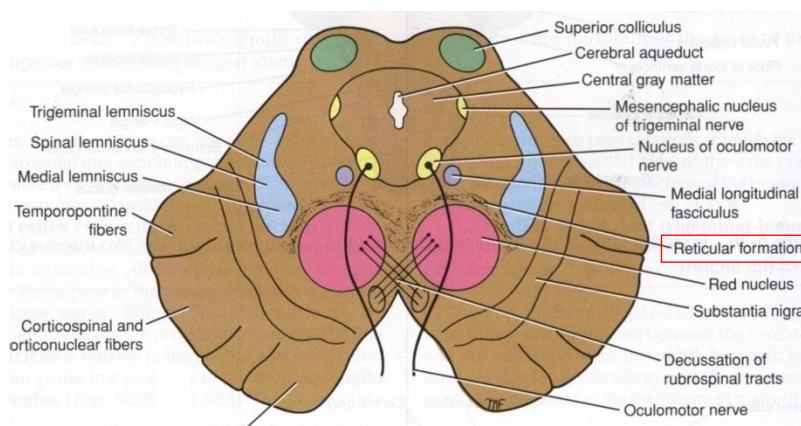
Reticular Neurons

1. Raphe Nuclei:

- Midline reticular nuclei.
- They are **serotonergic**.
- Its ascending fibers to the cerebral cortex **are involved in the mechanisms of sleep**.
- Its descending fibers to the spinal cord are involved in the **modulation of Pain**. So, **inhibit pain sensation**

2. Locus Coeruleus:

- Pigmented neurons that lie in the **tegmentum of the caudal mid brain & rostral pons**.
- It is **the main noradrenergic cell** group of the brain.
- Helps in **arousal and sleep-wake cycles**.





1. Most axons of cochlear nuclei cross the midline of pons forming :

- a. The medial lemniscus.
- b. The red nucleus.
- c. The trapezoid body.
- d. The medial longitudinal fasciculus.

2. The axons of the cochlear nuclei are represented in :

- a. Trapezoid body.
- b. Medial longitudinal bundle.
- c. Tectospinal tract.
- d. Spinal lemniscus.

3. Which one of these nuclei is lying in the tegmentum of the midbrain ?

- a. Oculomotor nucleus .
- b. Trochlear nucleus.
- c. Red nucleus.
- e. Facial nucleus.

4. Parkinson's disease results from degeneration of:

- a. Red nucleus.
- b. Pyramid.
- c. Substantia nigra.
- d. Inferior olivary nucleus.

5- The floor of 4th ventricle is formed by :

- a. Superior medullary velum .
- b. Open medulla and pons .
- c. Superior cerebellar peduncles .
- d. Inferior cerebellar peduncles .

6- The ascending fibers of Raphe nuclei are involved in :

- a. Modulation of pain .
- b. Mechanisms of sleep .
- c. the coordination of movement.
- d. taste sensation .

7- The roof of 4th ventricle is formed by :

- a. Superior medullary velum .
- b. Open medulla and pons .
- c. Superior cerebellar peduncles .
- d. Inferior cerebellar peduncles

8- The descending fibers of Raphe nuclei are involved in :

- a. the coordination of movement.
- b. Mechanisms of sleep .
- c. Modulation of pain.
- d. taste sensation .



SUMMARY FROM

Neuroanatomy book (Crossman)

- Cranial nerves III-XII attach to the brain stem, their fibers either originating from, or terminating in, the cranial nuclei.
- The reticular formation controls the level of consciousness, the cardiovascular system and the respiratory system.
- Ascending sensory system pass through the brain stem en route to thalamus. First-order proprioceptive fibers in the dorsal column relay in the dorsal column nuclei. Second-order fibers decussate to form the medial lemniscus. Second-order fibers originating in the trigeminal sensory nucleus constitute the trigeminothalamic tract (trigeminal lemniscus).
- Descending fibers systems end in the brain stem, pass through it and originate within it.
- Corticobulbar fibers terminate in the midbrain, pons and medulla. The corticospinal tract runs through the crus cerebri, the basal part of pons and the , medullary pyramid; 75-90% of fibers cross in the pyramidal decussation to form the lateral corticospinal tract.
- The reticular formation, red nucleus and vestibular nuclei give rise to descending fibers that pass to the spinal cord.



Q	Ans
1	C
2	A
3	C
4	C
5	B
6	B
7	A
8	C

GOOD LUCK

Anatomy Team Leaders:

Fahad AlShayhan & Eman AL-Bedica.