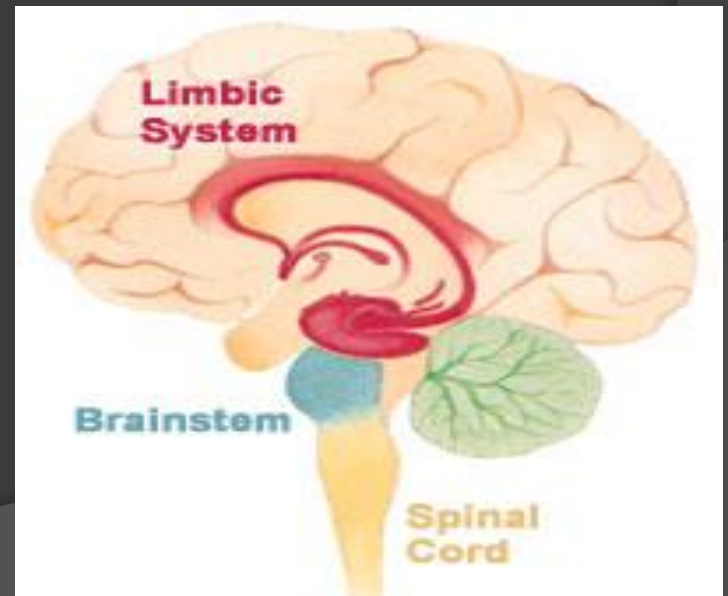


Thalamus & Limbic System



Prof. Saeed Abuel Makarem

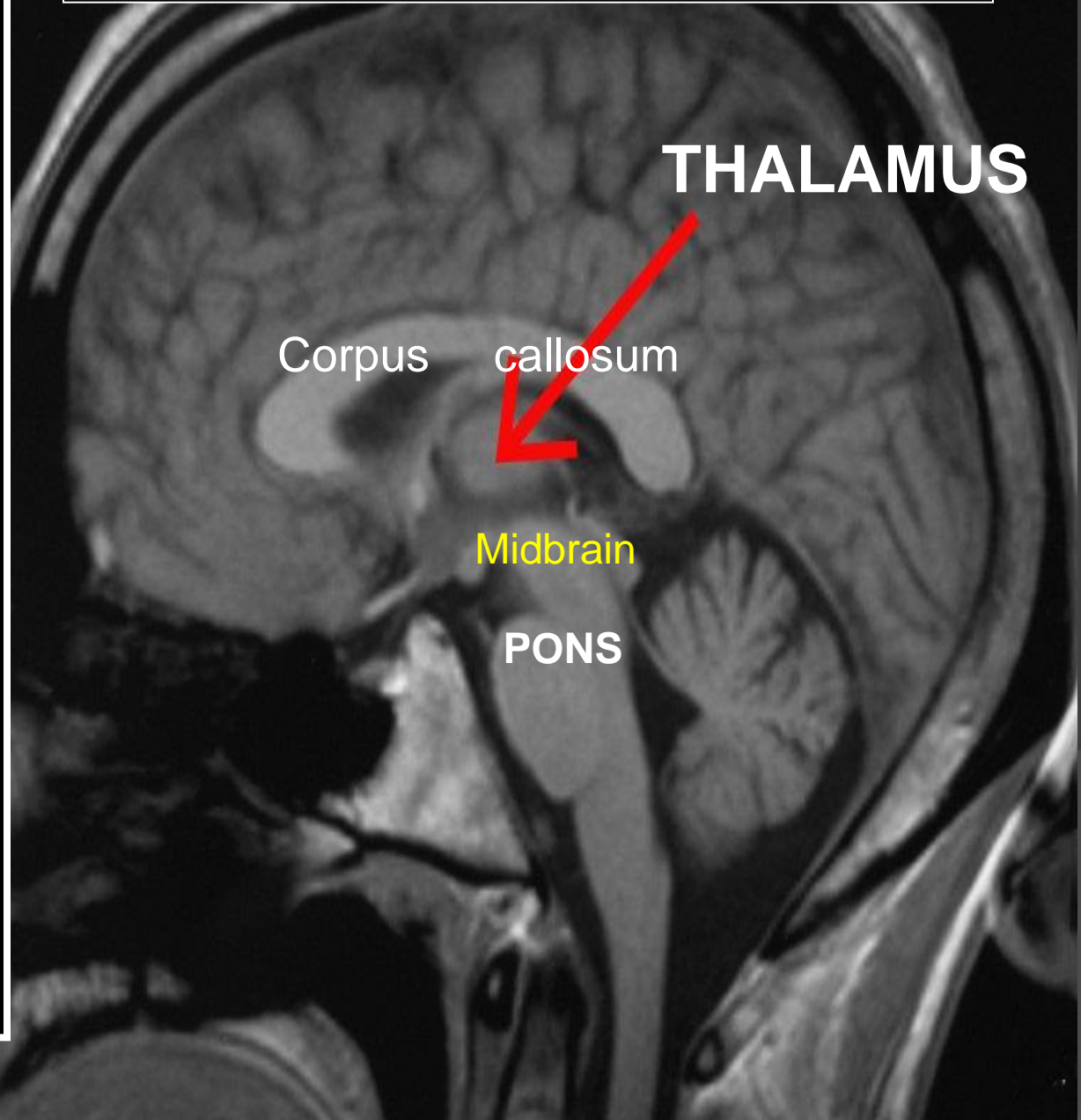
Objectives

By the end of the lecture, you should be able to:

- ⦿ Describe the anatomy and main functions of the thalamus.
- ⦿ Name and identify different nuclei of the thalamus.
- ⦿ Describe the main connections and functions of thalamic nuclei.
- ⦿ Name and identify different parts of the limbic system.
- ⦿ Describe main functions of the limbic system.
- ⦿ Describe the effects of lesions of the limbic system.

Thalamus

- It is the largest nuclear mass of the whole body.
- It is the largest part of the **diencephalon**
- It is formed of two oval masses of **grey matter**.
- It is the **gateway to the cortex**.
- Resemble a small hen.
- Together with the hypothalamus they form the lateral wall of the 3rd ventricle.



Thalamus

It sends received information from different brain regions to the **cerebral cortex**.

Axons from every sensory system (**except olfaction**) synapse in the thalamus as the last relay site '**last pit stop**' before the information reaches the cerebral cortex.

There are some thalamic nuclei that receive input from:

1. **Cerebellar nuclei,**
2. **Basal ganglia-** and
3. **Limbic-related** brain regions.



It has 4 surfaces & 2 ends.

Surfaces

Lateral:(L)

Posterior limb of the internal capsule

Medial: (3)

The 3rd ventricle

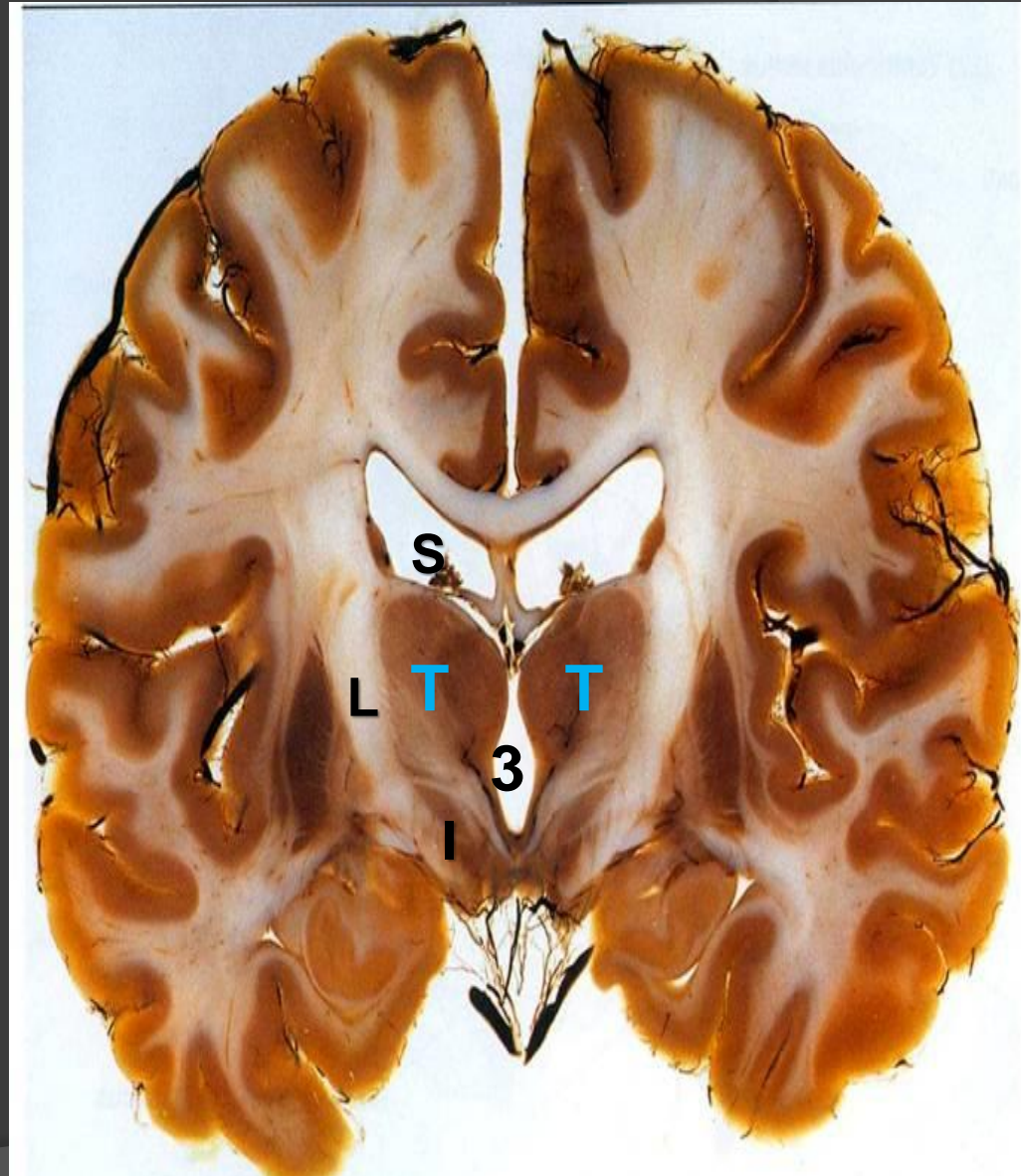
In some people it is connected to the thalamus of the opposite side by the interthalamic connexus, **(adhesion) or Massa intermedia.**

Superior: (s)

Lateral ventricle and fornix.

Inferior: Hypothalamus, anteriorly & Subthalamus posteriorly.

Relations



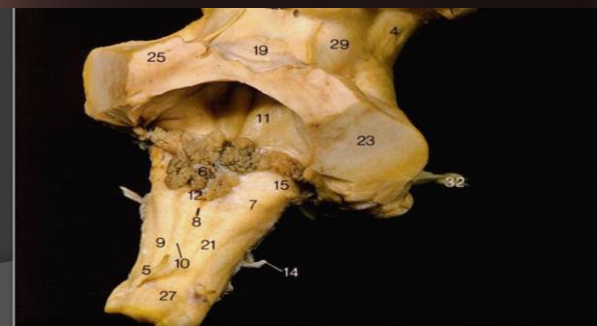
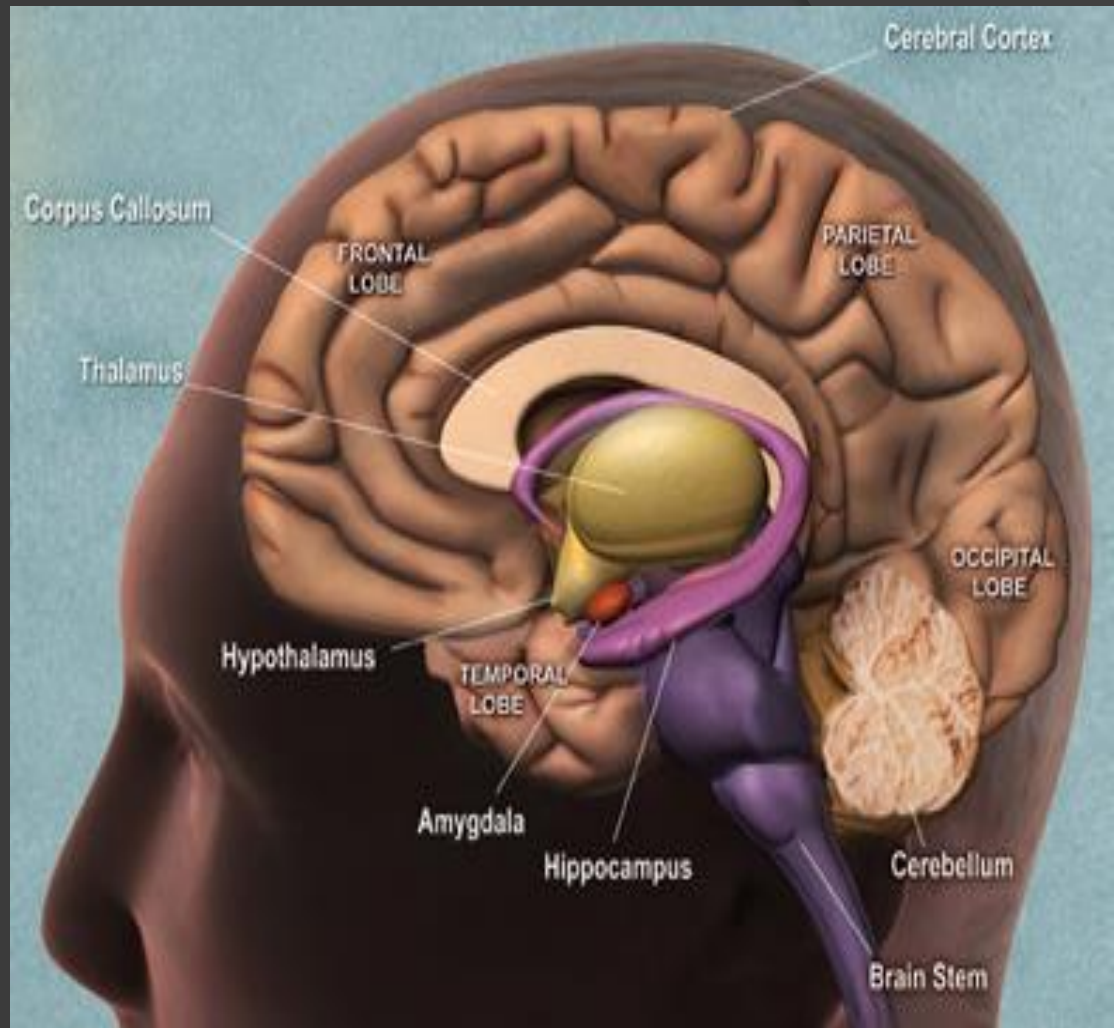
Anterior end:

Forms a projection, called the anterior tubercle.

