



ANAT 7000/7011

Brainstem

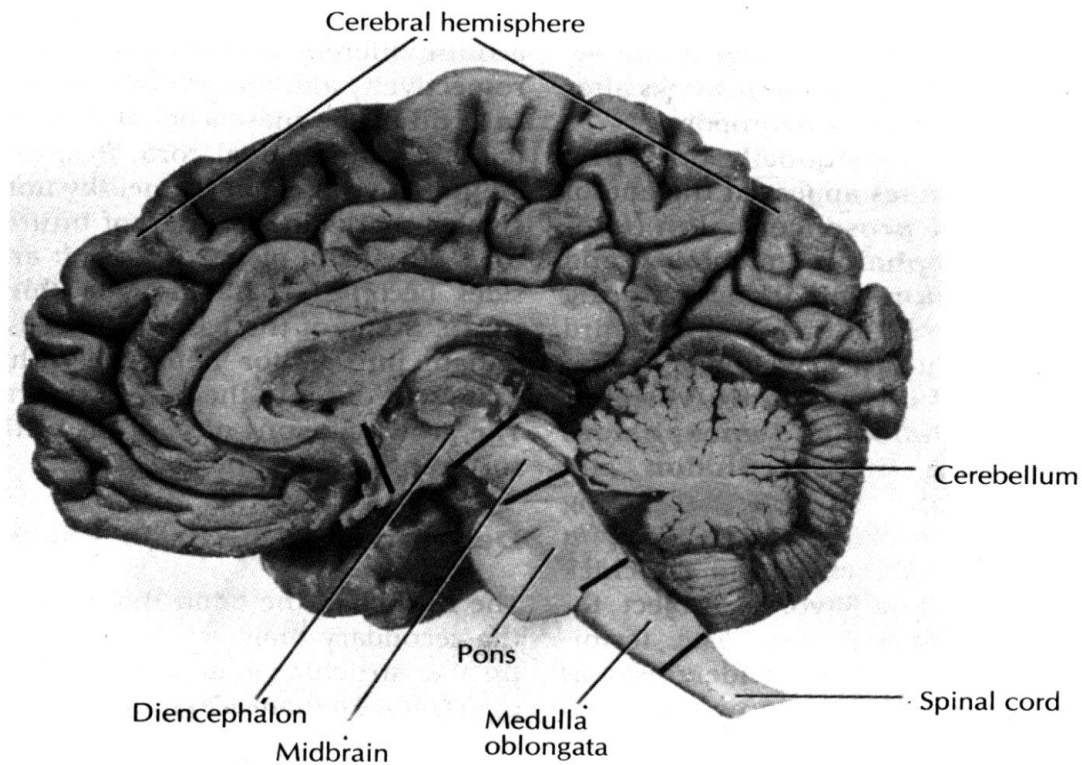
Prof. Amadi O. Ihunwo, PhD
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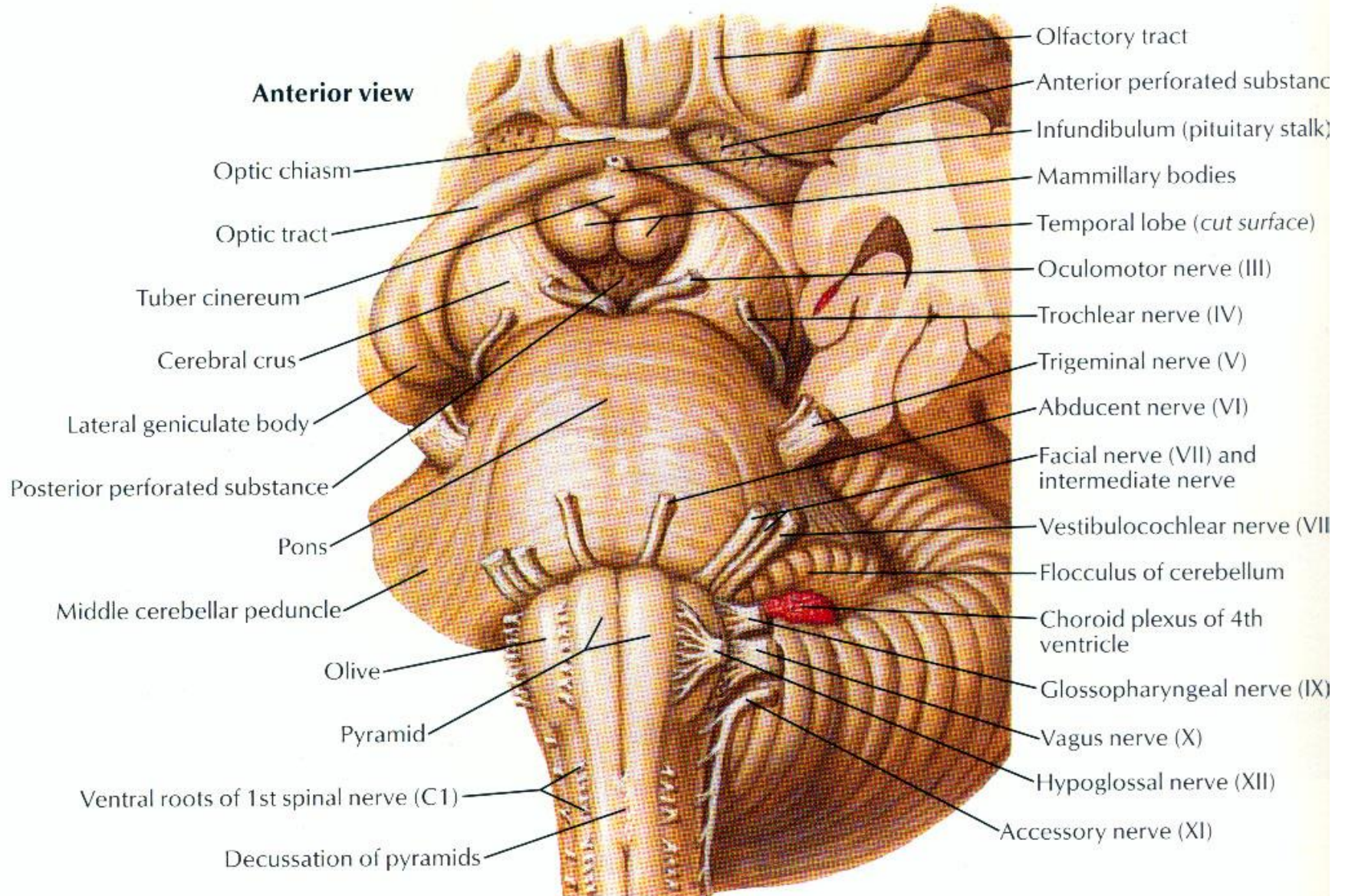
Lecture Outline

- Constituents
 - **Midbrain**
 - **Pons**
 - **Medulla Oblongata**
- External Features
- Internal features

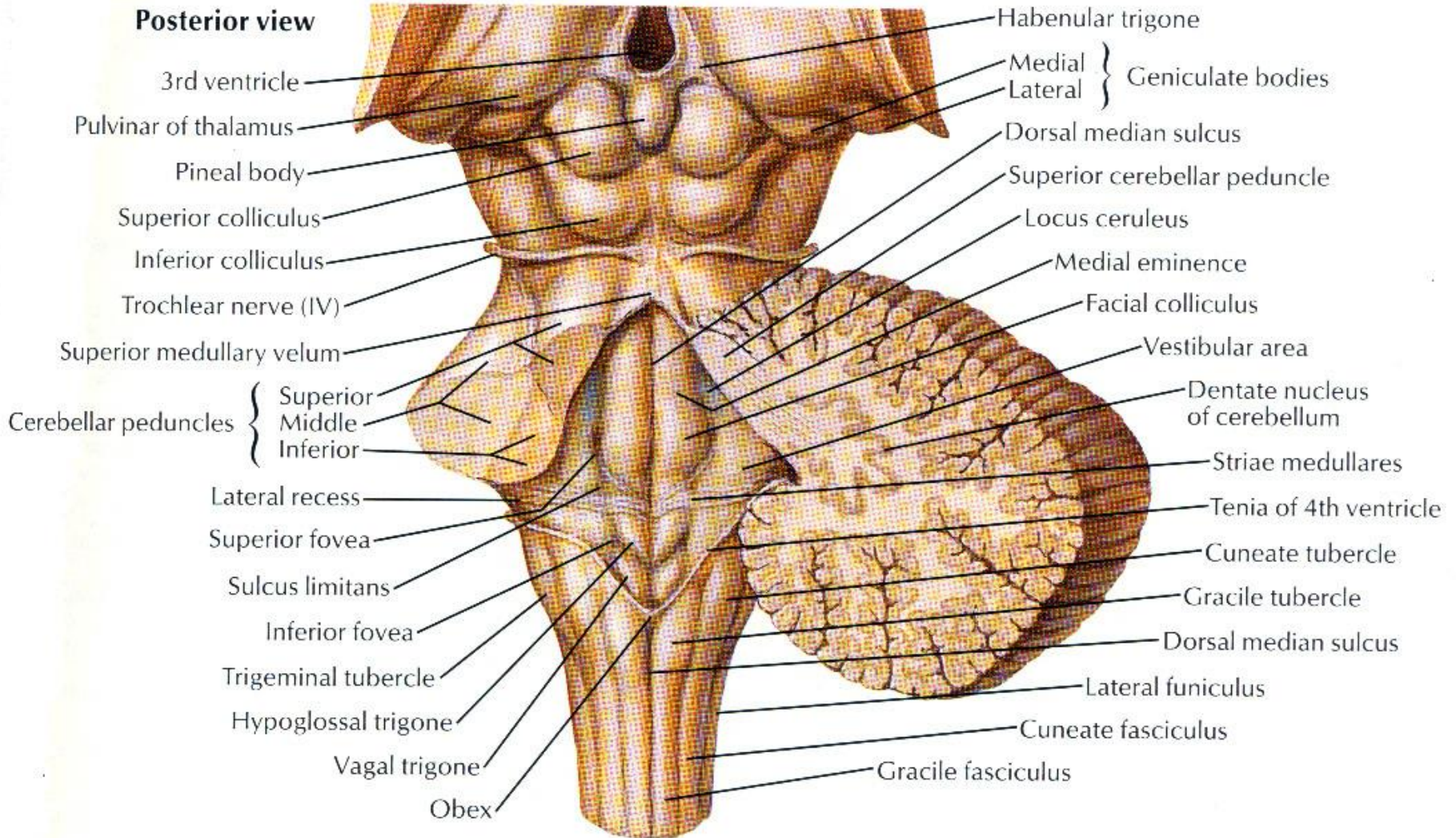
Brainstem: Midbrain, Pons, Medulla oblongata



