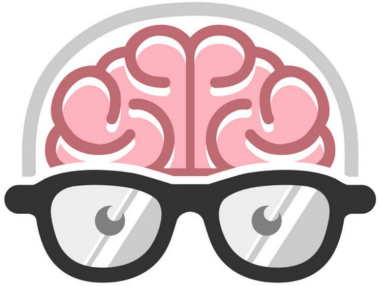


Internal structures of the Brainstem

Neuroanatomy block-Anatomy-Lecture 6

Editing file

Anatomy team
med 438

MED438
KING SAUD UNIVERSITY

Reviewed by Razan AlRabah & Ibrahim AlDakhil

Objectives

At the end of the lecture, students should 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. **Midbrain (superior and inferior colliculi).**

Medulla oblongata

Caudal (Closed) Medulla

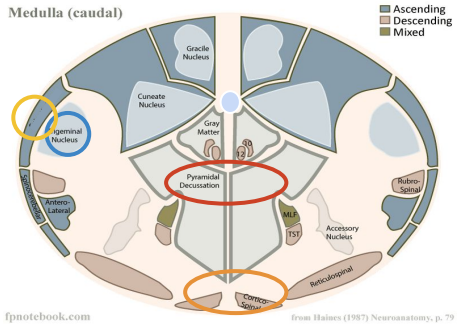
Traversed by the central canal

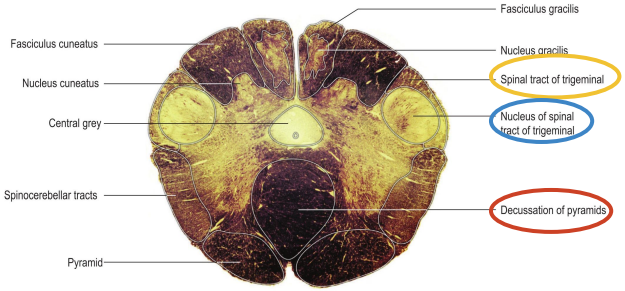
Motor decussation (decussation of the pyramids)

- 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

Trigeminal sensory nucleus.

- it is the larger sensory nucleus.
- The Nucleus Extends Through the whole length of the brainstem and its continuation of the substantia gelatinosa of the 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 (how its sensory and descend?see the note) fibers that terminate in the trigeminal nucleus.





note :All CN V afferent sensory information enters the brainstem through the nerve itself located in the pons. Thus, to reach the spinal nucleus (which spans the entire brain stem length) in the Caudal Medulla those fibers have to "descend" in what's known as the Spinal Tract of the Trigeminal

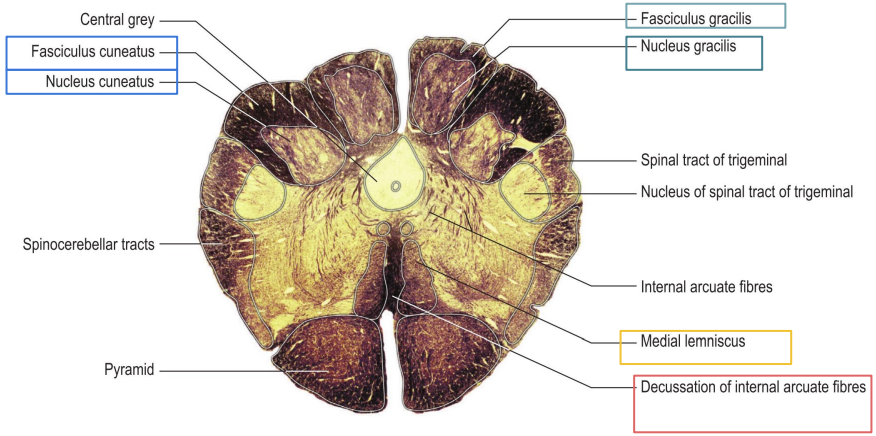
Medulla oblongata

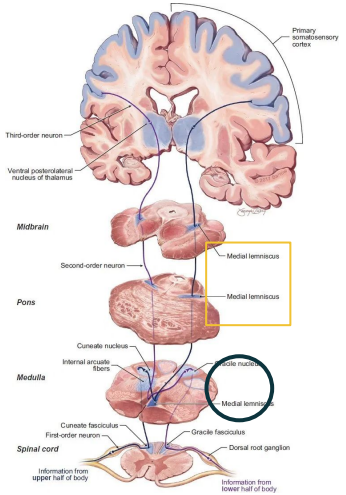
MId Medulla

- Traversed by the central canal
- Pyramids are prominent ventrally
- 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

Sensory Decussation:

- Formed by the crossed internal arcuate fibers which are called Medial Leminiscus after their crossing.
- Lies adjacent to the middle line ventral to the central canal
- Terminates in thalamus.
- Concerned with proprioceptive deep sensation.