It lies just behind the interventricular foramen.

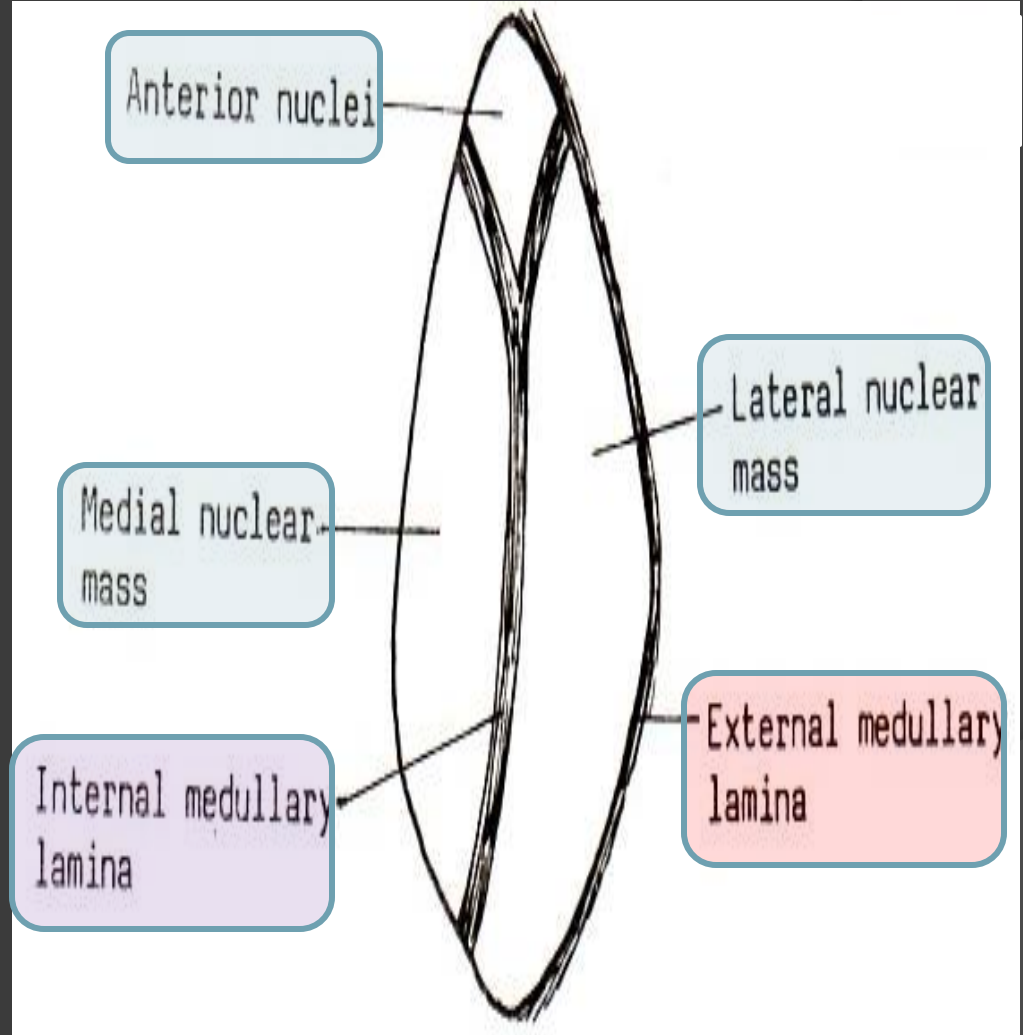
Posterior end: Broad

*Forms a projection called **Pulvinar** which lies above the superior colliculus and the lateral & medial **Geniculate bodies.***



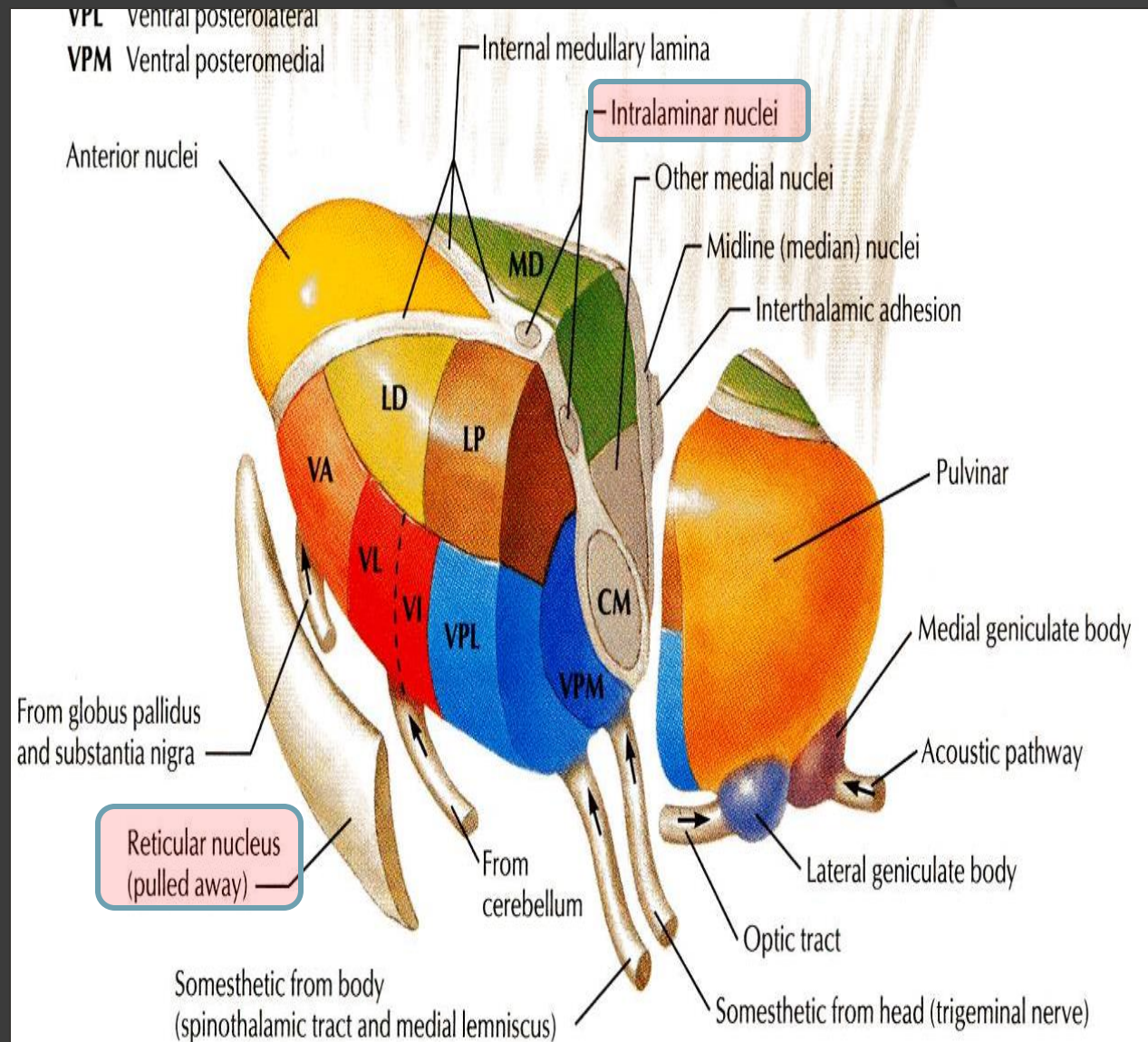
Internal Structure

- **White matter:**
- **External medullary lamina:**
- Covers the lateral surface.
- It consists of thalamocortical & corticothalamic fibers.
- **Internal medullary lamina:**
- Bundle of **Y-shaped** myelinated (afferent & efferent) fibers.
- It divides the thalamus into: **anterior, medial, lateral nuclear** groups.
- Each of these group is subdivided into a number of named nuclei.



Internal Structure

- Embedded within the **internal medullary lamina** lie intralaminar nuclei.
- The **external medullary lamina** covers the lateral surface, in which lies thin **reticular nucleus**.



Lateral Nuclear Group

○ It is divided into:
Dorsal & Ventral tiers.

○ **Dorsal tier:**

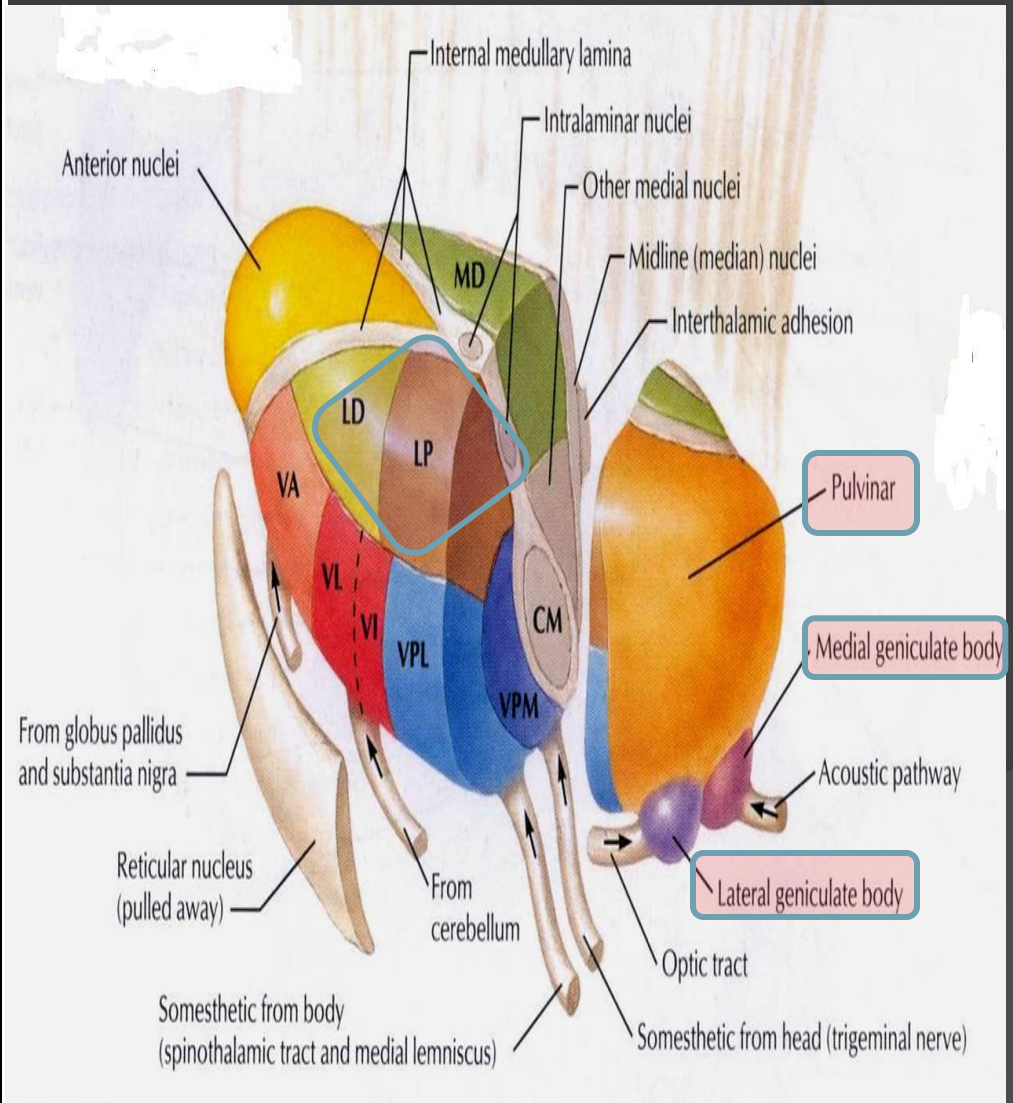
○ which contains:

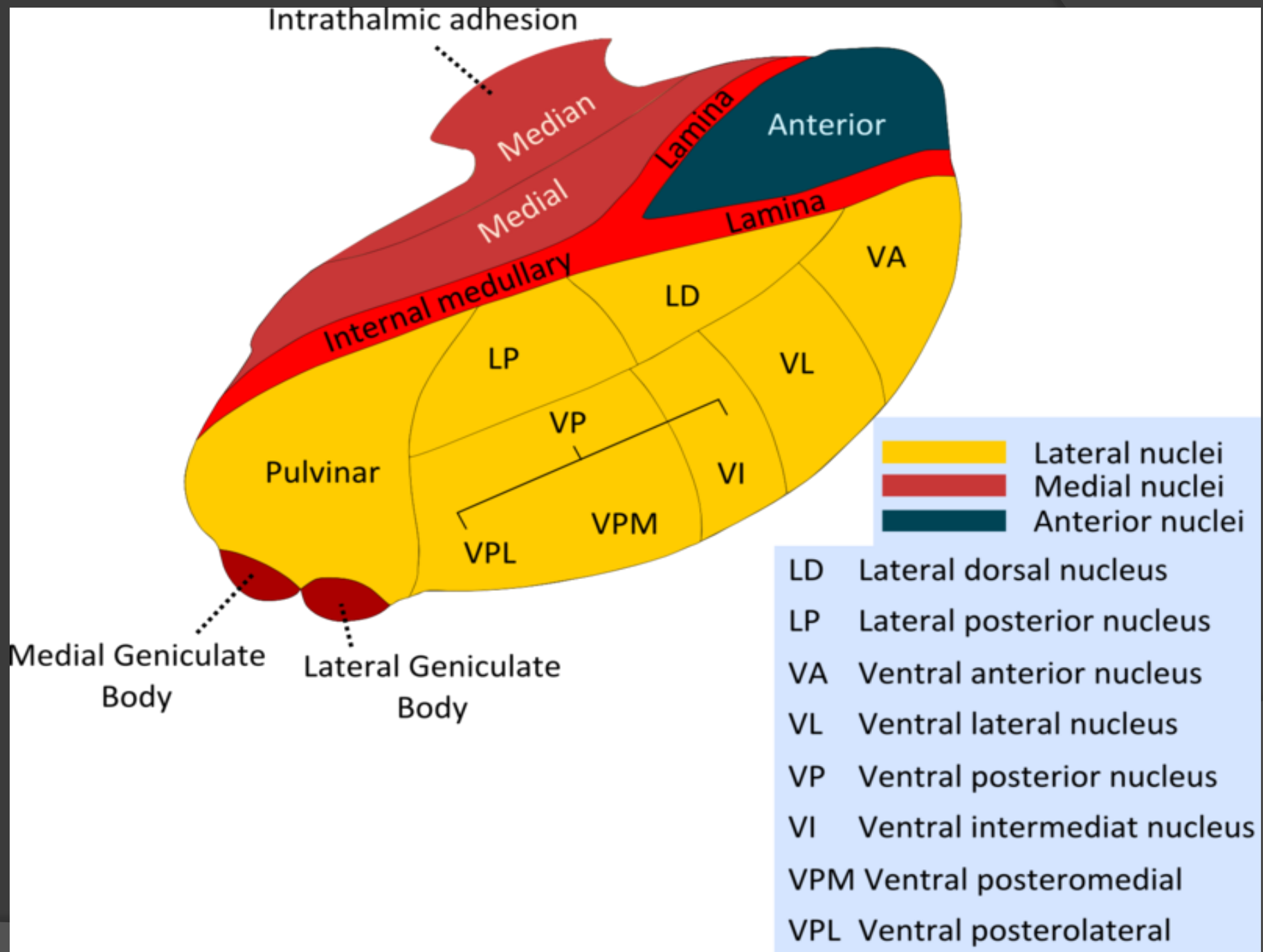
1. **Lateral Dorsal (LD).**
2. **Lateral Posterior (LP).**
3. **Pulvinar.**

○ **Ventral tier,**

○ Which contains :

1. **Ventral Anterior (VA).**
2. **Ventral Lateral (VL).**
3. **Ventral Intermediate (VI).**
4. **Ventral Posterior (VP).
(VPL, VPM).**
5. **Medial & Lateral
geniculate nuclei.**





- Lateral nuclei
- Medial nuclei
- Anterior nuclei

- LD Lateral dorsal nucleus
- LP Lateral posterior nucleus
- VA Ventral anterior nucleus
- VL Ventral lateral nucleus
- VP Ventral posterior nucleus
- VI Ventral intermedial nucleus
- VPM Ventral posteromedial
- VPL Ventral posterolateral

Projection of thalamic nuclei

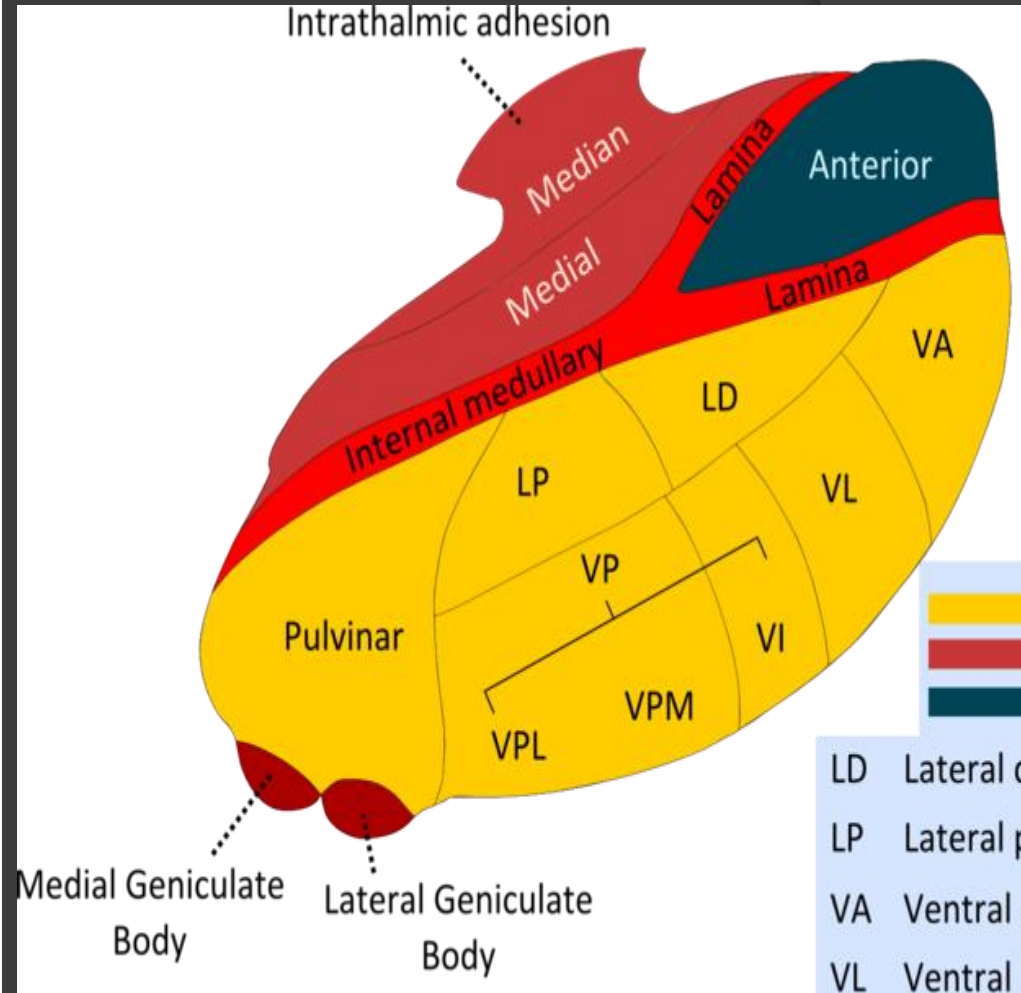
Anterior Thalamic Nucleus

- **Afferent:** Mammillary body.
- **Efferent:** Cingulate gyrus, (limbic system)

○ -----

Medial Nucleus

- **Afferent:** Hypothalamus.
- **Efferent:** Prefrontal cortex.



Projection of thalamic nuclei

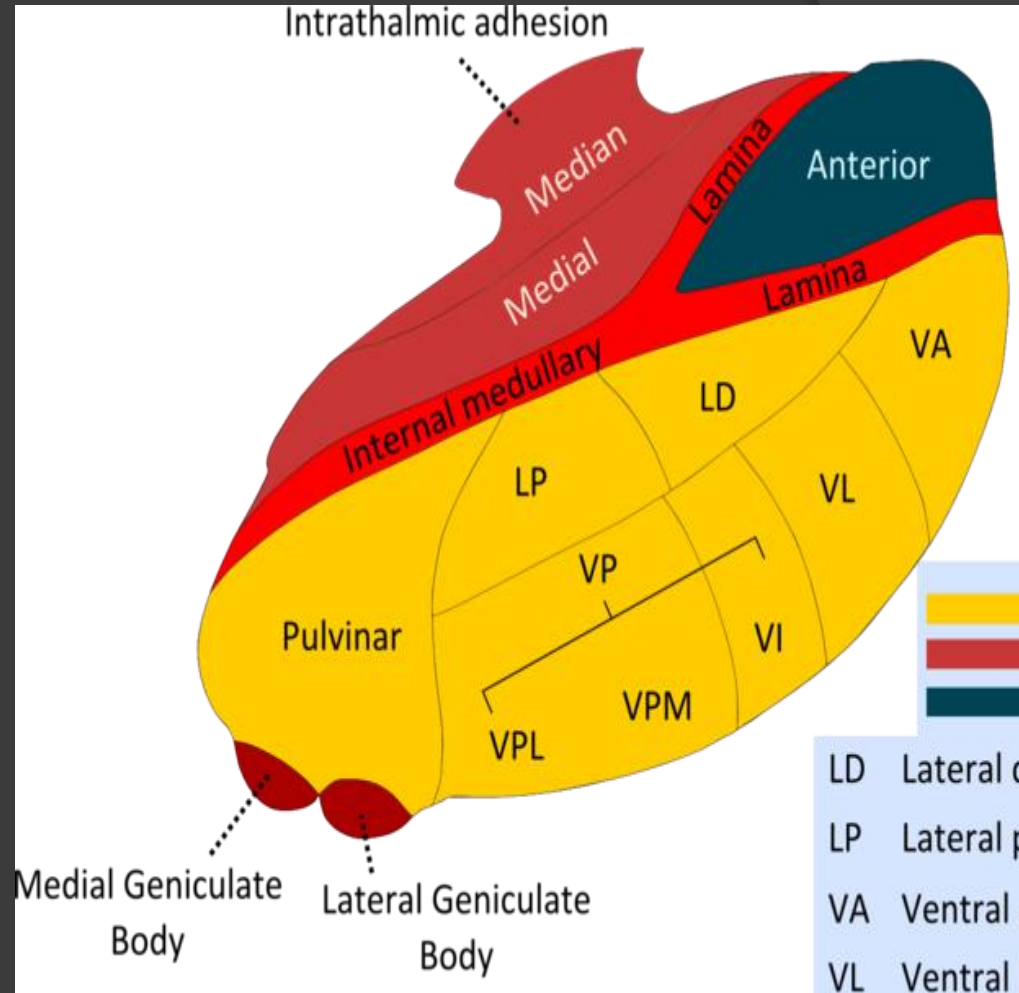
Ventral Anterior Nucleus

- **Afferent:** Globus pallidus and substantia nigra.
- **Efferent:** Premotor cortex.

○ -----

Ventral Lateral Nucleus

- **Afferent:** Dentate Nucleus.
- **Efferent:** Primary Motor Cortex.



