

Objectives

At the end of the lecture, students should:

- ✓ List the components of brain stem.
- ✓ Describe the site of brain stem.
- ✓ Describe the relations between components of brain stem & their relations to cerebellum.
- ✓ Describe the external features of both ventral & dorsal surfaces of brain stem.
- ✓ List cranial nerves emerging from brain stem.
- ✓ Describe the site of emergence of each cranial nerve.

Development of the Brain

- The **brain** develops from the **cranial** part of **neural tube***.
- The cranial part is divided into 3 parts:

	FOREBRAIN		MIDBRAIN	HINDBRAIN
Cavity	2 lateral ventricles	3rd ventricle	cerebral aqueduct	4th ventricle
Subdivided into	Two cerebral hemispheres	Diencephalon: 1. thalamus, 2. hypothalamus, 3. epithalamus & 4. subthalamus	The midbrain is also called mesencephalon	1- Pons. 2- Cerebellum. 3- Medulla oblongata.

Note: the brain stem develops from 2 different parts. The pons and medulla oblongata develop from the hindbrain where as the midbrain develops from the midbrain.

*recall from embryology the caudal 2/3 forms the spinal cord and the cranial or upper 1/3 forms the brain

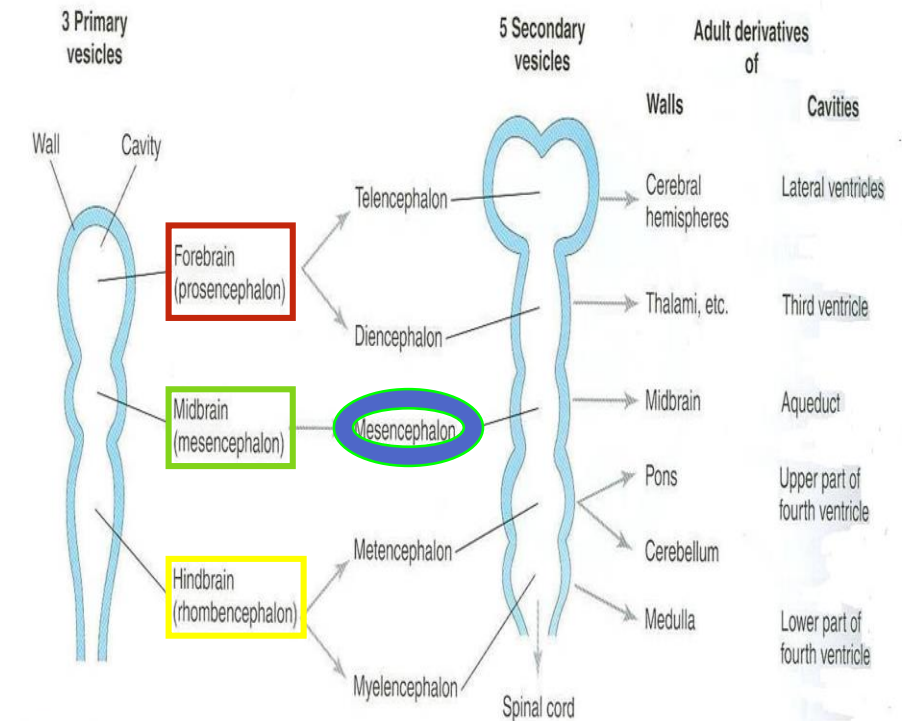


Figure 18-20. Diagrammatic sketches of the brain vesicles, indicating the adult derivatives of their walls and cavities. *The rostral part of the third ventricle forms from the cavity of the telencephalon; most of this ventricle is derived from the cavity of the diencephalon.

Brain Stem



01:58

- The brainstem is the region of the brain that connects the **cerebrum** with the **spinal cord**
- SITE:
It lies on the basilar part of occipital bone (**clivus**).
- PARTS: From above downwards:
Mid brain, pons & medulla oblongata
- CONNECTIONS WITH CEREBELLUM:
Each part of brain stem is connected to cerebellum by cerebellar peduncles (superior, middle & inferior).

Superior peduncle connects **midbrain** with cerebellum
Middle peduncle connects **pons** with cerebellum
Inferior peduncle connects **medulla oblongata** with cerebellum

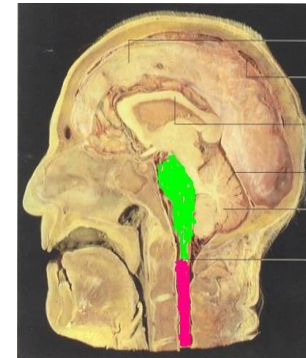
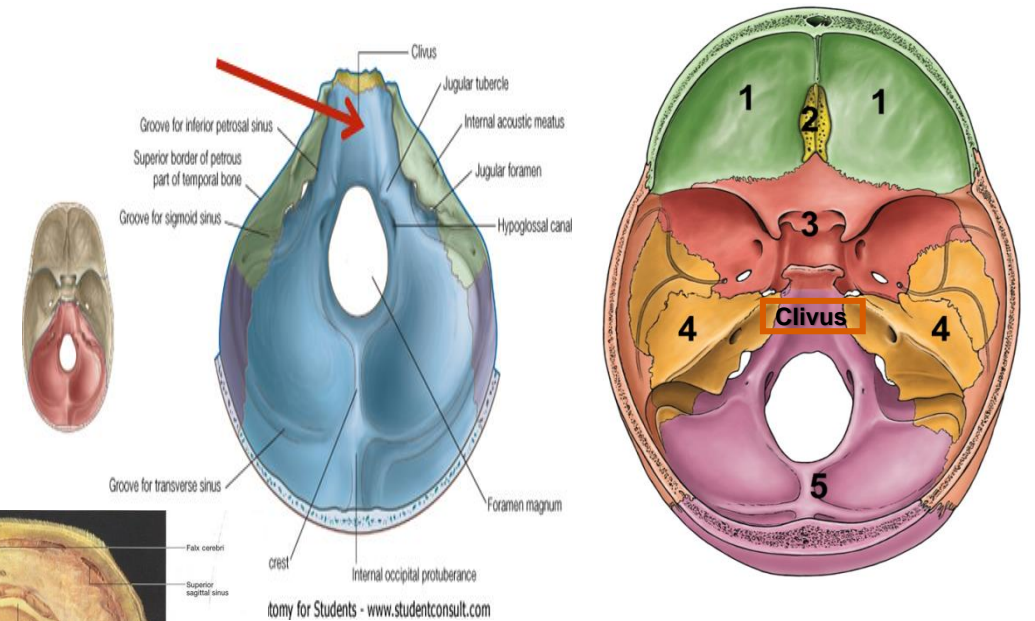
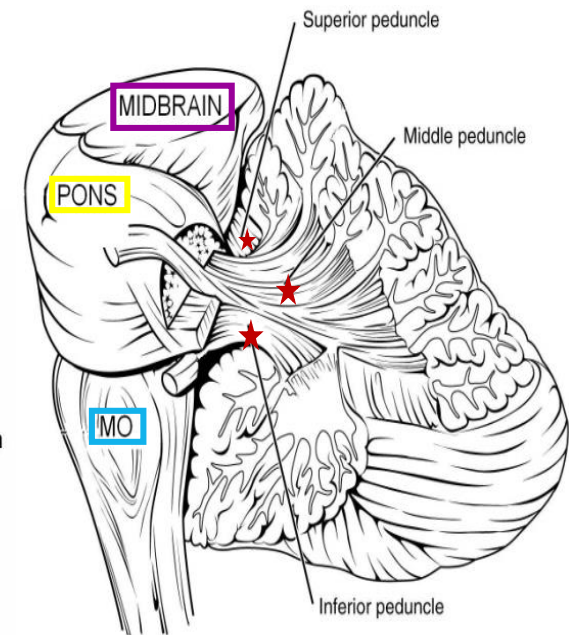
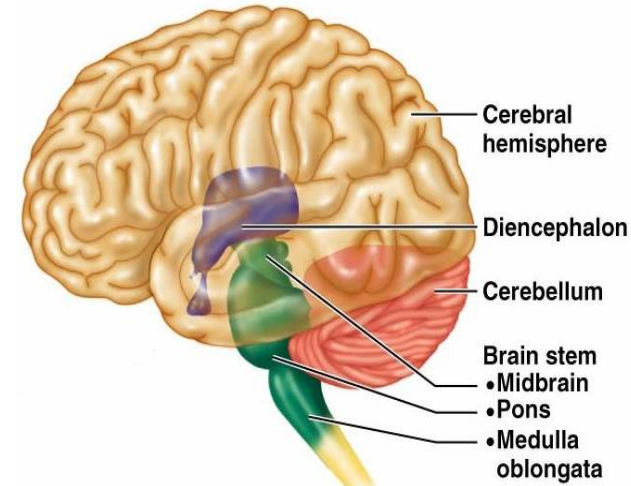
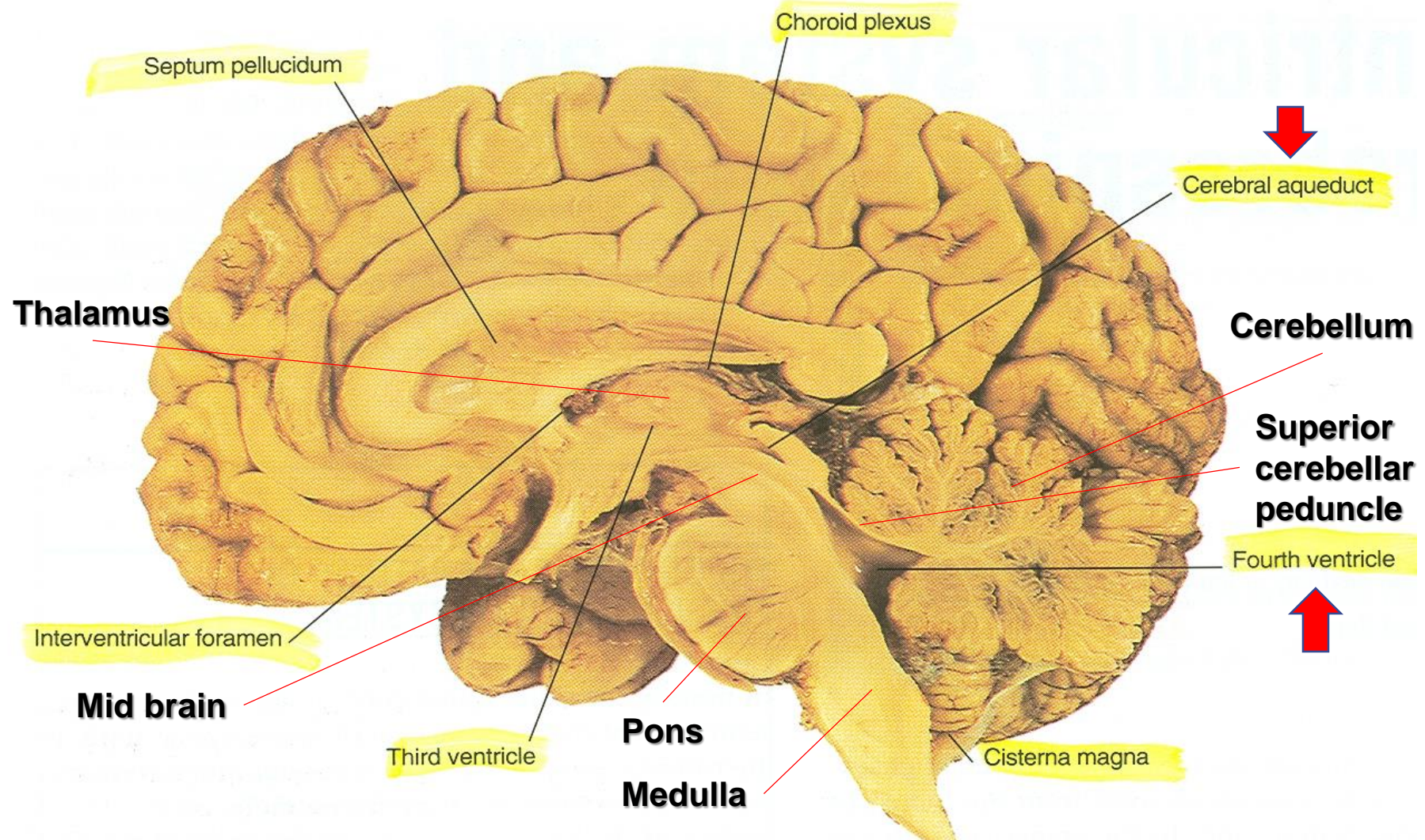


