Internal Features of the Brain Stem (Medulla & Pons)

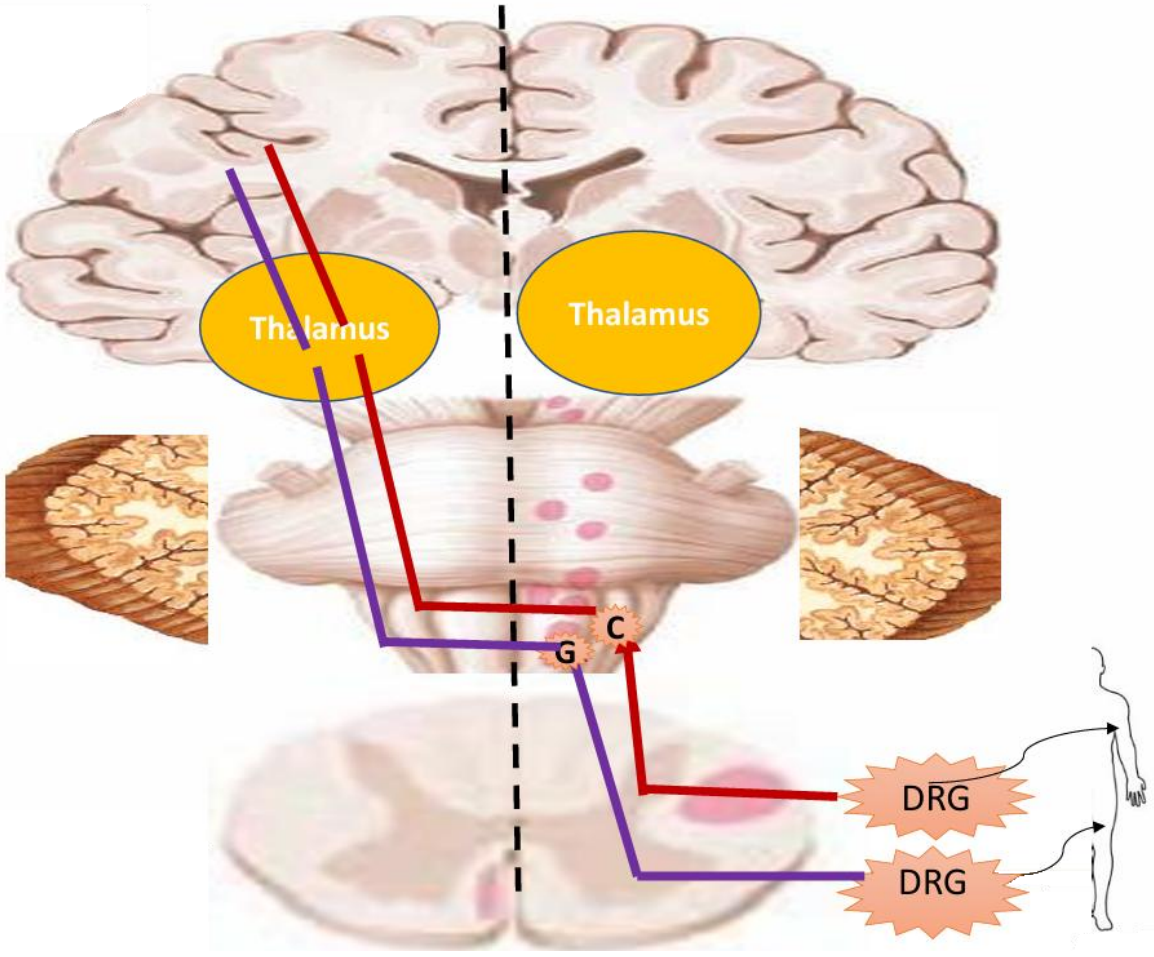
Internal features of the Medulla

- The nuclear groups present in the medulla are:

1. Gracile & Cuneate Nuclei
2. Cerebellar Relay Nuclei
3. Cranial Nerve Nuclei

1) Gracile & Cuneate Nuclei

Input	Output
They receive **gracile and cuneate tracts**	They contain the **2nd order neuron**; their axons form the **internal arcuate fibers** which cross to the opposite side in the sensory decussation which form the **medial lemniscus**.
They receive sensory information for **kinesthesia**, **discriminative touch** and **vibration** from the **same side** of the body	



