

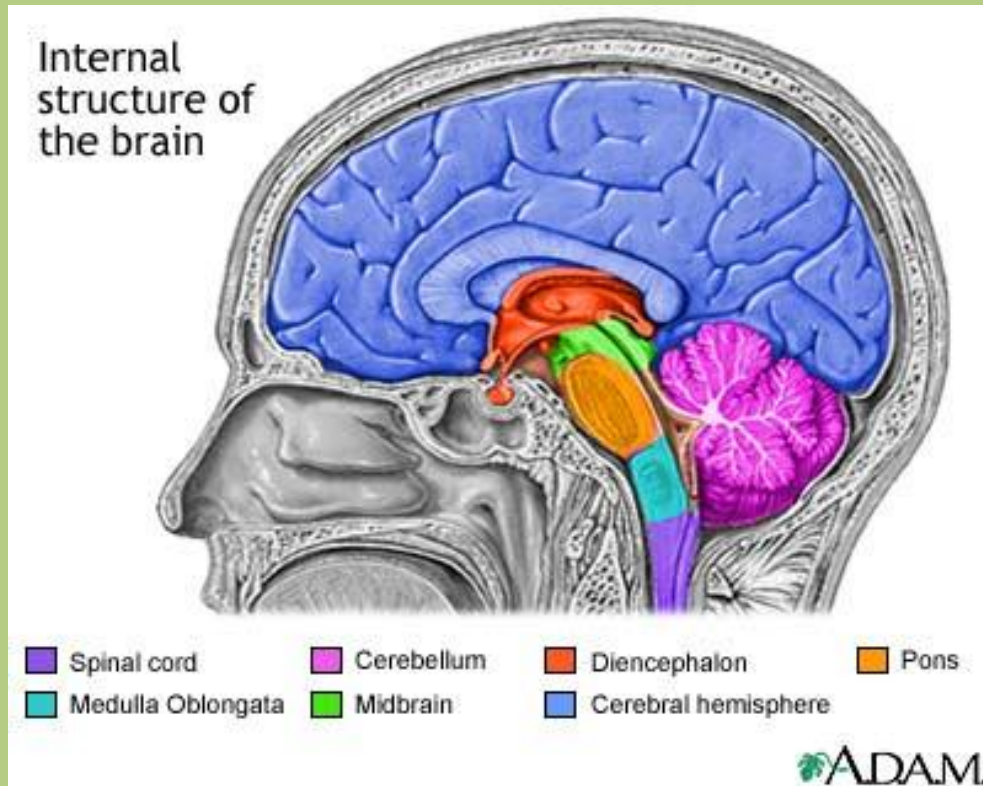


Diencephalon, brain stem, cerebellum and basal ganglia

Sándor Katz M.D., Ph.D.

Diencephalon - overview

- Located below the corpus callosum and above the midbrain
- Part of the telencephalon
- Forms the lateral wall of the third ventricle



Diencephalon

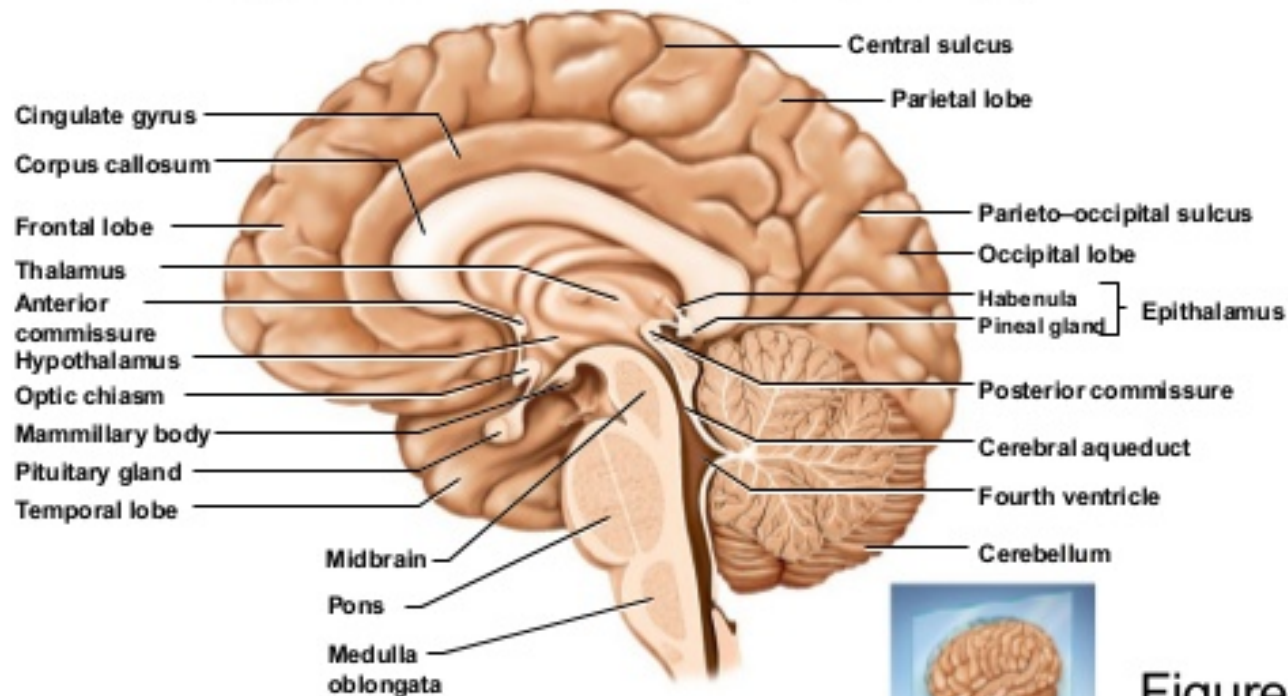


Diencephalon - parts

- Epithalamus
- Thalamus
- Subthalamus
- Hypothalamus

The Diencephalon: Epithalamus

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(a)

Figure 14.2a

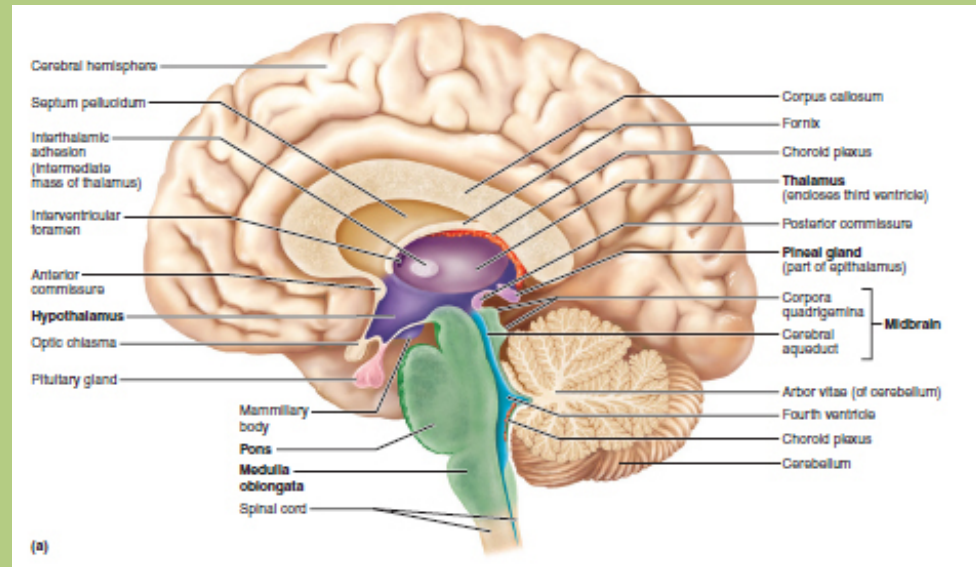
- **Epithalamus**—very small mass of tissue composed of:
 - **Pineal gland:** endocrine gland
 - **Habenula:** relay from the limbic system to the midbrain
 - Thin roof over the third ventricle

