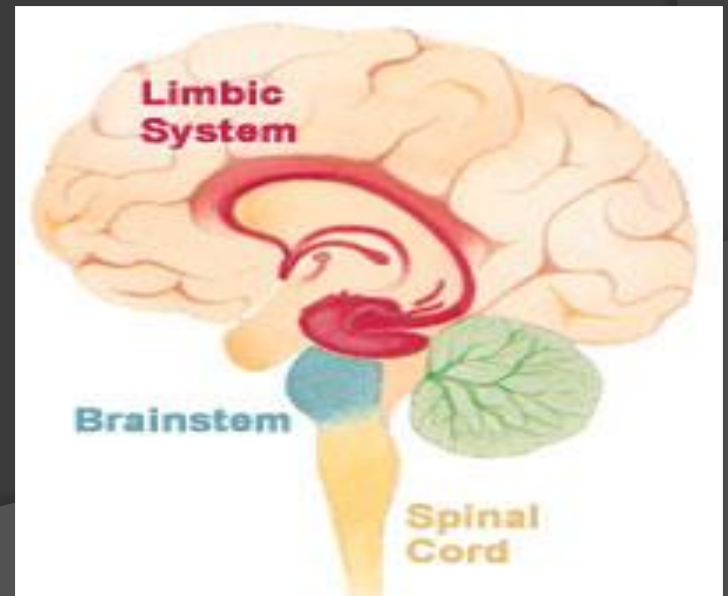


Thalamus & Limbic System



Prof. Saeed Abuel Makarem

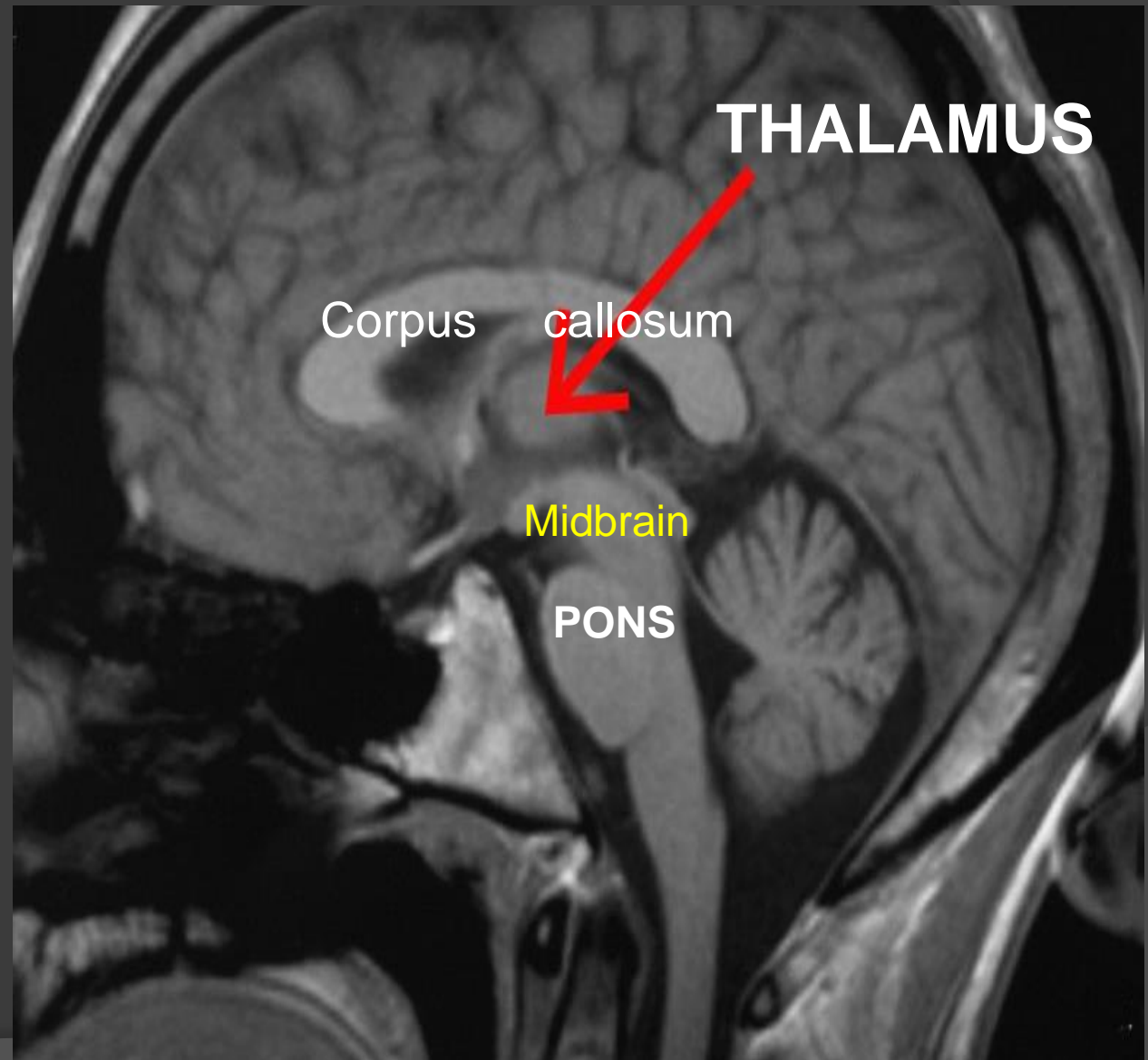
Objectives

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.

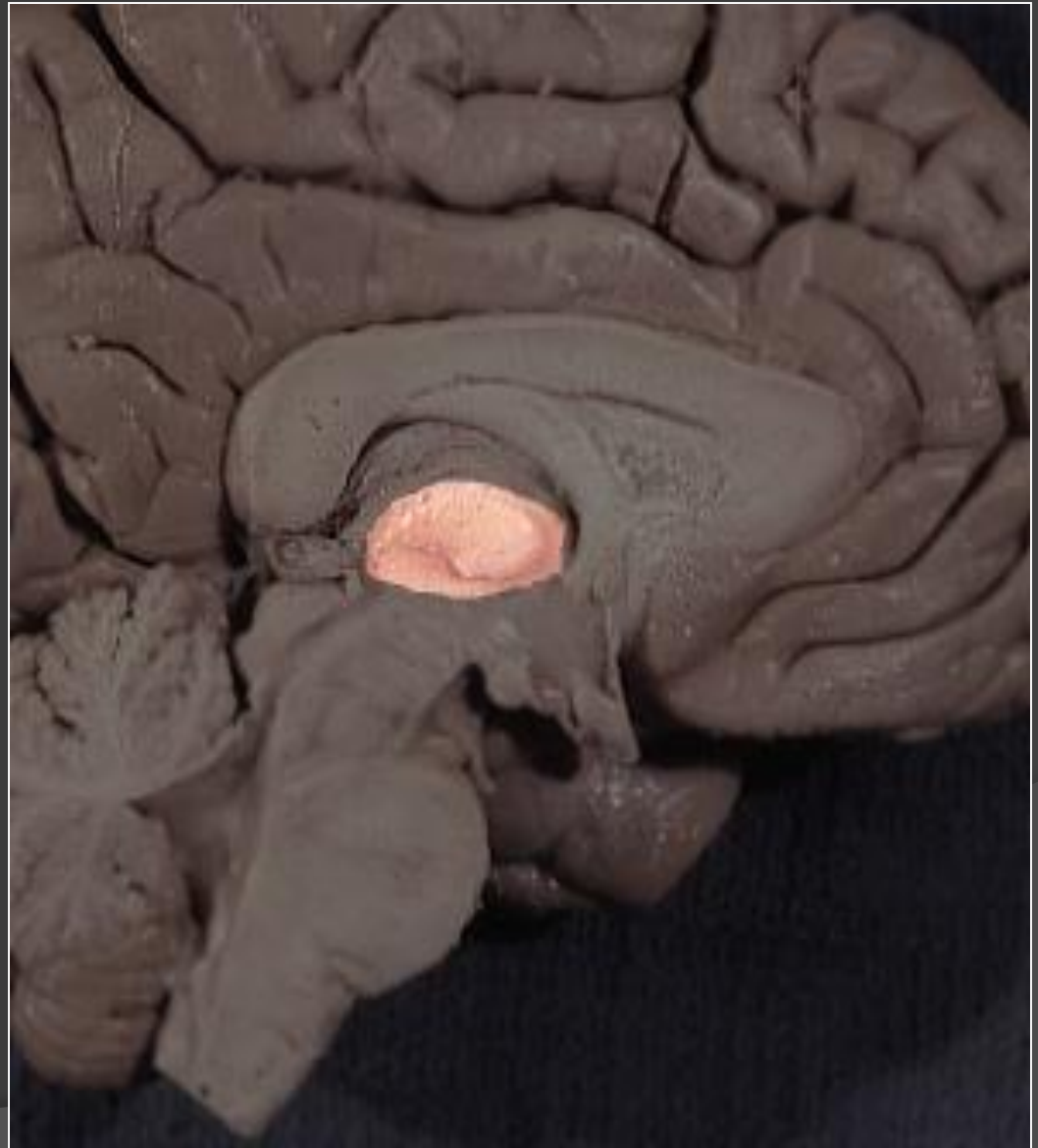


Thalamus

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

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 the 2 thalami are connected to each other by **interthalamic adhesion** (connexus,) **or Massa intermedia**, which crosses through the 3rd ventricle.

Superior: (s)

Lateral ventricle and fornix.

Inferior:

Hypothalamus, anteriorly & Subthalamus posteriorly.

Relations



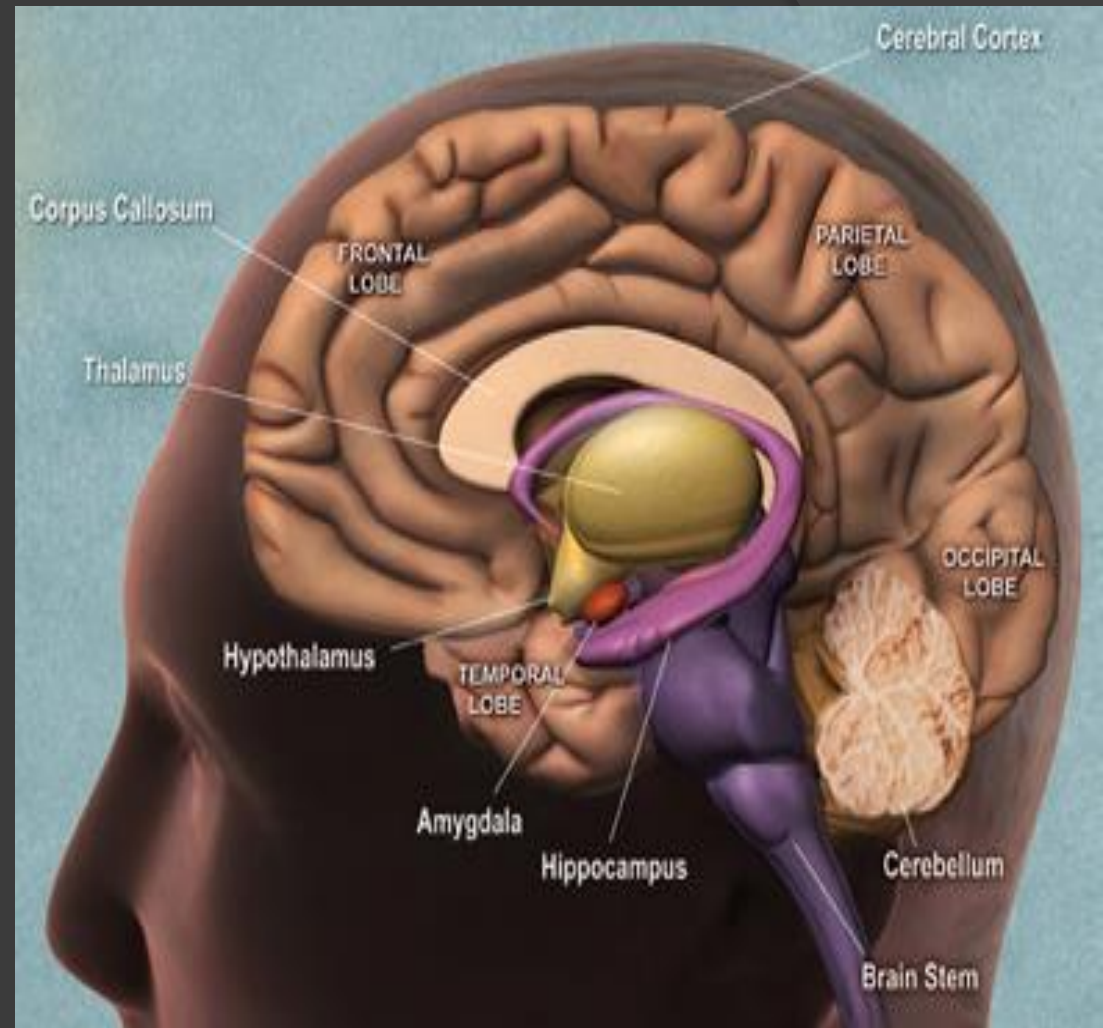
Anterior end:

Forms a projection, called the anterior tubercle.

It lies just behind the interventricular foramen.

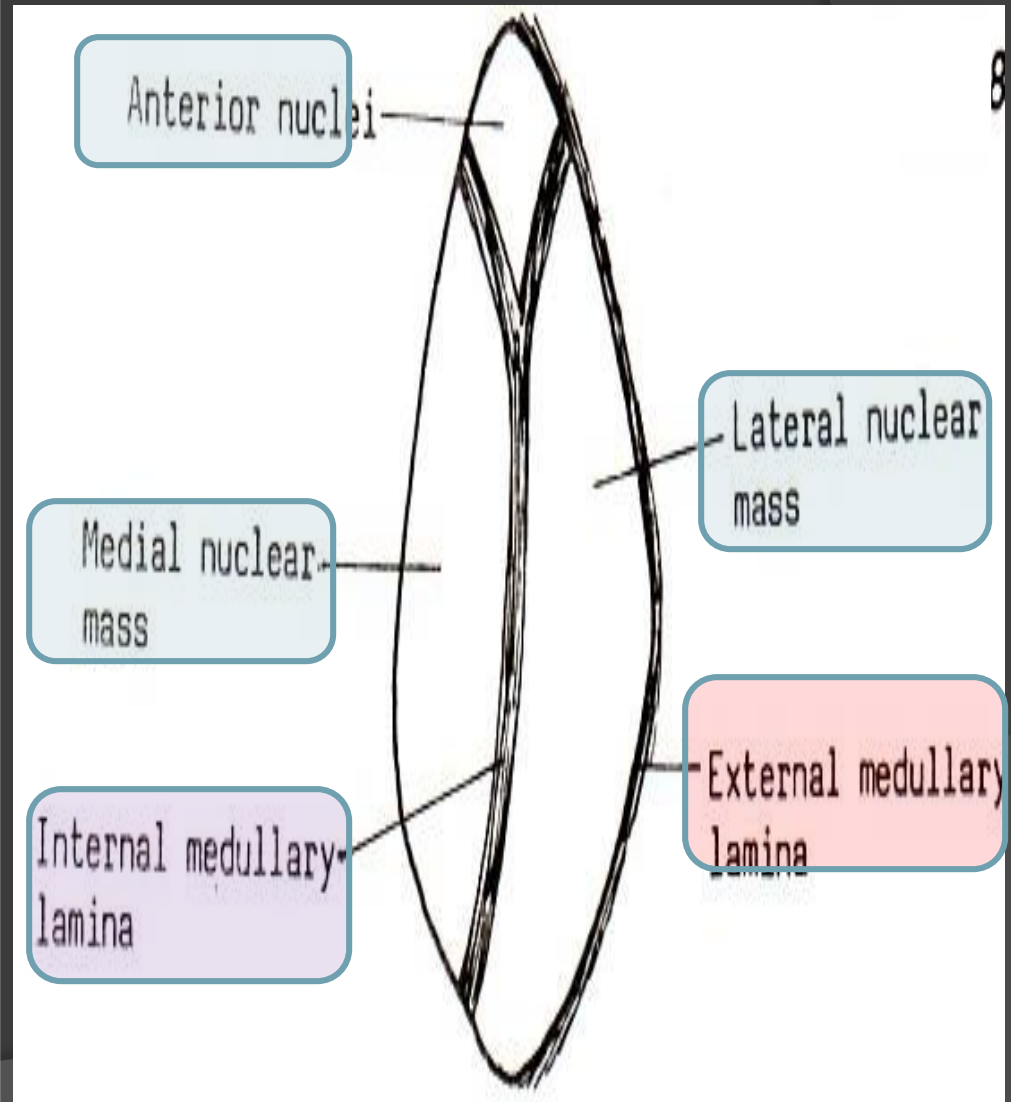
Posterior end:

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



- **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 **3 nuclear groups:**
- **Anterior,**
- **Medial, and**
- **Lateral.**
- Each is subdivided into a number of named nuclei.

Internal Structure



Lateral Nuclear Group

○ It is divided into:
Dorsal & Ventral tiers.

○ **Dorsal tier:**

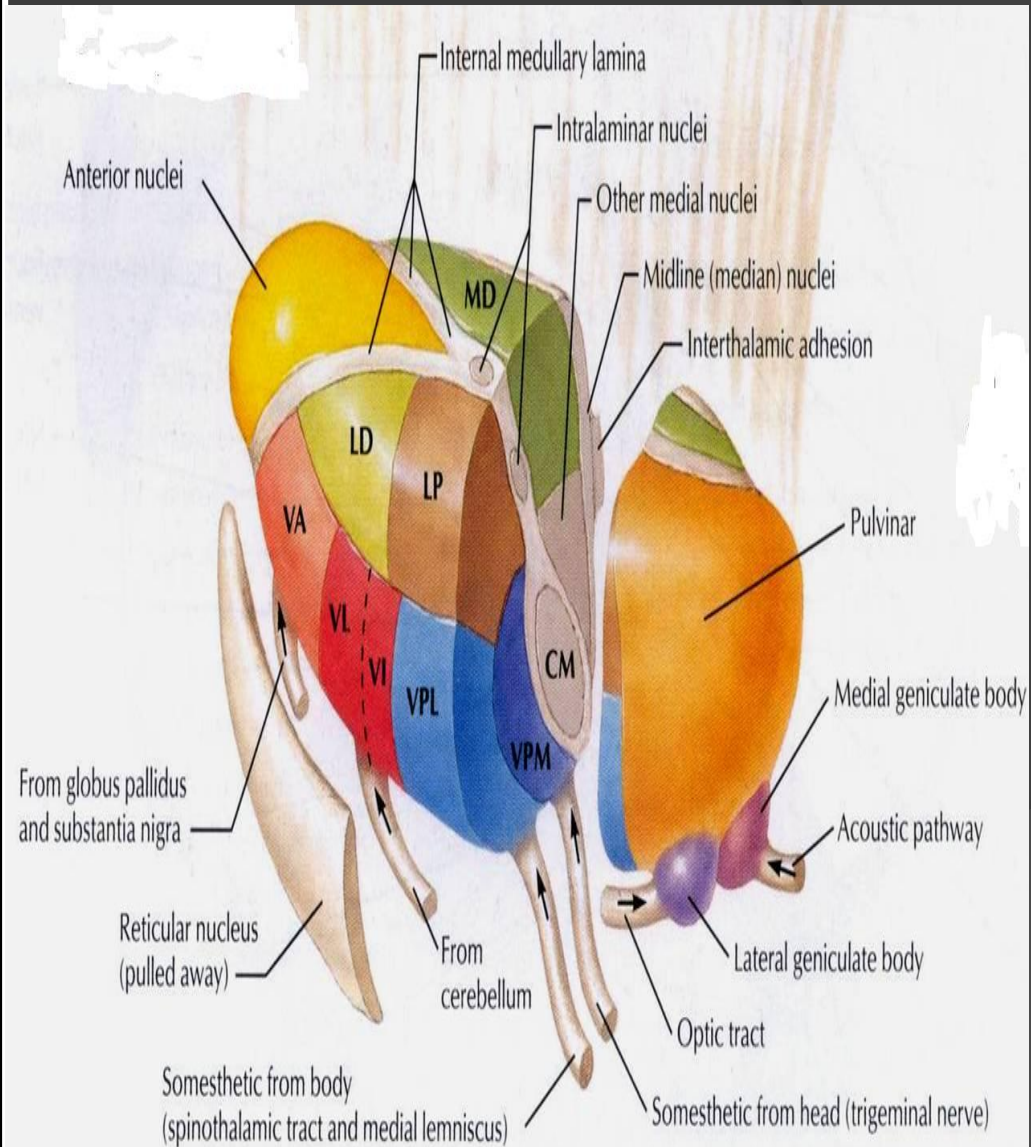
○ which contains:

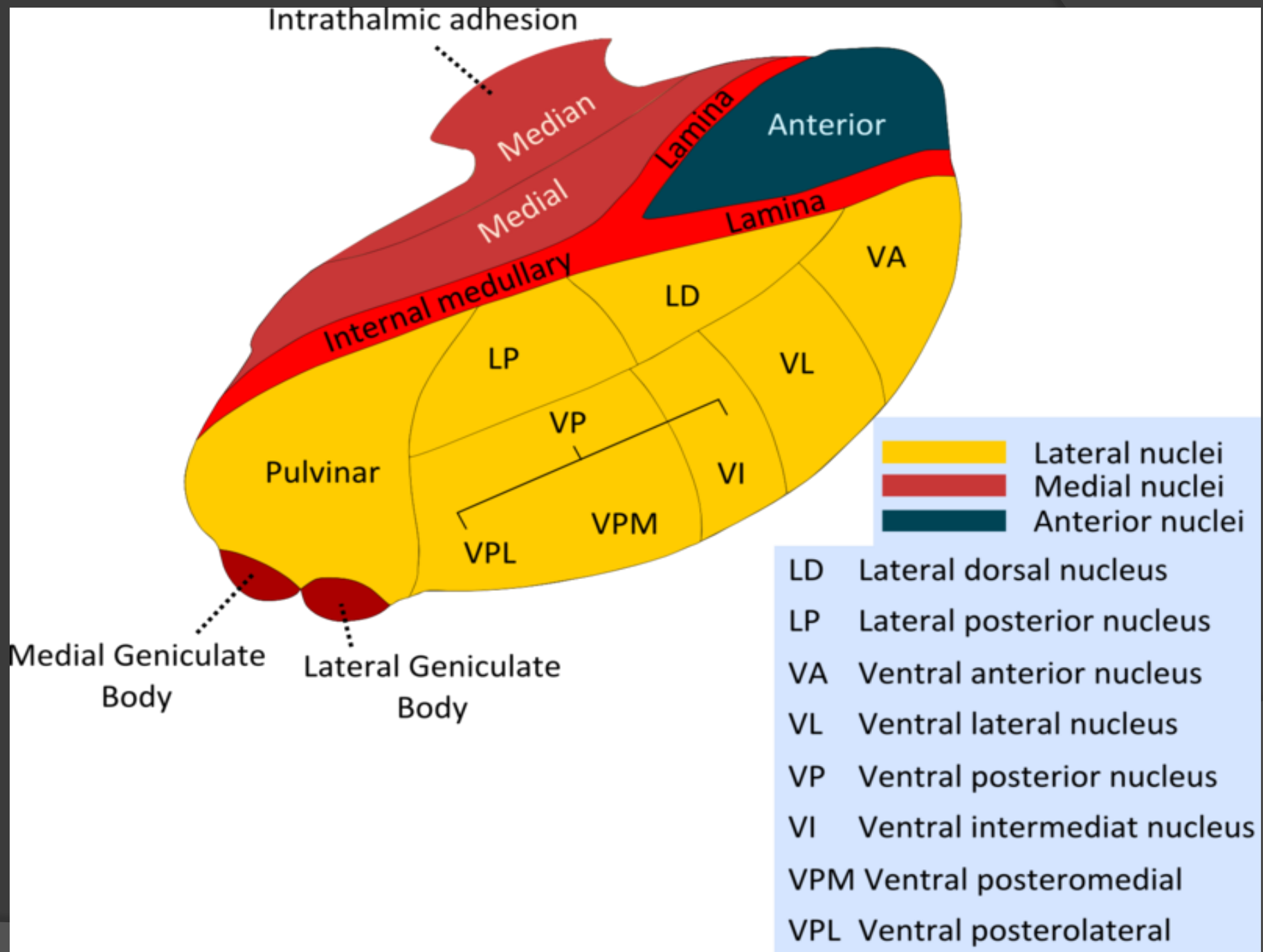
1. **Lateral Dorsal (LD)**
2. **Lateral Posterior (LP)**
3. **Pulvinar.**

○ **Ventral tier:**

○ Which contains:

1. **Ventral Anterior (VA)**
2. **Ventral Lateral (VL)**
3. **Ventral Intermediate (VI)**
4. **Ventral Posterior (VP)
(PLVNT, PMVNT)**
5. **Medial & Lateral
geniculate bodies or 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

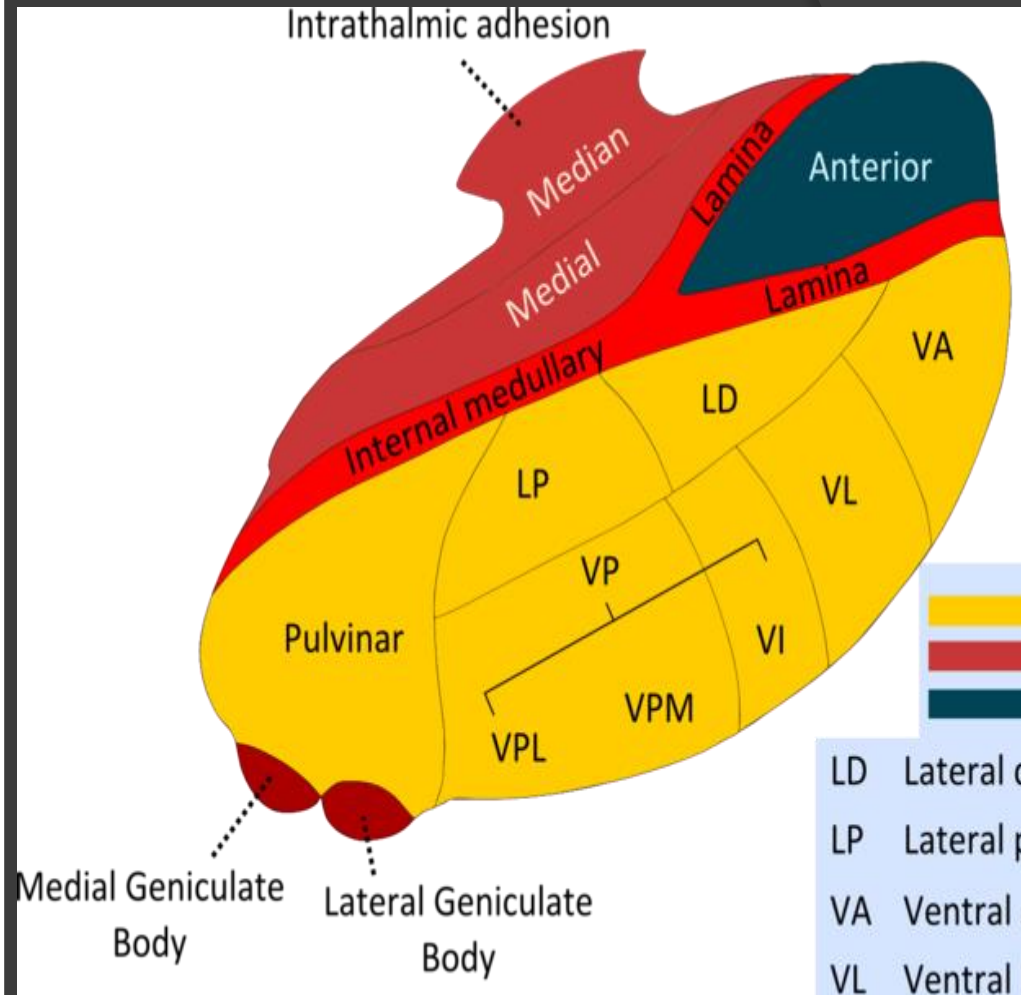
Anterior Thalamic Nucleus

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

○ -----

Medial Nucleus

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



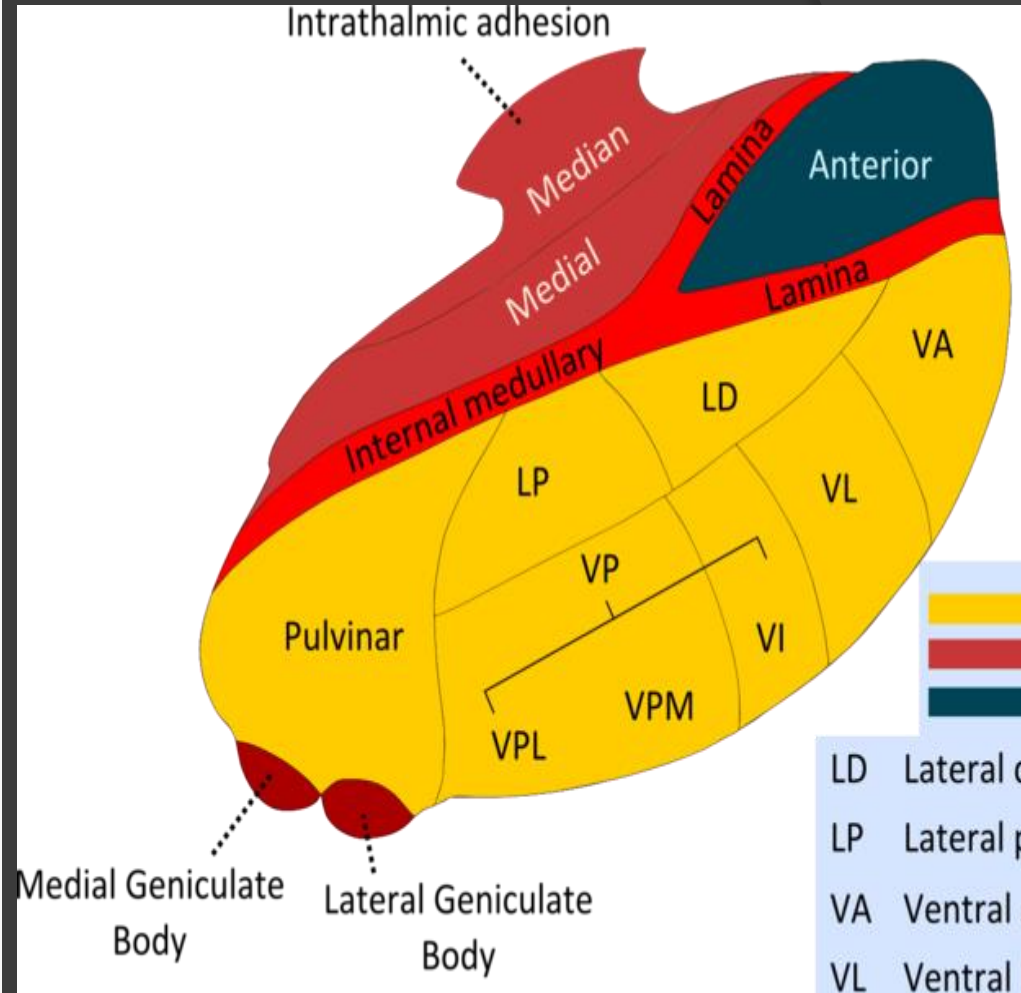
Projection of thalamic nuclei

Ventral Anterior Nucleus

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

Ventral Lateral Nucleus

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



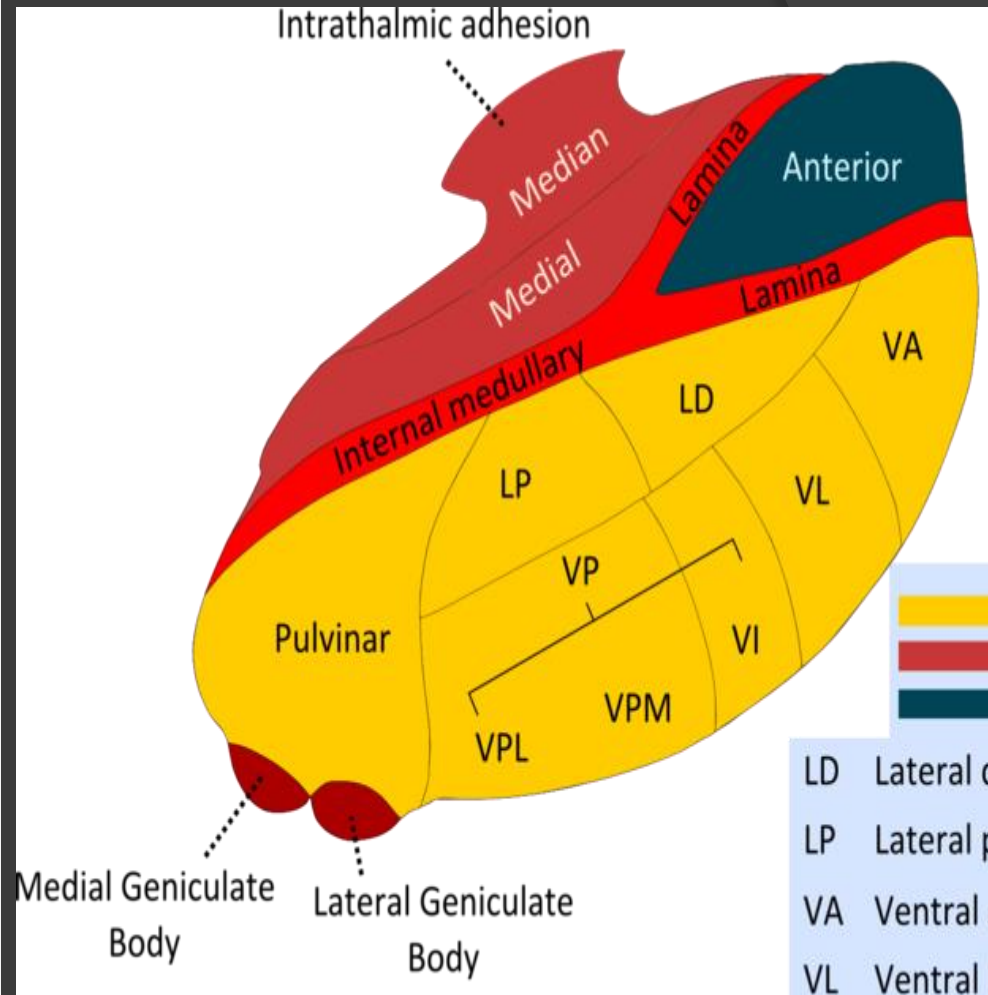
Projection of thalamic nuclei

Ventral Posterior Lateral Nucleus

- **Afferent:**
Medial & Spinal lemnisci.
- **Efferent:**
Sensory Cortex.

