

# Thalamus & Limbic System



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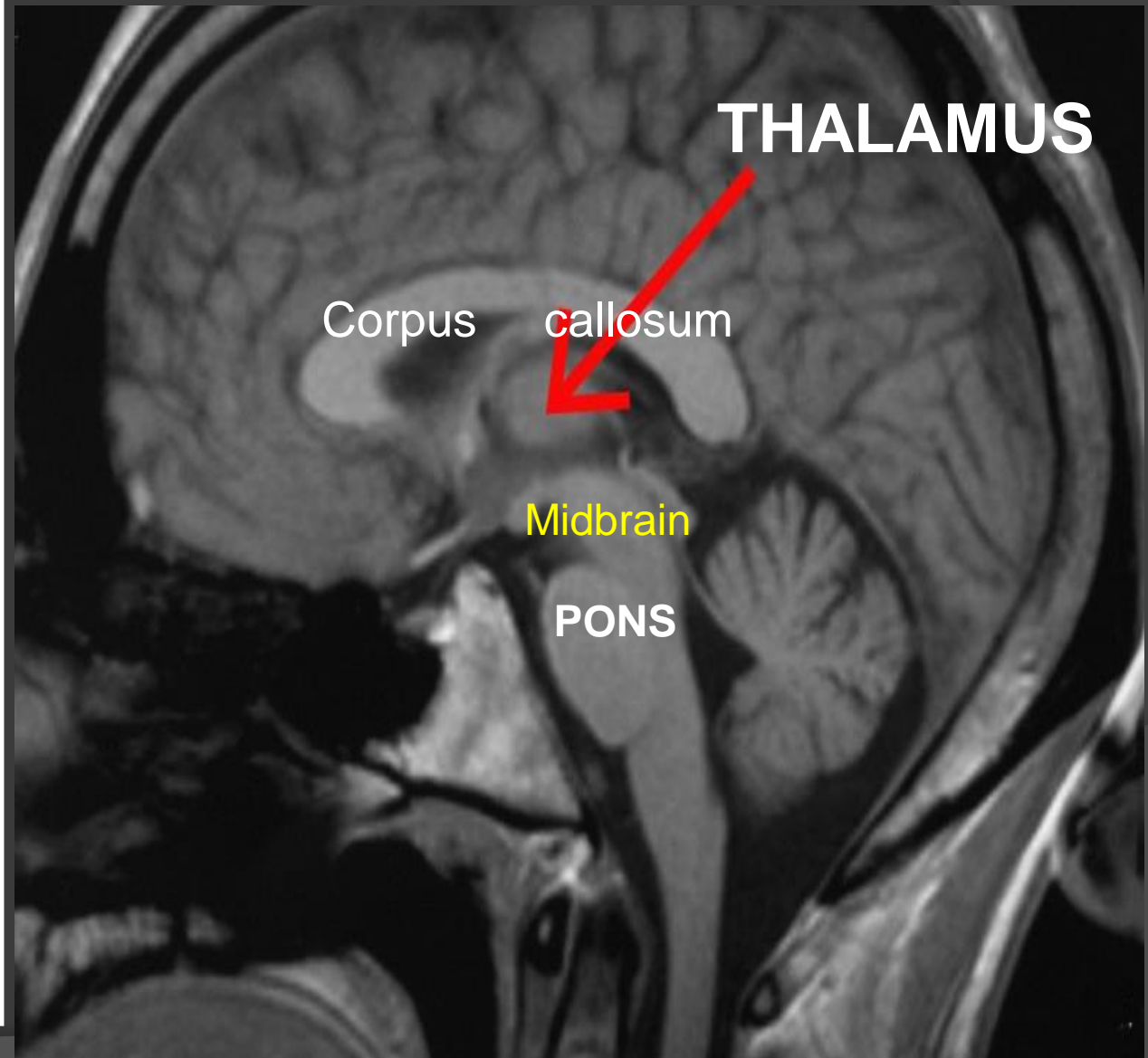
# Objectives

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

- ① Describe the anatomy and main functions of the thalamus.
- ① Name and identify different nuclei of the thalamus.
- ① Describe the main connections and functions of thalamic nuclei.
- ① Name and identify different parts of the limbic system.
- ① Describe main functions of the limbic system.
- ① Describe the effects of lesions of the limbic system.

# Thalamus

- It is the largest part of the **diencephalon**.
- It is the largest nuclear mass of the whole body.
- 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 3<sup>rd</sup> 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 (nuclei), and
3. Limbic system related brain regions.



It has 4 surfaces & 2 ends.

## Surfaces

Lateral: (L)

Posterior limb of the internal capsule.

Medial: (3)

The 3<sup>rd</sup> ventricle. In some people the 2 thalami are connected to each other by **interthalamic**

**Adhesion or Massa**

**intermedia**, which crosses through lumen of 3<sup>rd</sup> ventricle.

Superior: (s)

Lateral ventricle (S), & fornix, (F).

Inferior: (H)

Hypothalamus, anteriorly & Subthalamus posteriorly.

## Relations



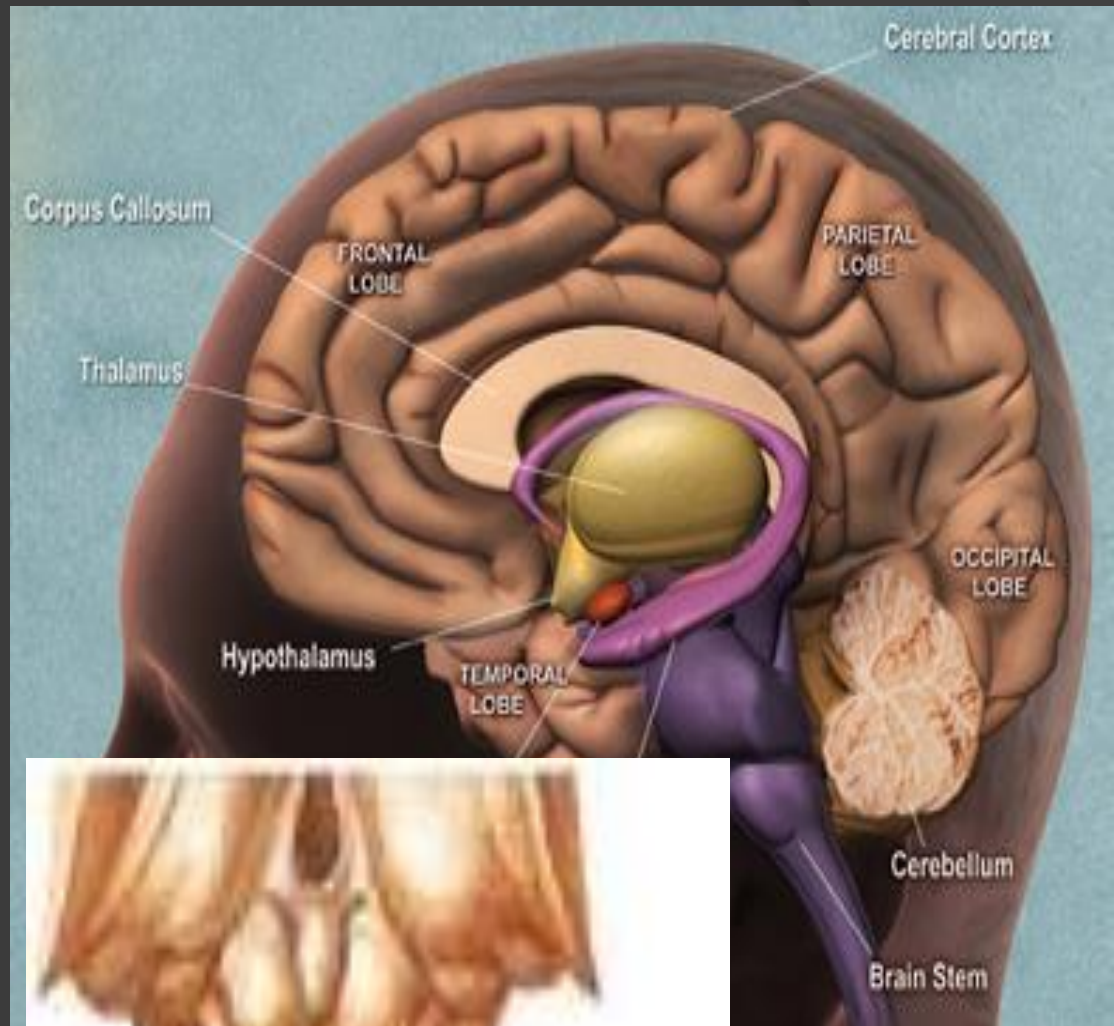


**Anterior end:**

Forms a projection, called the anterior tubercle of thalamus. It lies just behind the interventricular foramen of Monro.

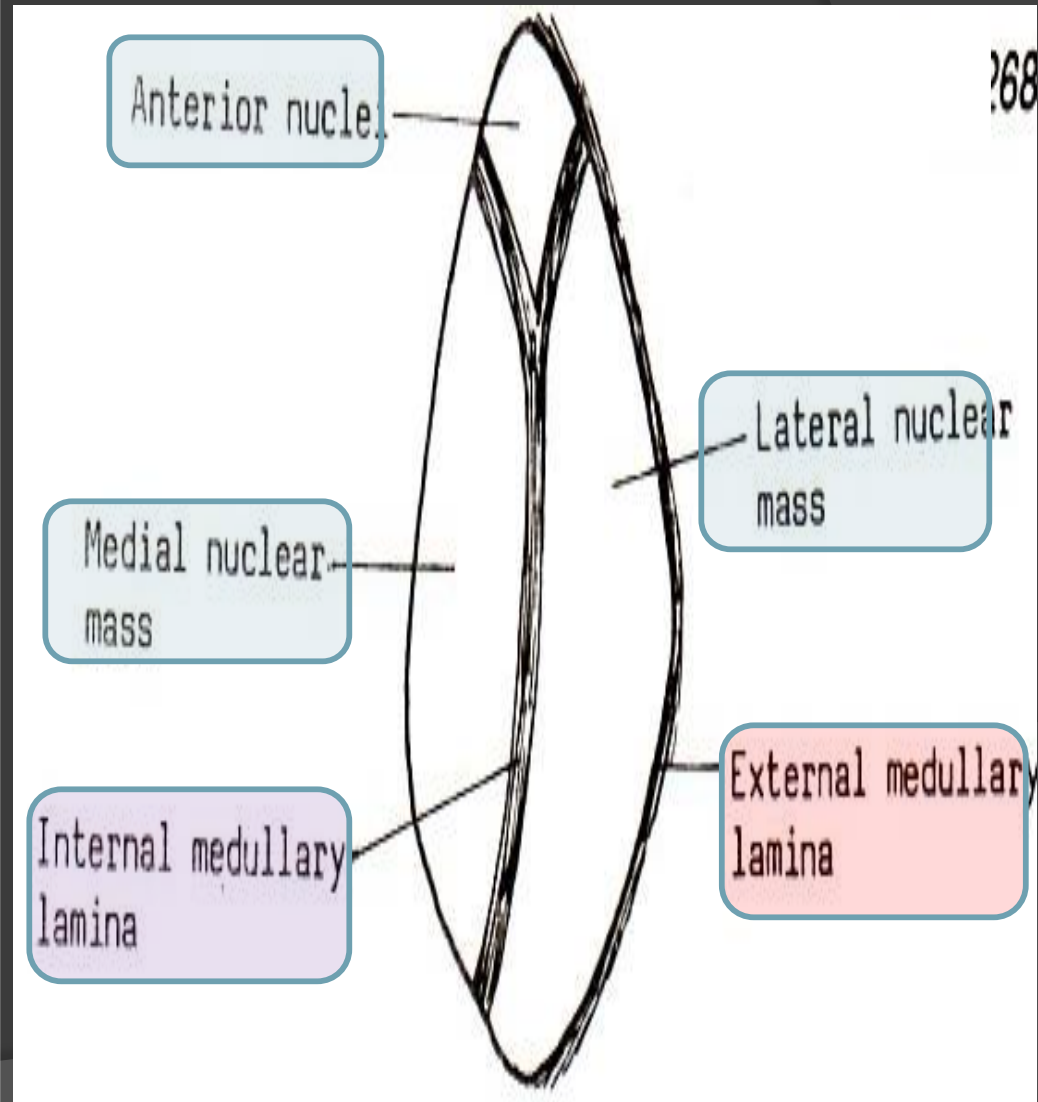
**Posterior end:**

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

# Internal Structure



○ It is divided into: Dorsal & Ventral tiers.

