CNS
Brain stem I

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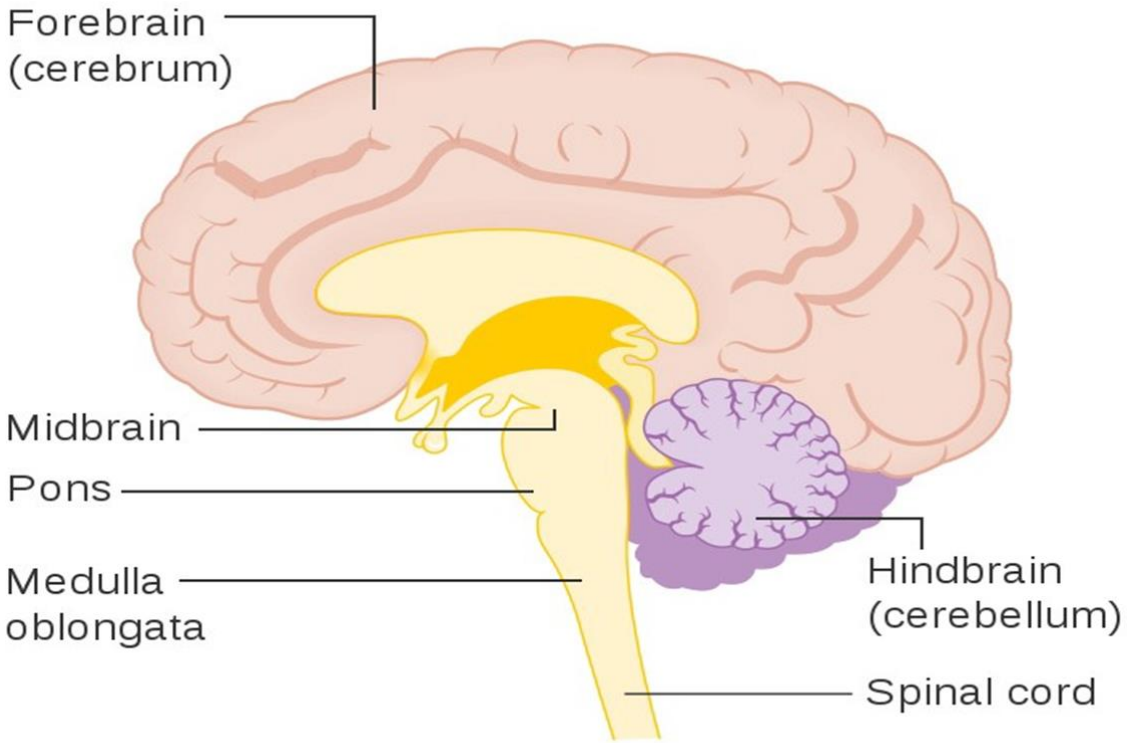
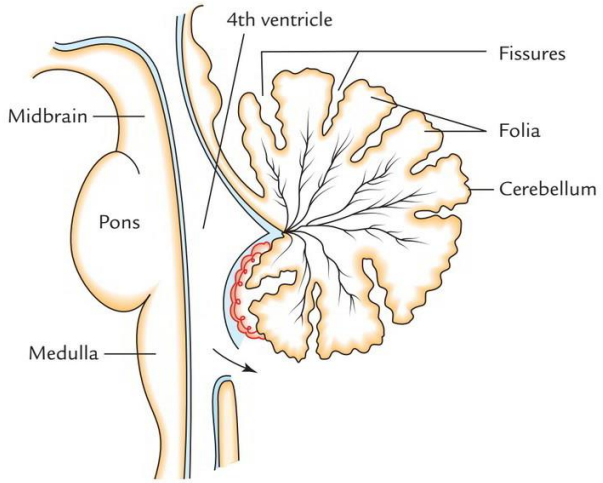
BRAIN STEM

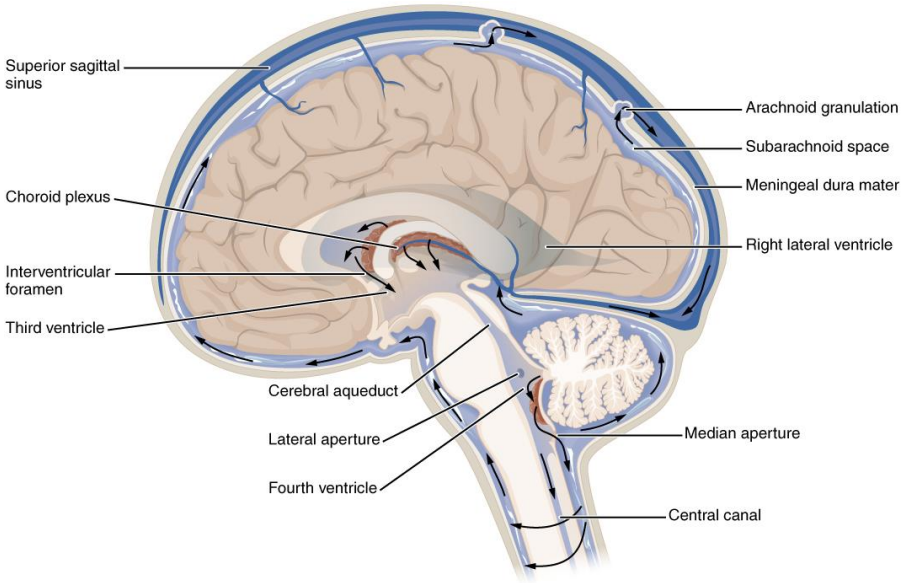
- It is irregular in structure externally and internally.
- It is formed from below upward from: 1- Medulla oblongata (5 cm). 2- Pons (2.5 cm). 3- Midbrain (2 cm).



