MED437
KING SAUD UNIVERSITY

ANATOMY
Team 437

External structure of the Brainstem

Lecture (5)

- Important
- Doctors Notes
- Notes/Extra explanation

Please check our Editing File

هذا العمل مبني بشكل أساسي على عمل دفعة ٤٣٦ مع المراجعة والتدقيق وإضافة الملاحظات ولا يغني عن المصدر الأساسي للمذاكرة

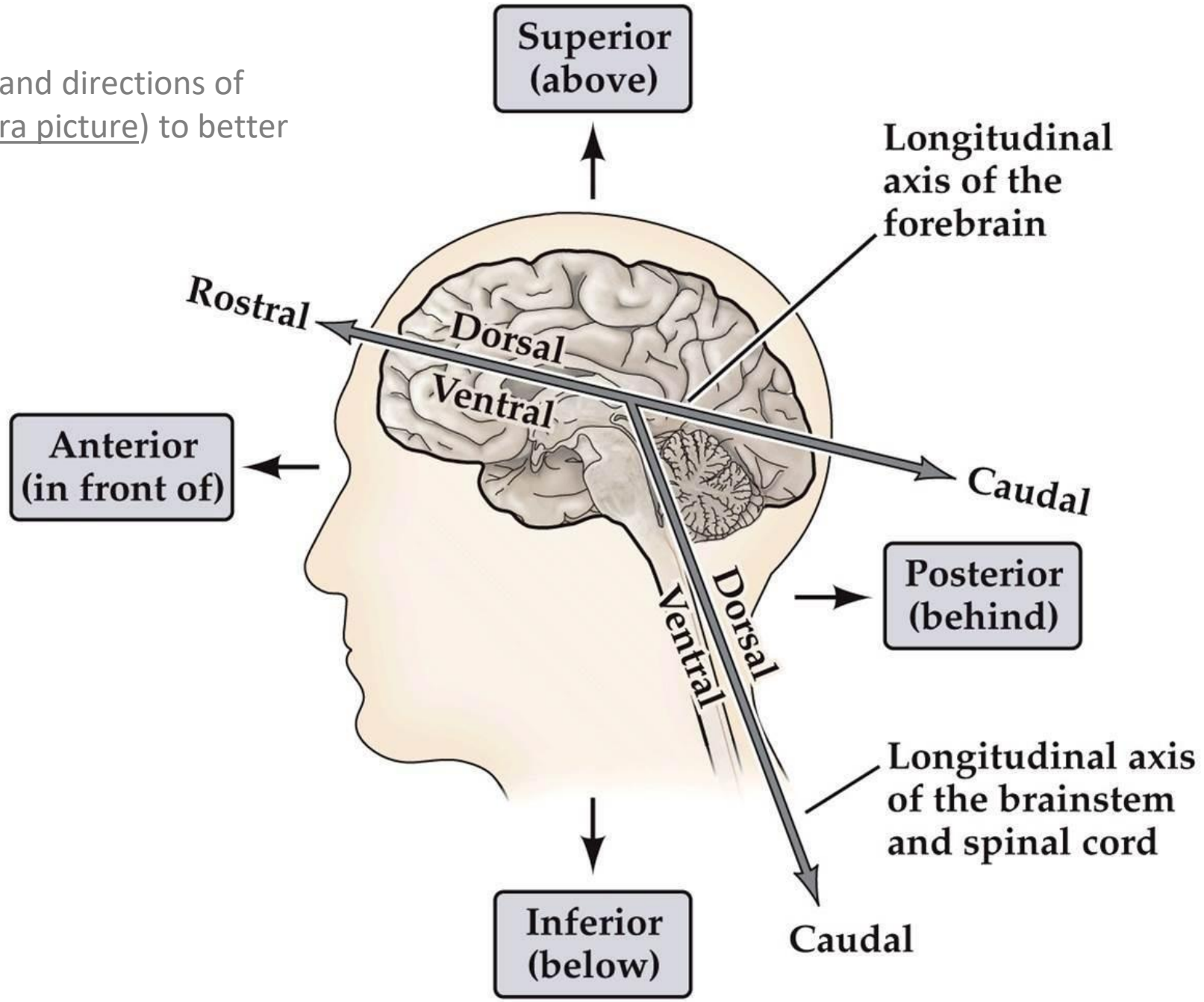
{وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ}

Objectives

At the end of the lecture, students should be able to:

- ✓ 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.

*Anatomical plane and directions of neuroanatomy (Extra picture) to better understand



Development of the Brain

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

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

	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.

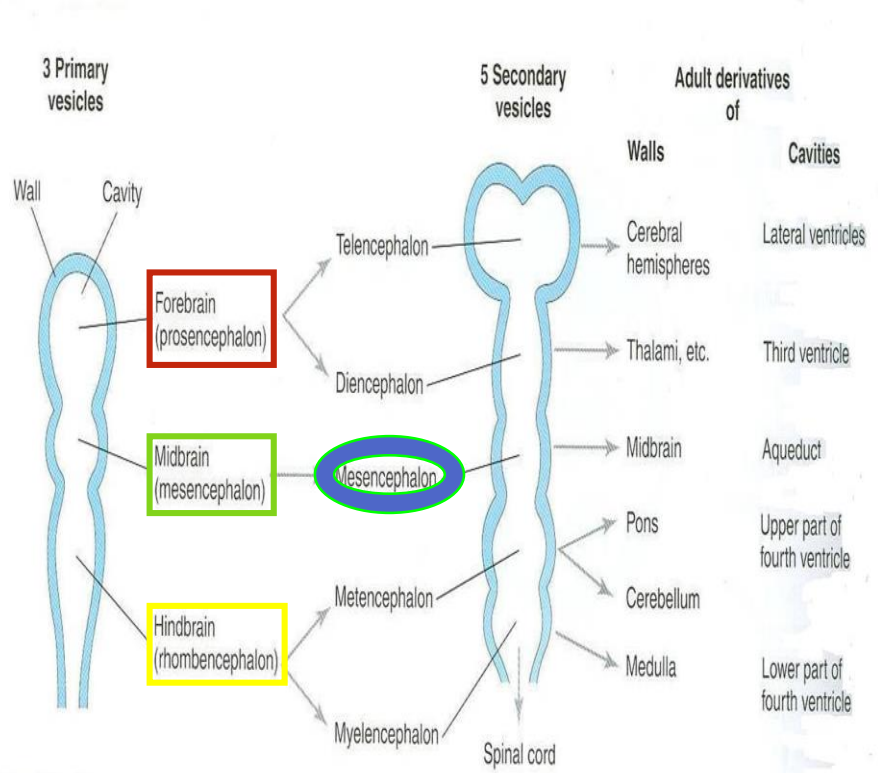
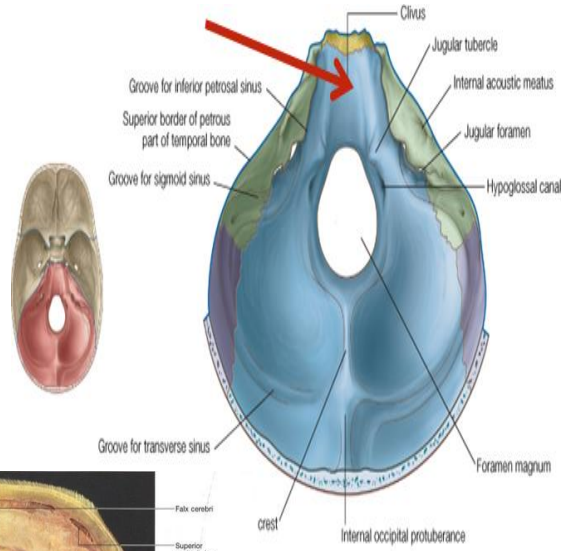


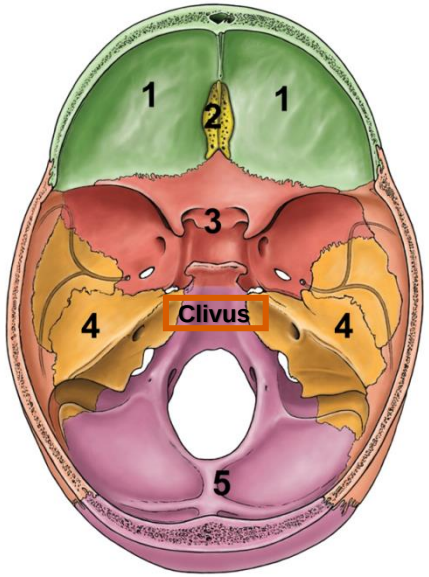
Figure 18-20. Diagrammatic sketches of the brain vesicles, indicating the adult derivatives of their walls and cavities. *The rostral part of the third ventricle forms from the cavity of the telencephalon; most of this ventricle is derived from the cavity of the diencephalon.