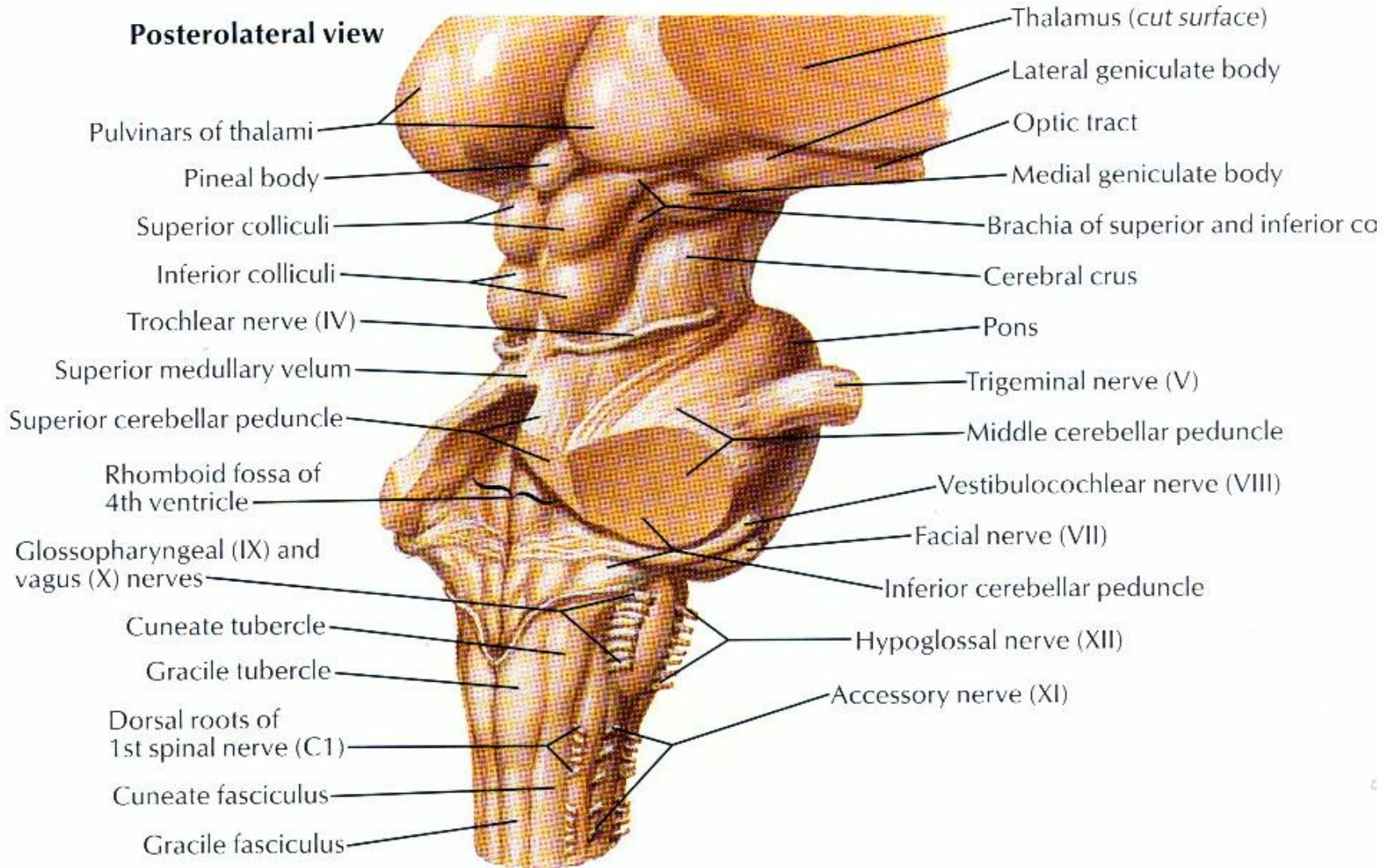
Brainstem - Anterior view:



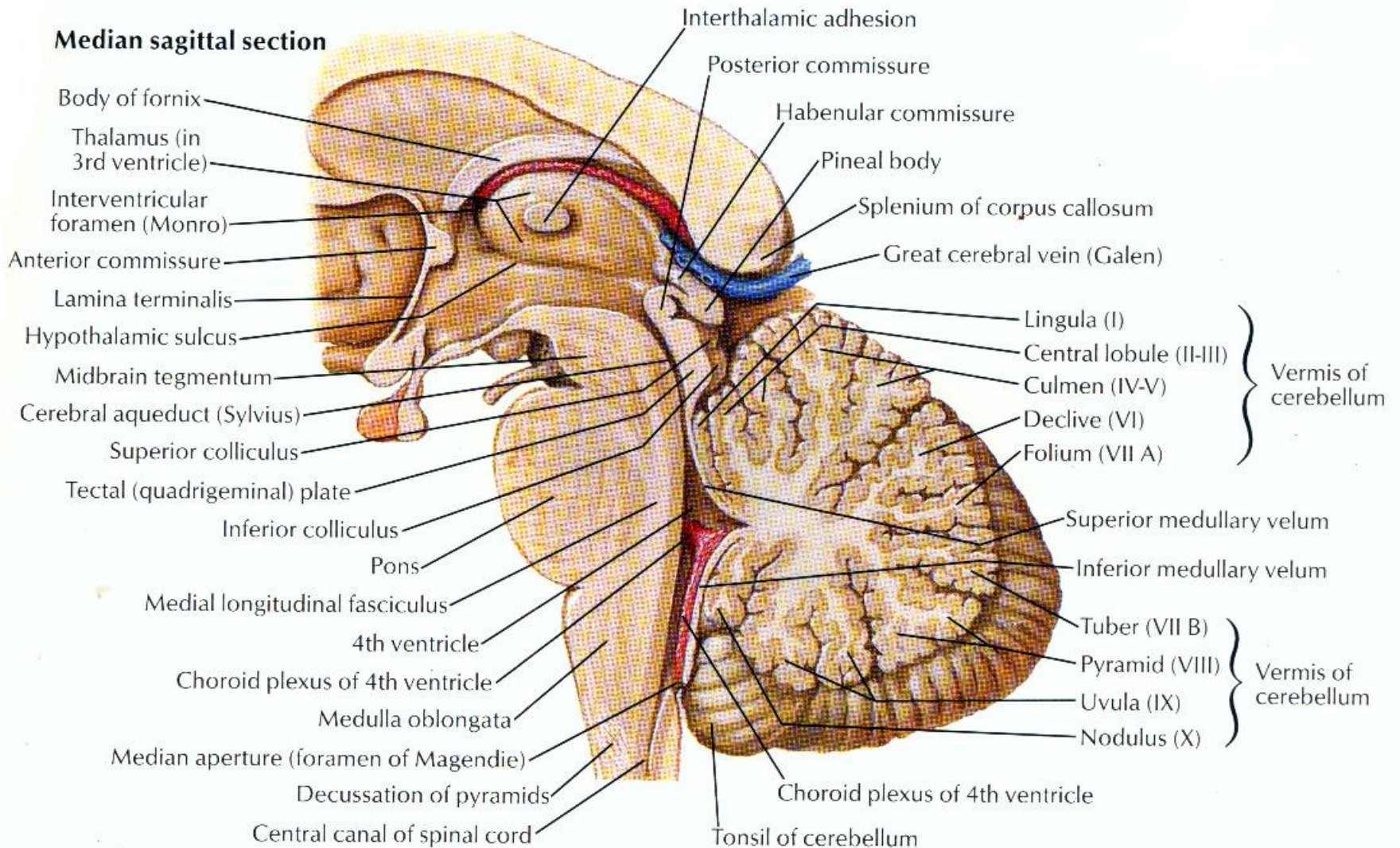
Brainstem - posterior view - contents of 4th ventricle:



Brainstem - posterolateral view:



Sagittal Section of Diencephalon and the brainstem

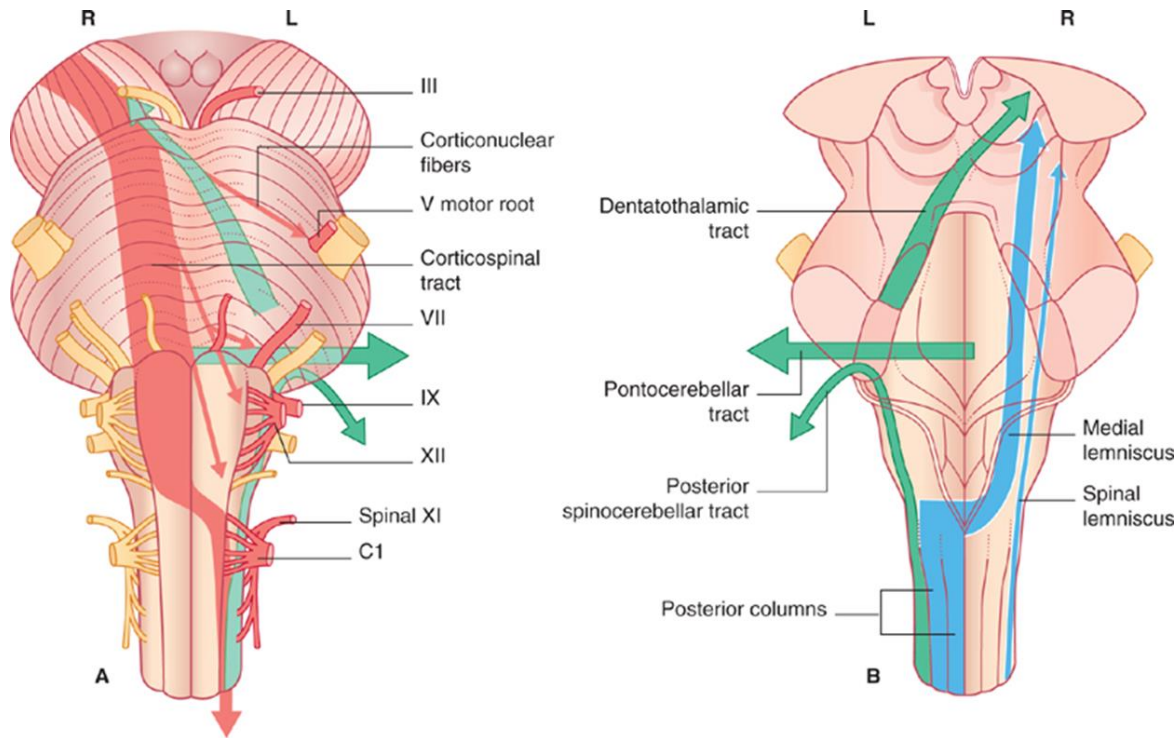




Basic internal components of Brainstem

- Ascending/descending fibre pathways
- Cranial nerve nuclei
- Neuromodulatory nuclei
- Intrinsic nuclei
- Tegmental/Reticular nuclei
- All components found in each part of the brainstem.

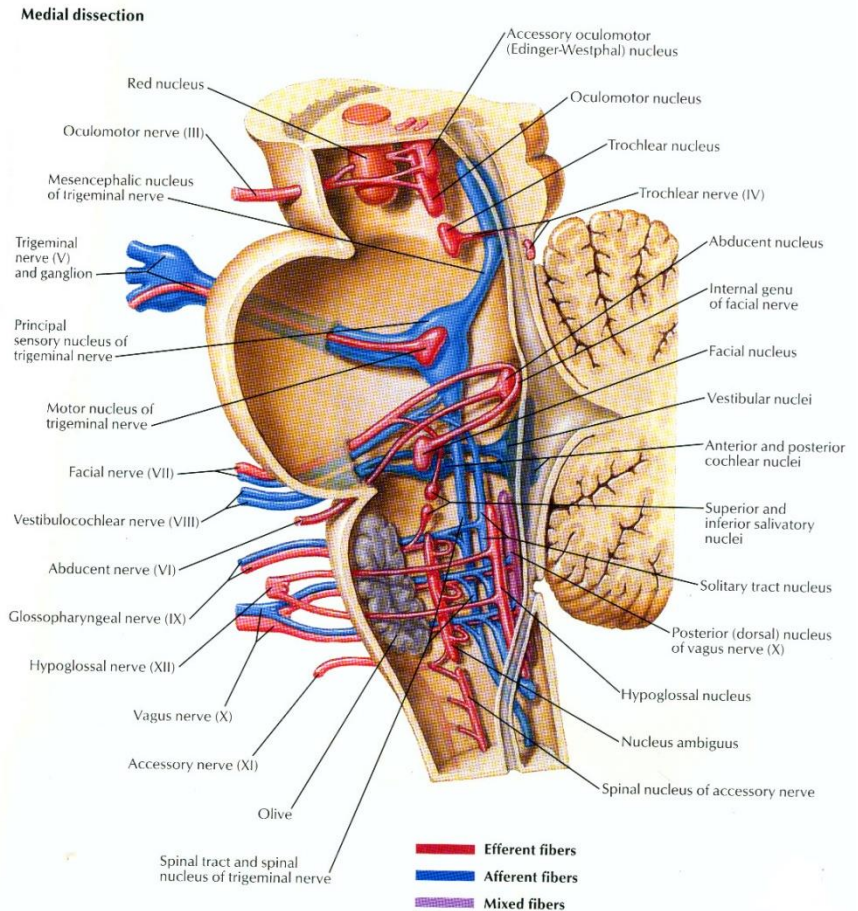
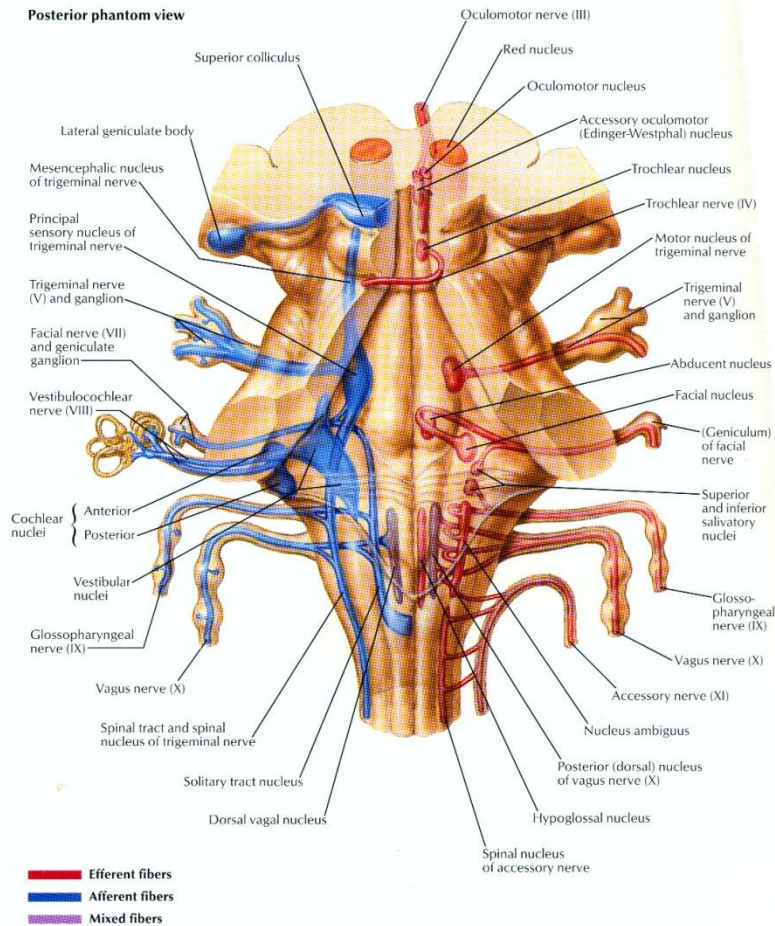
Ascending and Descending fibre pathways.



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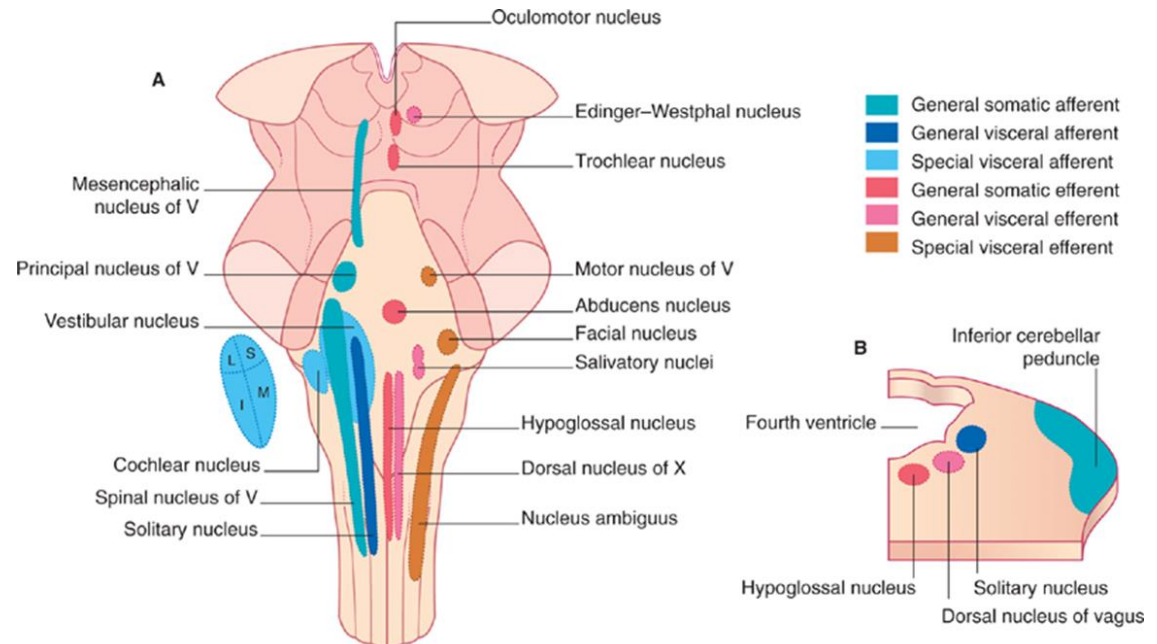
- These fibres carry information in the form of ascending sensory, or descending motor pathways. E.g.
- Ascending trigeminal sensory pathway and the Descending pyramidal motor pathway.