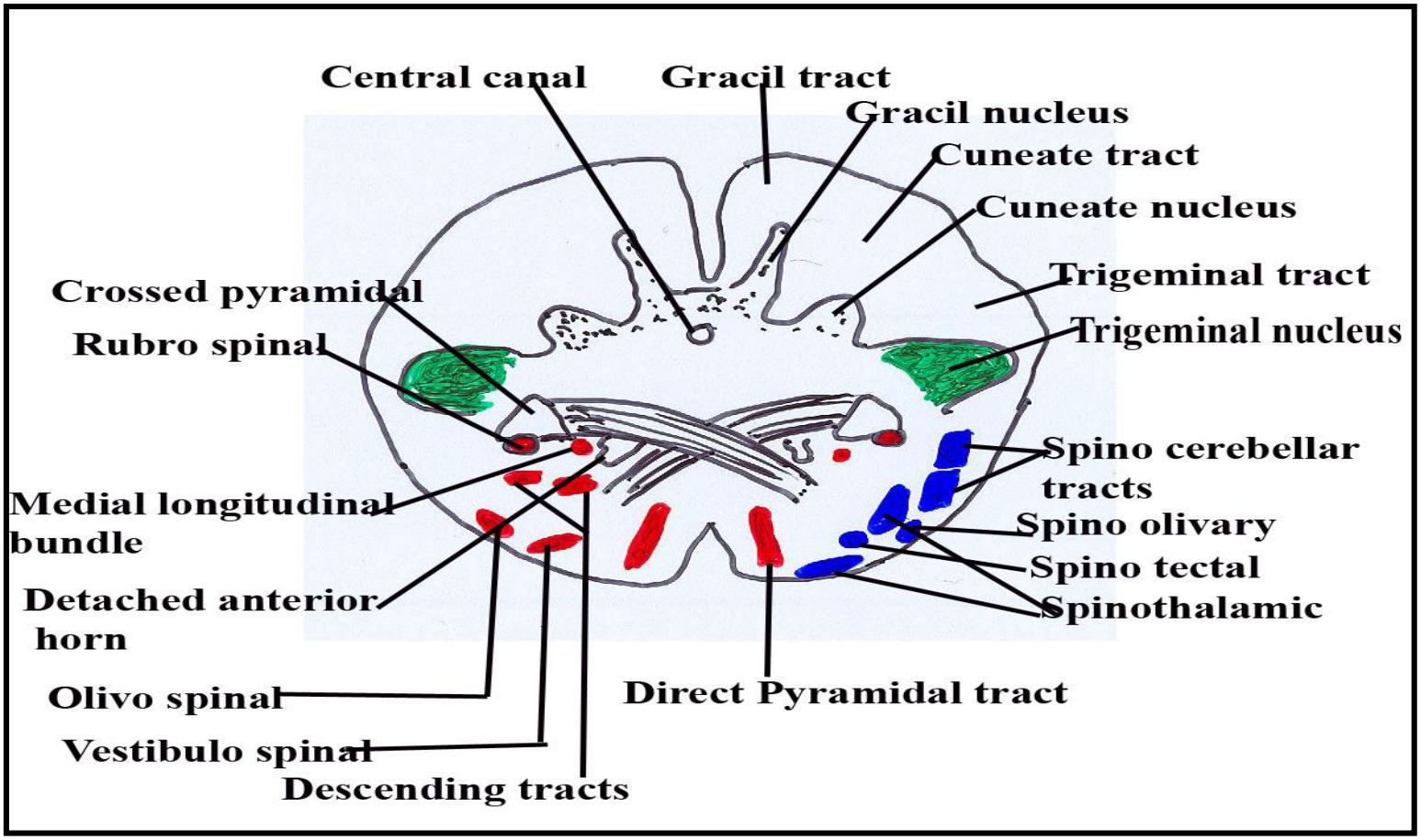
Medulla oblongata

- It is the lower part of brain stem.
- It connects the pons superiorly with the spinal cord inferiorly.
- The lower level contains central a canal and is known as closed medulla.
- The upper level opens in the 4th ventricle and is known as open medulla.
- The medulla oblongata has three levels from lower to upper (two closed & one open):





1- Closed medulla (motor decussation):

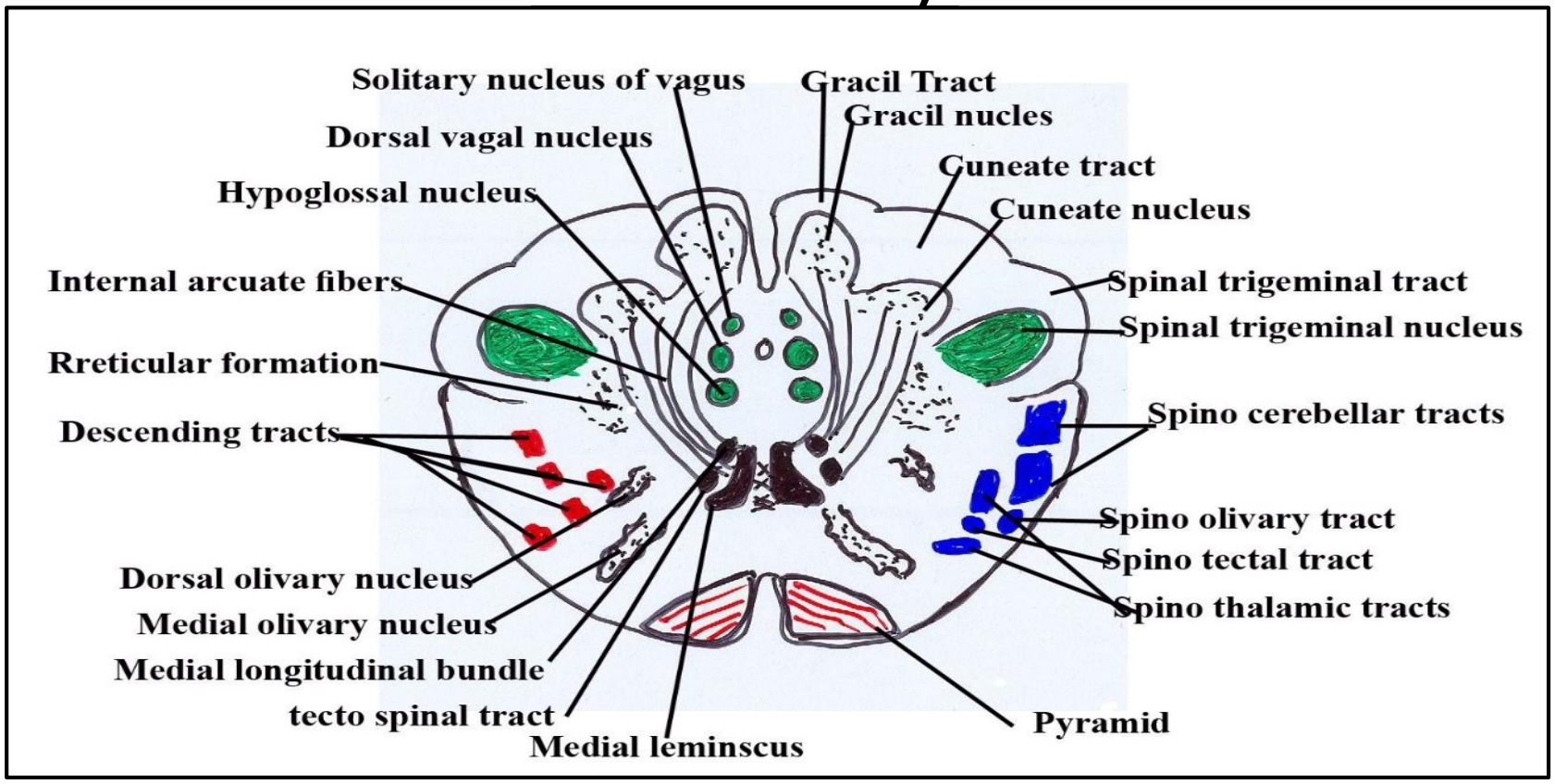


Closed medulla oblongata (motor decussation)

