

Sheet No. 10.2

Lecture Title: Brain Stem & Diencephalon

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دعاء لزميلنا رشيد:

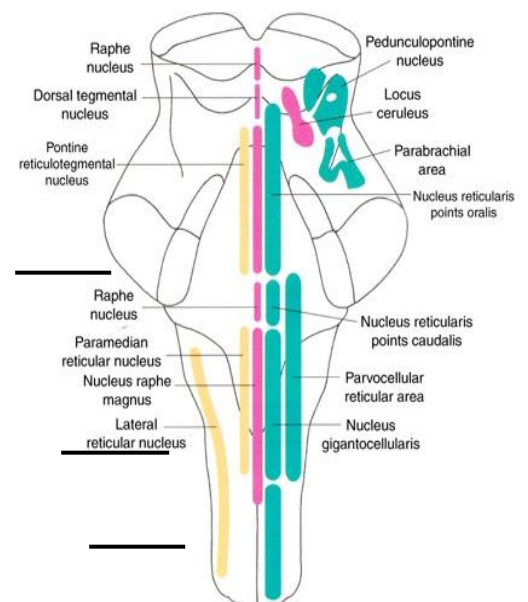
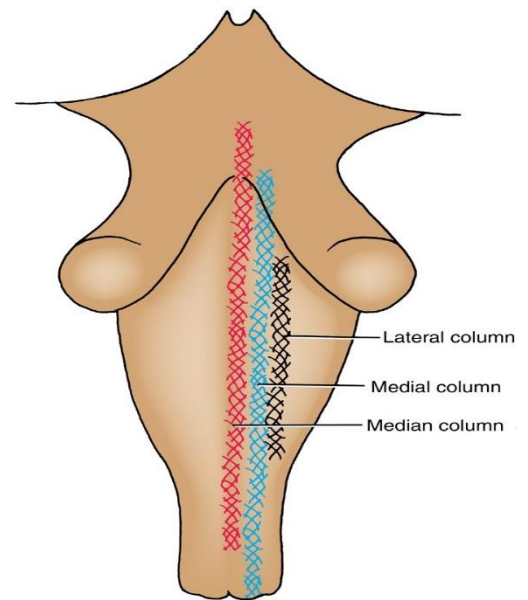
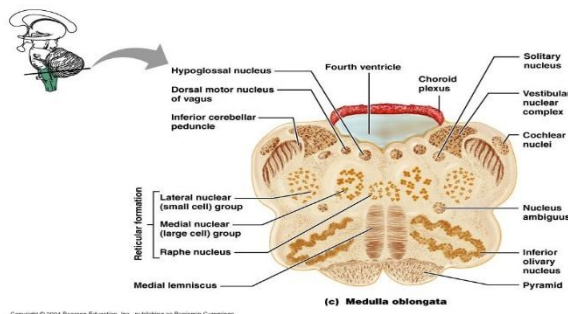
اللهم افسح له في قبره مدّ بصره، وافرش
قبره من فراش الجنة، اللهم أعذه من عذاب
القبر، وجفاف

Reticular Formation :

- It is scattered large nuclei in medulla, pons & midbrain distributed all over the CNS.
- Divided into:
 1. Lateral one third have small cells (parvocellular) that receive sensory inputs and cortical inputs.
 2. Medial two thirds have large cells (magnocellular) and function as output to spinal cord, brainstem nuclei, thalamus, hypothalamus & cerebral cortex.
- The reticular formation modulates (excite or inhibit) the activities of:
 - Sensory systems – e.g. pain

- Motor systems – e.g. muscle tone, segmental reflexes, eye movements
- Autonomic systems – e.g. respiration, blood pressure, cardiac function
- Consciousness – e.g. vital centers in the brainstem, awareness, attention & arousal
- Reticular formation is organized into three longitudinal columns:
 - Midline raphe group
 - Parasagittal medial zone
 - Parasagittal lateral zone