Pineal body

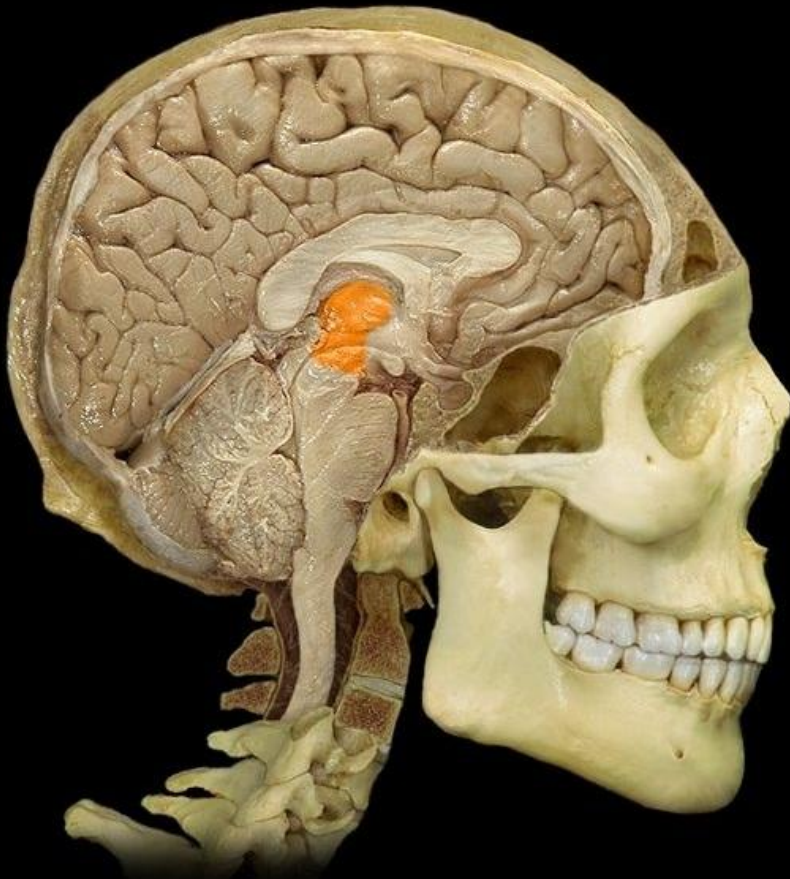


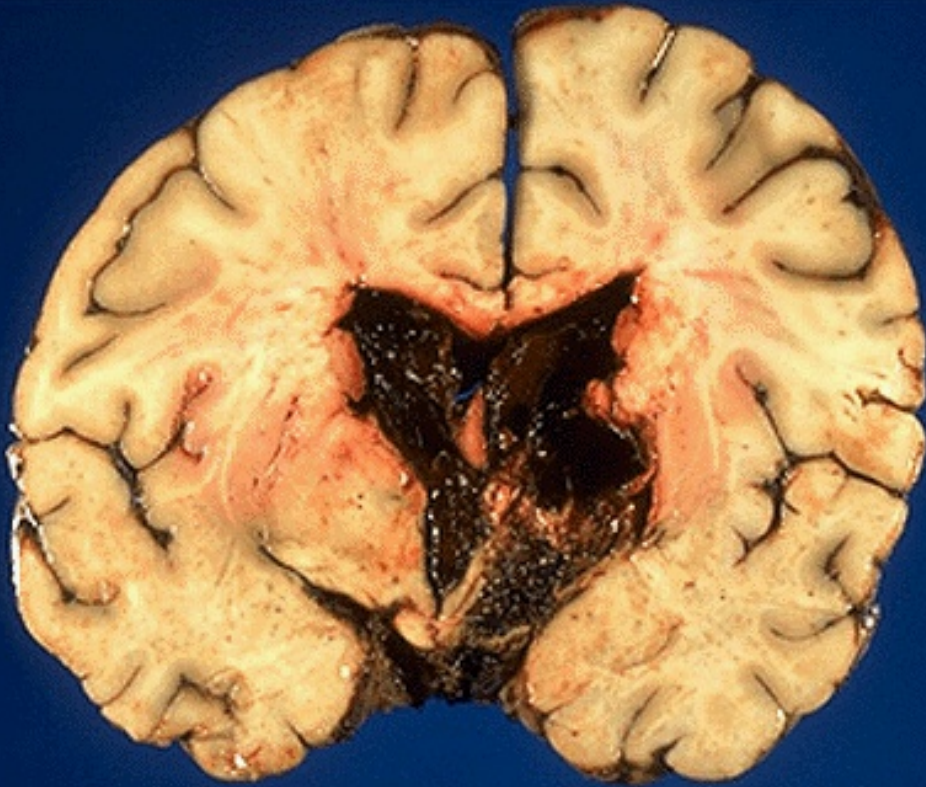
Thalamus

- Almost all of the sensory pathways are relayed via the thalamus and project to the cerebral cortex.
- Major descending motor tracts from the cerebral cortex generally bypass the thalamus.



Thalamus





Consequently, a lesion of the thalamus or its cortical projection fibers caused by a stroke or other disease leads to sensory disturbances.

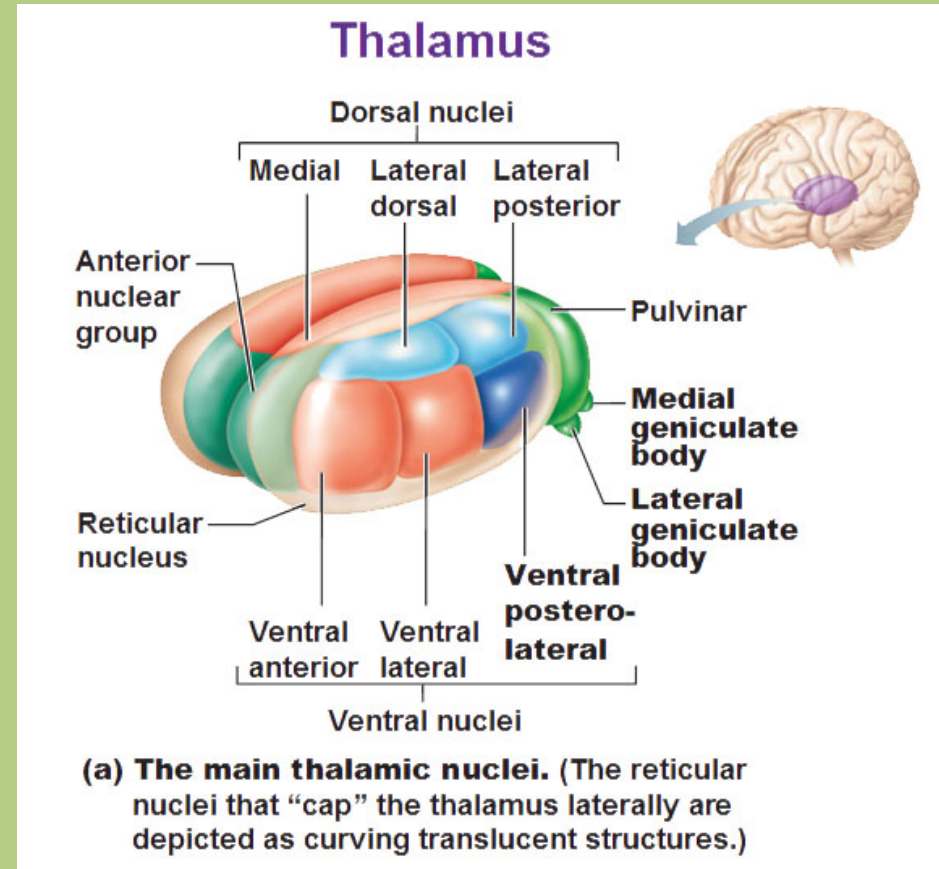
Thalamic Nuclei

Specific nuclei:

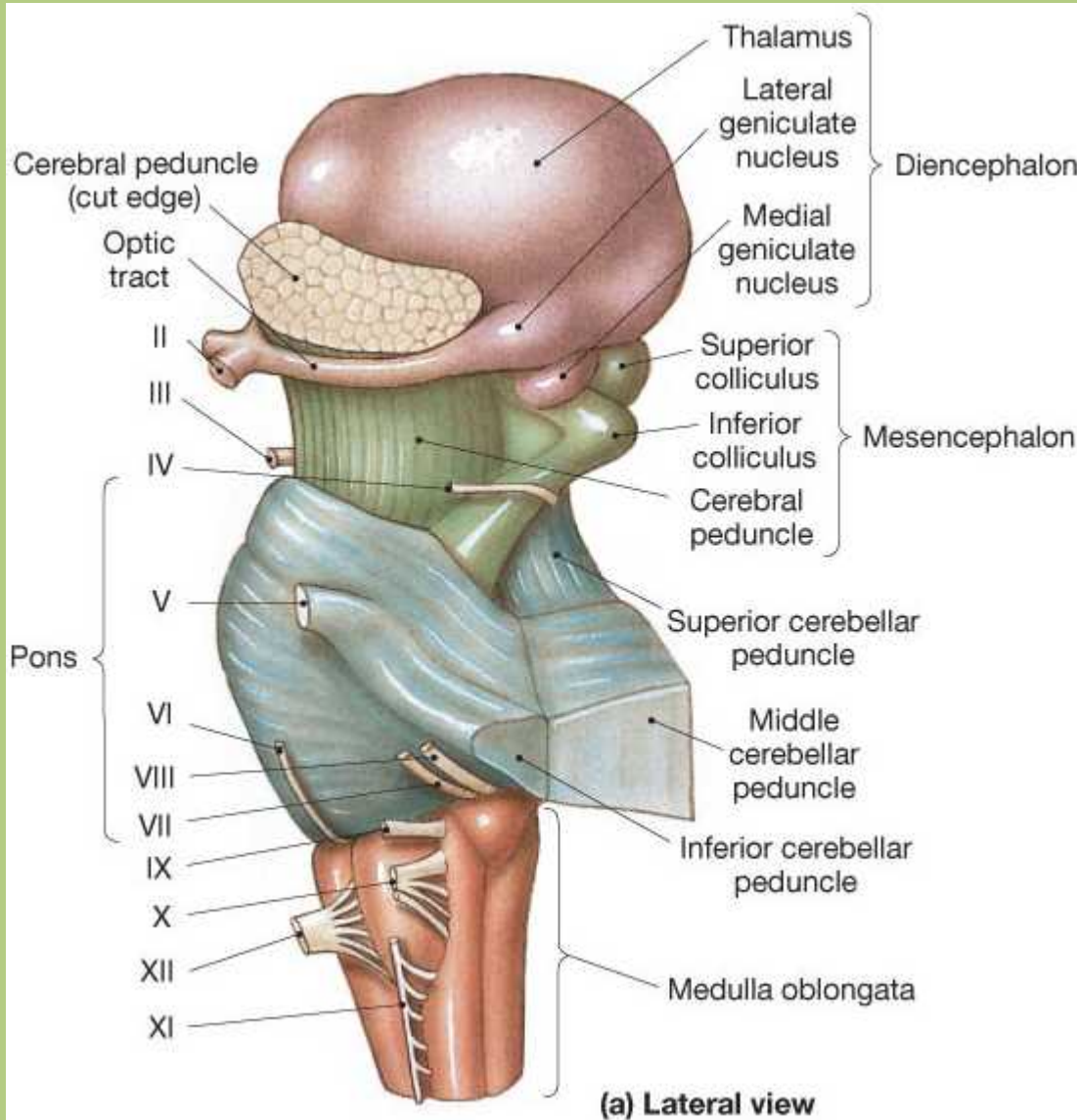
- **Anterior nuclei**
(Receive afferent fibers from the mammillary body.)
- **Medial nuclei**
(Receive afferent fibers from ventral and intralaminar nuclei, hypothalamus, mesencephalon and globus pallidus.)
- **Ventral nuclei: VA, VL, VPL, VPM**
(Receive afferent fibers- position sense, vibration, pressure, touch, pain and temperature- from the trunk and limbs.)
- **Dorsal nuclei: LD, LP, Pulvinar**
(Receive afferent fibers from other thalamic nuclei.)

They have direct connections with specific areas of the cerebral cortex.

Nonspecific nuclei: have no direct connections with the cerebral cortex. Part of the general arousal system, they are connected directly to the brainstem.



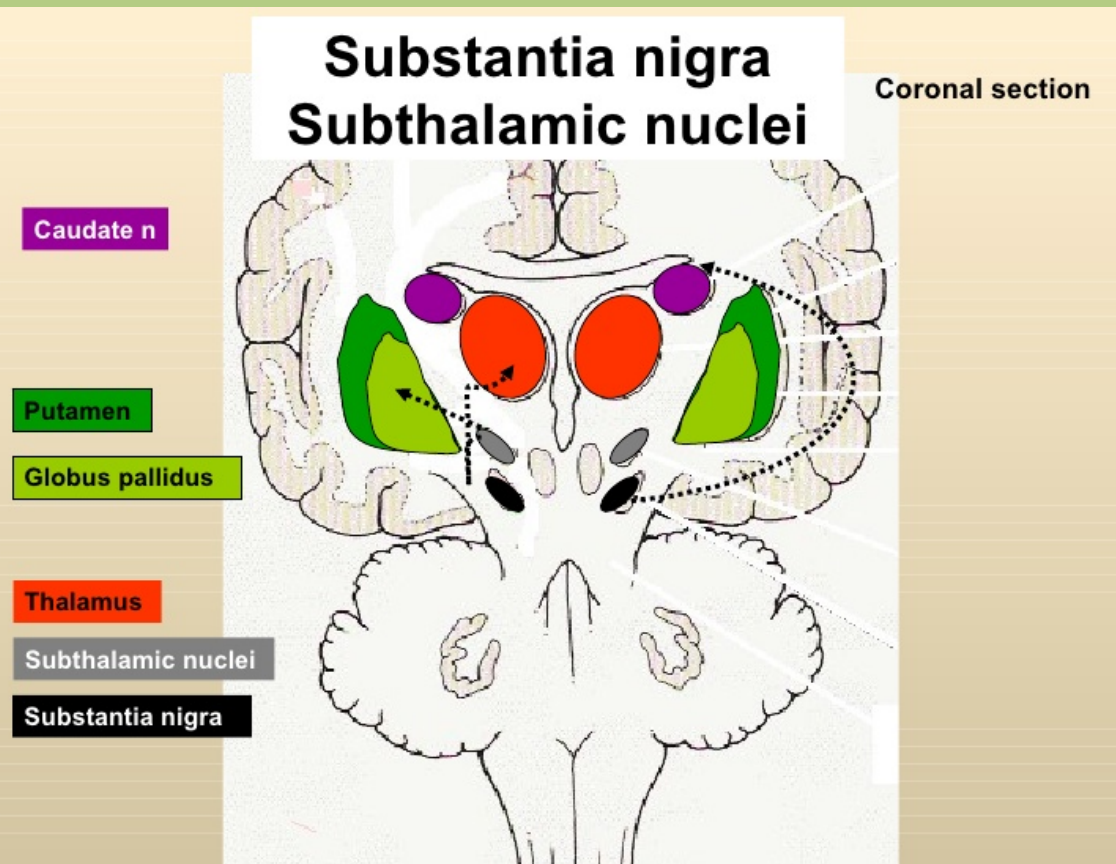
Thalamic Nuclei - Metathalamus



- Lateral geniculate body (component of the visual pathway)
- Medial geniculate body (component of the auditory pathway)