- It contains central canal which is posterior.
- Gracile and cuneate nuclei start to appear and they are small while their tracts are large and start to relay in their nuclei.
- Spinal trigeminal nucleus and tract replace the substantia gelatinosa of Rolandi and Lissauer`s tract carrying pain and temperature sensation from the face

- 80-85 % of pyramidal fibers cross to opposite side forming motor decussation and 10-15 % descend as direct pyramidal tract.
- All descending extrapyramidal tracts present except the ventral (anterior) vestibulo spinal tract and sulcomarginal tract join each other and form medial longitudinal bundle (M.L.B.)

Closed medulla oblongata (sensory decussation):



2-Closed medulla oblongata (sensory decussation)

- It contains central canal which becomes more posterior.
- Gracile and cuneate nuclei are large while their tracts become small.
- Axons from gracile and cuneate nuclei form the internal arcuate fibers which cross to opposite side forming sensory decussation. The crossed sensory fibers ascend in the opposite side as medial lemniscus.
- Medial longitudinal bundle (fasciculus).
- All ascending and descending tracts are present

- Cortico-spinal fibers (pyramidal tract) are present on both sides of anterior median fissure and form two masses on the anterior surface of the medulla (pyramids).

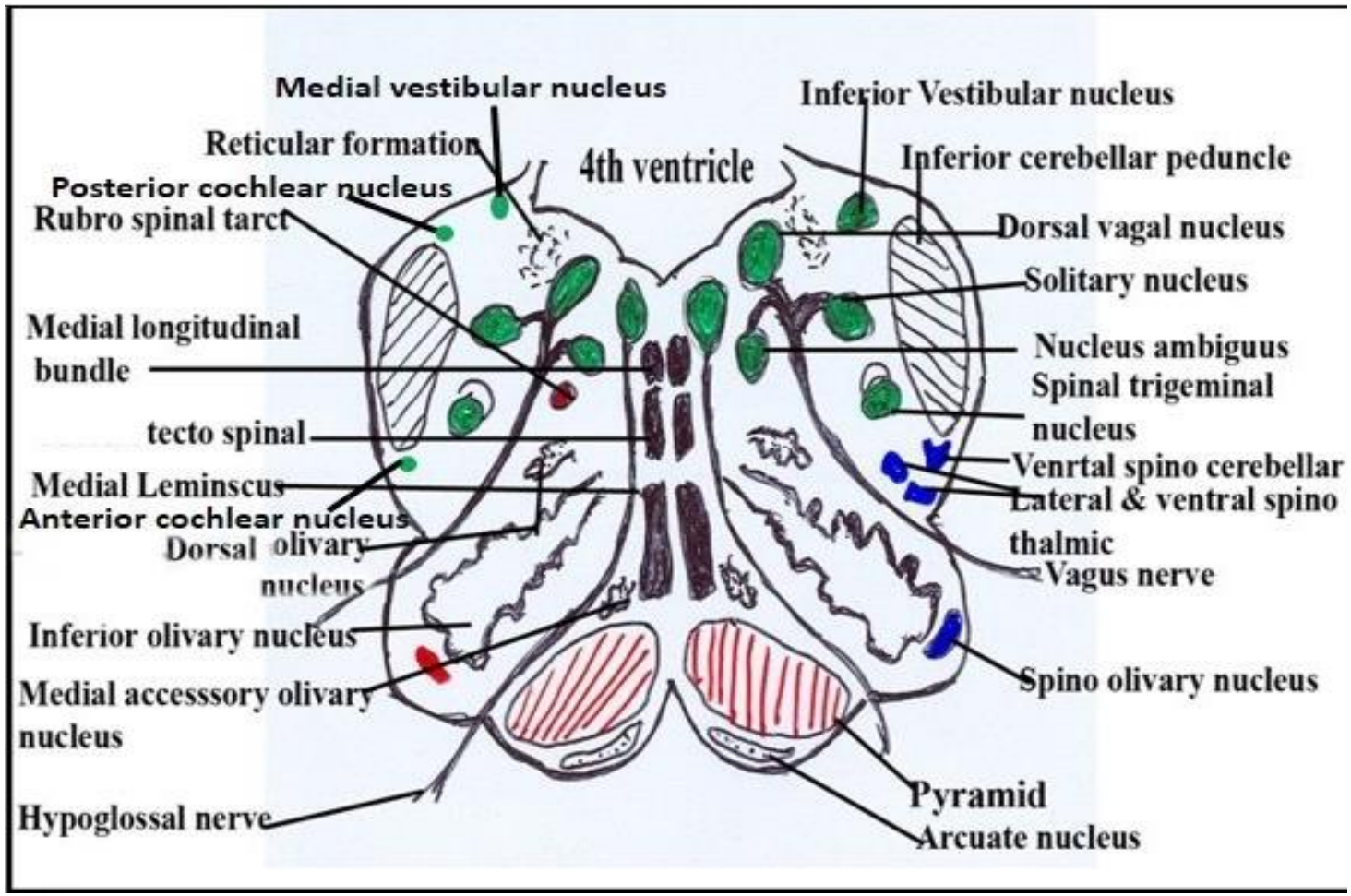
- Lower parts of some cranial nerve nuclei start to appear in the grey matter around the central canal which are:

a) Hypoglossal nucleus.

b) Dorsal vagal nucleus (motor).

c) Sensory vagal nucleus (lower part of solitary nucleus).

3-Open medulla oblongata



Open medulla oblongata

- **No central canal** (the central canal opens posteriorly into 4th ventricle).
- **The pyramids** are present in the anterior part.
- In the **midline** there are:

- Medial longitudinal bundle (posterior)
- Tecto spinal tract (at the middle)
- Medial lemniscus (anterior)

- The grey matter has increased due to the presence of **Olivary complex** which include:

- Inferior olivary nucleus (the largest one).
- Dorsal and medial accessory olivary nuclei which are smaller.

- **The arcuate nuclei:** they lie anterior to the pyramids. These nuclei act as relay station for the proprioceptive pathway. Other fibers from gracil and cuneate nuclei called **external arcuate fibers** arise and relay in arcuate nuclei then enter the cerebellum
- **Presence of cranial nerve nuclei** of the lower 4 cranial nerves (9, 10, 11 &12)
- **5th** (trigeminal) spinal nucleus and tract.
- **8th** (vestibular) and cochlear nuclei start to appear.
- **Inferior cerebellar peduncles** (I.C.P) are laterally located.