Fig. 1.14 Parasagittal view of the head showing the disposition of the falx and tentorium cerebelli



Sagittal Section Of Brain



Functions of the Brain Stem

1. **Pathway of tracts** between *cerebral cortex & spinal cord* (ascending and descending tracts).
2. **Site of origin of nuclei of cranial nerves** (from 3rd to 12th).
3. **Site of emergence of cranial nerves** (from 3rd to 12th).
4. **Contains** groups of nuclei & related fibers known as **reticular formation*** responsible for: control of level of *consciousness, perception of pain, regulation of cardiovascular & respiratory systems*.

*Complex matrix of nuclei and related fibers/axons

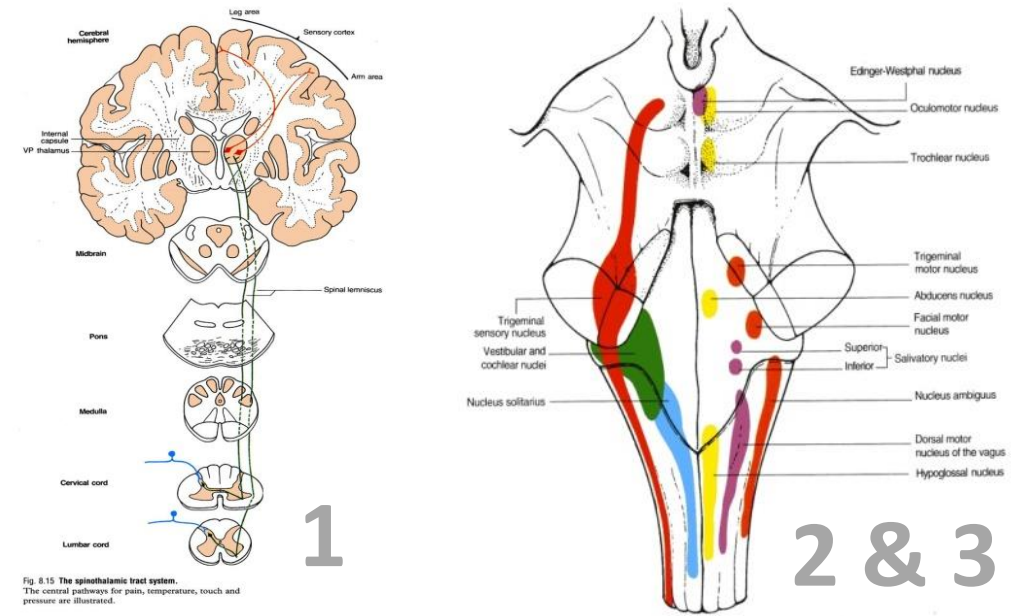
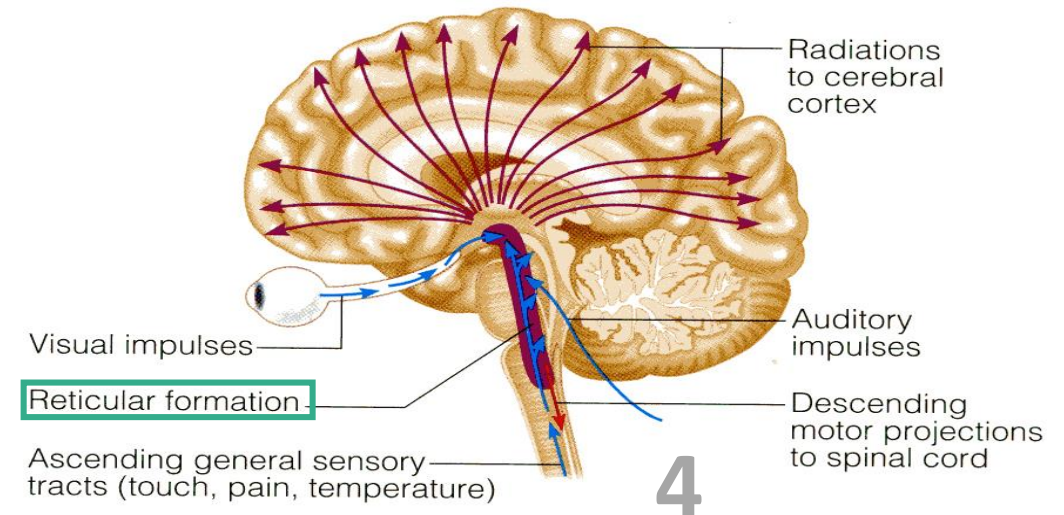
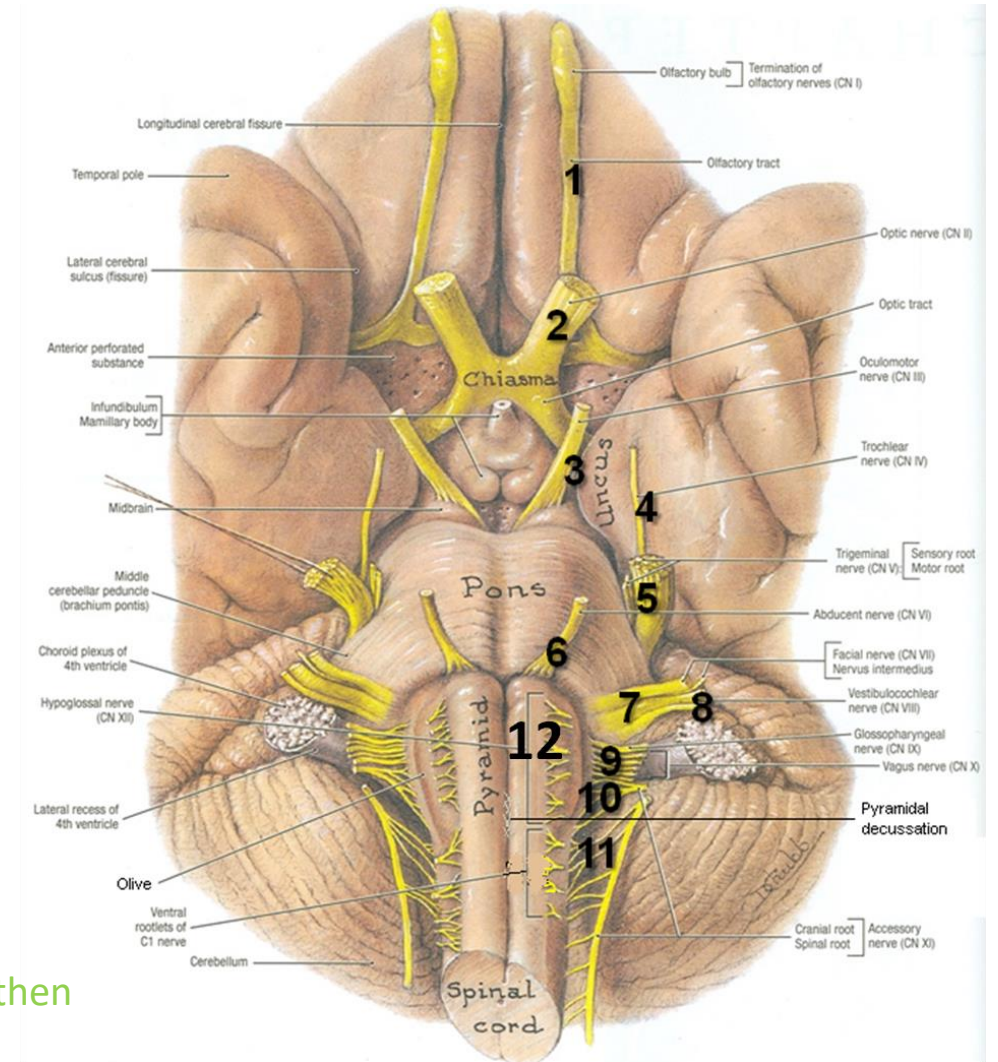
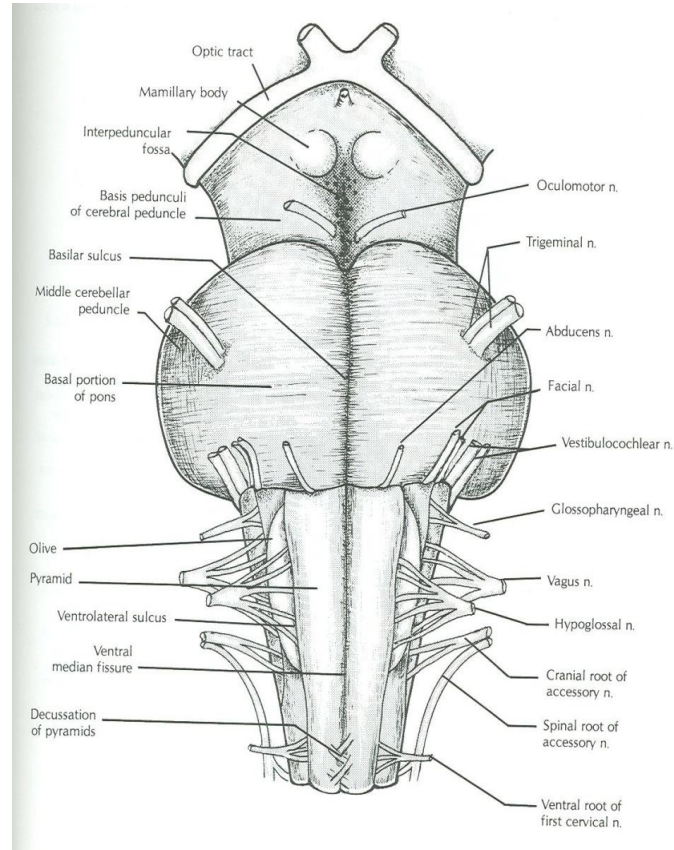
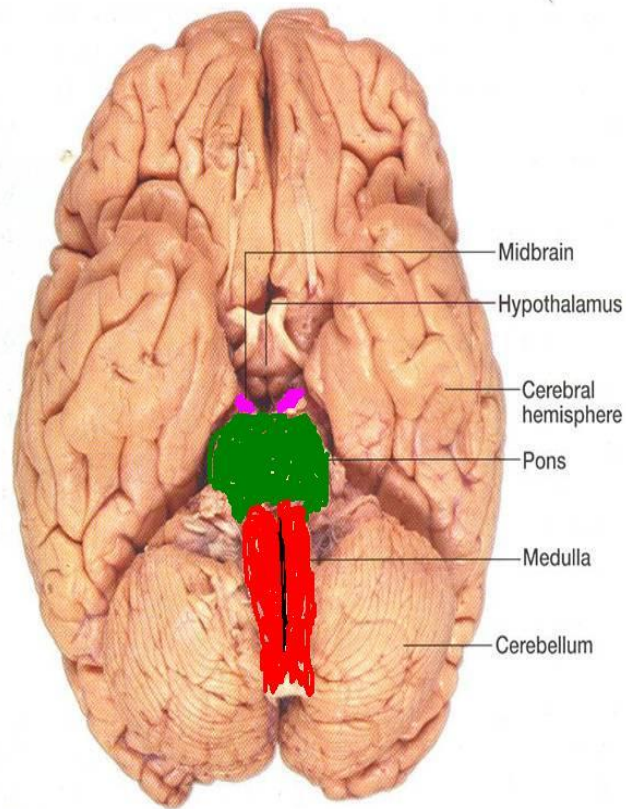