○ **Dorsal tier:**

○ which contains:

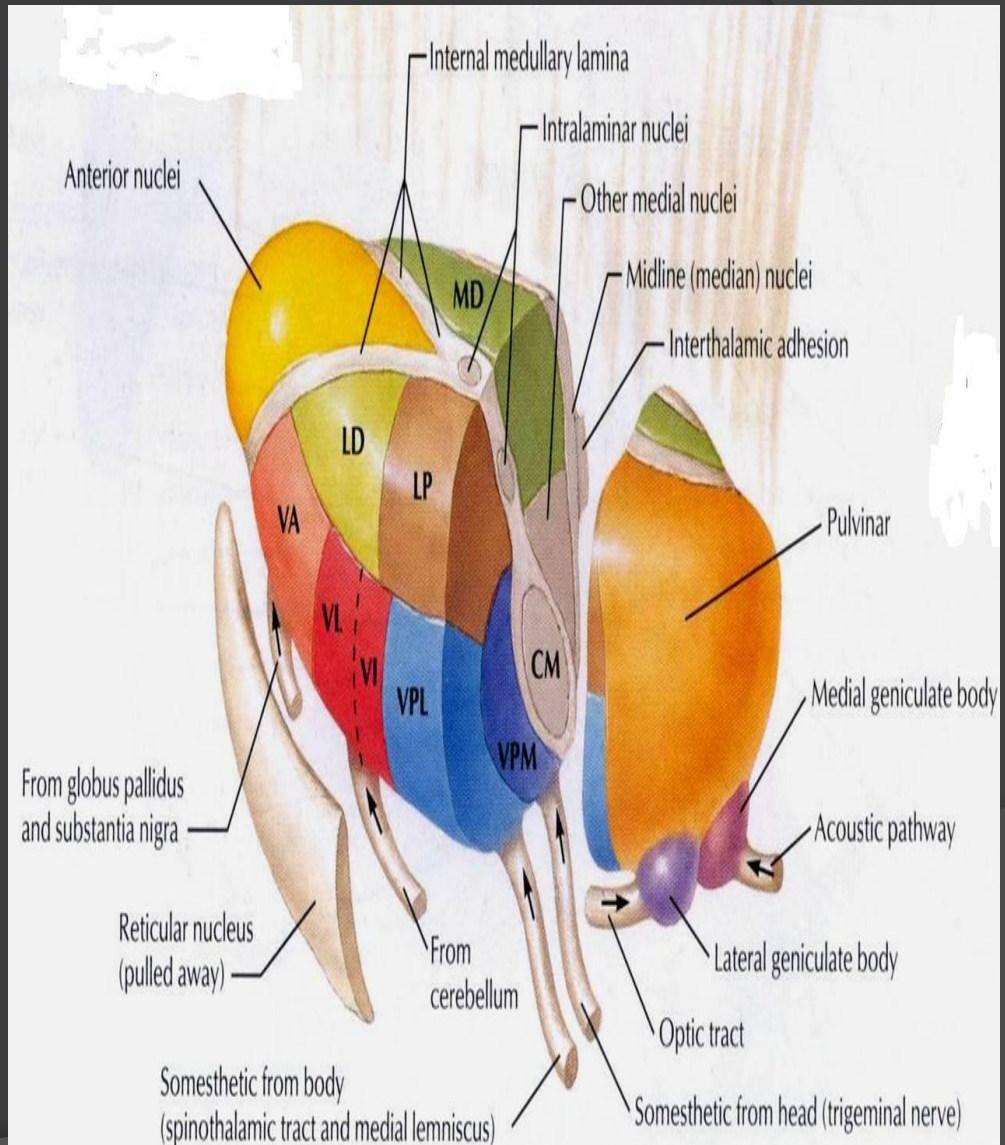
1. **Lateral Dorsal (LD).**
2. **Lateral Posterior (LP).**
3. **Pulvinar.**

○ **Ventral tier:**

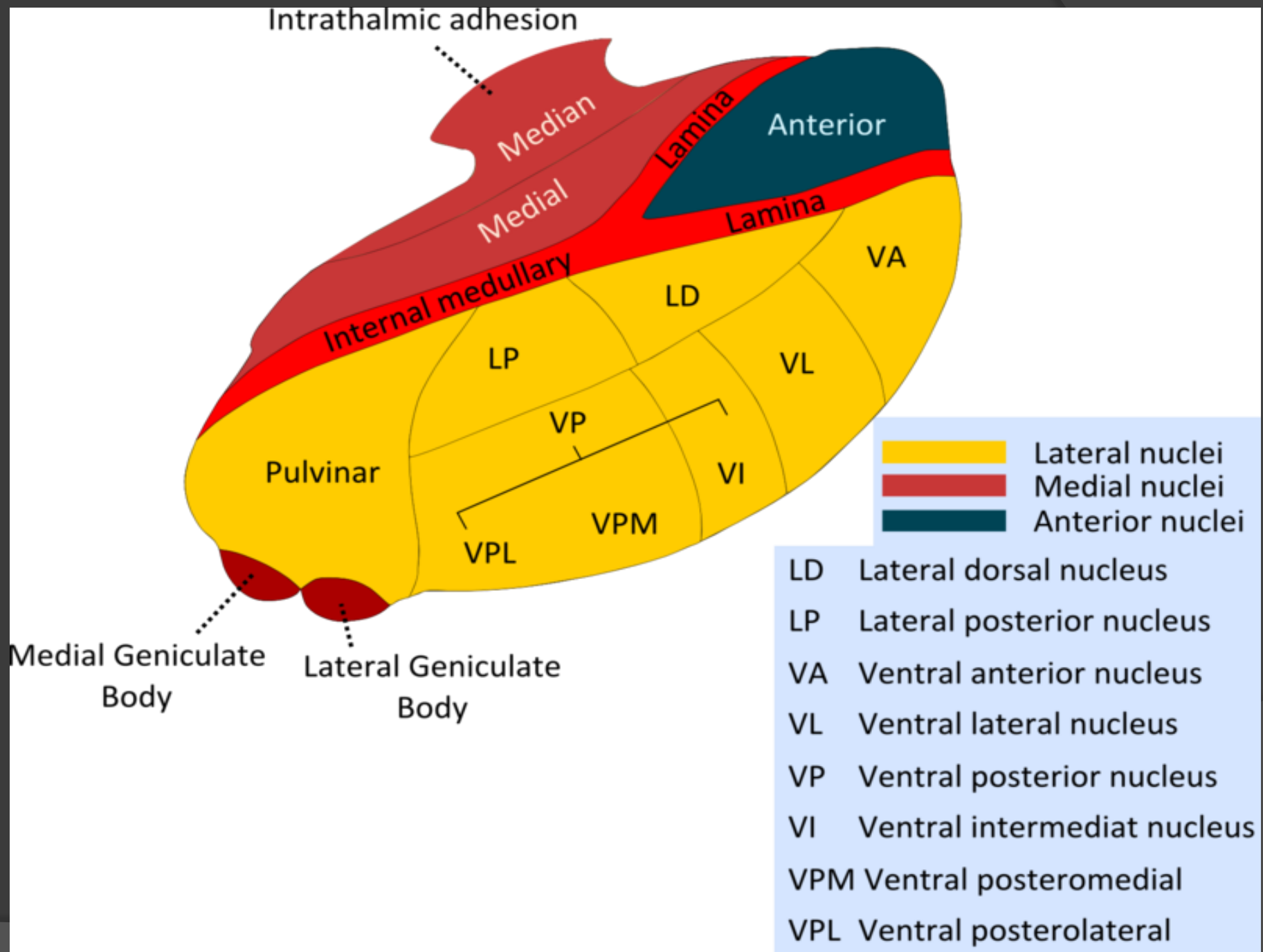
○ Which contains:

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

# Lateral Nuclear Group







- 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

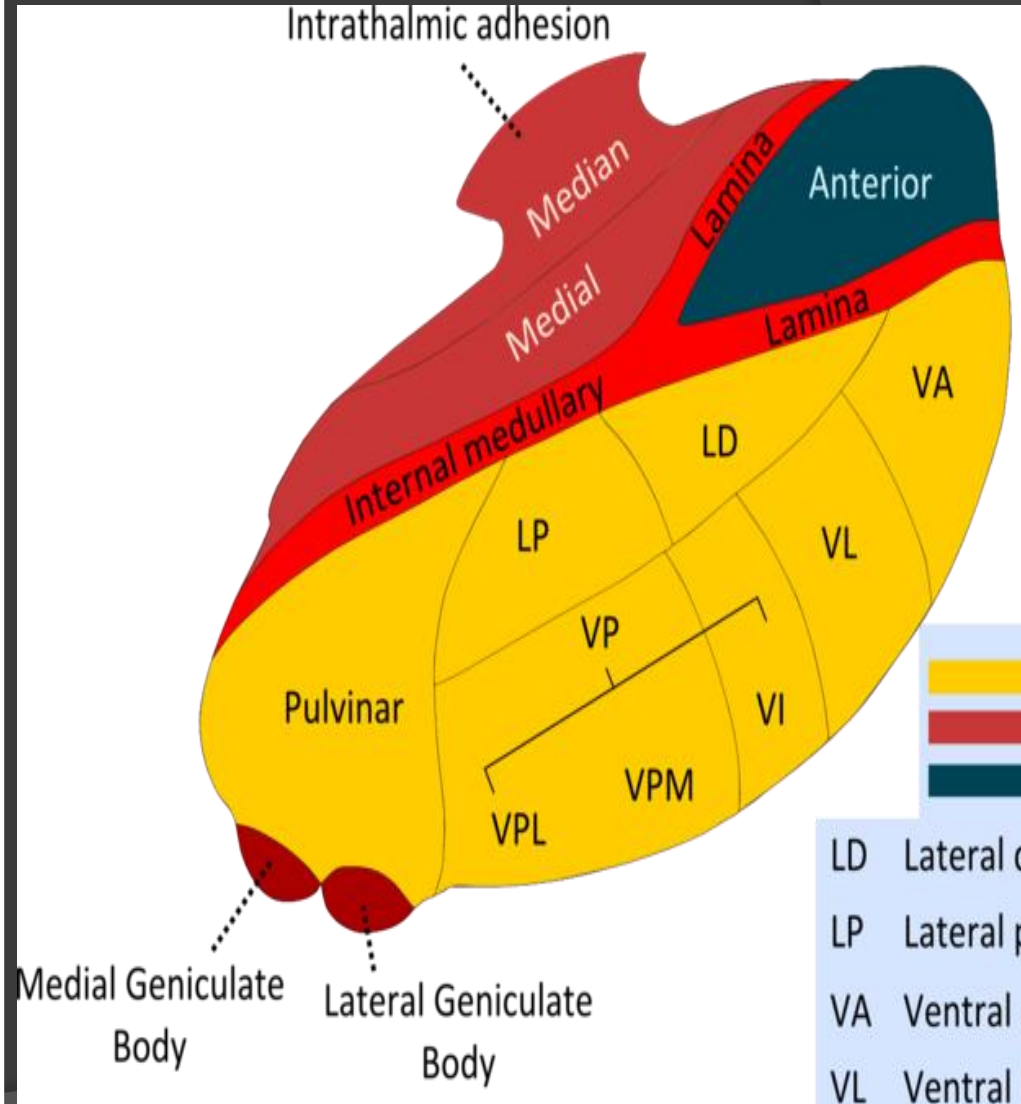
## Anterior Thalamic Nucleus

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

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## Medial Nucleus

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



# Projection of thalamic nuclei

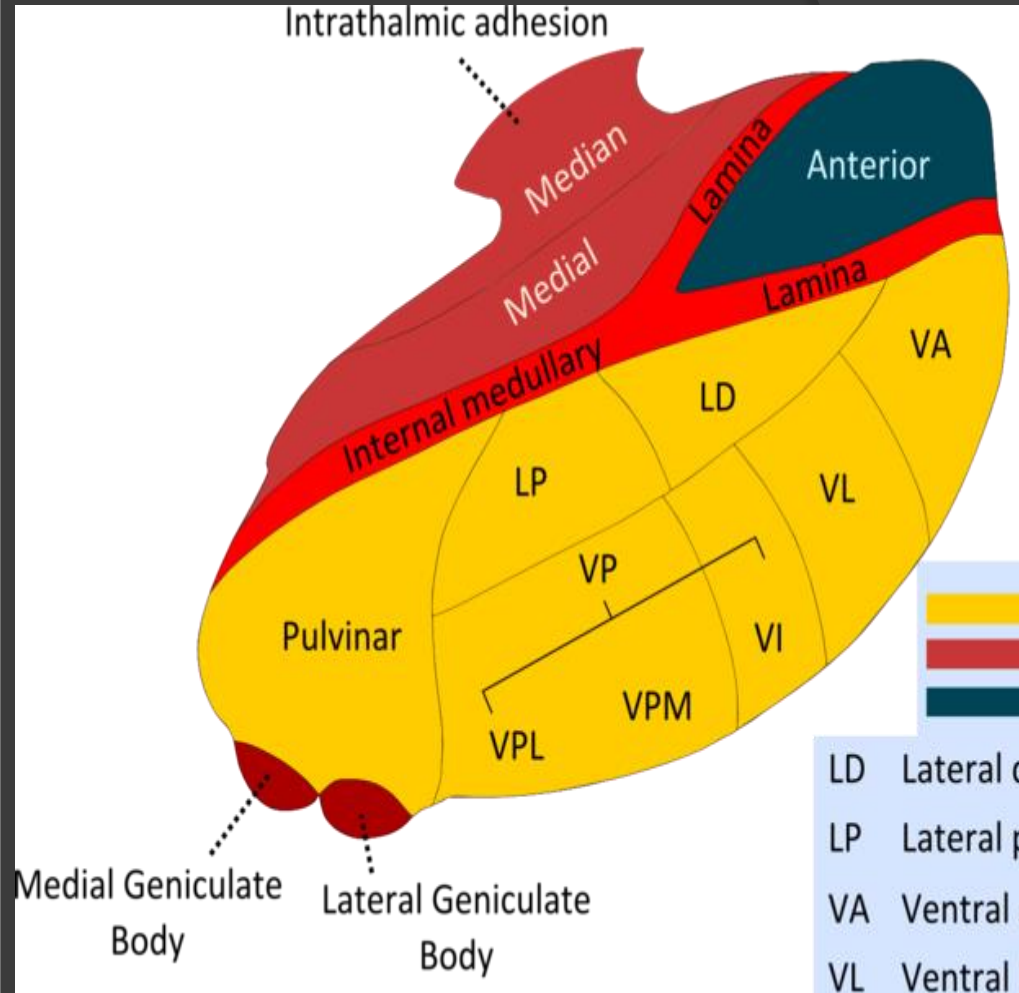
## Ventral Anterior Nucleus

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

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## Ventral Lateral Nucleus

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



# Projection of thalamic nuclei

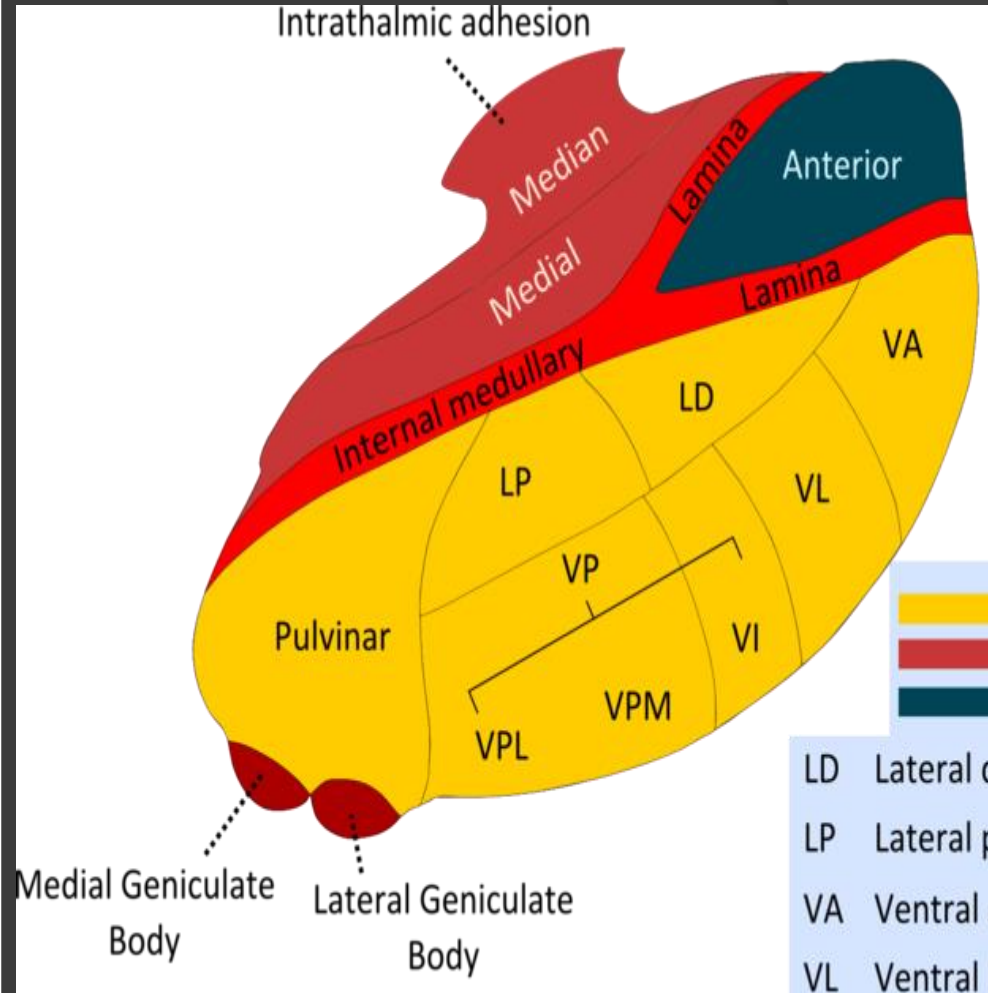
## Ventral Posterior Lateral Nucleus

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

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## Ventral Posterior Medial Nucleus