Location of the Cranial nerve nuclei in the brainstem



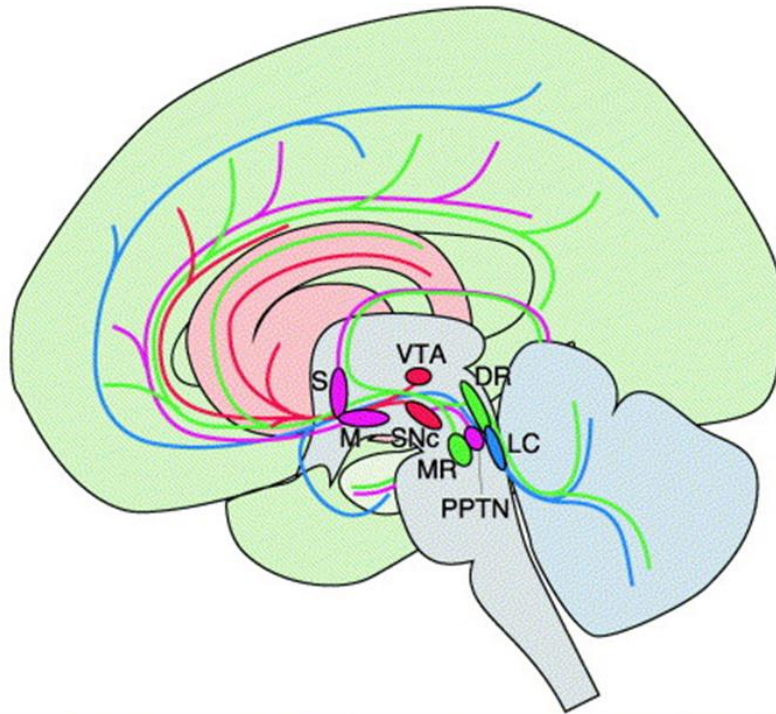
Cranial Nerve Nuclei Functions

- Motor
- Parasympathetic
- General Sensory
- Special Sensory
- Combination of two or more of above



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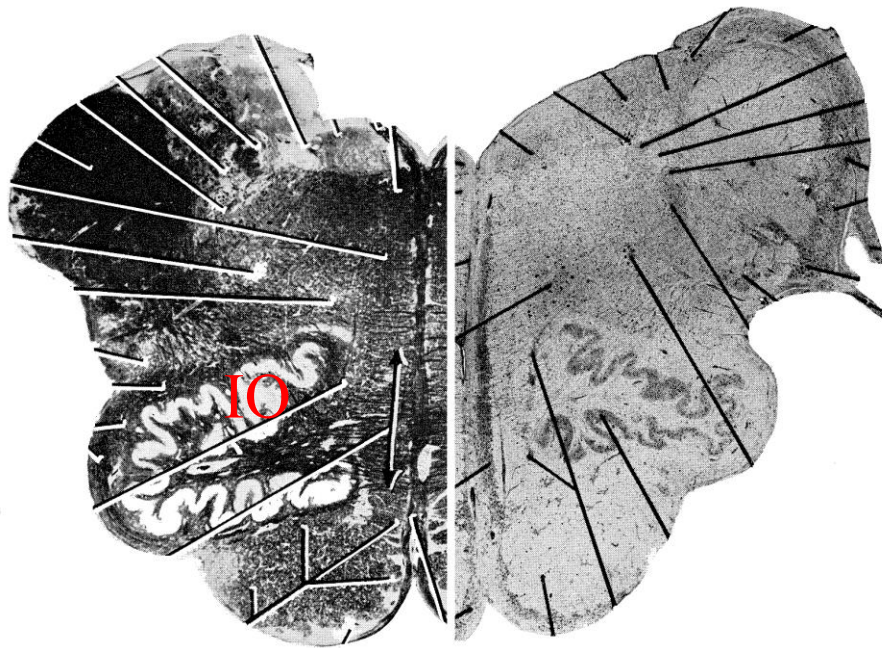
Neuromodulatory Nuclei



- Serve to modulate neuronal activity over large parts of the entire brain. E.g
- Raphe nuclei (serotonergic),
- Substantia nigra (dopaminergic),
- Locus coeruleus (noradrenergic),
- Area postrema (adrenergic), lateral dorsal tegmental and pedunculopontine (cholinergic)

neuromodulator	origin of projection	major target area
dopamine (DA)	substantia nigra, pars compacta (SNc) ventral tegmental area (VTA)	dorsal striatum ventral striatum frontal cortex
serotonin (5-HT)	dorsal raphe nucleus (DR)	cortex, striatum cerebellum
	median raphe nucleus (MR)	hippocampus
noradrenaline (NA) (norepinephrine, NE)	locus coeruleus (LC)	cortex, hippocampus cerebellum
acetylcholine (ACh)	Meynert nucleus (M)	cortex, amygdala
	medial septum (S)	hippocampus
	pedunculopontine tegmental nucleus (PPTN)	SNc, thalamus
		superior colliculus

Intrinsic Nuclei



- Form connections and undertake functions within regions of the brainstem.
E.g
- Inferior olive (IO)
 - Region of correlation of impulses from cerebellum, spinal cord, cerebral cortex, and corpus striatum and channels into the cerebellum for the coordination of learned patterns of movement.

Reticular Formation (RF)

A continuous core that traverses the whole brainstem

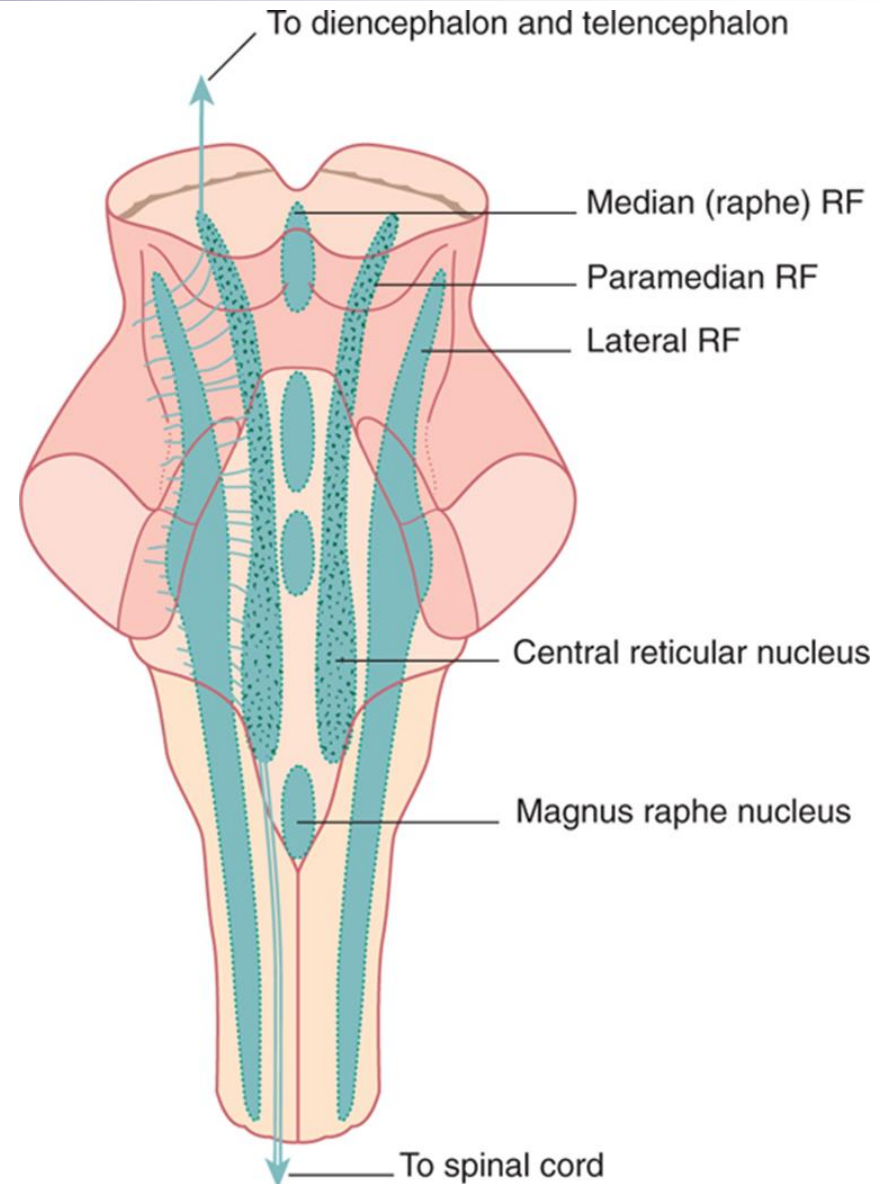
Continuous below with the reticular intermediate spinal grey laminae.