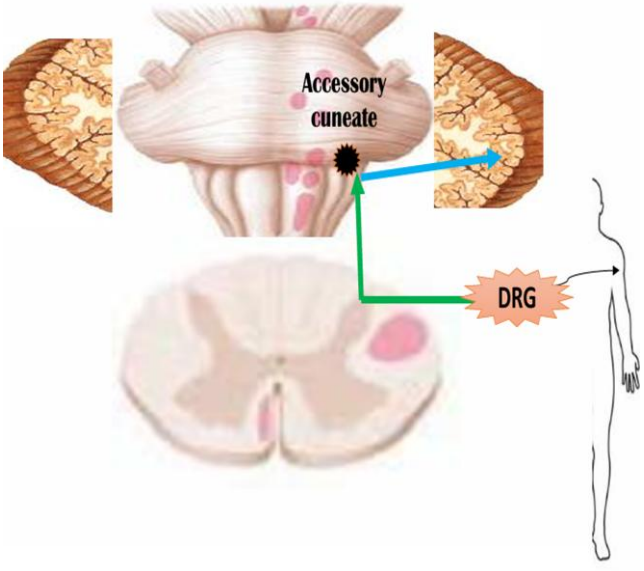
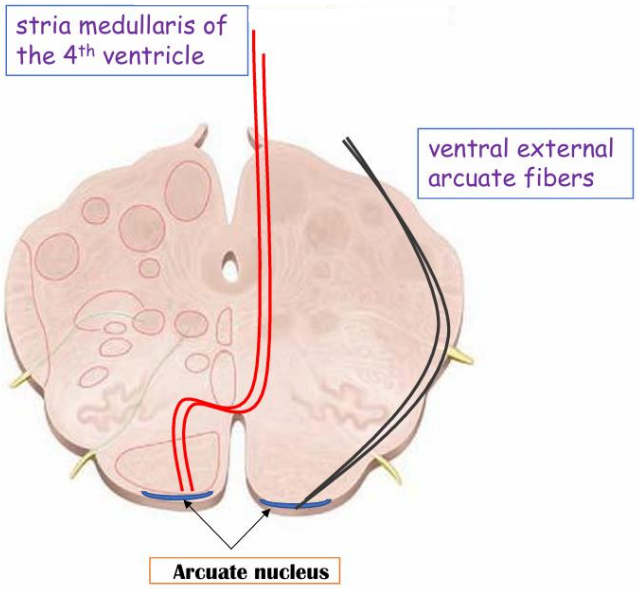
Note that the **Cuneate** receives from the **upper part** of the body, while the **Gracile** receives from the **lower part** of the body.

2) Cerebellar Relay Nuclei

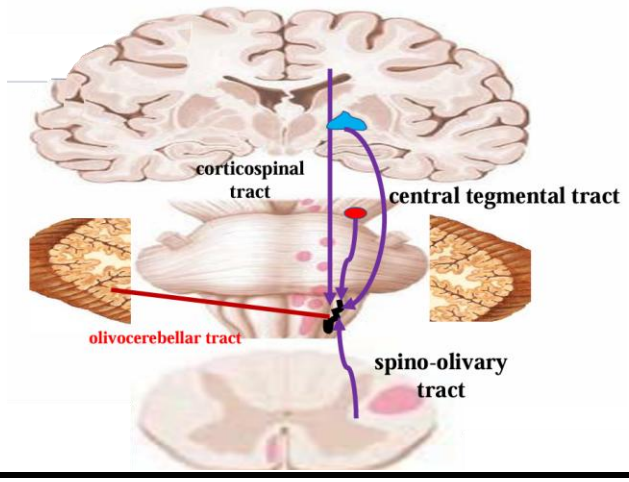
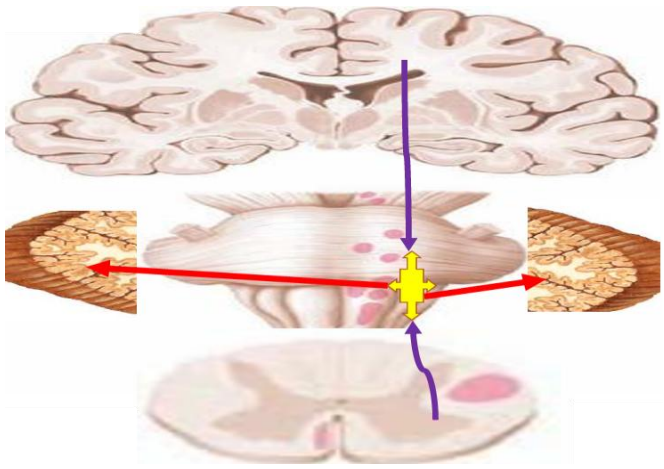
A. Accessory Cuneate B. Inferior Olivary Nucleus C. Reticular Formation