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





# Projection of thalamic nuclei

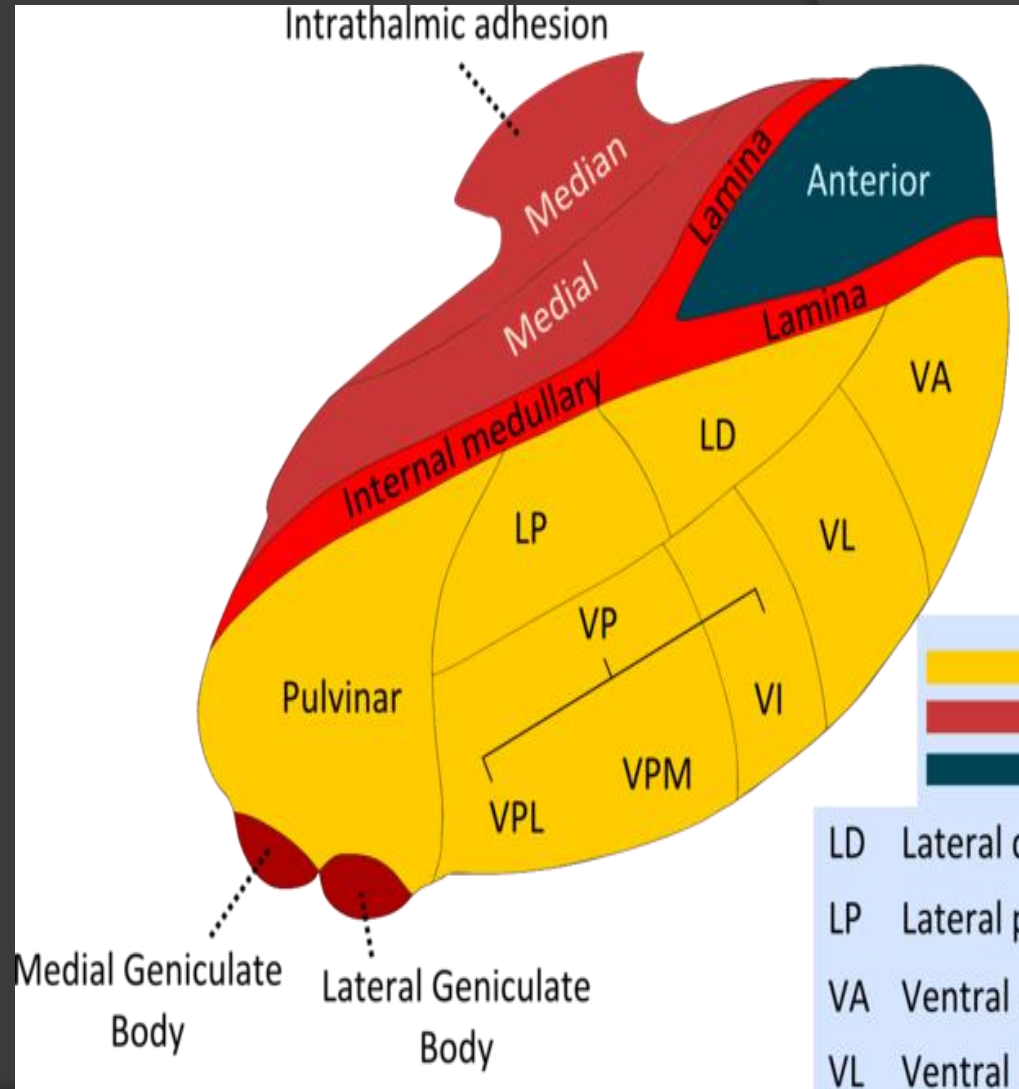
## Lateral Geniculate Nucleus

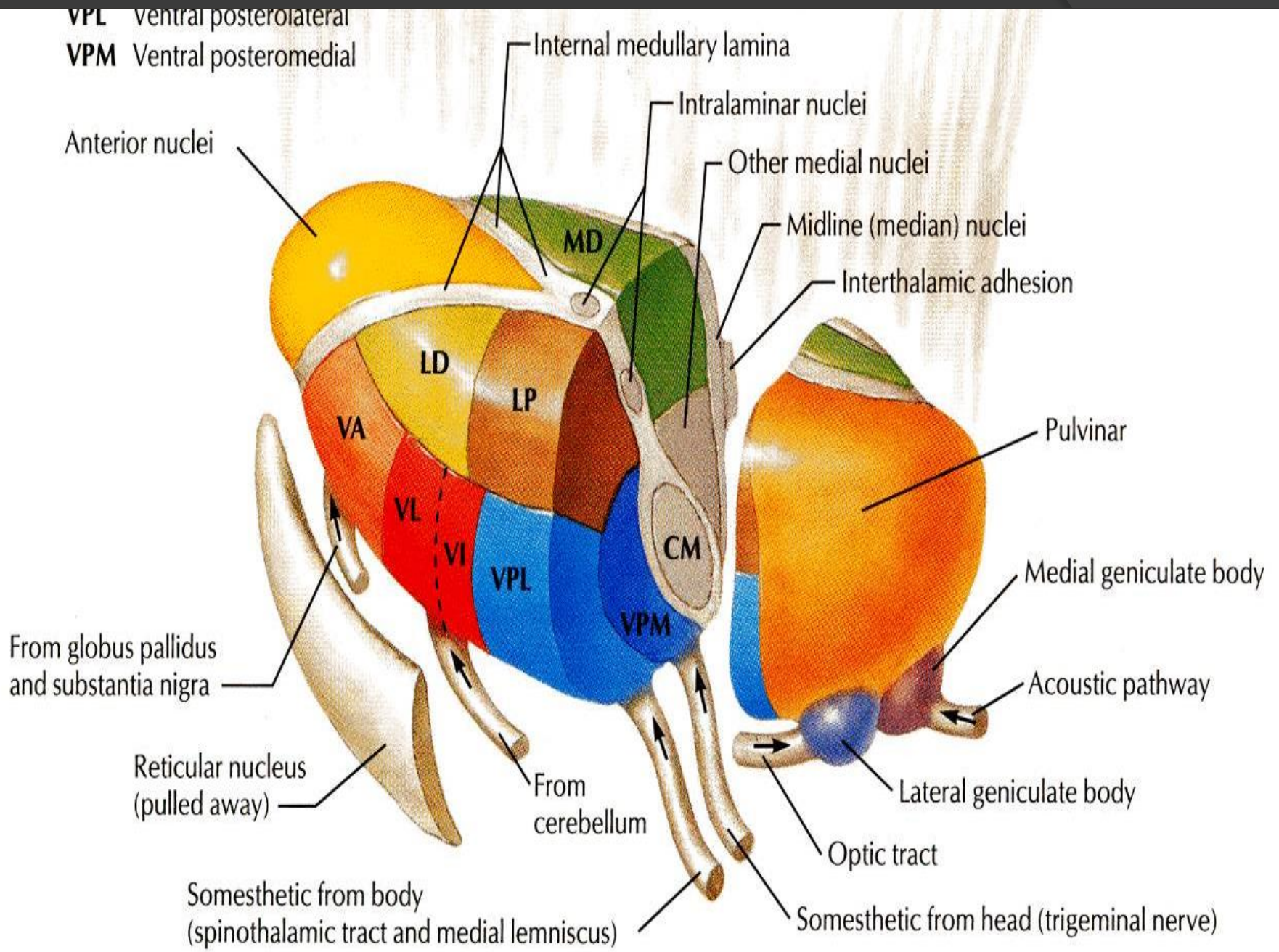
- **Afferent:**  
Optic tract.
- **Efferent:**  
Visual Cortex.

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## Medial Geniculate Nucleus

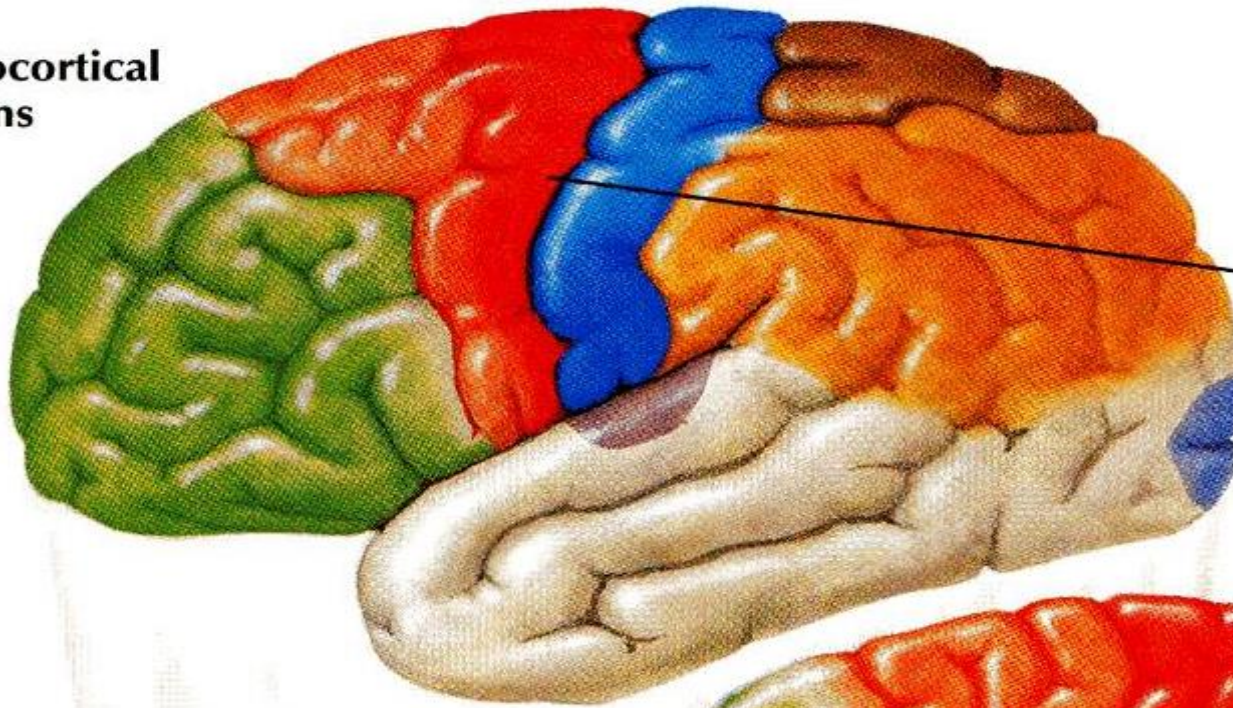
- **Afferent:**  
Lateral Lemniscus and inferior colliculus.
- **Efferent:**  
Auditory cortex.







Motor cortical  
sensory



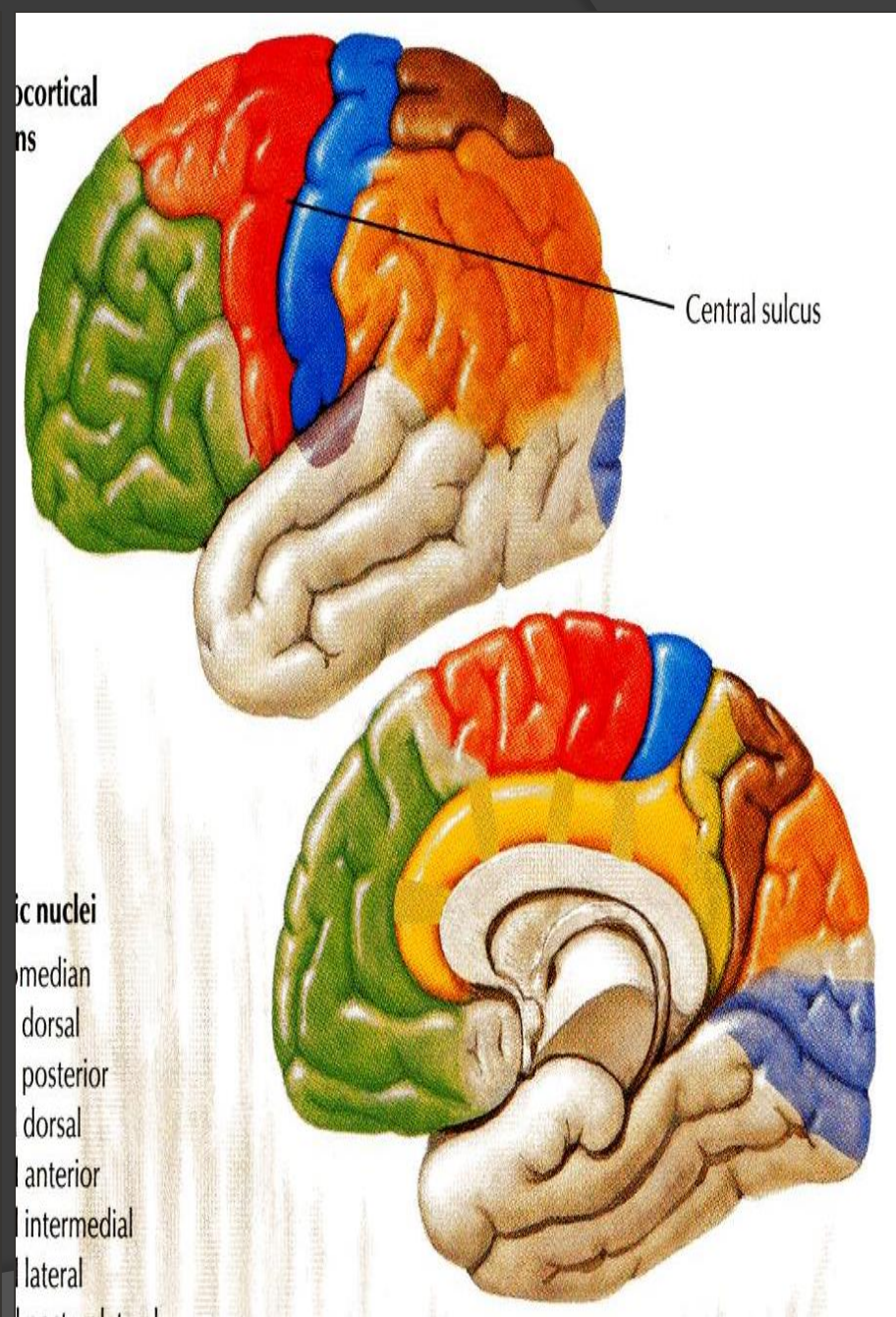
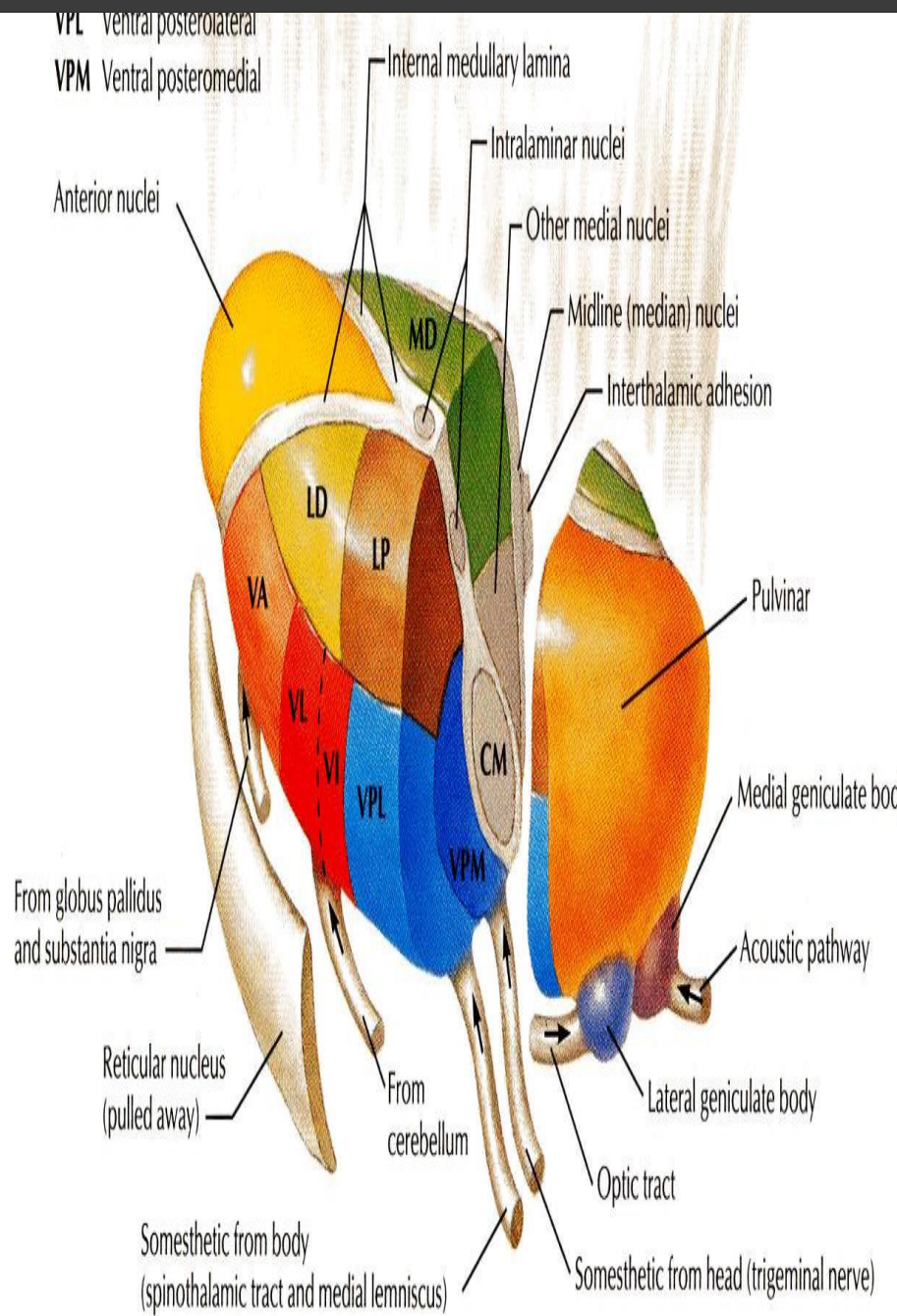
Central sulcus