Medulla oblongata

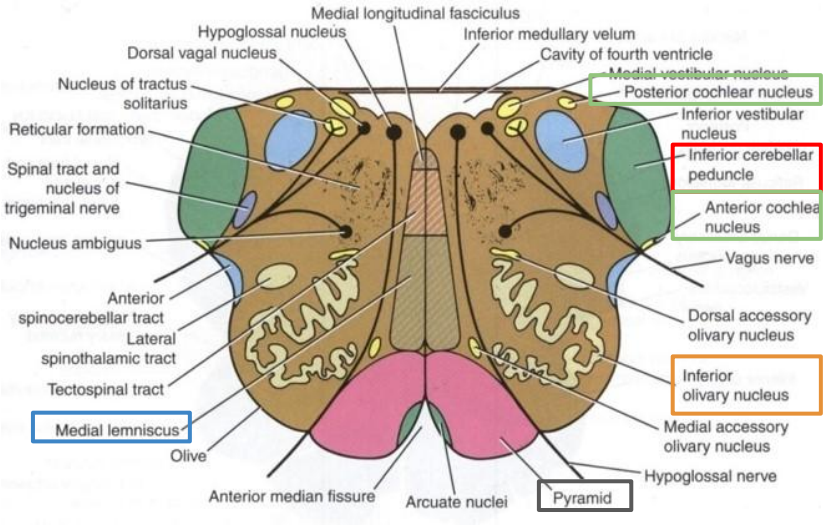
Rostral (Open Medulla)

On the ventral aspect

The pyramid is clear, with medial lemniscus on either sides of middle line dorsal to the pyramid
Inferior Olivary Nucleus: (see next slide for more info)

On the dorsal aspect

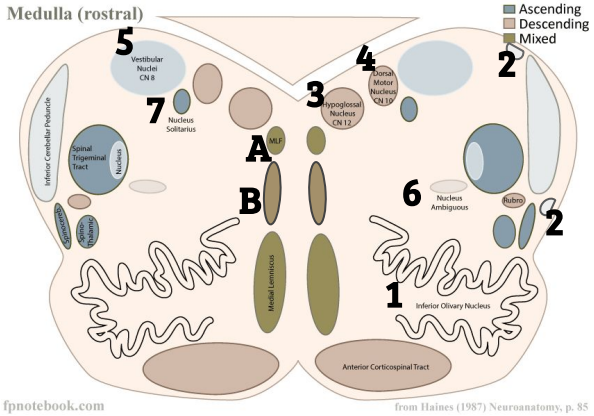
- Lower part of the floor of the 4th ventricle.
- The Inferior Cerebellar Peduncle is, connecting M.O. with cerebellum.
- dorsal and ventral to the Inferior cerebellar peduncle lie the Cochlear nuclei



Medulla oblongata

Rostral (Open Medulla)

Nuclei (beneath the floor of the 4th ventricle except 1,2)	Tract
1. 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 movement.	**A. Medial longitudinal fasciculus:** it is important association tract; **Upwards :** It links the vestibular nuclei with nuclei of extraocular muscles .(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.
2. Cochlear nuclei:. dorsal and ventral to the Inferior cerebellar peduncle, concerning with hearing.	
3. Hypoglossal Nucleus	
4. Dorsal vagal nucleus contains preganglionic parasympathetic fibers.	
5. Vestibular nuclei complex : composed of medial, lateral, inferior & superior nuclei ,concerned with equilibrium	
6. Nucleus Ambiguus: (motor nucleus)lies dorsal to olivary nucleus and gives motor fibers along 9th & 10th CN to Muscles of the pharynx, larynx & palate.	
7. Solitary nucleus (sensory nucleus) receive taste sensation from the tongue along the 7th, 9th 10th CN	**B. Tectospinal tract:** between tectum of midbrain and spinal cord involved in head movements during visual and auditory tracking