D. Arcuate Nucleus E. Vestibular Nuclei

a) Accessory Cuneate & Arcuate Nucleus

	Accessory Cuneate	Arcuate Nucleus
Site	Lateral to cuneate nucleus.	Ventral to the pyramid.
Input	It receives **proprioceptive** information from the **upper limb**.	It receives fibers from the **cerebral cortex** via **pyramidal tract.**
Output	Its axons form **cuneo-cerebellar tract** (dorsal external arcuate fibers), which reaches the cerebellum through the **inferior cerebellar peduncle**.	The axons form arcuato-cerebellar fibers, **reach the cerebellum** through the **ICP** by 2 routes: A- Ventral external arcuate fibers: to the cerebellum from the **same side**. B- Stria medullaris of the 4th ventricle: to the cerebellum from the **opposite side.**
Figure		

b) Inferior Olivary Nucleus & Reticular Formation

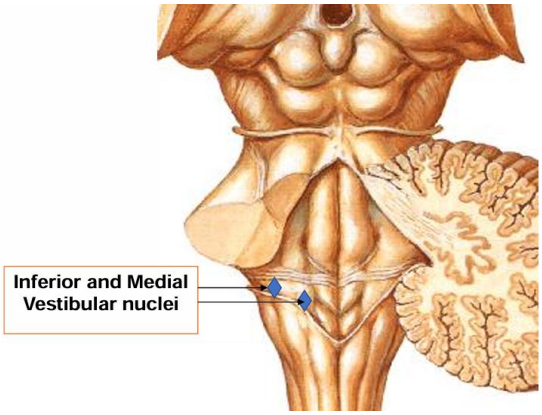
	Inferior Olivary Nucleus	Reticular formation
Input	Sensory data from spinal cord via spino-olivary tract. Motor data from cerebral cortex via corticospinal tract. Motor data from basal ganglia & red nucleus via central tegmental tract.	Sensory data from the spinal cord and special sense organs. Motor data from the motor areas of the cerebral cortex.
Output	Axons form **olivocerebellar tract** which cross to opposite side and enter the cerebellum through the **inferior cerebellar peduncle**	It projects these data **to the cerebellum** through the **inferior cerebellar peduncle.**
Functions	Cerebellar control of movement. N.B. Lesion → **Cerebellar ataxia**	Reticular Activating System (RAS): responsible for the electrical activity of the cerebral cortex. It is important for alertness & arousal from sleep. Motor Function: it influences the muscle tone. The medullary and pontine reticulospinal tracts facilitate the flexor and extensor muscles, respectively. Autonomic Function: it contains respiratory and cardiovascular centers
Figure		

N.B.

The Inferior Olivary Nucleus is formed of **3 groups**: Inferior, Medial & Dorsal