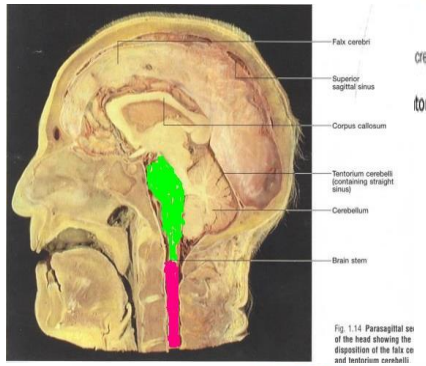
Brain stem

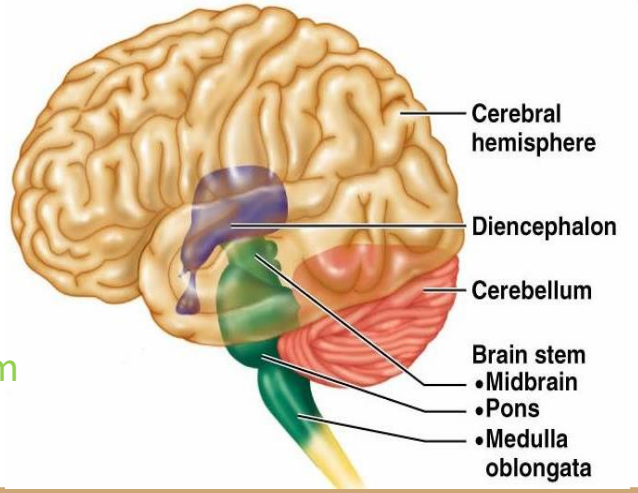
01:58

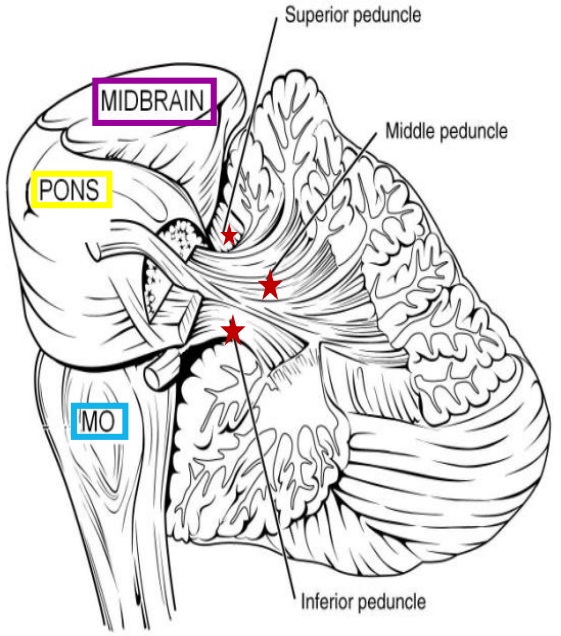
- The brainstem is the region of the brain that connects the **cerebrum** with the **spinal cord**
- SITE:
  It lies on the basilar part of occipital bone (**clivus**).
- PARTS: From above downwards:
  Mid brain, pons & medulla oblongata
- CONNECTIONS WITH CEREBELLUM:
  Each part of brain stem is connected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







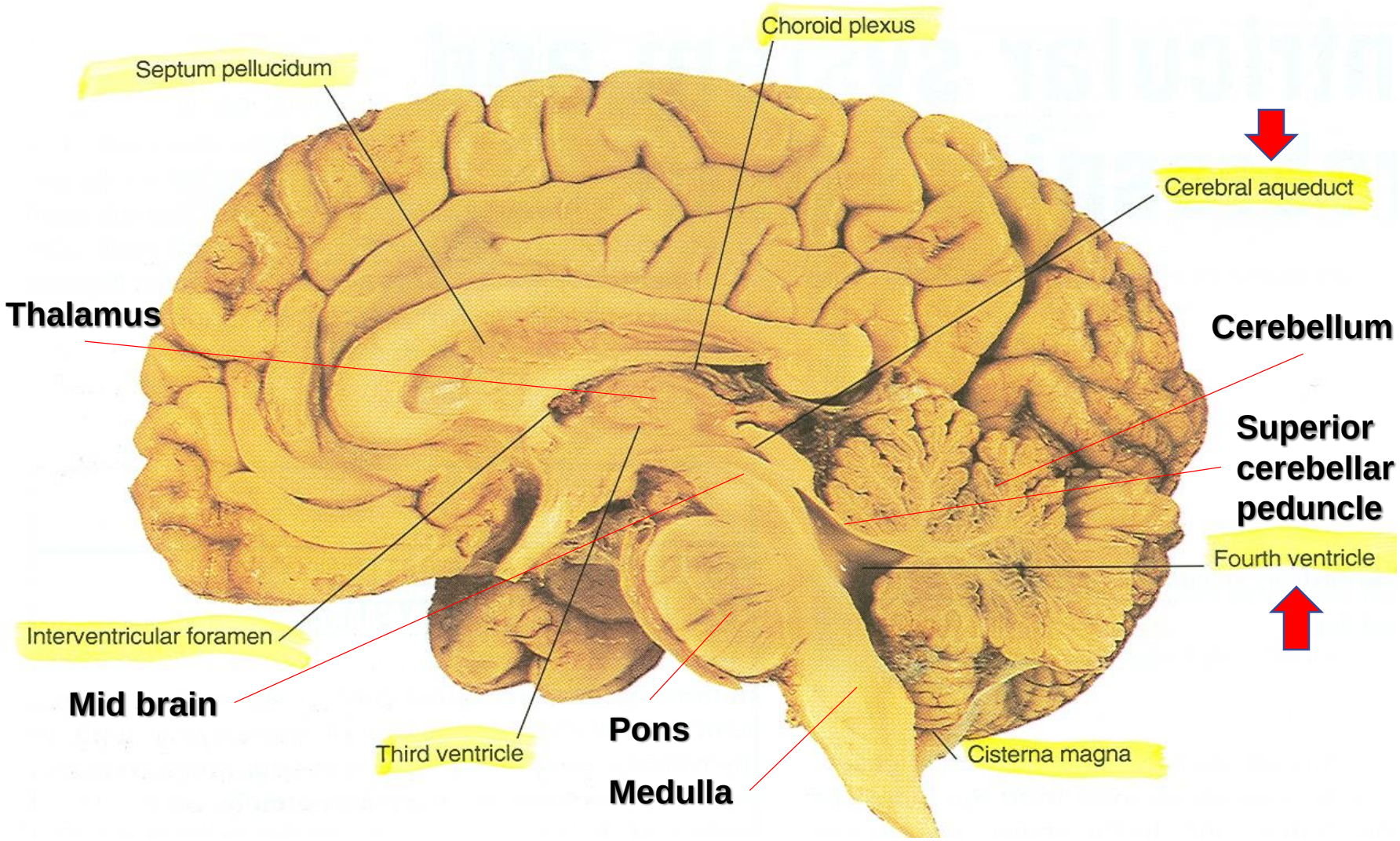




Superior peduncle connects **midbrain** with cerebellum
Middle peduncle connects **pons** with cerebellum
Inferior peduncle connects **medulla oblongata** with cerebellum

Only on the boy's slides

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 located throughout the brain stem

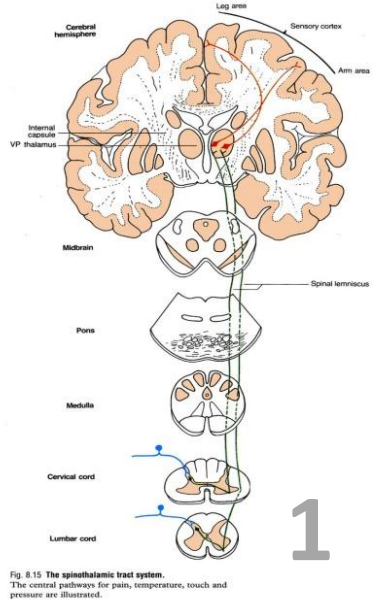
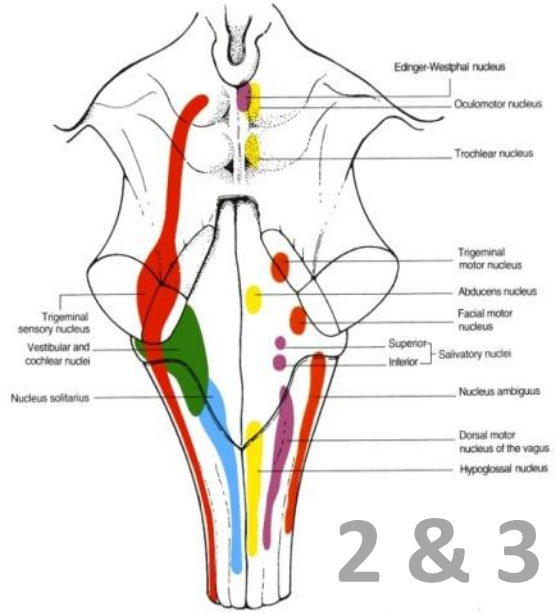


Fig. 8.15 **The spinothalamic tract system.** The central pathways for pain, temperature, touch and pressure are illustrated.