Ventral Posterior Medial Nucleus

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



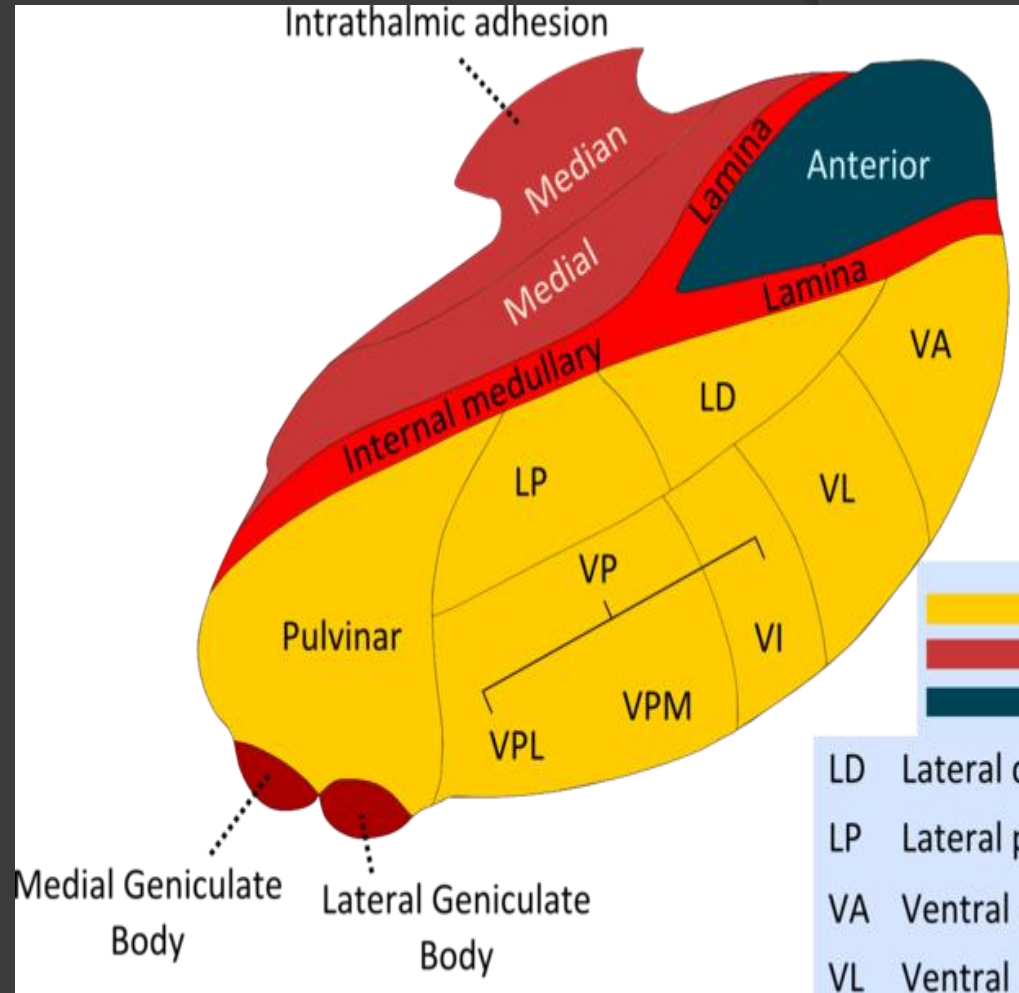
Projection of thalamic nuclei

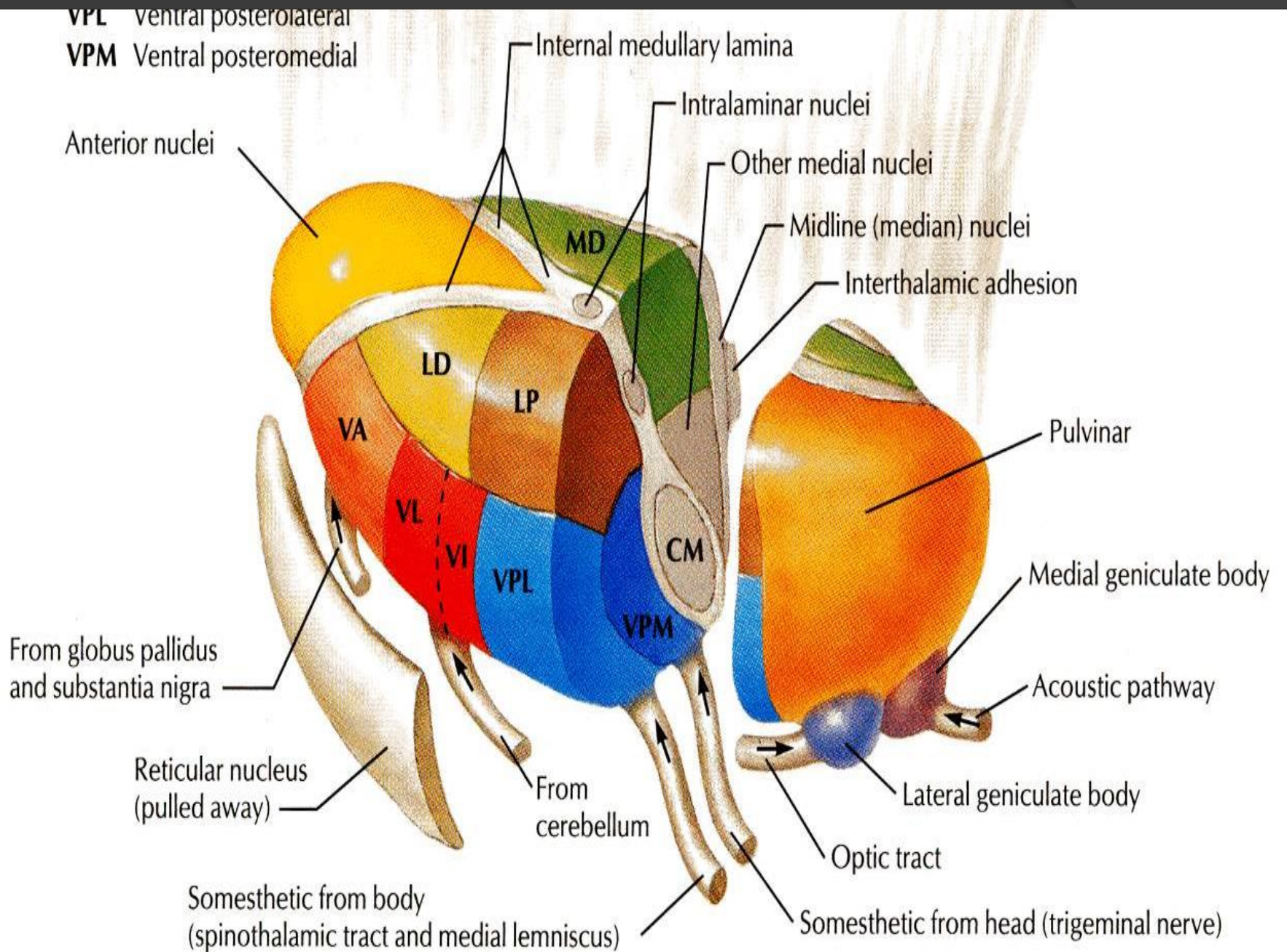
Lateral Geniculate Nucleus

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

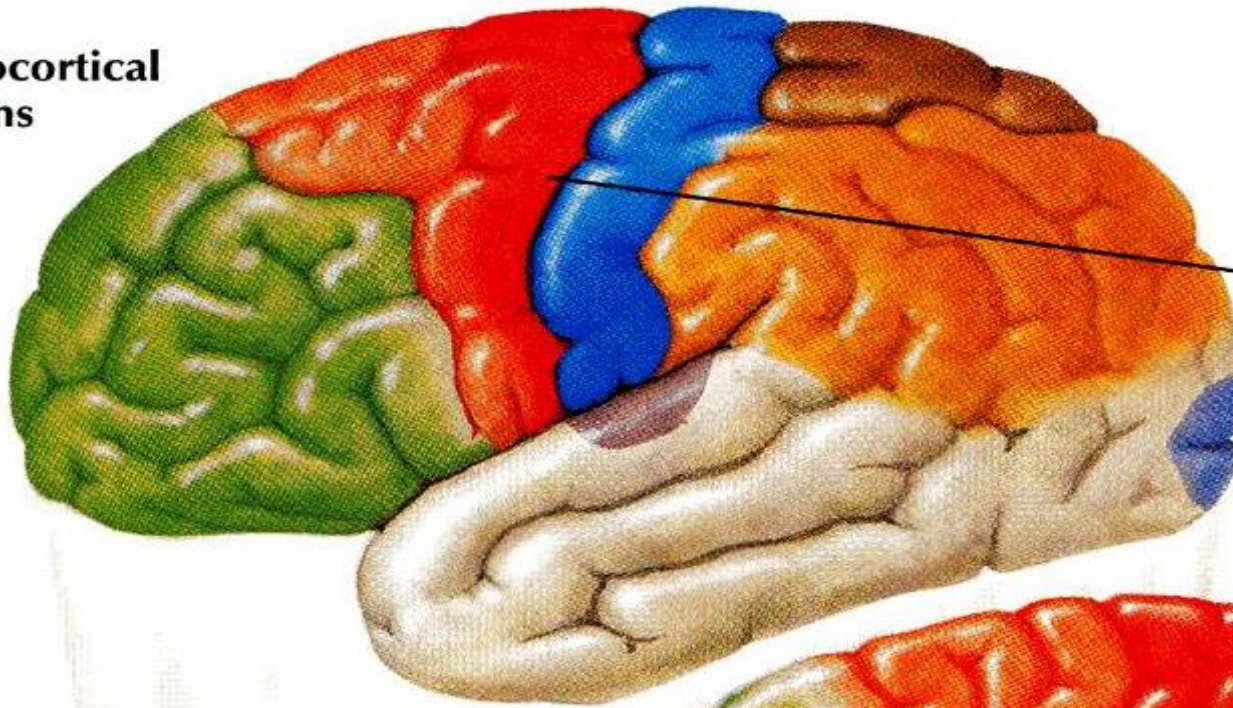
Medial Geniculate Nucleus