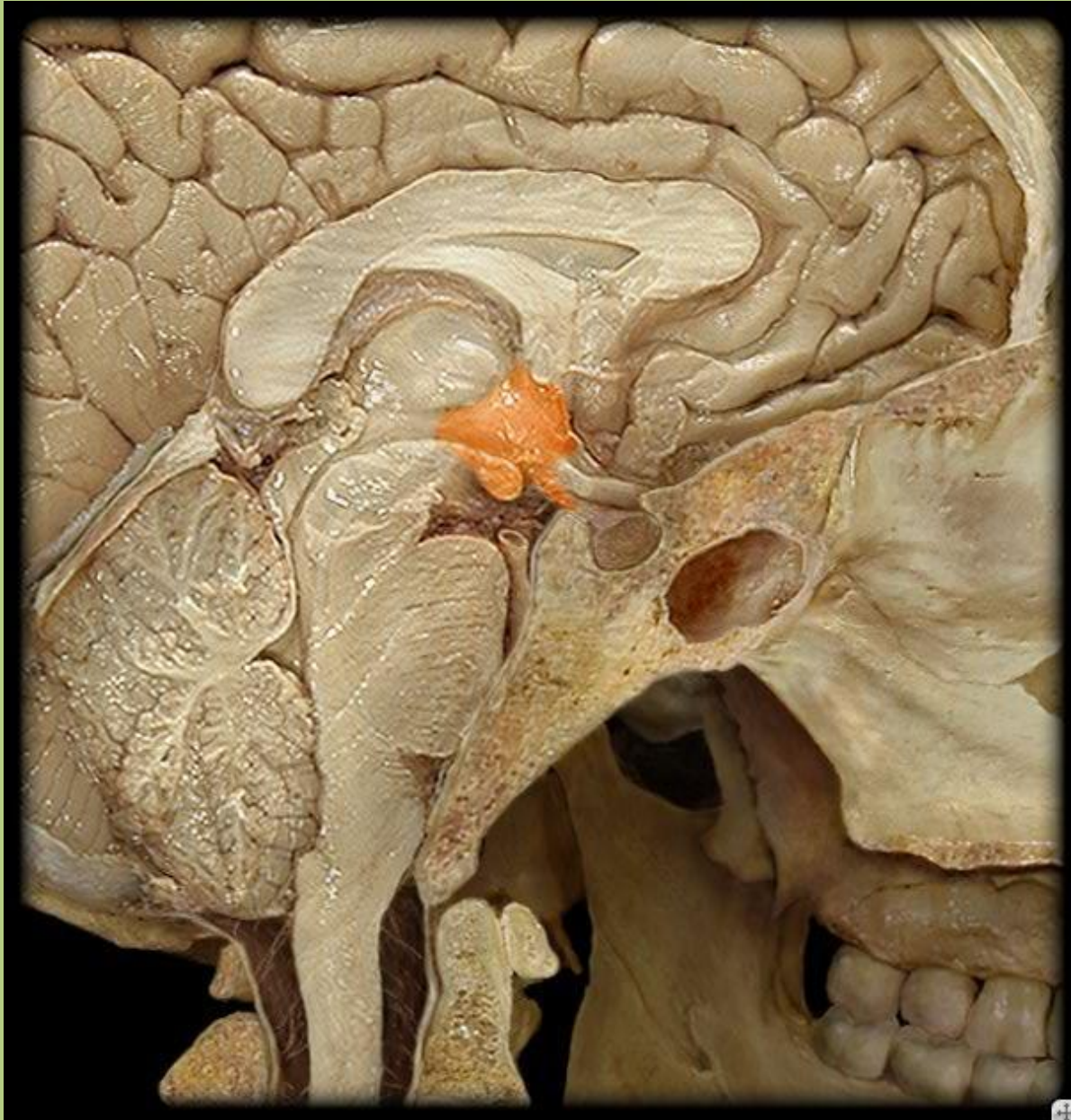
They belong to the category of specific thalamic nuclei.

Subthalamus

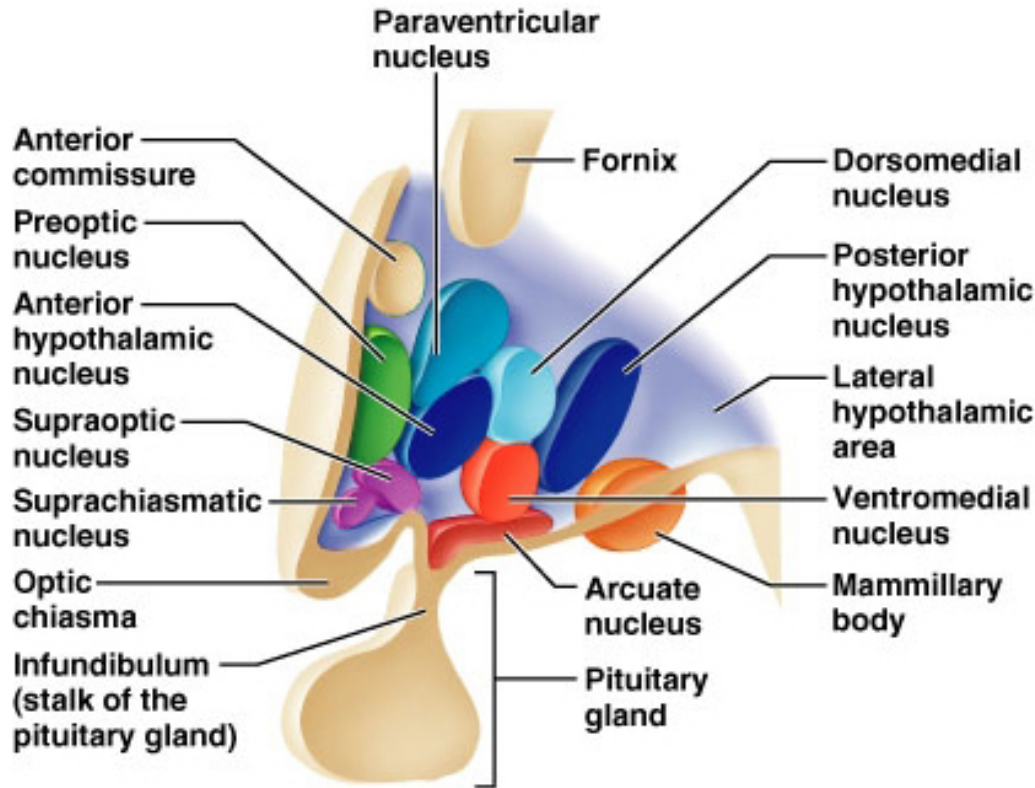


- S u b t h a l a m i c nuclei
- Zona incerta

Hypothalamus



Hypothalamic Nuclei



(b)

Anterior (rostral) group: Hormone synthesis.

- Preoptic nucleus
- Paraventricular nucleus
- Supraoptic nucleus

Middle (tuberal) group: Controls hormone release from the anterior lobe of the pituitary gland.

- Dorsomedial nucleus
- Ventromedial nucleus
- Tuberal nuclei

Posterior (mammillary) group: Activates the sympathetic nervous system when stimulated.

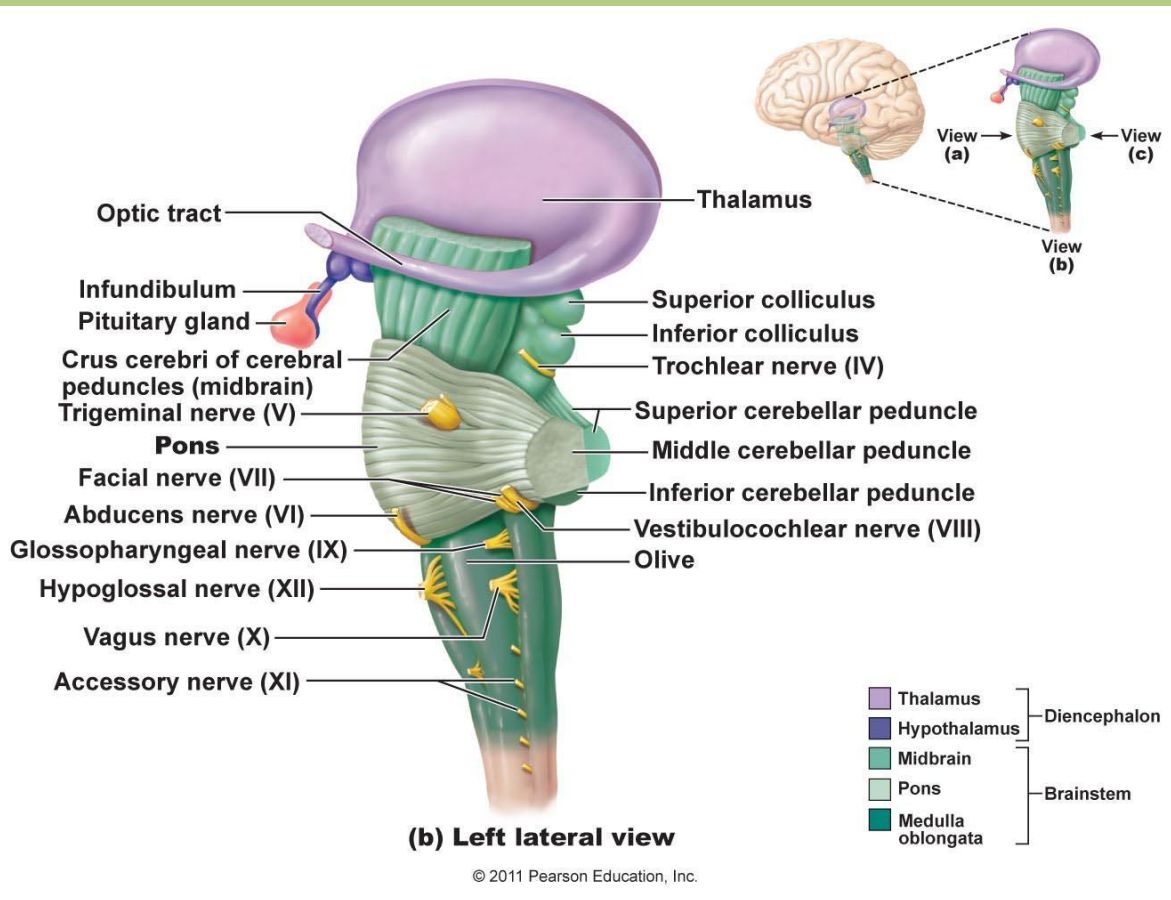
- Posterior nucleus
- Mammillary nuclei of mammillary body

Functions of the hypothalamus

Region or nucleus	Function
• Anterior preoptic region	• Maintain constant body temperature. Lesion: central hypothermia.
• Midanterior and posterior regions	• Activate sympathetic nervous system
• Paraventricular and anterior regions	• Activate parasympathetic nervous system
• Supraoptic and paraventricular nuclei	• Oxitocin production - uterine contractions. Vasopressin - regulation of water balance, lesion: diabetes insipidus.
• Anterior nuclei	• Regulate appetite and food intake. Lesion: obesity or anorexia.