Basal nuclei

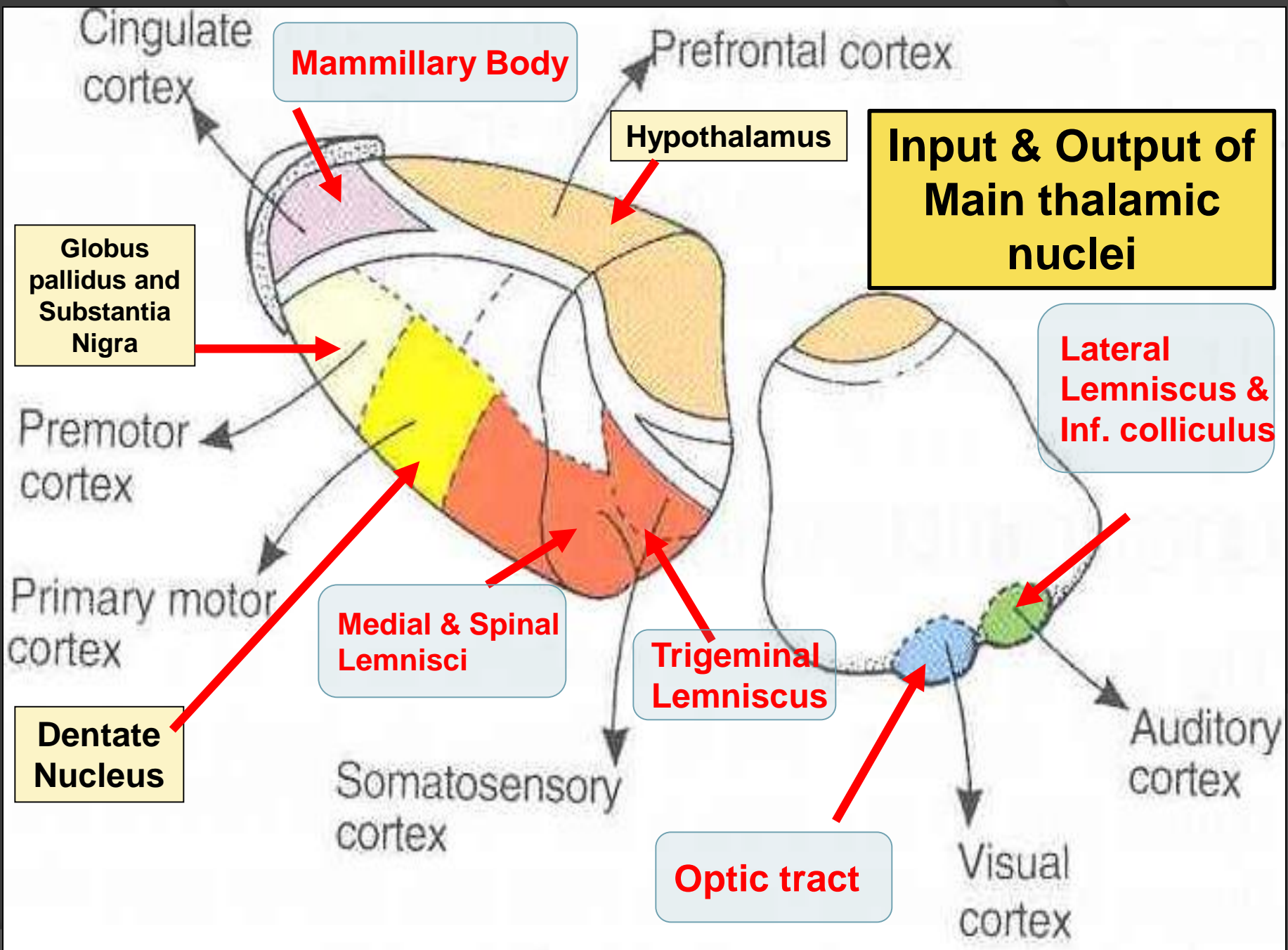
- medial
- dorsal
- posterior
- dorsal
- anterior
- intermedial
- lateral





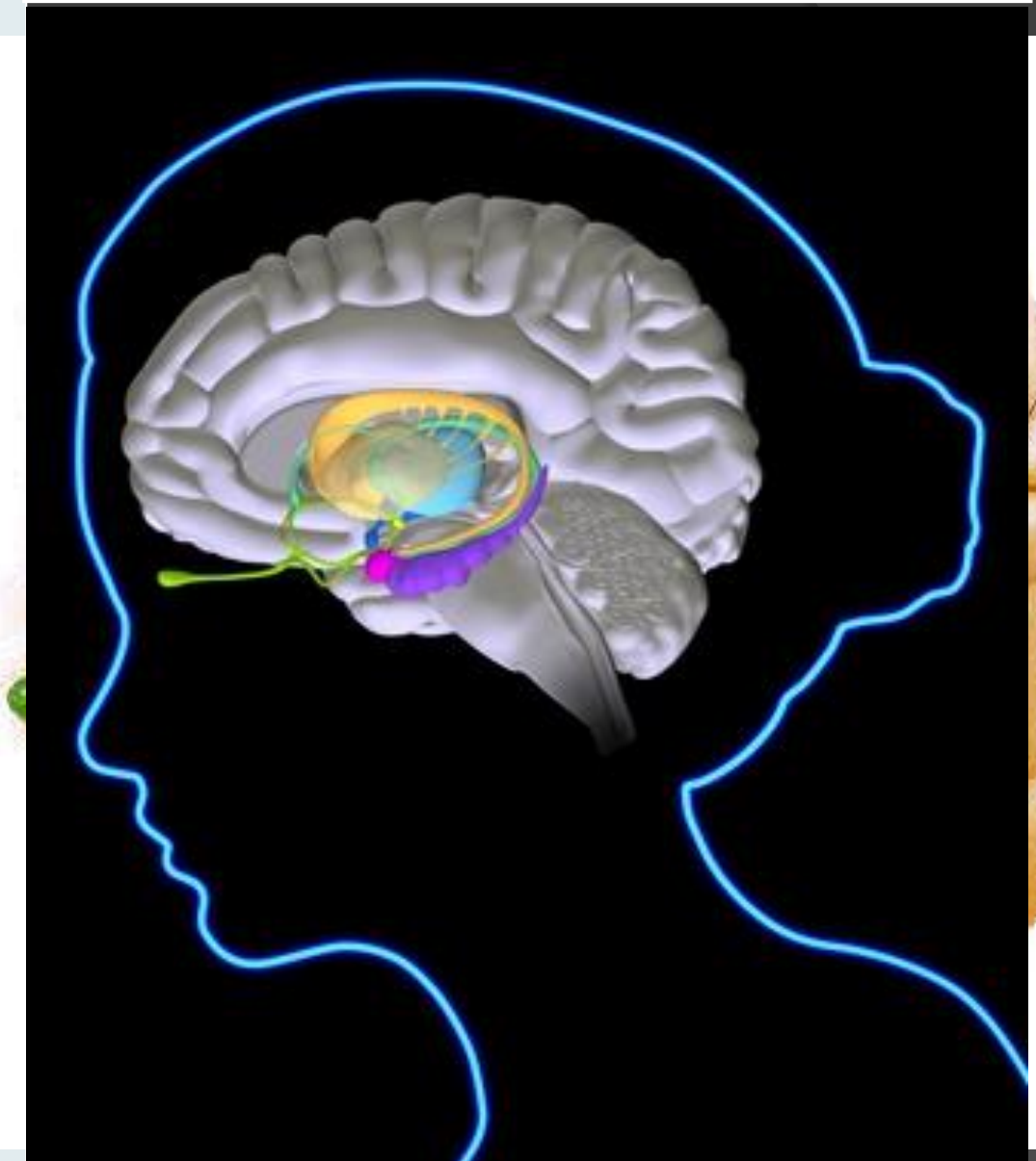






# LIMBIC SYSTEM

- 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 that all are connected with looped connections.
- Then all project to the hypothalamus, (particularly to the mammillary body).



