



- **Brain stem:**

- It is connected to the cerebellum and cerebral hemispheres.
- **Rostral end of brain stem:** diencephalon is the area which is connecting the brain stem to cerebral hemispheres. This area contains thalamus, hypothalamus... etc.
- **The brain stem has 3 parts:**
 - ✓ Midbrain.
 - ✓ Pons.
 - ✓ Medulla.
- **Features of brain stem:**
 - ✓ Cranial nerves.
 - ✓ Cranial nerve nuclei.
 - ✓ Lemnisci. What are the 4 criteria required to classify fibers as lemnisci?
 - ❖ Transmitting sensory information.
 - ❖ Present in the midbrain.
 - ❖ Crossing.
 - ❖ Terminating in the thalamus.
 - ✓ Reticular formation: which is extending from the spinal cord and connected to the intralaminar nuclei of the thalamus.

- **Anterior aspect of the brain stem (see the image in next page):**

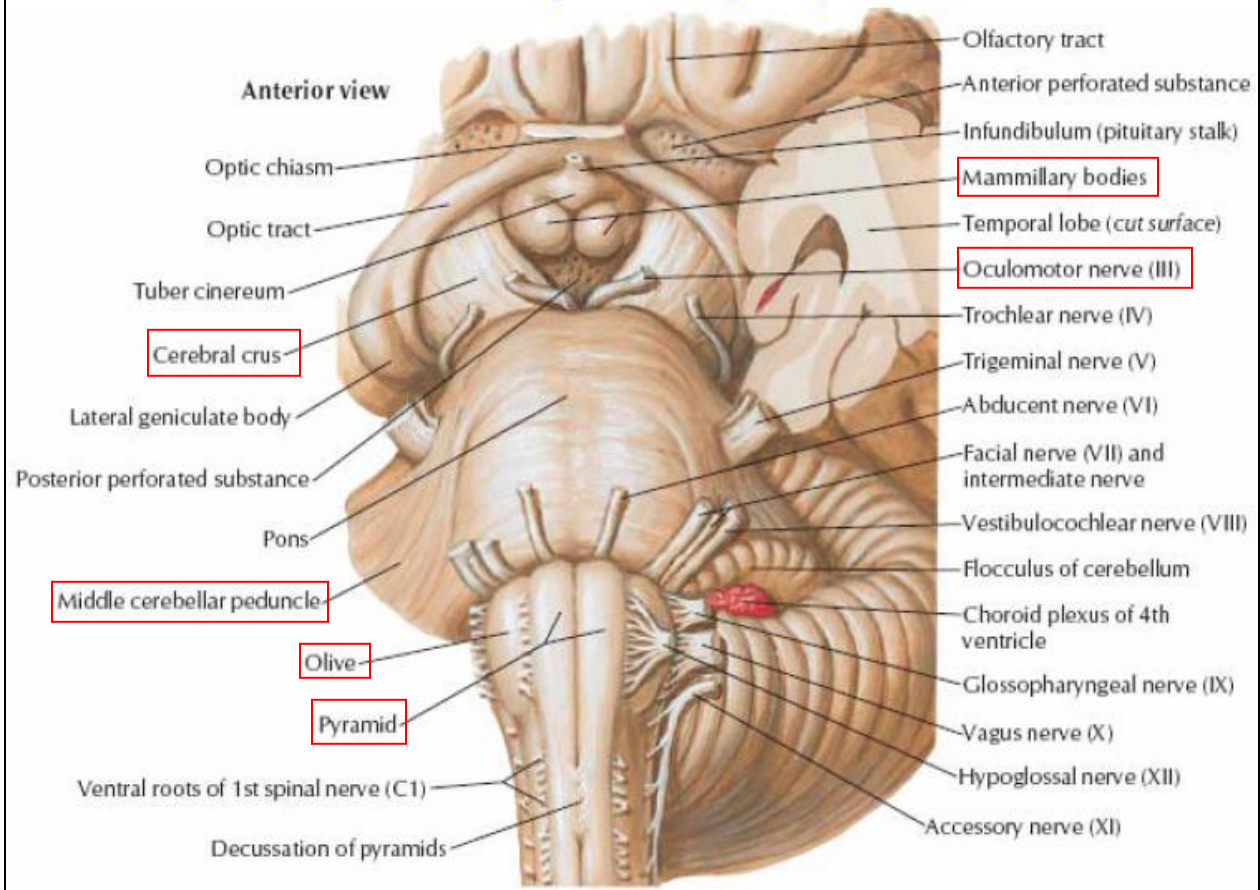
- **Midbrain:**
 - ✓ Mamillary bodies are projecting in between in the midbrain.
 - ✓ There are 2 cerebral peduncles connecting the midbrain to cerebral hemispheres (they are also known as basis pedunculi).
 - ✓ Interpeduncular fossa: it the area between the 2 cerebral peduncles where the 3rd cranial nerve (occulomotor) is going to exit.
- **Pons:**
 - ✓ It has a shallow groove/depression in its anterior surface which contains the basilar artery (formed by the merge of vertebral arteries).
 - ✓ At the anterolateral aspect → middle cerebellar peduncle is seen (it is the connection between pons and cerebellum).
- **Medulla:**
 - ✓ There are 2 prominent columns in its anterior surface known as pyramids (where corticospinal tract is going to pass).
 - ✓ Olives: they are the prominent areas which are located lateral to the pyramids and containing the inferior olivary nuclear complex (which is large and pushing the surface to form a bulge).