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





ocortical
ns

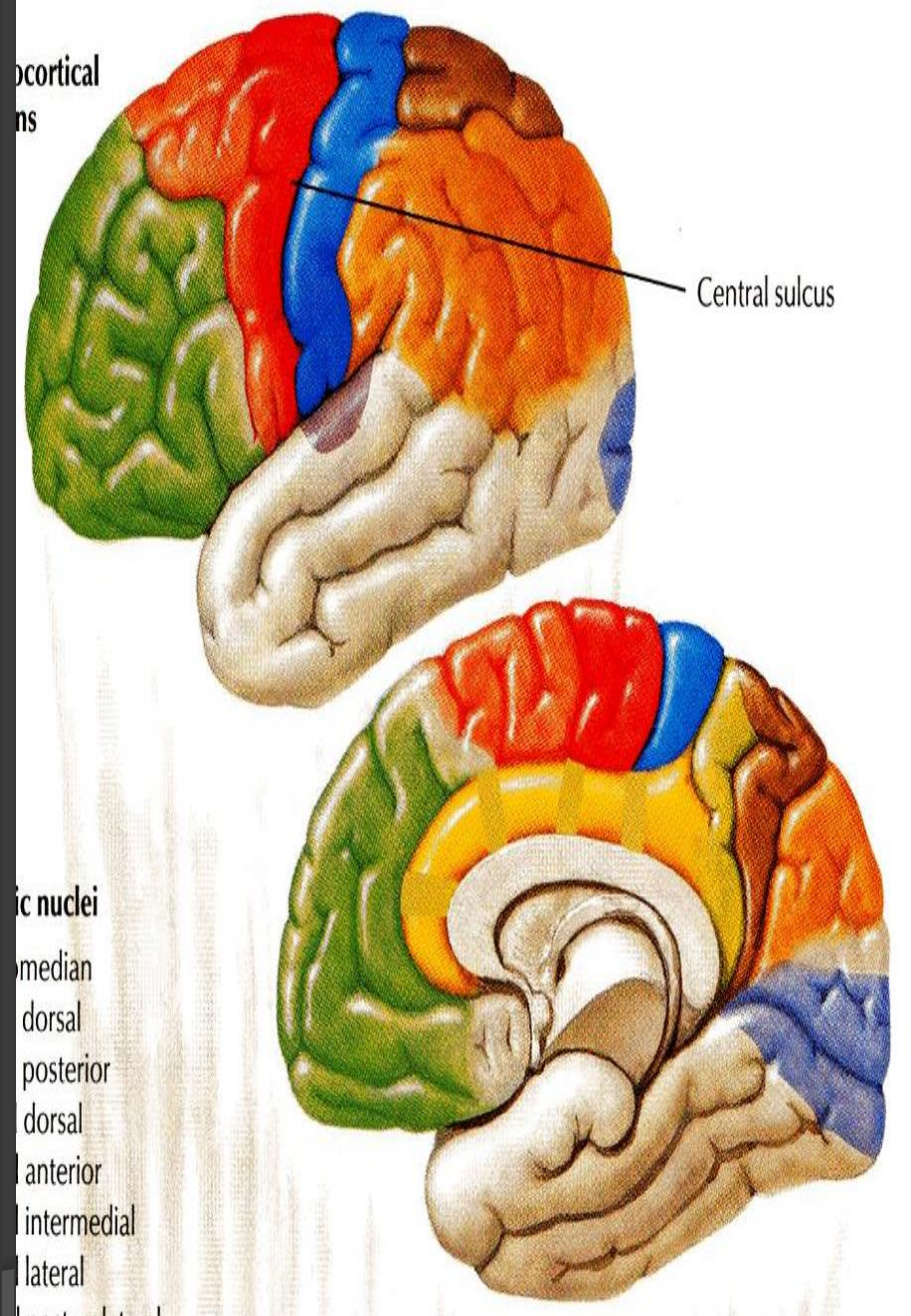
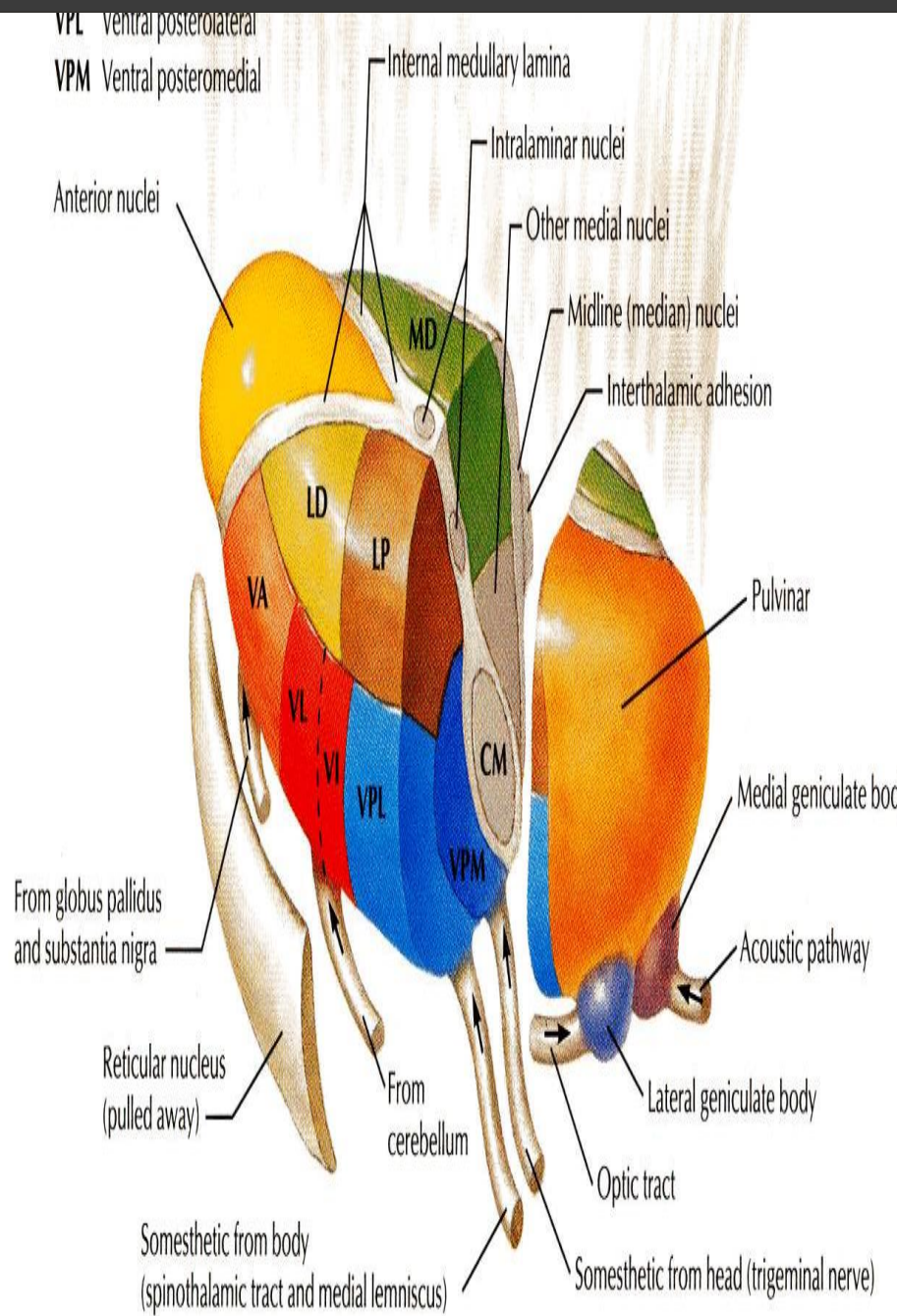


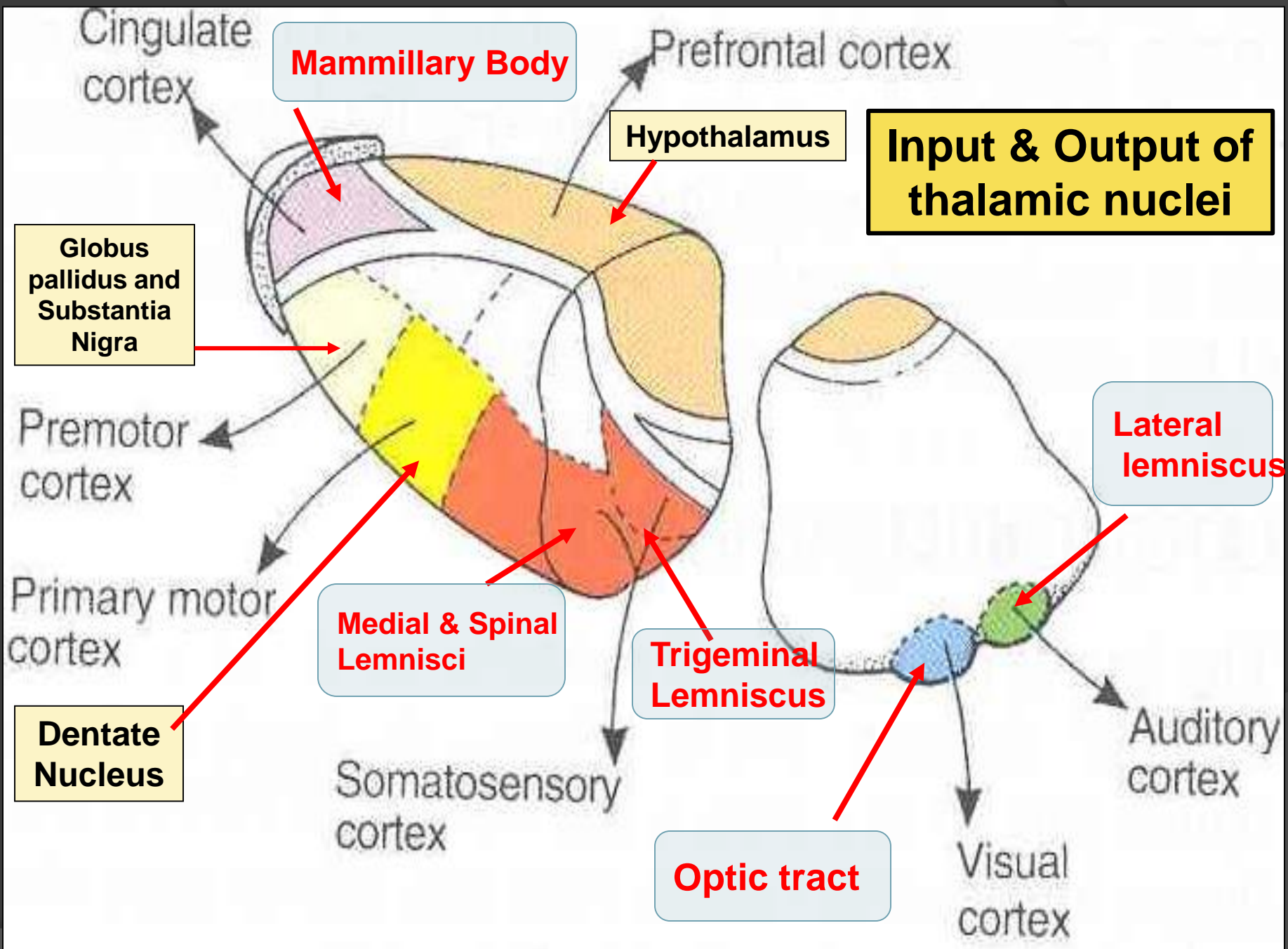
Central sulcus

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 structures &
- Subcortical structures
All are connected with looped connections.
- Then 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