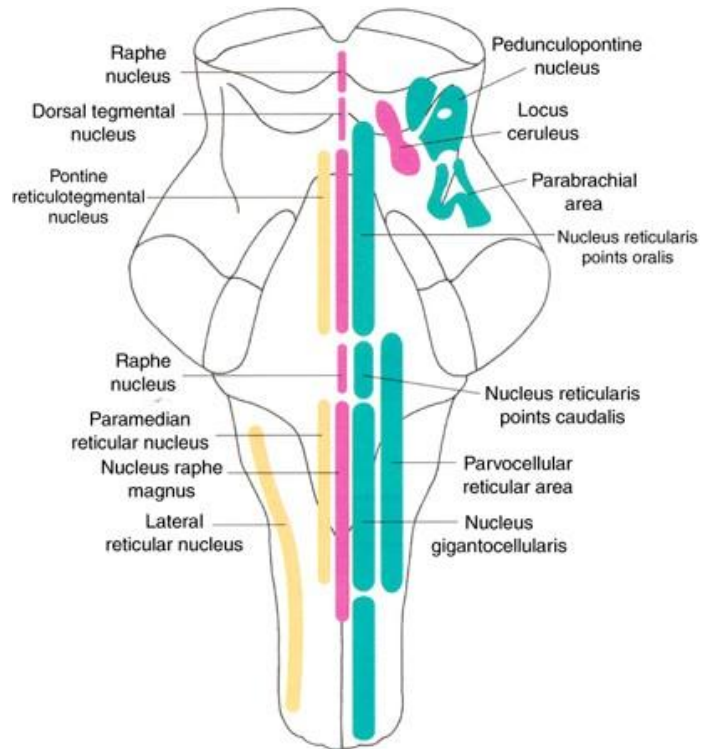
■ Organization of Reticular Formation



- Fourth set of nuclei that have common cerebellar projections (precerebellar reticular nuclei) that helps in coordination of muscle contraction
 - Paramedian reticular nucleus of the medulla
 - Lateral reticular nucleus of the medulla
 - Reticulotegmental nucleus of the pons

Raphe Nuclei

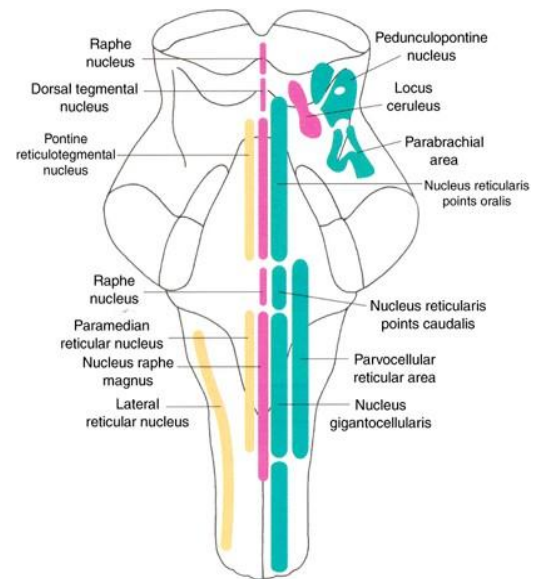
- **Serotonin** projecting cells.
- Divided into:
 1. Rostral group (upper pons & midbrain)
 - Project to cerebellum, cerebrum (cortex, basal ganglia, limbic system)
 - Involved in the regulation of forebrain activity like sleep, memory processing, mood.
 2. Caudal group (lower pons & medulla)
 - Receives nociceptive input from brainstem & spinal cord (Involved in the regulation of pain)



Medial Reticular Zone

- It is composed of a group of nuclei and is considered the essence of the reticular formation.
- The effector part of the reticular formation
- Provides most of the ascending & descending projection.
- Most inputs come from the lateral reticular zone (sensory somatic & visceral).
- Ascending projections form the Ascending Reticular Activating System (ARAS)
- Alter the levels of consciousness & state of attention by keeping the CNS in a state of arousal in order for other centers to function properly.
- Conscious activities of the cerebral cortex require excitatory influences from the ARAS.
- Descending projections regulate muscle tone, spinal reflexes & motor activity through

- Medial (pontine nuclei) reticulospinal tract which excites muscle tone spinal reflexes
- Lateral (medullary nuclei) reticulospinal tract which inhibits muscle tone spinal reflexes.
- Locus ceruleus in pons
 - contain norepinephrine & extensive projections throughout CNS
 - Ascending projections are part of the ARAS (Mainly by initializing the consciousness and arousal of centers involved in brain motor activity)
 - Involved in the mood, memory and regulation of motor activity
 - At night the Locus ceruleus shuts down spinal reflexes by specific centers in the brain related to motor activity and an impairment or injury to it could cause *Nocturnal Enuresis*.