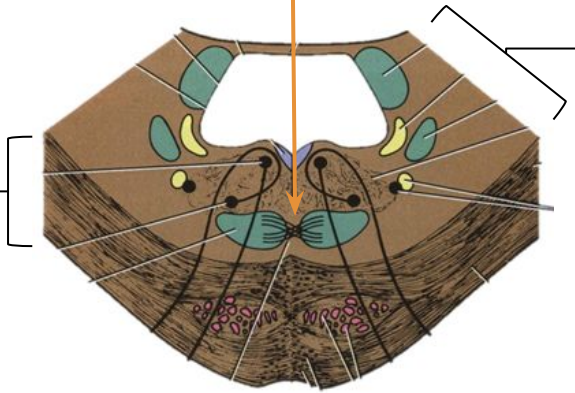


The Pons

Divided into

- **Anterior part (Basis Points)**
- **Posterior part (Tegmentum)**

by the Trapezoid Body (consists of acoustic fibres from cochlear nuclei to ascend into midbrain as lateral lemniscus and terminate in inferior colliculus).



The Pons

Caudal part of the Pons

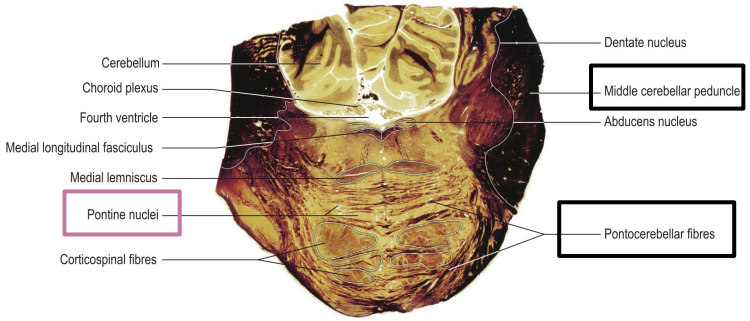
Pontine nuclei: Are small masses of nerve cells, receive cortico pontine fibers. Their axons form the transverse pontocerebellar fibers which pass to the contralateral side of the cerebellum through **Middle Cerebellar peduncles.**

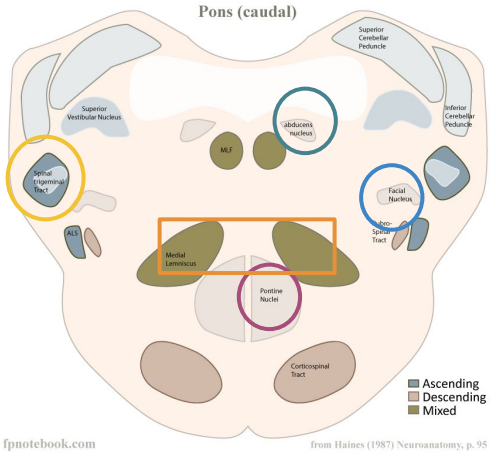
Bundles of corticospinal & corticonuclear fibres (Pyramidal fibres)

The ascending fibres of the Medial lemniscus:-
become separated from the pyramid and displaced dorsally.
rotates 90 degree and lies horizontally.

Spinal tract & nucleus of Trigeminal.

Deep origin of cranial nerve nuclei :-
Abducent nucleus
Facial motor nucleus

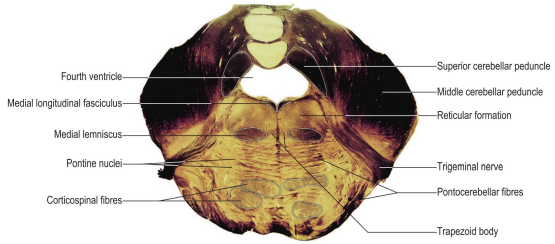


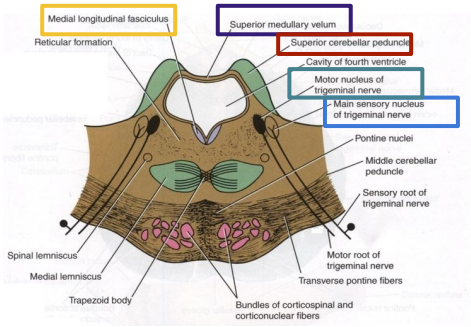


The Pons

Mid Pons (At the level of the trigeminal nerve)