# 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**



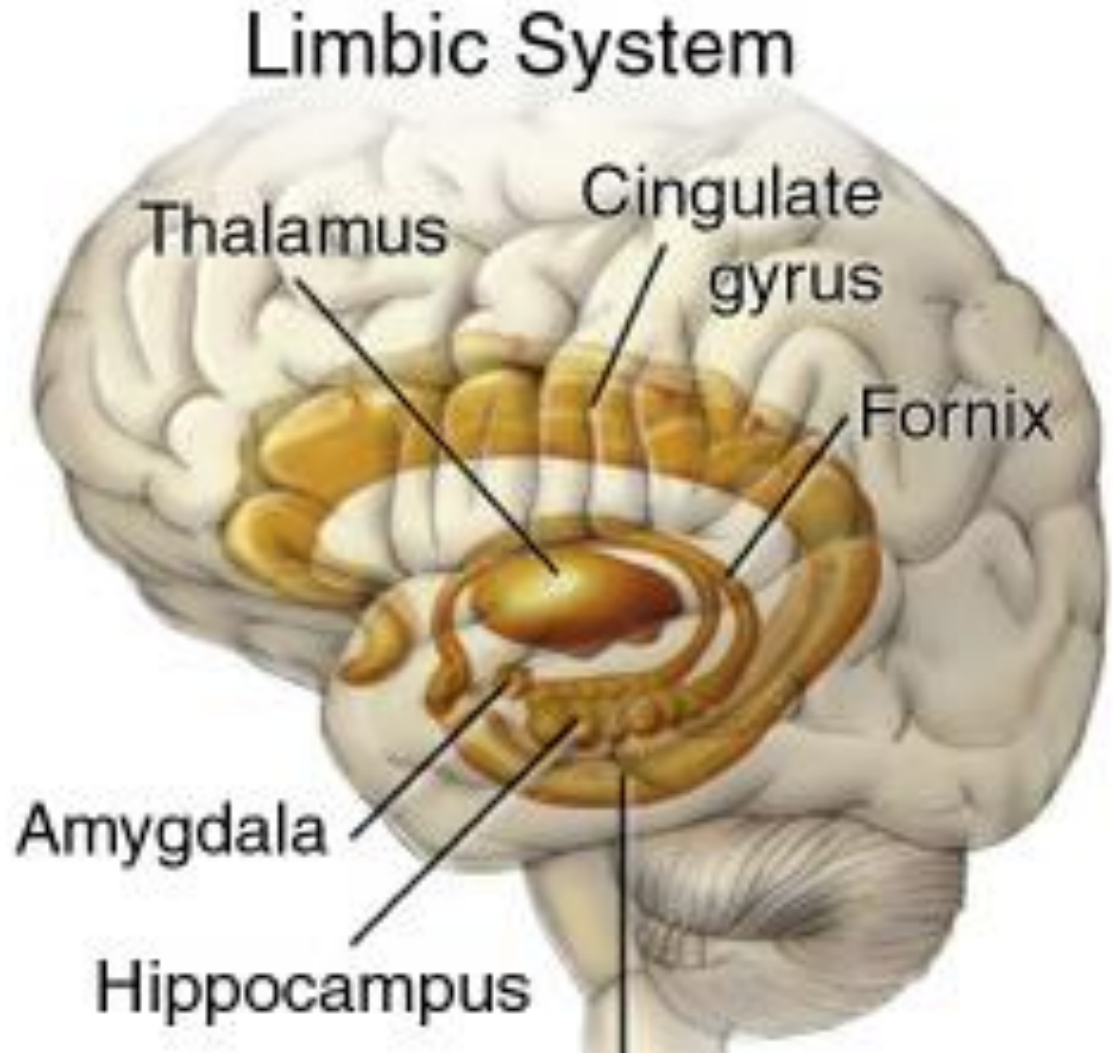
The limbic system is composed of four main structures:

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.

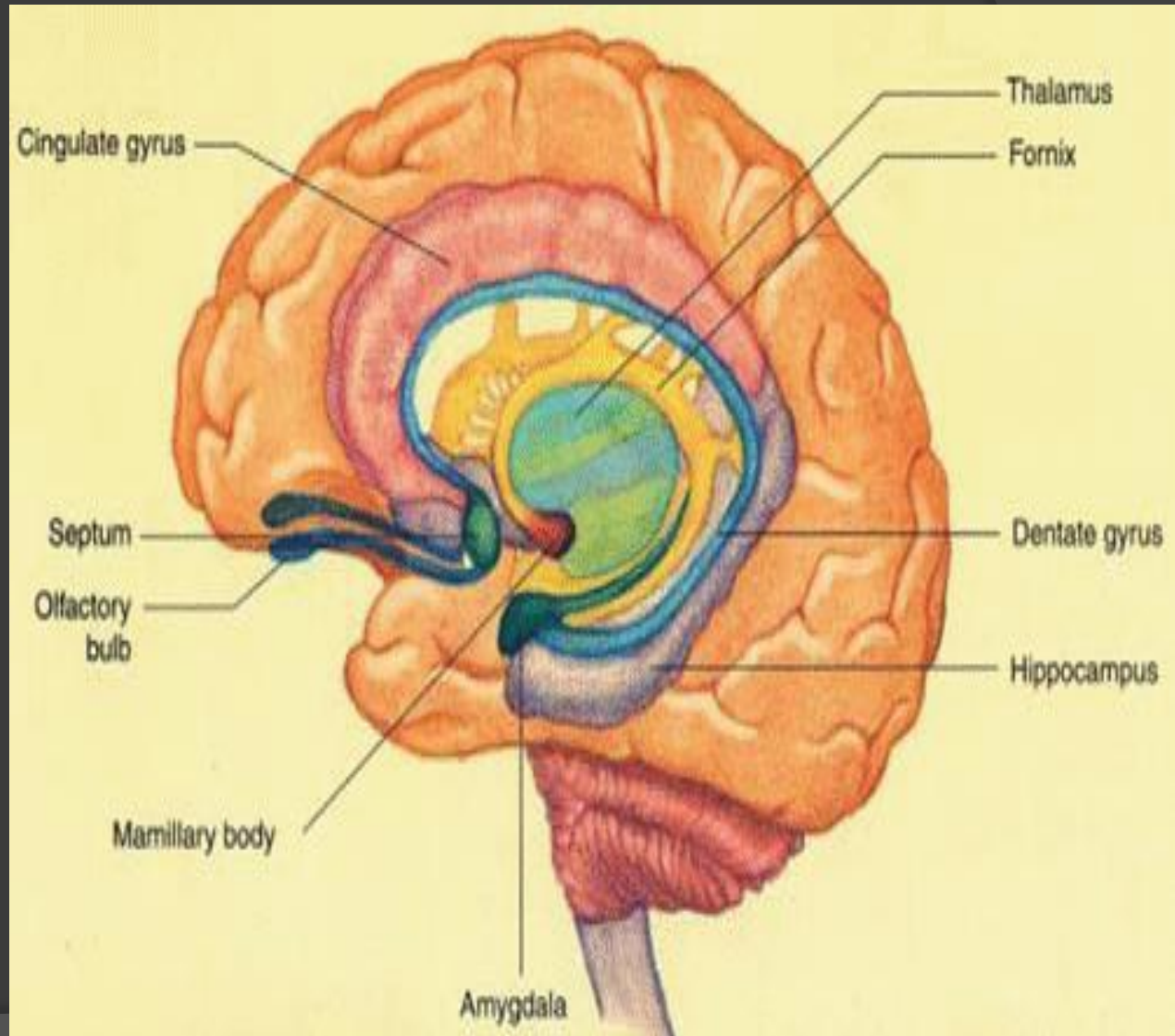
**The limbic system is a set of brain structures including**





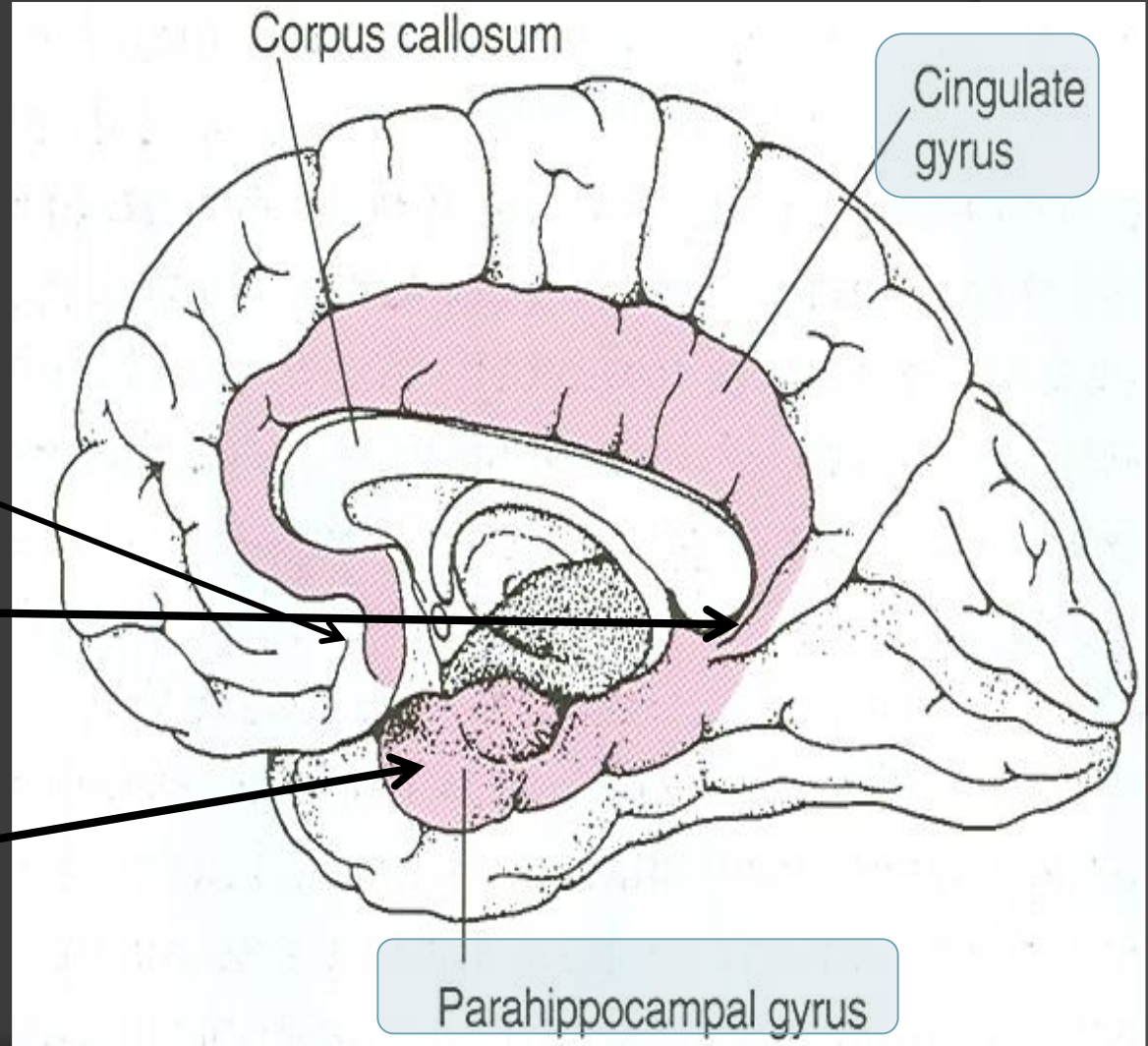
# CORTICAL STRUCTURES

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.
- It surrounding the corpus callosum.
- It includes:
  1. **Subcallosal area**
  2. **Cingulate gyrus**
  3. **Isthmus**
  4. **Parahippocampal gyrus,**  
**and**
  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.