(the structure connecting the cerebellum to the brain stem and the cerebrum)

- **Reticular formation**

VESTIBULAR NUCLEI

- Four cranial nuclei of the vestibular nerve
- They are located at the pons and medulla oblongata, at the floor of the 4th ventricle
- These nuclei are:

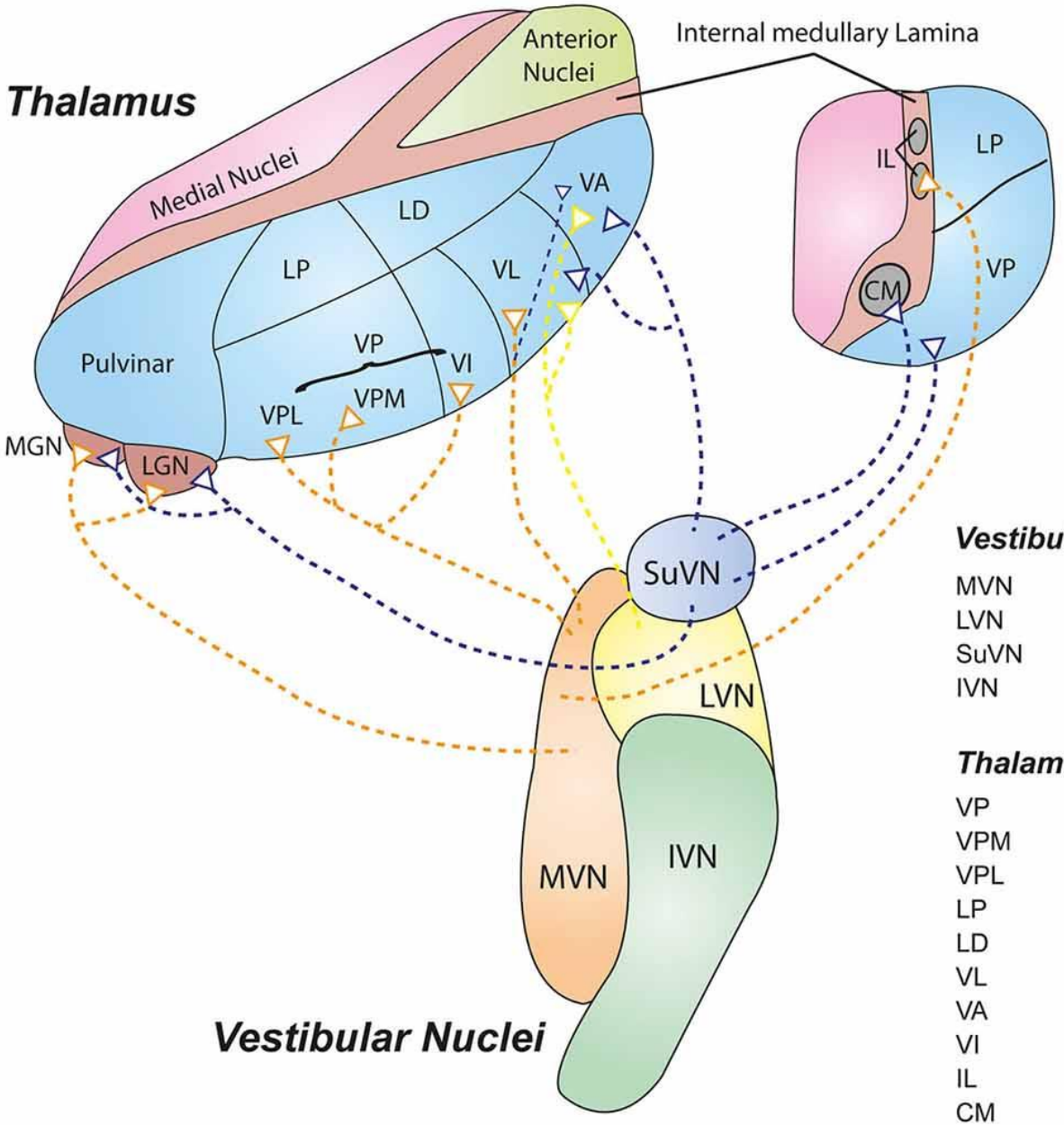
a-The medial vestibular nucleus: it is the largest nucleus (dorsal or chief vestibular nucleus)

b- The lateral vestibular nucleus: called nucleus of Deiters, as it contains an extremely large nerve cells called the giant cells of Deiters in addition to smaller neurons.

c- The inferior vestibular nuclei

These three vestibular nuclei are present in the medulla oblongata

d- The superior vestibular nucleus is present in the pons



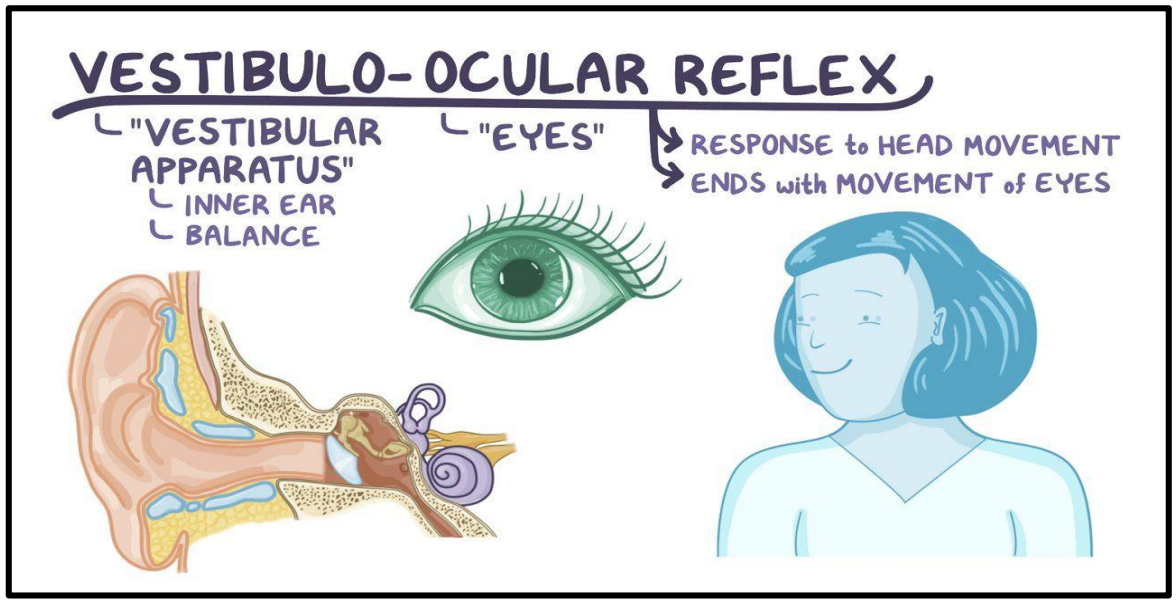
Vestibular Nuclei

MVN	Medial Vestibular Nucleus
LVN	Lateral Vestibular Nucleus
SuVN	Superior Vestibular Nucleus
IVN	Inferior Vestibular Nucleus