Projection of thalamic nuclei

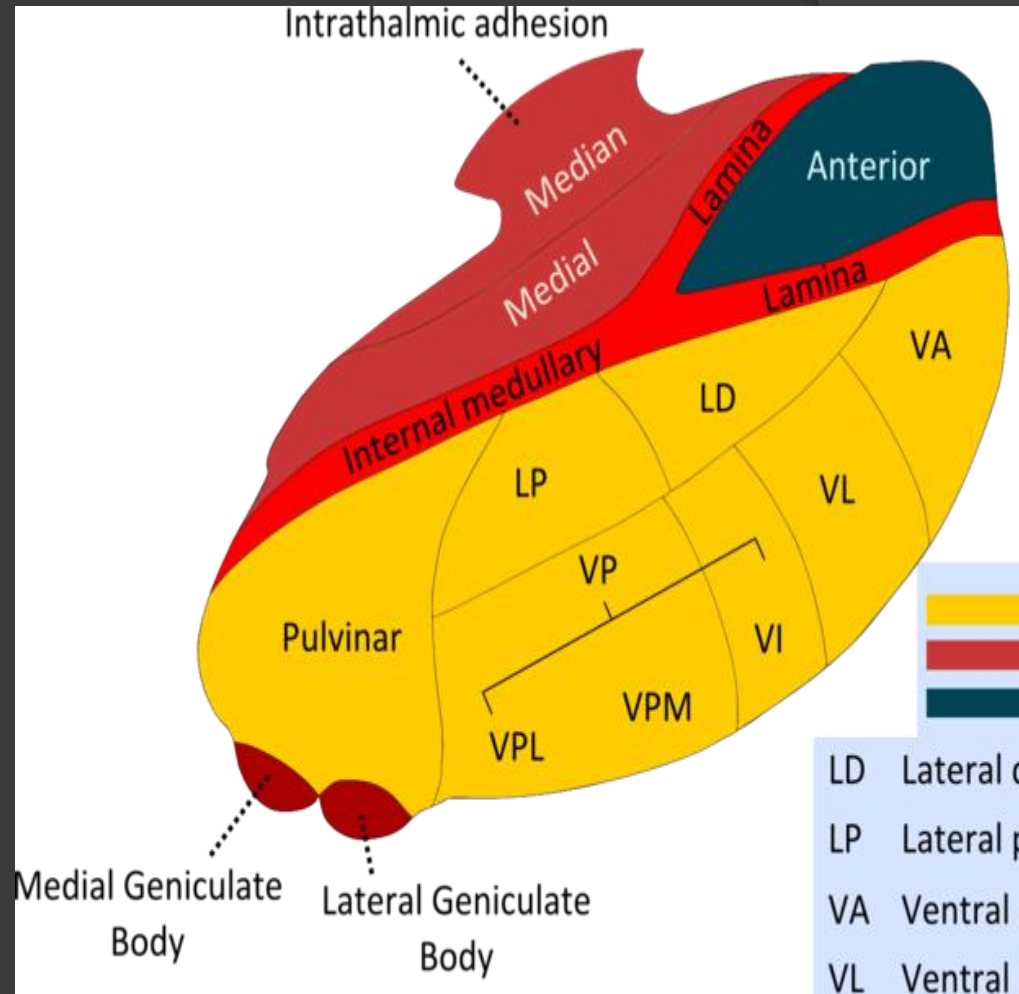
Ventral Posterior Lateral Nucleus

- **Afferent:** Medial and Spinal Lemnisci.
- **Efferent:** Sensory Cortex.

○ -----

Ventral Posterior Medial Nucleus

- **Afferent:** Trigeminal Lemniscus.
- **Efferent:** Sensory Cortex.



Projection of thalamic nuclei

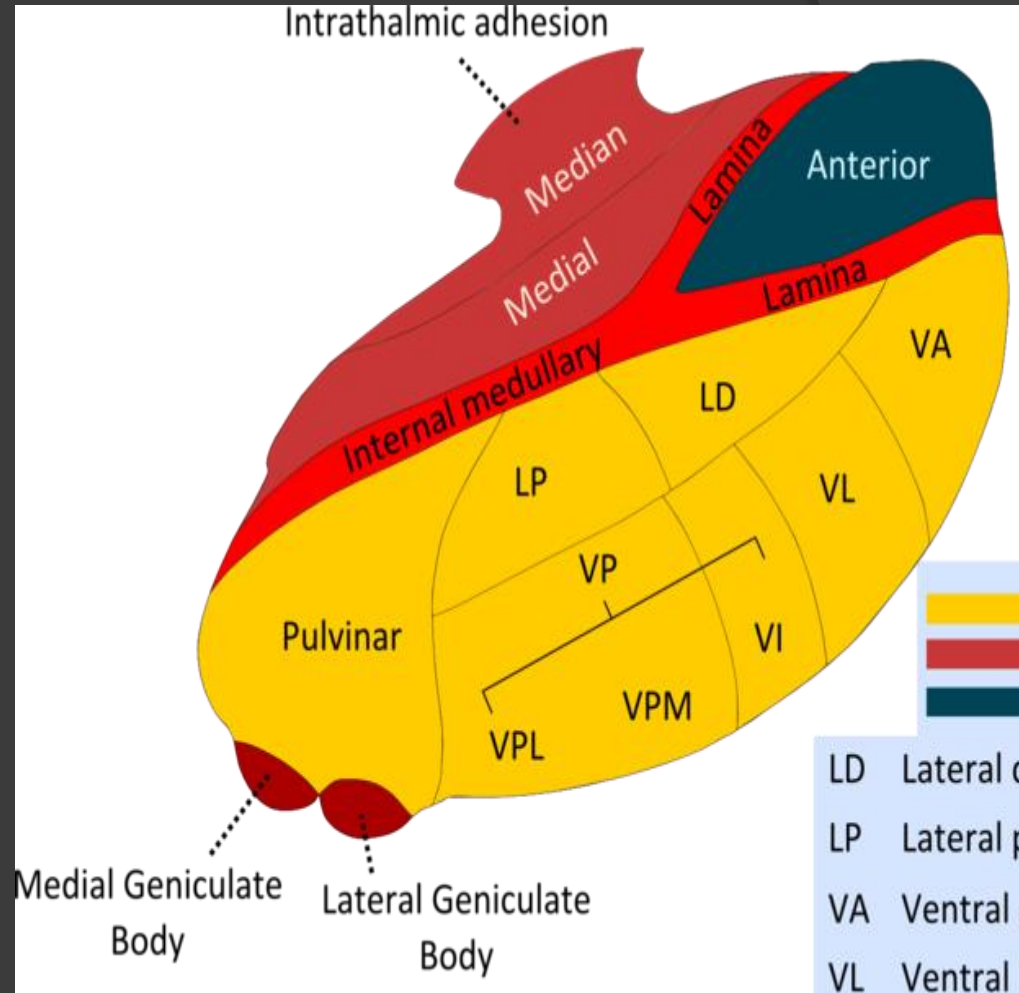
Lateral Geniculate Nucleus

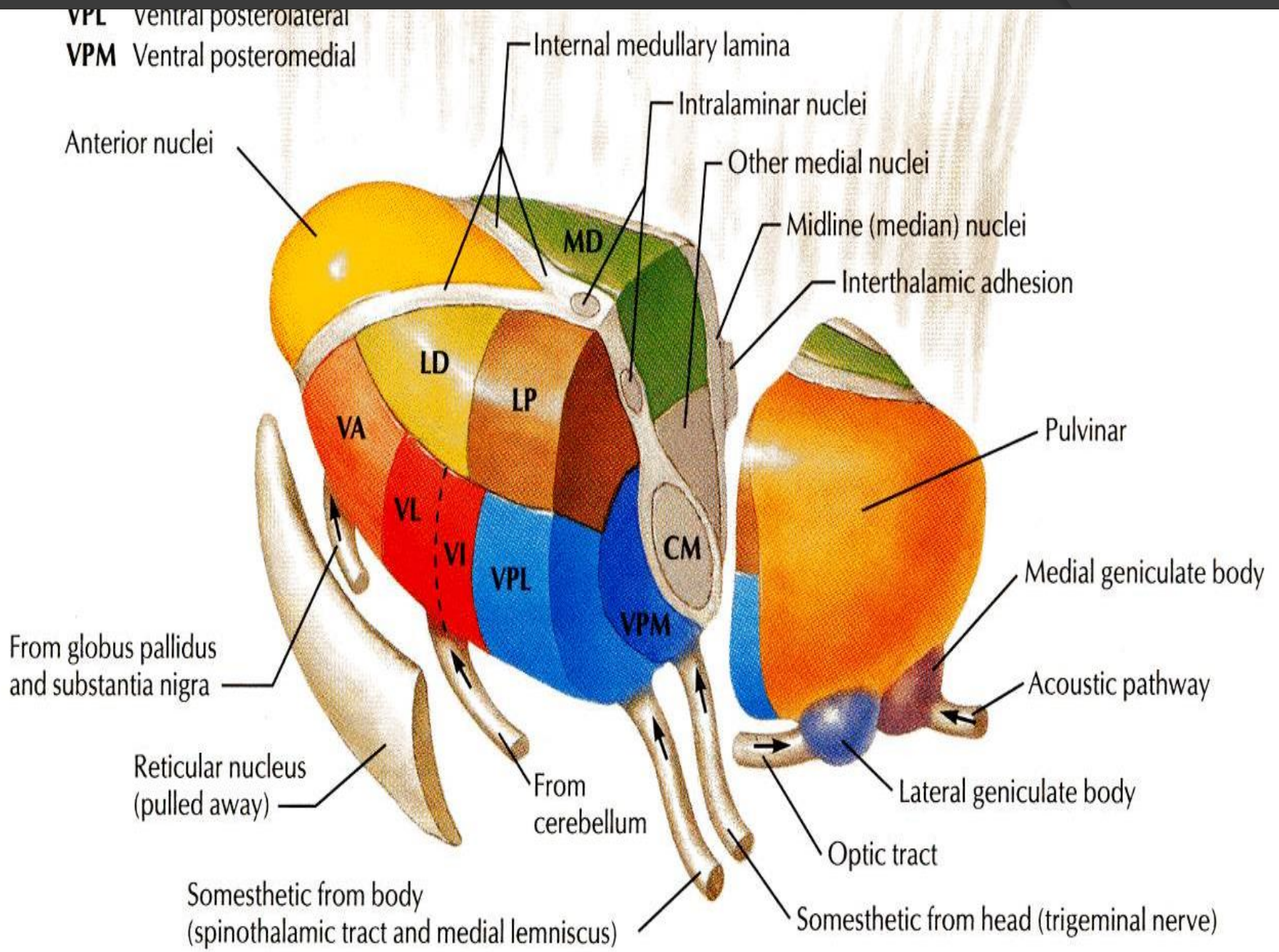
- **Afferent:** Optic tract.
- **Efferent:** Visual Cortex.

○ -----

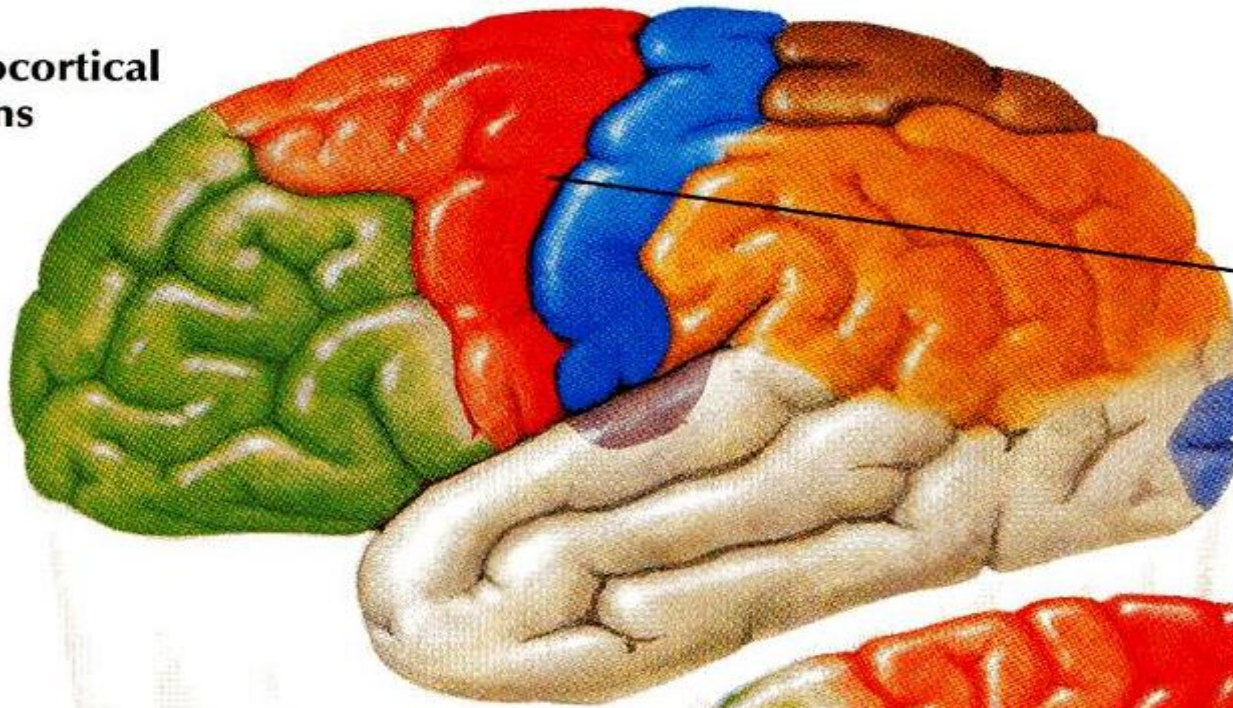
Medial Geniculate Nucleus

- **Afferent:** Lateral Lemniscus.
- **Efferent:** Auditory Cortex.