- **Posterior aspect of the brain stem (see the image in next page):**

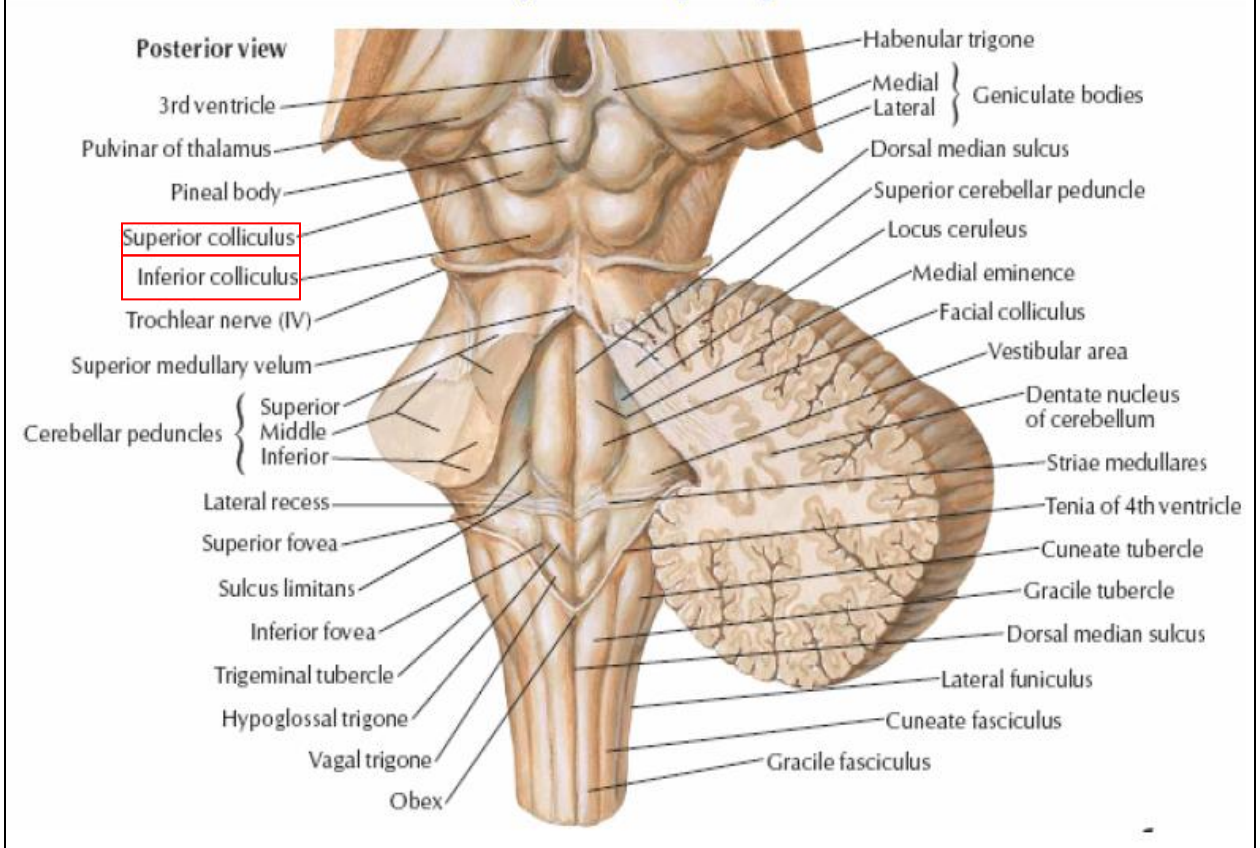
- **Midbrain:**
 - ✓ It has 4 small rounded structures:
 - ❖ *The superior 2 are → superior colliculi → for vision.*
 - ❖ *The inferior 2 are → inferior colliculi → for hearing.*
- **Pons:**
 - ✓ It has the 4th ventricle which is covered by the cerebellum (so the cerebellum must be removed to expose this area).
- **Medulla:** divided into 2 parts from its posterior aspect:
 - ✓ The upper (rostral) part: which is open and forming floor of the 4th ventricle.
 - ✓ The lower (caudal) part: which is closed and has no ventricle.