Brain stem – overview



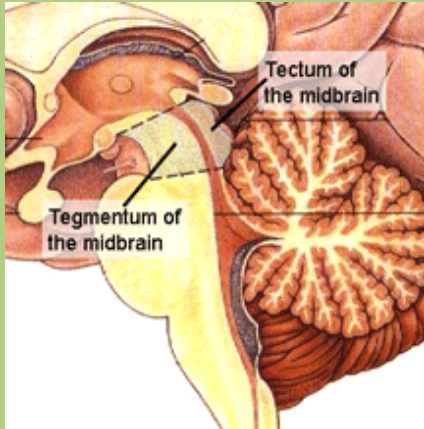
It is divided macroscopically into three parts:

- Mesencephalon
- Pons
- Medulla oblongata

Brain stem



Midbrain - mesencephalon



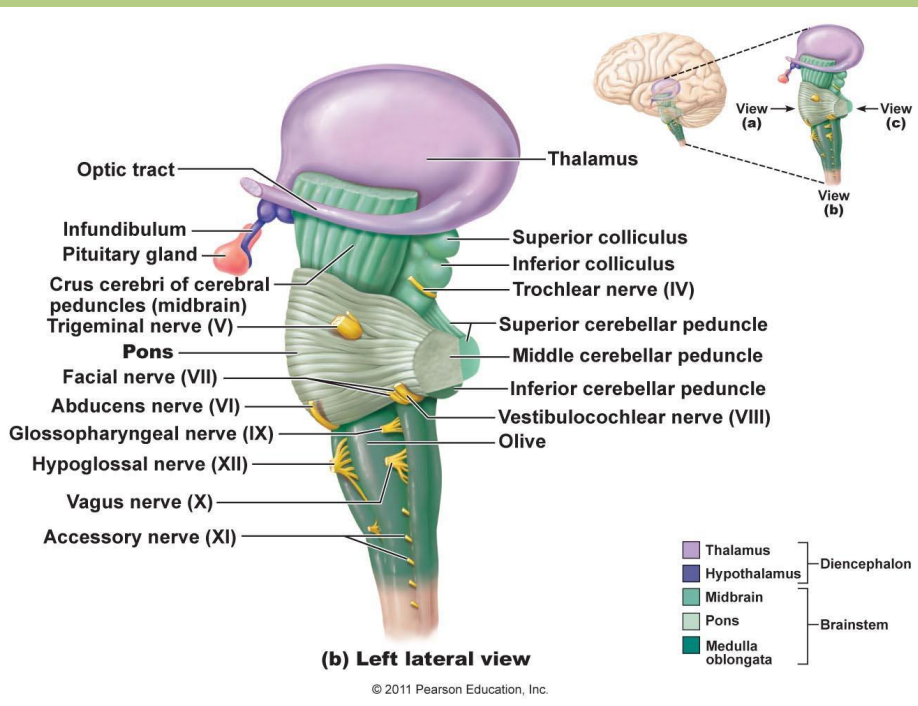
Tectum (quadrigeminal plate):

- Superior colliculi (part of the visual pathway)
- Inferior colliculi (part of the auditory pathway)

Cerebral aqueduct

Tegmentum (nuclei, ascending-, descending pathways)

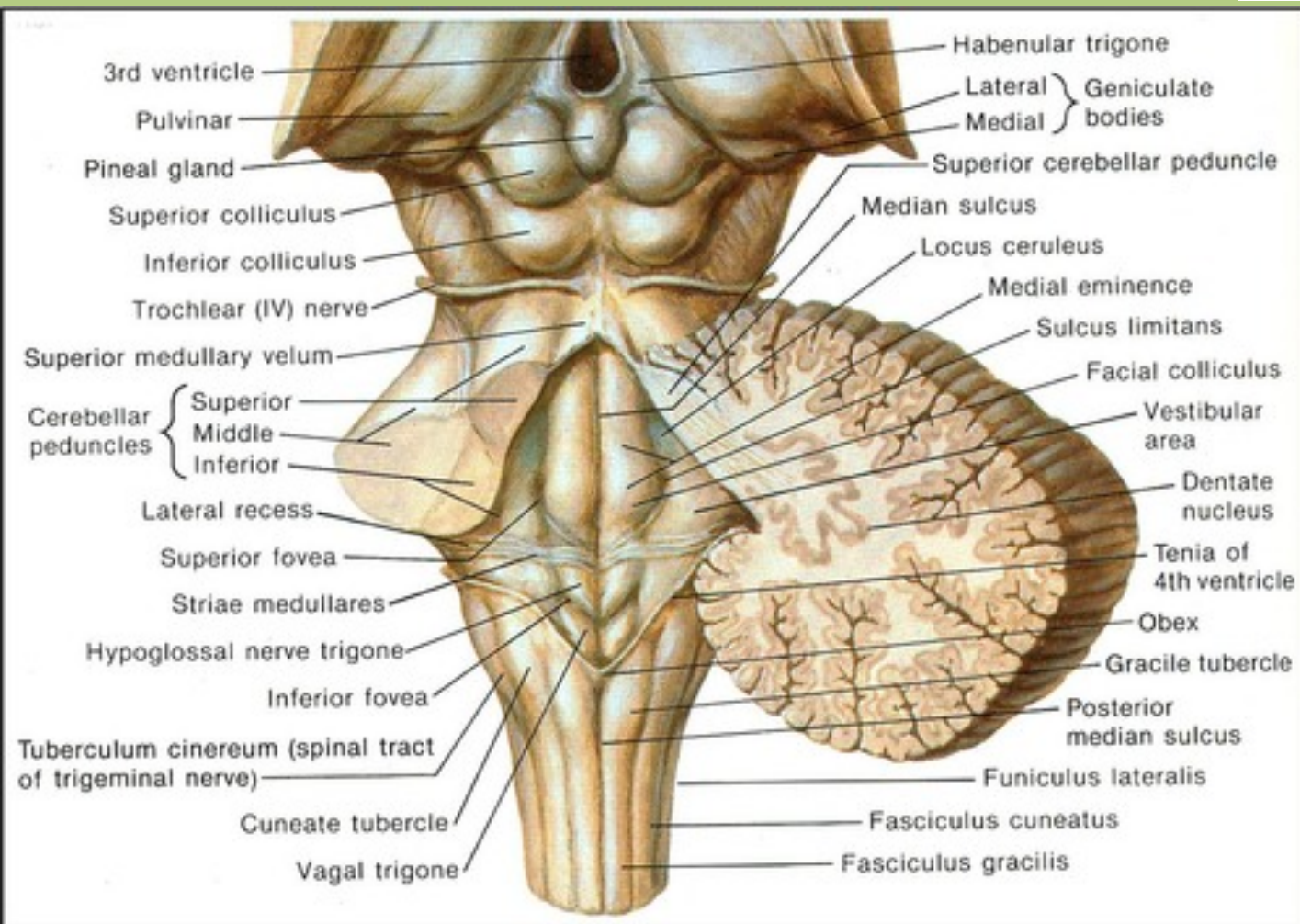
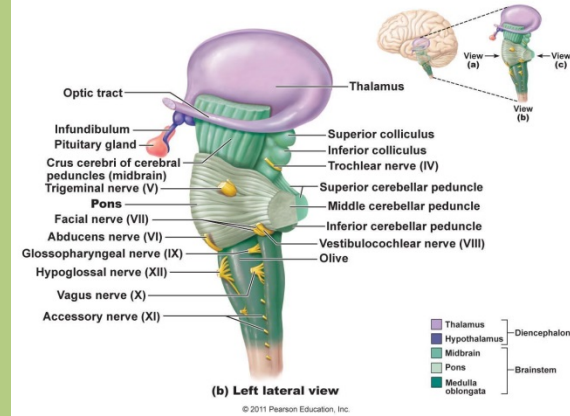
Cerebral peduncles



