

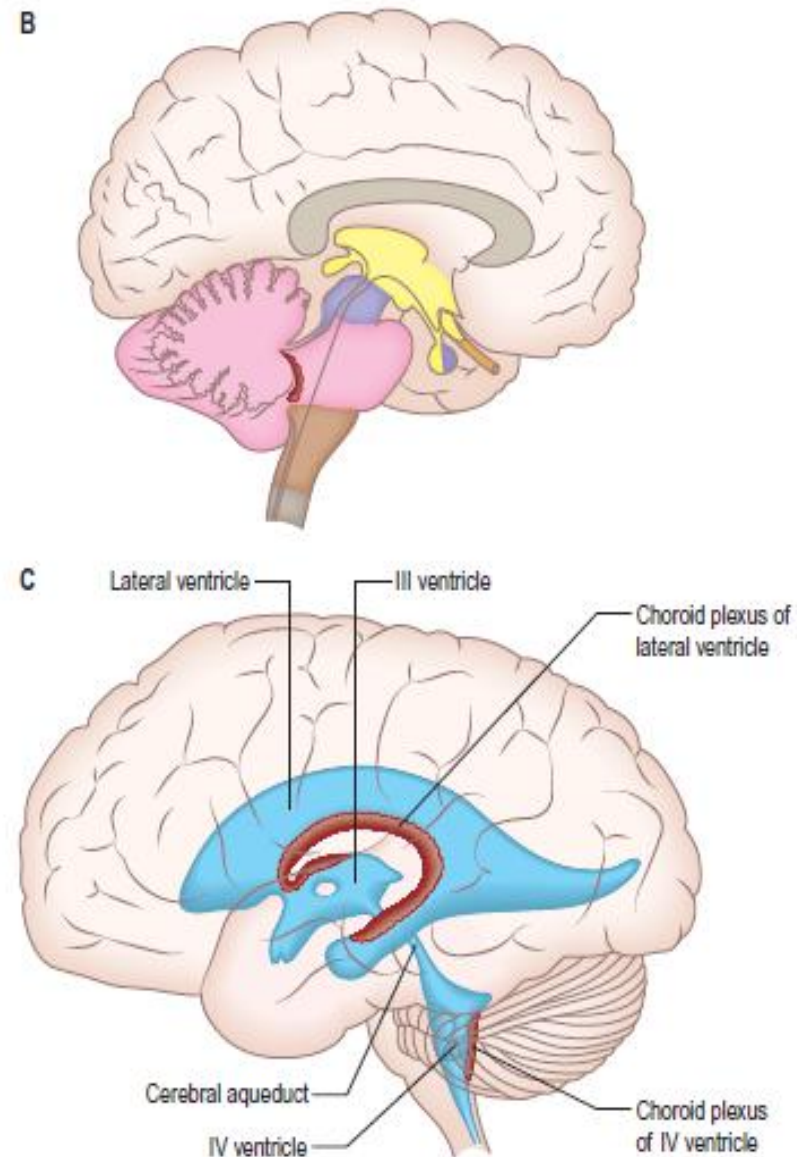
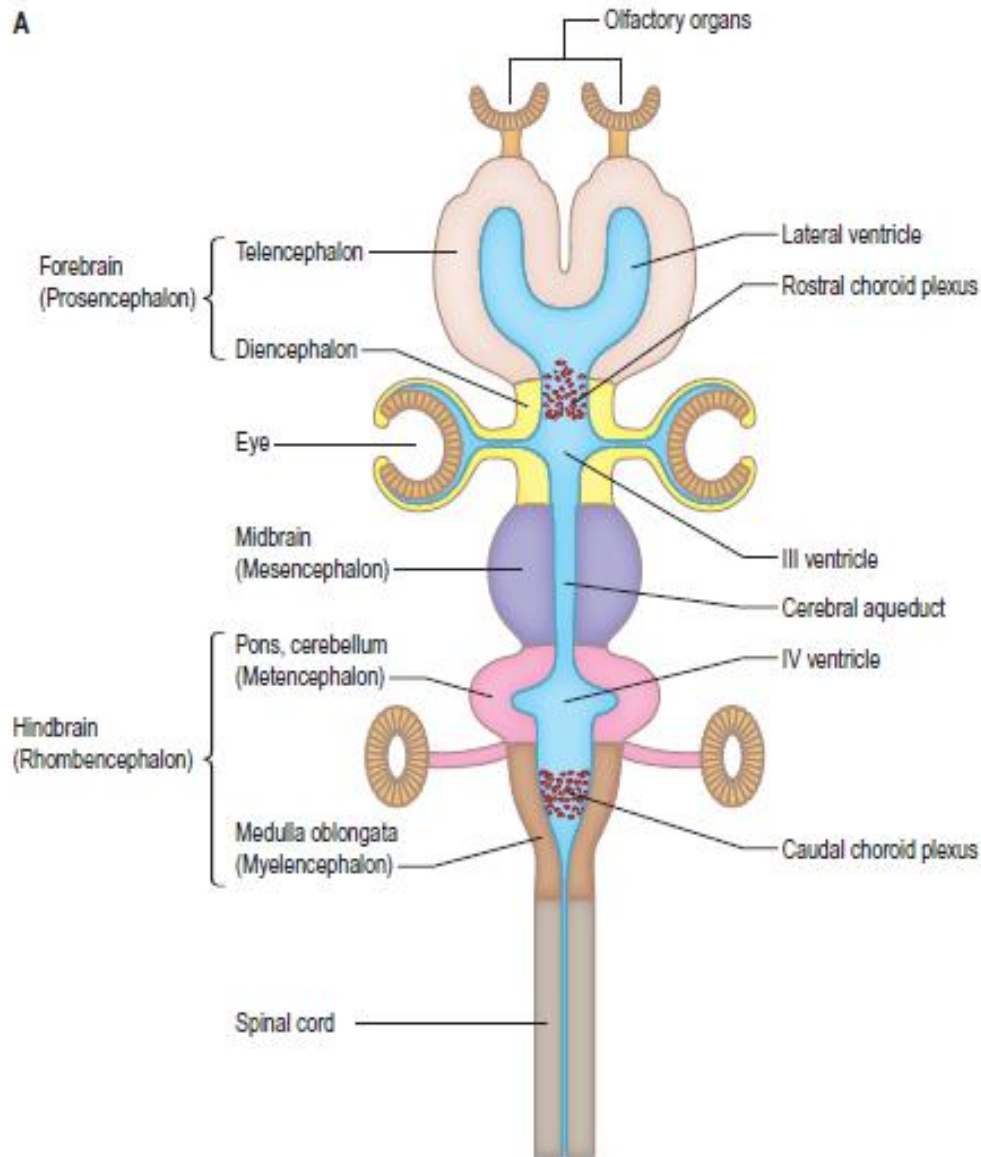
- Today we will discuss about
 - > which CN carries which type of fibers (functional component)
 - > main nuclei of each cranial nerve and supranuclear connections
 - > foramen /fissure of skull through which cranial nerves enter or leave the skull
- We will be discussing detailed course and distribution , functions and effect of lesion of different CNs nerves in our upcoming classes .

- To orient you people to the topic we will go through some of the points already discussed in our previous classes on CNs then we will come to today's topic .
- We have already discussed
 - > number and names of different CNs
 - > functional components of CNs ,
 - > development , orientation and positioning of different CN nuclei in brainstem
 - > connection of different CNs to brain and position on brain surface where they enter or leave the brain .

- There are **12 pairs** of cranial nerves, which leave the brain and pass through foramina and fissures in the skull.
- All the nerves are distributed in the head and neck, except cranial nerve X, which also supplies structures in the thorax and abdomen.
- The cranial nerves are named as follows:

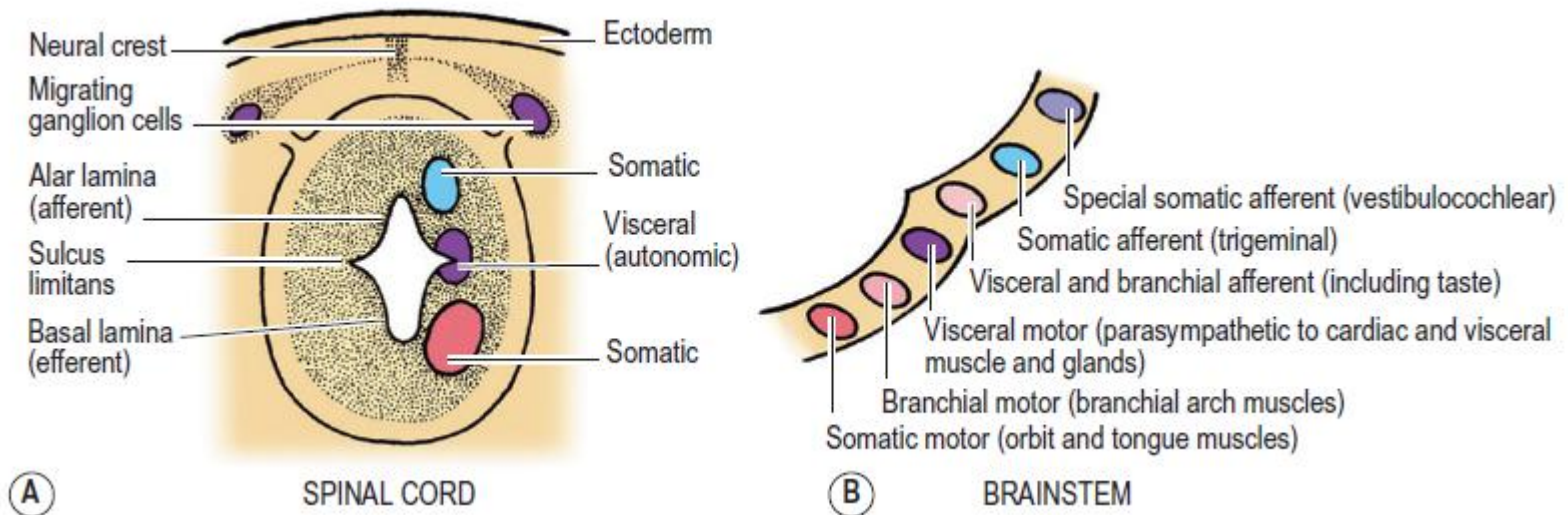
CN I	Olfactory
CN II	Optic
CN III	Oculomotor
CN IV	Trochlear
CN V	Trigeminal
CN VI	Abducent
CN VII	Facial
CN VIII	Vestibulocochlear
CN IX	Glossopharyngeal
CN X	Vagus
CN XI	Accessory
CN XII	Hypoglossal