Anterior (ventral) aspect



Posterior (dorsal) aspect





- **Connections between the brain stem and cerebellum:**

- **The cerebellum is attached to the brain stem by 3 peduncles:**
 - ✓ Superior cerebellar peduncle → connecting cerebellum and midbrain.
 - ✓ Middle cerebellar peduncle → connecting cerebellum and pons.
 - ✓ Inferior cerebellar peduncle → connecting cerebellum and medulla.

- **The brain stem has 2 main contents:**

- **Nuclei of cranial nerves.**
- **Tracts.**

- **Cranial nerves:**

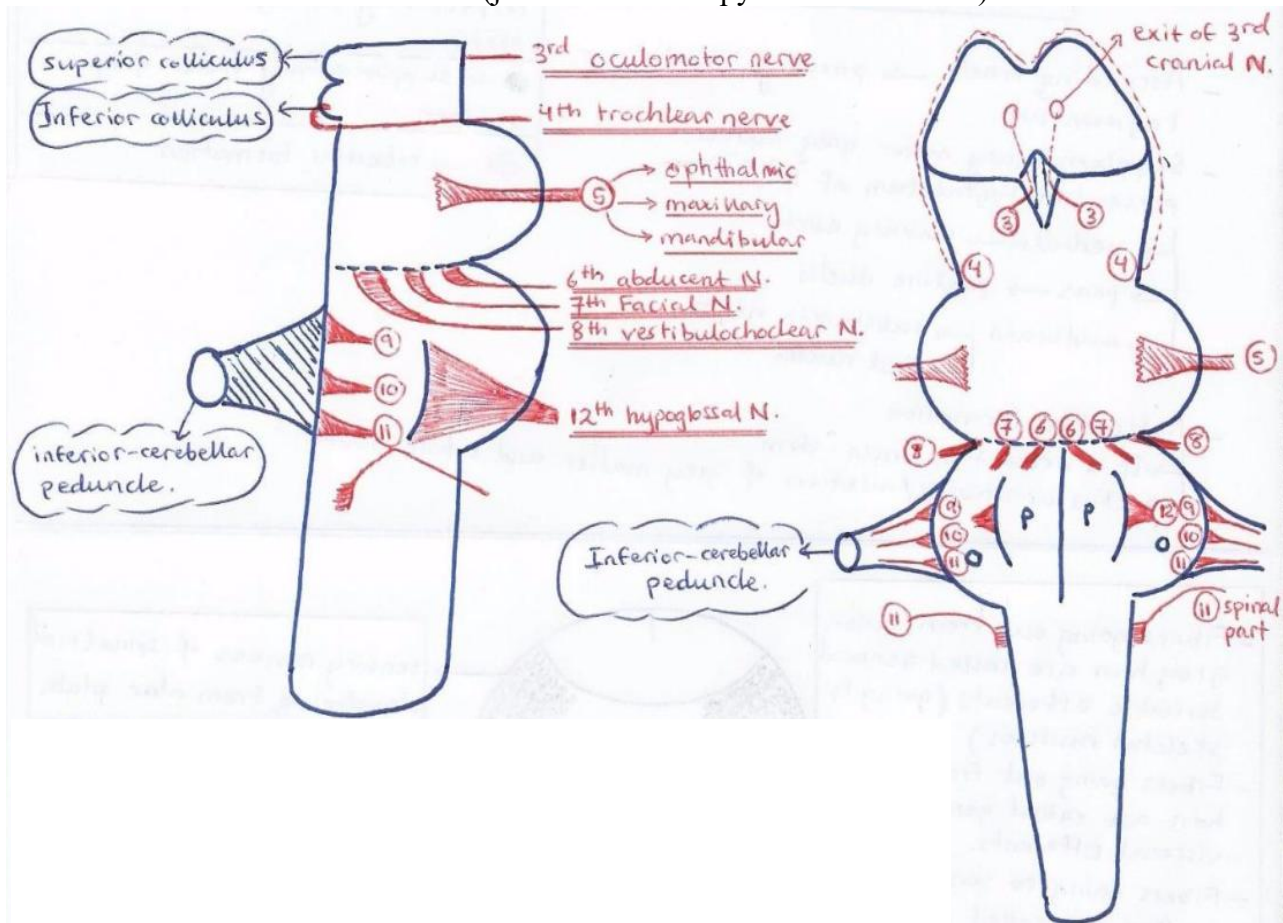
- They are peripheral nerves which are attached to specific nuclei in the brain stem. Therefore, 1st and 2nd nerves are not classified as cranial nerves because they are not attached to the brain stem (but for simple explanation they will be included with other cranial nerves).
- **Each cranial nerve has a specific function which can be:**
 - ✓ Motor.
 - ✓ Sensory.
 - ✓ Or both.
- **Cranial nerves supply their structures ipsilaterally (except the 4th cranial nerve which is decussating ventral to inferior colliculi).**

Cranial nerve	Component fibers	Function
I (olfactory)	Sensory	Olfaction (smelling)
II (optic)	Sensory	Vision
III (oculomotor)	Motor	Movement of eyeball (supplying all extraocular muscles except lateral rectus and superior oblique muscles).