Divisible, on basis of cytoarchitectonic, chemoarchitectonic and functional criteria, into 3 longitudinal columns:

median;

medial, mostly large reticular neurones;

lateral, small to intermediate neurones



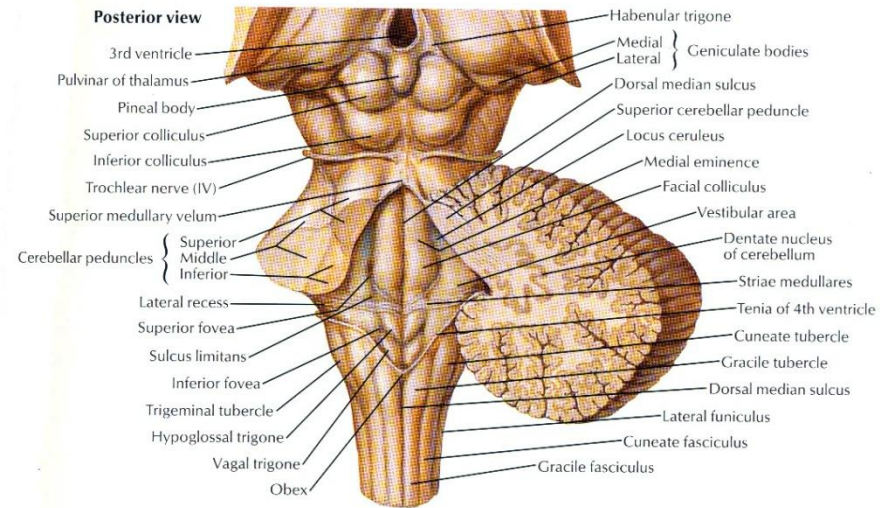
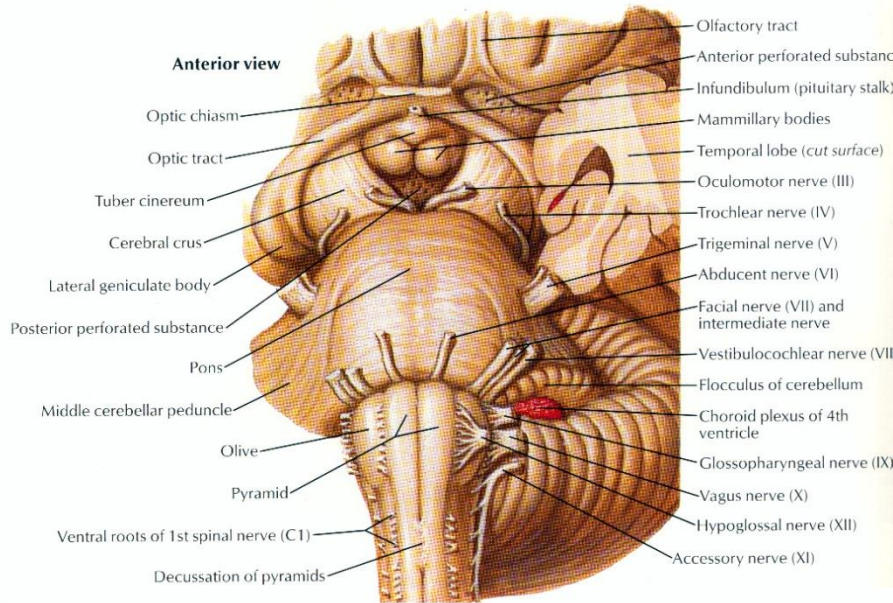
Characteristics of RF

- Ill-defined collections of neurones and fibres with diffuse connections
- Their conduction paths are difficult to define, often complex and polysynaptic,
- They have ascending and descending components that are partly crossed and uncrossed.
- Components are associated with somatic and visceral functions

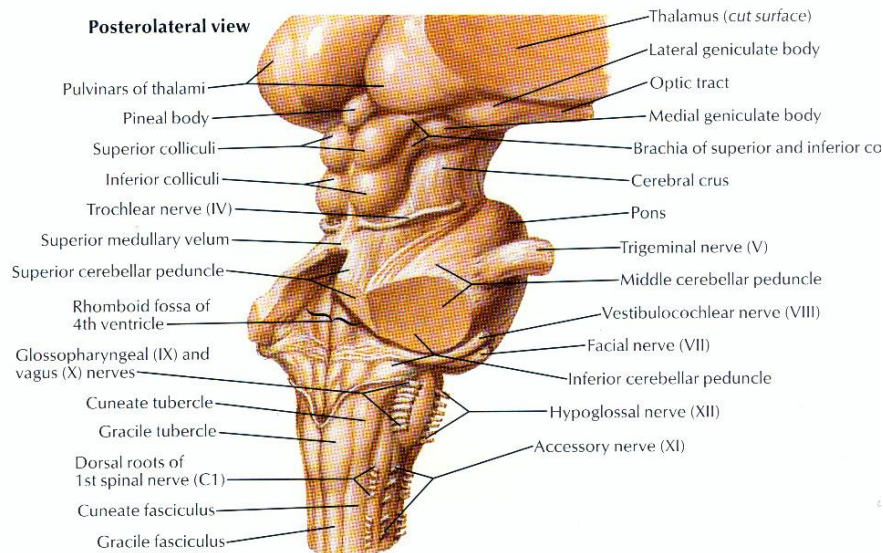
Functions of Reticular Nuclei

- Coordination of muscles movements
- Modulate pain sensation
- Eye movements
- Conscious state
- Speed of reflexes
- General level of alertness
- Regulation of feeding, respiration, circulation
- Drug induced vomiting