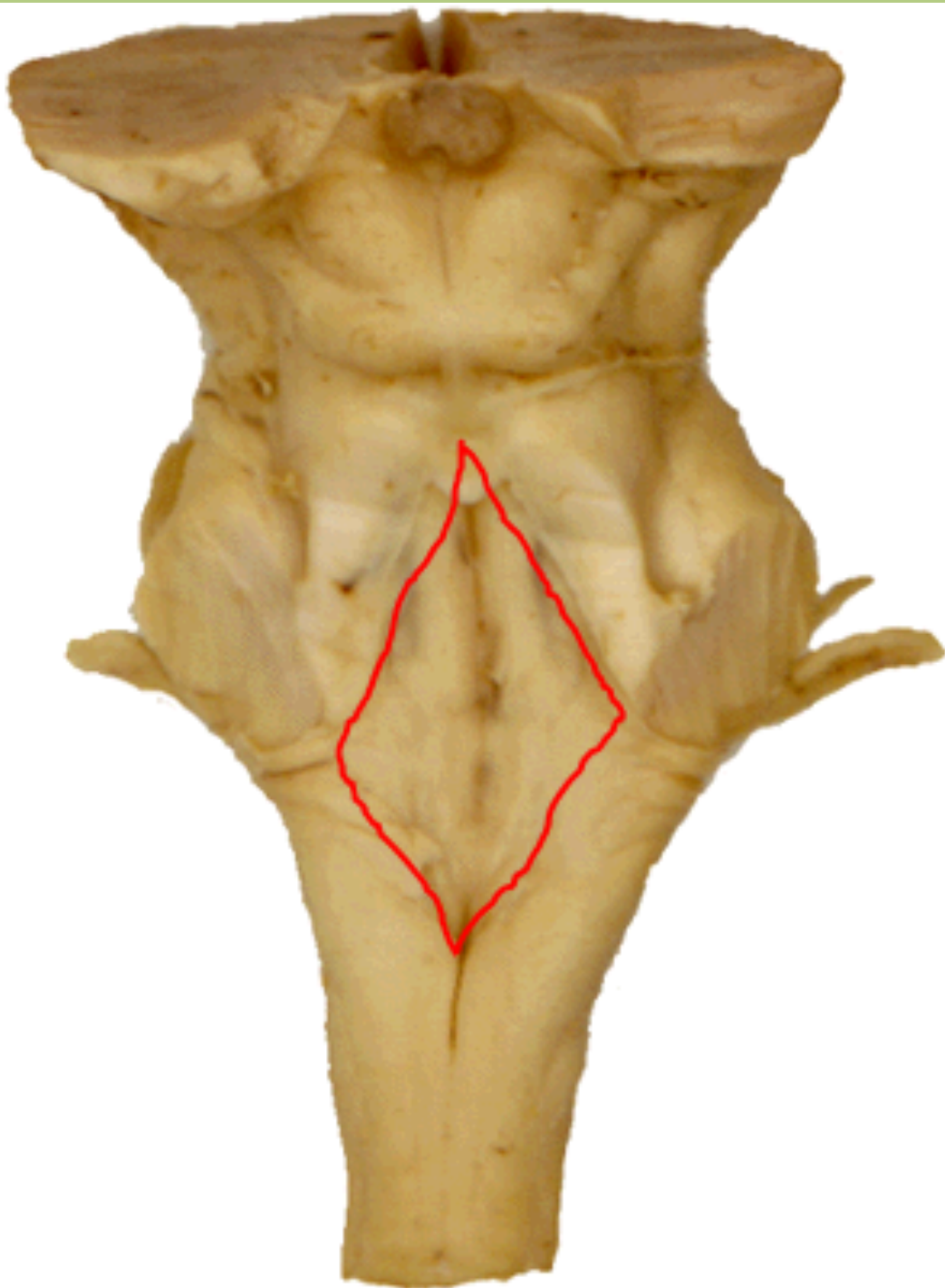
Midbrain



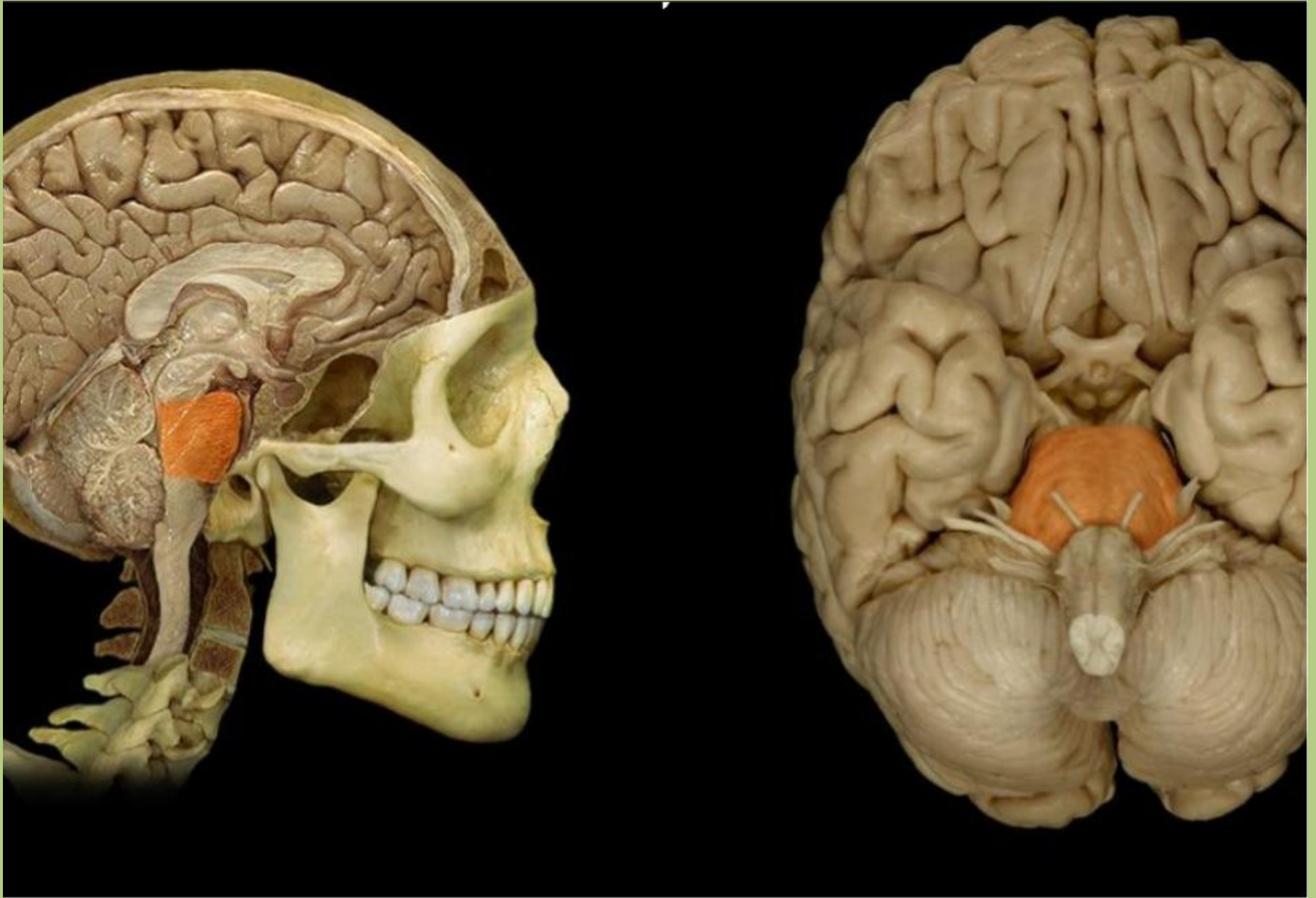
Pons and medulla oblongata



The dorsal wall is formed by the rhomboid fossa.



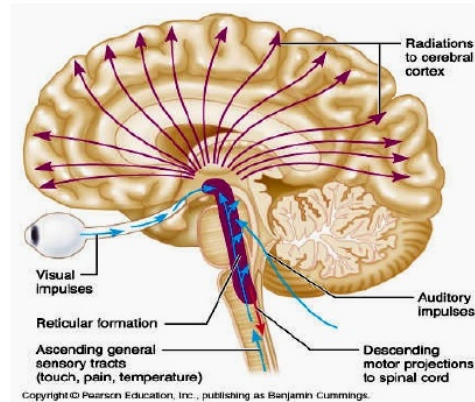
Pons



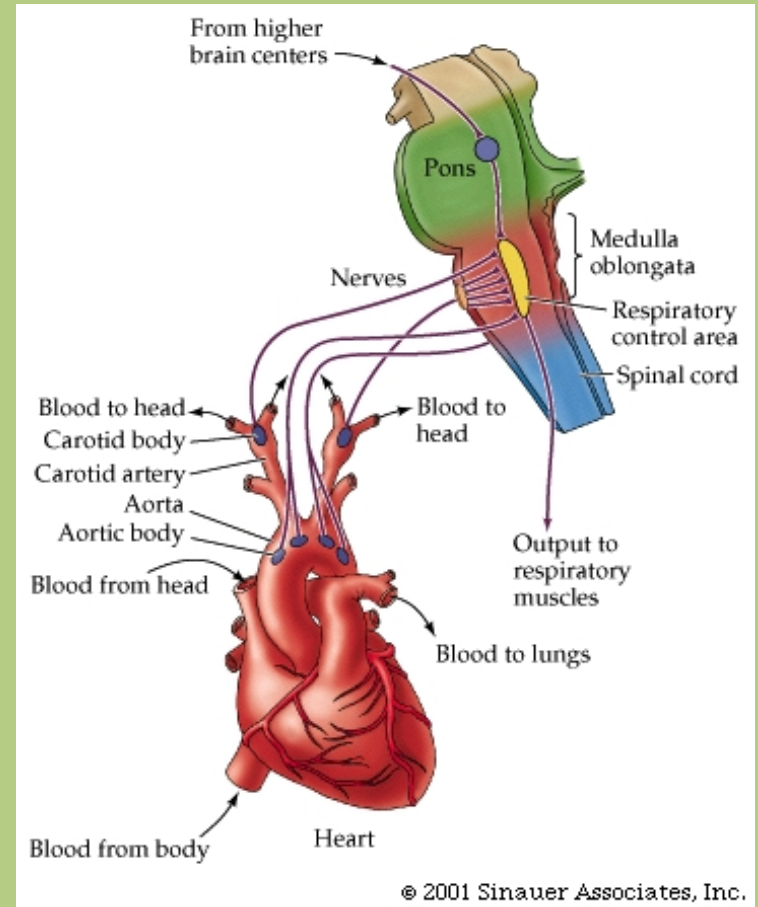
Reticular Formation

The Reticular Formation

- The reticular formation extends through the central core of the medulla oblongata, pons, and midbrain.
- It is an intricate system composed of loosely clustered neurons in what is otherwise white matter