c) Vestibular Nuclei

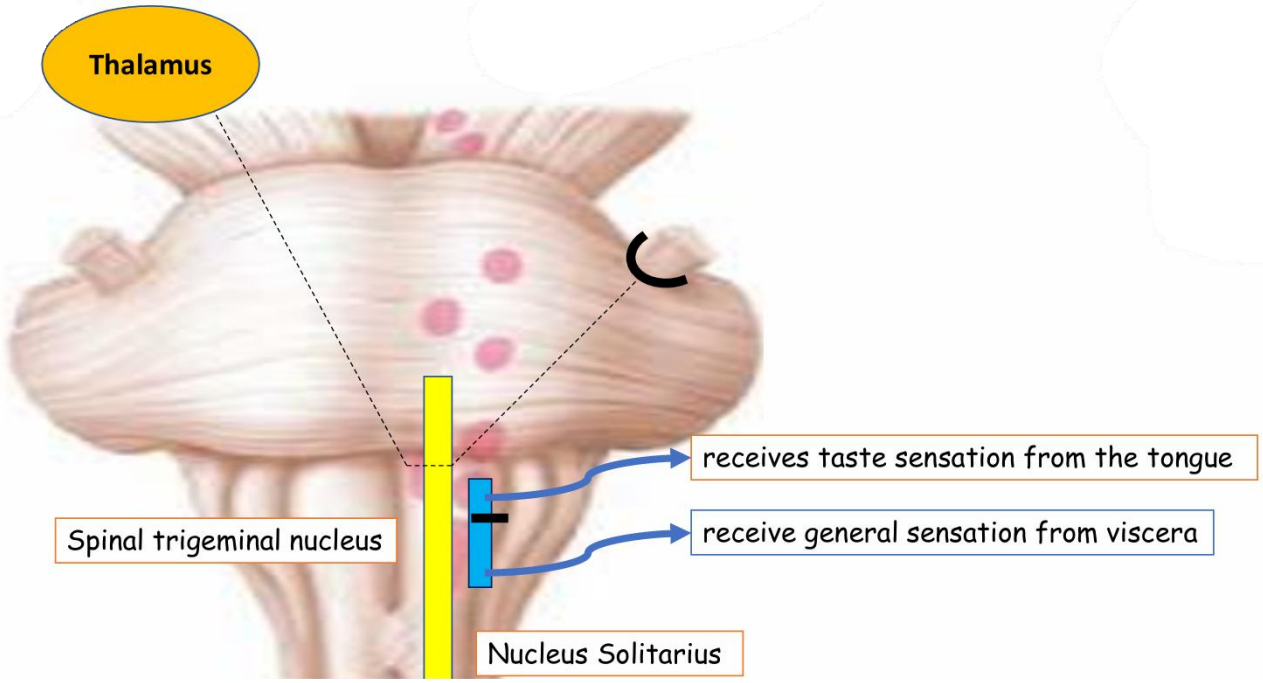
- *They project **vestibulo-cerebellar** fibers by 2 routes:*
  1. *Direct: from the vestibular nerve.*
  2. *Indirect: from the vestibular nuclei.*



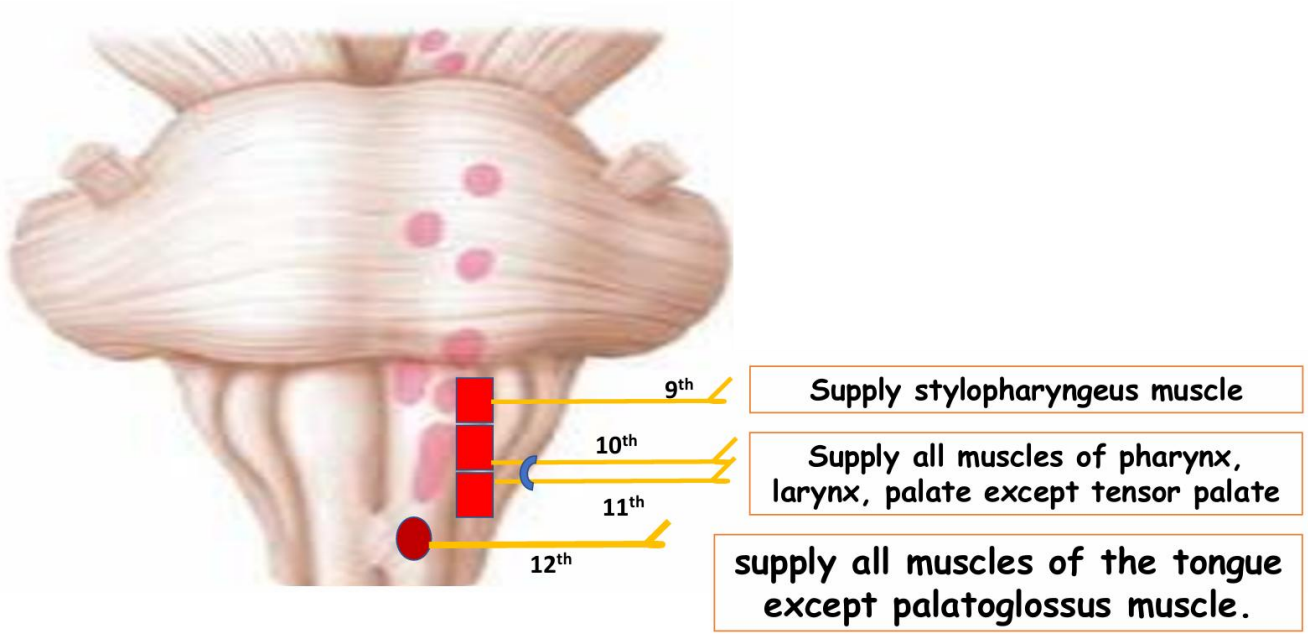
3) Cranial Nerve Nuclei

Two sensory	Two motor
• Spinal nucleus of trigeminal. • Nucleus solitaries.	• Hypoglossal nucleus. • Nucleus ambiguous.
Two Vestibular	**Two Parasympathetic**
• Medial Vestibular Nucleus. • Inferior Vestibular Nucleus.	• Inferior salivatory nucleus. • Dorsal motor nucleus of vagus.