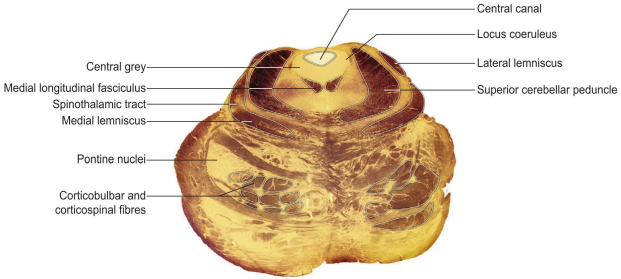
- **Motor nucleus of the trigeminal nerve:** Lies in the lateral part of the floor of the 4th ventricle.
- **Main sensory nucleus of the trigeminal nerve:** it lies lateral to the motor nucleus.
- **Superior cerebellar peduncles** form the lateral boundary of the 4th ventricle





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



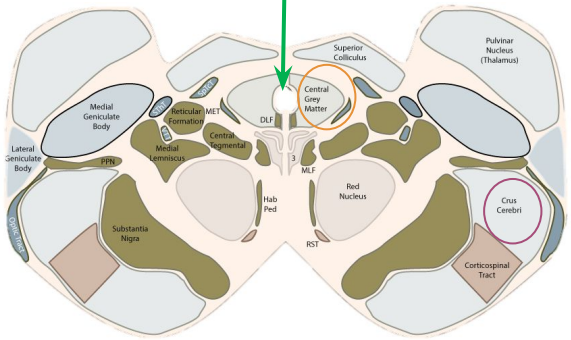
Midbrain

Divided into

Ventral part (Tegmentum) at the level of the cerebral aqueduct. The most ventral part of the tegmentum is the massive fibrous mass (Crus Cerebri)

by the The cerebral aqueduct which is surrounded by a pear shaped periaqueductal (central) gray matter.

Dorsal part (Tectum) of 4 colliculi



Midbrain

Inferior Colliculus Level

Inferior colleculus 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

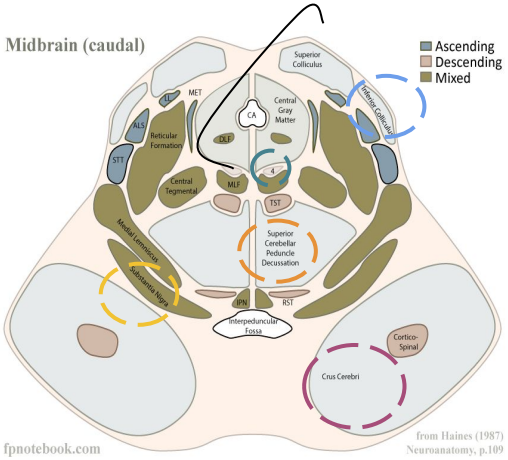
Trochlear nucleus: lies in the central gray matter close to the median plane. The fibers of the trochlear nerve decussate (the only CN that decussate completely) in the superior medullary velum and emerge from posterior surface of midbrain.

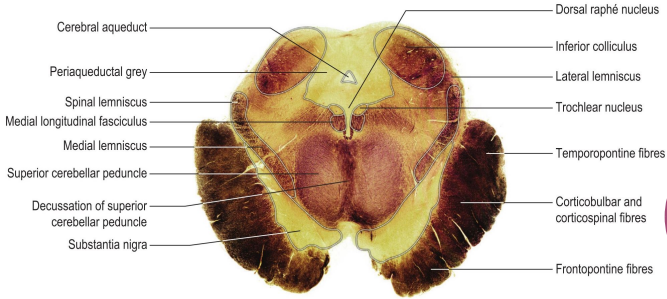
Decussation of the superior cerebellar peduncles in the midline.

Ascending LEMNISCI: Medial, Lateral, Spinal (Lateral & anterior spinothalamic tracts), and Trigeminal (Lateral & medial).