Lateral Reticular Zone

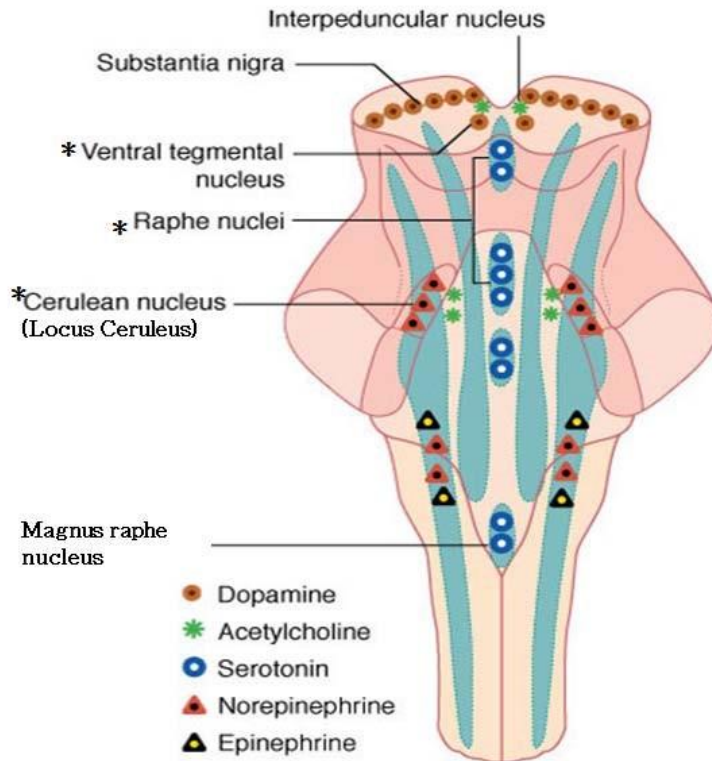
- Receives extensive afferents to mediate cranial nerve reflexes and visceral functions.
- Output is mainly to medial zone
- Other projections:
 - Pedunclopontine nucleus (acetylcholine neurons) which projects to the substantia nigra, subthalamic nucleus, motor cortex, & medial zone and they all have important motor control functions.

Note:

Substantia Nigra + Subthalamic Nucleus + Basal Ganglia + Motor Cortex = are part of the Motor System

Organization of Reticular Formation

Neurotransmitter Distribution



Every part has its own neurotransmitter:

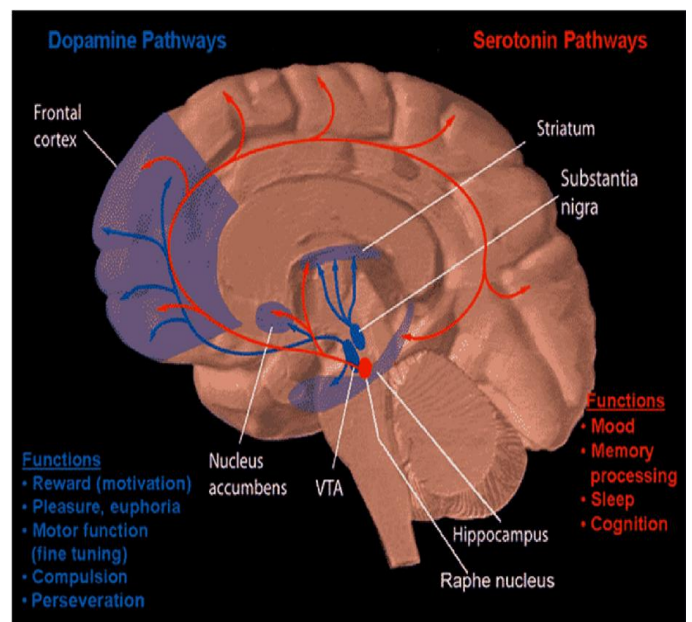
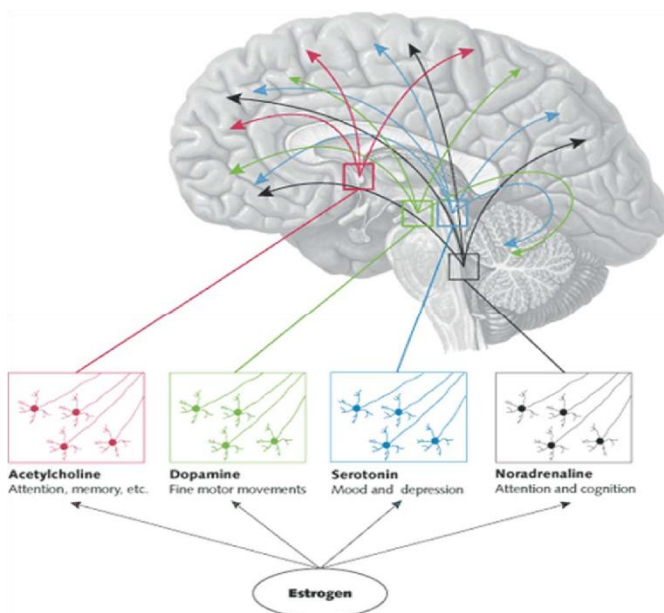
Raphe Nuclei → Serotonin