ocortical
ns

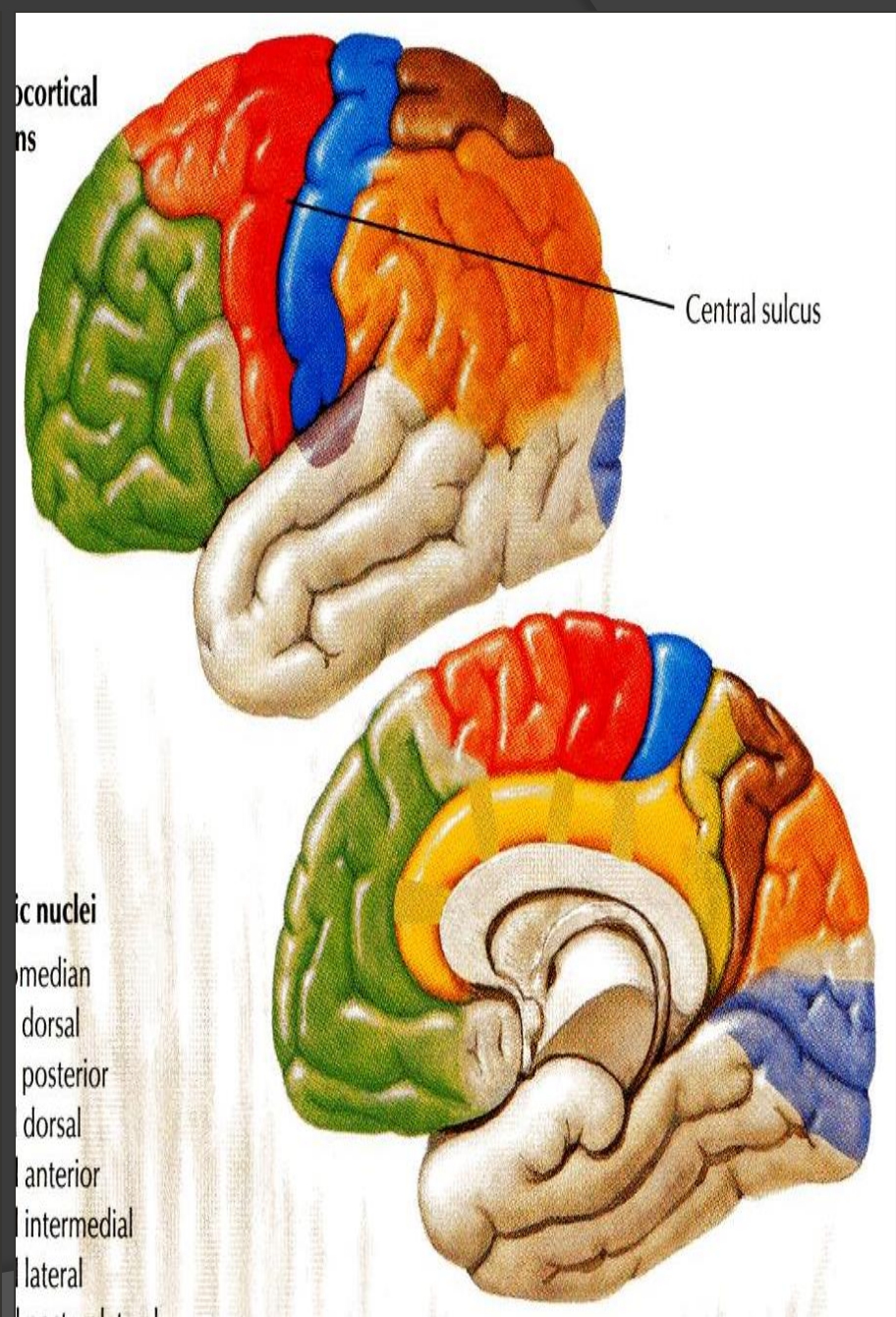
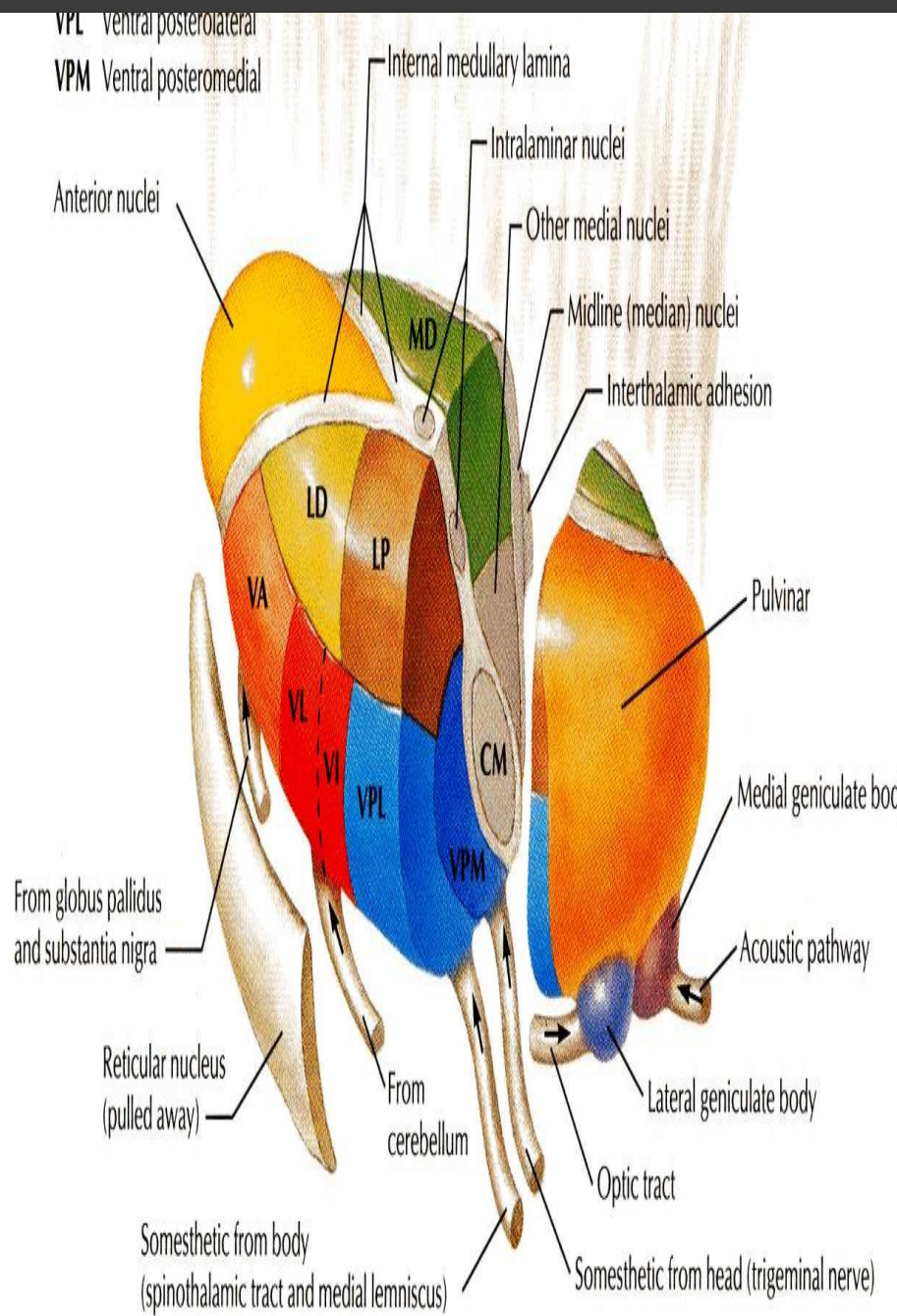


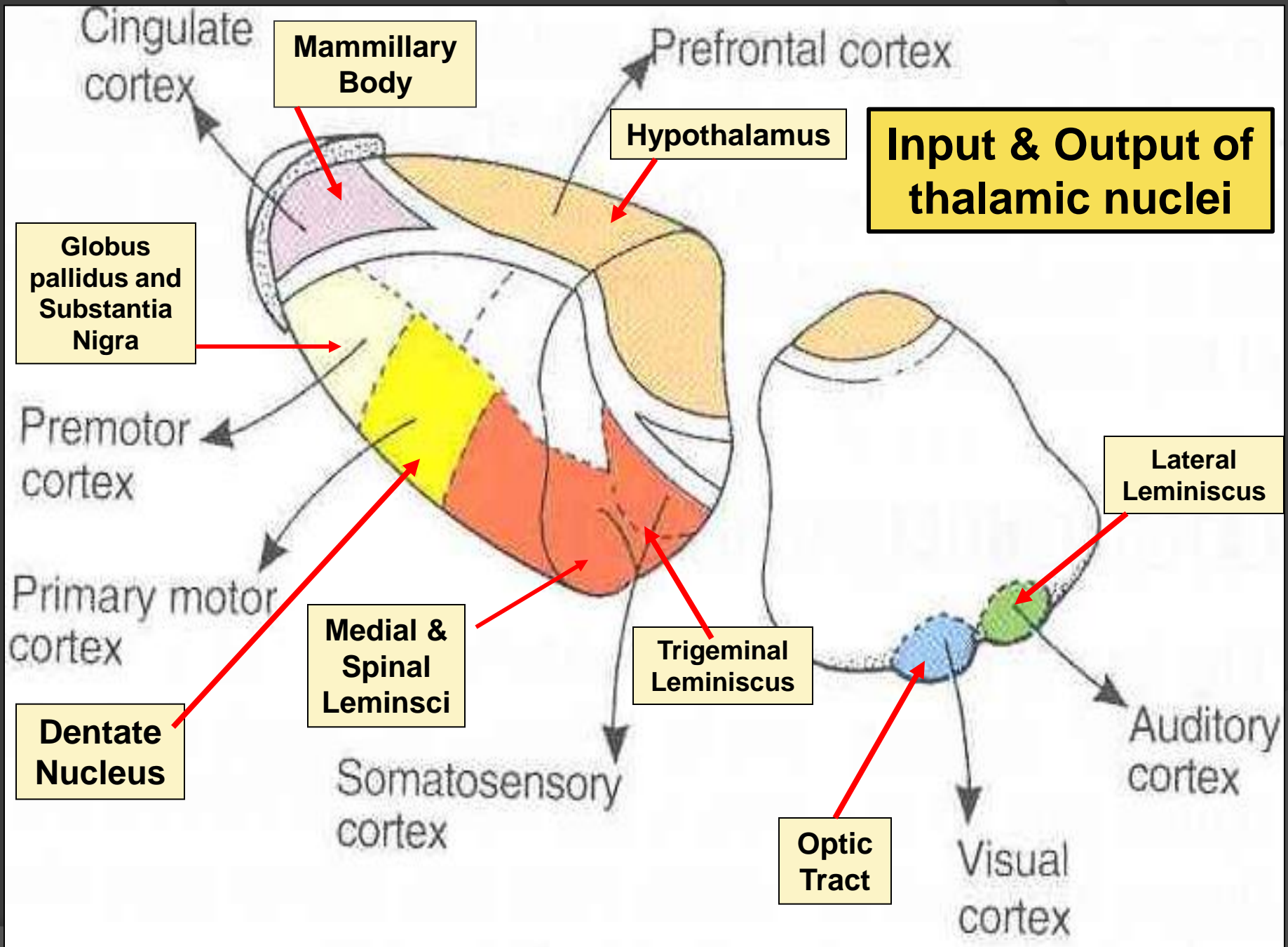
Central sulcus

ic nuclei

- o median
- o dorsal
- o posterior
- o dorsal
- o anterior
- o intermedial
- o lateral