1



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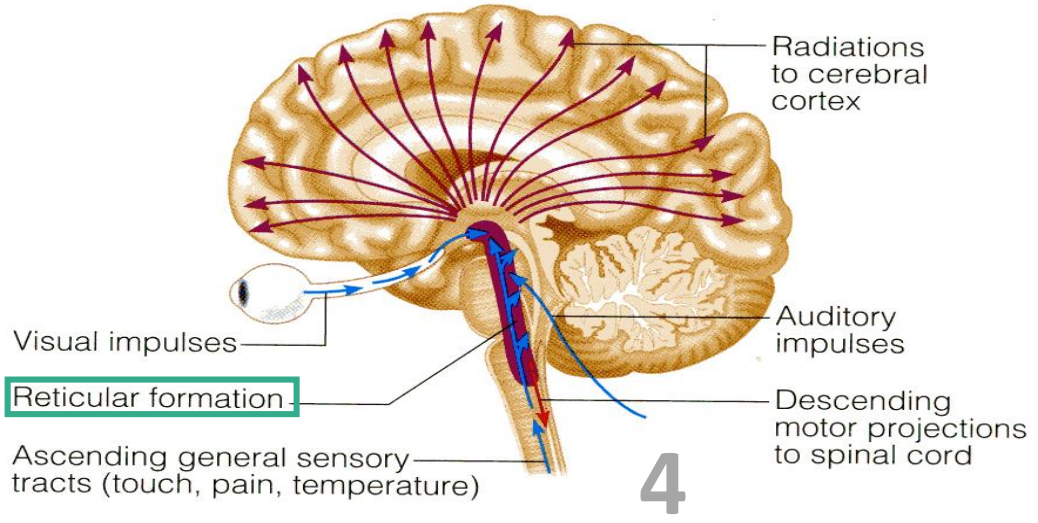

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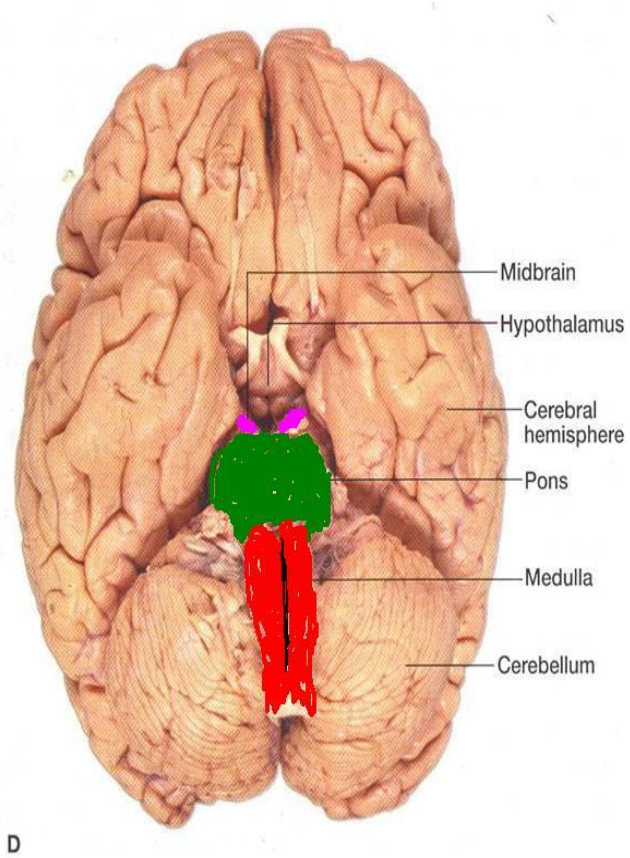
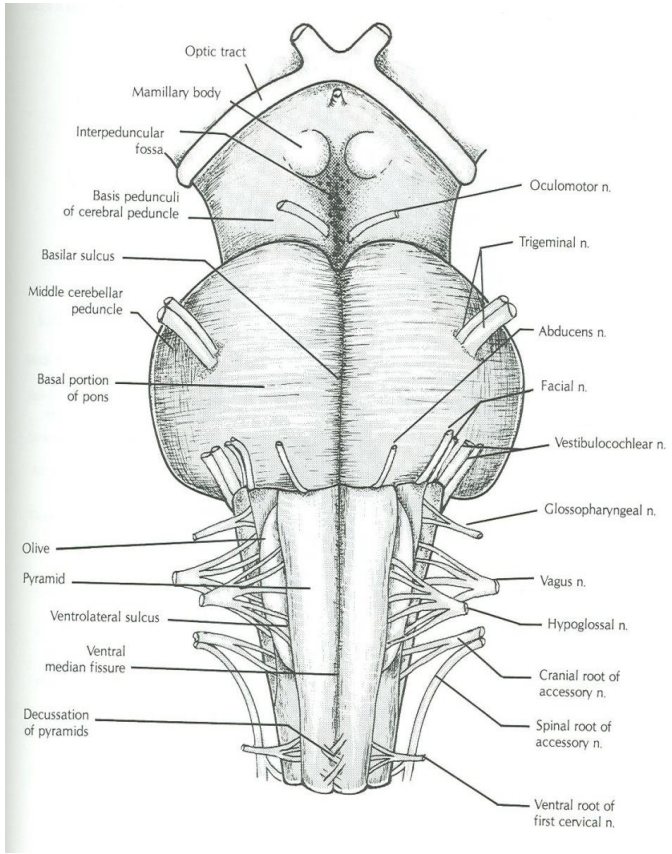
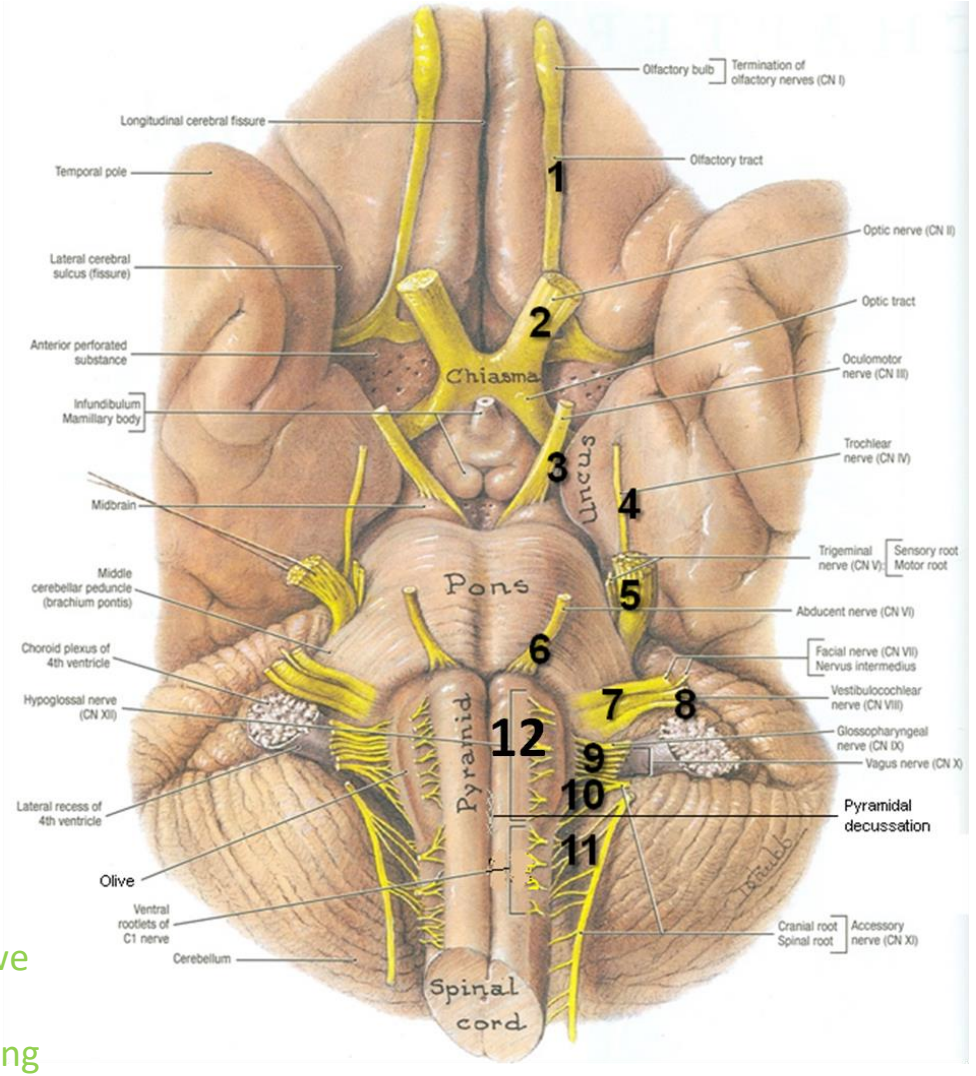
Brain Stem
Ventral Surface







Outline of the lecture

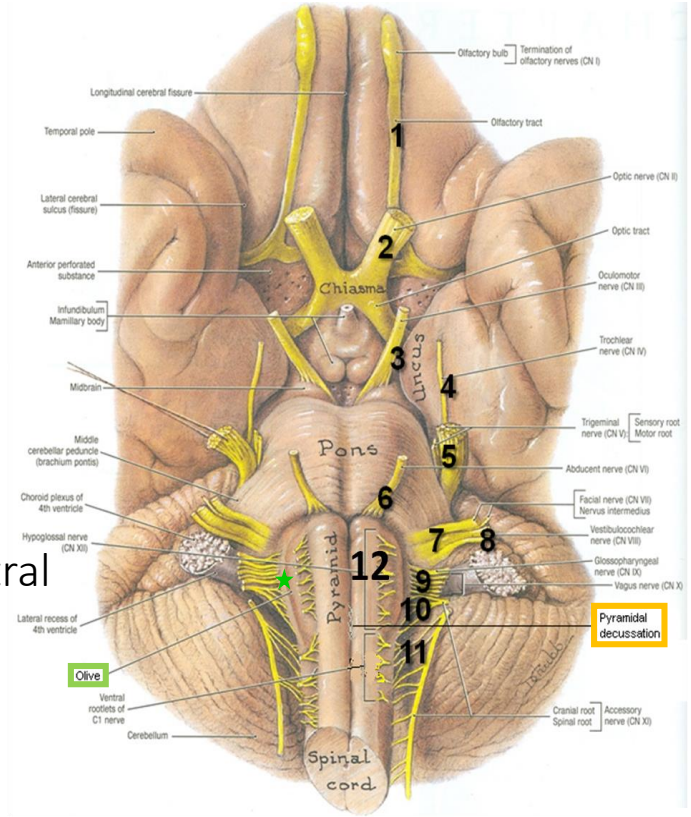
We will discuss the ventral surface of each part (medulla, pons, midbrain) then we will discuss the dorsal.