Fig. 8.15 The spinothalamic tract system. The central pathways for pain, temperature, touch and pressure are illustrated.



Brain Stem – Ventral Surface



Outline of the lecture

We will discuss the ventral surface of each part (medulla, pons, midbrain) then we will discuss the dorsal. In each side (ventral/dorsal) we will see the general feature and the nerves coming out.

Note: the numbers refer to the cranial nerves

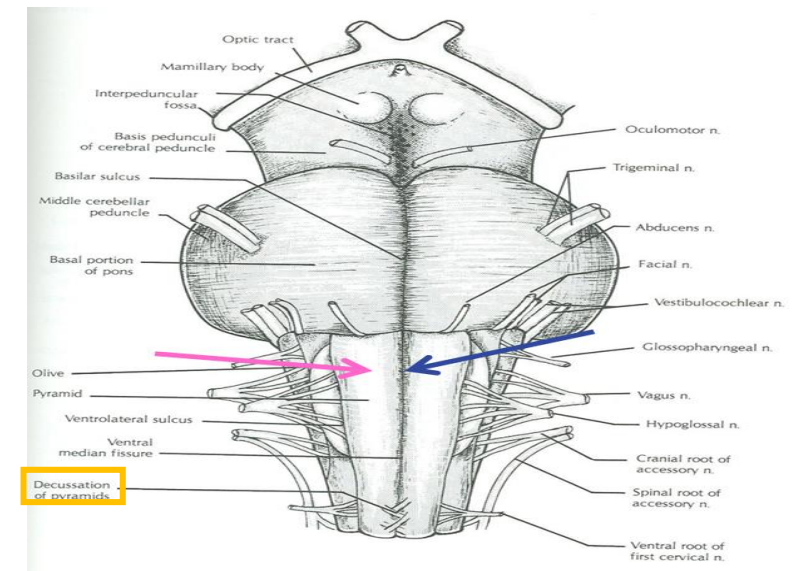
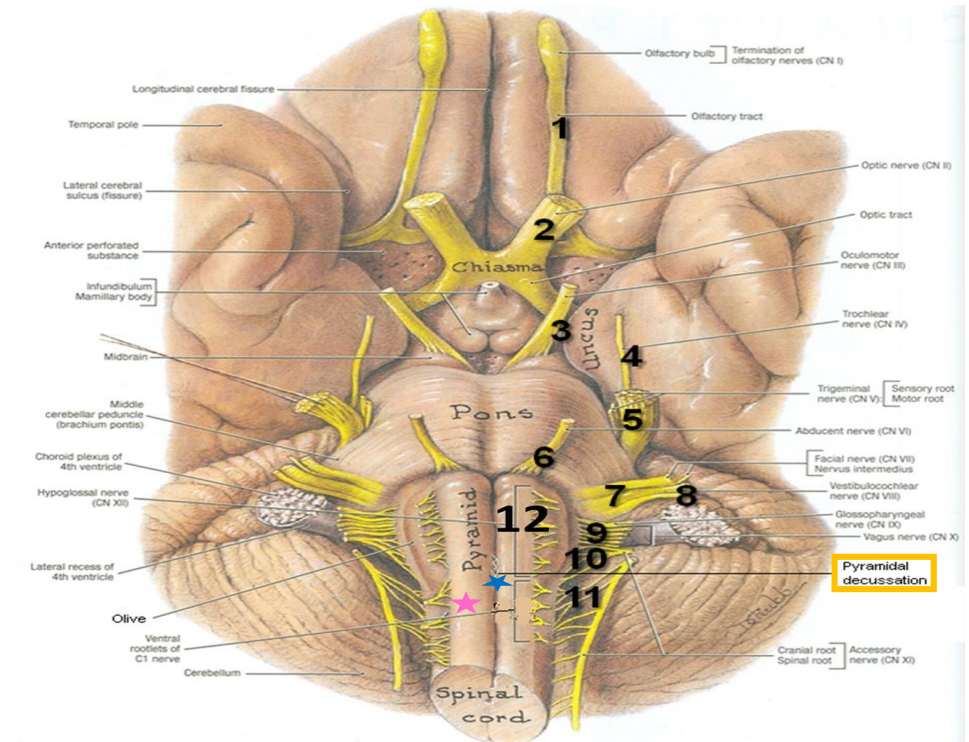
Medulla – Ventral Surface

○ Ventral median fissure:

- Continuation of ventral median fissure of spinal cord.
- Divides the medulla into 2 halves
- Its lower part is marked by decussation of most of pyramidal (corticospinal) fibers (75%-90%).

○ Pyramid:

- An elevation, lies on either (lateral) side of ventral median fissure
- Produced by **corticospinal tract**.



Medulla – Ventral Surface

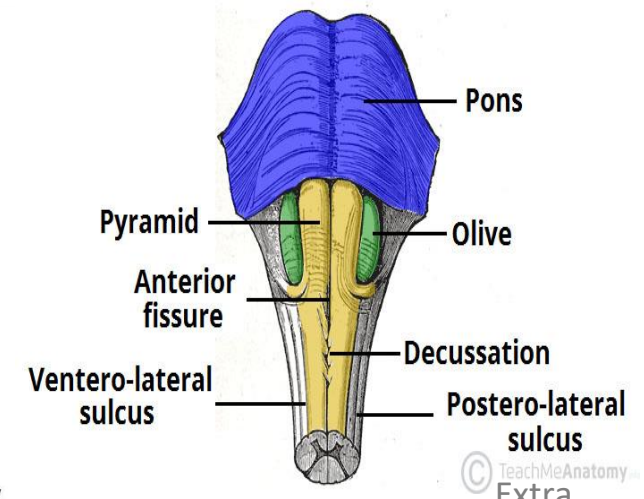
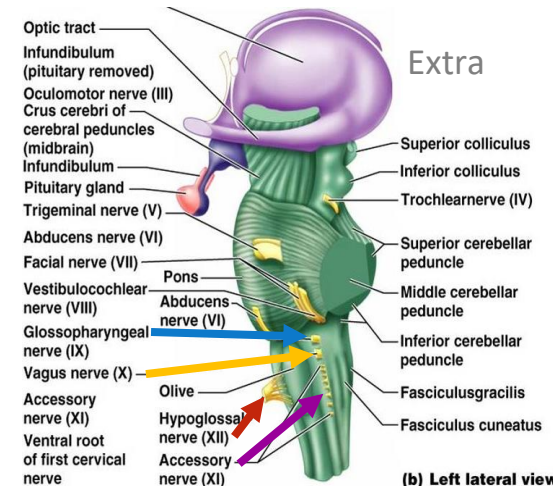
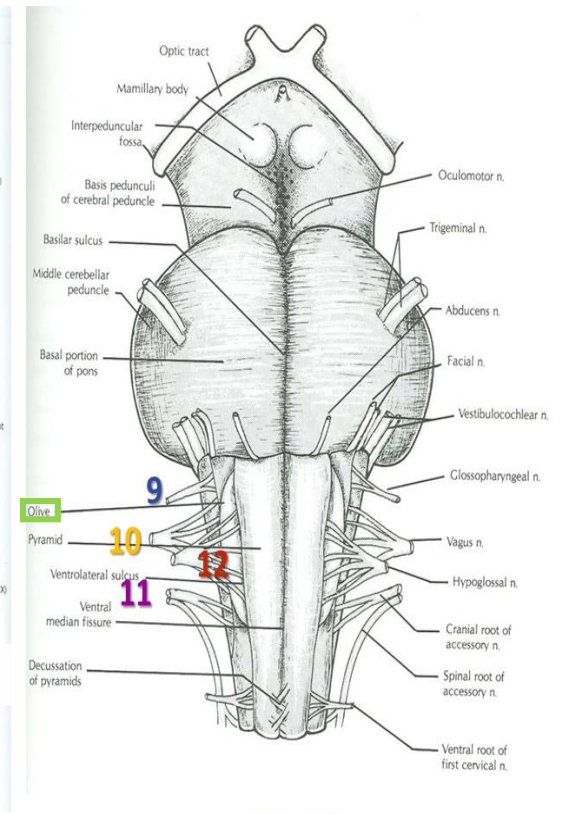
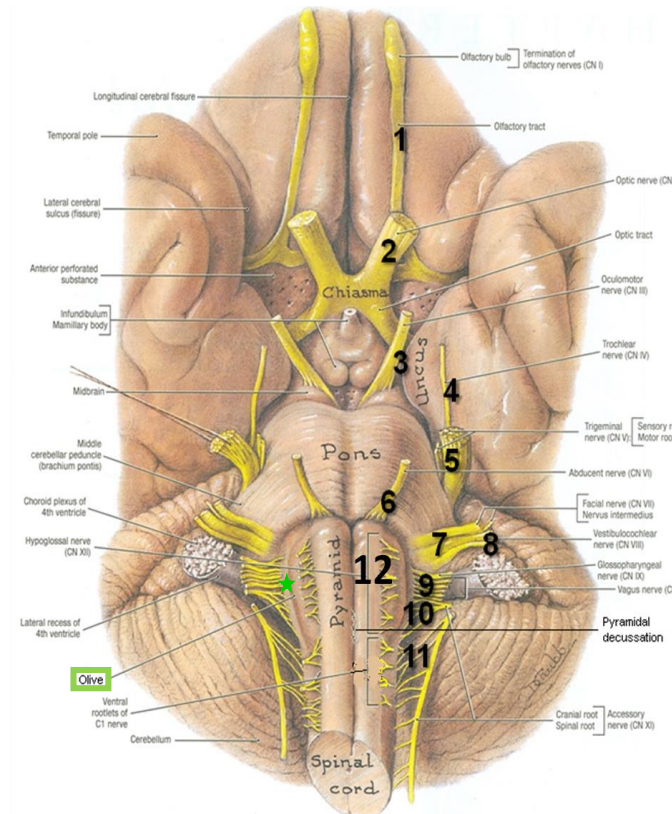
○ Olive:

- An elevation, lies lateral to the pyramid.
- Produced by inferior olivary nucleus* (important in control of movement).

○ *Nerves emerging from Medulla (4 nerves):*

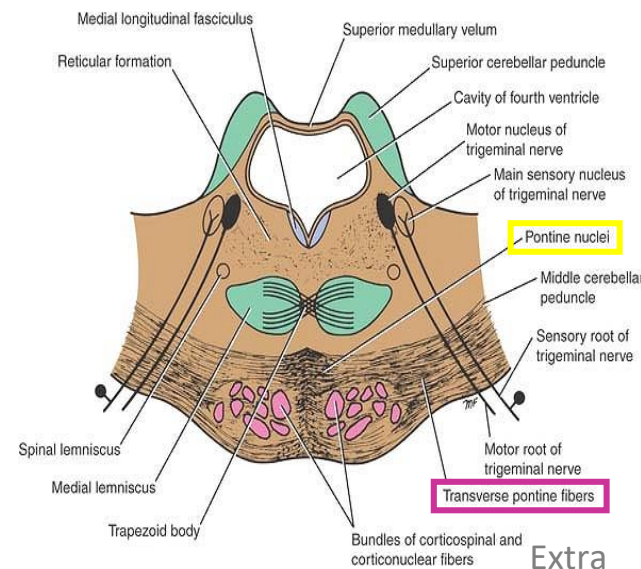
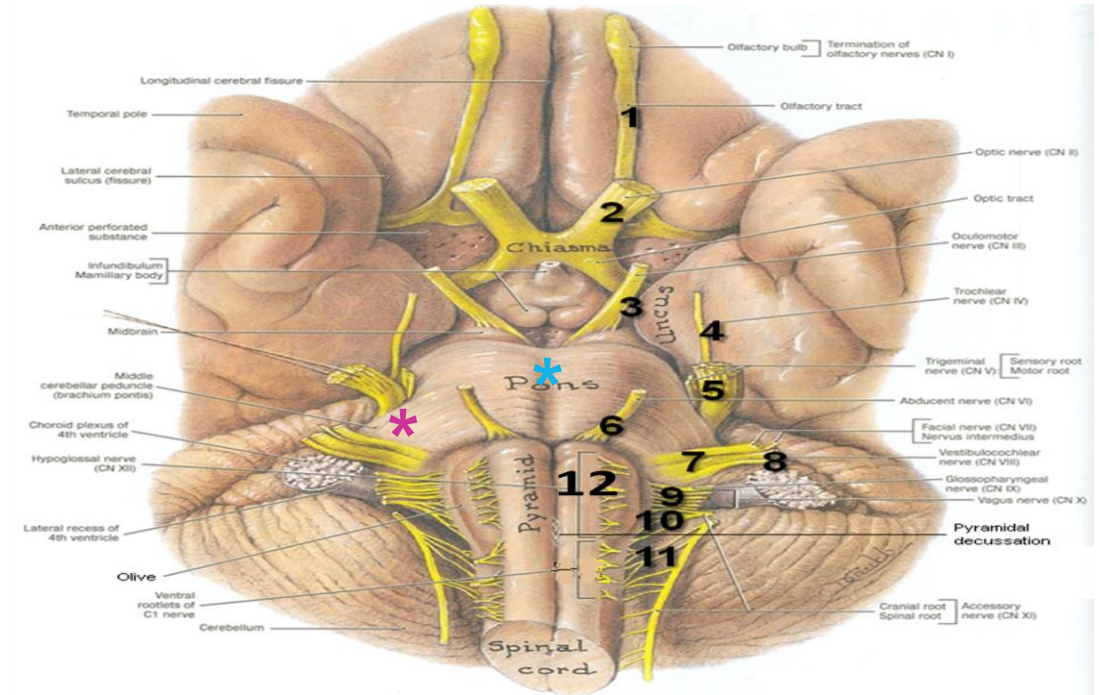
- Hypoglossal (12th): from sulcus between pyramid & olive
- Glossopharyngeal (9th), vagus (10th) & cranial part of accessory (11th): from sulcus dorsolateral to olive (from above downwards)

*Convolved mass of grey matter

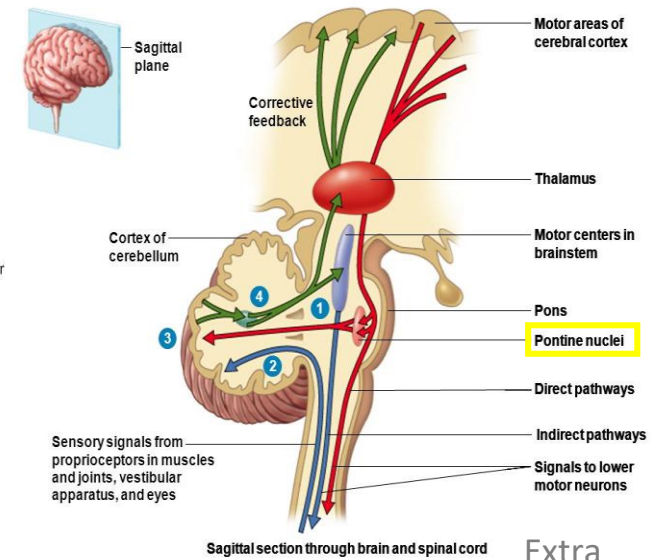


Pons – Ventral Surface

- **Basilar sulcus:**
 - Divides the pons into 2 halves, occupied by **basilar artery**.
- **Transverse pontine (pontocerebellar) fibers:**
 - Originate from **pontine nuclei**,
 - They cross the midline & pass through the contralateral middle cerebellar peduncle to enter the opposite cerebellar hemisphere.



Extra



Extra

Pons – Ventral Surface

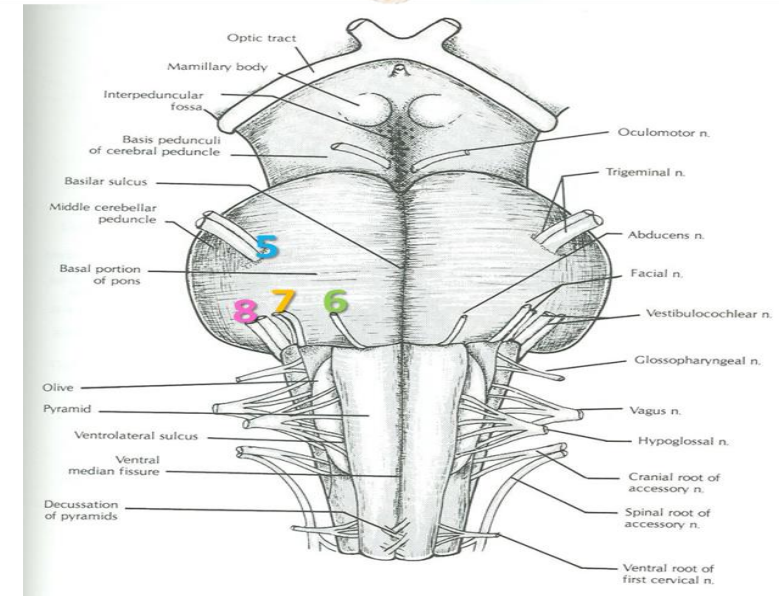
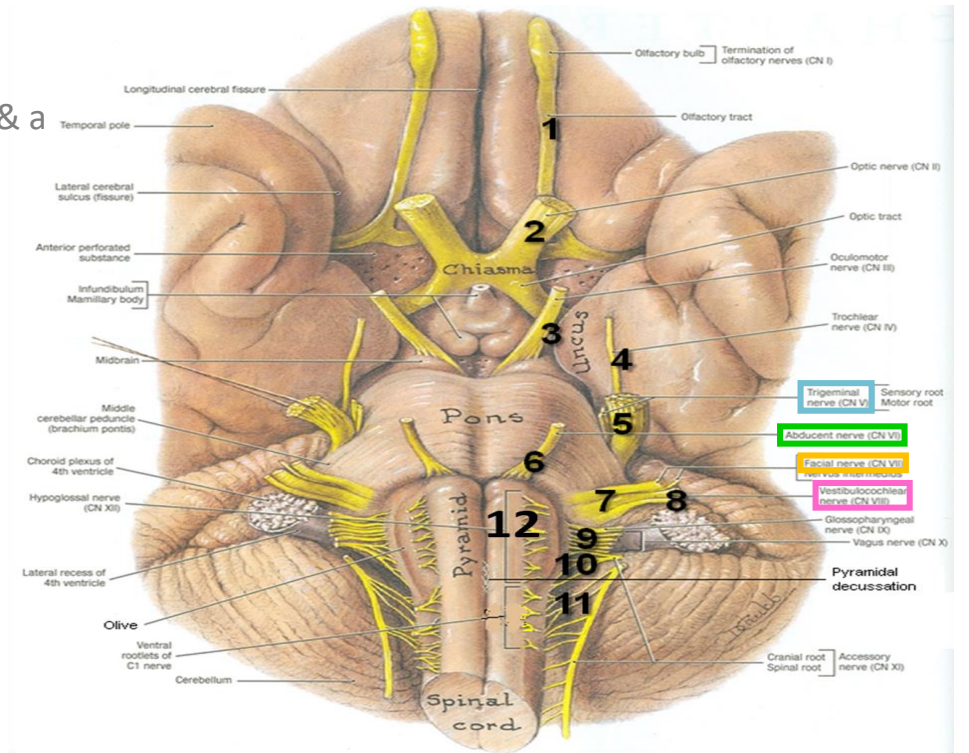
*to remember
small medial motor root & a
large lateral sensory root