Nomenclature and arrangement of major divisions of brain



Cell groups of the spinal cord and brainstem :

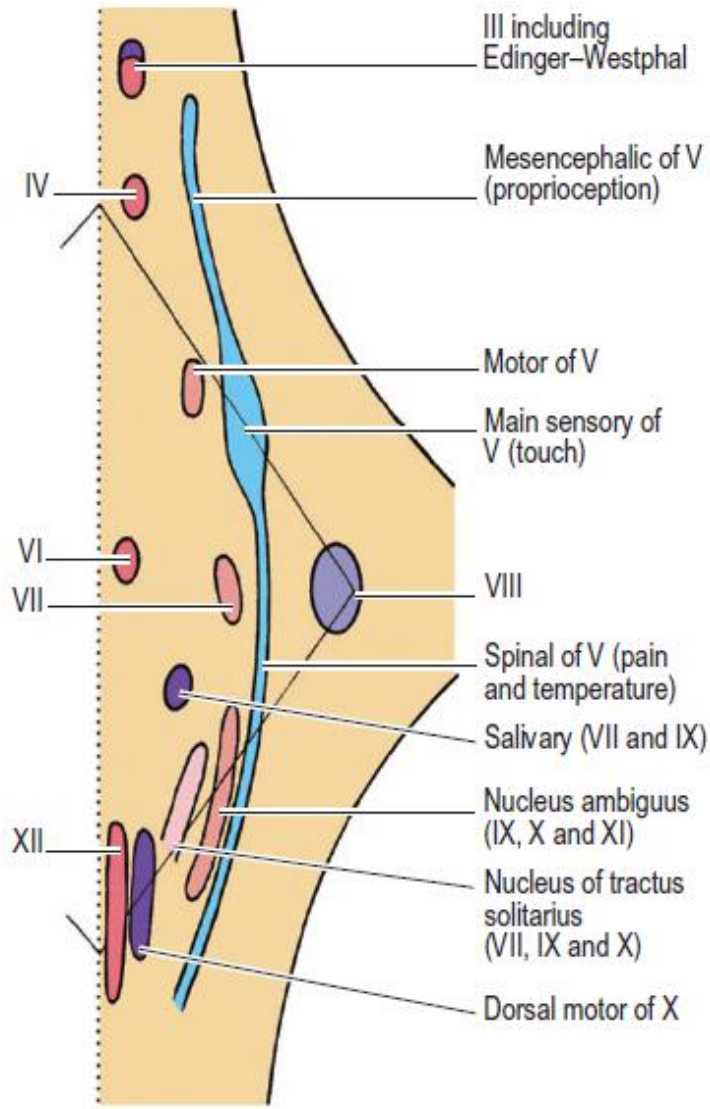
- A. **in the developing spinal cord**, where motor cells are ventral and sensory cells dorsal with autonomic cells in between;
- B. **in the brainstem** (floor of the fourth ventricle) which resembles an 'opened out' spinal cord(opened from behind), with motor cells now lying medially and sensory cells laterally with autonomic cells in between.



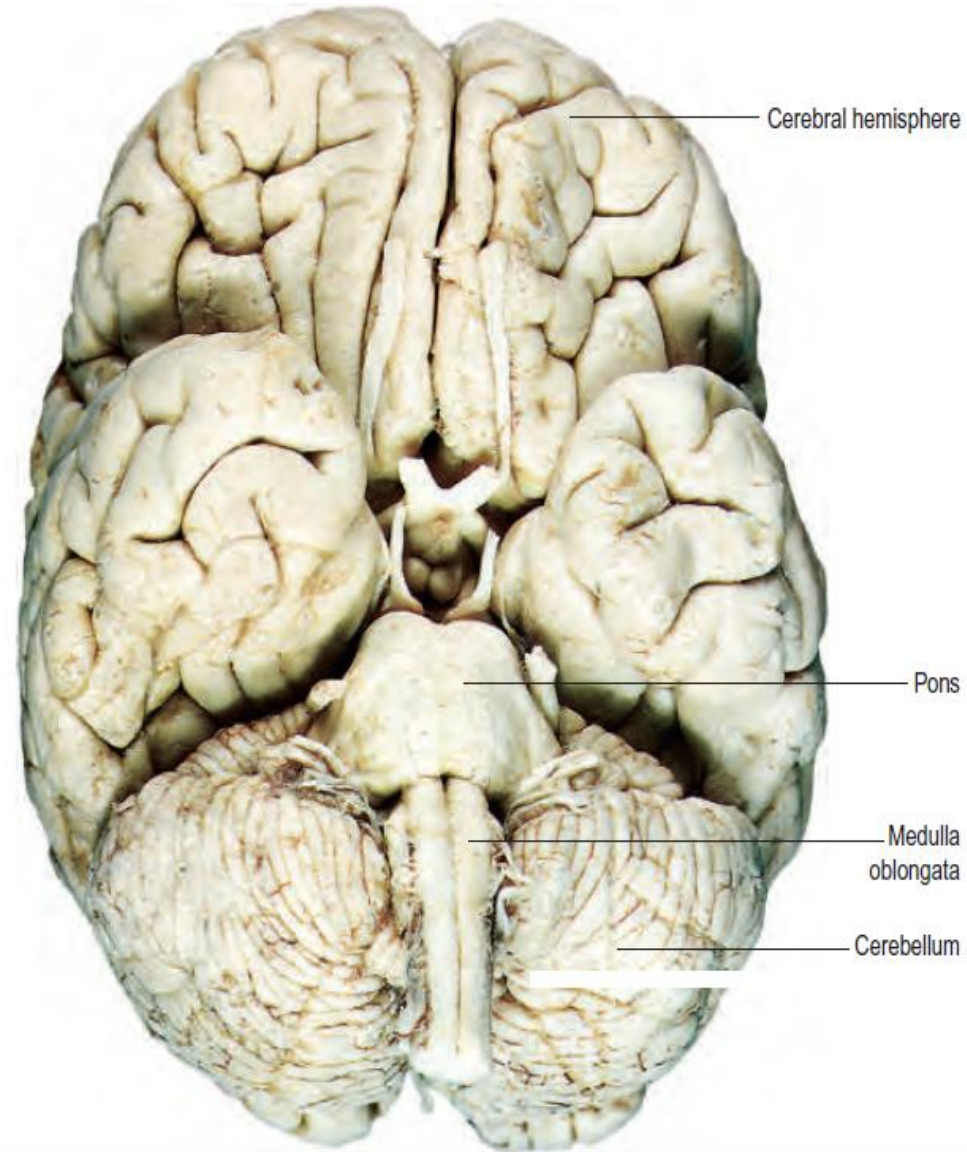
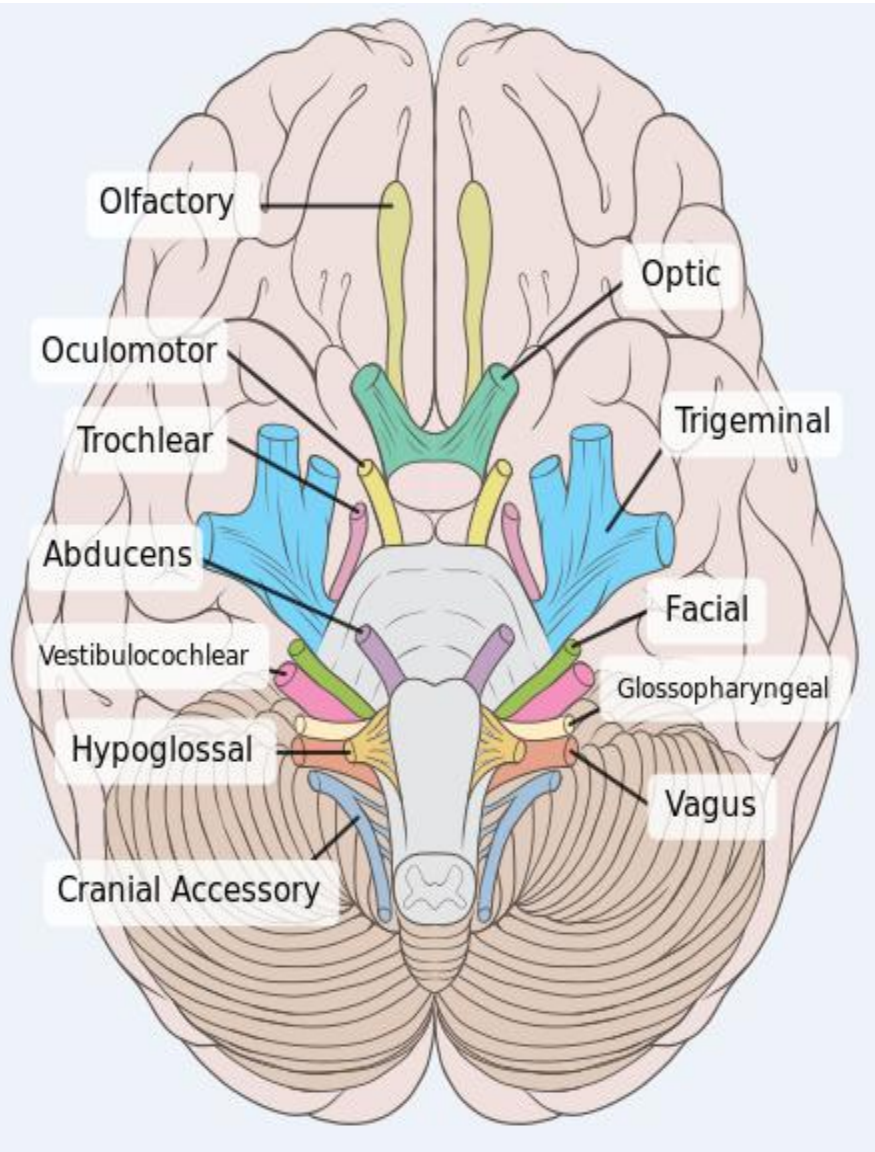
Functional Components of Each Cranial Nerve