IV (trochlear)	Motor	Movement of the eyeball (through attachment to superior oblique muscle).
V (trigeminal)	Both	For general sensation from the face. motor for muscles of mastication.
VI (abducens)	Motor	Movement of the eyeball (through attachment to lateral rectus muscle)
VII (facial)	Sensory	Taste (from anterior 2/3 of tongue)
	Motor	Muscles of facial expression
	Parasympathetic	Salivation and lacrimation
VIII (vestibulocochlear)	Sensory	Balance (from vestibular apparatus) and hearing (from cochlea)
IX (glossopharyngeal)	Sensory	Taste (from posterior 1/3 of tongue)
	Motor	Swallowing (through stylopharyngeus muscle)
	Parasympathetic	Salivation
X (vagus)	Sensory	General sensation (taste from posterior most aspect of tongue)
	Motor	Speech and swallowing (laryngeal & pharyngeal muscles).
	Parasympathetic	Control of cardiovascular respiratory and GI systems
XI (accessory-spinal part)	Motor	Movement of head & shoulder (through innervations of sternomastoid and trapezius muscles)
XII (hypoglossal)	Motor	Movement of tongue

Note: taste is transmitted by 3 cranial nerves (VII, IX and X) → all of them will terminate in a nucleus known as nucleus solitaries in medulla oblongata.