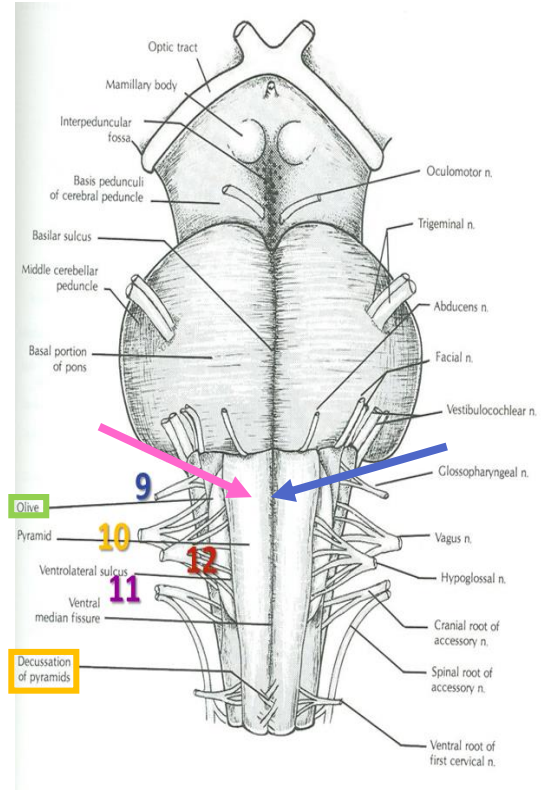
In each side (ventral/dorsal) we will see the general feature and the nerves coming out.

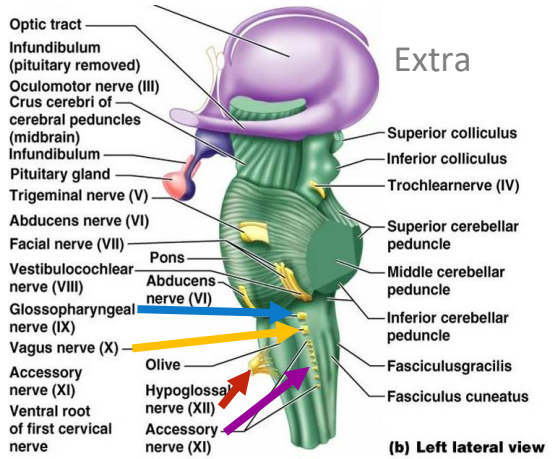
Note: the numbers refer to the cranial nerves

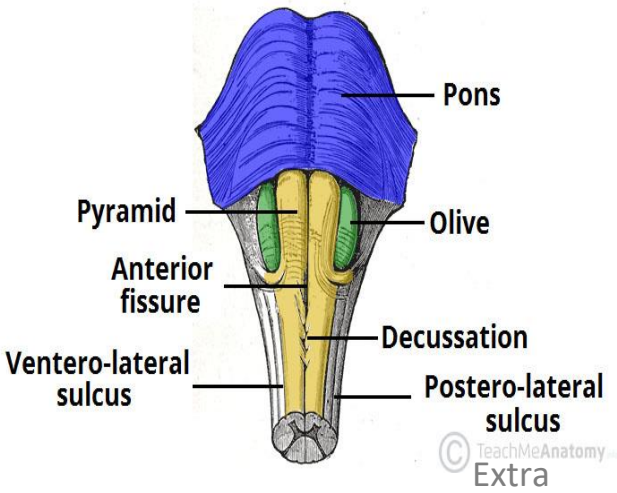
Medulla
Ventral Surface

- **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 (انتفاخ), lies on either (lateral) side of ventral median fissure
  - Produced by **corticospinal tract**.
- **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 (must medial compared to ➲)
  - **Glossopharyngeal** (9th), **vagus** (10th) & cranial part of **accessory** (11th): from sulcus dorsolateral to olive (from above downwards)





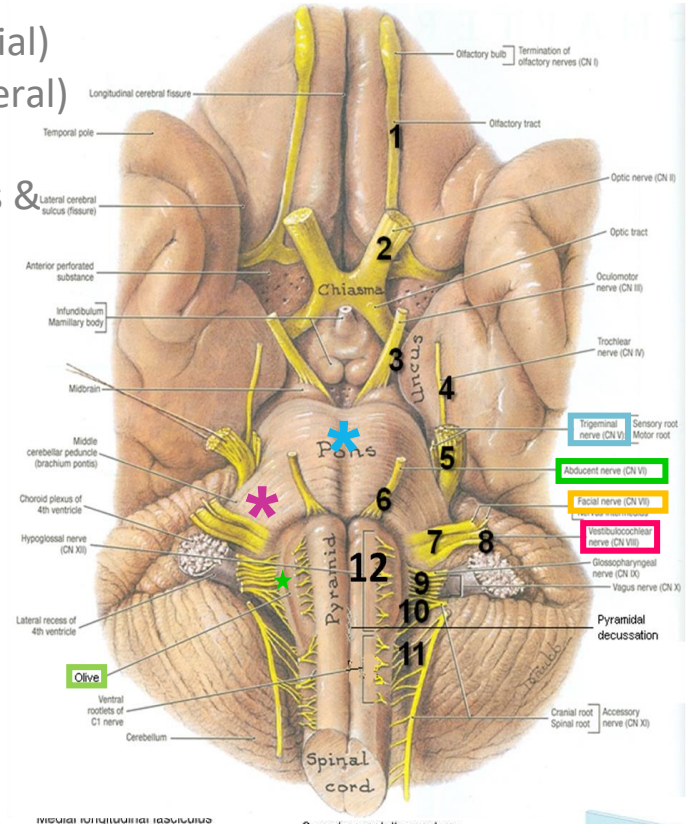


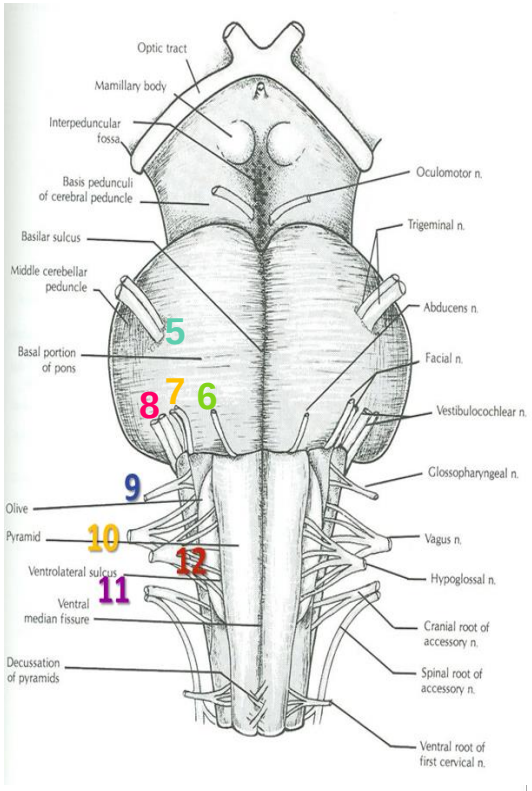


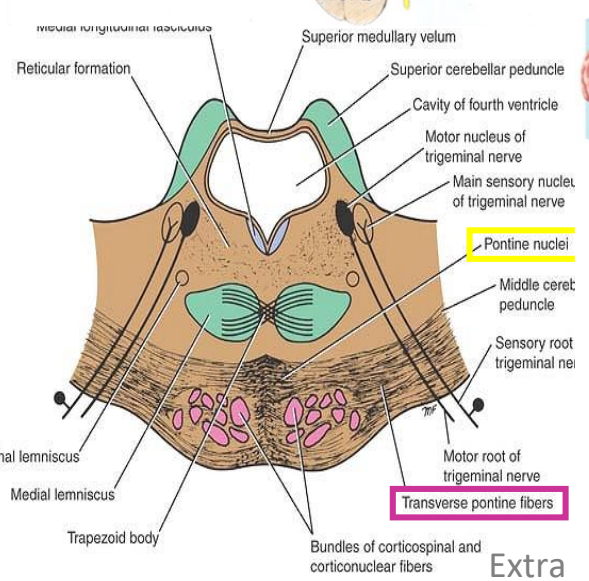
Pons
Ventral Surface

*Pure motor (must medial)
*Pure sensory (must lateral)
*Mixed (middle)
*Ventral surface of pons & medulla white matter because of motor fiber

- **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.
- **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







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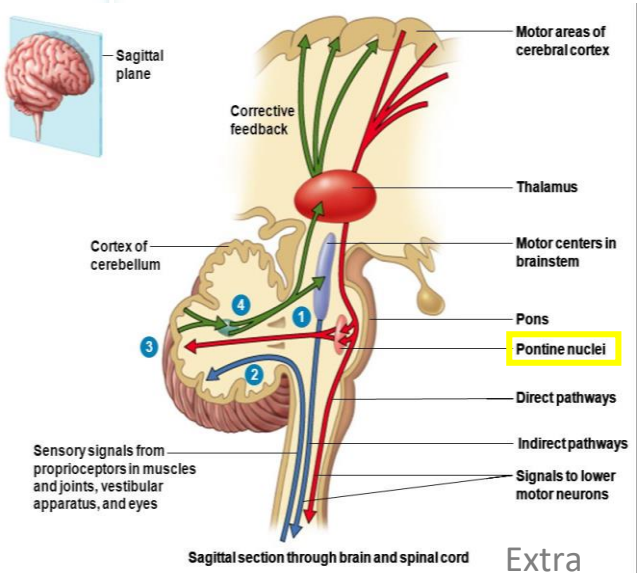