Thalamic Nuclei

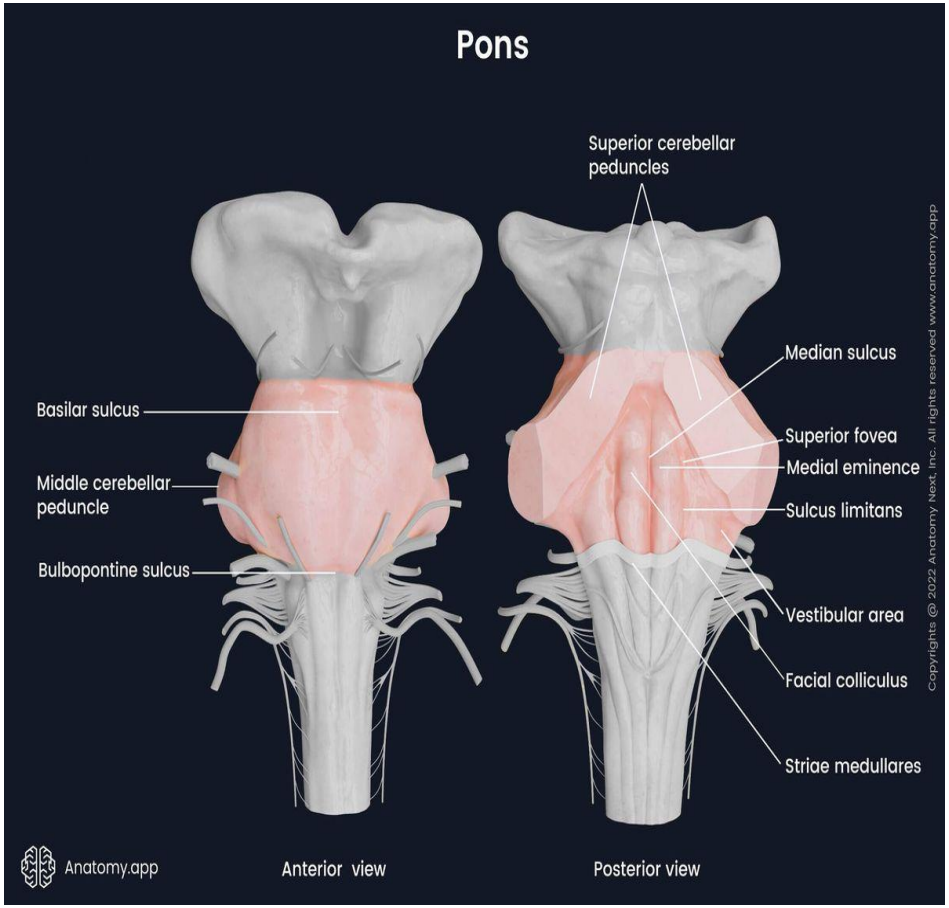
VP	Ventral Posterior Nucleus
VPM	Ventral Posteromedial Nucleus
VPL	Ventral Posterolateral Nucleus
LP	Lateral Posterior Nucleus
LD	Lateral Dorsal Nucleus
VL	Ventral lateral Nucleus
VA	Ventral Anterior Nucleus
VI	Ventral Intermediate Nucleus
IL	Interlaminar Nuclei
CM	Centromedian Nucleus

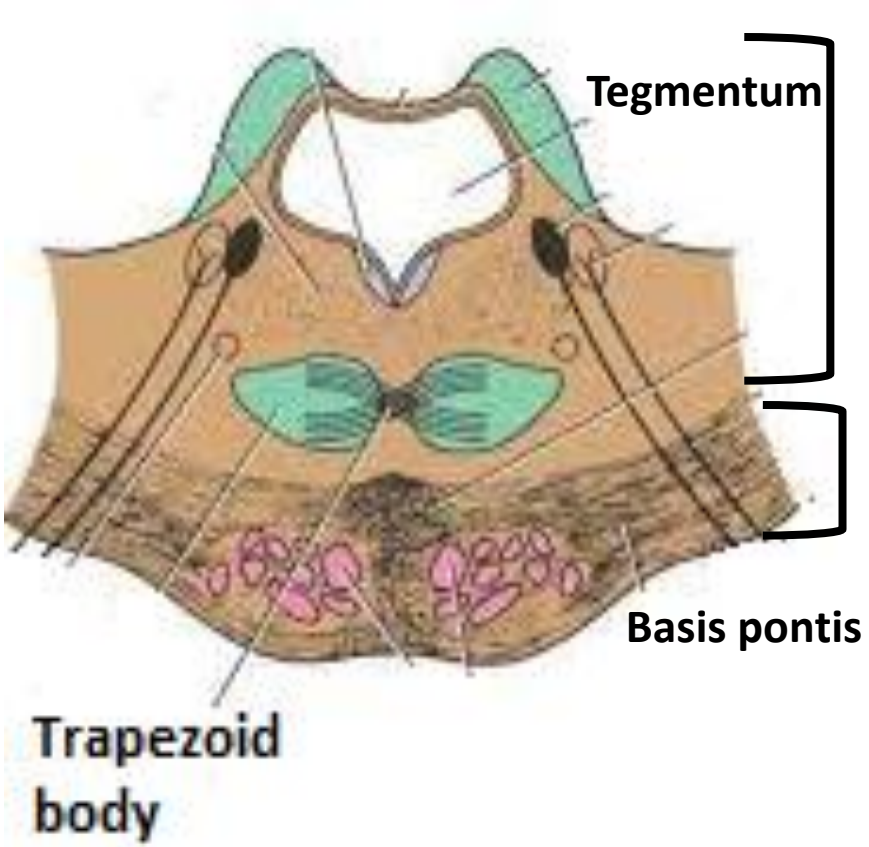
- All nuclei are connected with the vestibular apparatus, cerebellum, reticular formation, spinal cord, thalamus, cranial nuclei of extra ocular-muscles responsible for vestibule-ocular reflex (III, IV & VI) and motor nuclei of (VII, XI, XII)
- They are responsible for maintenance of equilibrium and posture, perception of head position and acceleration, as well as general muscle tone.
- All nuclei is consist of grey matter (bodies of nerve cells, dendrites, unmyelinated axons and neuroglia).