- **Where do cranial nerves originate from? (see the figure in next page)**
 - ✓ III → in midbrain at level of superior colliculi.
 - ✓ IV → in midbrain at level of inferior colliculi.
 - ✓ V → in pons (mid-pontine area) from anterolateral aspects (on both sides).
 - ✓ VI, VII and VIII → in ponto-medullary sulcus (medial to lateral respectively).
 - ✓ IX, X and XI → in medulla at both sides.
 - ✓ XII → in medulla (junction between pyramids and olives).



- **Tracts in the brain stem: are classified into:**

• **Ascending (sensory) tracts: these include:**

- ✓ **Dorsal column:** which is transmitting sensations of fine touch, vibration, conscious proprioception and 2-point discrimination → crossing in medulla and continue as the medial lemniscus to terminate in VPL nucleus of thalamus.
- ✓ **Spinothalamic tract:**
 - ❖ *Anterior:* transmitting sensation of crude touch → crossing 2-3 segments above the level of entry to the spinal cord.
 - ❖ *Lateral:* transmitting sensation of pain and temperature → crossing 1-2 segments above the level of entry to the spinal cord.Both of these tracts will ascend and merge to form the spinal lemniscus which will terminate in VPL nucleus of thalamus.
- ✓ **Spinocerebellar tract:**
 - ❖ *Dorsal:* synapse with Clark's nuclei (without crossing) and terminating at the level of medulla by passing to the cerebellum through inferior cerebellar peduncle.
 - ❖ *Ventral:* crossing at level of entry to the spinal cord and terminating at level of midbrain by passing to the cerebellum through superior cerebellar peduncle (recrossing → therefore going to ipsilateral cerebellum).



- **Descending (motor) tracts: including mainly:**

- ✓ Corticospinal tract: which is passing through crus cerebri of midbrain → going to pons → and then passing through pyramids of medulla (to cross in the lower part of medulla: pyramidal decussation).

Note: the 4 lemnisci which will be seen all together in midbrain are:

- ✓ Medial lemniscus → taking sensations of dorsal column.
- ✓ Spinal lemniscus → taking sensations of spinothalamic tract.
- ✓ Trigeminal lemniscus → taking sensations from the face to VPM nucleus of thalamus.
- ✓ Lateral lemniscus → taking auditory sensations to medial geniculate body.

- **Scalp:**

- **Arterial supply: the scalp has a rich blood supply from internal and external carotid arteries:**

- ✓ Internal carotid artery branches:

- ❖ *Ophthalmic artery.*
- ❖ *Supratrochlear artery.*
- ❖ *Supraorbital arteries.*

- ✓ External carotid artery branches:

- ❖ *Posterior auricular artery (smallest)* → supplying area of the scalp posterior to the ear.
- ❖ *Pre-auricular artery (superficial temporal artery)* → supplying most of the lateral aspect of the scalp.
- ❖ *Occipital artery* → supplying a large part of the posterior aspect of scalp.

- **Layers: there are 5 layers (the first 3 are intimately bound together and move as a unit: scalp proper):**

- ✓ Skin: thick and contains many sebaceous glands.
- ✓ Connective tissue (dense): highly vascular.
- ✓ Aponeurotic layer:
 - ❖ *Central*: epicranial aponeurosis.
 - ❖ *Frontal*: frontalis.
 - ❖ *Posterior*: occipitalis.
- ✓ Loose connective tissue.
- ✓ Pericranium.

- **The muscle of the scalp is called occipitofrontalis muscle → it moves the scalp proper, wrinkle the forehead and raise the eyebrows.**