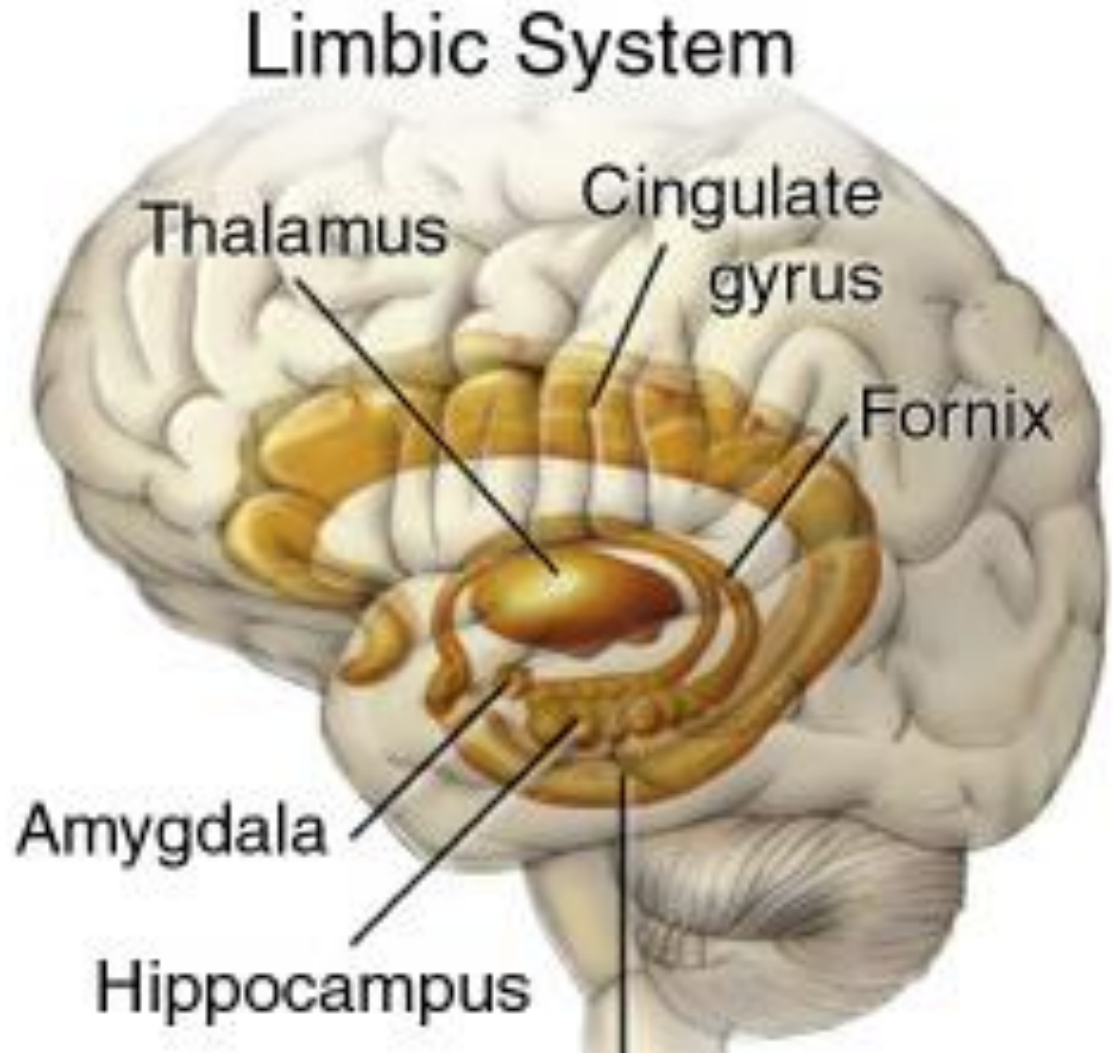
The limbic system is composed of four main structures:

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.

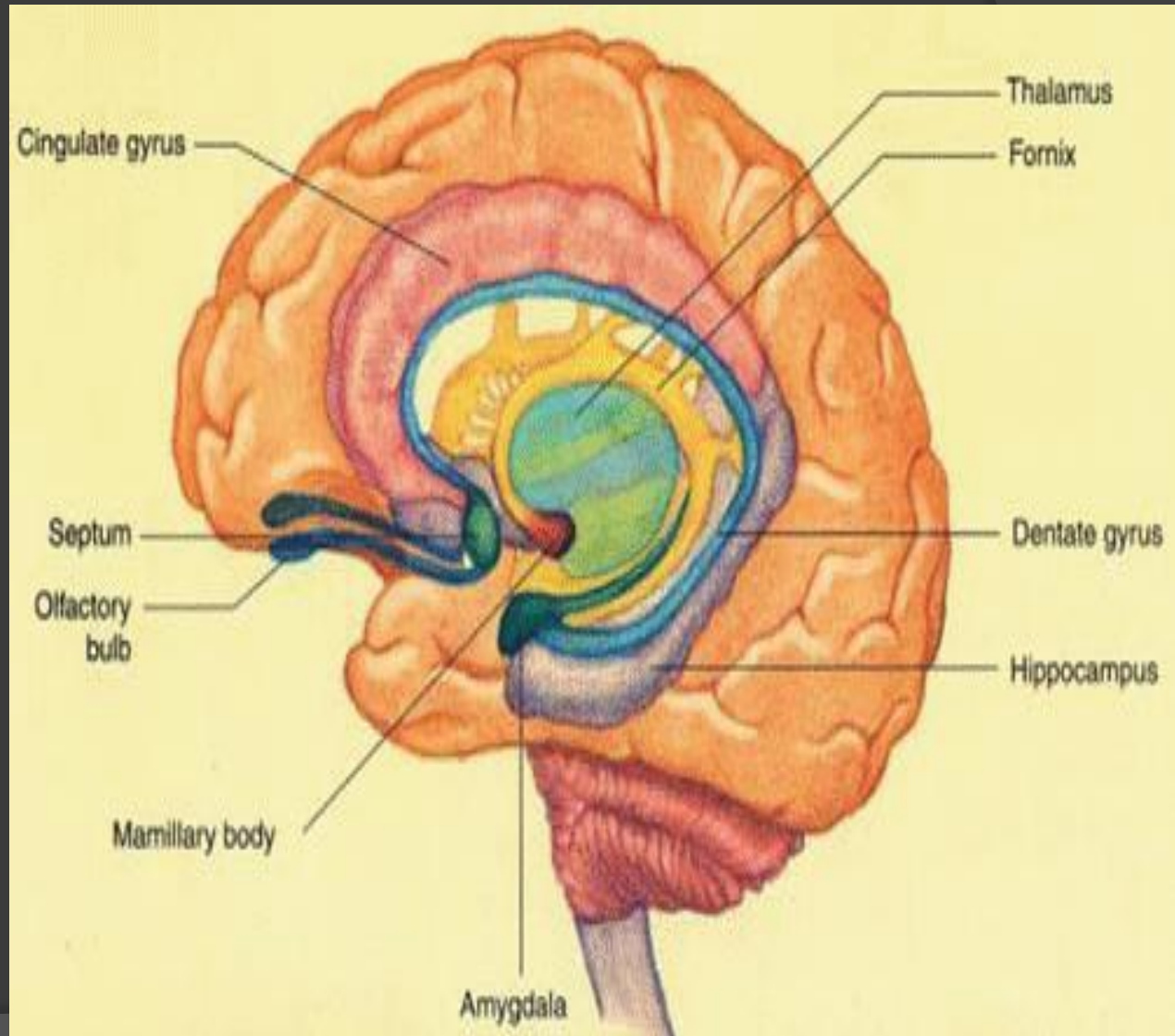
The **hippocampus** is important in memory and learning, while the limbic system itself is important in the control of the emotional responses.

The limbic system is a set of brain structures including



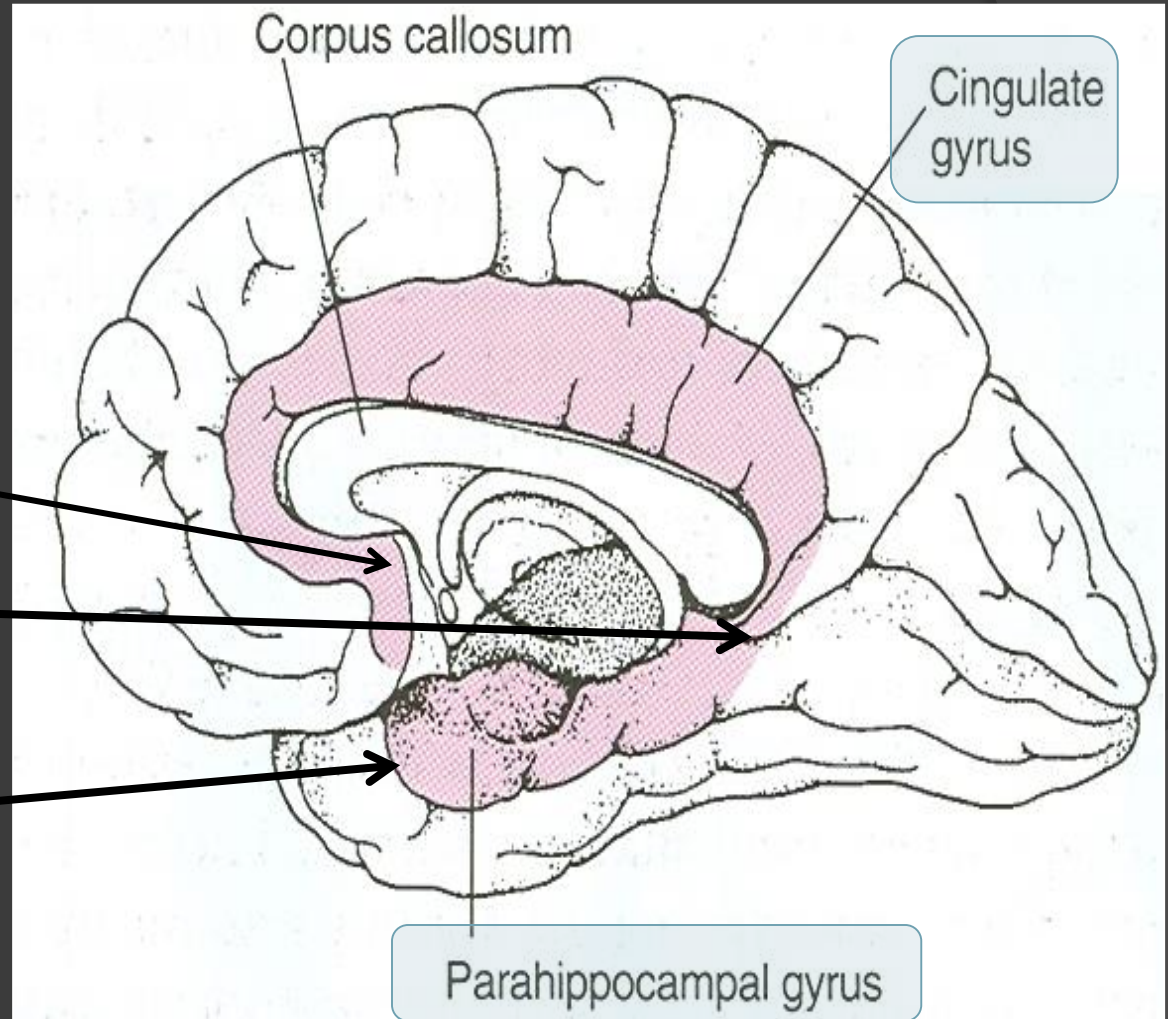
CORTICAL STRUCTURES

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



LIMBIC LOBE

- ◎ C-shaped ring of **grey matter** on the medial side 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: *(FOS, of memories)*

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.