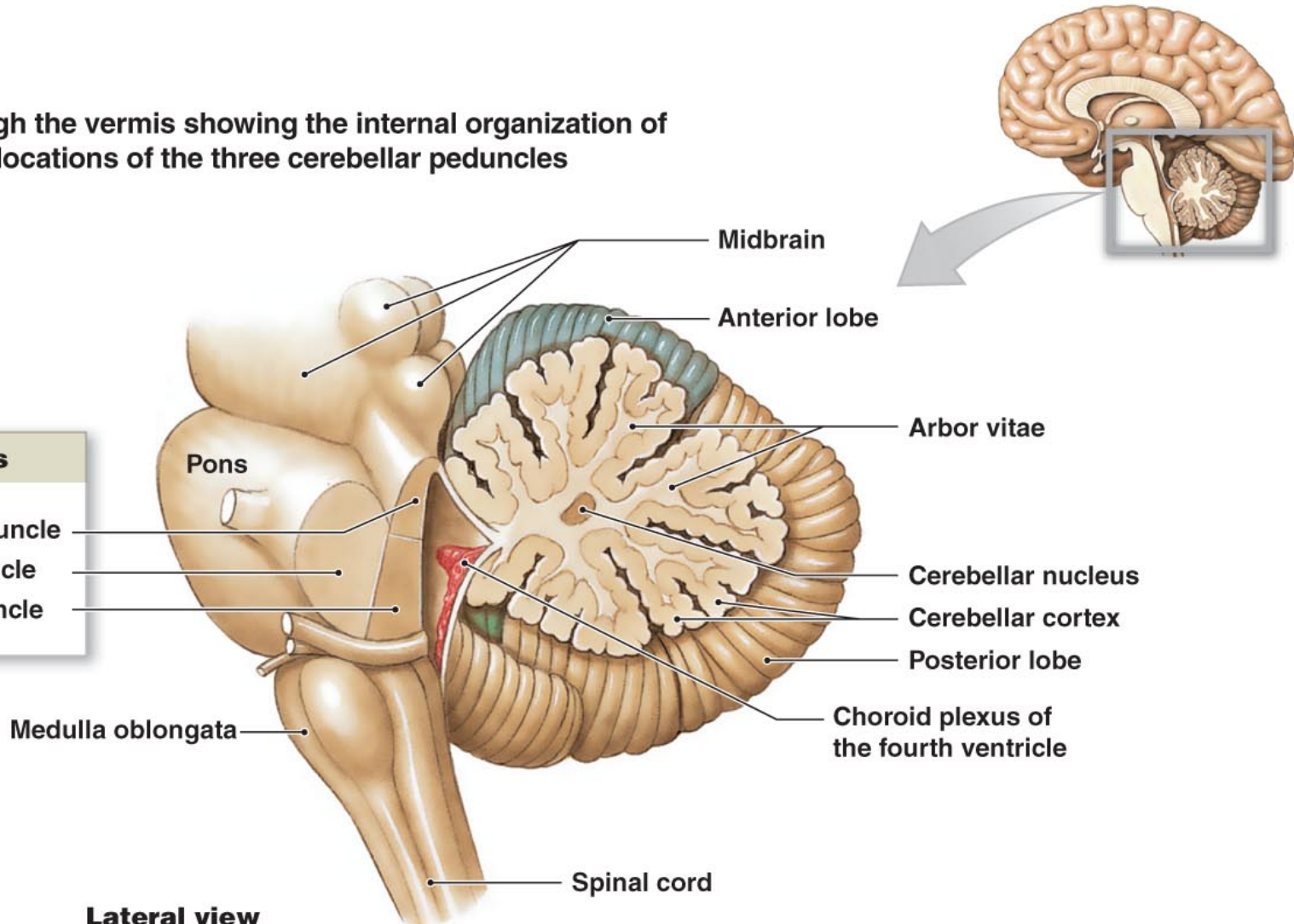


- Respiratory and circulatory regulation
- Swallowing center
- Vomiting center
- Reticular activating center (wake up function)
- Effect on the motor system

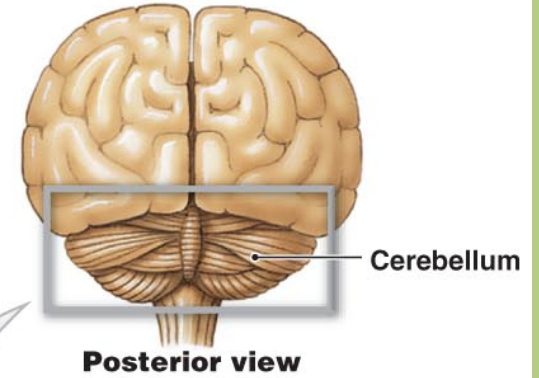


Cerebellum - overview

A sagittal section through the vermis showing the internal organization of the cerebellum and the locations of the three cerebellar peduncles

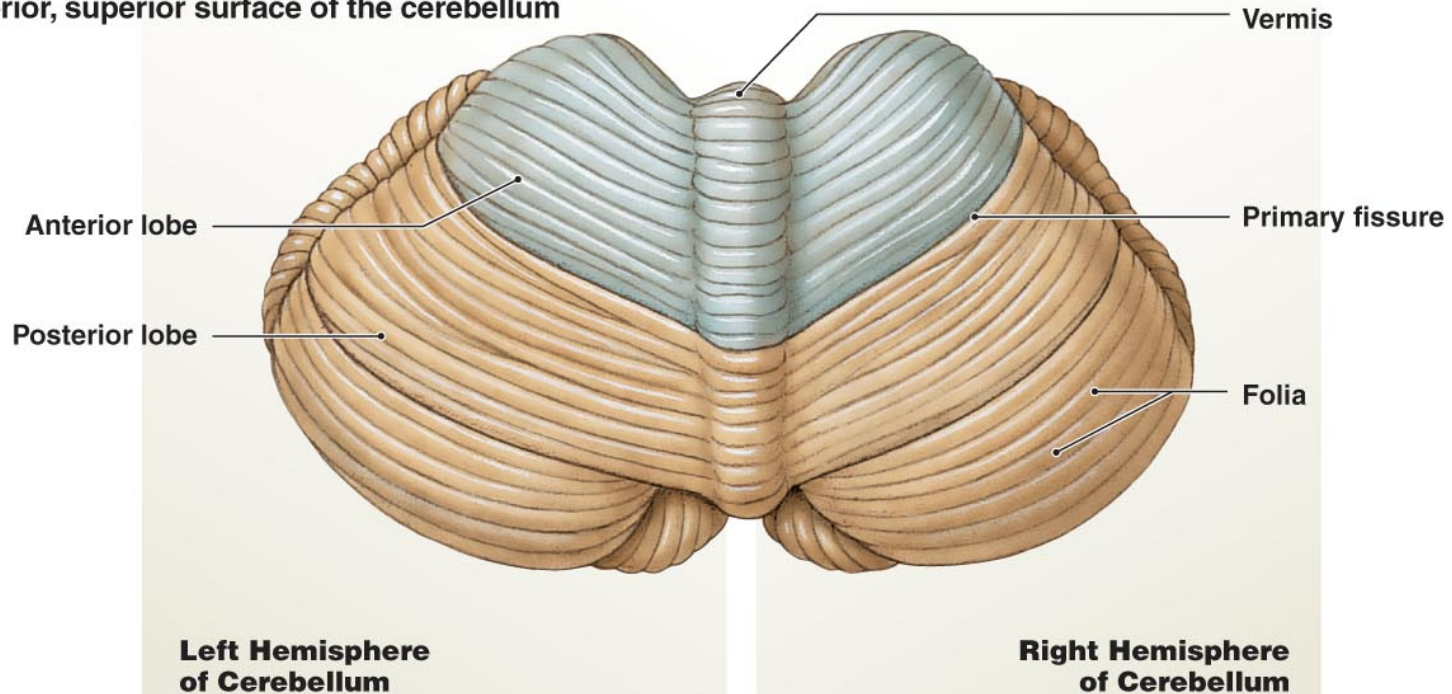


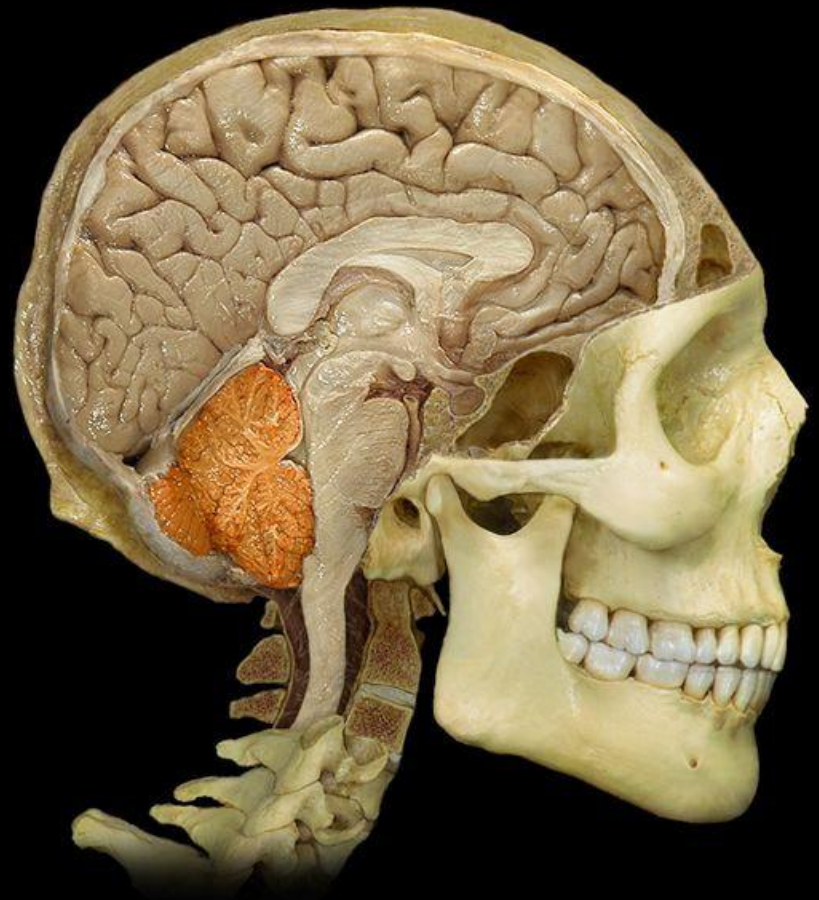
Cerebellum - overview



Structural features of the cerebellum

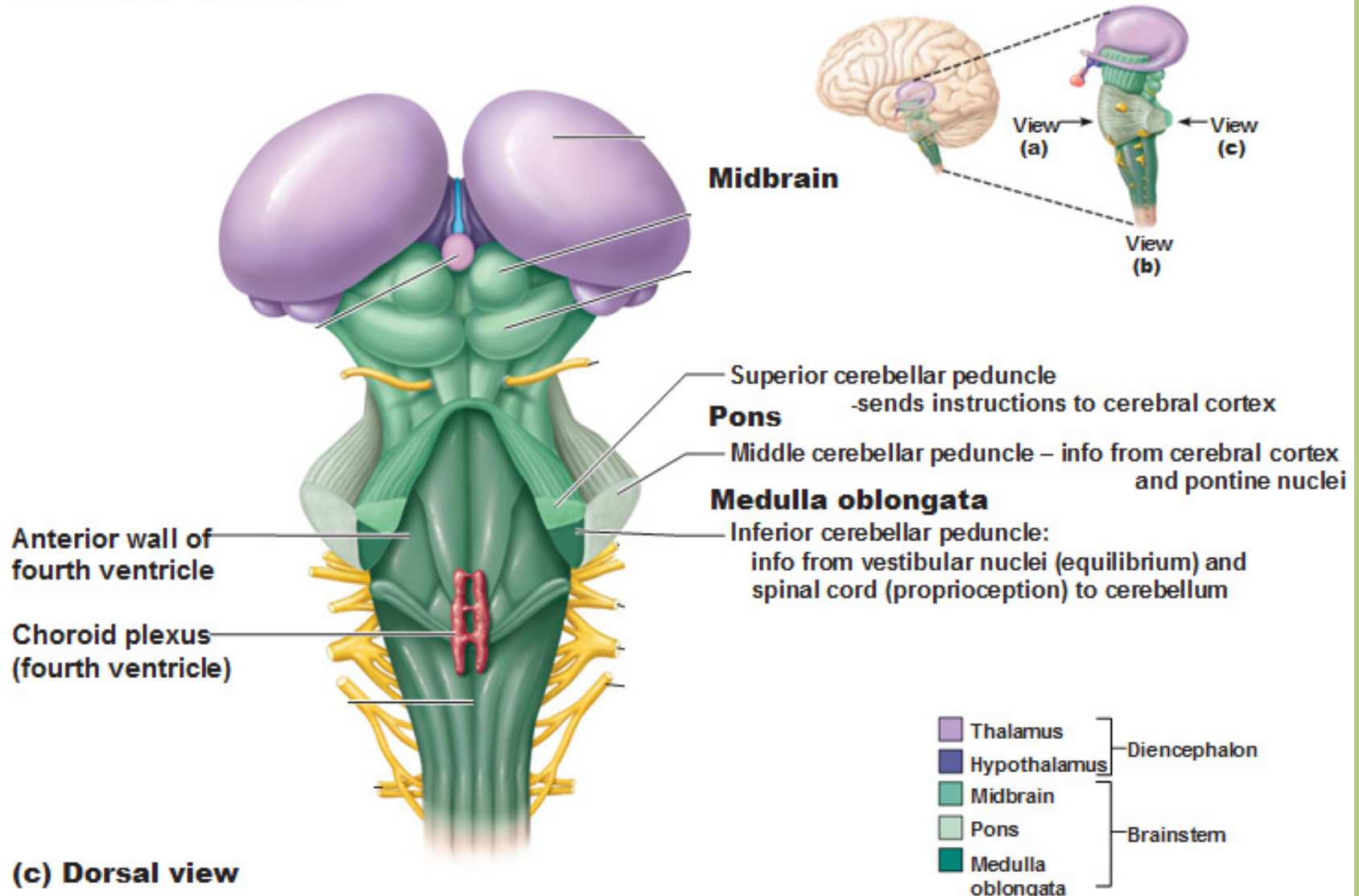
The posterior, superior surface of the cerebellum