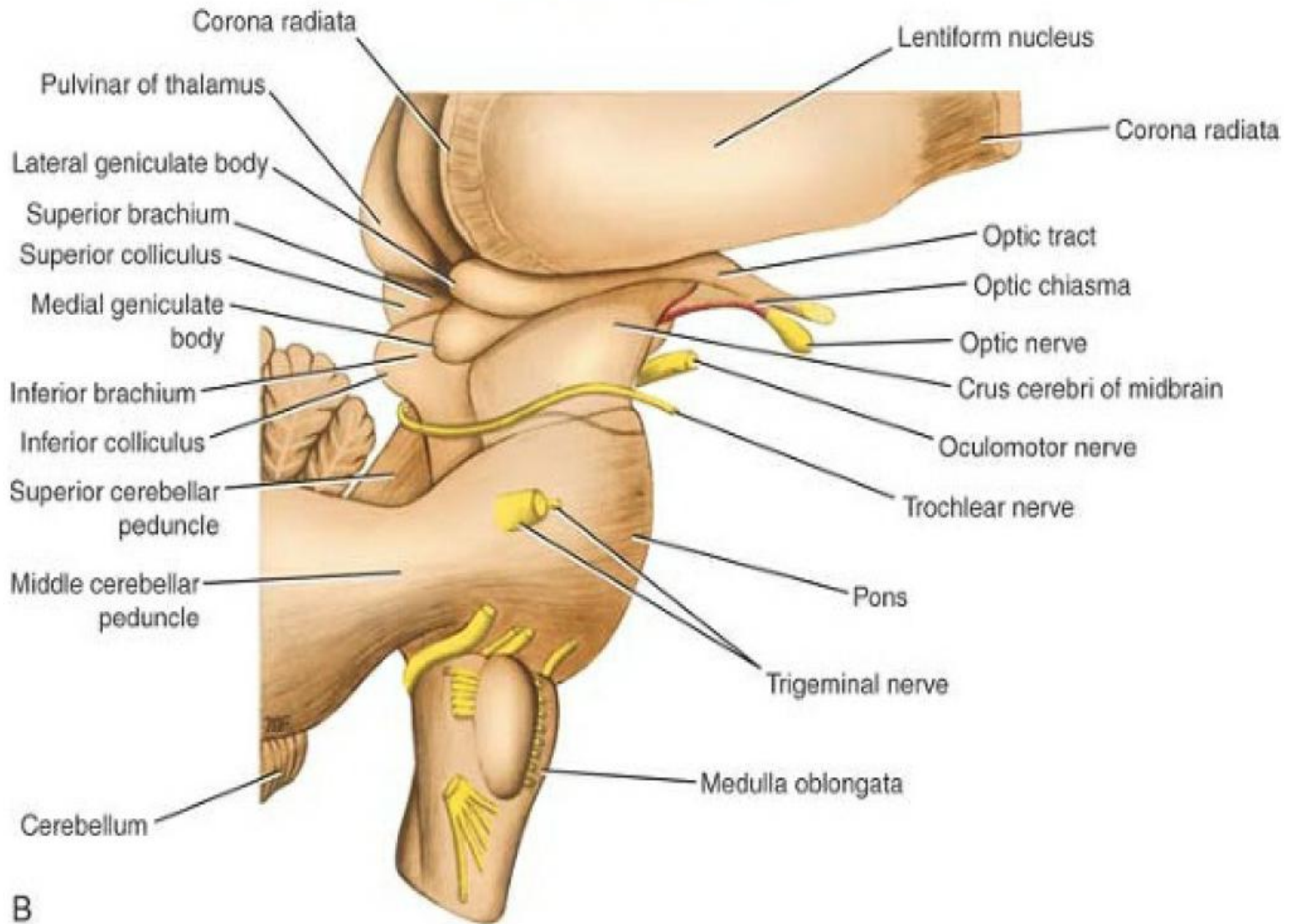
Component	Function	Letter Symbols
Afferent Fibers	Sensory	
General somatic afferent	General sensations	GSA
Special somatic afferent	Hearing, balance, vision	SSA
General visceral afferent	Viscera	GVA
Special visceral afferent	Smell, taste	SVA
Efferent Fibers		
General somatic efferent	Somatic striated muscles	GSE
General visceral efferent	Glands and smooth muscles (parasympathetic innervation)	GVE
Special visceral efferent	Branchial arch striated muscles	SVE

Sites of cranial nerve nuclei in the right half of the brainstem as seen from the dorsal aspect.

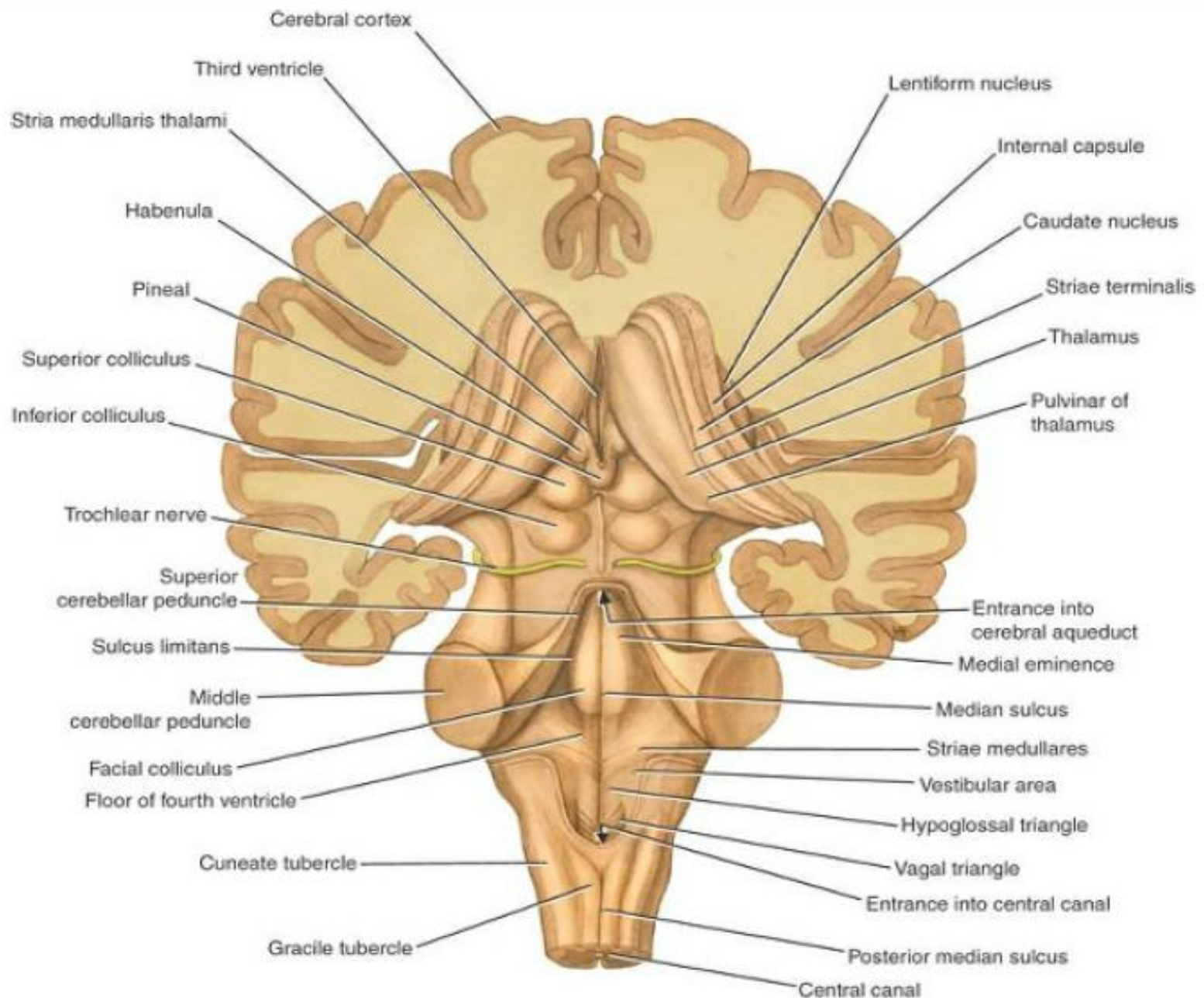


CNs close to brains inferior surface





B



CRANIAL NERVE ORGANIZATION

- **CNs can be**
 - > entirely sensory - CN I, CN II, and CN VIII
 - > entirely motor - CN III , CN IV, CN VI , CN XI , CN XII
 - > mixed with both motor and sensory components – CN V , CN VII , CN IX , CN X
- **The cranial nerves have**
 - > motor / sensory nuclei in the brain (part of CNS)
 - > nerve fibers emerging from or entering these nuclei leave brain surface and pass through the skulls foramina and fissures to reach their effector or sensory organs – they form **part of PNS** (peripheral nervous system) .
 - > nuclei of cranial nerves are further controlled by inputs coming from higher centres of brain like cerebral cortex and diencephalon – these are the **supranuclear connections** of CN nuclei .