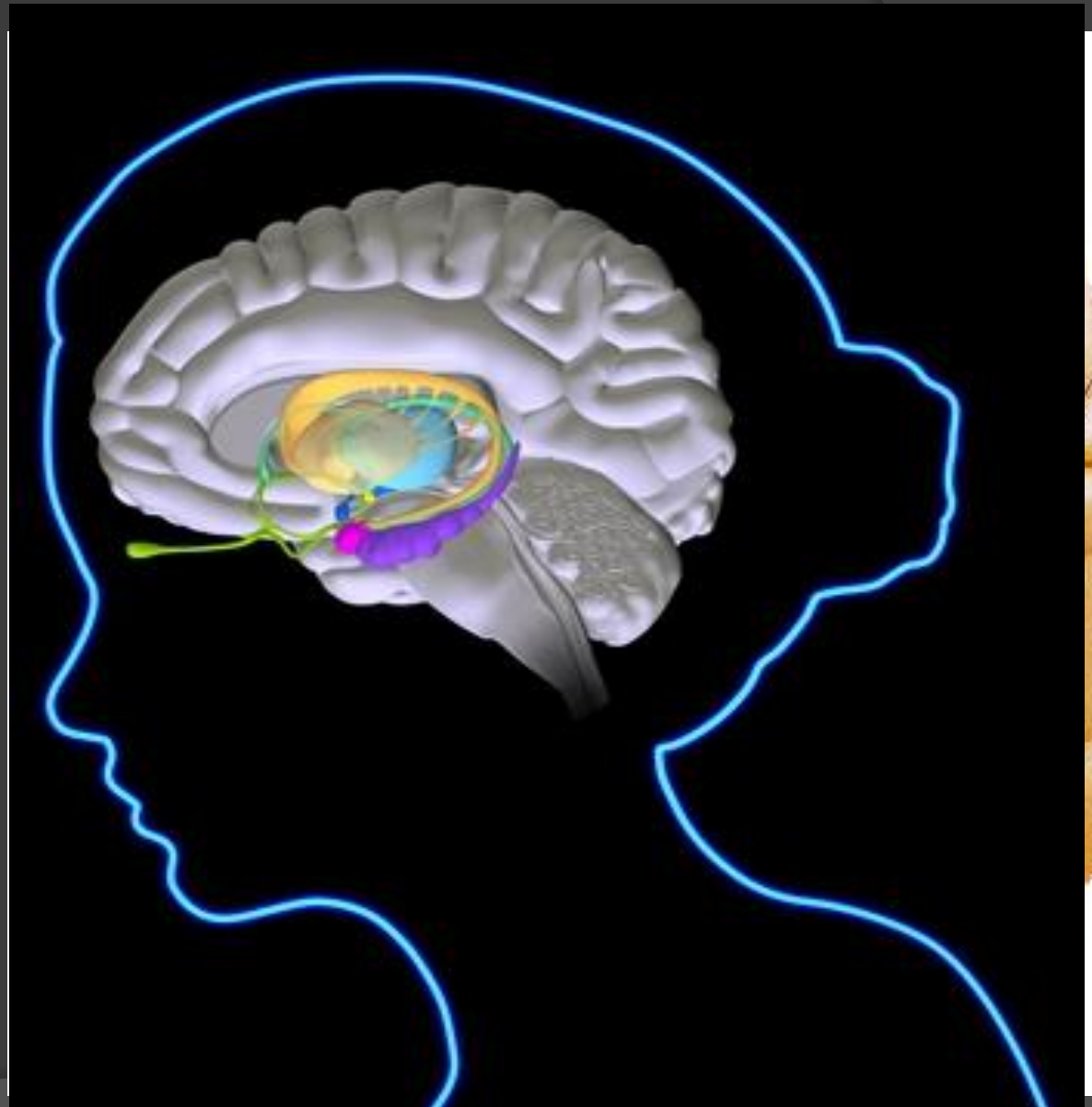






LIMBIC SYSTEM

- The term "limbic" is from the Latin word *Limbus*, for "border" or "edge".
- It separates the medial surface of the cerebral cortex from the diencephalon
- It consists of a number of cortical & subcortical structures with looped connections that all project to the hypothalamus.



WHAT IS THE FUNCTION OF THE LIMBIC SYSTEM?

It control a variety of functions including:

- ❖ **Emotions,**
- ❖ Emotional responses
- ❖ Behaviour & Mood
(happy, cry, laugh, sad, afraid, aggression, depression)
- ❖ Motivation.
- ❖ **Memory.**
- ❖ Visceral & Motor responses involved in (sex, **pleasure**, hunger, and reproduction).
- ❖ **Olfaction.**



MEMORY

**Pleasure
sensation**

OLFACTION



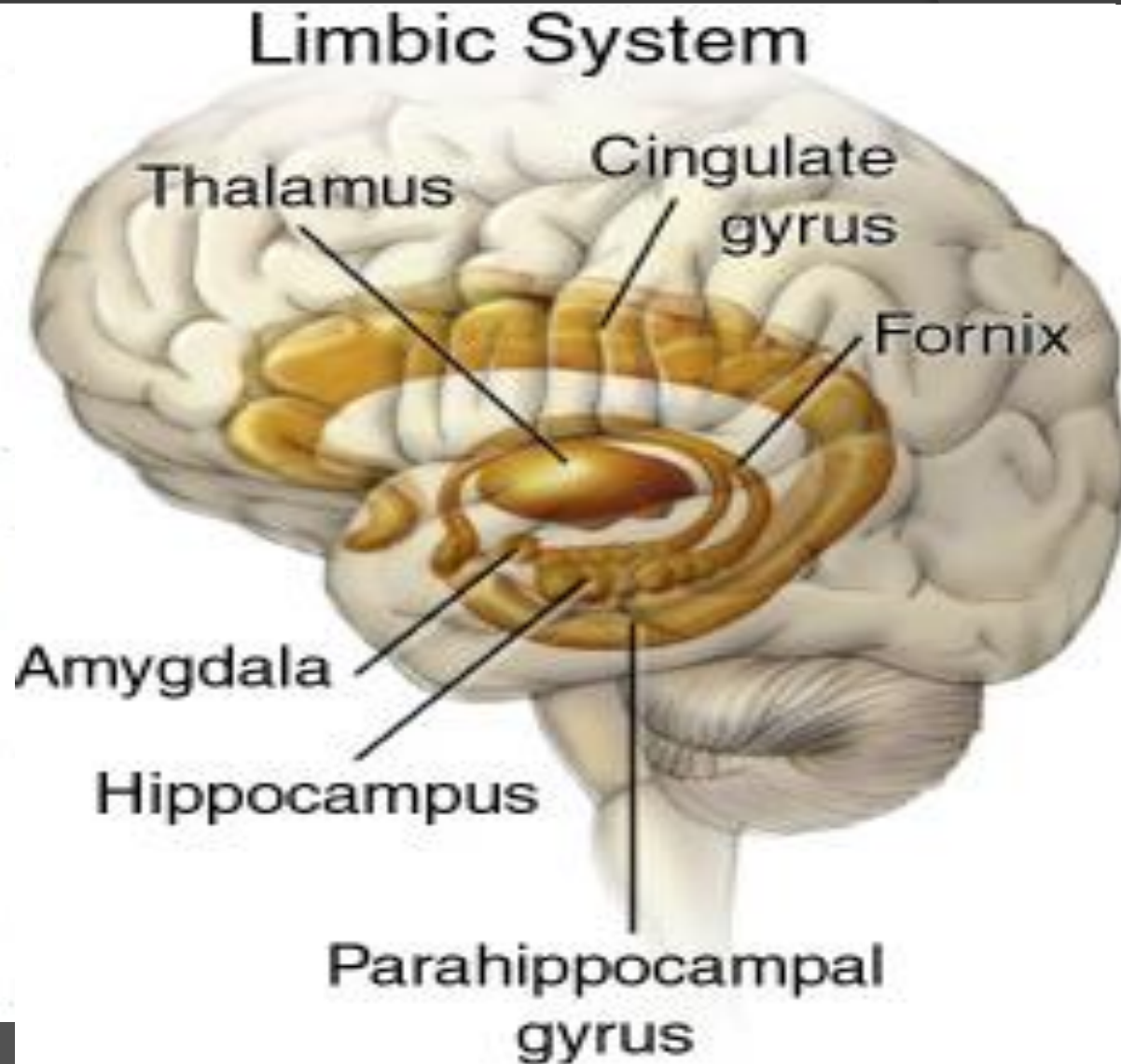
The limbic system is composed of four main structures:

1. Limbic cortex
2. Amygdala.
3. Hippocampus, &
4. Septal area.

These structures form connections between the limbic system and the hypothalamus, thalamus and cerebral cortex.

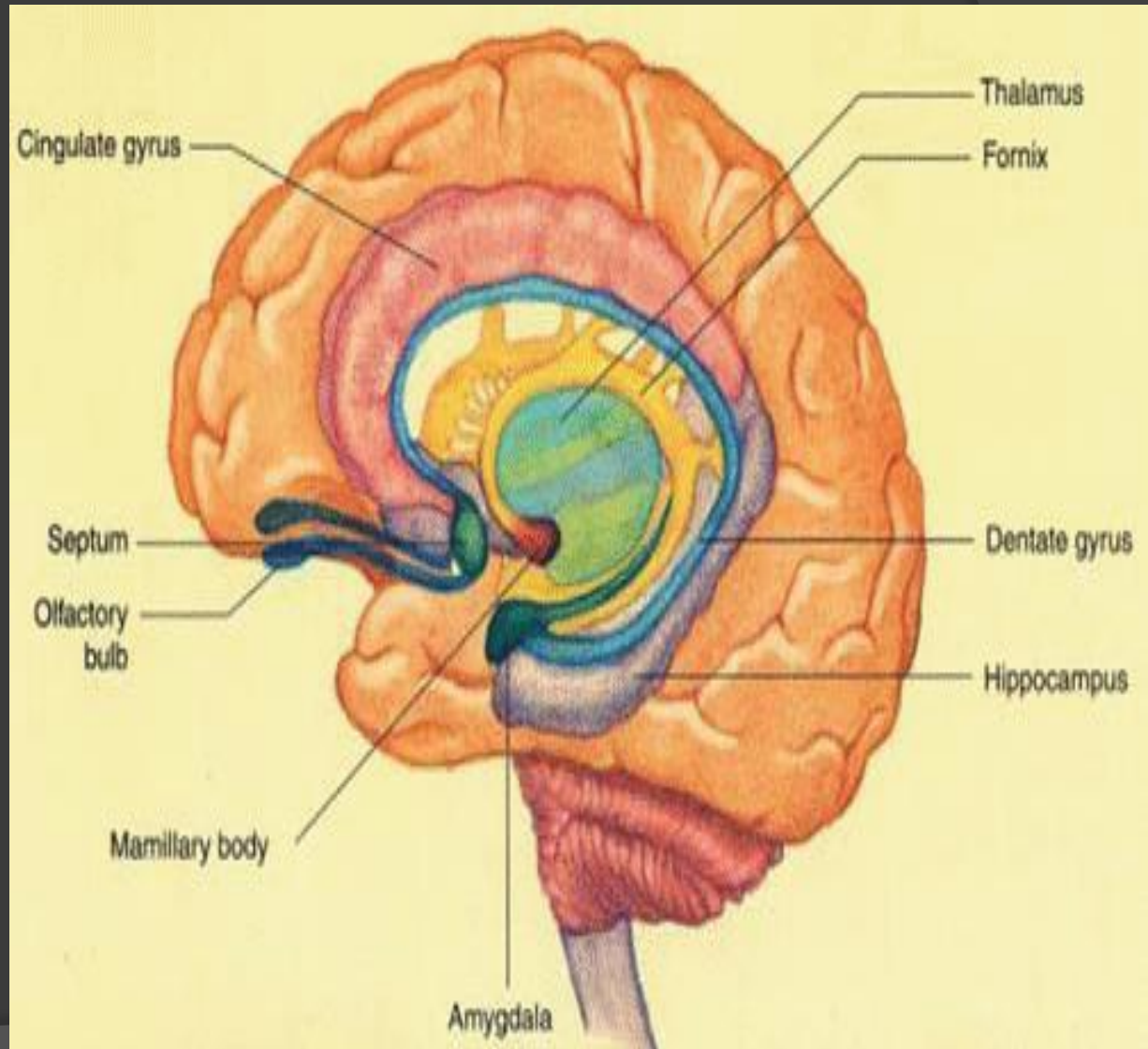
The **hippocampus** is important in memory and learning, while the limbic system itself is important in the control of the emotional responses.

The limbic system is a set of brain structures including



CORTICAL STRUCTURES

1. Limbic lobe.
2. Hippocampal formation.
3. Septal areas.
4. Prefrontal area.

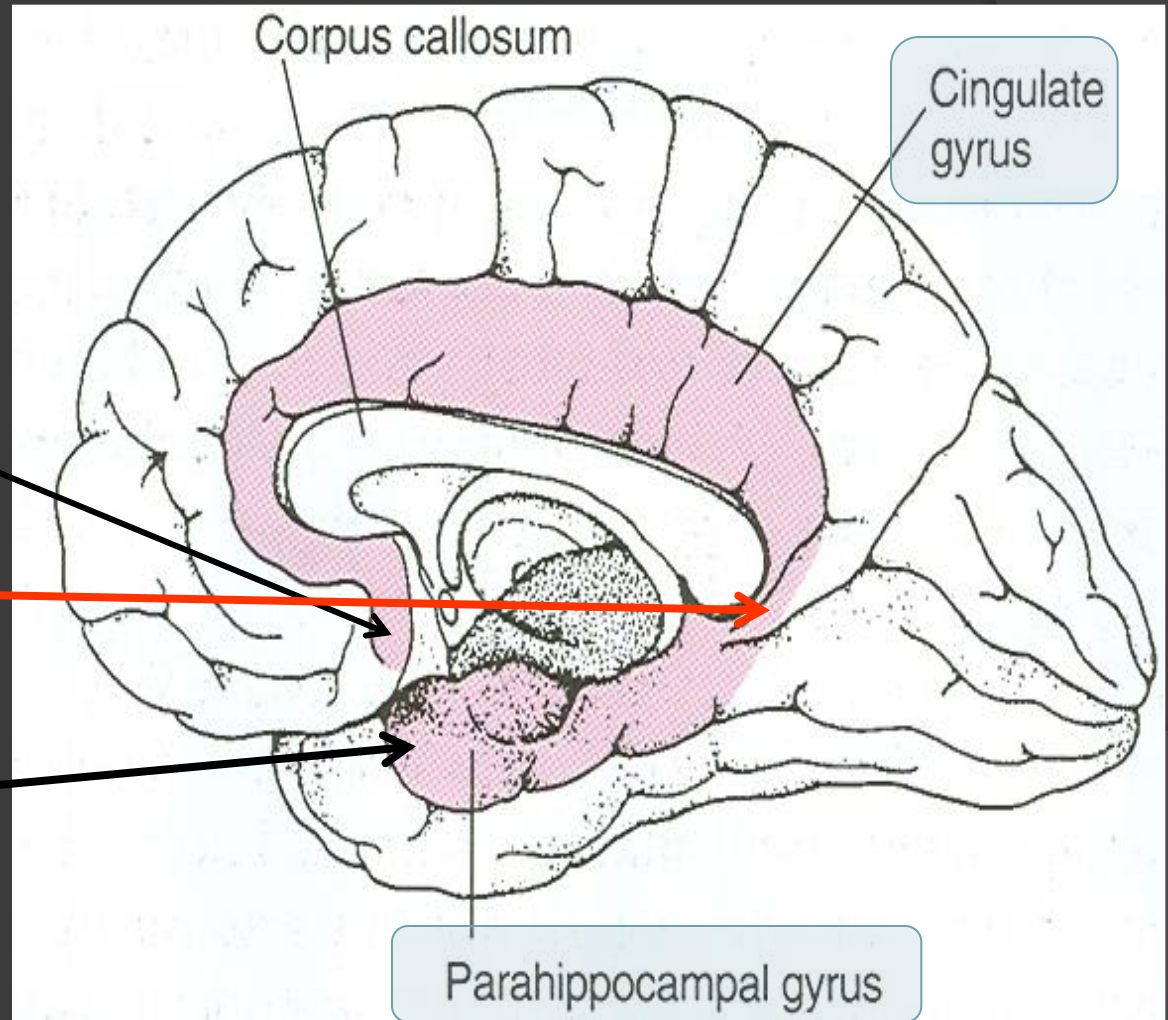


LIMBIC LOBE

- C-shaped ring of **grey matter** on the medial surface of each cerebral hemisphere, surrounding the corpus callosum.