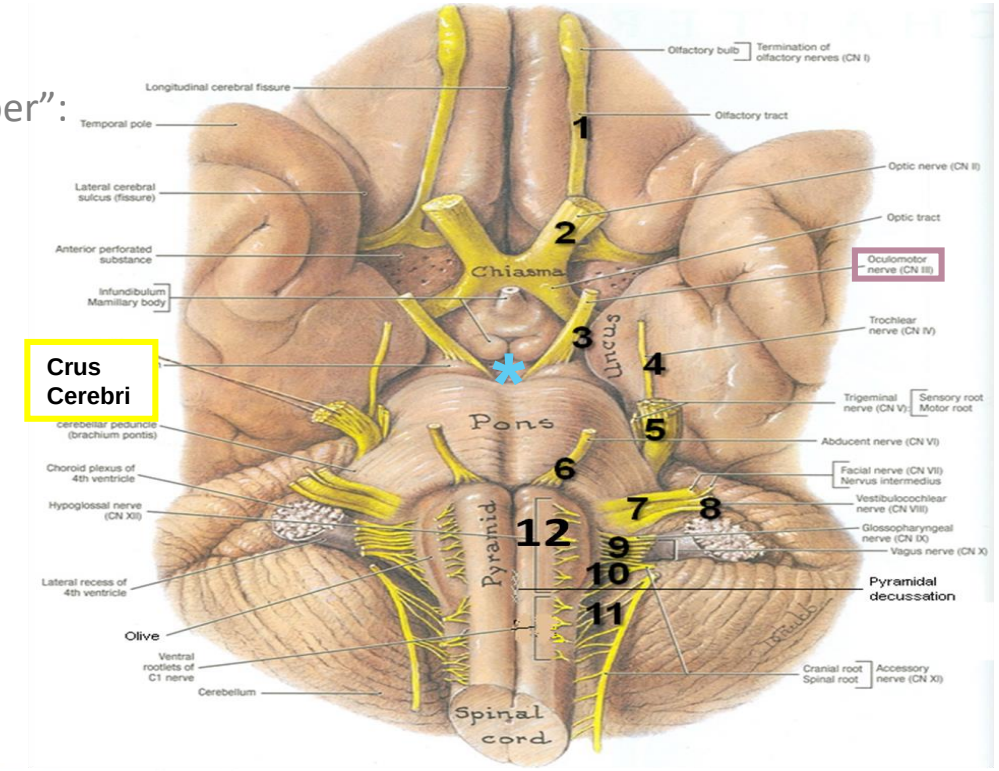
Extra

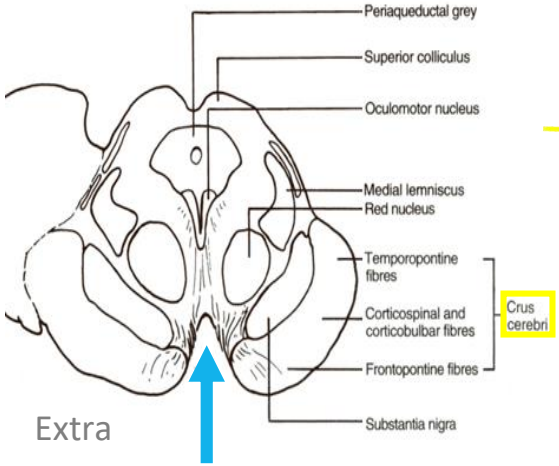
Midbrain
Ventral Surface

*"descending motor fiber":
- Corticocerebellar
- Corticobulbar
- Corticospinal

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

Trochlear (4th) is in the posterior (dorsal) aspect
Muscle arising from:
1- myotome by spinal nerve (general motor)
2- pharyngeal arch (special motor)





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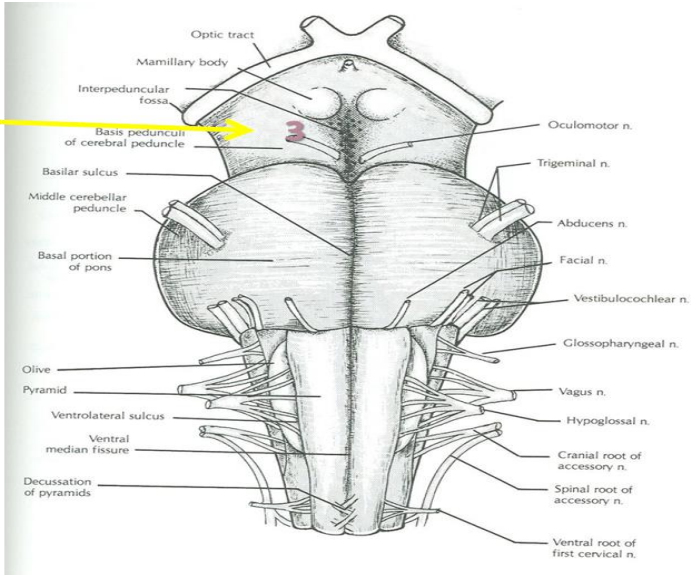
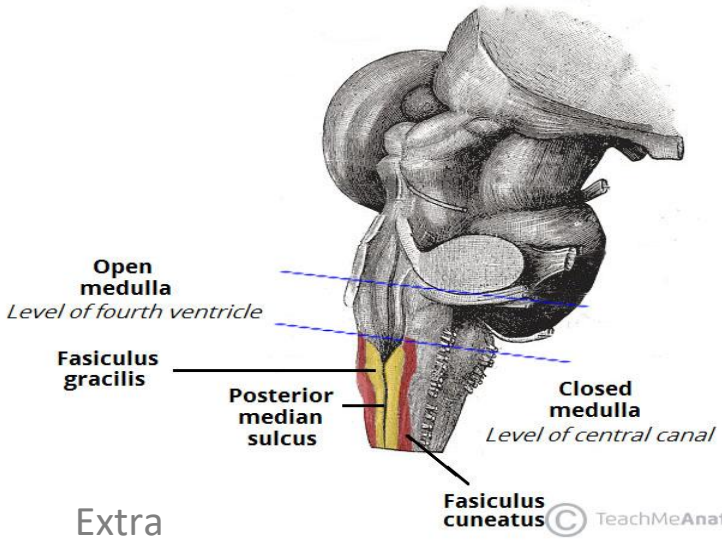


Medulla
Dorsal Surface

- 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.



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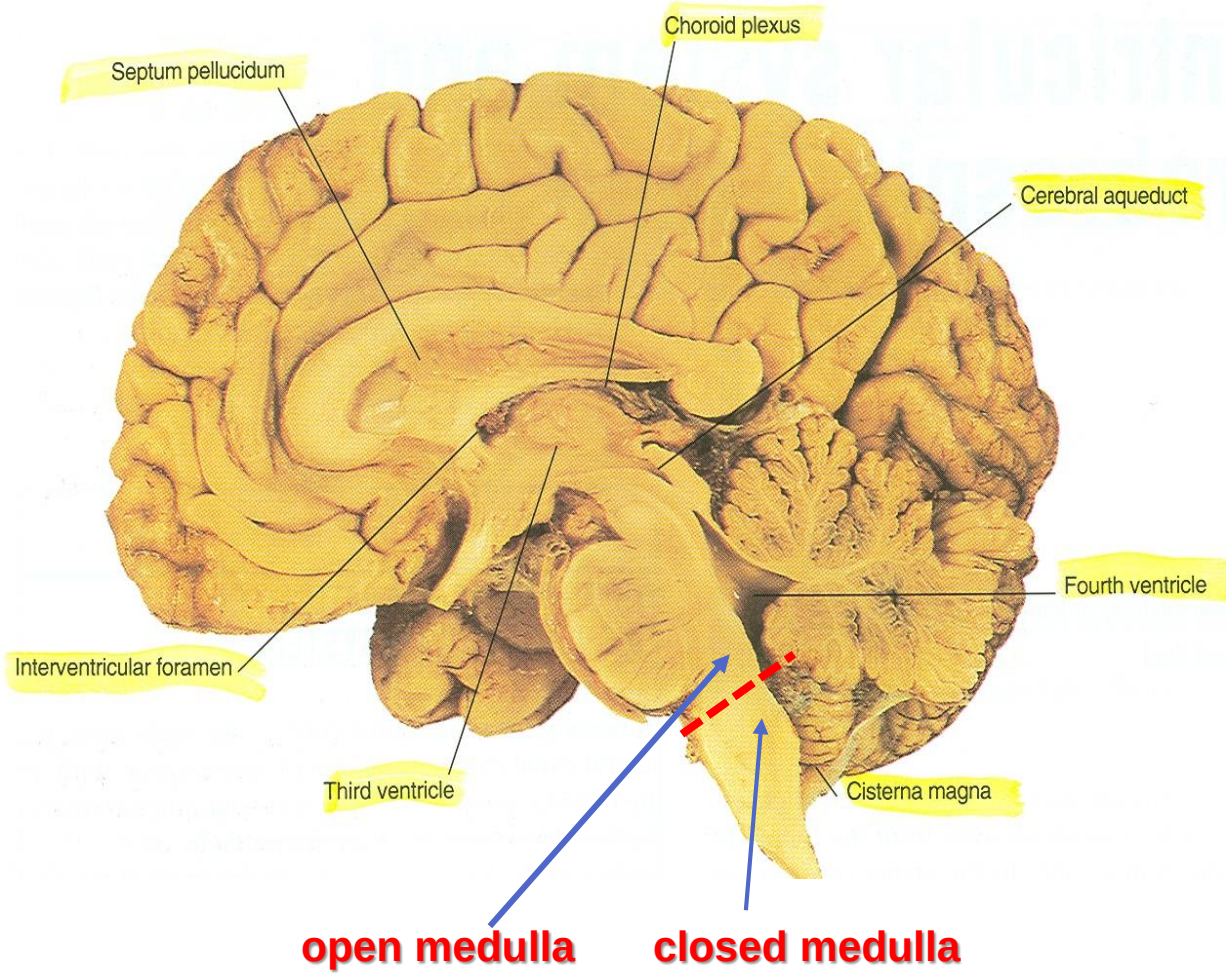
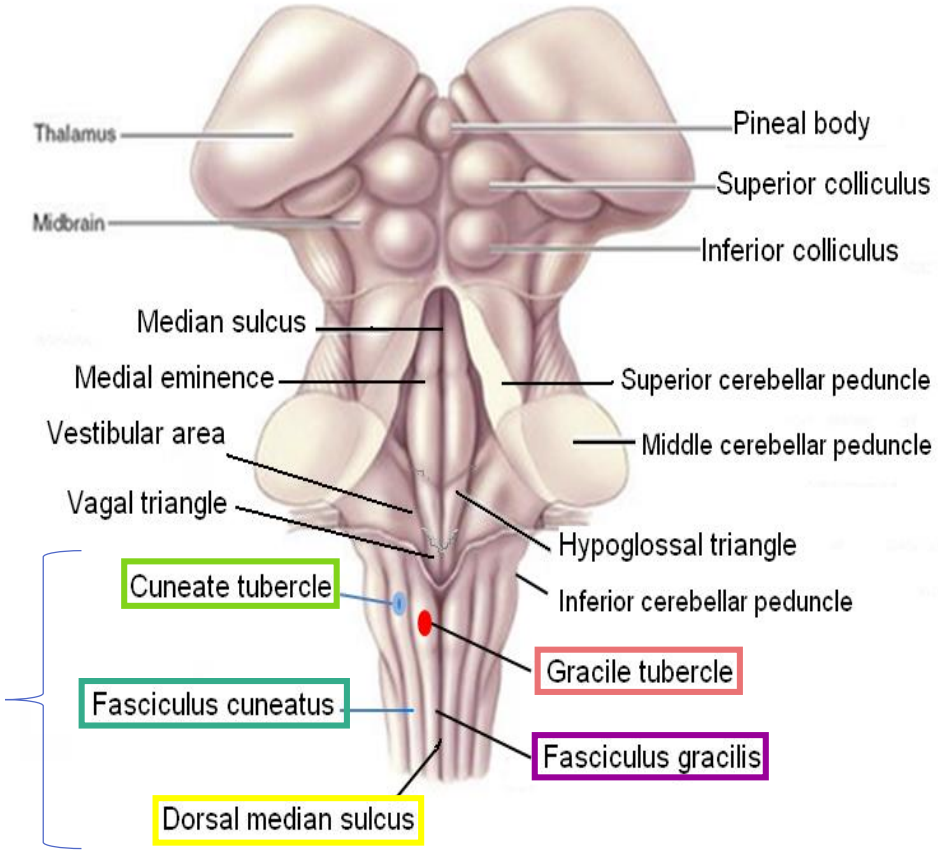