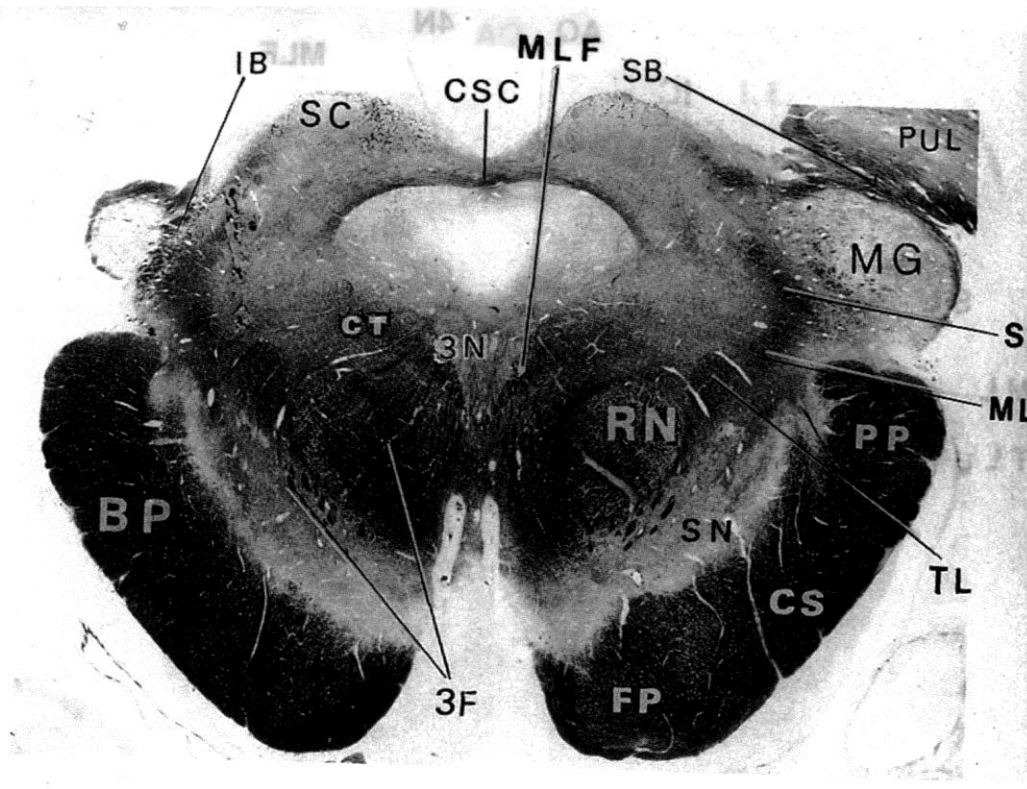
Midbrain – External Features



Swellings
 Peduncles
 Cranial Nerves/
 Nuclei
 Anterior Perforated space

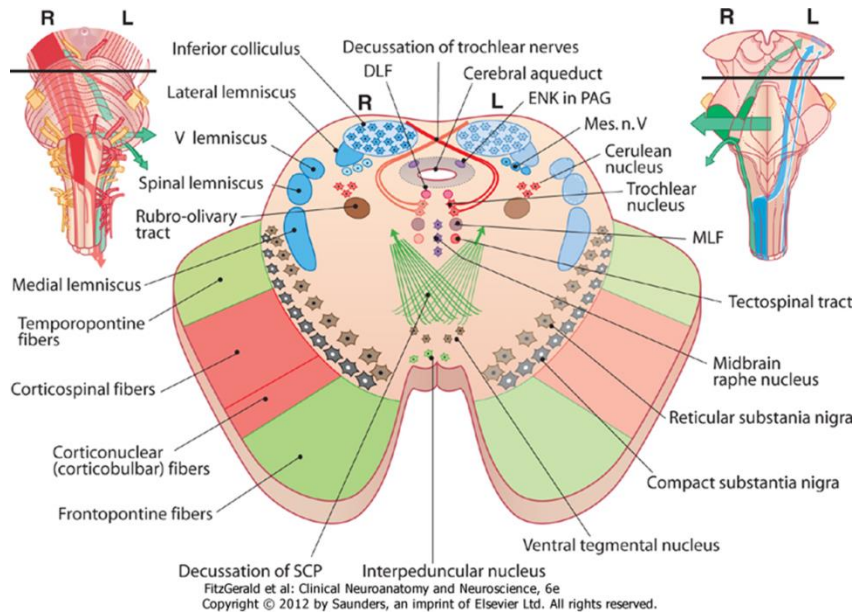
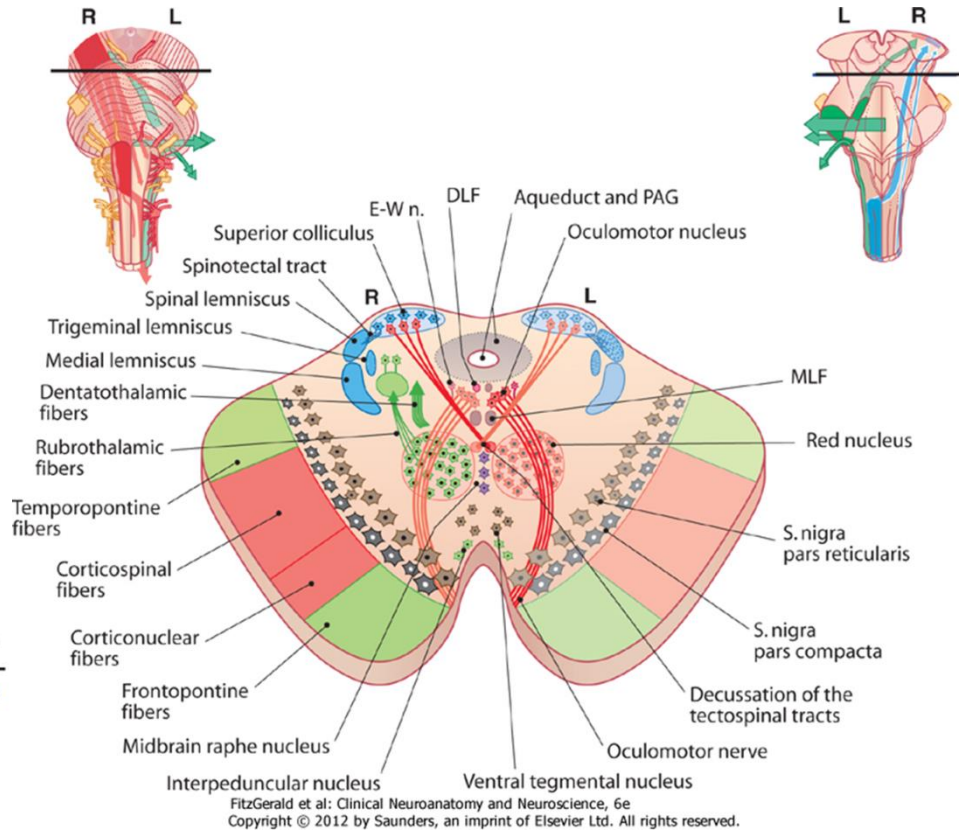
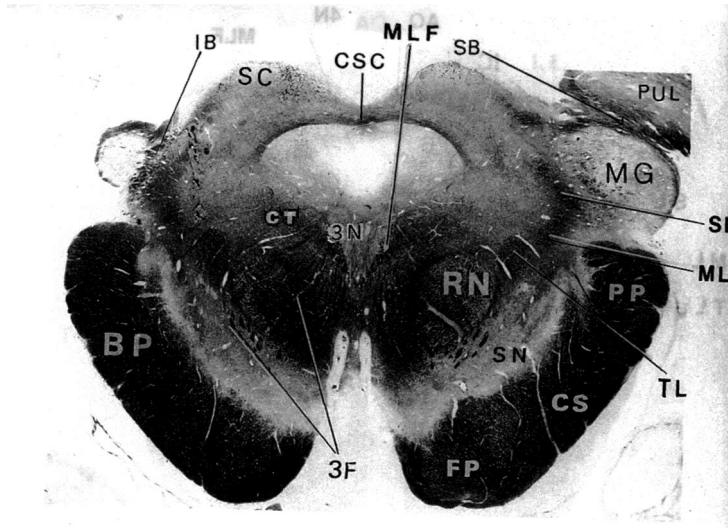


Midbrain: Components



- 4 parts
- 1. Tectum/Colliculi
- 2. Tegmentum
- 3. Substantia Nigra
- 4. Basis pedunculi

Midbrain: level of superior & Inferior colliculi



Fibre Pathways -

- medial longitudinal fasciculus, lateral and medial lemniscus, corticobulbar and corticospinal tracts.

Cranial Nerve Nuclei -

- III (oculomotor) and IV (trochlear)

Neuromodulatory nuclei -

- dorsal raphe (serotonergic), substantia nigra and ventral tegmental area (dopaminergic)

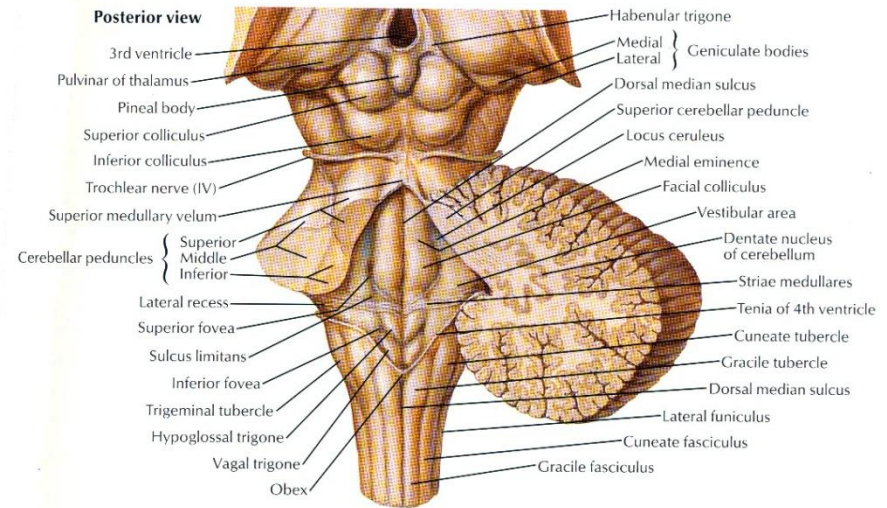
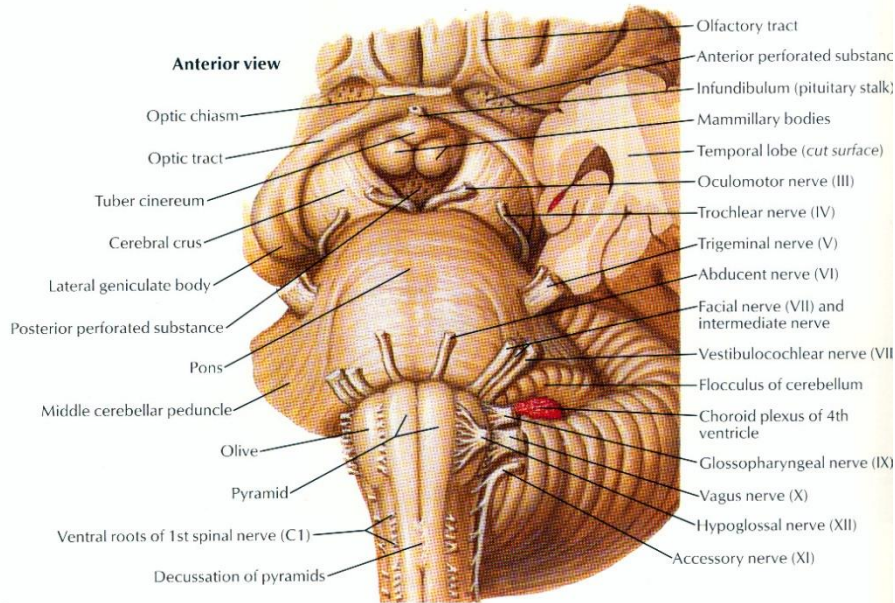
Intrinsic Nuclei -

- superior and inferior colliculi, red nucleus, periaqueductal gray matter.