- It includes:

1. **Subcallosal area**
2. **Cingulate gyrus**
3. **Isthmus**
4. **Parahippocampal gyrus and the**
5. **Uncus.**



HIPPOCAMPUS

It is a limbic system structure that is involved in:

Formation,
Organization, and
Storage of memories.

It is important in forming new memories and connecting emotions and senses, such as smell and sound, to memories.

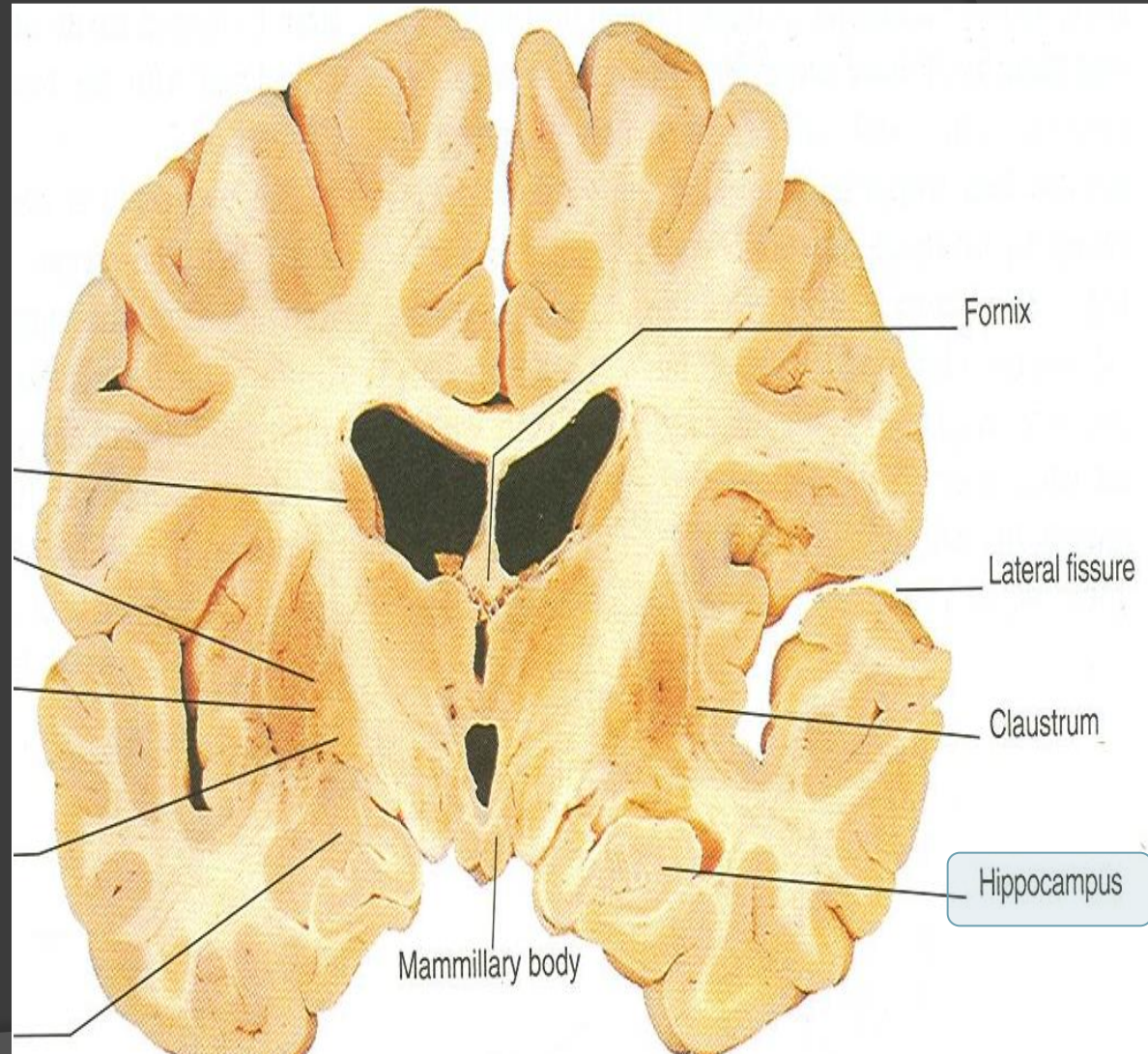
It is a horseshoe paired structure, one in each cerebral hemisphere.

It acts as a memory indexer by sending memories to the appropriate part of the **cerebral hemisphere** for long-term storage and retrieving them when necessary.



HIPPOCAMPUS

- **Site:**
- It is a scrolled structure in the inferomedial part of the temporal lobe.
- **Function:**
- Memory (file new memories as they occur).
- The hippocampus & its connections are necessary for **consolidation** of **new short-term memories**.



HIPPOCAMPUS

- Its principal efferent pathway is called the:

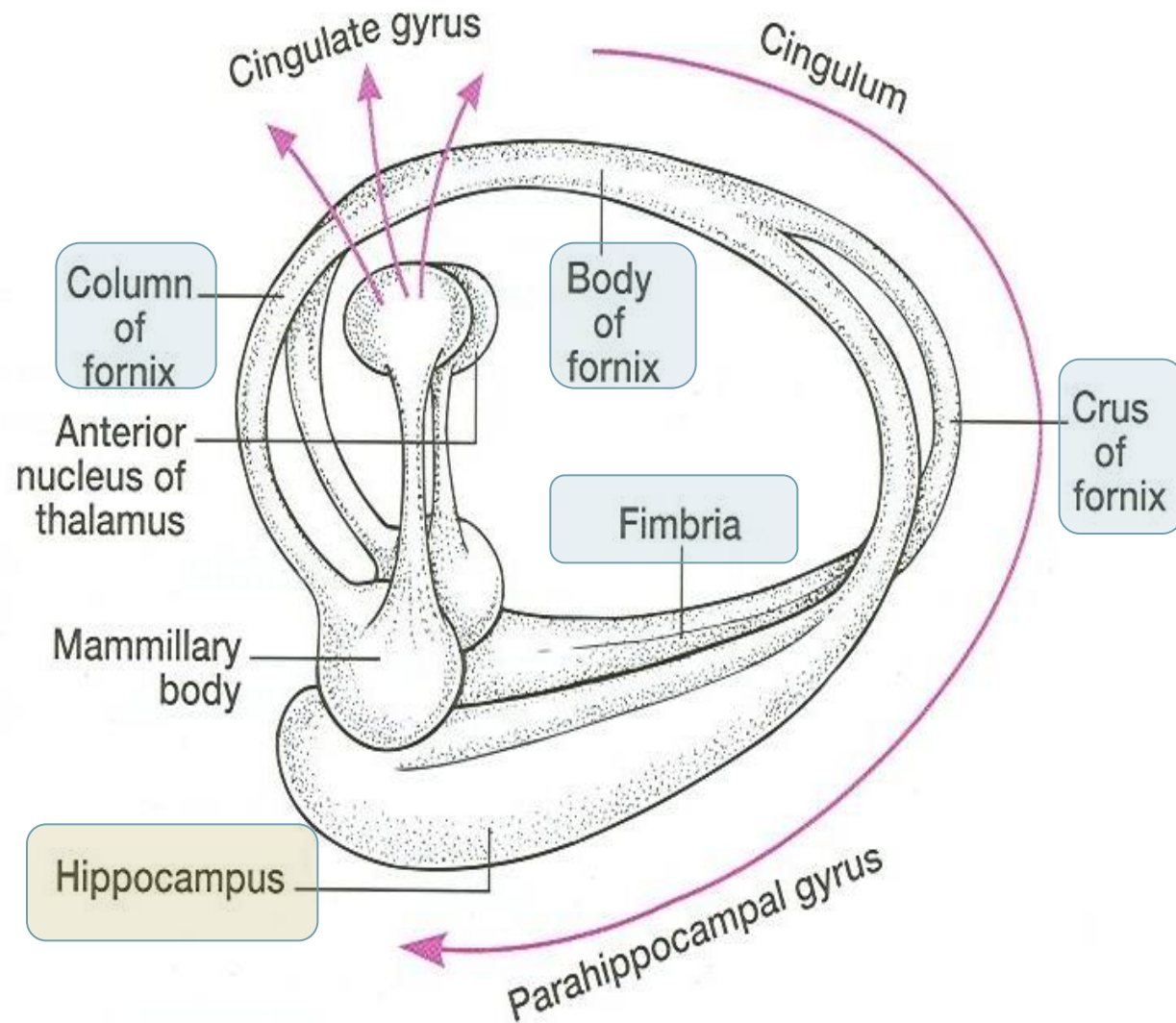
FORNIX:

It is C-shaped group of fibers connecting the hippocampus with mammillary body.

it consists of:

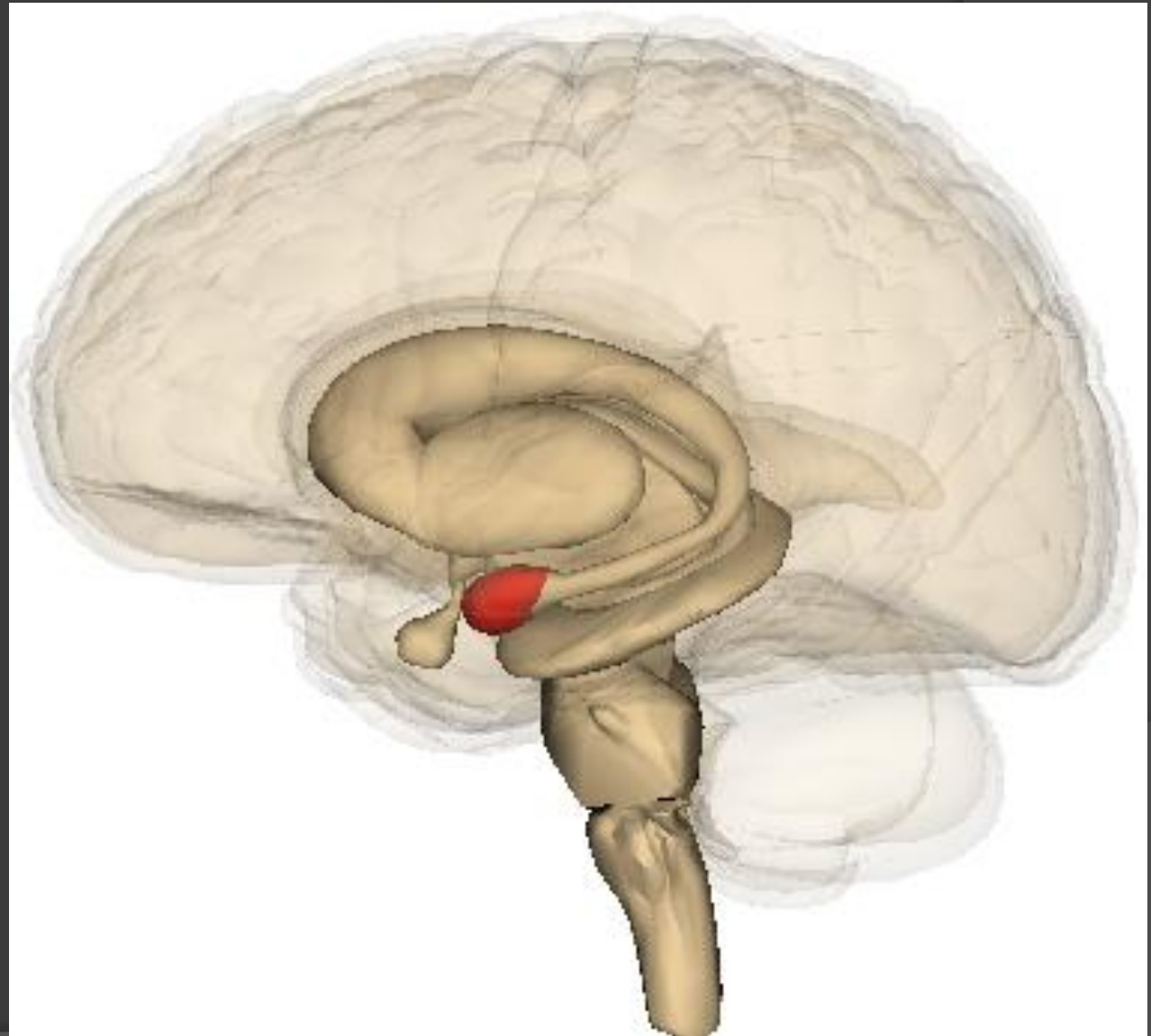
2 Fimbria,
2 Crus,
1 Body &
2 Column.