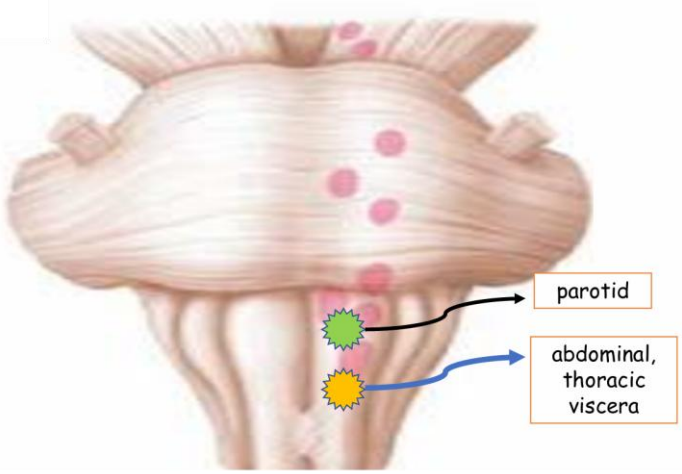
a) Sensory Nuclei

	Spinal Nucleus of Trigeminal	Nucleus solitaries
Site	Located in **medulla** ascends to the pons and descends to **C3 of the spinal cord**.	-
Input	It mediates the **pain, temperature and light touch sensations from the same side of the face, oral cavity and external ear** via (**5th, 7th, 9th and 10th cranial nerves**)	**Upper 1/3:** receives **taste** sensation from the tongue via (**7th, 9th and 10th** cranial nerves). **Lower 2/3:** receive **general sensation** from viscera supplied by (**9th and 10th** cranial nerves).
Output	Axons cross to the opposite side and form **trigeminal lemniscus** which end in the **VPMN of thalamus**	Axons cross the opposite side and terminate in the **thalamus**
Figure		

b) Motor Nuclei

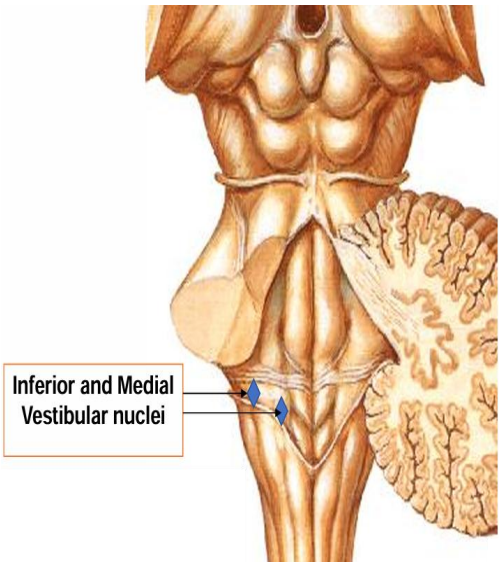
	Hypoglossal Nucleus	Nucleus Ambiguous
Site	In the floor of the 4th ventricle.	In the medulla, divided into 3 parts: Upper part: for the 9th cranial nerve. Middle part: for the 10th cranial nerve. Lower part: for the 11th cranial nerve.
Function	Supply **all muscles of the tongue** EXCEPT palatoglossus muscle.	Supply **all muscles of pharynx, larynx, palate** EXCEPT tensor palate muscle.
Figure		

c) Parasympathetic Nuclei

	Dorsal Motor Nucleus of Vagus	Inferior Salivatory Nucleus
Site	Floor of the 4th ventricle.	-
Function	Supplies the **glands, smooth muscles** and **blood vessels** of the **thoracic and abdominal viscera** via **10th cranial nerve.**	Supplies the **parotid gland** through the **9th cranial.**
Figure		