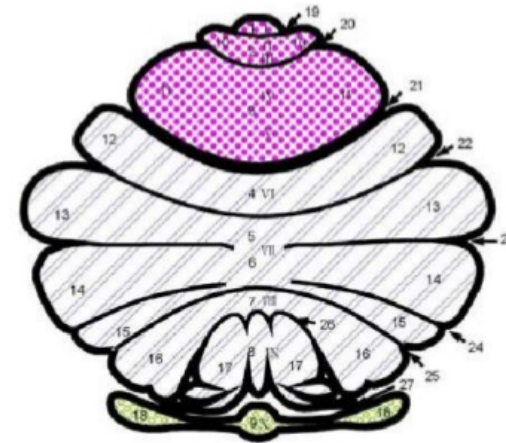


Cerebellum - peduncles

The Brain Stem and Cerebellar Peduncles-Note that there is **NO crossing of fibers**



Cerebellum - functions



Spinocerebellum

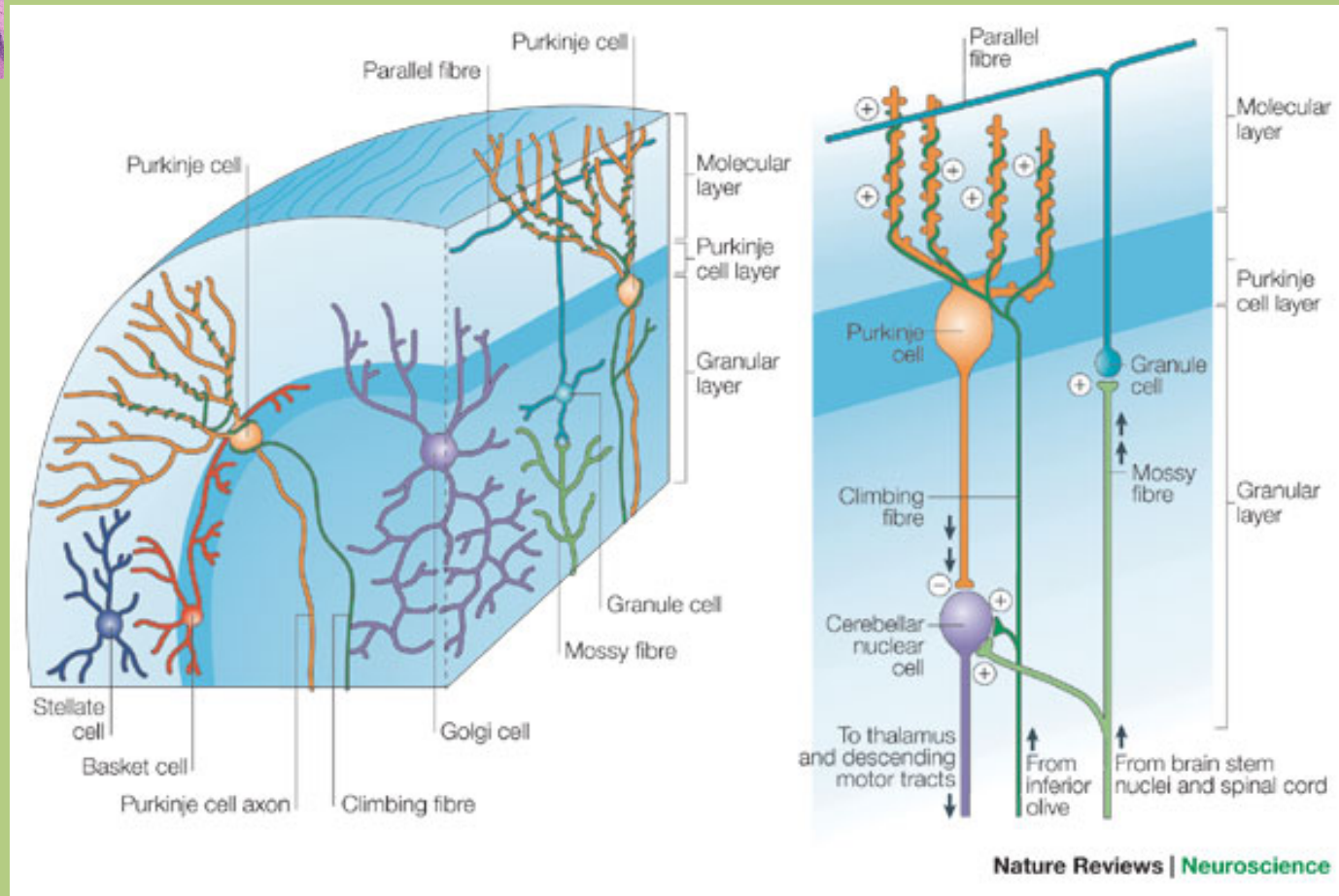
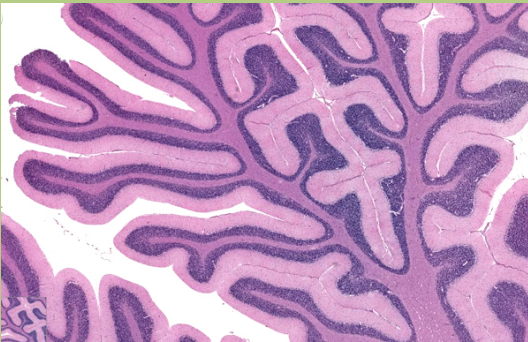
Pontocerebellum

Vestibulocerebellum

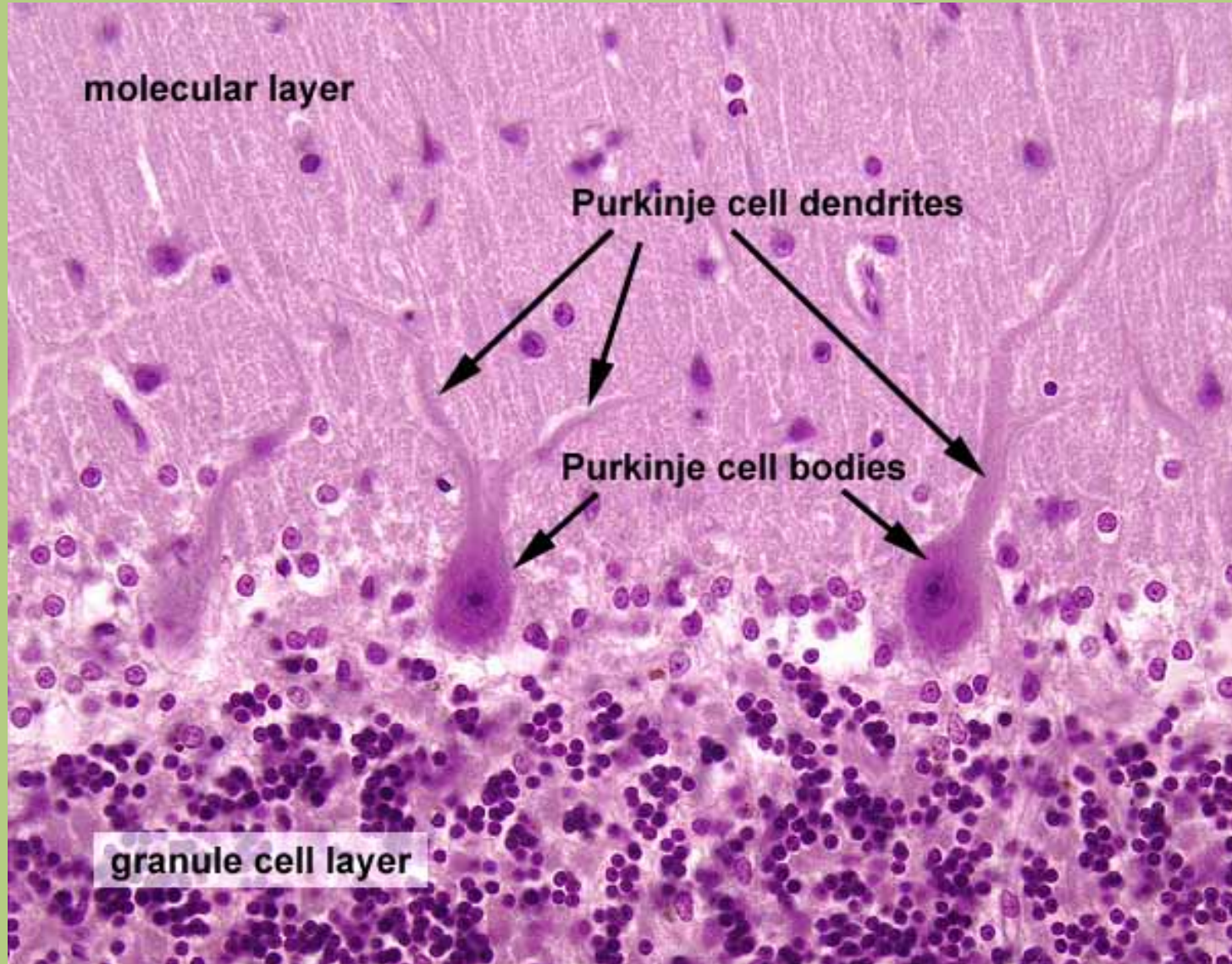
FUNCTIONAL AND PHYLOGENETIC ROLE

<i>Phylogenetic denomination</i>	Anatomical parts	Role
Vestibulocerebellum (<i>Archicerebellum</i>)	Flocculonodular lobe (+ adjacent vermis)	Regulates balance and eye movements.
Spinocerebellum (<i>Paleocerebellum</i>)	Vermis and intermediate parts of the hemispheres ("paravermis")	regulates body & limb movements. The spino cerebellum is able to elaborate proprioceptive input in order to anticipate the future position of a body part during the course of a movement.
Cerebrocerebellum (<i>Neocerebellum</i>)	Middle portion of the vermis & Lateral parts of the hemispheres	involved in planning & initiation of movement. It has purely cognitive functions as well.