Substantia nigra : Occupies the most ventral part of the tegmentum. It consists of a pigmented, melanin containing segment (Pars Compacta) and a non pigmented segment (Pars Reticulata) and projects to the basal ganglia. Its degeneration (Pars Compacta) 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.**





Midbrain

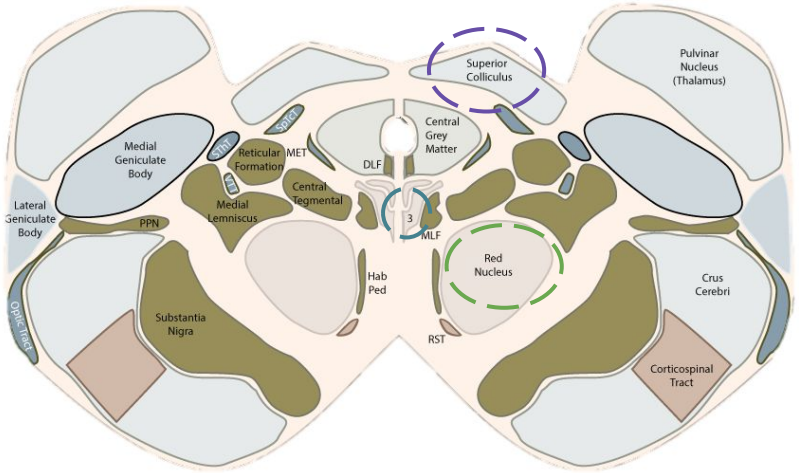
Superior Colliculus Level

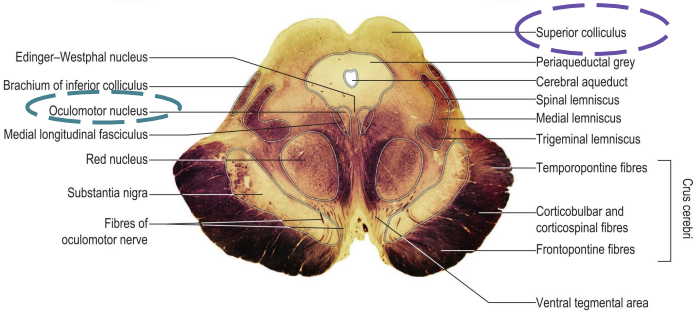
Superior colliculus is a A large nucleus of gray matter that lies beneath corresponding elevation.

- 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

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)

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





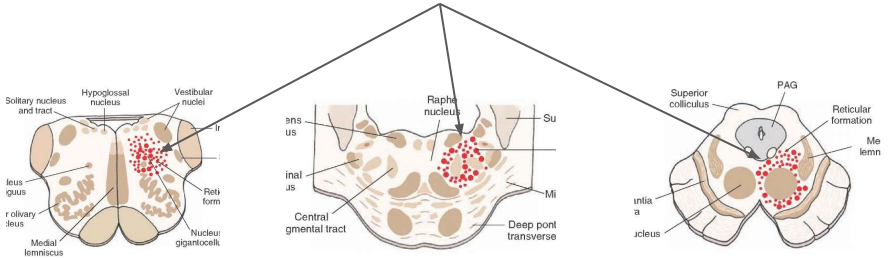
Reticular Formation

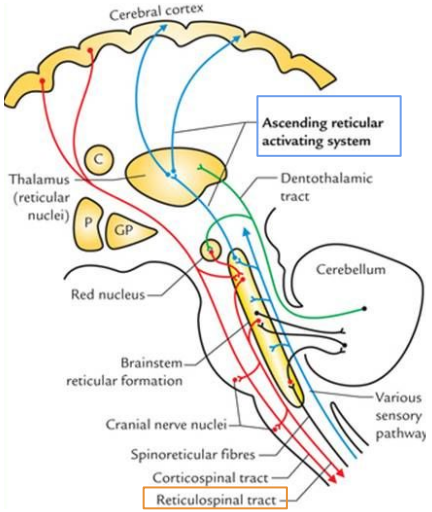
- It is a complex matrix of nerve fibers & groups of nerve cells that extends throughout the brain stem.(coordination between the structures of the brain stem)
- It has a number of important functions i.e. Respiratory and Cardiovascular centers.

Reticular tract

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

Reticular Formation





It's NOT HARD .. this is the whole lecture !!