Medulla (Closed)
Dorsal Surface

- 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.



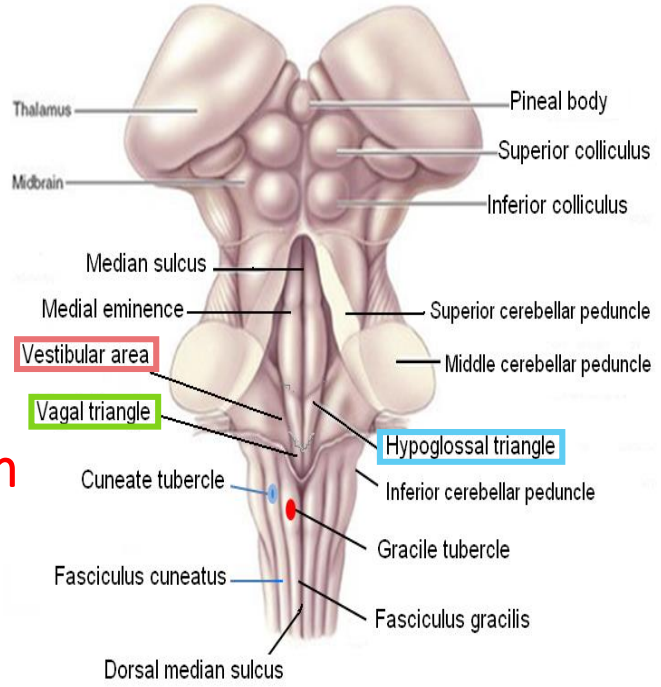
Recall: Fasciculus gracilis and fasciculus cuneatus are ascending tracts in the dorsal white column which terminate on their respective nuclei: gracile nucleus and cuneate nucleus.

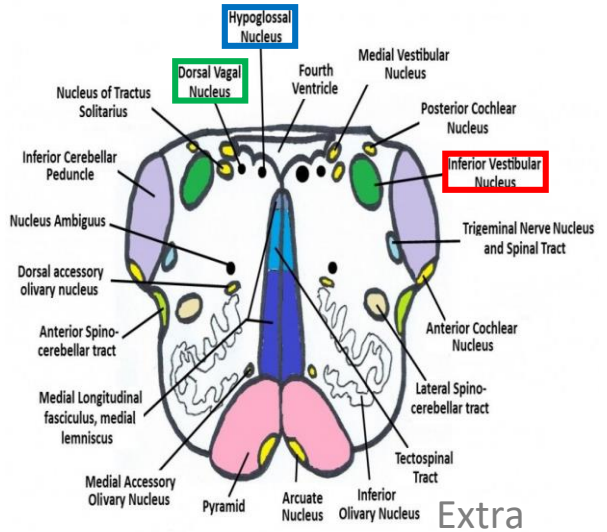
Medulla (Open)
Dorsal Surface

- 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





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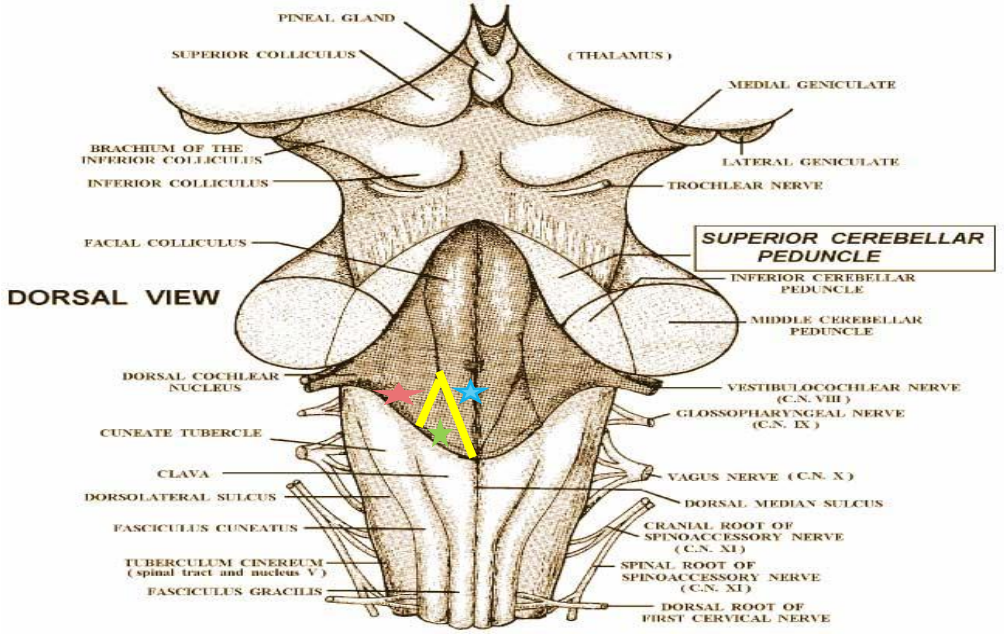
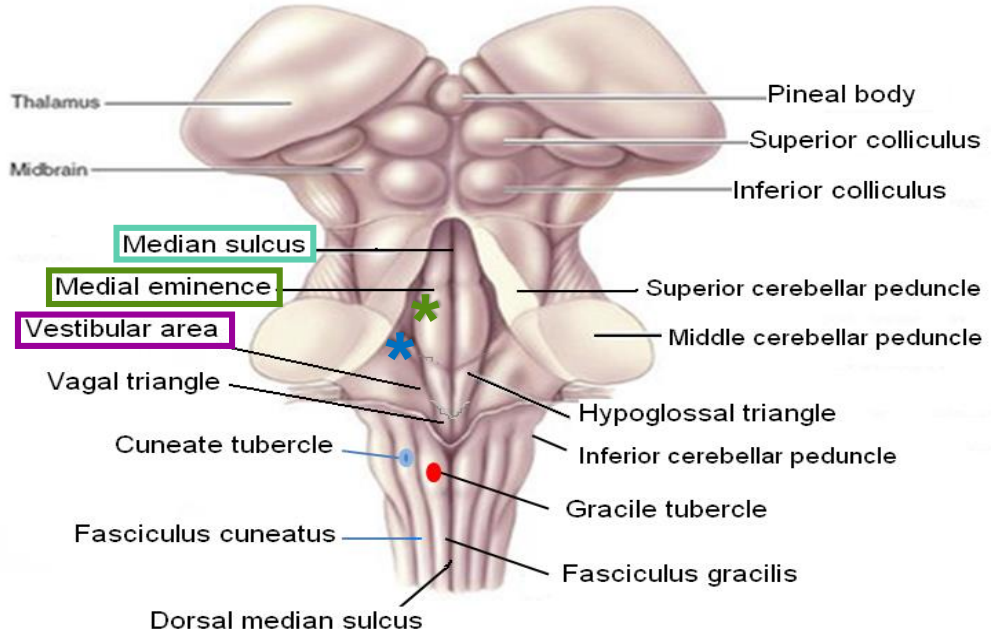