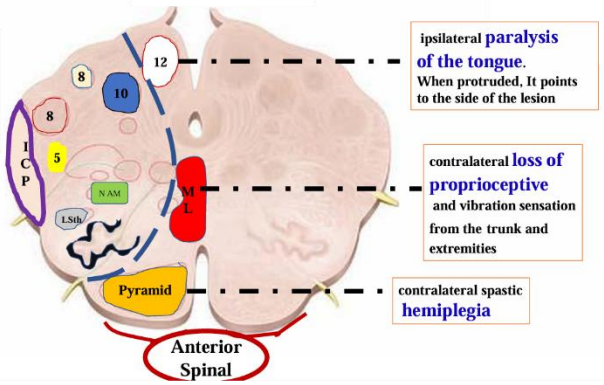
d) Vestibular Nuclei

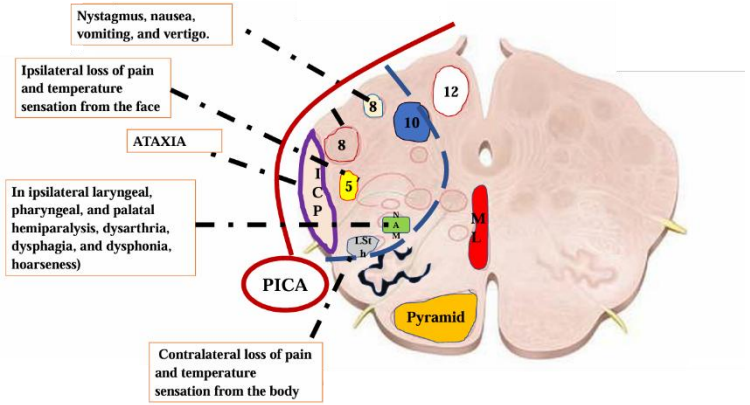
	Medial Vestibular Nucleus	Inferior Vestibular Nucleus
Site	In the **floor of the 4th ventricle.**	
Function	Maintain **balance and equilibrium**	



Lesions of the Medulla

	Affected Structures	Signs
Medial Medullary Syndrome (anterior spinal artery syndrome)	Corticospinal tract lesions	Contralateral spastic hemiplegia.
	Medial lemniscus lesions	Contralateral loss of proprioceptive and vibration sensation from the trunk and extremities
	Hypoglossal nucleus lesions	Ipsilateral flaccid hemiparalysis of the tongue. When protruded, the tongue points to the side of the lesion.
Lateral Medullary (Wallenberg Syndrome) (PICA Syndrome)	Vestibular nuclei lesions	Nystagmus, nausea, vomiting, and vertigo.
	Inferior cerebellar peduncle lesions	Cerebellar ataxia.
	Nucleus Ambiguous lesions	Ipsilateral laryngeal, pharyngeal, and palatal hemiparalysis (dysarthria, dysphagia, and hoarseness).
	Spinothalamic tracts (spinal lemniscus) lesions	Contralateral loss of pain & temperature sensation.
	Spinal trigeminal nucleus and tract lesions	Ipsilateral facial loss of pain & temperature sensation.
	Descending sympathetic tract lesions	Ipsilateral Horner syndrome (ptosis, miosis, enophthalmos & anhidrosis).





Internal features of the Pons

- The internal structures of the pons include:

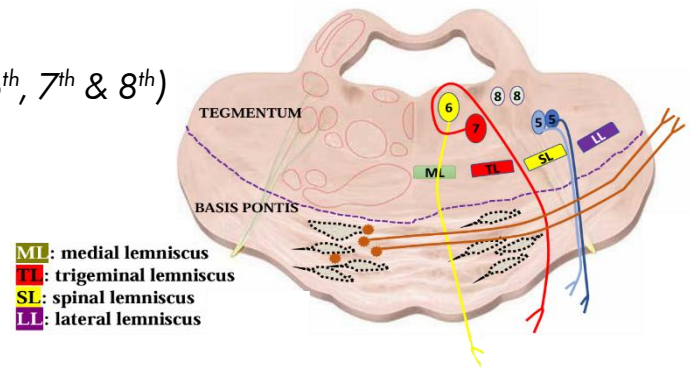
1. Basis Pontis (Anterior Part) **2. Tegmentum (Posterior Part)**

1) Basis Pontis

- It is the **anterior part** of the pons.
- It contains:
  - Bundles of the pyramidal tract fibers:
    - Corticospinal fibers and Corticobulbar fibers.
  - Pontine Nuclei:
    - 2nd order neurons of the cortico-ponto-cerebellar Pathway.
  - Transverse pontine fibers:
    - Axons for pontine nuclei.
  - Fibers of the middle four cranial nerves:
    - On their way outside the pons.