Distribution of functional components in different cranial nerves

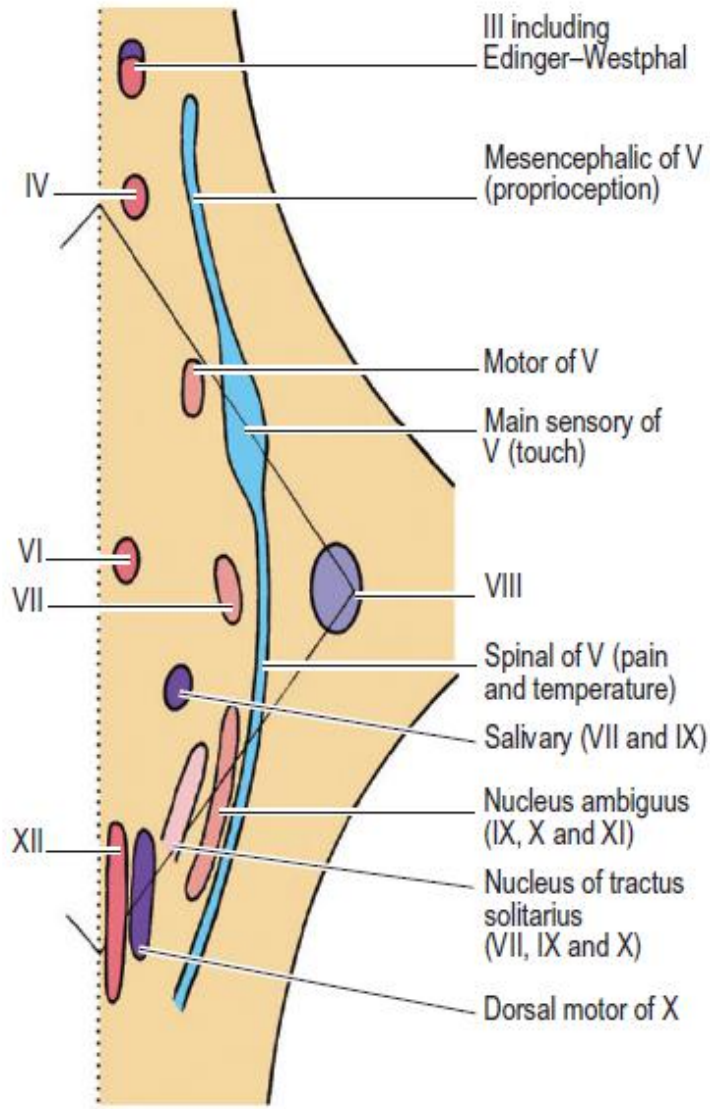
- Efferent fibers
 - > GSE - CN III , CN IV , CN VI , CN XI , CN XII
 - > SVE - CN V , CN VII , CN IX, CN X , CN XI
 - > GVE - CN III , CN VII , CN IX , CN X

- Afferent fibers
 - > GVA - CN IX , CN X
 - > SVA - Olfaction(CN I) , taste (CN VII , CN IX , CN X)
 - > GSA - CN V , CN VII , CN IX , CN X
 - > SSA - CN II (vision) , CN VIII (hearing and balance)

We can study the fact in previous slide nerve wise

- CN I - SVA (olfaction)
- CN II - SSA (vision)
- CN III - GSE , GVE
- CN IV - GSE
- CN V - SVE , GSA
- CN VI - GSE
- CN VII - SVE , GVE , SVA , GSA
- CN VIII - SSA
- CN IX - SVE , GVE , GVA , SVA , GSA
- CN X - SVE , GVE , GVA , SVA , GSA
- CN XI - SVE , GSE
- CN XII - GSE

Sites of cranial nerve nuclei in the right half of the brainstem as seen from the dorsal aspect.



CN nuclei and their supranuclear connections

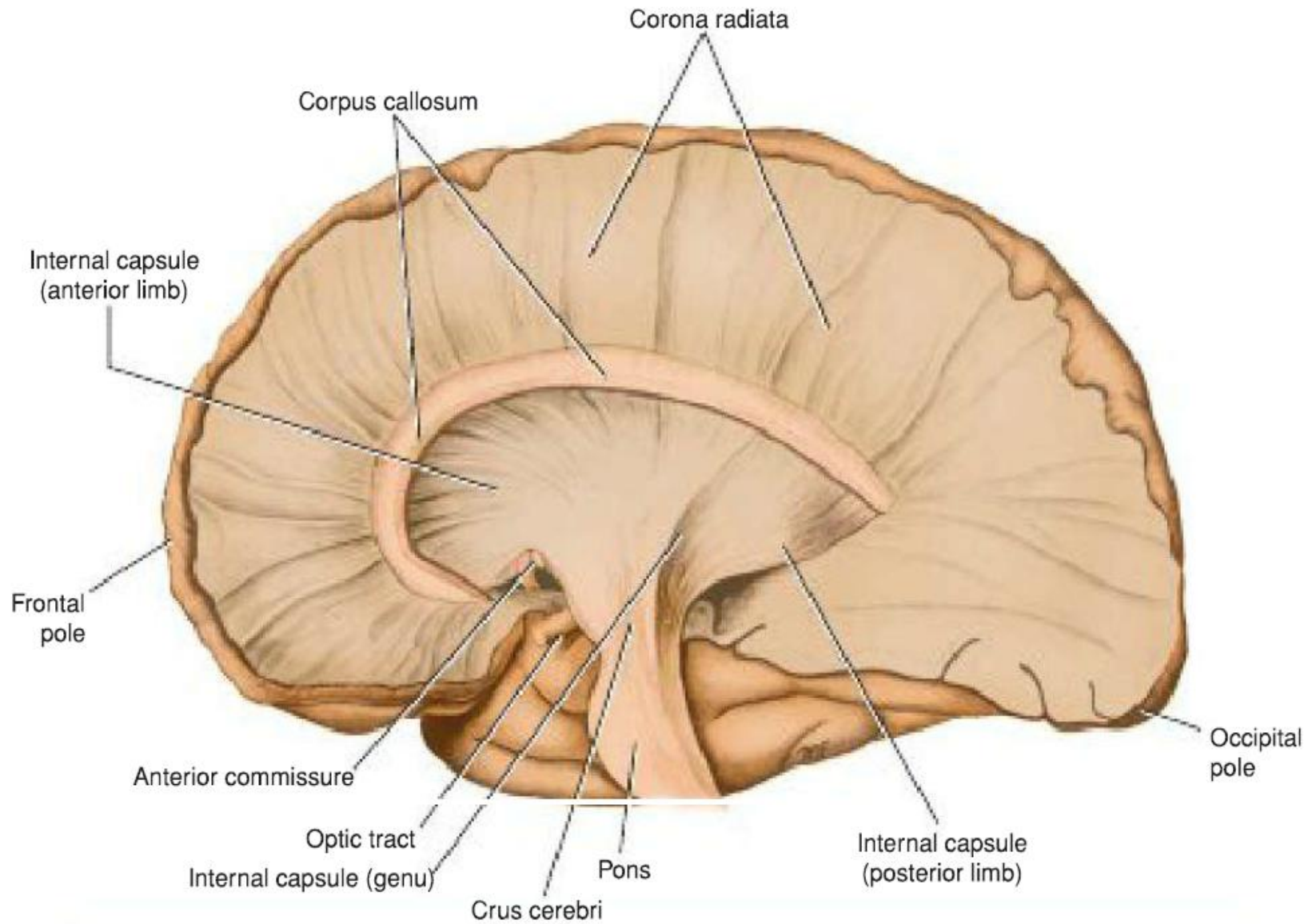
- **Cranial Nerve Motor Nuclei**
 - > Receive impulses from cerebral cortex through **corticonuclear (corticobulbar) fibers**.
 - > These fibers originate from
 - < pyramidal cells in inferior part of precentral gyrus (area 4) and
 - < adjacent part of the postcentral gyrus.
 - > The corticonuclear fibers descend through corona radiata and genu of internal capsule.
 - > They pass through midbrain just medial to corticospinal fibers in the basis pedunculi and end by synapsing
 - < either directly with lower motor neurons within cranial nerve nuclei or
 - < indirectly through the internuncial neurons.
 - > The **corticonuclear fibers** thus constitute the **first-order neuron of descending pathway**, the **internuncial neuron** constitutes the **second order neuron**, and the **lower motor neuron** constitutes the **third-order neuron**.

- > Majority of corticonuclear fibers to motor cranial nerve nuclei cross the median plane before reaching the nuclei.