The pons

- The pons is divided into posterior part, tegmentum and an anterior part, basis pontis by the transversely running fibers of the trapezoid body.





A- The Basis Pontis:

- It is the same for all levels and contains:

1. **Pontine nuclei:** receive the corticopontine fibers from the cerebral cortex. They are motor nuclei and give pontocerebellar connections in the corticocerebellar pathway.

2. **Transverse pontine fibers**: they are axons from the pontine nuclei to the cerebellum through the middle cerebellar peduncle (M.C.P).

3. **Pyramidal tract bundles:** they are descending corticopontine fibers (which end on the pontine nuclei), cortico spinal fibers & cortico bulbar fibers which are separated into bundles by transverse pontine fibers.

4. **Middle cerebellar peduncles.**

B- The Tegmentum:

- In all levels of pons the tegmentum contains the following structures:

1– Medial longitudinal bundle.

2– Tectospinal tract.

3– Medial lemniscus which **rotates so that its axis runs transversely**.

4 – Spinal lemniscus (dorsal& ventral spinothalamic tracts).

- Reticular formation

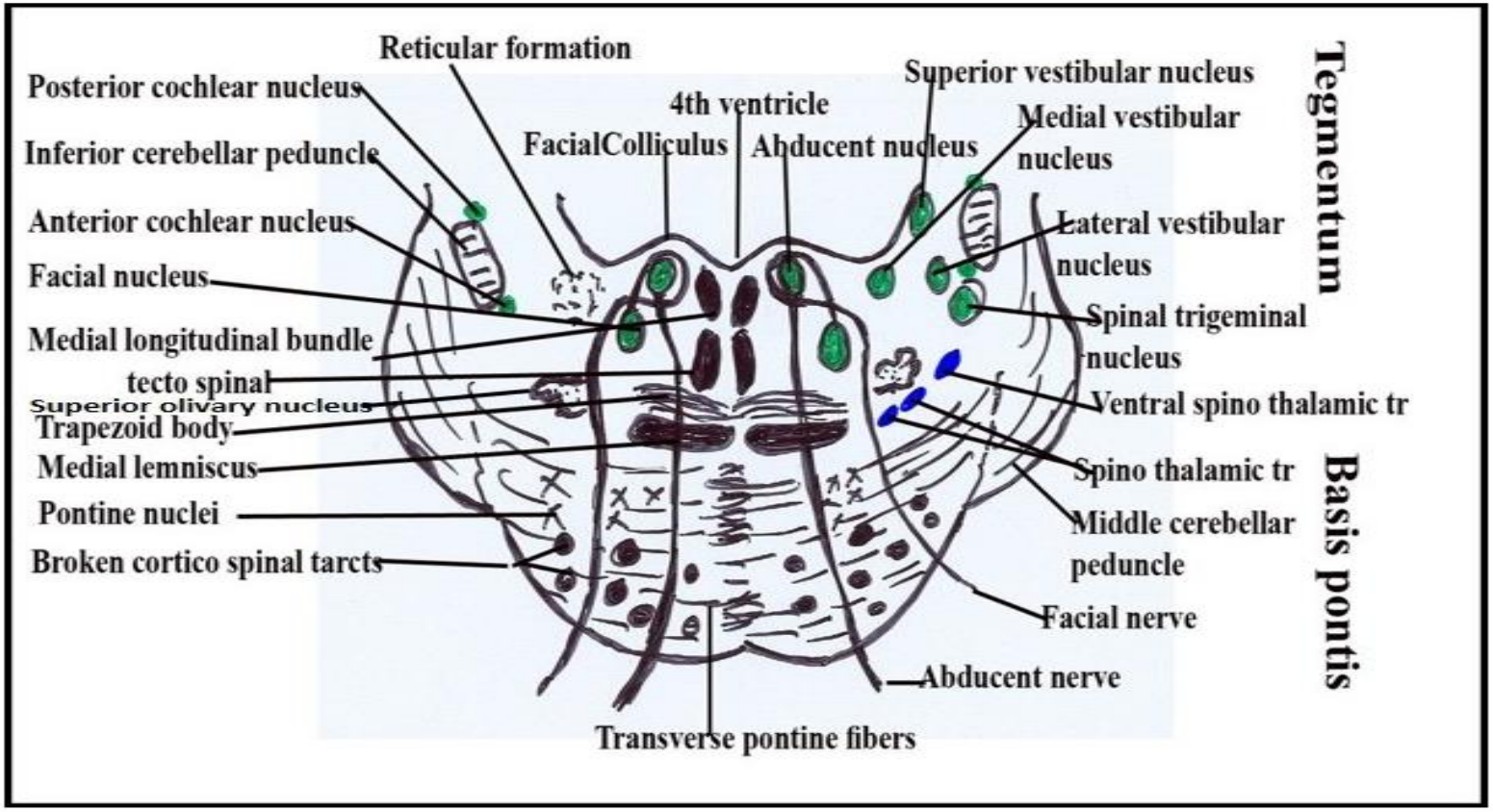
Levels of the pons:- In addition to previous structures there are other structures which characterize each level of pons.

1- Lower level at facial colliculus.

2- Middle level at trigeminal nuclei.

3- Upper level at the site of the four lemnisci.

1-Inferior level of pons (at facial colliculus):



1-Inferior level of pons (at facial colliculus):

It is characterized by the presence of:

1- Cavity of the 4th ventricle.

2- Spinal nucleus of trigeminal nerve (V), abducent nucleus (VI), Facial nerve nucleus (VII) and vestibulo-cochlear nerve nuclei (VIII).

NB. Facial nerve fibers loop around abducent nucleus to form facial colliculus.

3- Lateral lemniscus starts to appear: axons from ventral (anterior) cochlear nucleus cross to opposite side and ascend as lateral leminiscus. (auditory pathway)

4-Trapezoid body between tegmentum & basis pontis: axons from ventral and dorsal cochlear nuclei decussate in midline of pons. It also contains trapezoid nuclei. (auditory pathway)

5- Presence of inferior cerebellar peduncle (I.C.P.).