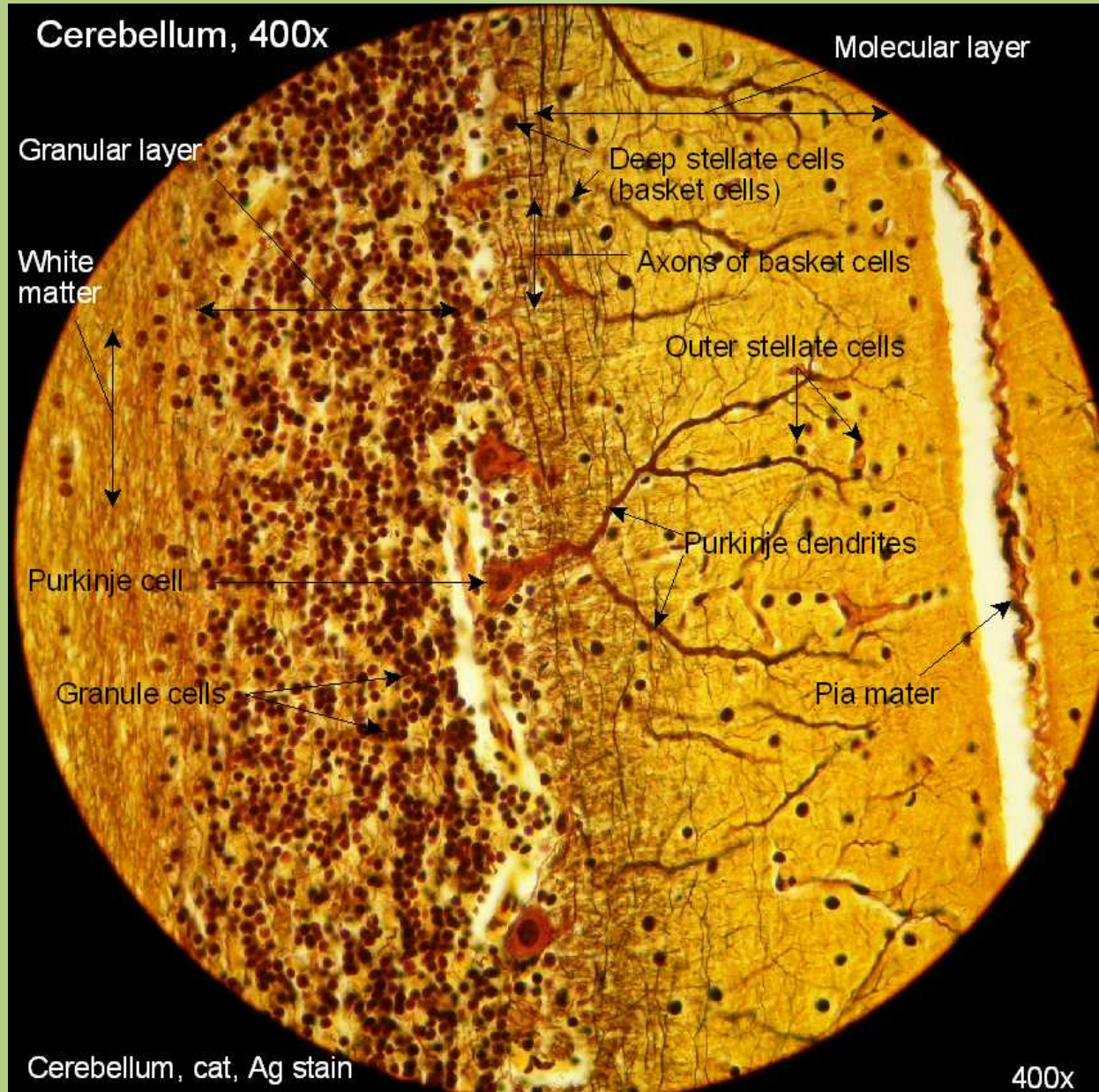
Cerebellum - histology



Cerebellum - histology

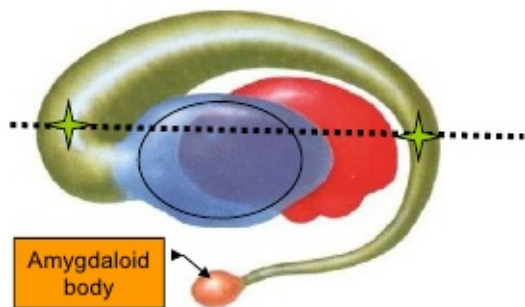


Cerebellum - histology



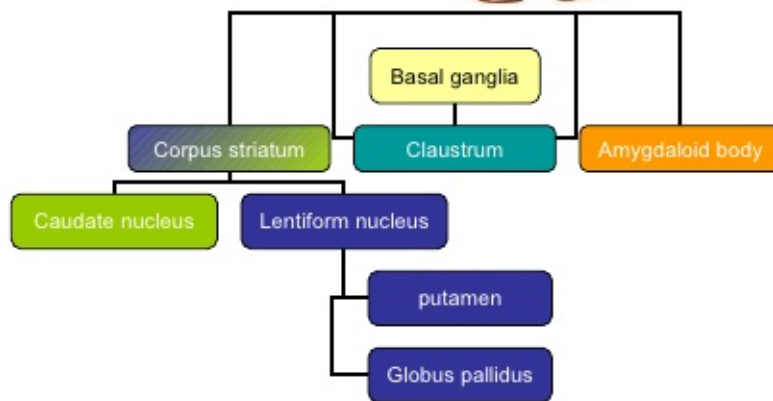
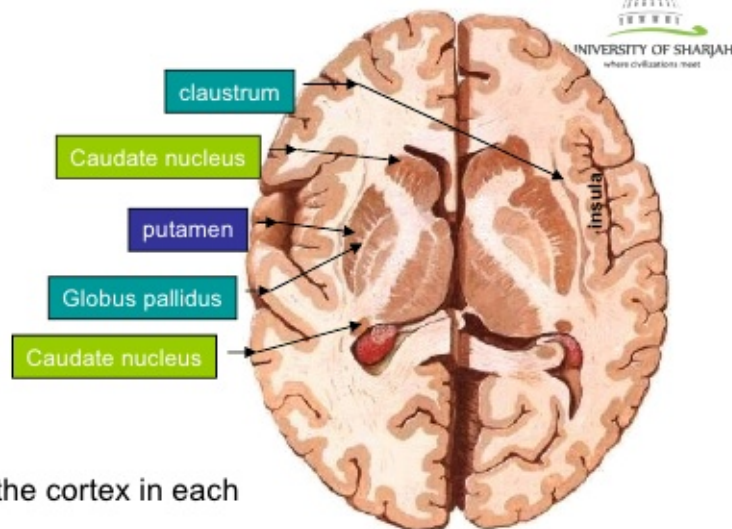
Basal Ganglia

Basal nuclei (ganglia)

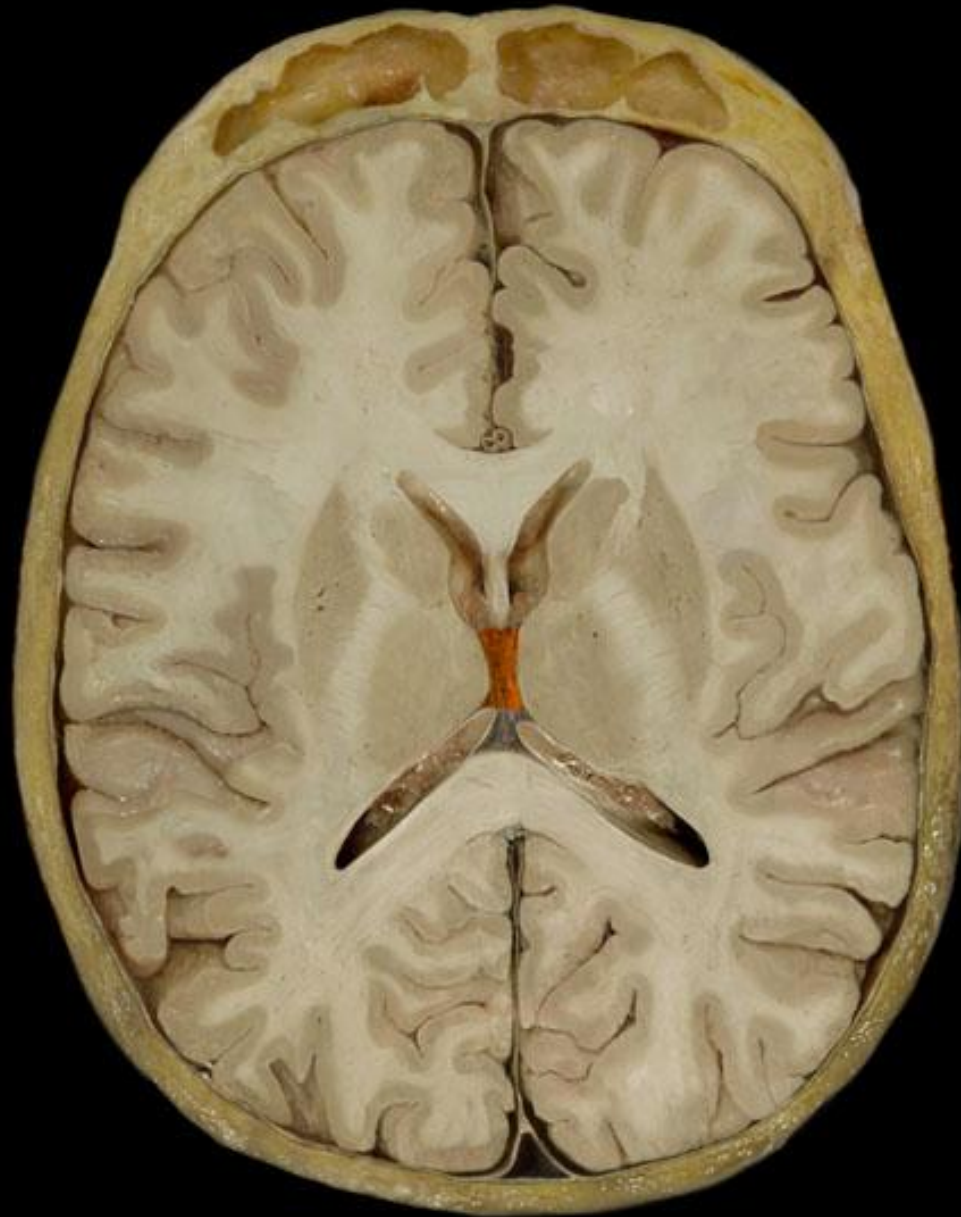


Masses of grey matter located deep to the cortex in each cerebral hemisphere

- Corpus striatum: is involved in the regulation of movement.
- Amygdaloid body: is concerned with emotional behavior
- Claustrum: uncertain function



- Modulate and regulate specific cortical functions
- Preparation, planning, execution of motor activity
- **Related nuclei:**
- subthalamic nucleus of diencephalon
- substantia nigra of mesencephalon
- VA, VL thalamic nuclei



Thank you for your attention.

References:

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