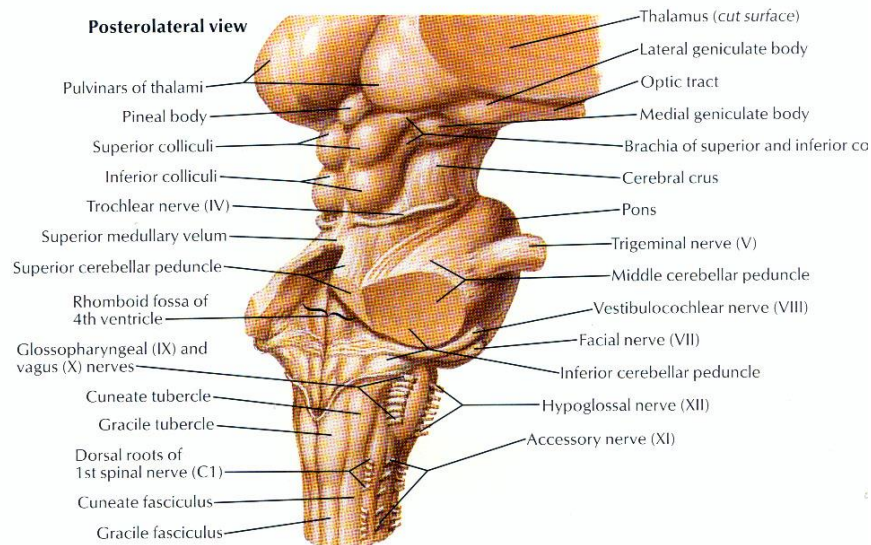
Tegmental/Reticular Nuclei -

- parabrachium, cuneiform, subcuneiform

Pons – External Features



Swellings
 Pontomedullary junction
 Cranial Nerves/
 Nuclei

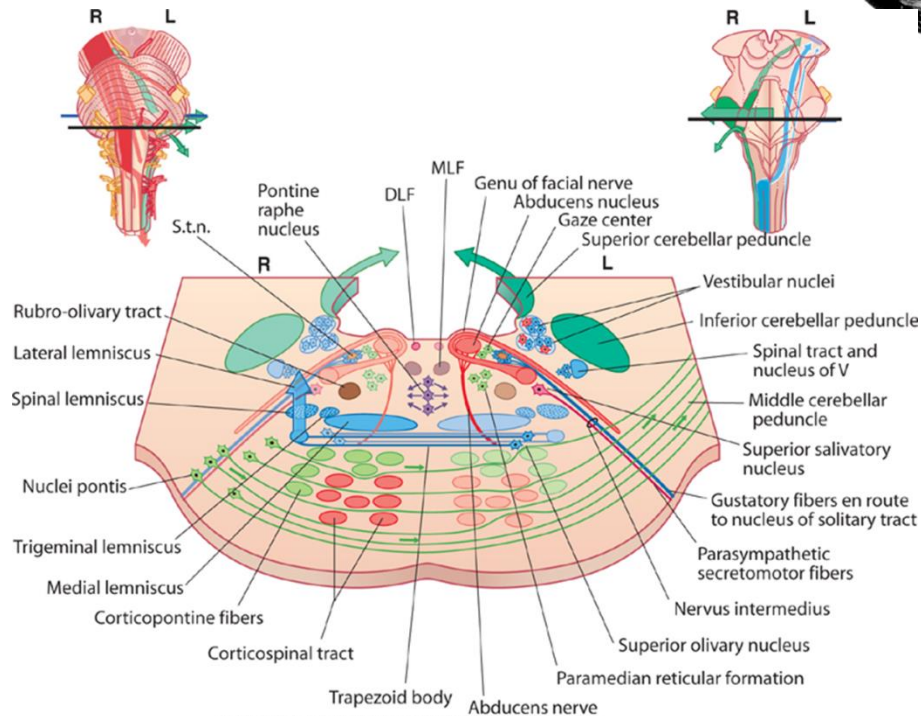
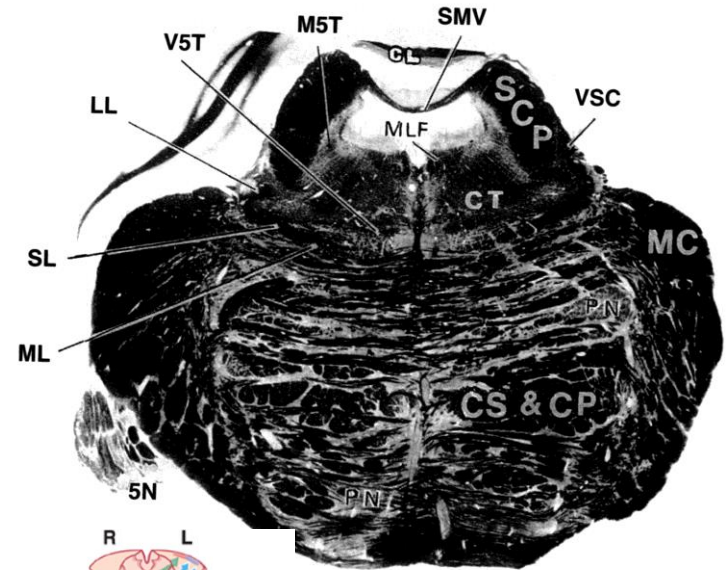


Pons - components

2 main parts

1. Dorsal
sensory/motor
tegmental
portion

2. Ventral
pontine nuclei



Fibre Pathways -

- brachium conjunctivum, tegmental and lemniscal tracts, corticospinal, corticopontine, pontocerebellar.

Cranial Nerve Nuclei -

- V (trigeminal, motor and sensory), VI (abducens), VII (facial) & VIII (vestibulocochlear – part)

Neuromodulatory nuclei -

- raphe (serotonergic), locus coeruleus (noradrenergic), lateral dorsal tegmental and pedunculopontine (cholinergic)

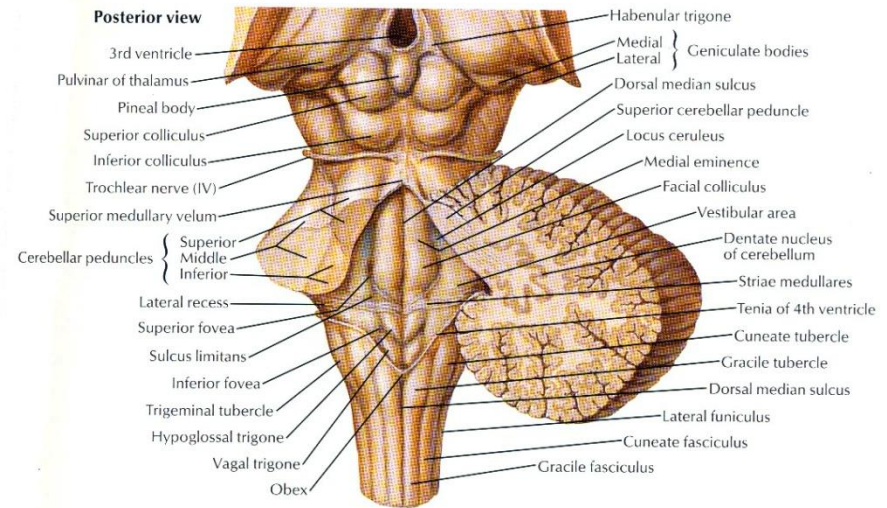
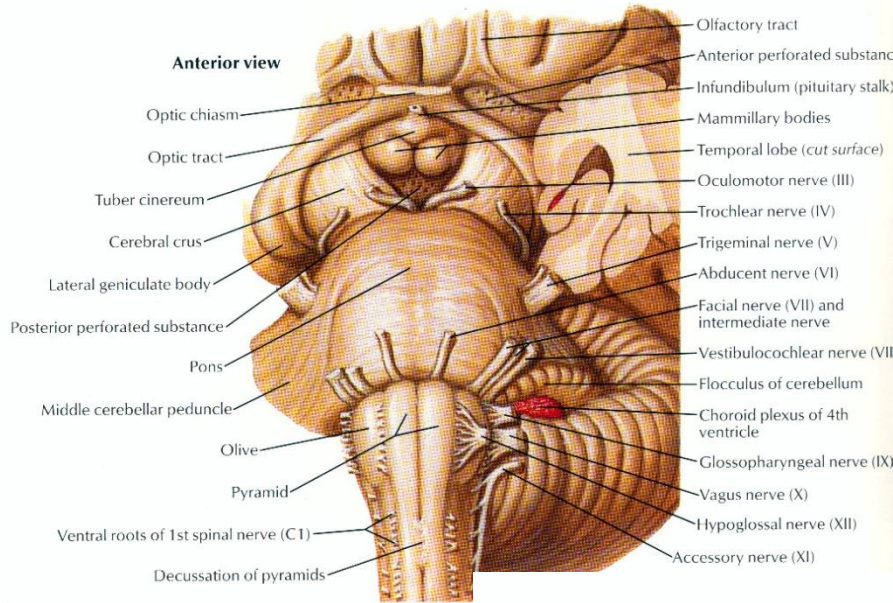
Intrinsic Nuclei -

- pontine gray, cochlear nuclei

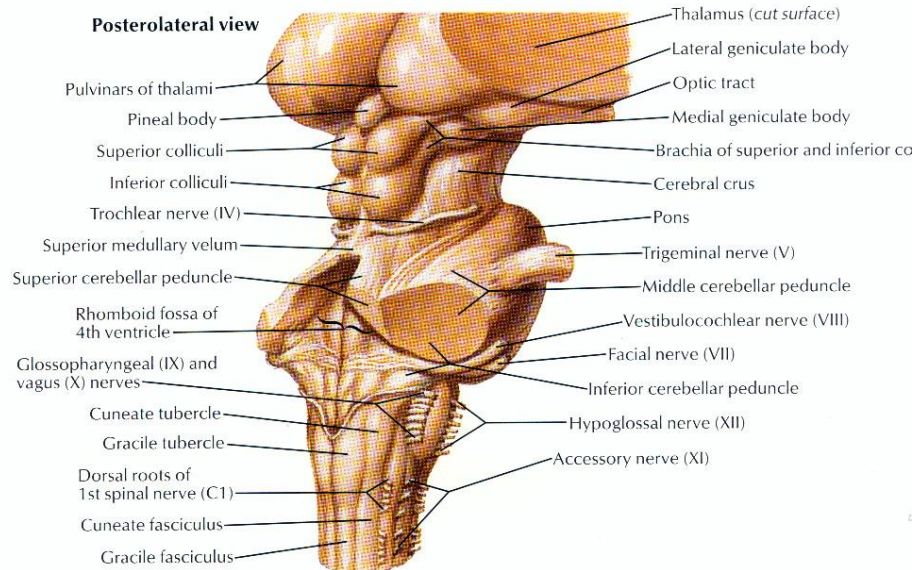
Tegmental/Reticular Nuclei -

- oral pontine, caudal pontine, pontine reticulotegmental.