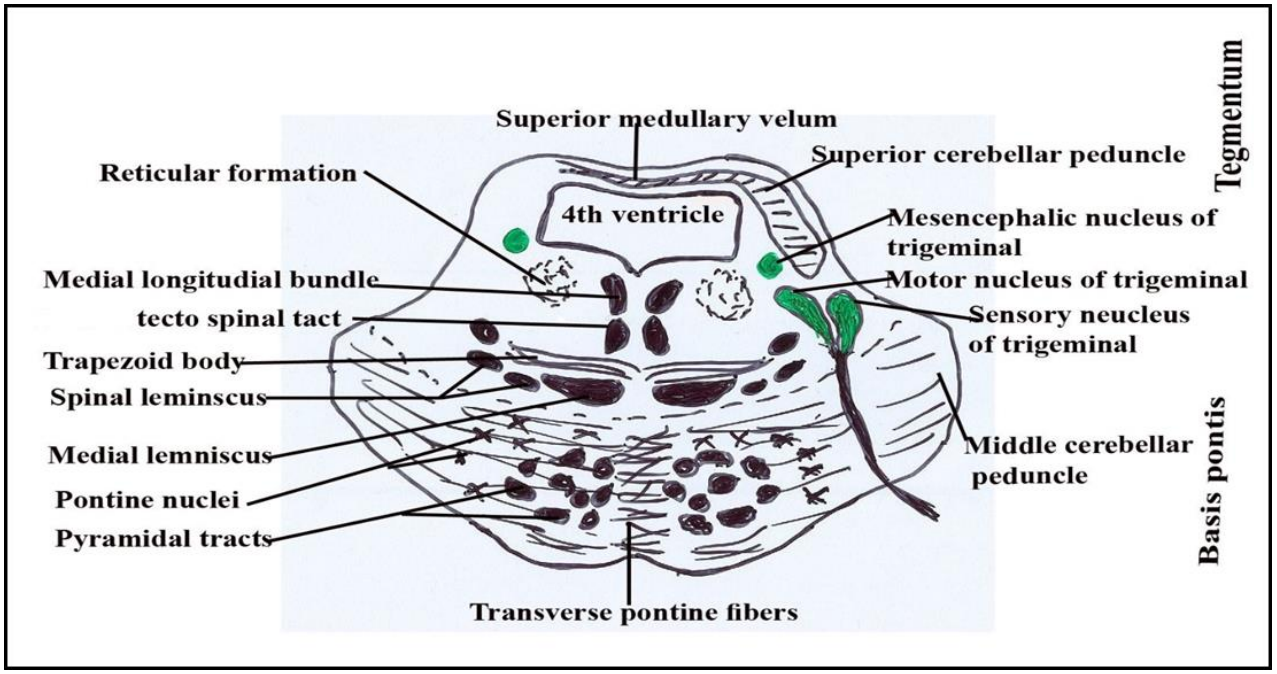
Middle level of pons (at the trigeminal nuclei)

It is characterized by the presence of:

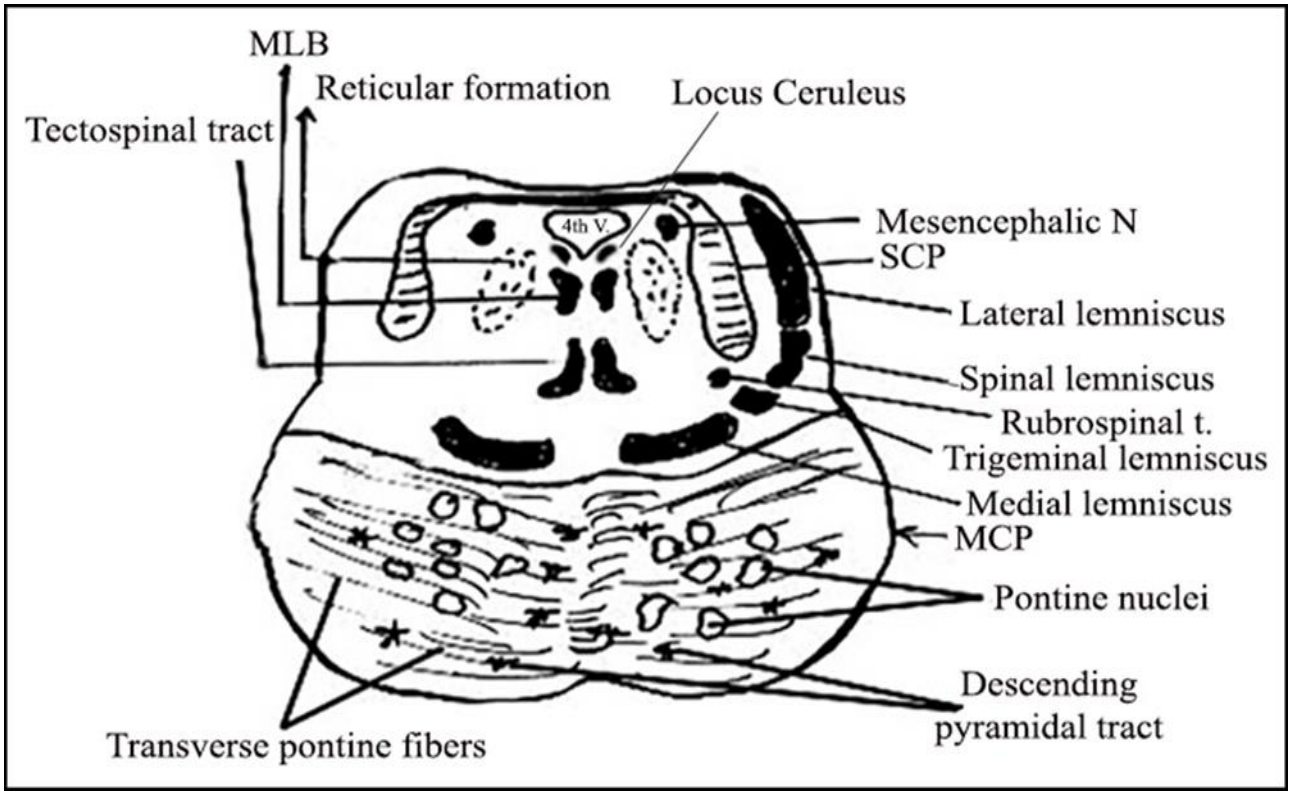
1. 4th ventricle is closed. 2. Lateral lemniscus well be seen.

3. Trigeminal nuclei (motor, main sensory & mesenchephalic nuclei).

4. Trapezoid body. 5. Superior cerebellar peduncle (S. C. P.).



Superior level of pons (site of the four lemnisci)



Superior level of pons (site of the four lemnisci)

- This level is characterized by:

1. Trapezoid body disappears. 2. Well-developed lateral lemniscus.

3. Presence of S. C. P.

4. Presence of 4 lemnisci (Medial, trigeminal, spinal & lateral leminisci).

- **Trigeminal leminiscus:** fibers from trigeminal nuclei (spinal, main sensory and mesencephalic) cross to opposite side, ascend in pons and midbrain to thalamus.

5. Mesenchephalic nucleus of V cranial nerve (trigeminal).

6. Presence of Locus Ceruleus nucleus (noradrenergic neurons)

Locus Ceruleus

1. It is a nucleus located in the posterior area of the rostral (superior) pons at the lateral edge of the 4th ventricle.