2) Tegmentum

- It is the **posterior part** of the pons.
- It contains 4 lemnisci & 4 cranial nerve nuclei.
- Tracts:
  - Four lemnisci:
    - **Medial lemniscus**, **trigeminal lemniscus**, **spinal lemniscus** and **lateral lemniscus**.
  - Medial longitudinal fasciculus (MLF):
    - It connects the **vestibular nuclei** with **motor nuclei** that move the eyes **(3rd, 4th and 6th cranial nerves)** to coordinate the eye movements.
  - Other tracts:
    - **Tectospinal**, **rubrospinal**, **central tegmental tract** and other tracts.
- Nuclei:
  - Nuclei of the middle 4 cranial nerves (5th, 6th, 7th & 8th)
  - Pontine Reticular Formation.



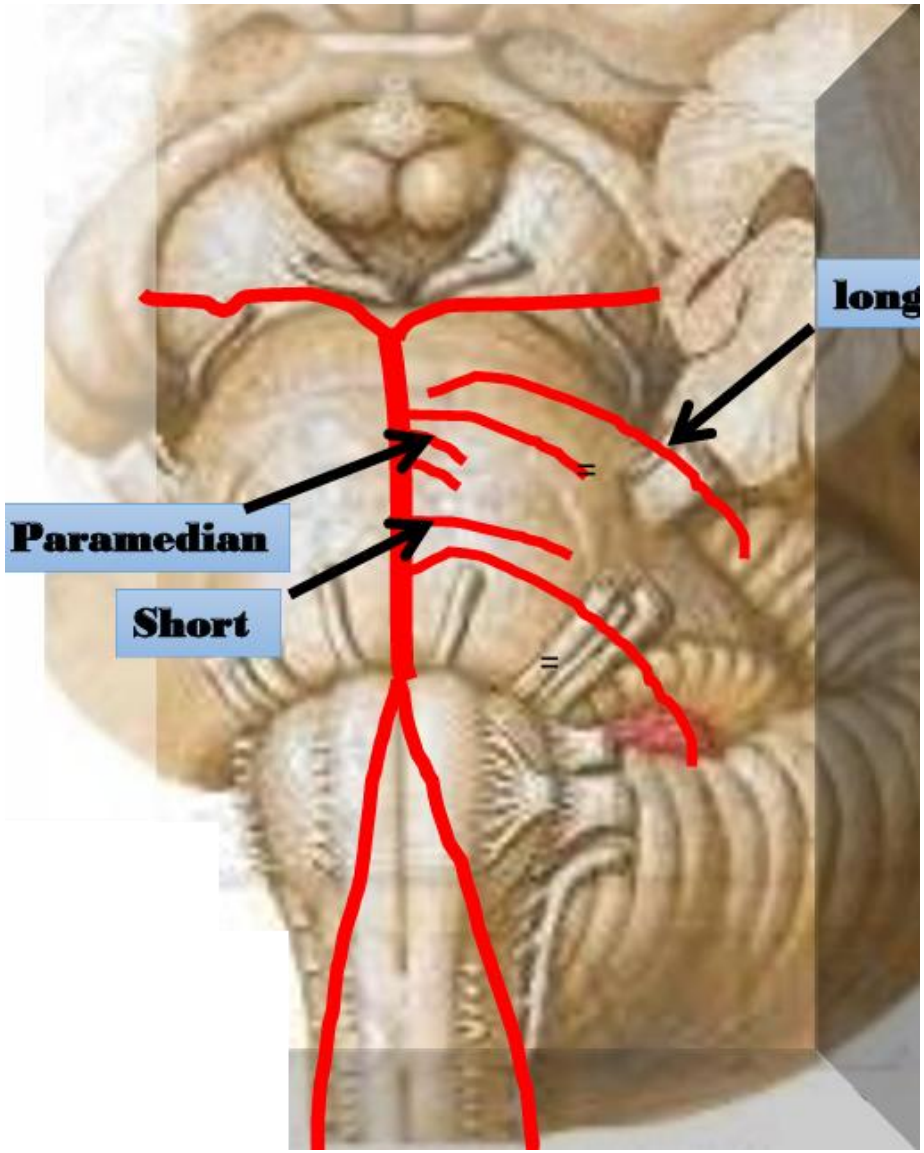
Lesions of the Pons

- *Basal Pontine Syndrome:*

Part	Cause	Affected Structures	Signs
Caudal Basal Pontine Syndrome	Occlusion of paramedian branches of basilar artery.	Corticospinal tract.	Contralateral spastic hemiplegia.
		Abducent nerve.	Ipsilateral lateral rectus paralysis.
		Facial nerve.	Ipsilateral facial paralysis LMNL.
Rostral Basal Pontine Syndrome	Occlusion of short circumferential branches of basilar artery.	Corticospinal tract.	Contralateral spastic hemiplegia.
		Trigeminal nerve.	Ipsilateral paralysis of trigeminal: A. Paralysis of muscles of mastication on the same side. B. Loss of sensation from the face on the same side.