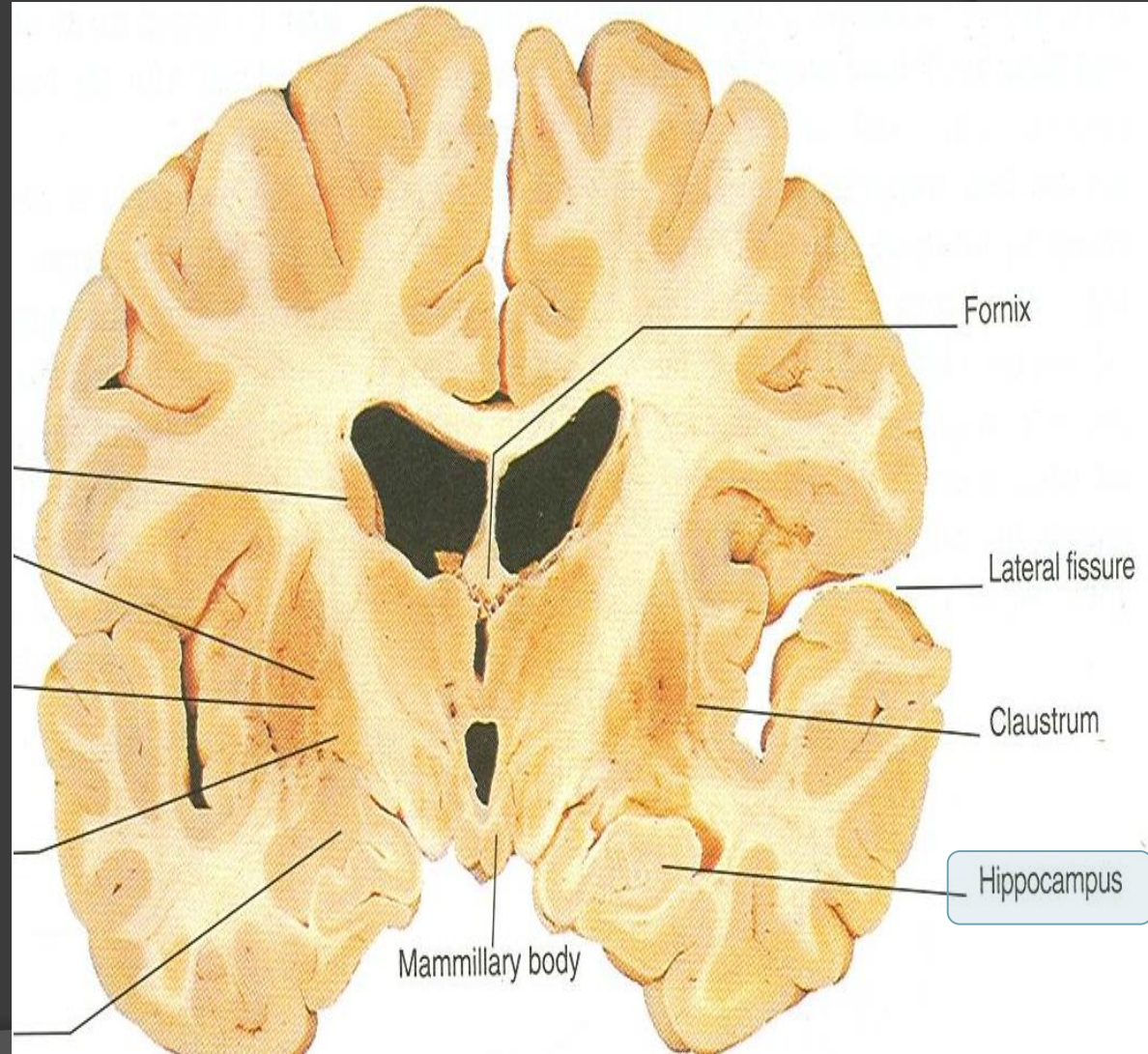
It acts as a memory indexer by sending memories to the appropriate part of the **cerebral hemisphere** for long-term storage and retrieving them when necessary.





# 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:

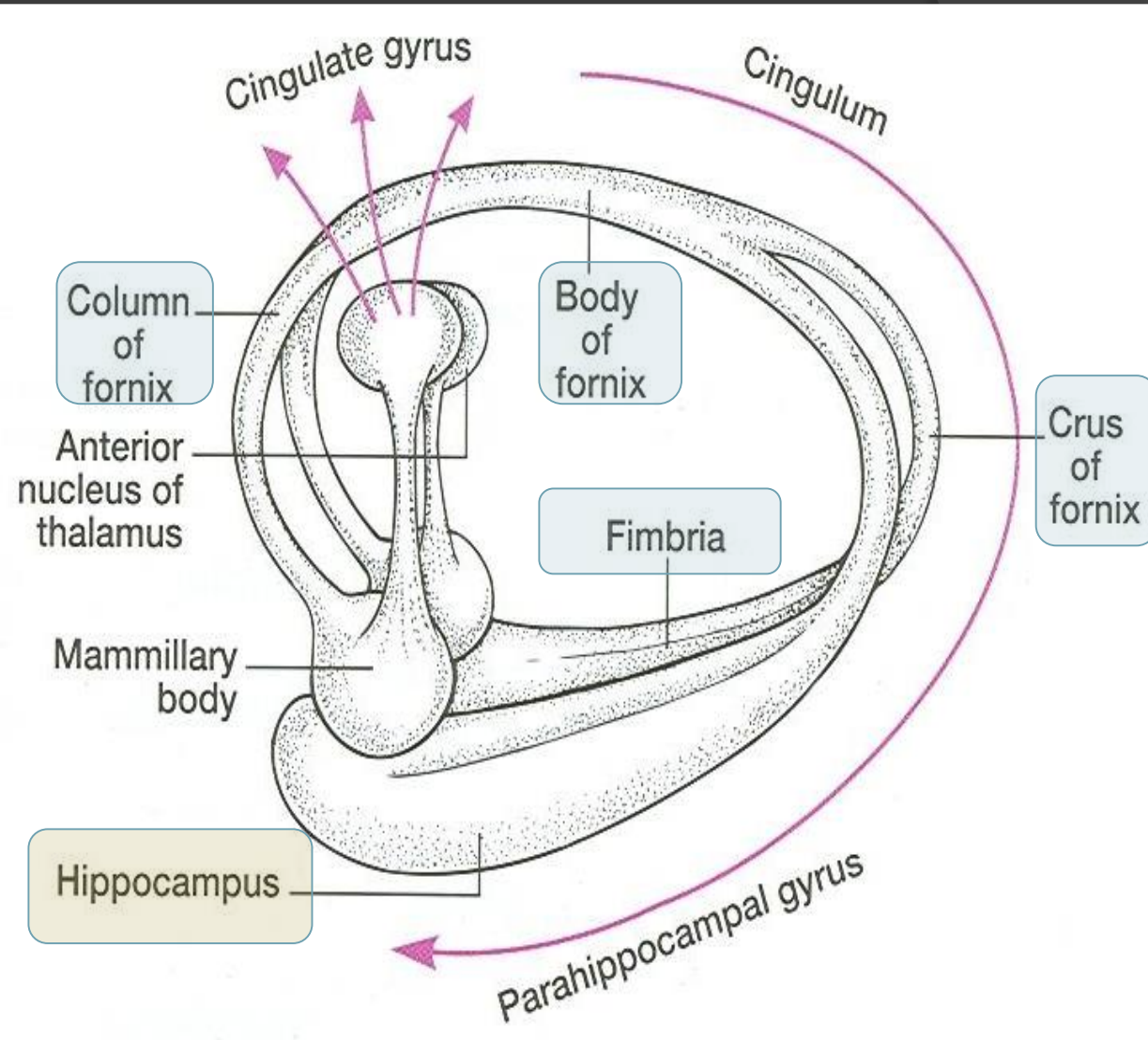
## FORNIX:

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

*it consists of:*

**2 Fimbria,**  
**2 Crura, (Crus).**  
**ONE Body &**  
**2 Column.**

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

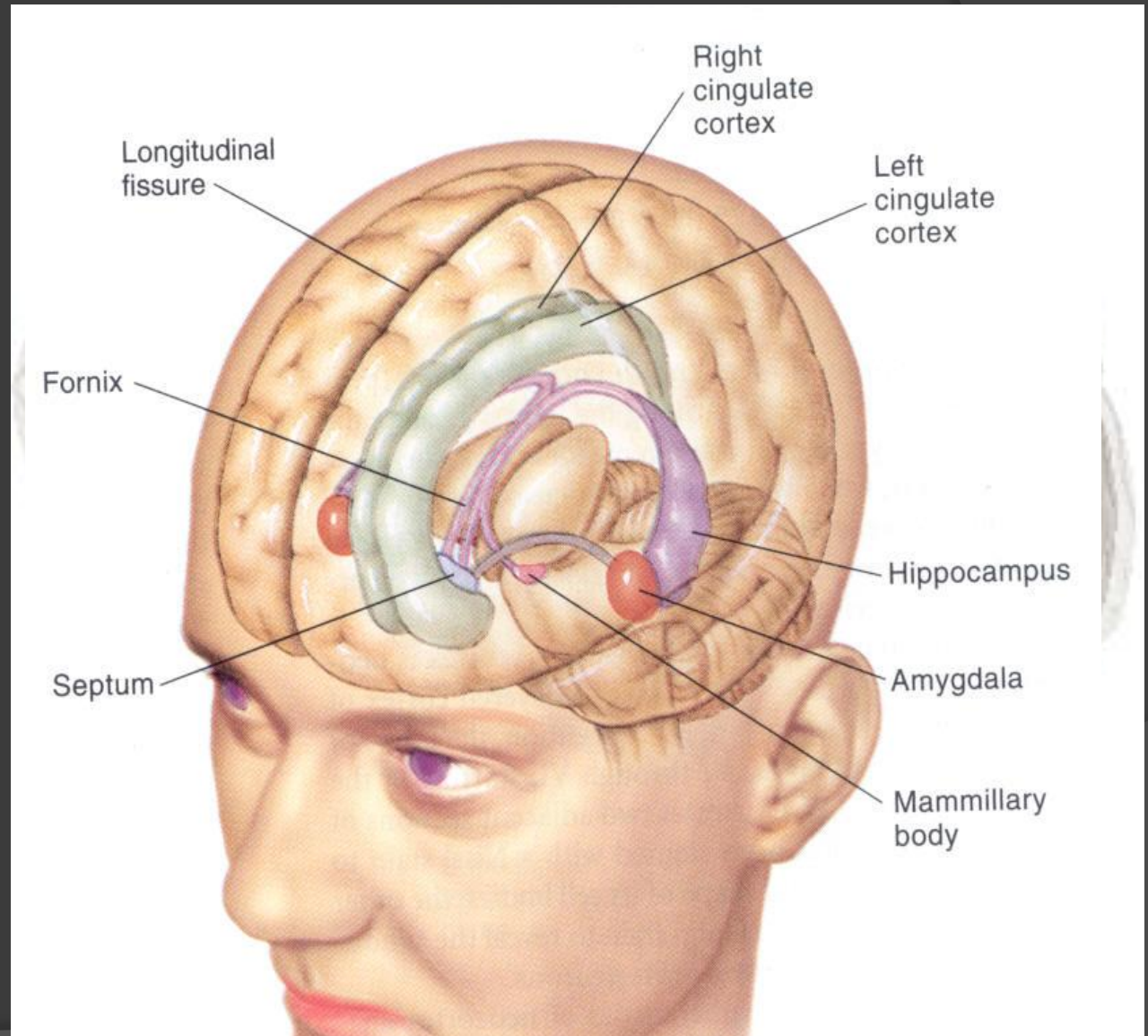


- **Site:**
- almond shaped mass of nuclei that

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

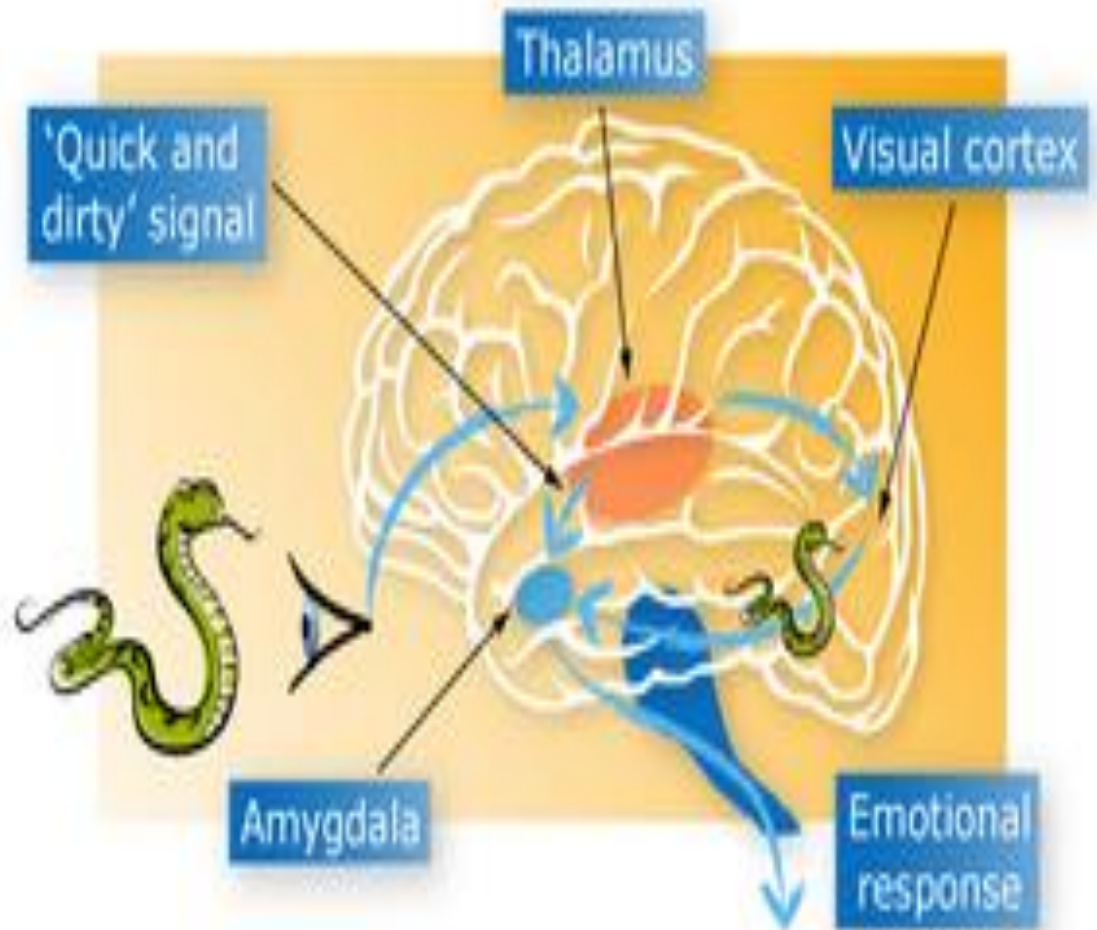
- **Function:**
- It is involved in
  1. **FEAR,**
  2. **Emotions**
  3. **Anger, &**
  4. **Release of Hormonal.**

# AMYGDALA



# 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:

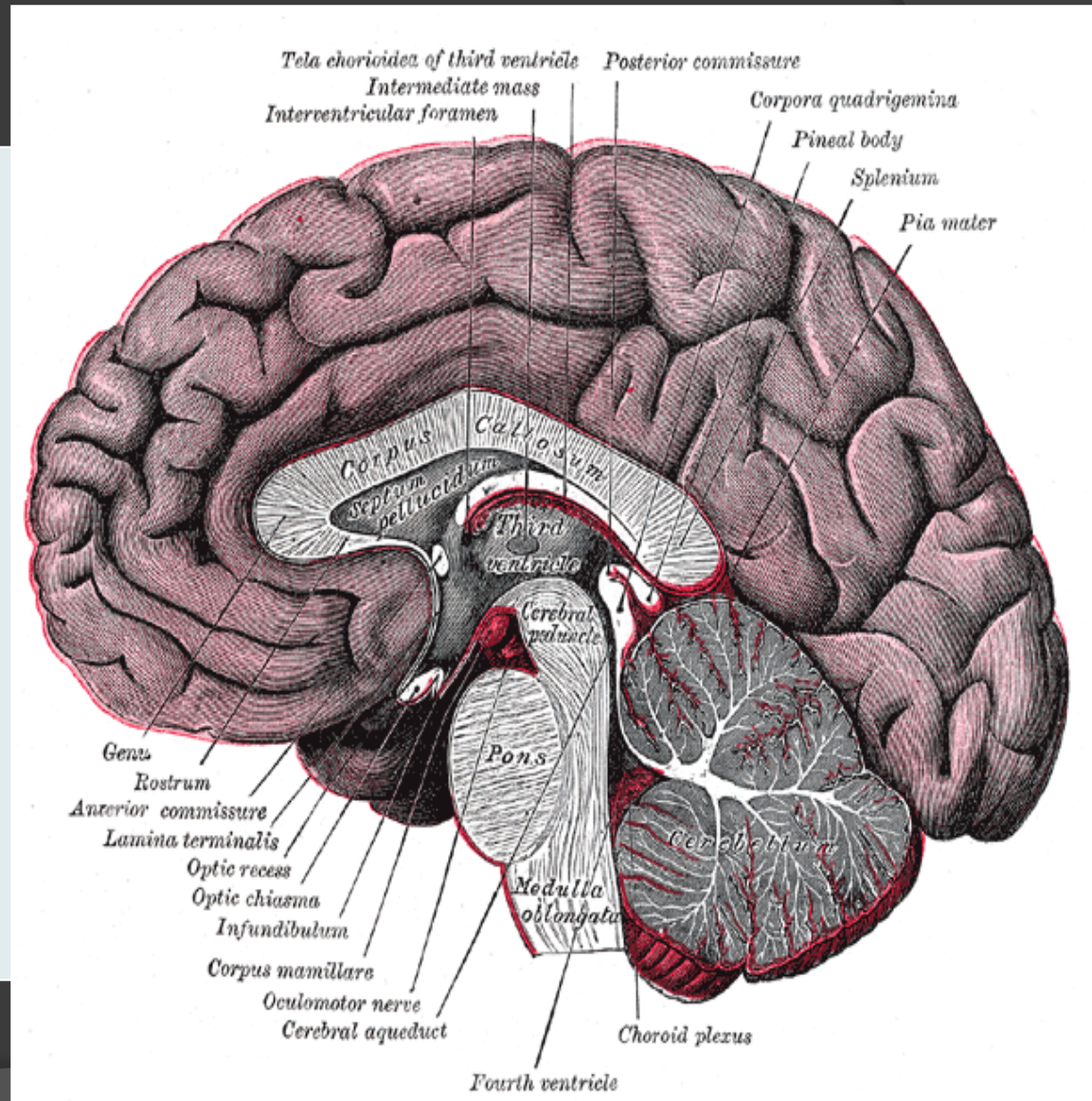
Located anterior to the interventricular septum.

## 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), It is due to Thiamine deficiency (B1) or due to chronic alcoholism. .

- ◎ **Temporal lobe epilepsy**

- ◎ The **hippocampus** is a common focus site in epilepsy, and can be damaged through chronic seizures.

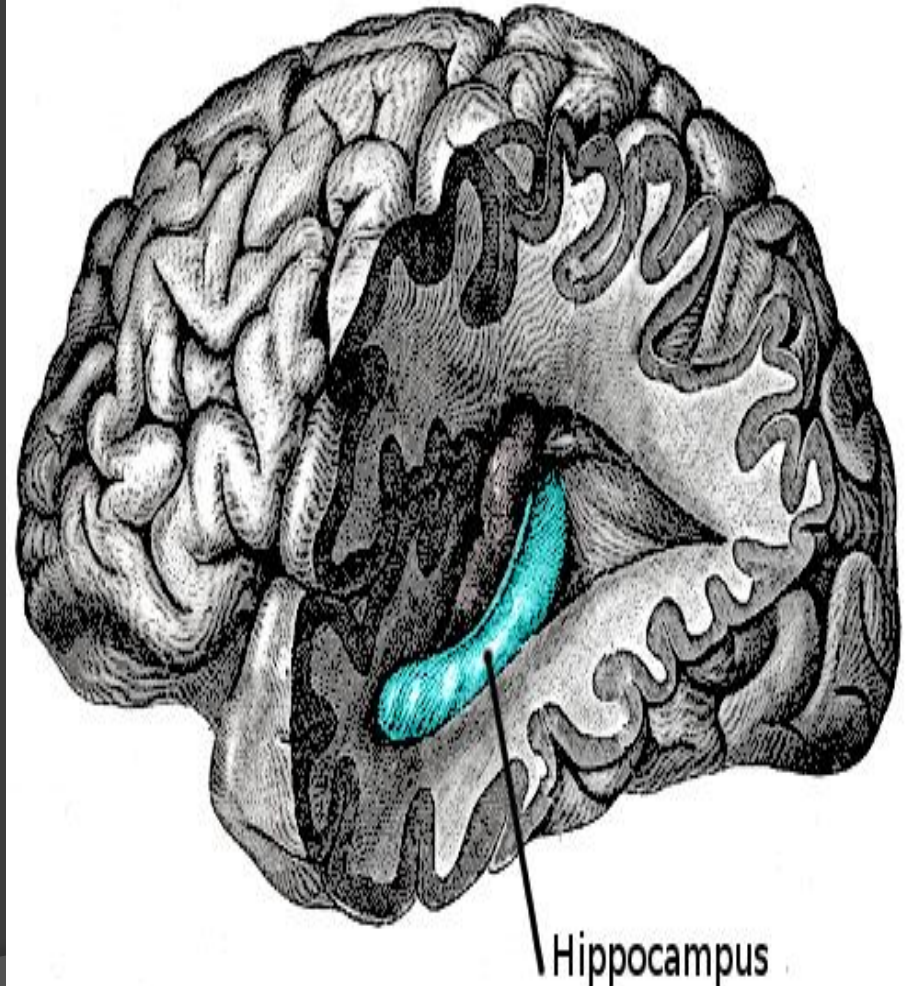
- ◎ It is sometimes damaged in diseases such as herpes encephalitis,

- ◎ **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**