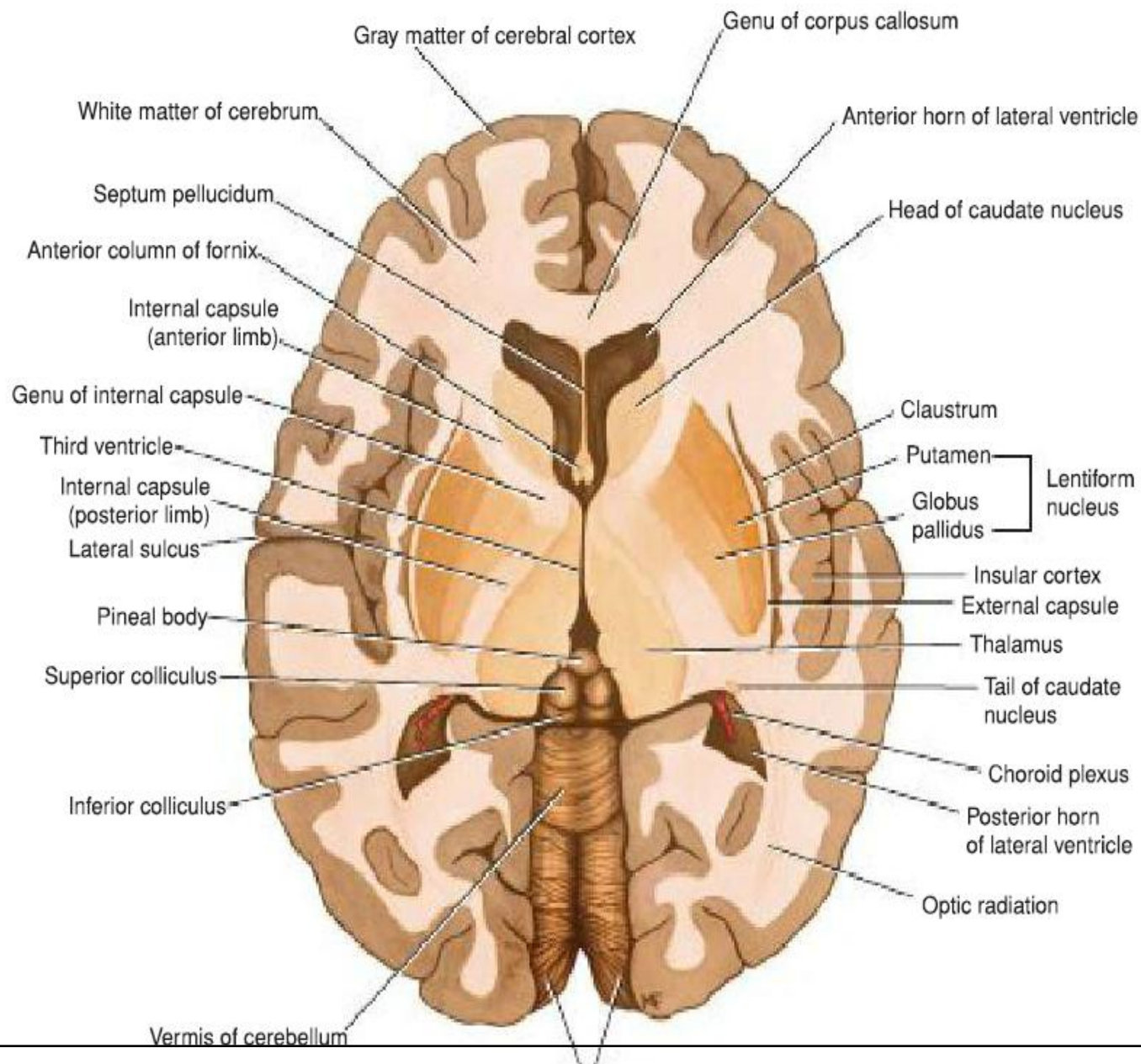
- > Bilateral connections are present for all cranial motor nuclei except for
 - < part of facial nucleus that supplies muscles of lower part of the face and
 - < a part of hypoglossal nucleus that supplies genioglossus muscle.

- > The corticonuclear(corticobulbar) fibers and their cell bodies constitute Upper motor neuron , while the motor nuclei and their axons entering the CNs constitute Lower motor neuron .