Locus Coeruleus → Norepinephrine

Substantia Nigra → Dopamine

**** Pay attention that the Substantia nigra isn't part of the reticular formation rather it's a part of the motor system.**

Reticular Formation: Neurotransmitter Pathways & Functions



The Diencephalon

Thalamus

Structure:

- It is composed of two oval shaped collection of grey matter connected together by interthalamic connection.
- It is the base of the Diencephalon.
- It contains the following structures from Medial to Lateral:

- **Medial Nucleus:**

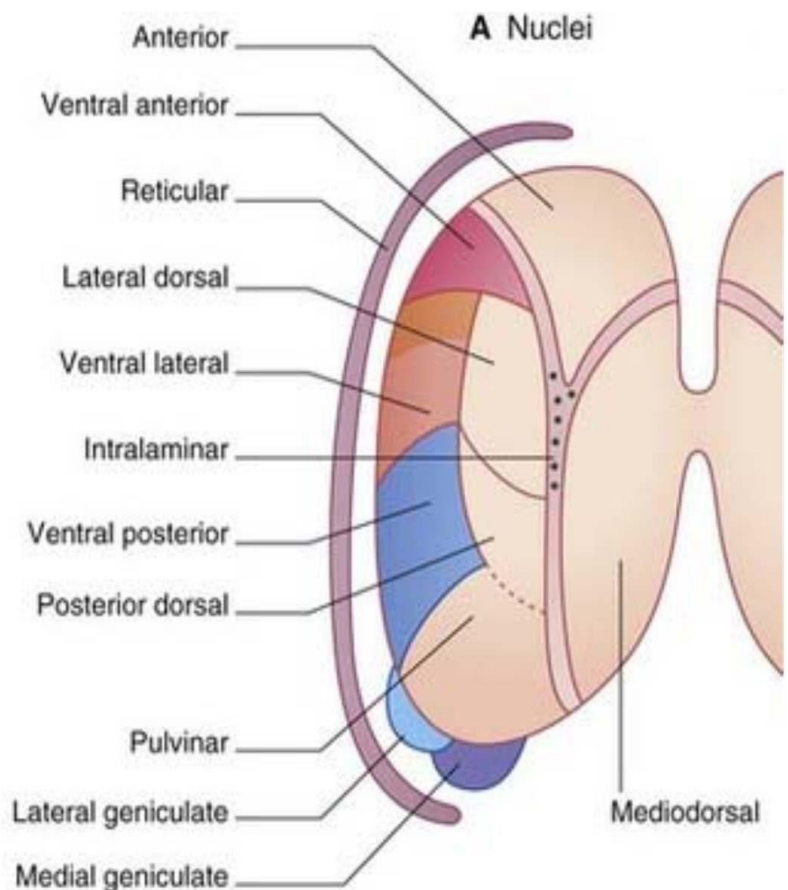
-Dorsomedial nucleus

- **Anterior nucleus** (mainly related to limbic system)
- **Internal medullary lamina**

It is Y-shaped axons (white matter)that separates between Anterior Nuclei , Dorsomedial Nuclei and Lateral Nuclei.

Intralaminar nuclei (small islets of grey matter within the internal medullary lamina).

- **Lateral nuclei**
- **External medullary lamina**(White Matter) – Reticular n.
- **Internal capsule** (Between Thalamus & Basal Nuclei)



Lateral Nucleus

- It is subdivided into:

1. Dorsal tier

- Lateral dorsal (LD)
- Lateral posterior (LP)
- Pulvinar (Pu) (Visual Function)

2. Ventral tier

- Ventral anterior (VA)

Afferent: from Basal Nuclei

Efferent: Cerebrum

- Ventral lateral (VL)

Afferent : from Cerebellum

Efferent: Cerebrum

- Ventral posterior (VP) which divides into:

- Ventral posterolateral (VPL)
- Ventral posteromedial (VPM)