○ Nerves emerging from Pons (4 nerves):

- **Trigeminal (5th)**: from the middle of ventrolateral aspect of pons, as 2 roots: a small medial motor root & a large lateral sensory root*.
- **Abducent (6th)**: from sulcus/junction between pons & pyramid.
- **Facial (7th) & Vestibulocochlear (8th)**: at cerebellopontine angle (*junction between medulla, pons & cerebellum*). Both nerves emerge as 2 roots: from *medial to lateral*:

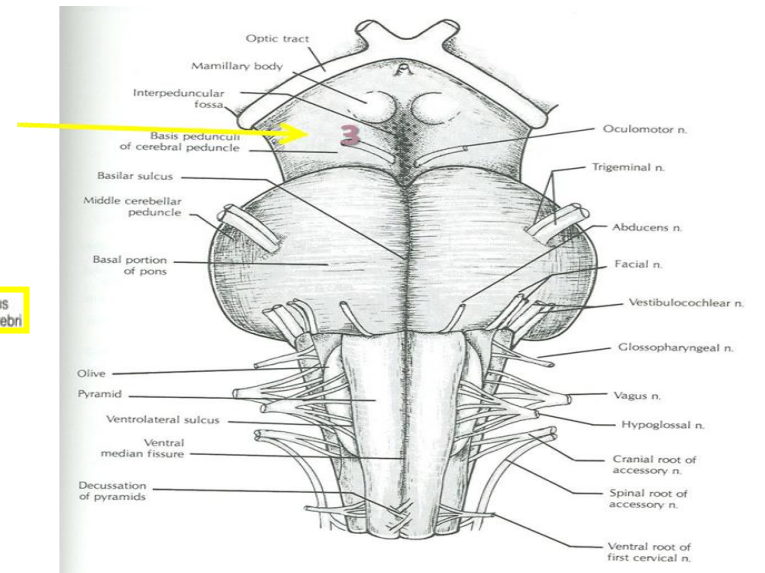
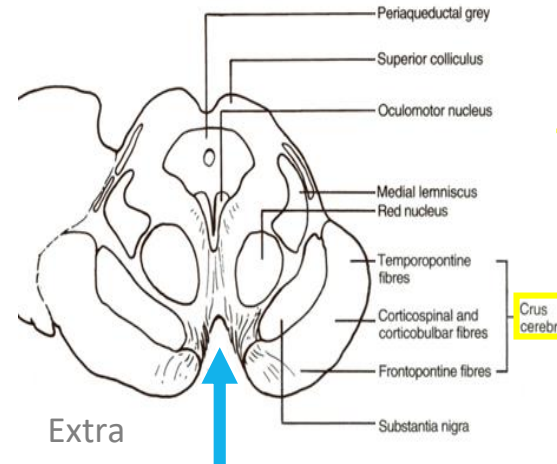
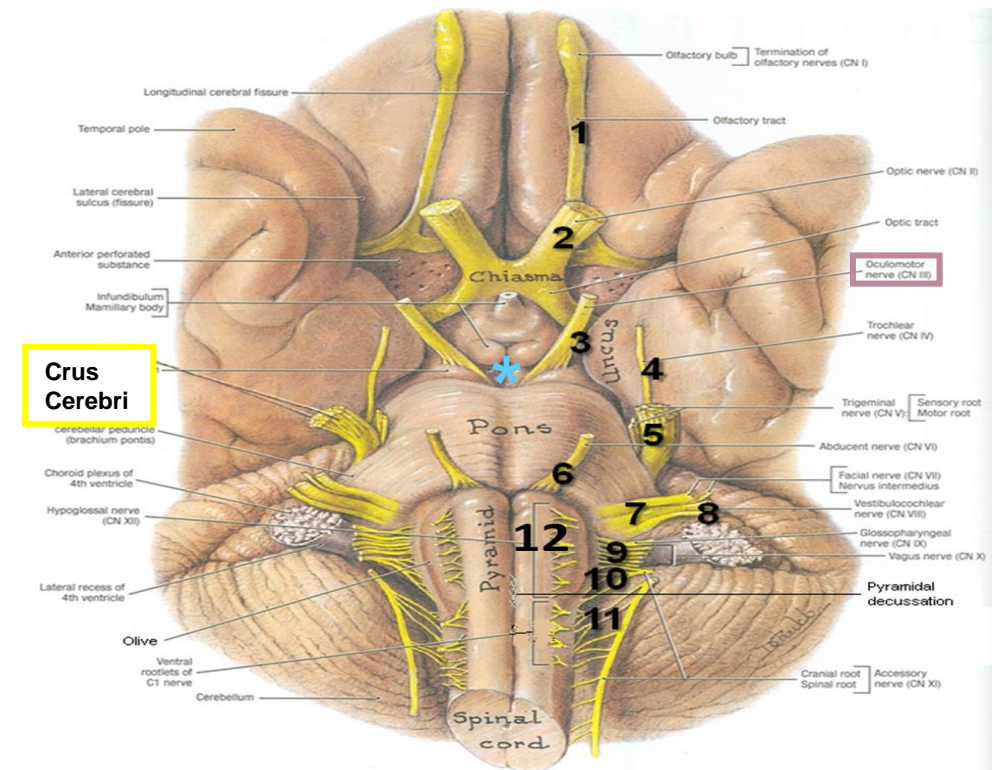
motor root of 7th, sensory root of 7th
vestibular part of 8th & cochlear part of 8th.

Vestibulo 1st since its first
in the name then cochlear



Midbrain – Ventral Surface

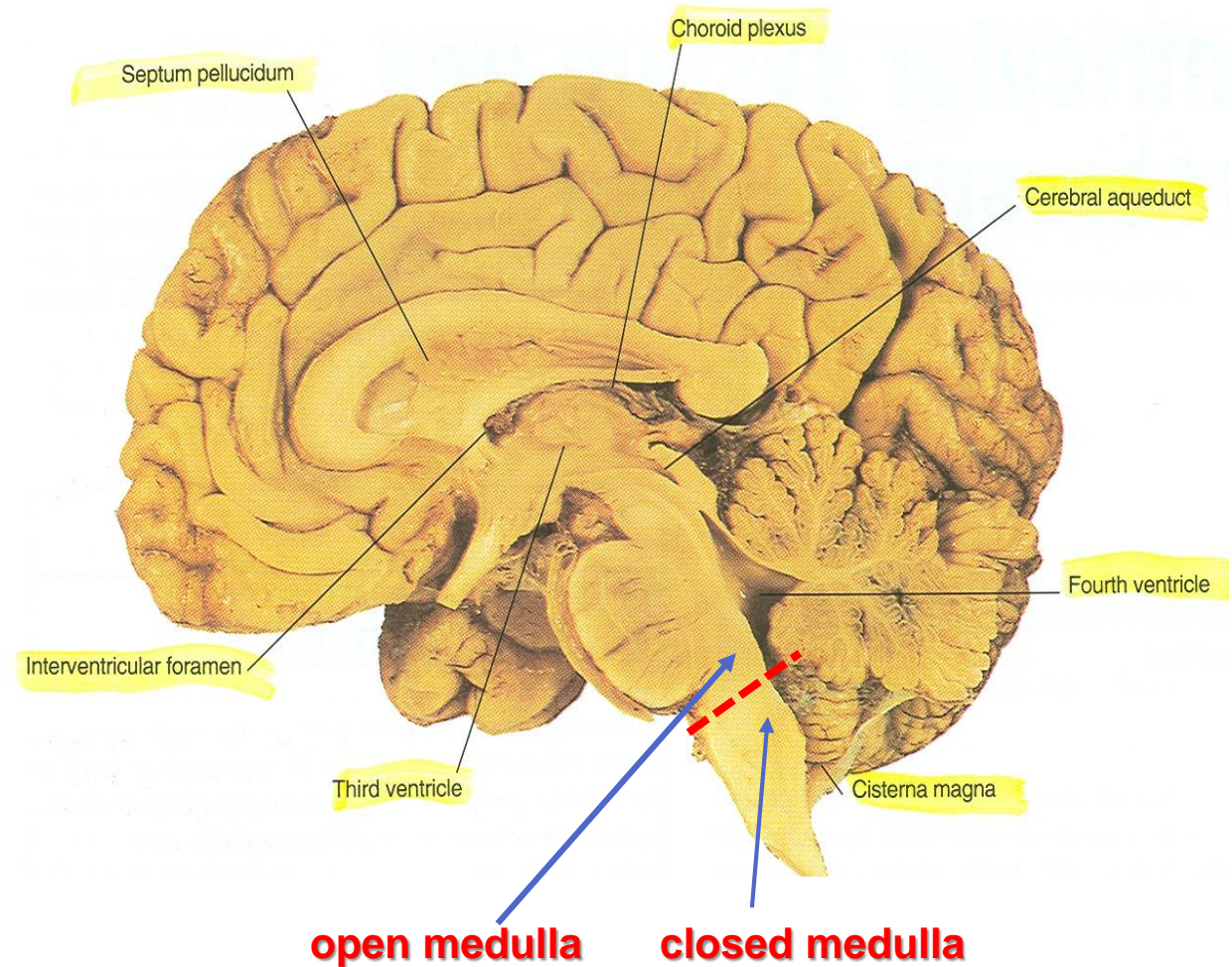
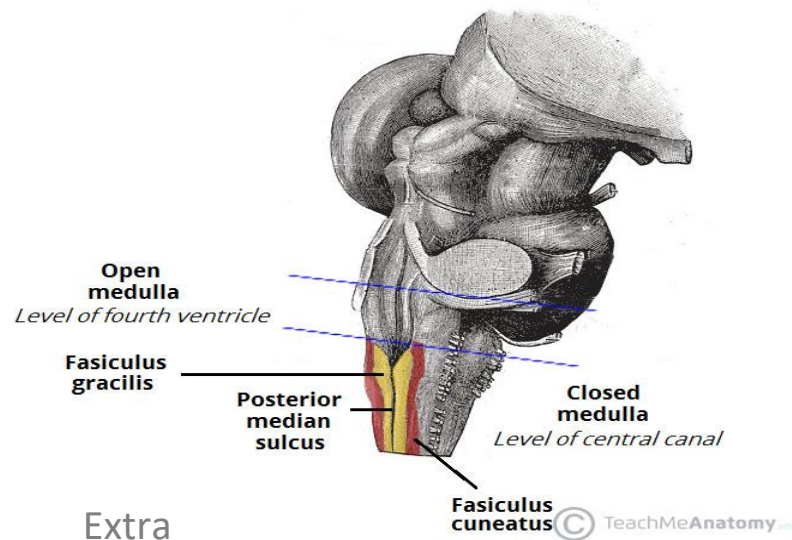
- It is formed of a large column of descending fibers (**crus cerebri or basis pedunculi**), on either side.
- The 2 crura cerebri are separated by a depression called the **interpeduncular fossa**.
- Nerve emerging from Midbrain (one):
 - **Oculomotor (3rd)**: from medial aspect of crus cerebri.