- *Tegmental Pontine Syndrome:*

Cause	Affected Structures	Signs
Occlusion of long circumferential branches of basilar artery.	Medial lemniscus.	Contralateral loss of **Proprioceptive discriminative touch** and **vibration sensation** from the trunk and extremities
	Abducent nucleus.	Ipsilateral paralysis of **lateral rectus muscle & lateral gaze**.
	Facial nerve.	Ipsilateral **facial paralysis** LMNL.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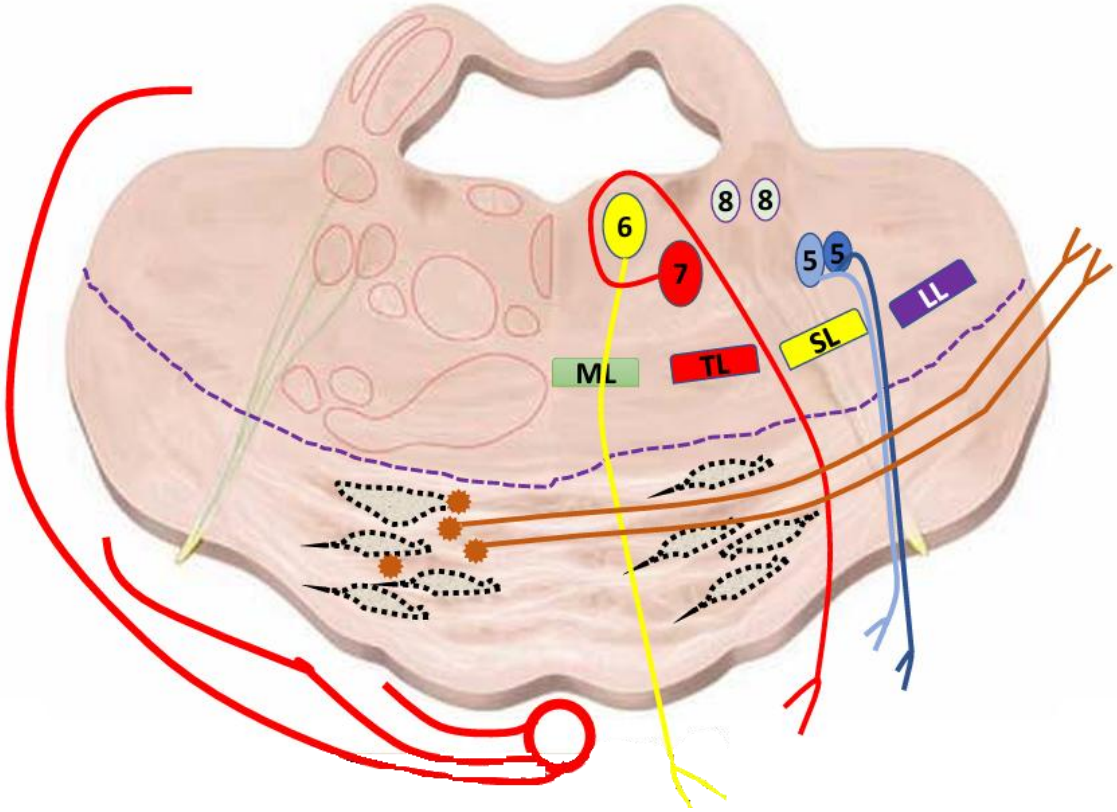
Paramedian
Short


6
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- *Quiz:*

1. Nucleus solitarius is responsible for which sensation

A. Taste

B. Equilibrium

C. Proprioception

D. Pain and temperature

F. Touch

Answer: A

2. Nucleus Ambiguous is a motor nucleus for which cranial nerve

A. 3rd & 4th

B. 5th & 6th

C. 7th & 9th

D. 9th, 10th & 11th

F. 10th, 11th & 12th

Answer: D