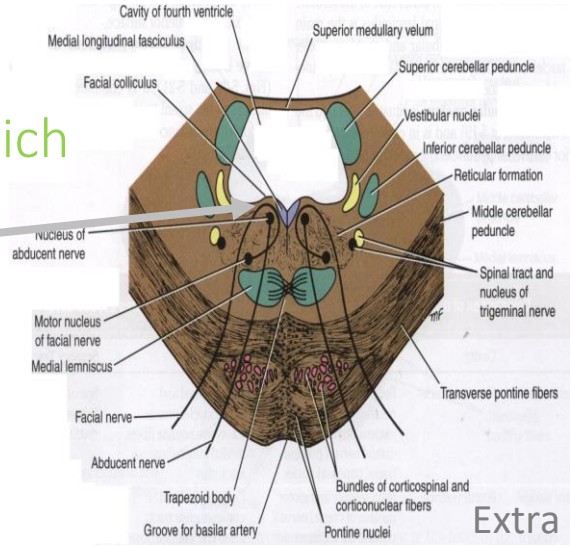
Pons
Dorsal Surface

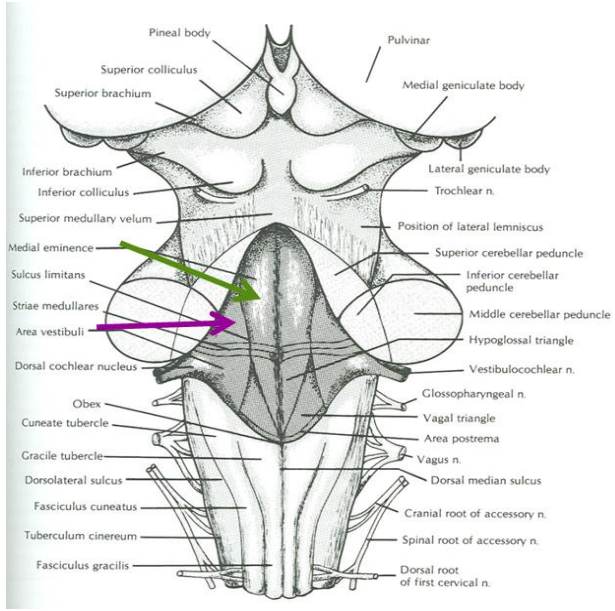
- Separated from open medulla by an imaginary line passing between the caudal margins of **middle cerebellar peduncle**.
- On either side of **median sulcus**, it divides into 2 parts (from medial to lateral):
  - **Medial eminence** & **facial colliculus**: overlies abducent nucleus

    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.