Medulla – Dorsal Surface

- The features differ in the *caudal part (closed medulla)* and the *cranial part (open medulla)*.

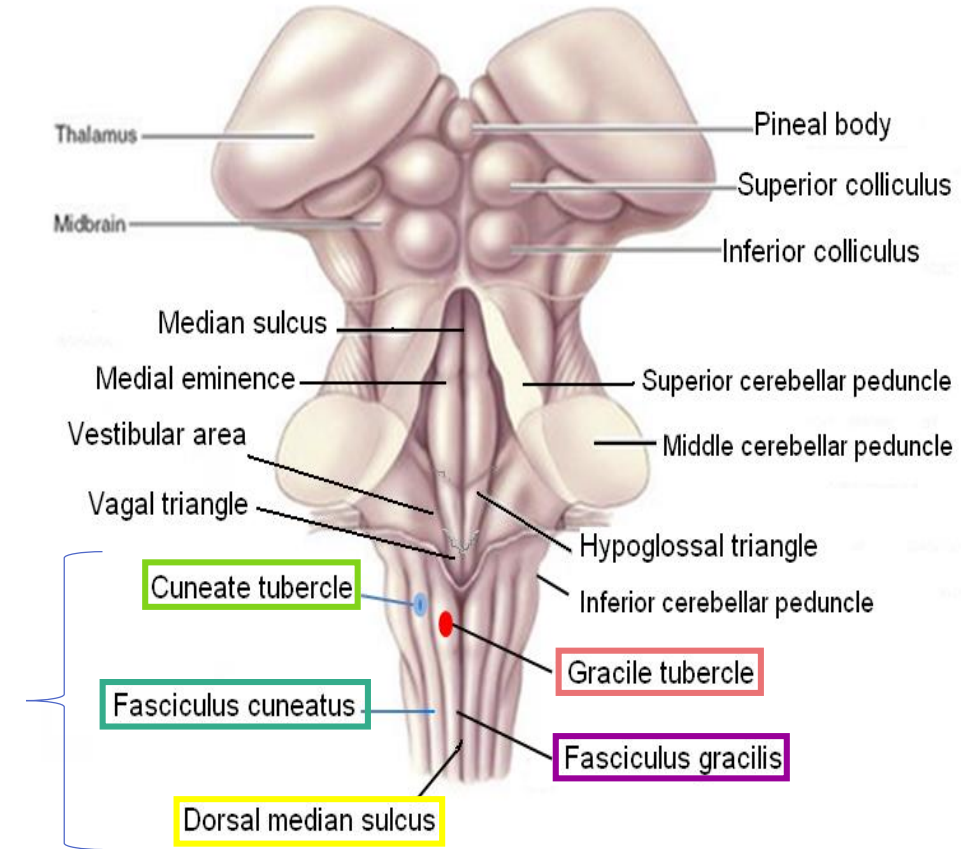
The caudal part closes around the fourth ventricle forming the central canal so it is called closed medulla.



Medulla – Dorsal Surface

Closed Medulla

- *Cavity*: central canal.
- *Composed of*:
 - **Dorsal median sulcus**: divides the closed medulla into 2 halves.
 - **Fasciculus gracilis**: on either side of dorsal median sulcus.
 - **Gracile tubercle**: an elevation produced at the upper part of fasciculus gracilis, marks the site of *gracile nucleus*.
 - **Fasciculus cuneatus**: on either side of fasciculus gracilis.
 - **Cuneate tubercle**: an elevation produced at the upper part of fasciculus cuneatus, marks the site of *cuneate nucleus*.



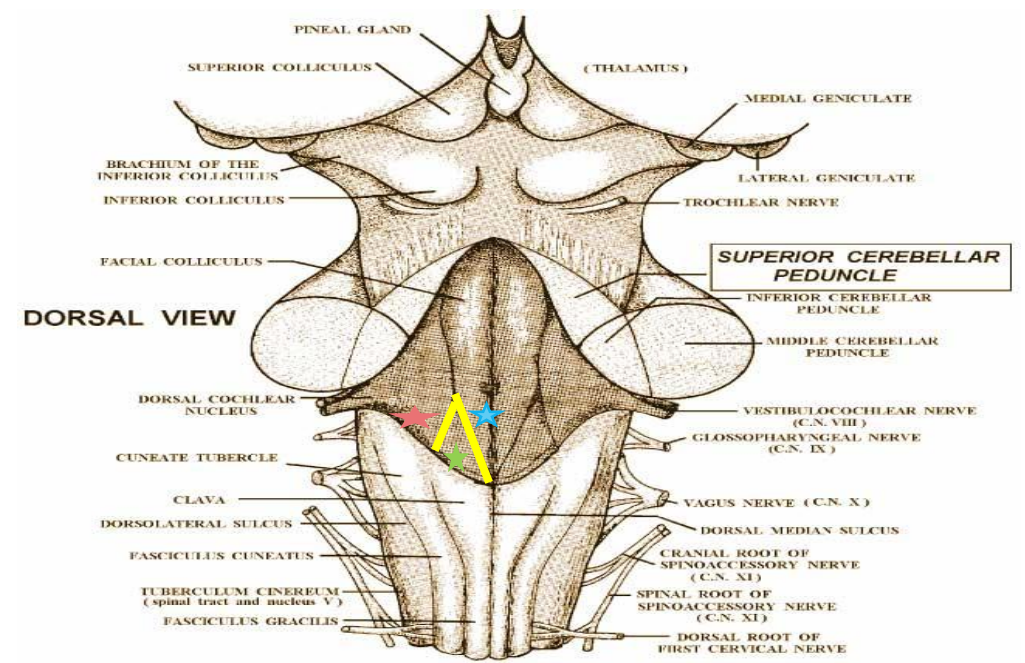
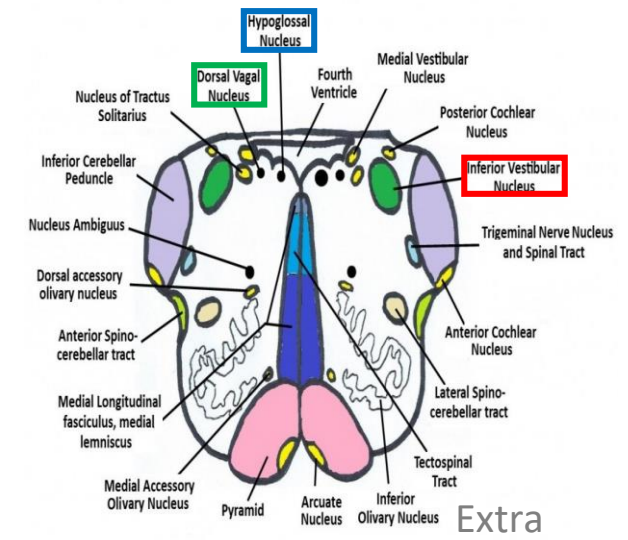
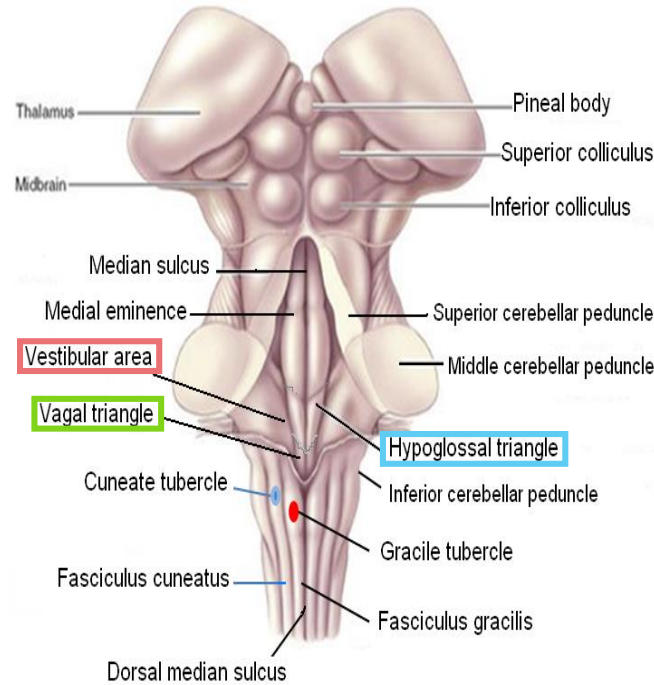
Recall: Fasciculus gracilis and fasciculus cuneatus are ascending tracts in the dorsal white column which terminate on their respective nuclei: gracile nucleus and cuneate nucleus.