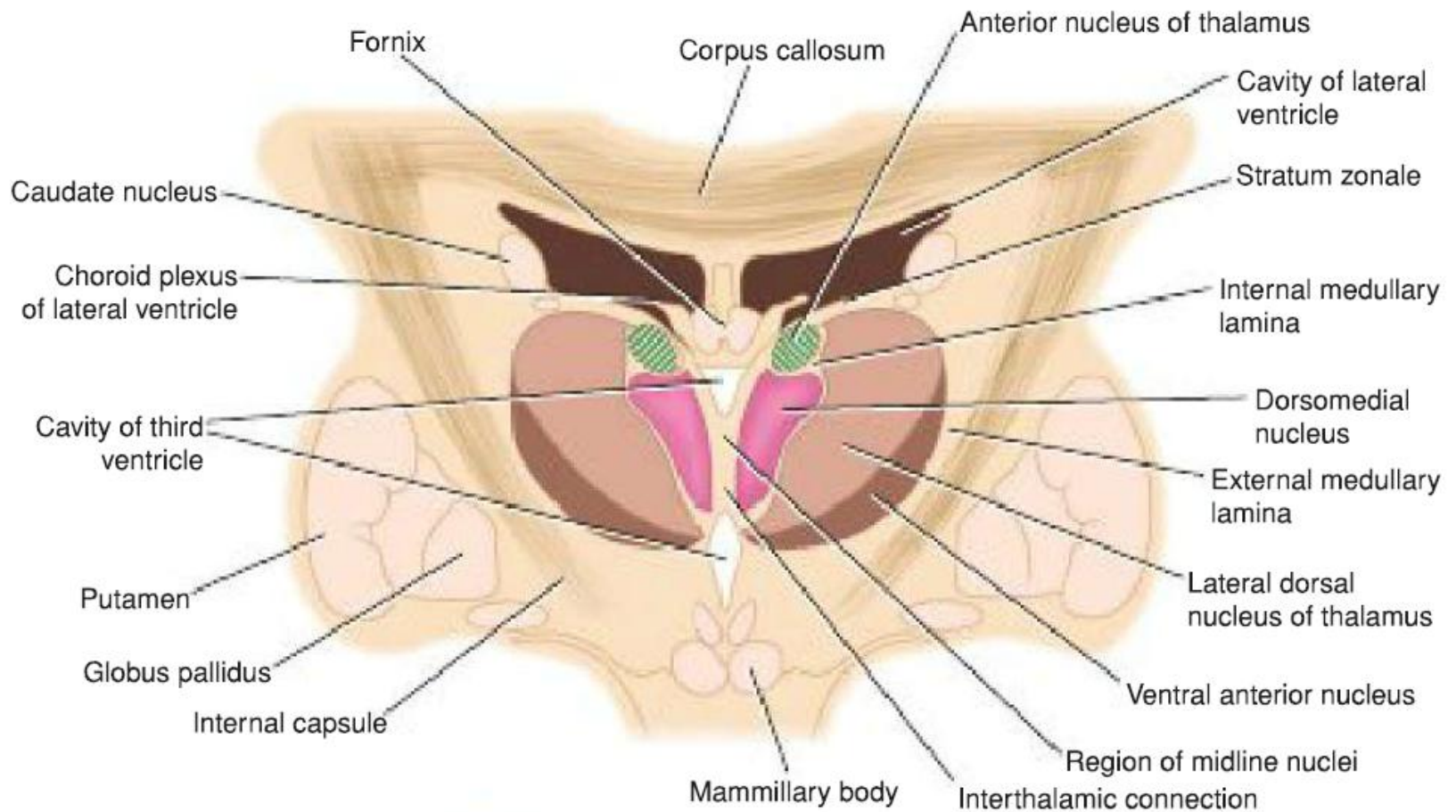
Corona radiata and internal capsule



TS(axial section) of brain depicting course of internal capsule

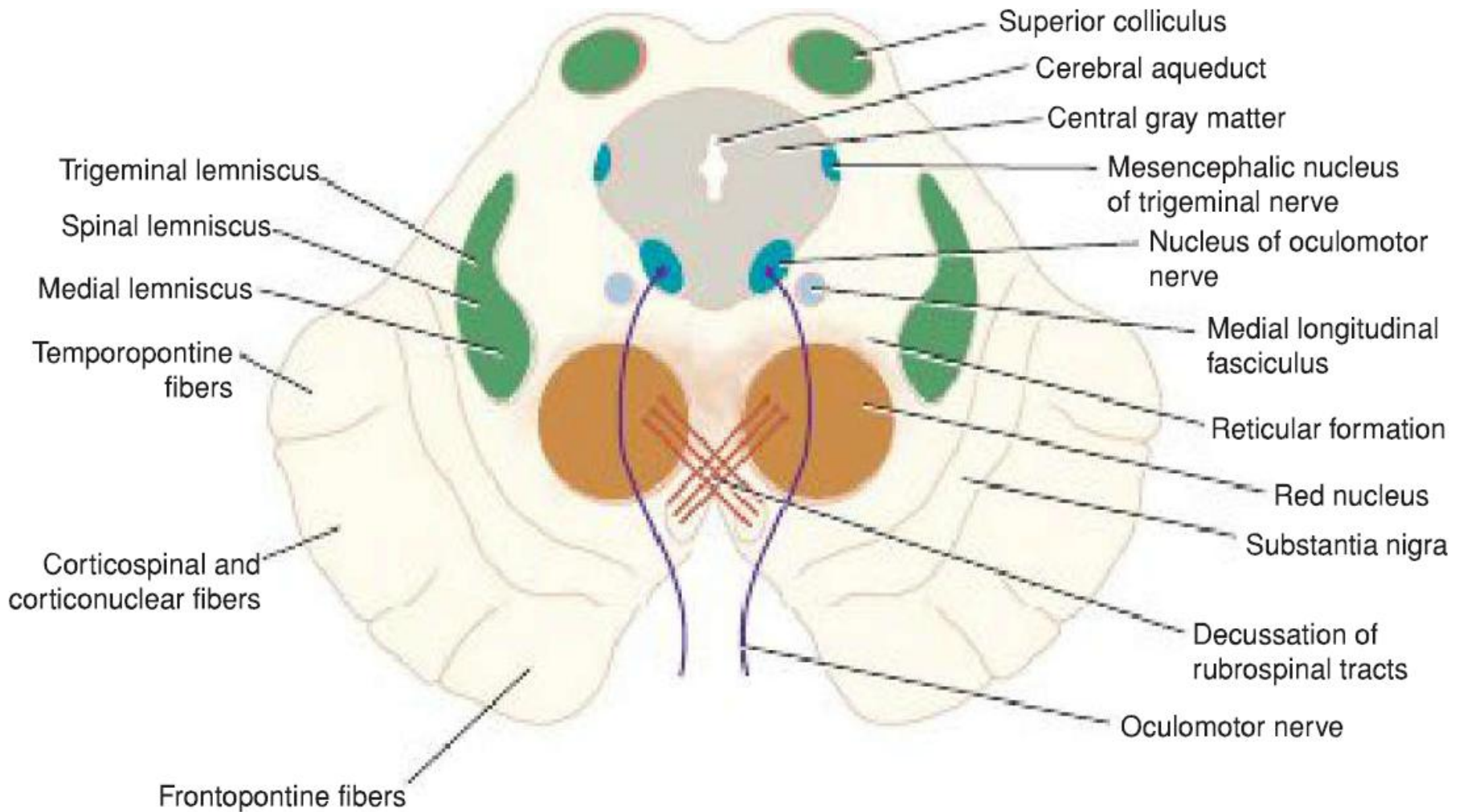


CS of brain depicting passage of internal capsule between thalamus and basal nuclei