3. Posterior nucleus (Po) (Behind Pu)

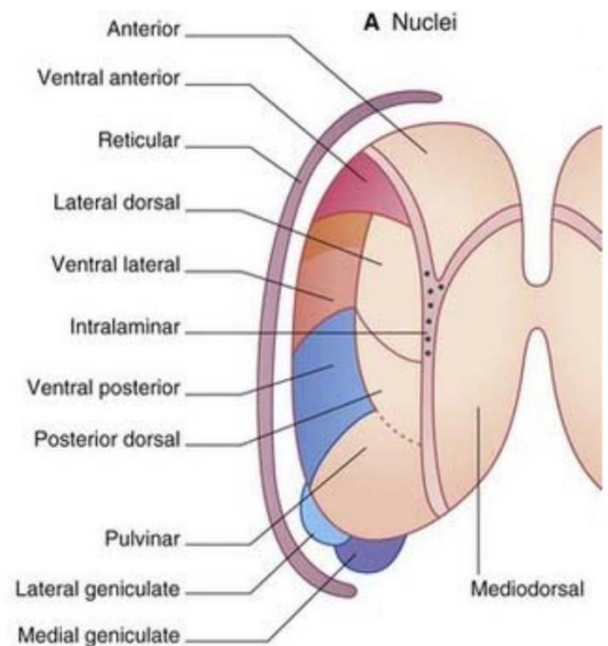
4. Medial Geniculate Nuclei

connects with Inferior Colliculi for Auditory sensation

5. Lateral Geniculate Nuclei

connects with Superior Colliculi & is a station for Lateral optic tract for optic sensation

- **The major function of the thalamus is to connect between the Cerebrum and other parts of the CNS.**
- **Thalamus is also called Relay Station as it gathers all the information then organizes it then sends it to specific parts of the cerebrum.(Especially the ventral tier)**



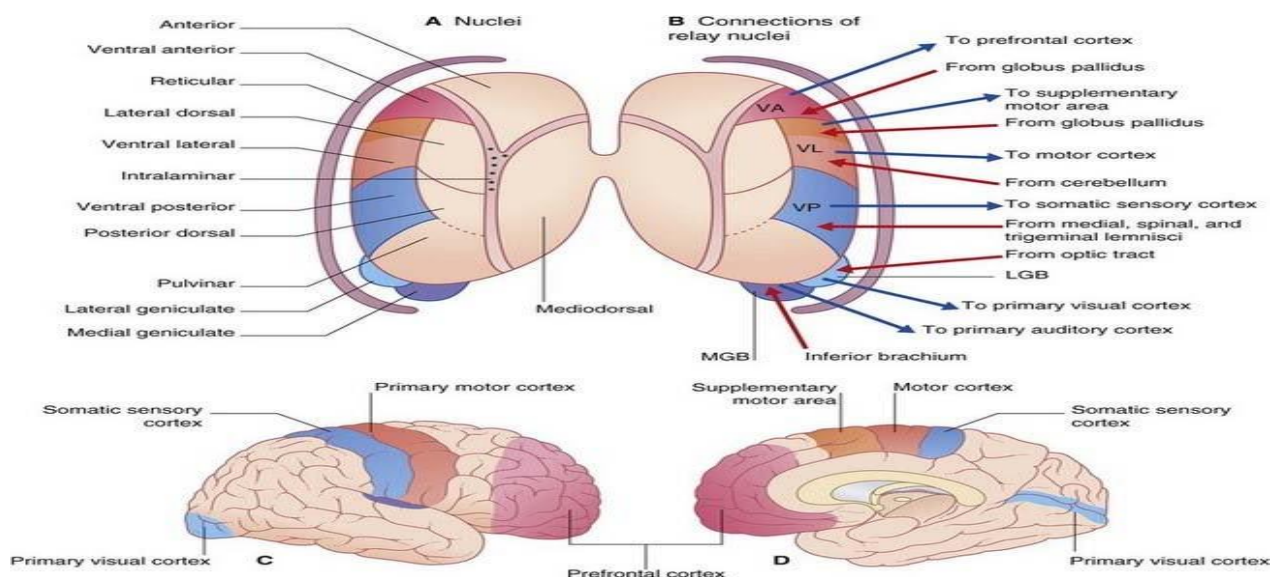
Specific Nuclei

Important memorize this table

Nucleus	Afferents	Efferents	Functions
Ventral posterior (VP)			
• Ventral posteromedial (VPM)	Trigeminal lemniscus Solitariothalamic tract	To postcentral gyrus (area 3, 1, and 2)	Relay station for impulses from face and head, and taste buds
• Ventral posterolateral (VPL)	Medial lemniscus Spinal lemniscus	To postcentral gyrus (area 3, 1, and 2)	Relay station for exteroceptive (pain, touch, and temperature) and proprioceptive sensations from whole of body except face and head
Ventral anterior (VA)	From globus pallidus through subthalamic fasciculus	To premotor cortex (area 6 and 8)	Relay station for striatal impulses
Ventral lateral (VL) (also called ventral intermediate (VI))	From cerebellum (dentatorubrothalamic fibres and dentatothalamic fibres)	To motor and premotor areas of cerebral cortex (area 4 and 6)	Relay station for cerebellar impulses
Medial geniculate body	Auditory fibres from inferior colliculus	To primary auditory area (area 41 and 42)	Relay station for auditory impulses
Lateral geniculate body	Optic tract	To primary visual cortex (area 17)	Relay station for visual impulses