- The Fornix is an important component of **PAPEZ CIRCUIT**



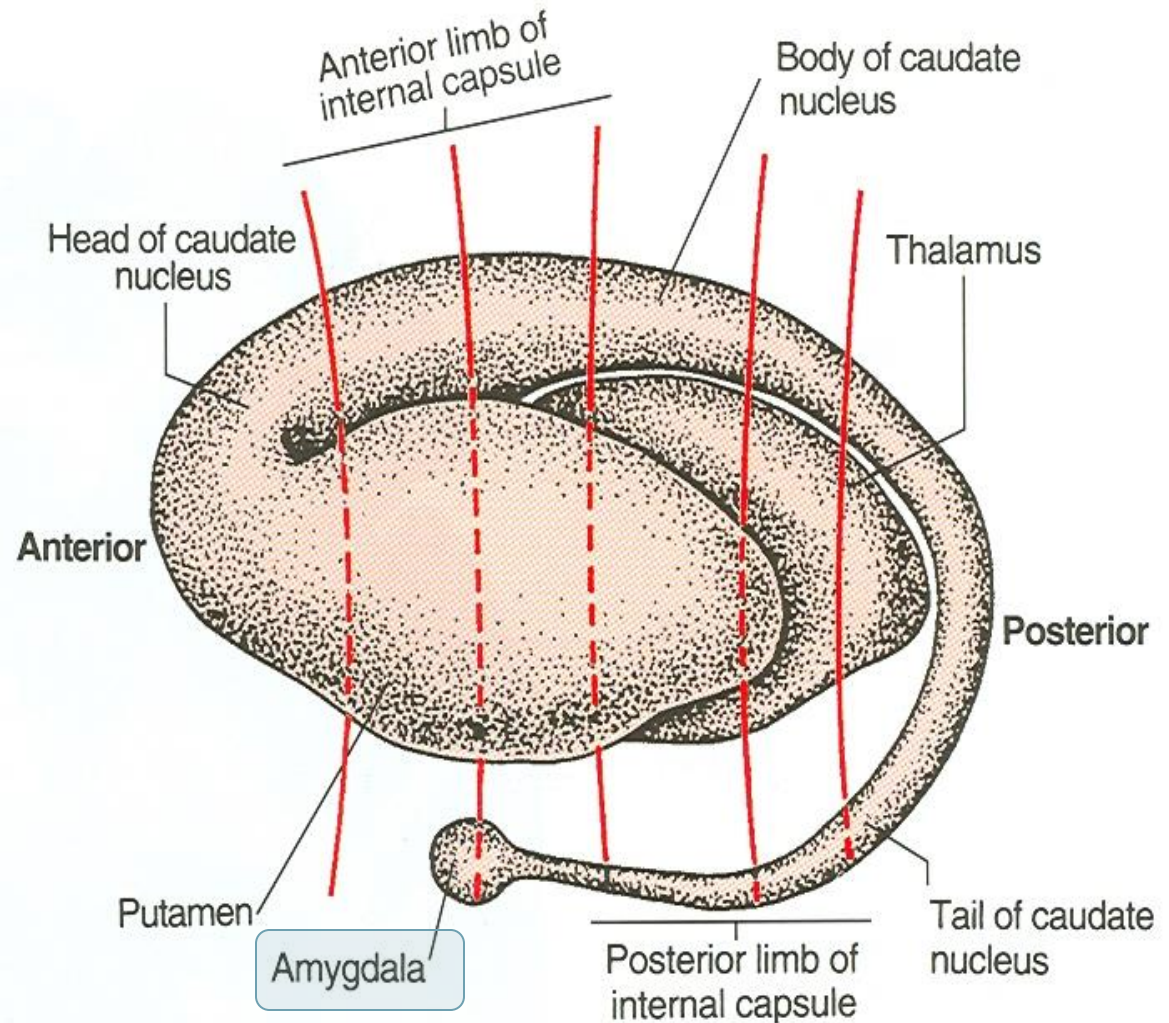
AMYGDALA

- **Site:**
- almond shaped mass of nuclei that lies near the temporal pole, close to the tail of the caudate nucleus.
- **Function:**
- It is involved in
 1. **FEAR,**
 2. **Emotions**
 3. **Anger, &**
 4. **Hormonal secretions.**



CONNECTIONS OF AMYGDALA

- **Inputs:**
- **Association** areas of visual, auditory & somatosensory cortices.
- **Outputs:**
- Hypothalamus &
- Autonomic nuclei in the brain stem,
- **Lesion:**
- Lack of emotional responses & docility.



Septal nuclei

Site:

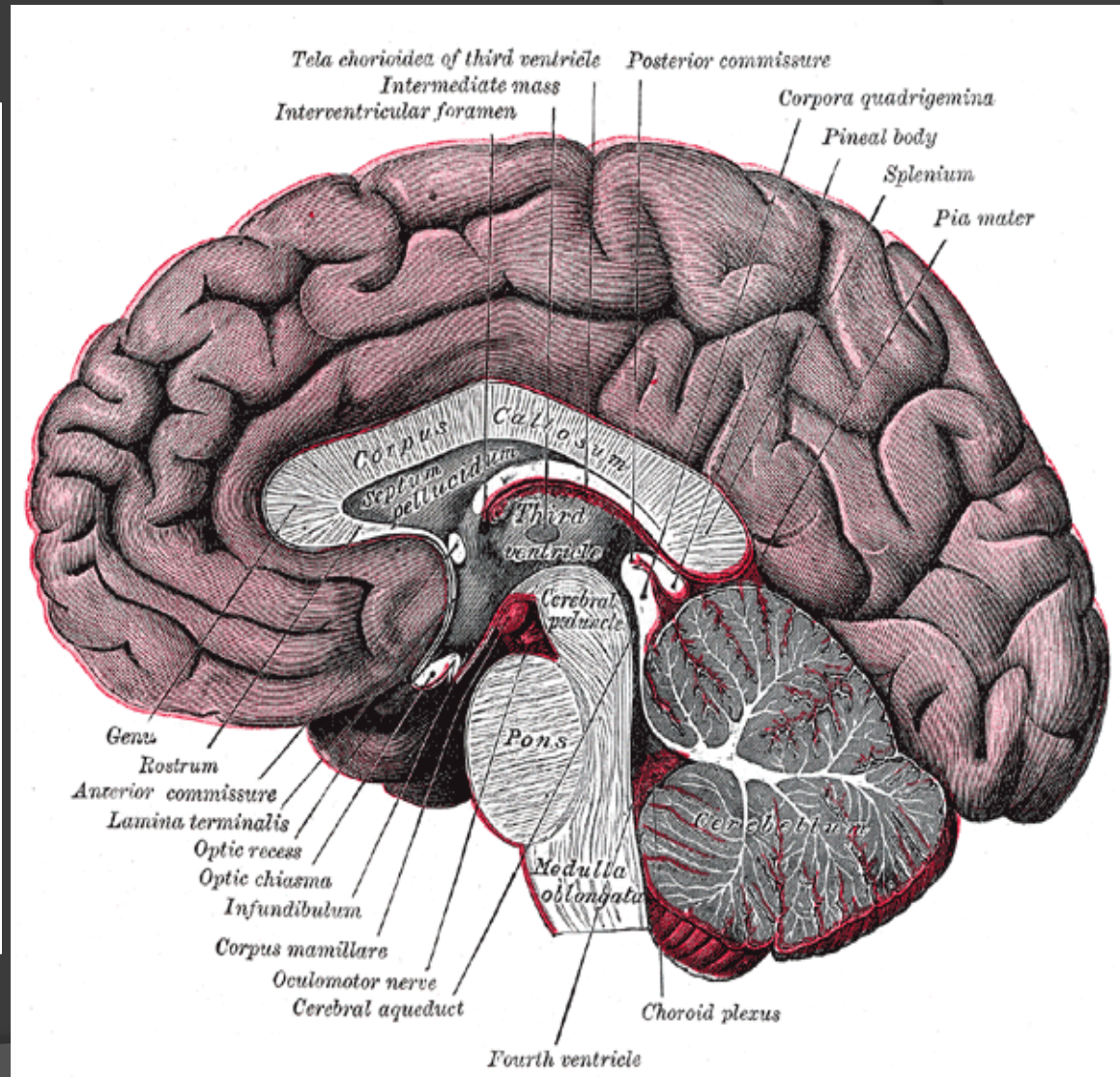
Located anterior to the interventricular septum

Main connections:

1. To Hypothalamus
2. To Habenular nuclei

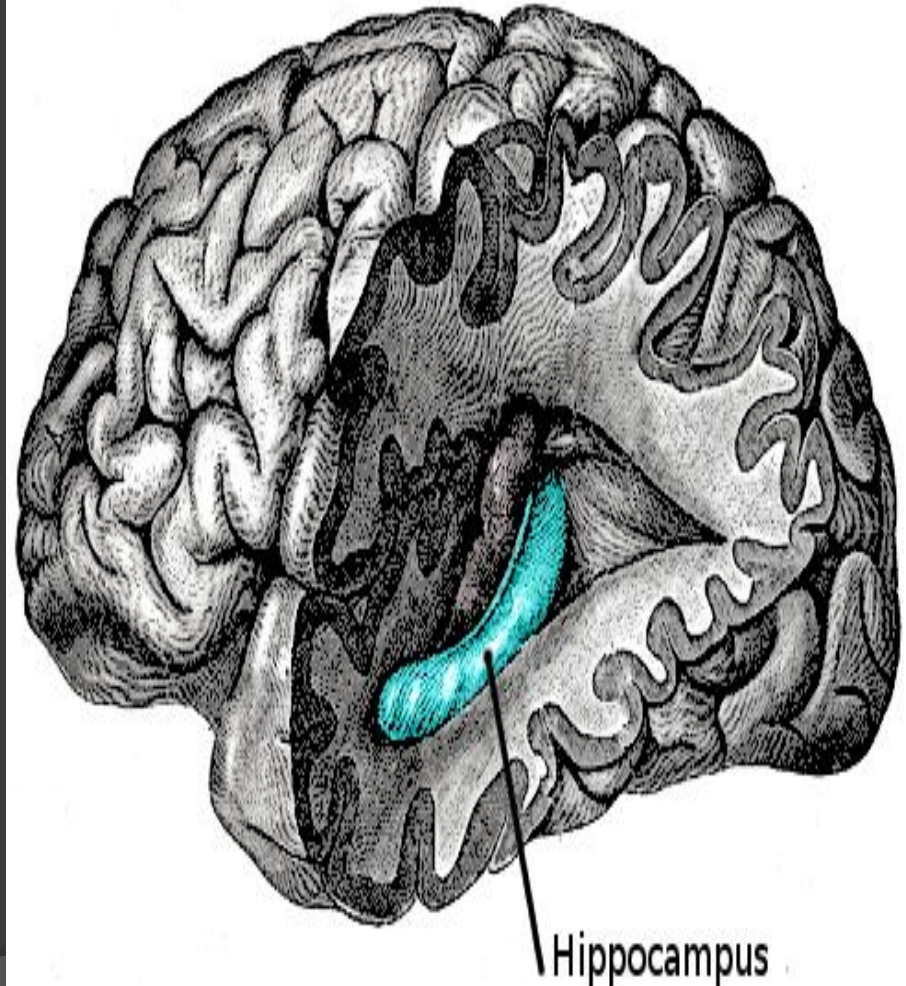
Function:

It is the pleasure zone.



- **Korsakoff's psychosis** (**Retrograde** = loss of new memories at the time of lesion with retained old memories & **anterograde amnesia**= inability to gain new memories)
- **Temporal lobe epilepsy**
- The **hippocampus** is a common focus site in epilepsy, and can be damaged through chronic seizures.
- It is sometimes damaged in diseases such as herpes encephalitis,
- **Alzheimer's disease:** The hippocampus is one of the first brain areas to show damage in Alzheimer's disease
- **Schizophrenia.**

Lesions associated with limbic lobe disorders



**THANK YOU
AND
GOOD LUCK**