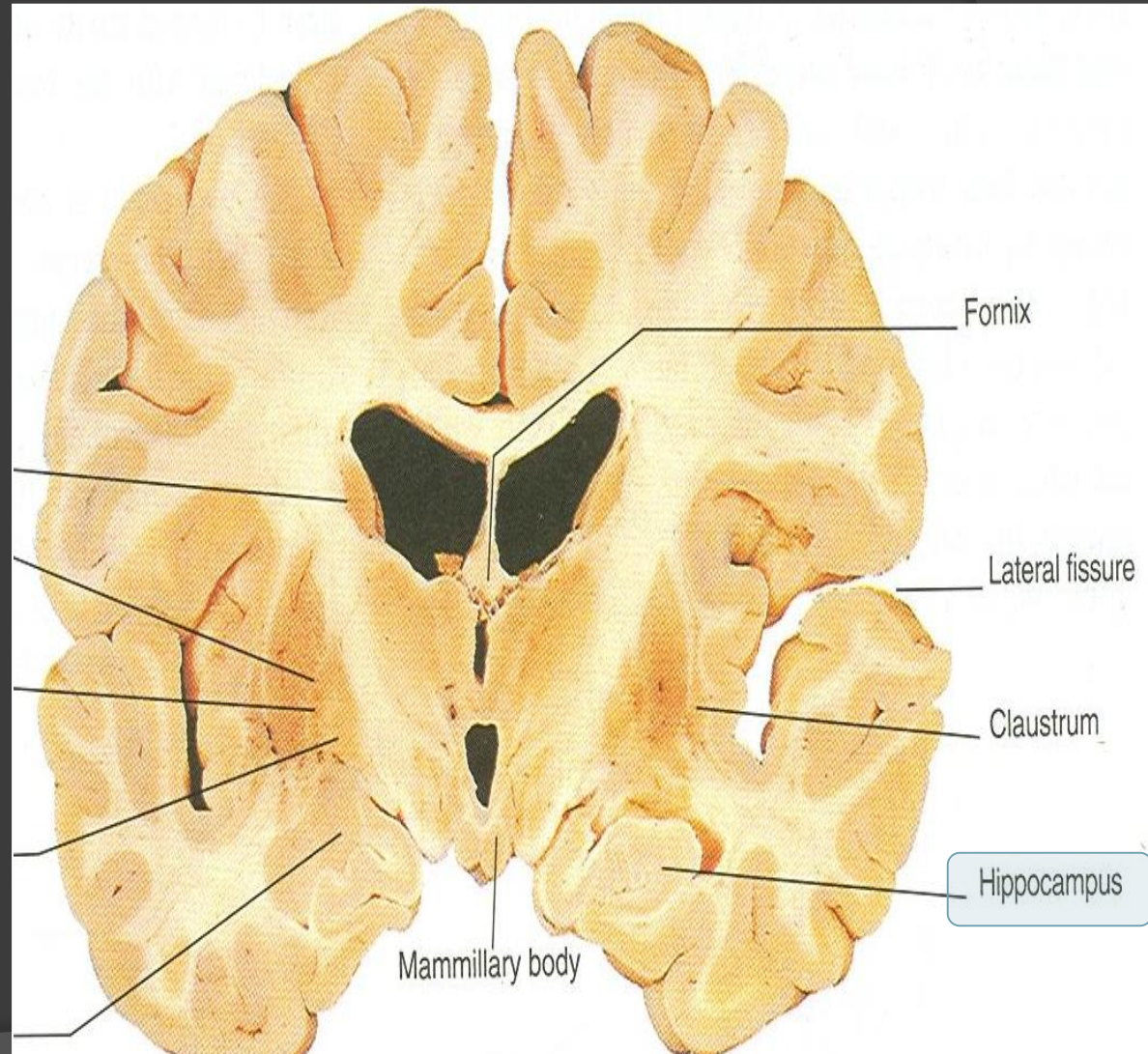
It is a horseshoe paired structure, one in each cerebral hemisphere.

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:

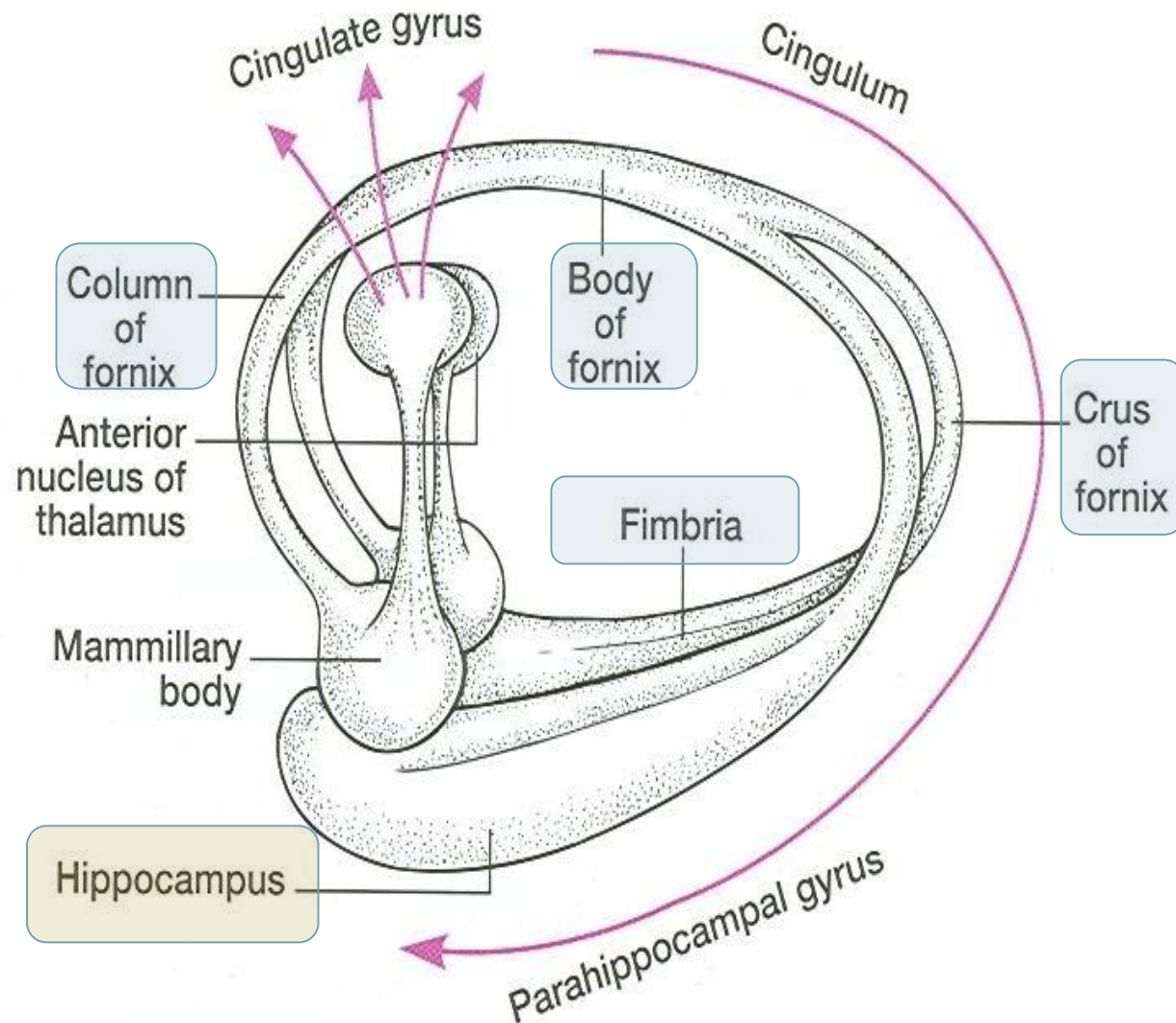
FORNIX:

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

it consists of:

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

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

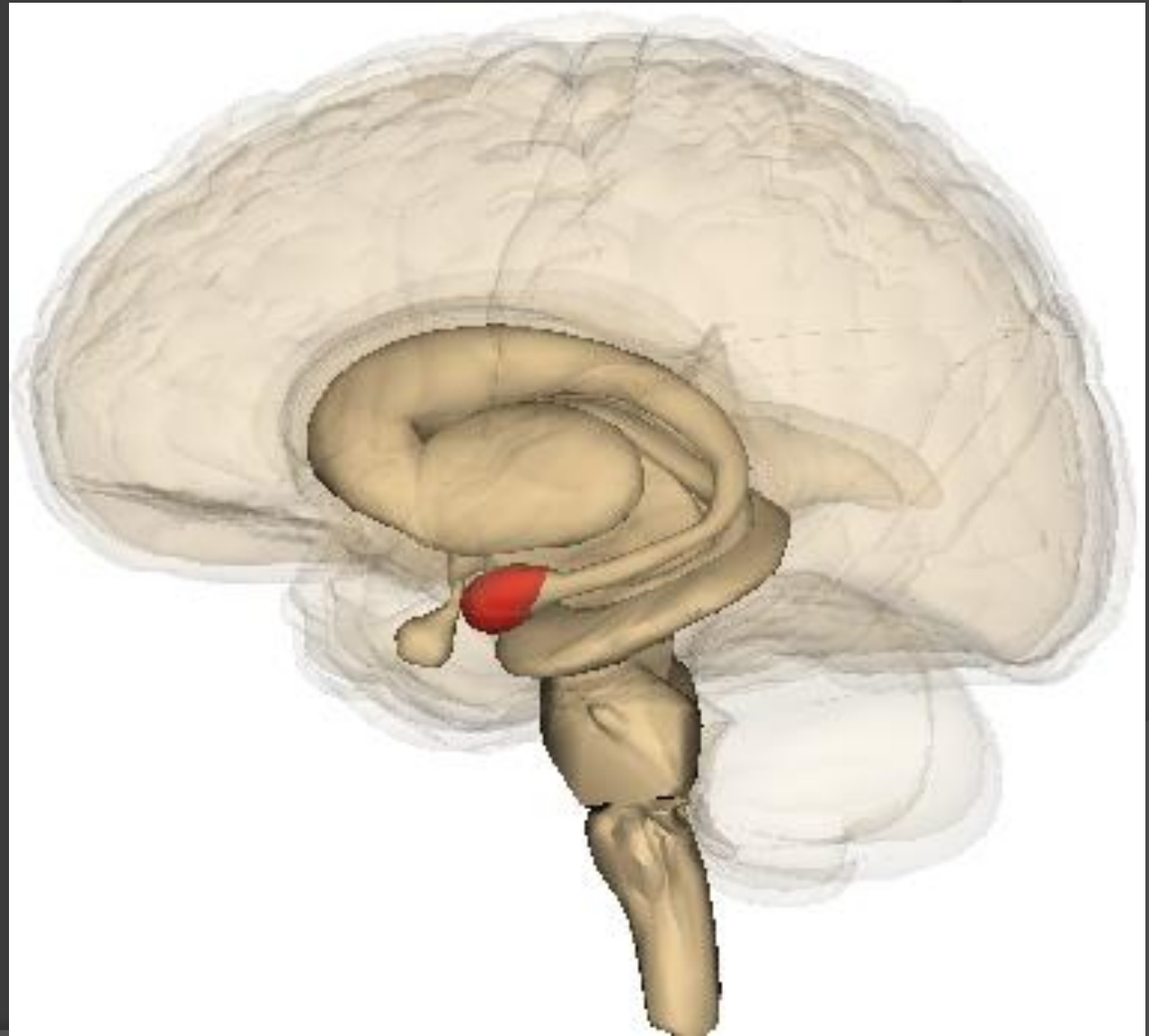


AMYGDALA

- **Site:**
- almond shaped mass of nuclei that

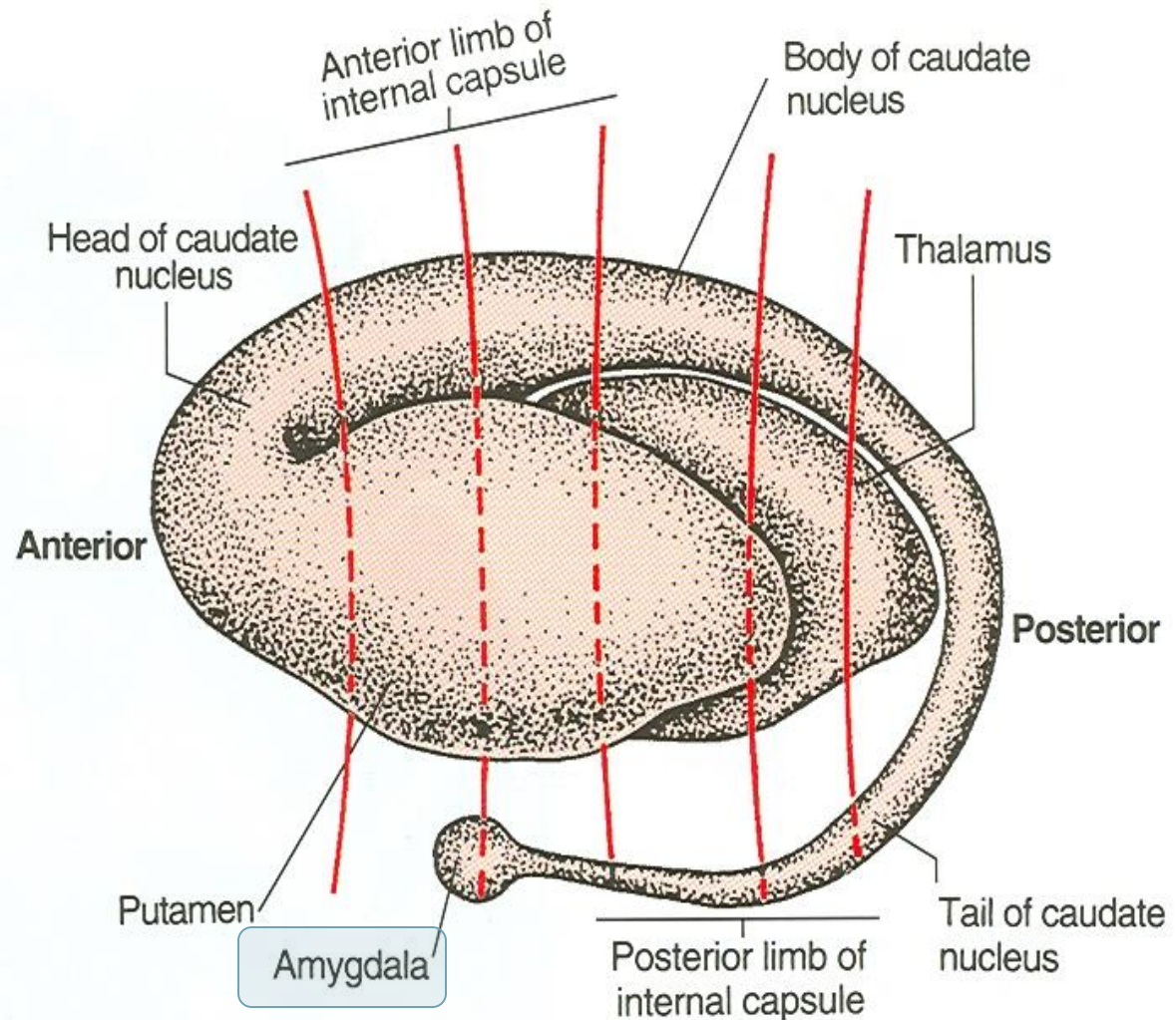
lies near the temporal pole, close to the tail of the caudate nucleus.

- **Function:**
- It is involved in
 1. **FEAR,**
 2. **Emotions**
 3. **Anger, &**
 4. **Release of Hormonal.**



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:

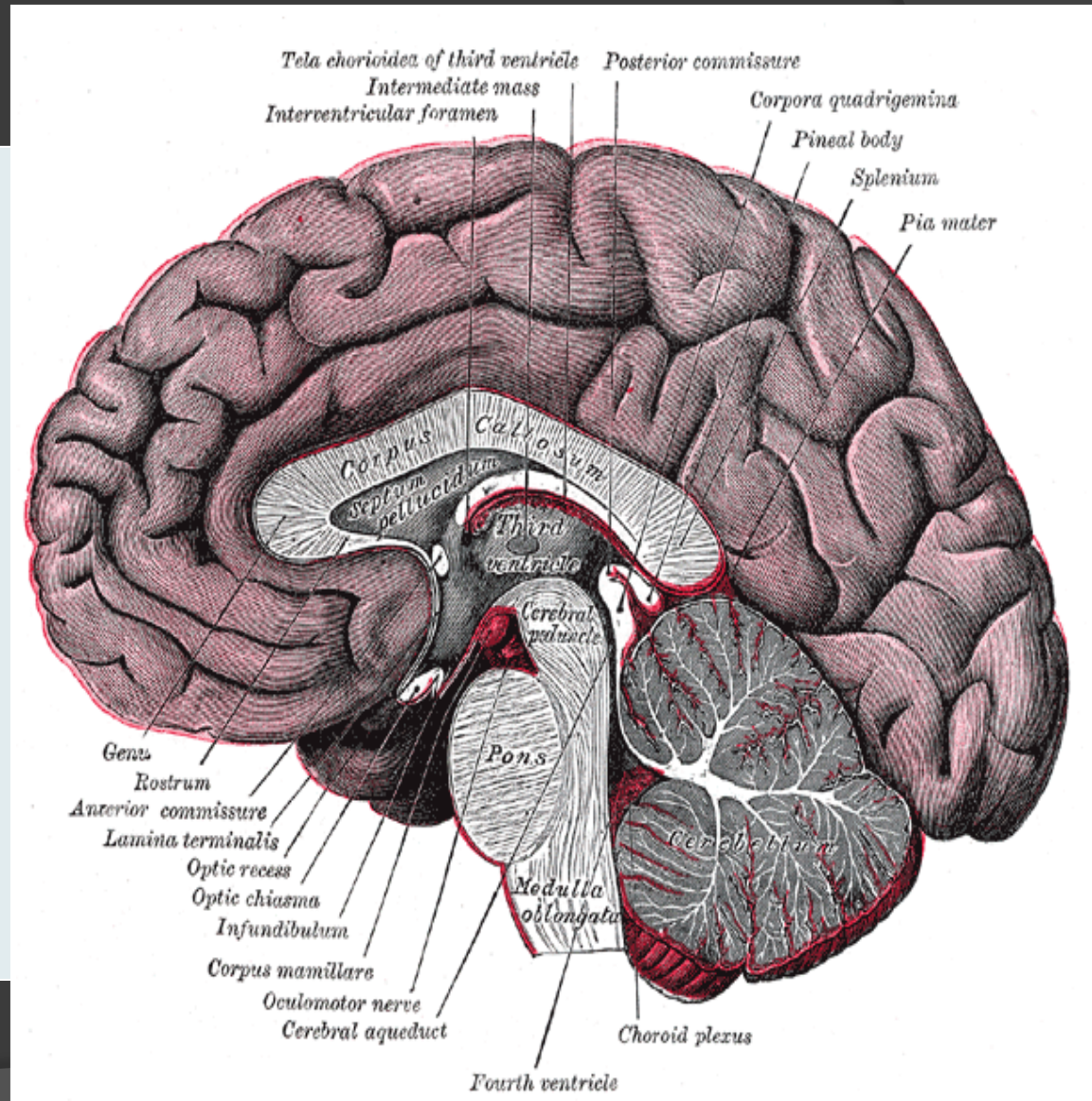
Located anterior to the interventricular septum.

Main connections:

1. To Hypothalamus.
2. To Habenular nuclei.

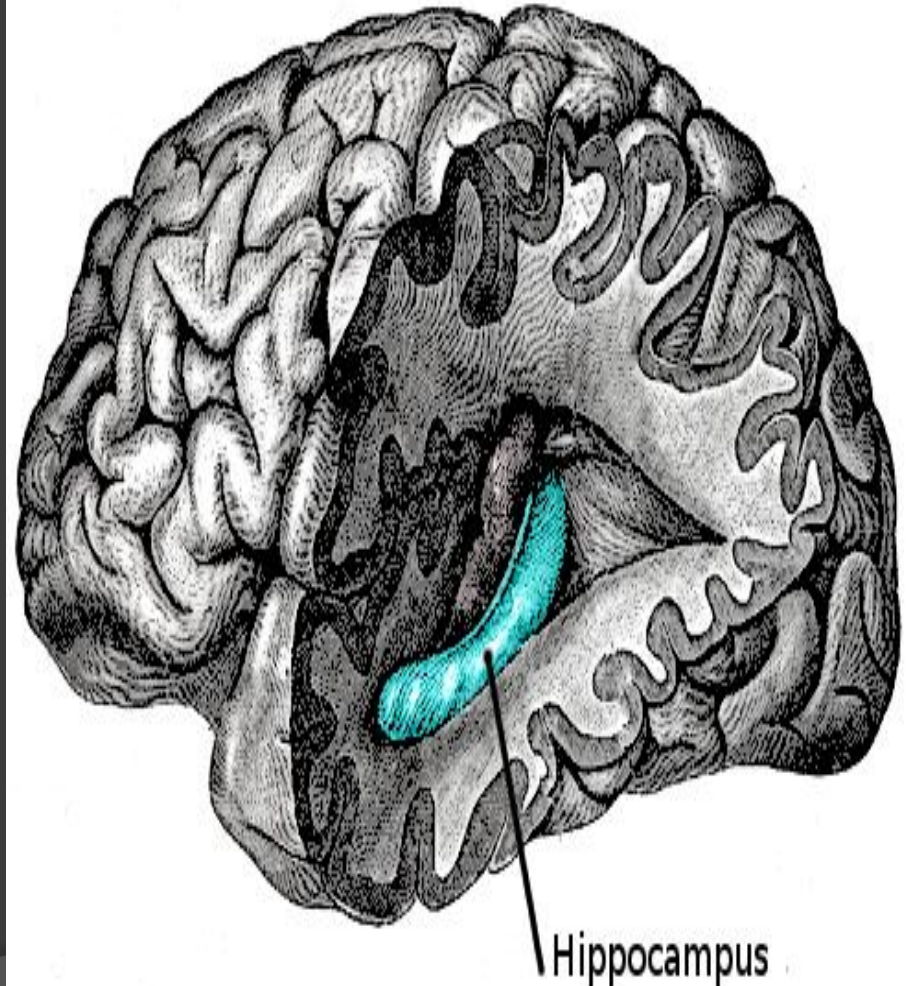
Function:

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 LUCK