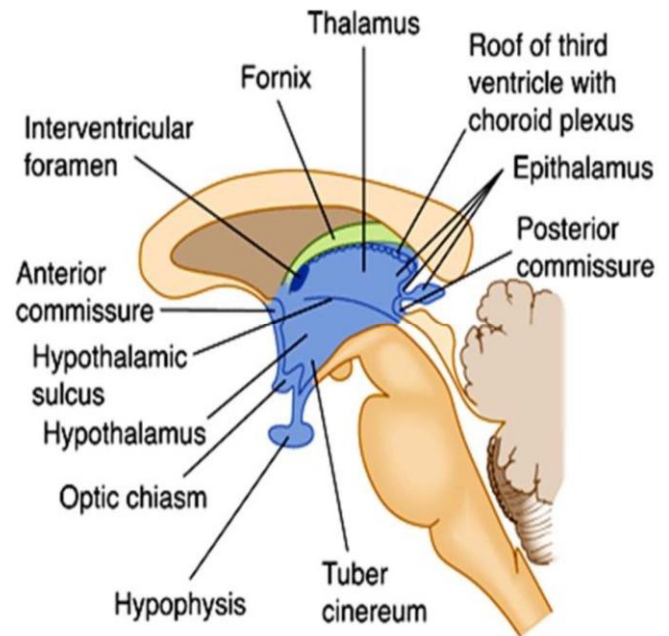
Non – Specific Nuclei

This table is for reading purposes only (not included)



Hypothalamus

- Location : Anterior inferior to the Thalamus and separated from it by Hypothalamic sulcus.
- Boundaries:
 - Limited anteriorly by Lamina terminalis & optic chiasm.
 - Medially bordered by 3rd ventricle

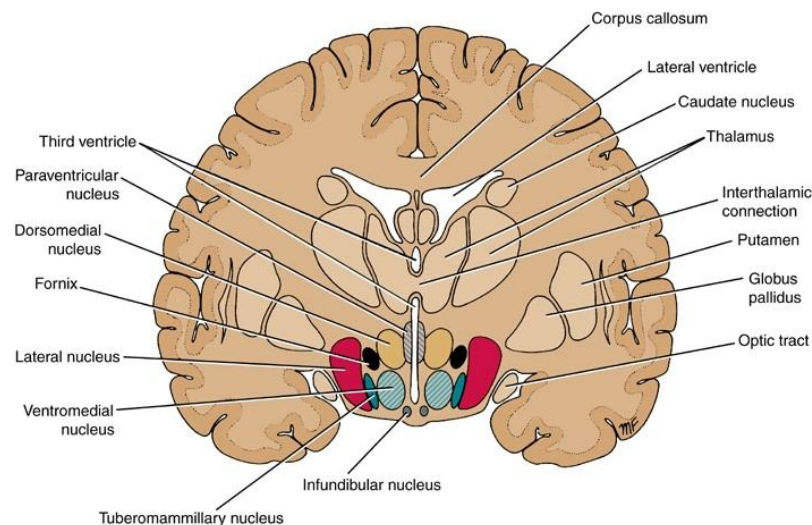


Hypothalamus: Nuclei

Two Divisions:

1. In coronal section from medial to lateral:

- Periventricular Nuclei
 - Paraventricular nucleus : closest to the midline (third ventricle)
- Medial Nucleus(Ventral & Dorsal)
- Fornix
- Tuberomammillary Nucleus
- Lateral Nucleus