Medulla – Dorsal Surface

Open Medulla

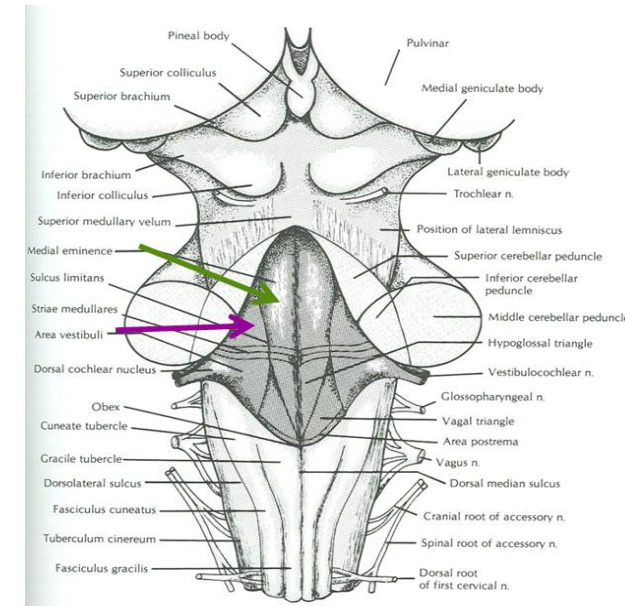
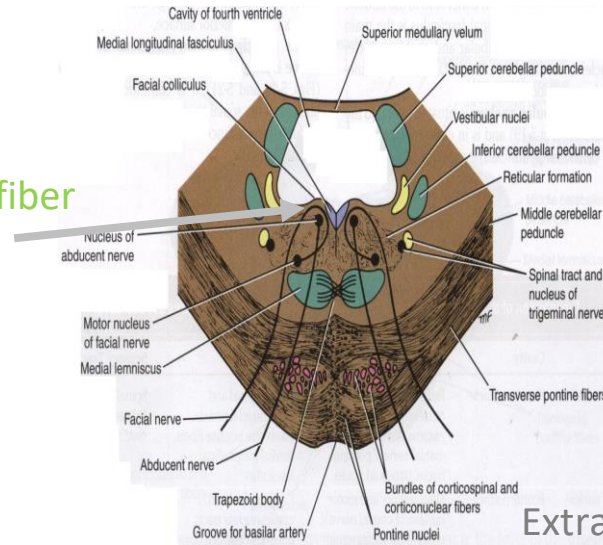
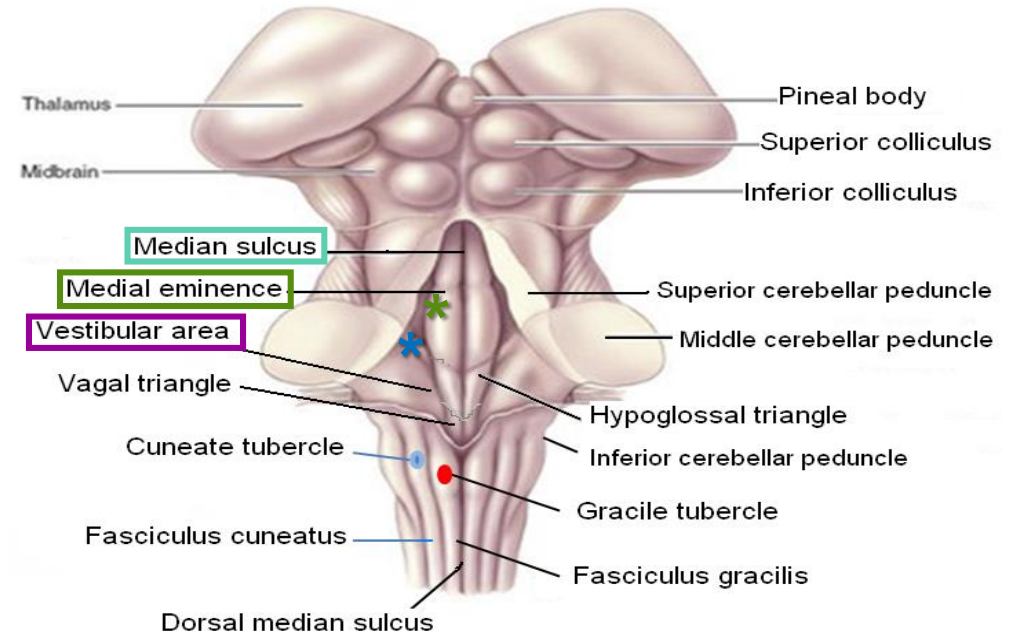
- *Cavity:* 4th ventricle
- On either side, an inverted V-shaped sulcus divides the area into *3 parts* (from medial to lateral):

1. Hypoglossal triangle: overlies hypoglossal nucleus.
2. Vagal triangle: overlies dorsal vagal nucleus.
3. Vestibular area: overlies vestibular nuclei.



Pons – Dorsal Surface

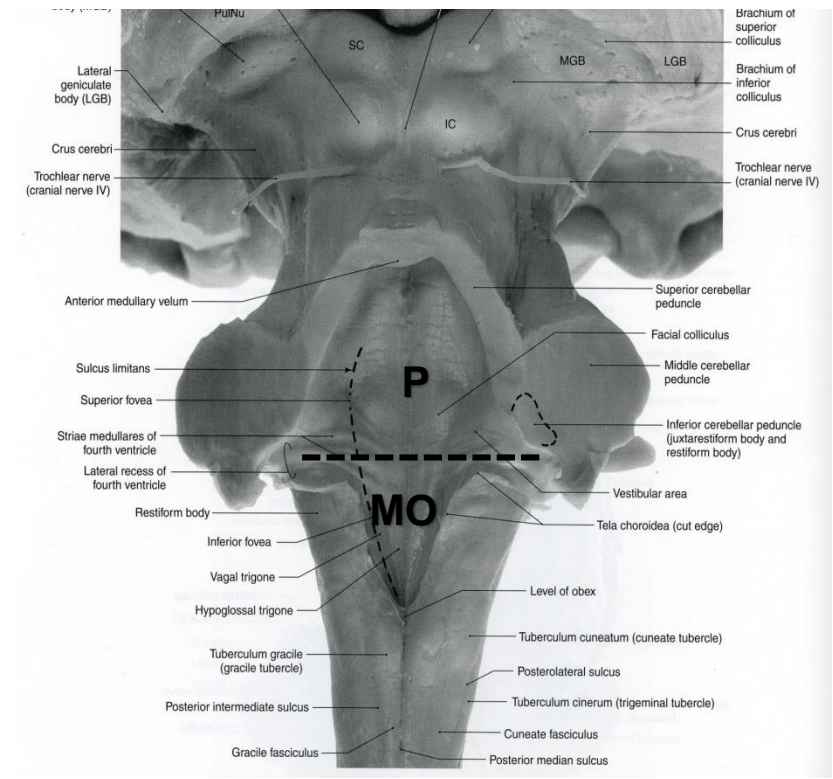
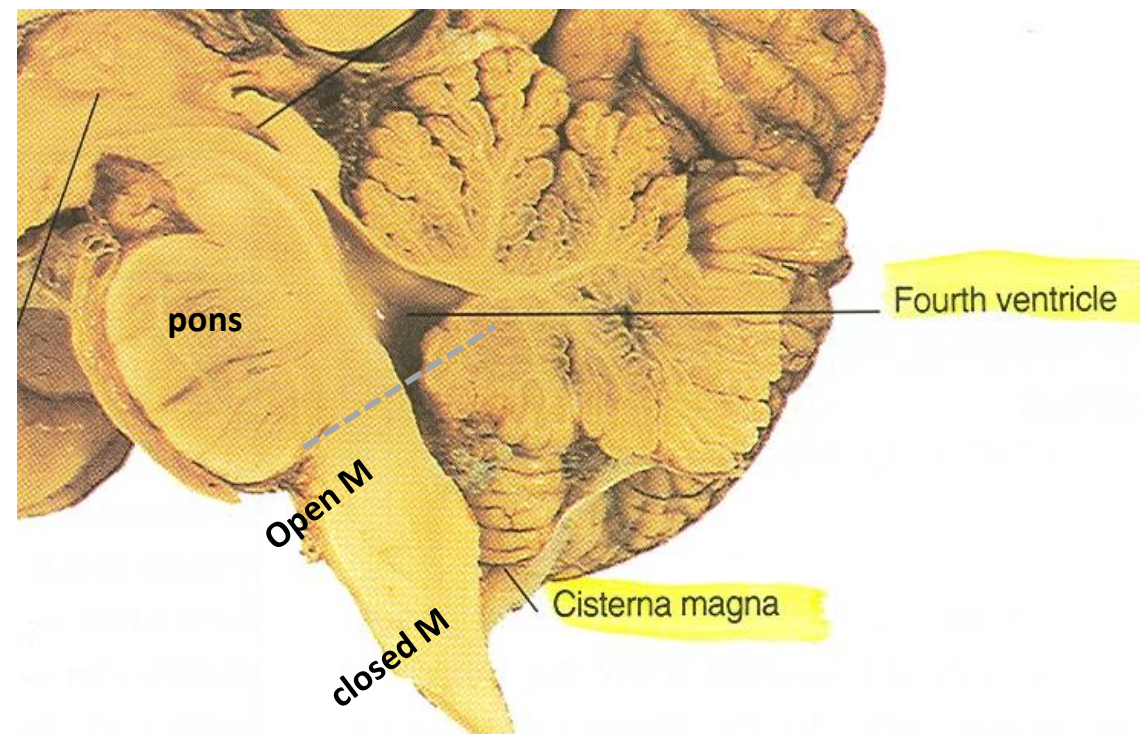
- Separated from open medulla by an *imaginary line* passing between the caudal margins of middle cerebellar peduncle.
- On either side of median sulcus, it divides into 2 parts (from medial to lateral):
 - Medial eminence & facial colliculus: overlies abducent nucleus
The abducent nucleus lies medially, and below it is the fiber of the facial nerve which goes above and around it and forms the facial colliculus.
 - Vestibular area: overlies vestibular nuclei.



- The dorsal surfaces of **open medulla** and **pons** lie in the **caudal 1/3rd** and the **rostral 2/3rd** of the floor of the **4th ventricle** respectively.