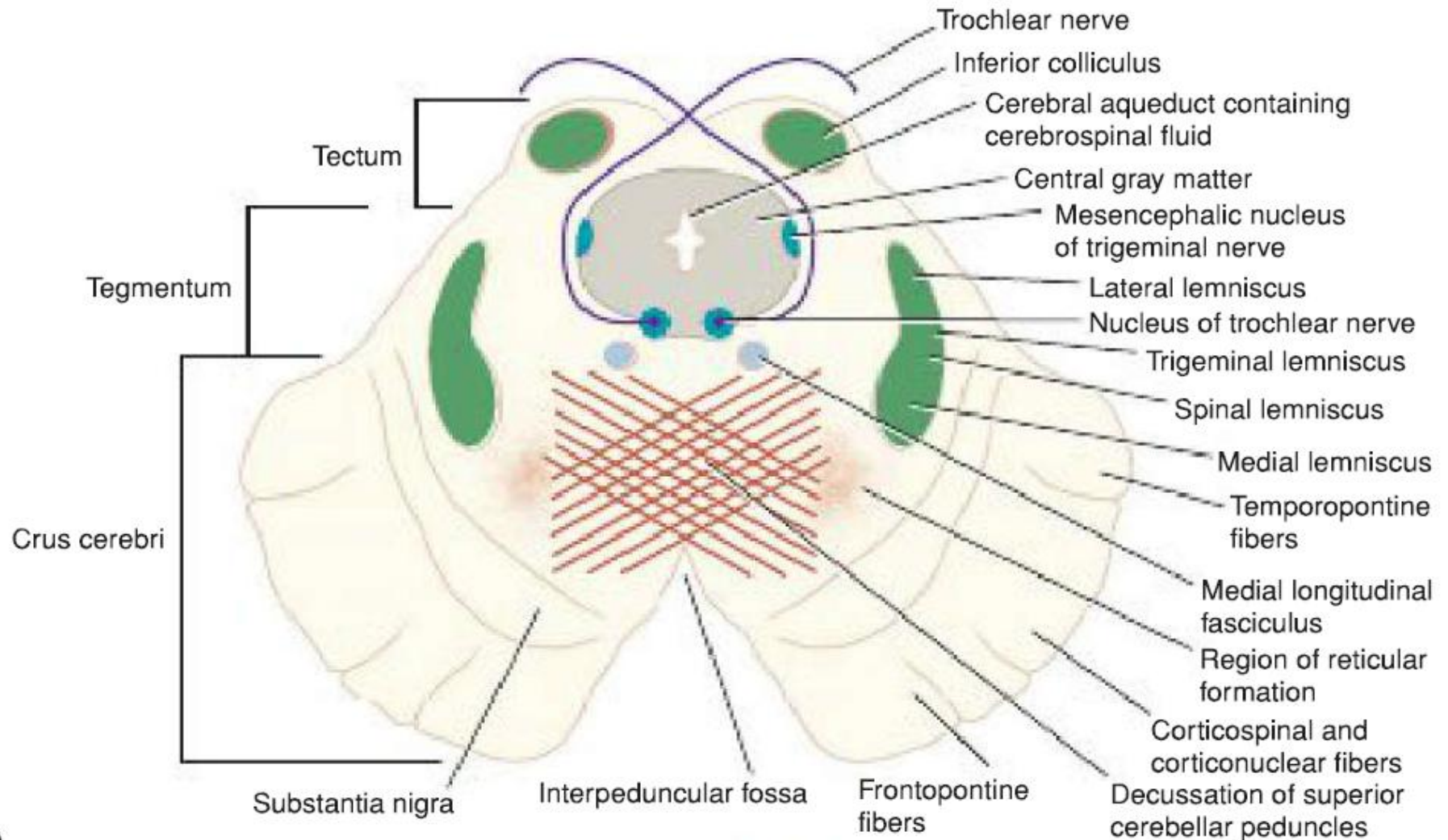


A

TS of midbrain at level of superior colliculus

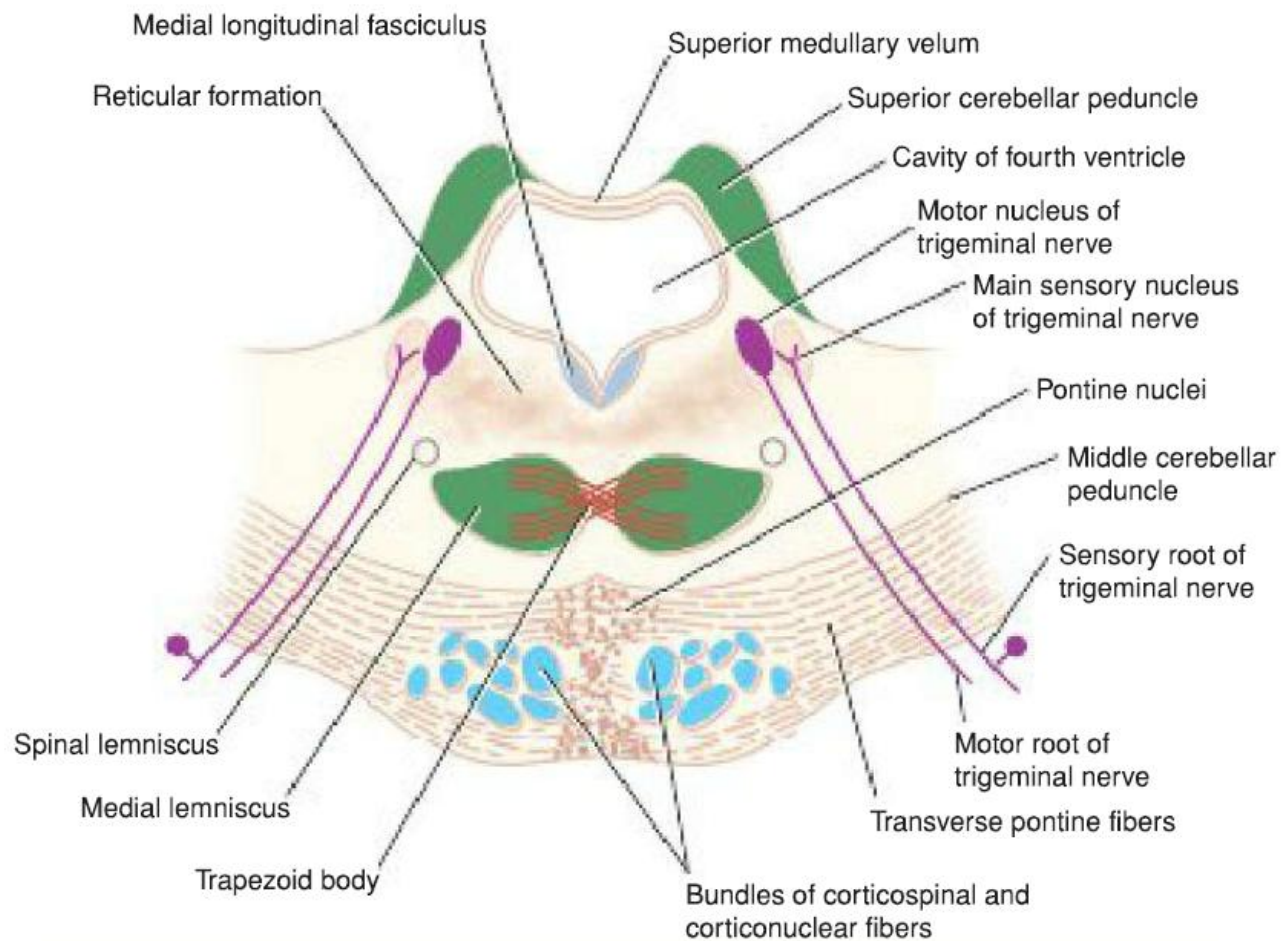


TS of midbrain at level of inferior colliculus

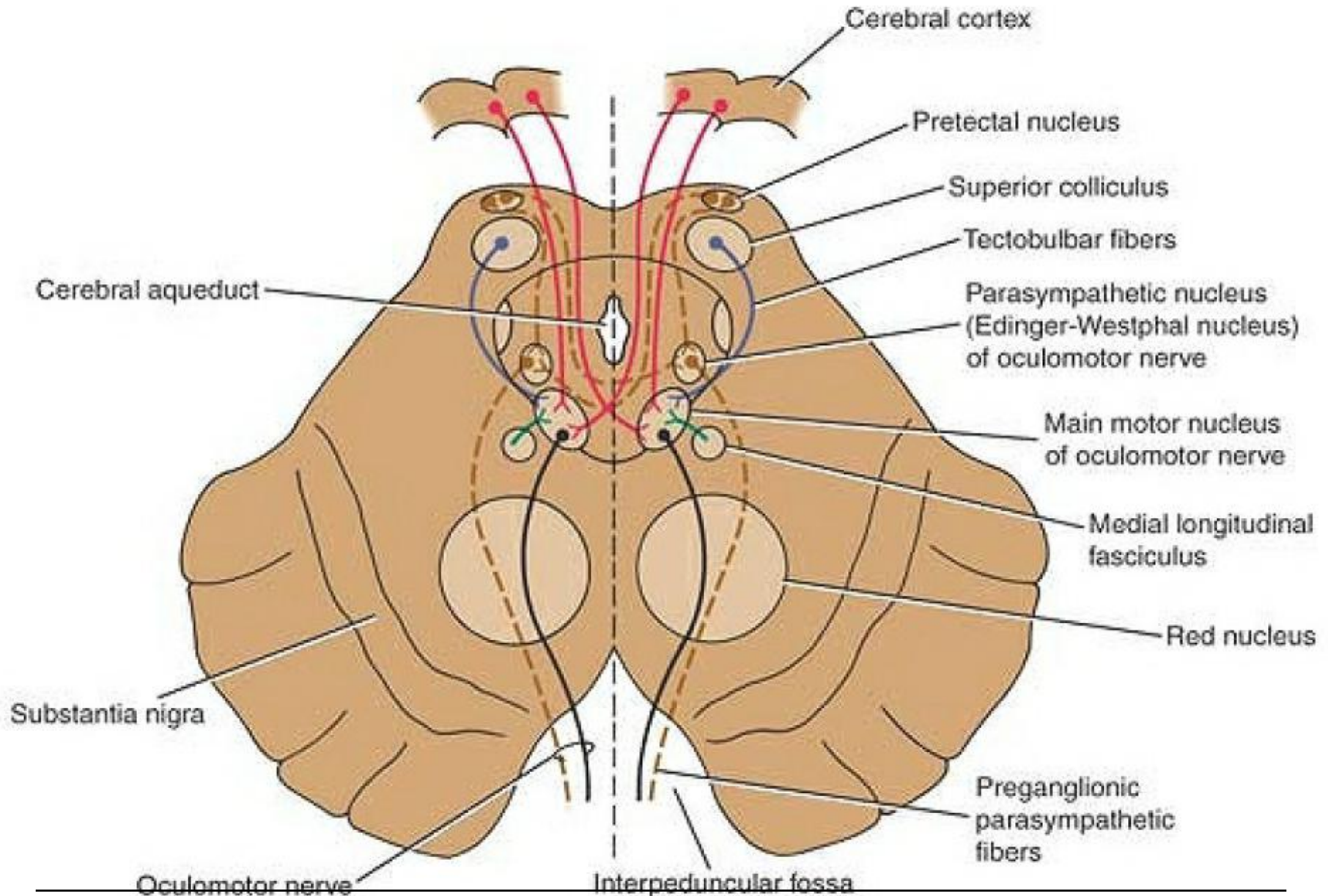


A

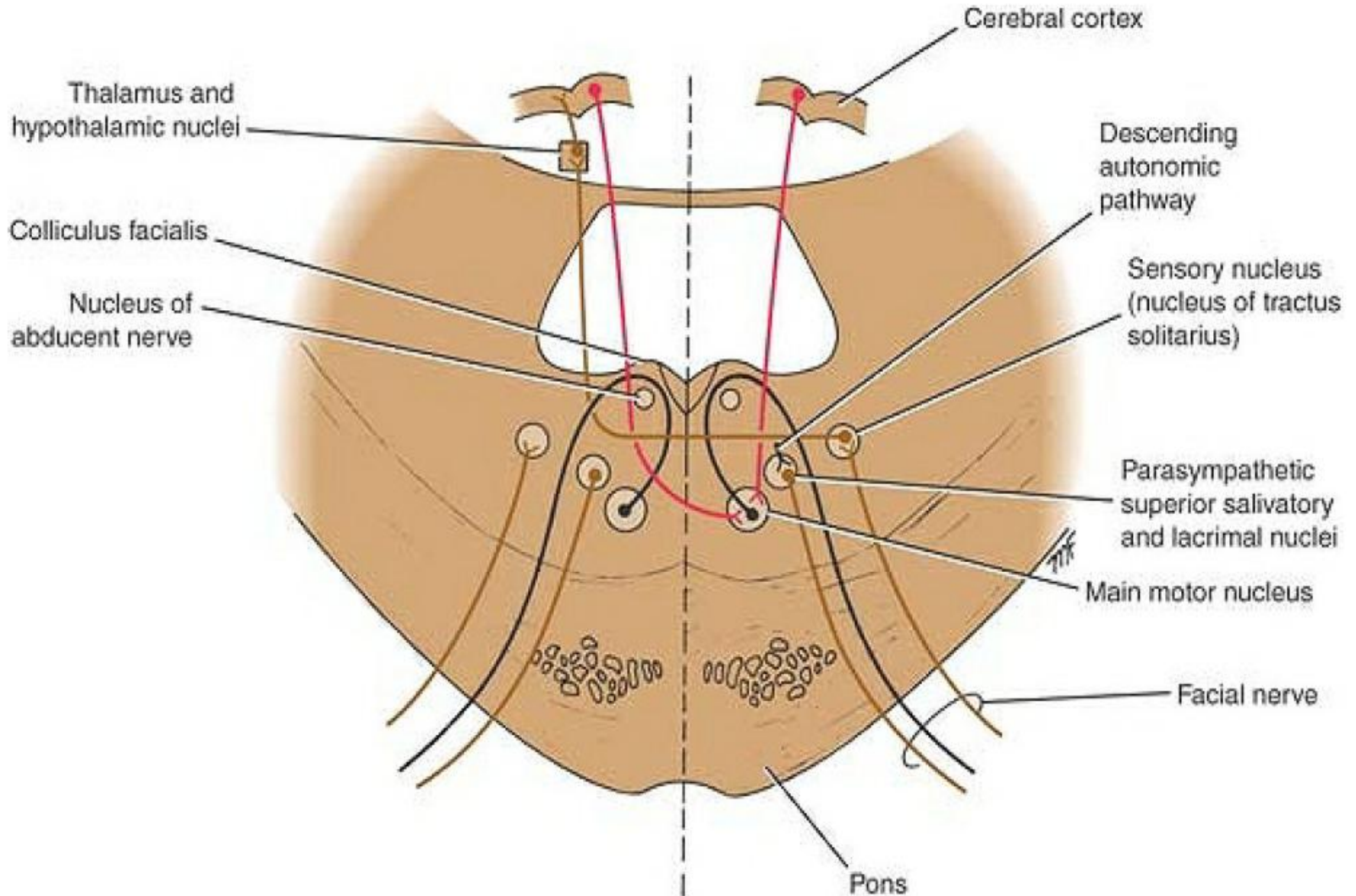
TS of pons at level of trigeminal nerve motor nucleus



Oculomotor nerve nuclei and their central connections.