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2. In Sagittal Section

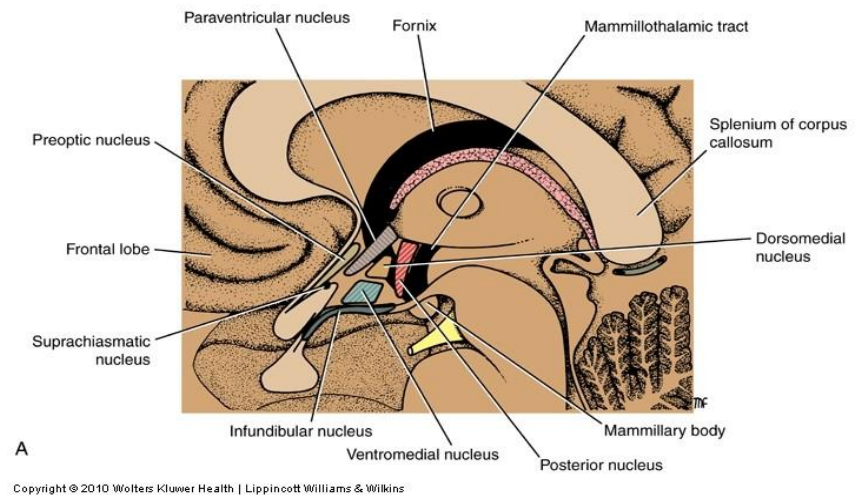
- Chiasmatic (anterior, supraoptic, preoptic) near to the optic chiasm

- Tuberal (middle)

contains
paraventricular
nuclei & Medial
Nuclei

- Mamillary (posterior)

Contains Mammillary
bodies and Posterior
Nuclei



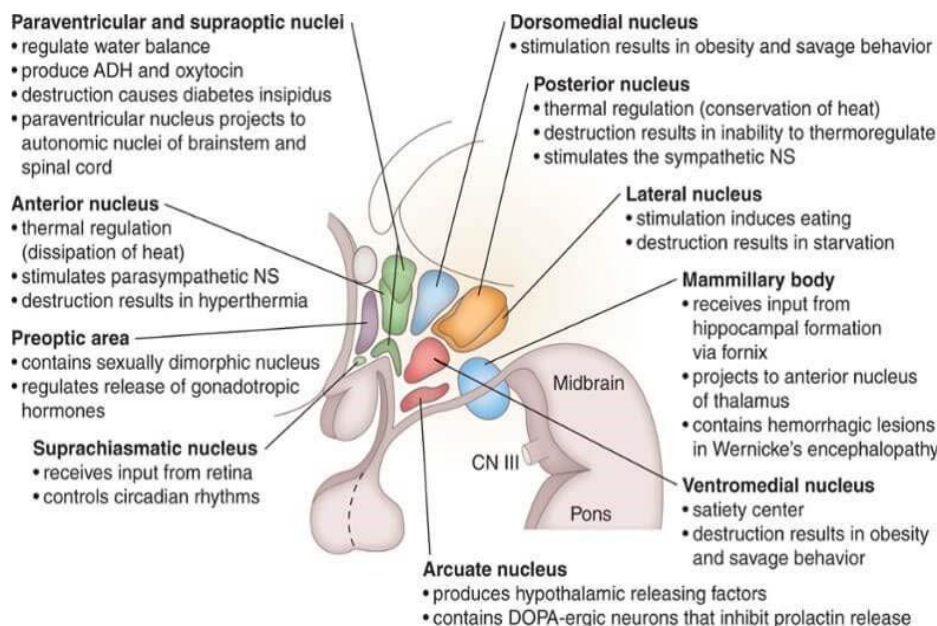
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Hypothalamus: Function

- It receives afferent Neural Influences & Hormonal Influences and then sends efferent fibers to :
 - Endocrine System (by pituitary gland)
 - Limbic System
 - Autonomic Nervous System