    *Same medulla dorsal surface





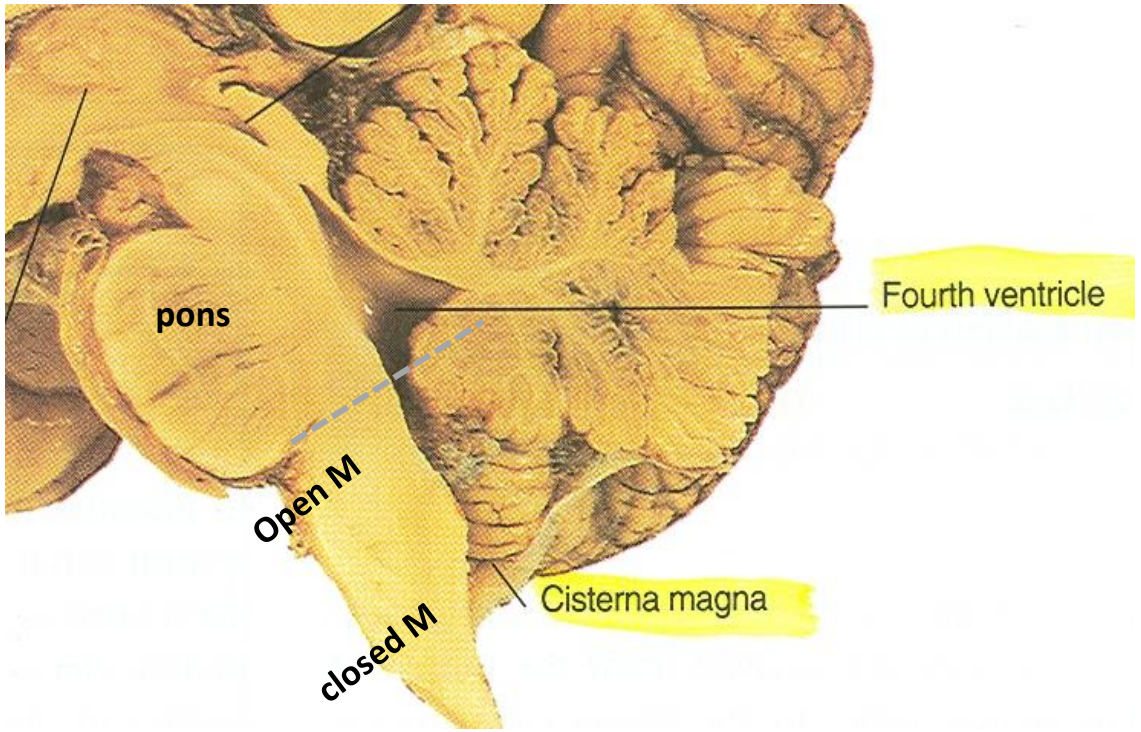


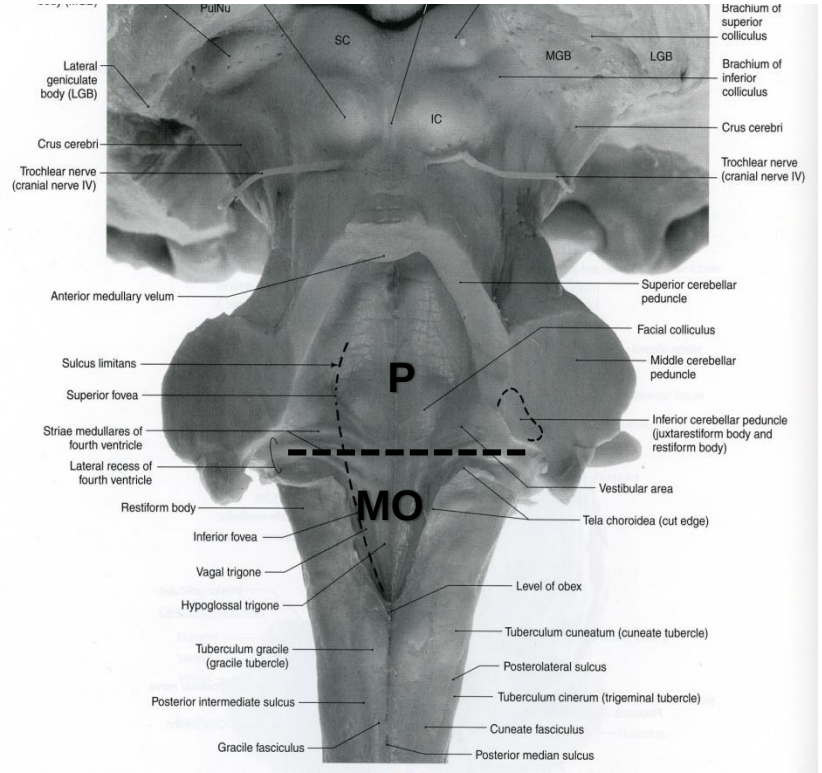
Only on the girl's slides

- 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

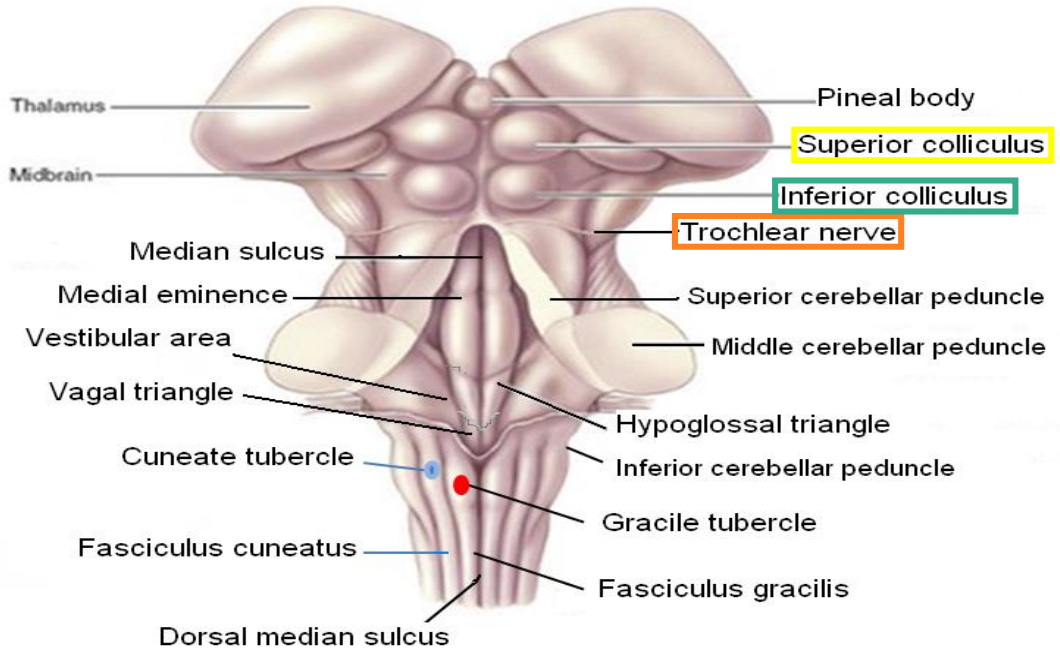


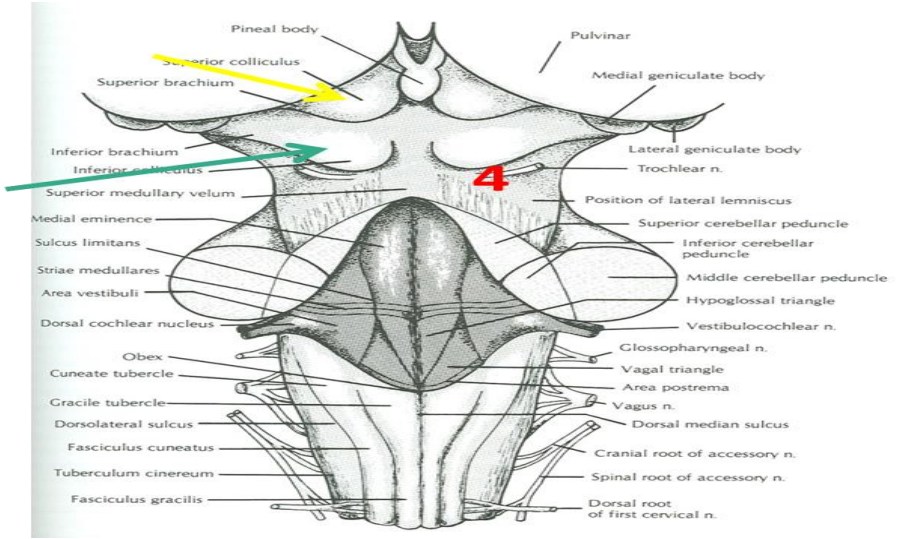


Midbrain
Dorsal Surface

- 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: he superior colliculi is concerned with the eyes (auditory) & the eyes are at the top of the face (superior).





To remember:
The trochlear is the only cranial nerve that emerges from the dorsal / posterior surface.
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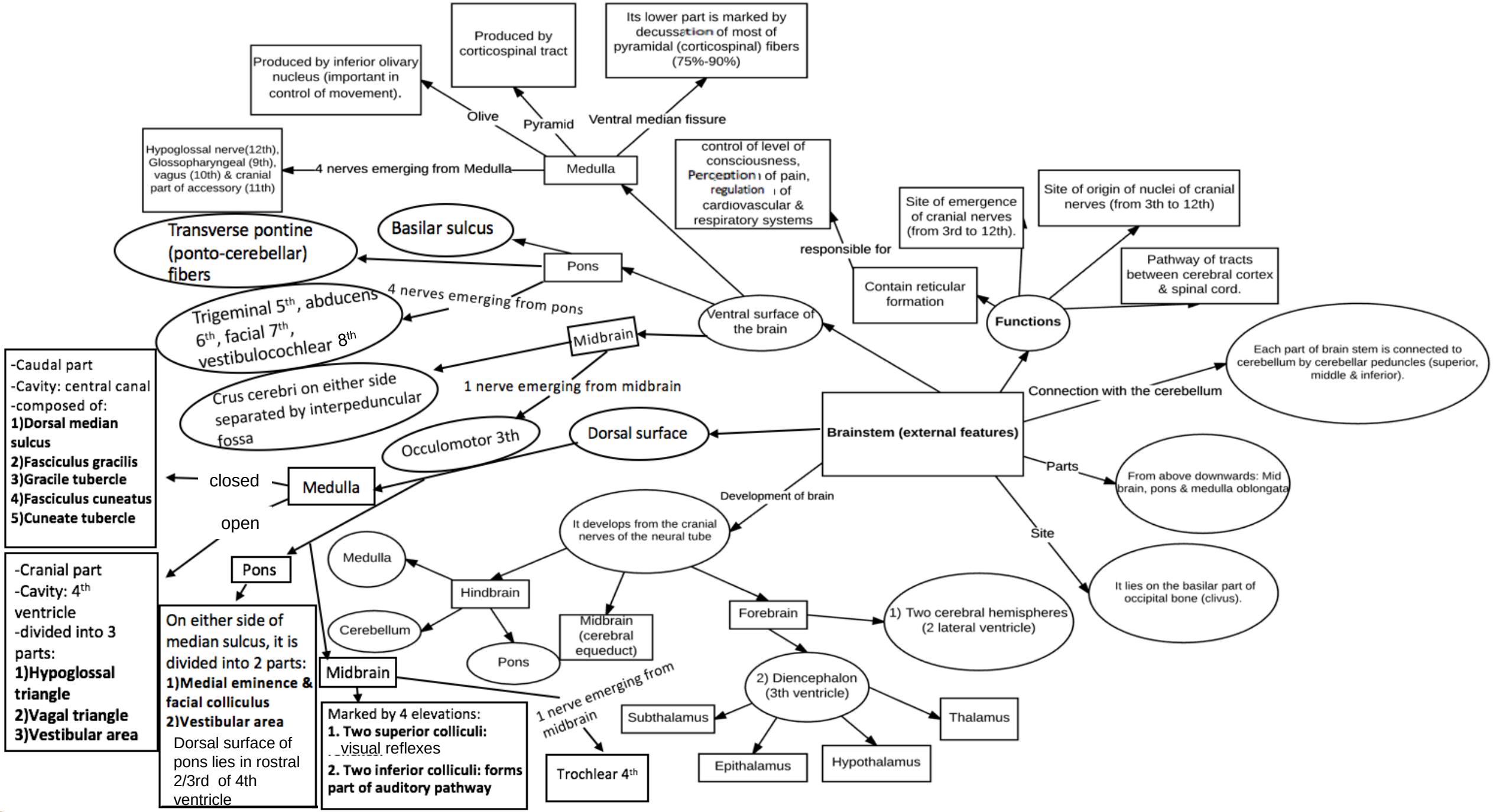
Brainstem (external features)
Ventral surface of the brain
Medulla
Produced by inferior olivary nucleus (important in control of movement).
Olive
Produced by corticospinal tract
Pyramid
Its lower part is marked by decussation of most of pyramidal (corticospinal) fibers (75%-90%)
Ventral median fissure
Hypoglossal nerve(12th), Glossopharyngeal (9th), vagus (10th) & cranial part of accessory (11th)
4 nerves emerging from Medulla
control of level of consciousness, Perception of pain, regulation of cardiovascular & respiratory systems
responsible for
Pons
Basilar sulcus
Transverse pontine (ponto-cerebellar) fibers
Trigeminal 5th, abducens 6th, facial 7th, vestibulocochlear 8th
4 nerves emerging from pons
Midbrain
Crus cerebri on either side separated by interpeduncular fossa
1 nerve emerging from midbrain
Occulomotor 3th
Functions
Contain reticular formation
Site of emergence of cranial nerves (from 3rd to 12th).
Site of origin of nuclei of cranial nerves (from 3th to 12th)
Pathway of tracts between cerebral cortex & spinal cord.
Connection with the cerebellum
Each part of brain stem is connected to cerebellum by cerebellar peduncles (superior, middle & inferior).
Parts
From above downwards: Mid brain, pons & medulla oblongata
Site
It lies on the basilar part of occipital bone (clivus).
Dorsal surface
Medulla
closed
open
-Caudal part
-Cavity: central canal
-composed of:
1)Dorsal median sulcus
2)Fasciculus gracilis
3)Gracile tubercle
4)Fasciculus cuneatus
5)Cuneate tubercle
Pons
-Cranial part
-Cavity: 4th ventricle
-divided into 3 parts:
1)Hypoglossal triangle
2)Vagal triangle
3)Vestibular area
On either side of median sulcus, it is divided into 2 parts:
1)Medial eminence & facial colliculus
2)Vestibular area
Dorsal surface of pons lies in rostral 2/3rd of 4th ventricle
Development of brain
It develops from the cranial nerves of the neural tube
Medulla
Hindbrain
Cerebellum
Pons
Midbrain (cerebral equeduct)
Forebrain
1) Two cerebral hemispheres (2 lateral ventricle)
2) Diencephalon (3th ventricle)
Subthalamus
Thalamus
Epithalamus
Hypothalamus
Midbrain
Marked by 4 elevations:
1. Two superior colliculi: visual reflexes
2. Two inferior colliculi: forms part of auditory pathway
1 nerve emerging from midbrain
Trochlear 4th

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

(2) This cranial nerve exits from the dorsal side of the brain?

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

(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 10^{th}
D) 7th nerve only

(4) Nucleus of cranial nerve 3 is located in?

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

(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

(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

(7) Basilar sulcus of the pons is occupied by?

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

(8) Cranial nerve 4 is located inferior to what landmark?

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

(9) At the dorsal surface of open medulla an inverted V-shaped sulcus divides the area into 3 parts (from medial to lateral)?

A) Vagal triangle , Vestibular area , Hypoglossal triangle
B) Vestibular area , vagal triangle , Hypoglossal triangle
C) Hypoglossal triangle , vagal area , Vestibular triangle
D) Vestibular area , vagal triangle , glossopharyngeal triangle

(10) Nerves emerging from Pons?

A) 3rd , 4th , 5th , 6th
B) 3rd , 4th , 5th
C) 5th , 6th , 7th , 8th
D) 5th , 6th , 7th

Answers

(1) A
(2) D
(3) B
(4) C
(5) B
(6) C
(7) B
(8) D
(9) C
(10) C

SAQ

(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?

1. **Forebrain:** cerebral hemispheres → 2 lateral ventricles, Diencephalon → 3rd ventricle
2. **Midbrain**: cerebral aqueduct
3. **Hindbrain:** 4th ventricle

(3) Name the roots of the nerves that located at cerebellopontine angle , “from medial to lateral”?

Motor root of 7th, sensory root of 7th vestibular part of 8th & cochlear part of 8th

Good luck
Special thank for team436 ❤

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