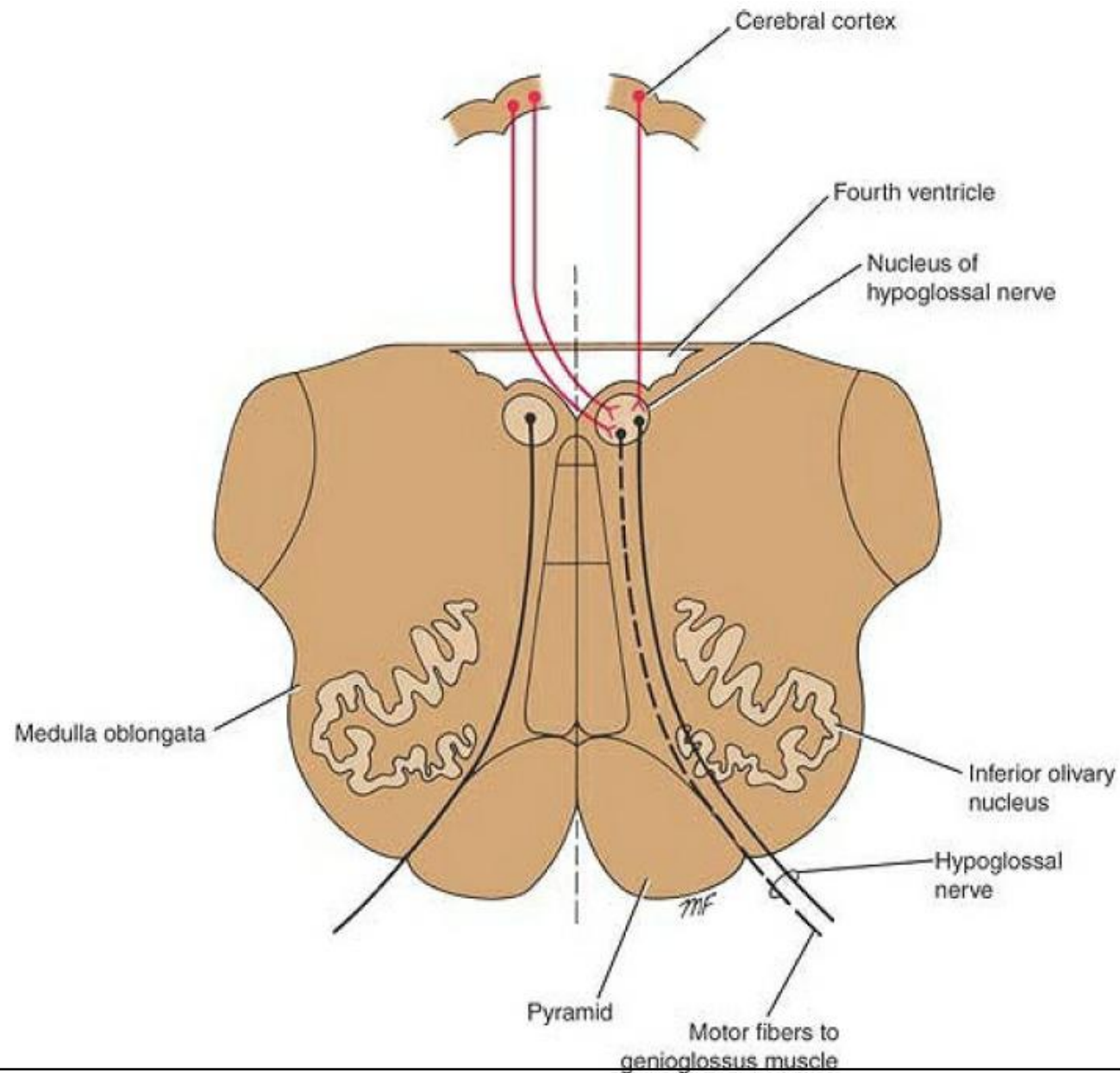


Facial nerve nuclei and their connections



- **Supranuclear connections of facial nerve nuclei**
- Part of nucleus that supplies muscles of upper part of face receives corticonuclear fibers from both cerebral hemispheres.
- Part of nucleus that supplies muscles of lower part of face receives only corticonuclear fibers from opposite cerebral hemisphere.
- Clinical implication
 - supranuclear facial nerve palsy affects lower half of face on opposite side
i.e – damage to right supranuclear fibers will produce weakness in muscles of lower half of face on left side and vice versa
 - nuclear or infranuclear palsy affects whole of face on affected side i.e. – right infranuclear palsy will cause weakness of whole of face on right side not only the lower part .

Hypoglossal nucleus and its central connections.



- It receives corticonuclear fibers from both cerebral hemispheres. However, the cells responsible for supplying the genioglossus muscle only receive corticonuclear fibers from the opposite cerebral hemisphere.
- Effect similar to lesion of supranuclear fibers of facial nerve .

- **Somatic motor and branchiomotor nuclei**

- > The somatic motor and branchiomotor nerve fibers of a cranial nerve are the axons of nerve cells situated within the brain.
- > These nerve cell groups form motor nuclei and innervate striated muscle.
- > Each nerve cell with its processes is referred to as a **lower motor neuron**.
- > Such a nerve cell is, therefore, equivalent to motor cells in anterior gray columns of the spinal cord.

- **General visceral motor nuclei**

- > Axons of cells in these nuclei form cranial outflow of parasympathetic portion of autonomic nervous system.
 - > They are
 - < Edinger Westphal nucleus of oculomotor nerve,
 - < Superior salivatory and lacrimal nuclei of facial nerve,
 - < Inferior salivatory nucleus of glossopharyngeal nerve, and
 - < Dorsal motor nucleus of the vagus.
 - > These nuclei receive numerous afferent fibers(**supranuclear connections**), including descending pathways from the hypothalamus.
-

- CN sensory nuclei

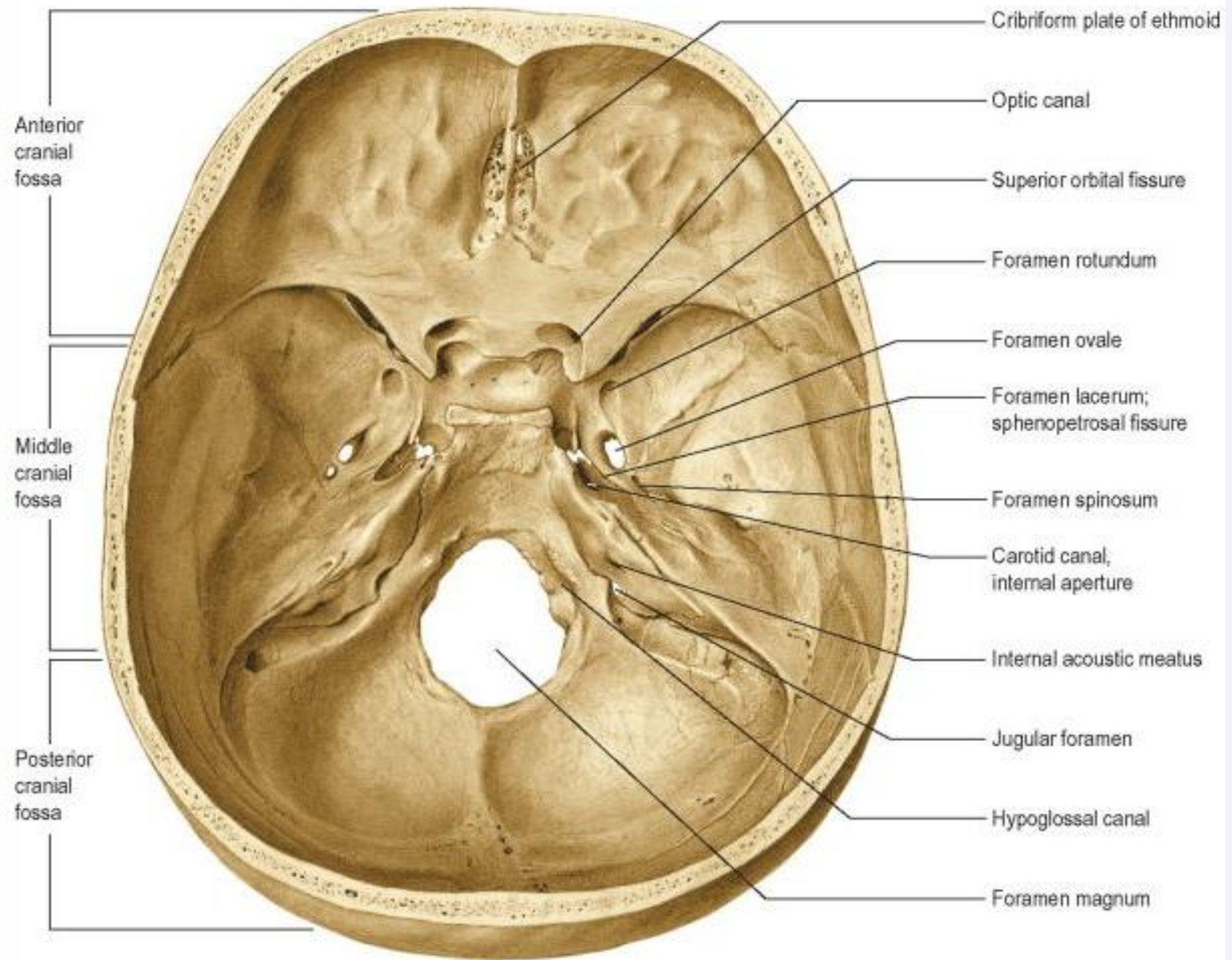
- > Sensory nuclei of cranial nerves include somatic and visceral afferent nuclei.
- > The sensory or afferent parts of a cranial nerve are the axons of nerve cells outside the brain and are situated in
 - < ganglia on the nerve trunks (equivalent to posterior root ganglion of a spinal nerve) or may be situated in
 - < a sensory organ, such as the nose, eye, or ear.

These cells and their processes form the first-order neuron. The central processes of these cells enter the brain and terminate by synapsing with cells forming the sensory nuclei.

- > Cells of sensory nuclei and their processes form the second-order neuron. Axons from these nuclear cells now cross the midline and ascend to other sensory nuclei, such as the thalamus, where they synapse.
- > The nerve cells of these other sensory nuclei such as thalamus form the third-order neuron and their axons terminate in the cerebral cortex.

Openings in skull through which CNs pass

- Cribriform plate of ethmoid - CN I
- Optic canal - CN II
- Superior orbital fissure - CN III , CN IV , CN VI , CN V (Ophthalmic division)
- Foramen rotundum - CN V (Maxillary division)
- Foramen ovale - CN V (Mandibular division)
- Internal auditory meatus - CN VII , CN VIII
- Jugular foramen - CN IX , CN X , CN XI
- Hypoglossal canal - CN XII



THANK YOU