Hypothalamus: Nuclei & Functions

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Limbic System

- Includes

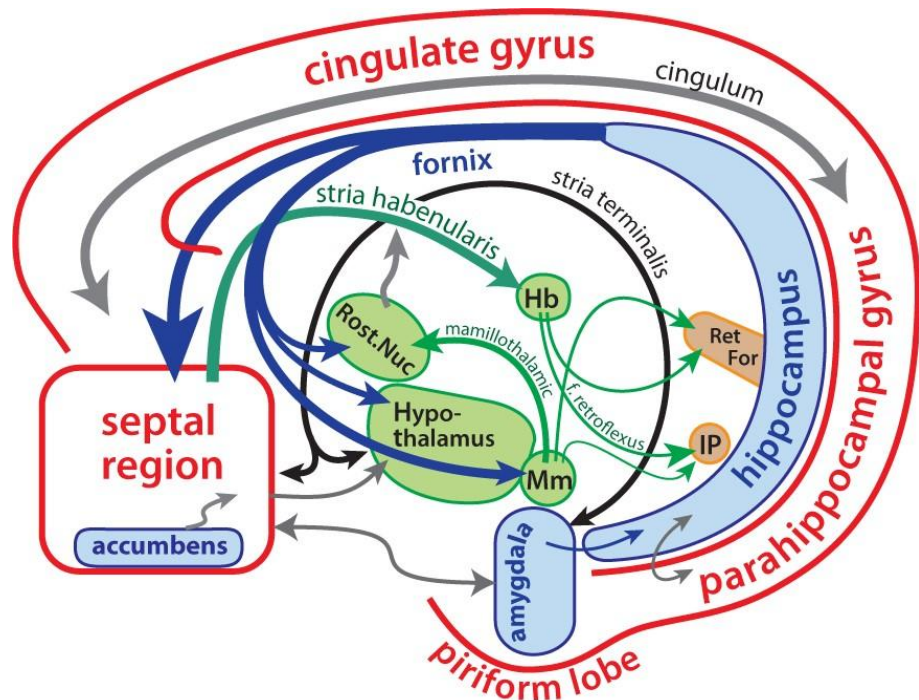
- Cingulate gyrus
- Parahippocampal gyrus (Cortex)
- Mamillary body
- Hippocampus
- Anterior & Dorsomedial Thalamic Nuclei
- Amygdala (Found in Temporal lobe anterior to Hippocampus)
- Septal nuclei (Anterior Stria Terminalis)
- Nucleus accumbens
In Ventral striatum(Most ventral part of Basal Nuclei)
- Substantia innominate (innominate means has no name) It is a group of nuclei that are important for rehearsal , attention & consolidation in memory.

- Involved in Complex behaviors:

- To preserve life
- Motivation
- Emotions
- Affective behavior
- Memory

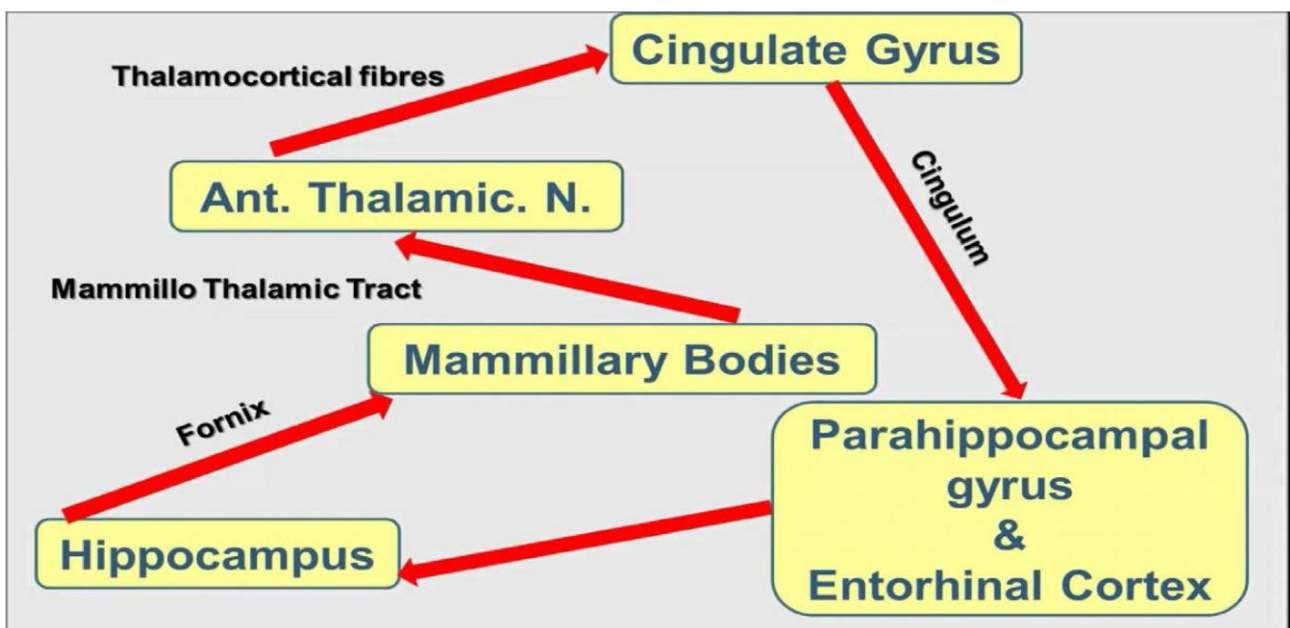
Striate Nuclei + Cingulate Gyrus + Parahippocampal Gyrus & Entorhinal Cortex = Limbic Lobe

Limbic System: Components



Limbic System: Circuit of Papez

- Thought to have role in emotions, motivation & affective behavior.



Thank you