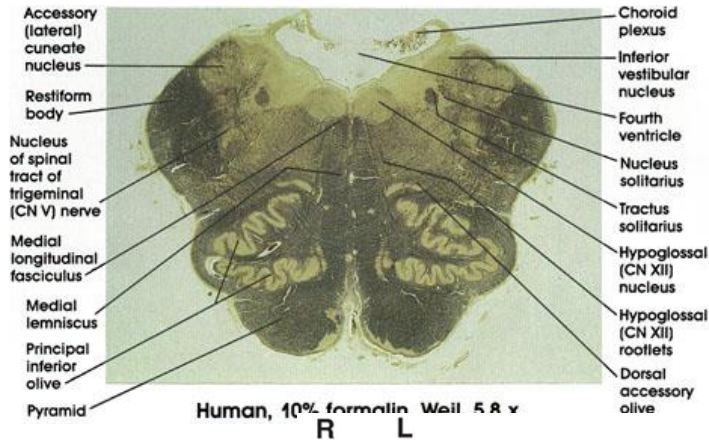
Medulla – External Features



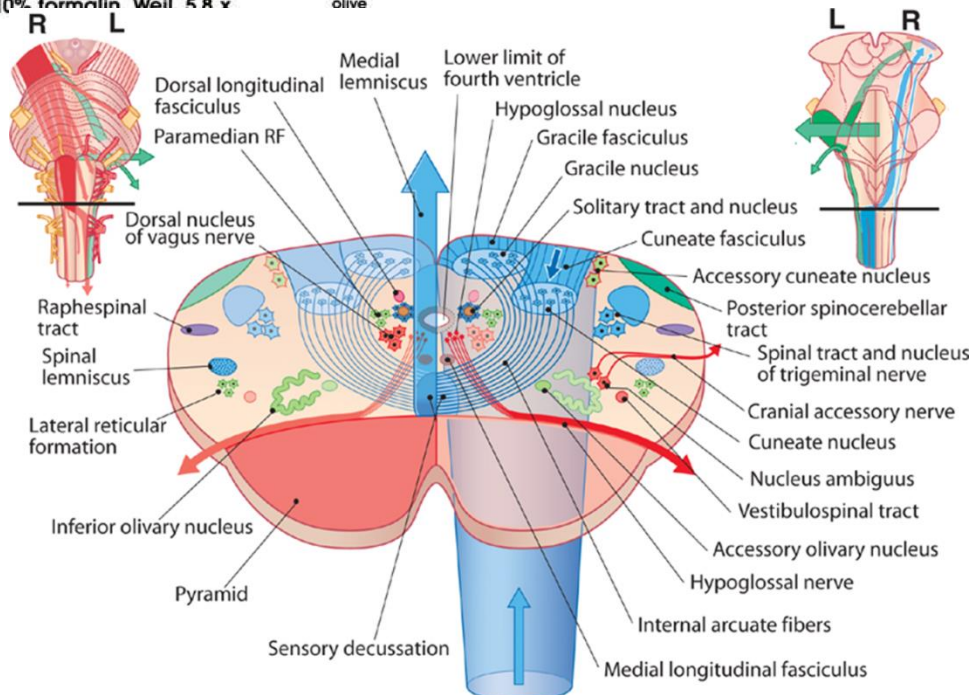
Sulcus
Swellings
CN
Nuclei



Medulla Oblongata: Components



- Composed mostly of continuations of fibre tracts of spinal cord & various cranial nerve nuclei (VIII – XII).



Fibre Pathways -

- pyramidal tract, tectospinal tracts, various spinal related tracts

Cranial Nerve Nuclei -

- VIII (vestibulocochlear – part), IX (glossopharyngeal), X (vagus), XI (accessory), XII (hypoglossal)

Neuromodulatory nuclei -

- ventral raphe (serotonergic)

Intrinsic Nuclei -

- inferior olivary nucleus, dorsal vagal motor nucleus, area postrema

Tegmental/Reticular Nuclei -

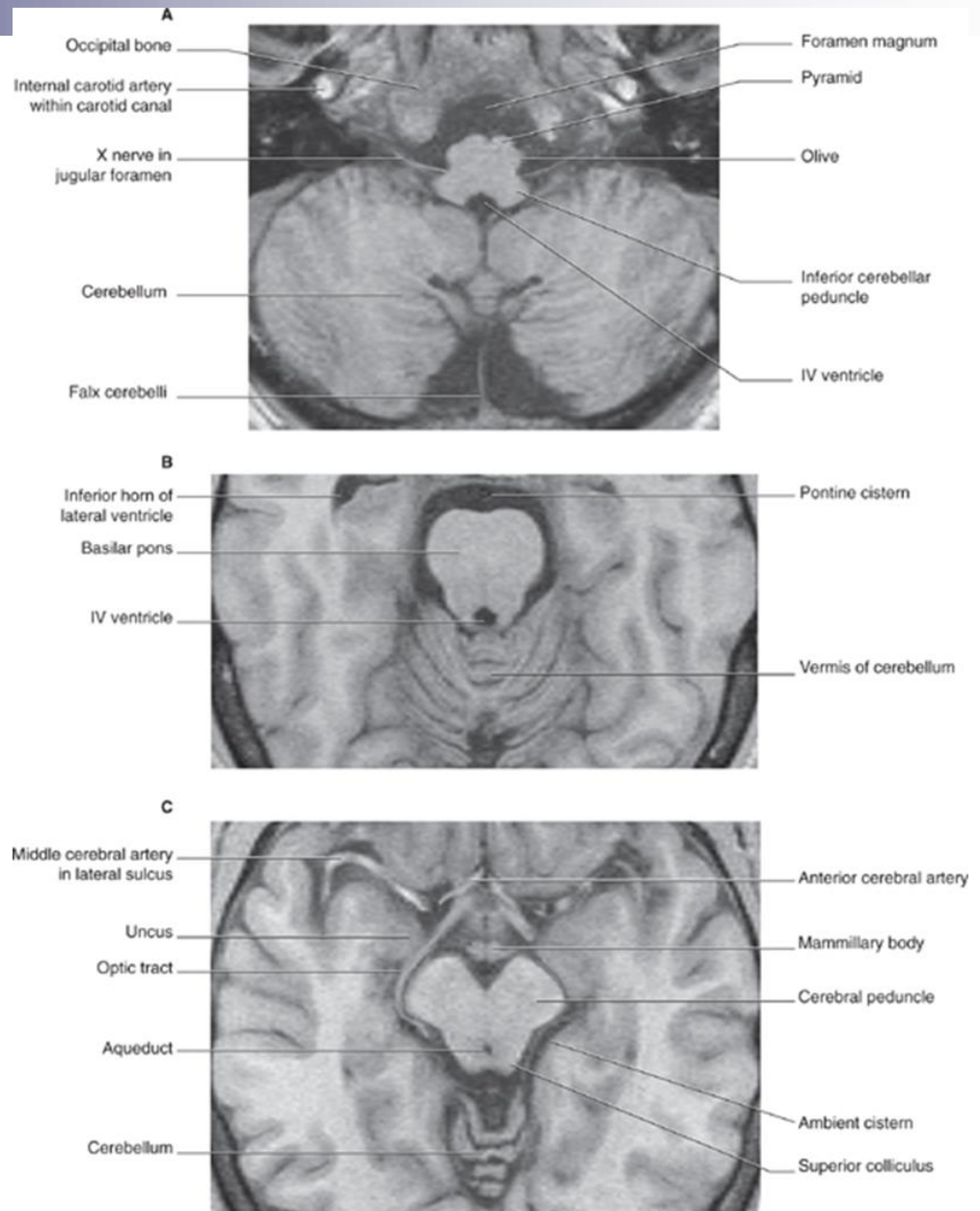
- parvocellular reticular area, gigantocellular nucleus, central medullary nucleus, paramedian and lateral reticular nuclei.

Fig 17.20 MRI of brainstem

A- medulla

B- pons

C- midbrain



Questions

- What are the five basic components (contents) of the brainstem?
- Enumerate the functions of the reticular nuclei?
- List the external features of the medulla oblongata (pons or medulla)
- Using a diagram, depict the anatomic structures in a cross-section of the midbrain at the level of the superior colliculus.
- Compare and contrast the intrinsic and cranial nerve nuclei present at the levels of the superior and inferior colliculi of the midbrain