Dorsal surface of pons → rostral or cranial 2/3rd of 4th ventricle

Dorsal surface of open medulla → caudal 1/3rd of 4th ventricle



Midbrain – Dorsal Surface

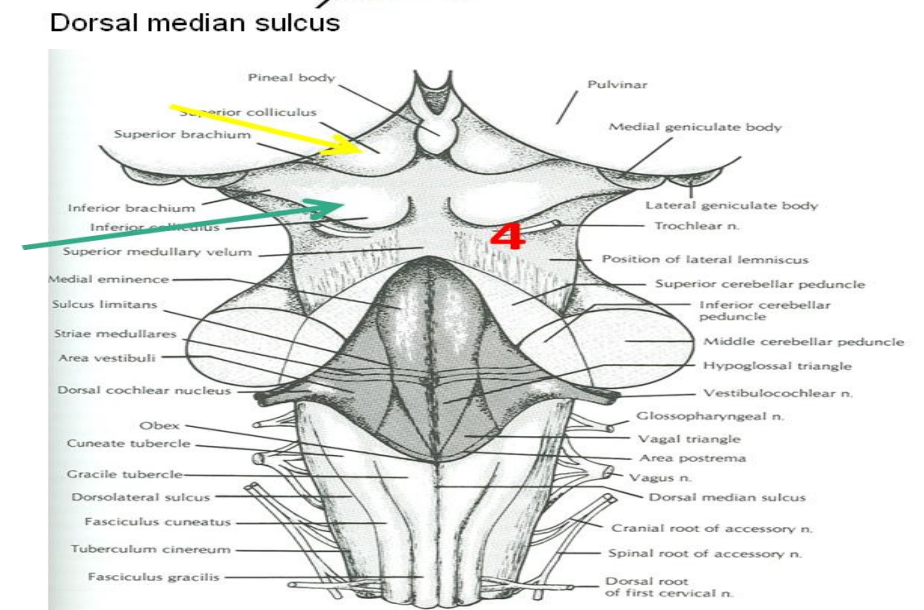
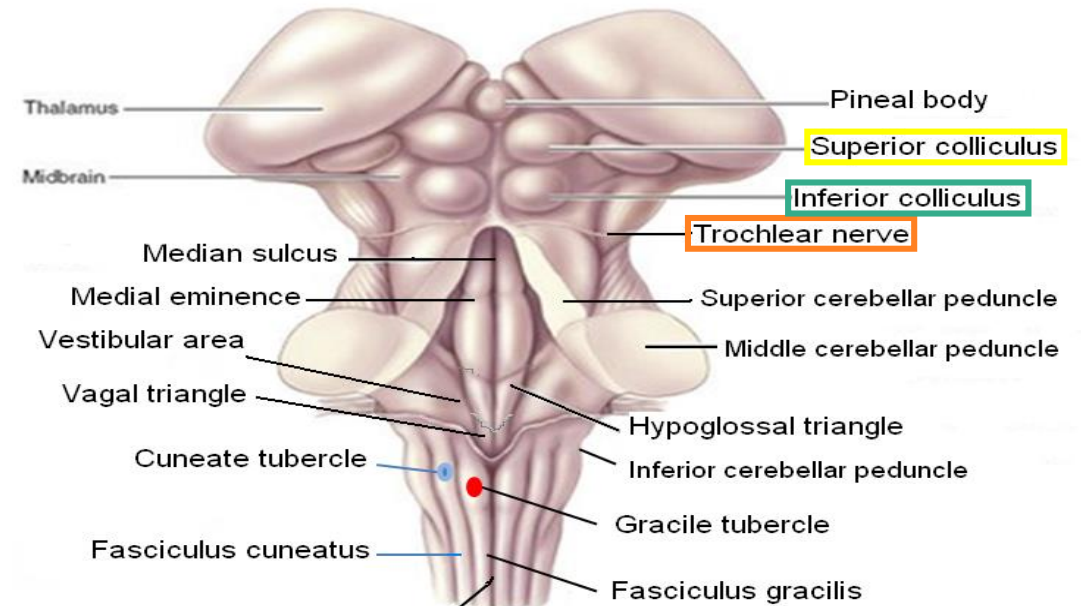
- *Marked by 4 elevations/colliculi:*
 - **Two superior colliculi:** concerned with *visual* reflexes*.
 - **Two inferior colliculi:** forms part of *auditory* pathway.
- *Nerve emerging from Midbrain (one):*
 - **Trochlear (4th):** just caudal to inferior colliculus (The **only cranial nerve** emerging from **dorsal** surface of brain stem, the rest were from the ventral).

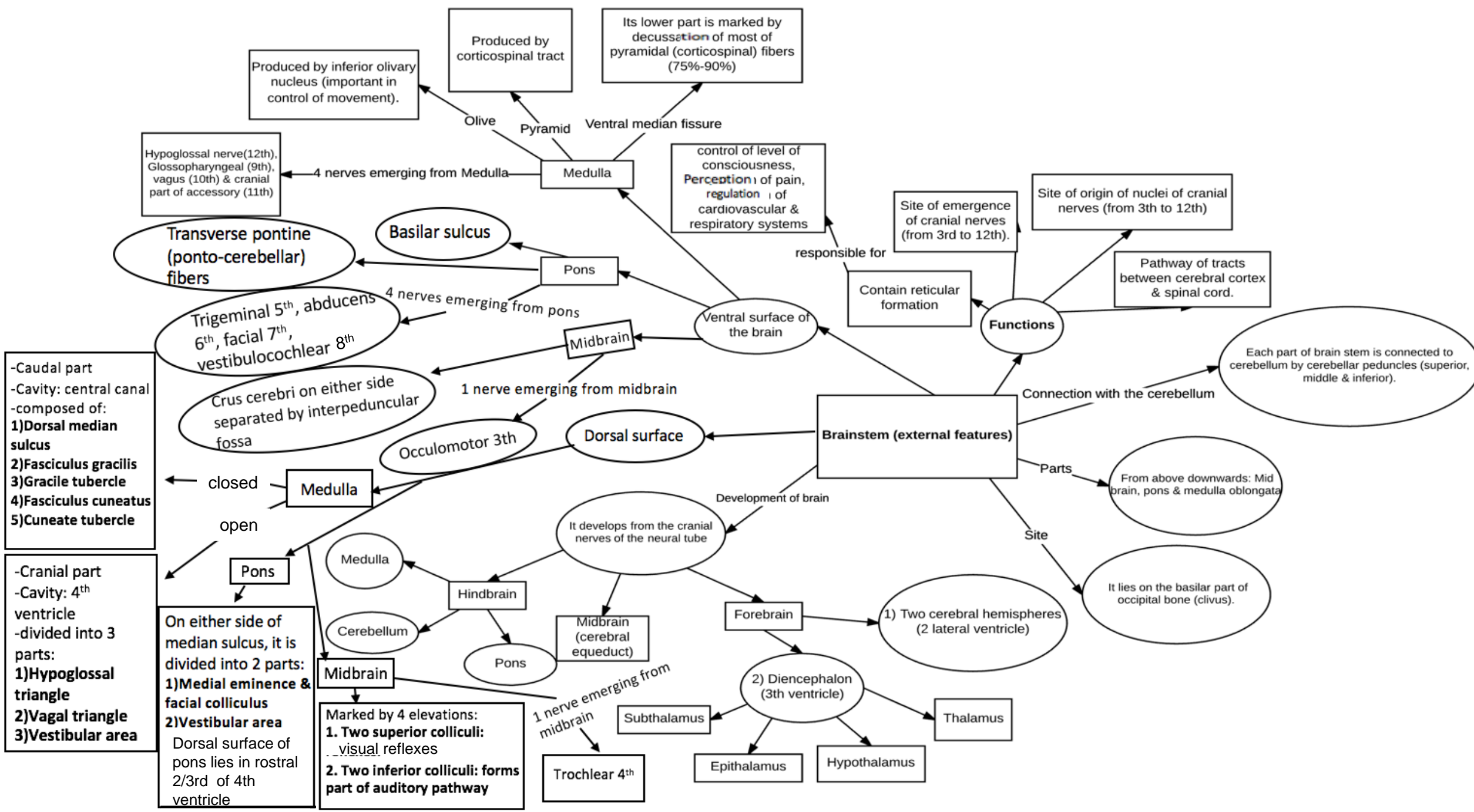
To remember:

The trochlear is the only cranial nerve that emerges from the dorsal / posterior surface.

ترکوه و راء!

*To remember: the superior colliculi is concerned with the eyes (auditory) & the eyes are at the top of the face (superior).





SUMMARY

- The brain stem is composed (from above downwards) of: midbrain, pons & medulla oblongata which are continuous with each other, and with **diencephalon** *above* & with **spinal cord** *below*.
- The brain stem is connected with cerebellum through three pair of **cerebellar peduncles**.
- The brain stem is the site of (1) cranial nuclei, (2) the pathway of important ascending & descending tracts & (3) the site of emergence of cranial nerves (from **3rd** to **12th**).
- Cranial nerves (**with the exception of 4th**) emerge from ventral surface of brain stem.

MCQs

1. The trigeminal nerve emerge from the aspect of pons.

- A- Ventrolateral
- B- Ventromedial
- C- Dorsolateral
- D- Dorsomedial

Answer: A

2. This cranial nerve exits from the dorsal side of the brain:

- A- CN 1
- B- CN 2
- C- CN 3
- D- CN 4

Answer: D

3. The brainstem is the site of origin and emergence of the following cranial nerves:

- A- All cranial nerves
- B- From 3rd to 12th
- C- From 1st to 10th
- D- 7th nerve only

Answer: B

4. Nucleus of cranial nerve 3 is located in:

- A- Intramedullary fossa
- B- Pons
- C- Midbrain
- D- Spinal coed

Answer: C

5. The part of medulla is marked by decussation of most of fibers.

- A- Middle, corticobulbar
- B- Lower, corticospinal
- C- Upper, corticospinal
- D- Lower, corticobulbar

Answer: B

6. The cranial nerves originating from the cerebellopontine angle are:

- A- 6th and 3rd
- B- Trochlear nerve
- C- 7th and 8th
- D- None of the above

Answer: C

7. Basilar sulcus of the pons is occupied by:

- A- Basilar vein
- B- Basilar artery
- C- Basilar nerve
- D- Basilar nucleus

Answer: B

8. Cranial nerve 4 is located inferior to what landmark?

- A- Lateral colliculus
- B- Medial colliculus
- C- Superior colliculus
- D- Inferior colliculus

Answer: D

SAQs

1. Describe the pathway of the pontocerebellar fibers:

Originate from pontine nuclei → cross the midline and pass through the contralateral middle cerebellar peduncle → enter the opposite cerebellar hemisphere.

2. Mention the cavities located in the following structures: forebrain, midbrain, and hindbrain:

Forebrain: cerebral hemispheres → 2 lateral ventricles, Diencephalon → 3rd ventricle

Midbrain: cerebral aqueduct

Hindbrain: 4th ventricle