Parts Of the Brain Stem		Nuclei (Function)	Fibers
Medulla Oblongata	Caudal (Closed) Medulla	1. **Spinal Nucleus Of Trigeminal** (receives pain and temperature from face, forehead.)	• **Spinal Tract Of Trigeminal** • **Motor decussation**
	Mid Medulla	1. **Gracile Nucleus** (concerned with proprioceptive deep sensations of the body). 2. **Cuneate Nucleus** (concerned with proprioceptive deep sensations of the body.)	• **Medial Leminiscus**
	Rostral (Open) Medulla	1. **Inferior Olivary Nucleus** (concerned with the control of movements) 2. **Cochlear nuclei** (concerning with hearing.) 3. **Hypoglossal Nucleus.** (Movement of tongue) 4. **Dorsal Vagal Nucleus** (contains preganglionic parasympathetic fibers) 5. **Vestibular Nuclei Complex** (concerned with equilibrium) 6. **Nucleus Ambiguus** (gives motor fibers along 9th, 10th to Ms. of the pharynx, larynx & palate. (Speech, swallowing) 7. **Solitary Nucleus** (receive taste sensation from the tongue along the 7th, 9th, 10th CN)	• **Medial Longitudinal Fasciculus** • **Tectospinal Tract**
Pons	Caudal Part Of The Pons	1. **Pontine Nuclei** (receive cortico pontine fibers) 2. **Spinal Nucleus Of Trigeminal** (receives pain and temperature from face, forehead.) 3. **Abducent Nucleus** (motor to Lateral rectus muscle =Movement of eyeball) 4. **Facial Motor Nucleus** (Facial movement)	• **Pontocerebellar fibres** (in all levels of the pons) • **Trapezoid Body** (Lateral Lemniscus) (in all levels of the pons) • **Spinal Tract Of Trigeminal** • **The Ascending Fibres Of The Medial Leminiscus** • **Bundles of corticospinal & corticonuclear fibres**
	At The Level Of The Trigeminal Nerve	1. **Motor Nucleus Of The Trigeminal Nerve:** 2. **Main Sensory Nucleus Of The Trigeminal Nerve**	• _____
	Rostral Pons	_____	• **Continuation Of Medial Longitudinal Fasciculus**
Midbrain	Inferior Colliculus Level	1. **Inferior Colleculus Nucleus** (part of the auditory pathway.) 2. **Trochlear Nucleus** (motor to Superior oblique muscle=Movement of eyeball) 3. **Substantia Nigra**	• **Crus Cerebri** • **Ascending Leminisci** • **Decussation of the superior cerebellar peduncles**
	Superior Colliculus Level	1. **Superior Colliculus Nucleus** (part of the visual reflexes.) 2. **Oculomotor Nucleus** 3. **Red Nucleus** (It is involved in motor control)	• **Crus Cerebri**

Note: there are some nuclei & fibers that appear in more than one part of brain stem, but we just put them in the part where they are mentioned in the lecture

Practice

Q1: which of the following receives pain and temperature from face and forehead

A. Substantia nigra

B. red nucleus

C. trigeminal sensory nucleus

D. Superior colliculus nucleus

Q2: Which of the following happens in mid medulla

A. internal arcuate fibers; decussating forming Sensory Decussation.

B. Decussation of the superior cerebellar peduncles

C. Medial lemniscus rotates 90 degree and lies horizontally.

D. start of Motor decussation (decussation of the pyramids)

Q3: which of the following present in the rostral medulla

A. Pontine nuclei

B. Cochlear nuclei

C. Abducent Nucleus

D. Facial Motor Nucleus

Q4: Tectospinal tract involved in ?

A. head movements during visual and auditory tracking

B. movements of the eyes, head and neck in response to visual stimuli

C. coordination of eye movements with head movements.

D. maintaining balance of the body trunk and head.

Q5: The trapezoid body terminates in ?

A. cerebellum

B. cochlear nuclei

C. Superior Colliculus

D. inferior colliculus

Q6: Trochlear nucleus lies

A. superior medullary velum

B. in central gray matter close to the median plane

C. lateral to the central gray matter.

D. anterior to the central gray matter.

Q7: inferior colliculus is part of

A. Auditory pathway

B. visual reflexes.

C. memory pathway

D. Reticular tract

Q8 : Ascending lemnisci on the level of inferior colliculus NOT Composed Of

A. spinothalamic tracts

B. Lateral lemniscus

C. Corticobulbar tract

D. Medial lemniscus

Answers: Q1(C) Q2(A) Q3(B) Q4(A) Q5(D) Q6(B) Q7(A) Q8(C)

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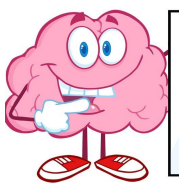

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