2. It is composed of medium-size pigmented neurons containing melanin granules.

3. Locus ceruleus is the main source of noradrenaline supplying all the neuraxis that utilize norepinephrine as their primary neurotransmitter:

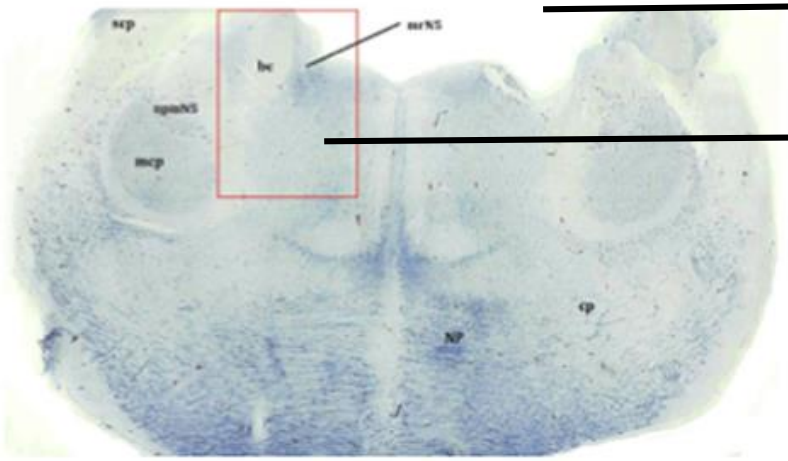
a) Cerebral Cortex b) Cerebellar cortex c) Thalamus, subthalamus

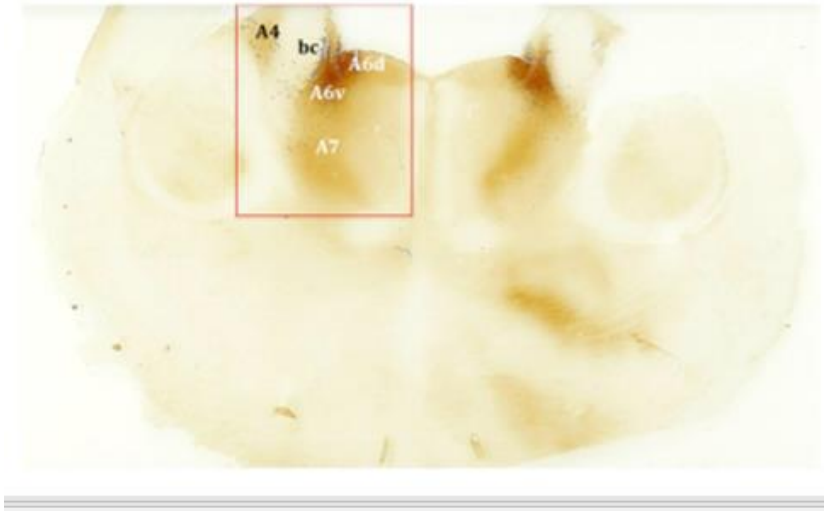
and hypothalamus d) Brain stem e) Spinal cord (sympathetic nuclei)

4. It is subdivided into four nuclei: 1- Central nucleus 2, 3- Subceruleus

nuclei (ventral and caudal) 4- Rostral nucleus.

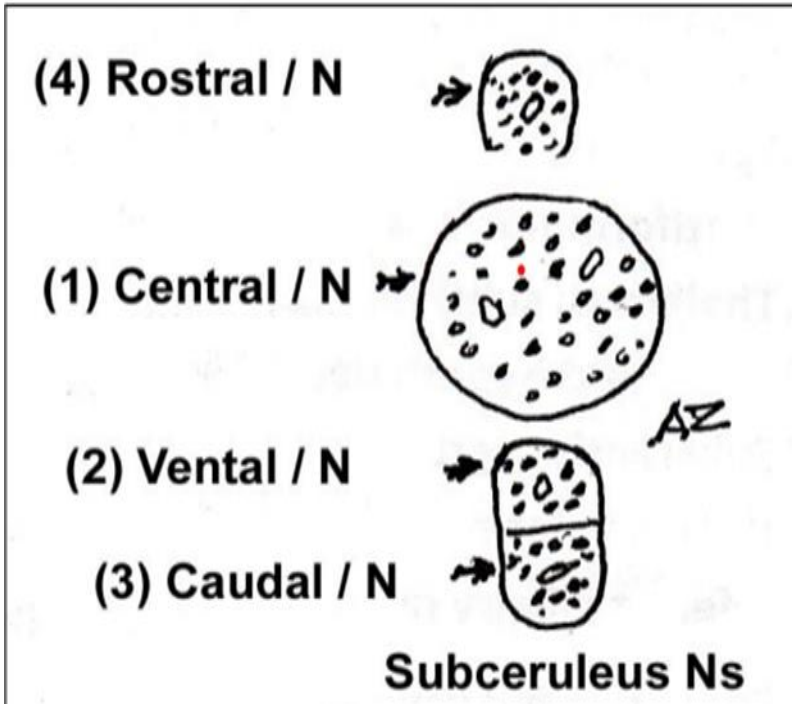
- They contain 16.000 - 18.000 cells on each side





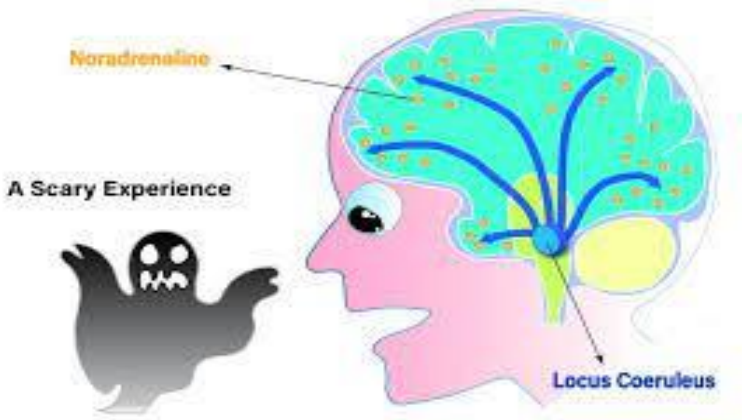
4th Ventricle

Locus cerulus



6. Microscopically, it consists of grey matter (bodies of nerve cells, dendrites, unmyelinated axons and neuroglia).

7. It is a part of the reticular activating system and involved with physiological responses to stress and panic.



8. Lesion of ascending supply leads to:

I- Alzheimer (Rostral part)

II-Parkinsonism (generalized loss)

III- Downs syndrome (With one transverse crease of hand)

9. Lesion of descending supply leads to Horner`s syndrome (miosis, anhydrosis and enophthalmos


Thank
you