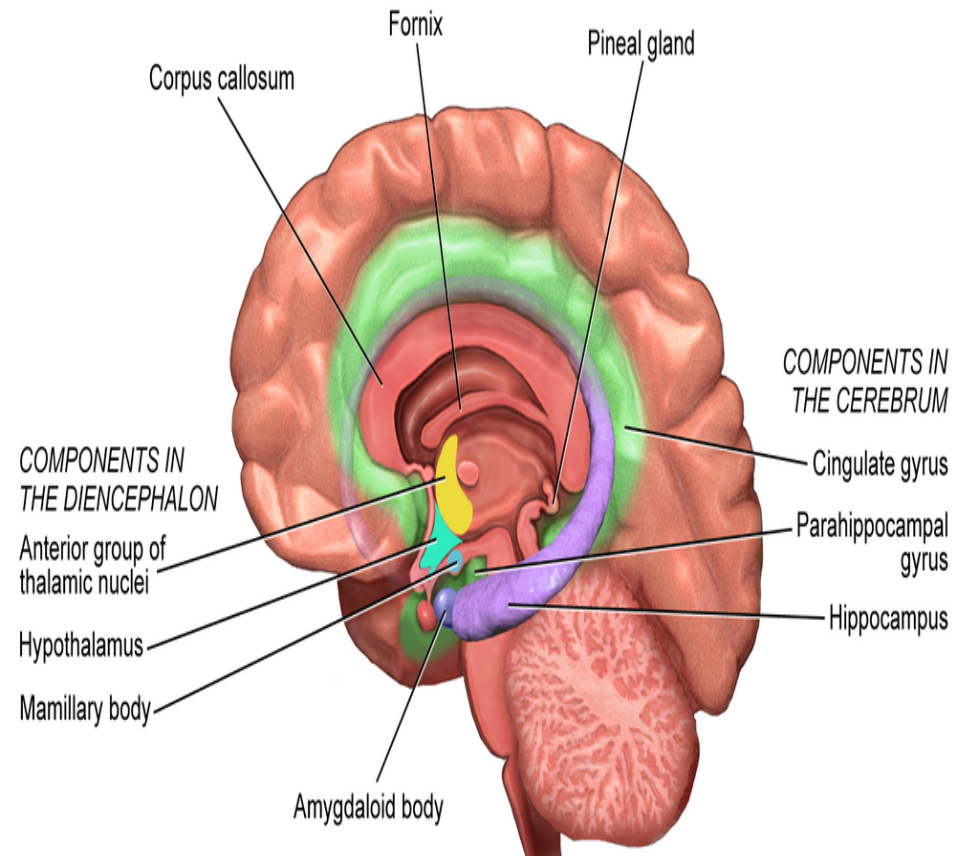
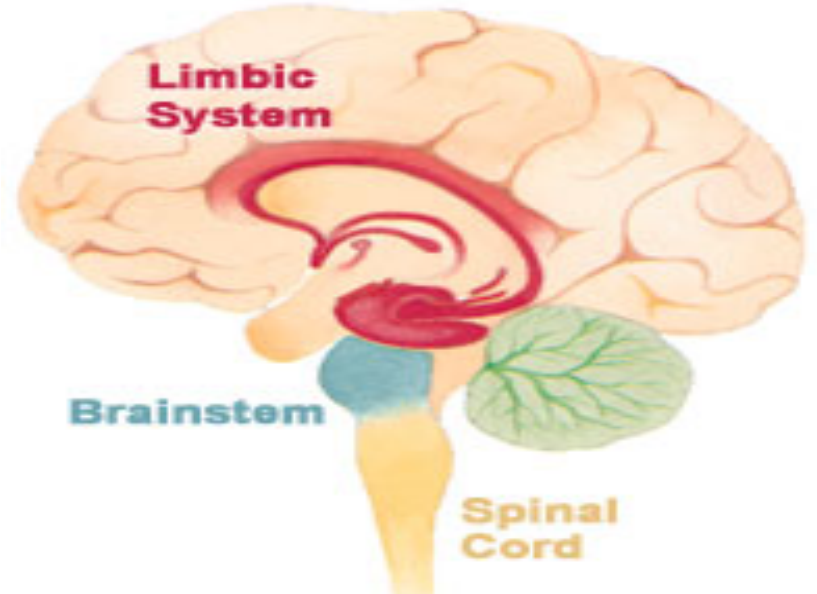


The Limbic System



Thalamus & Limbic System



Prof. Saeed Abuel Makarem &
Dr.Sanaa Alshaarawy

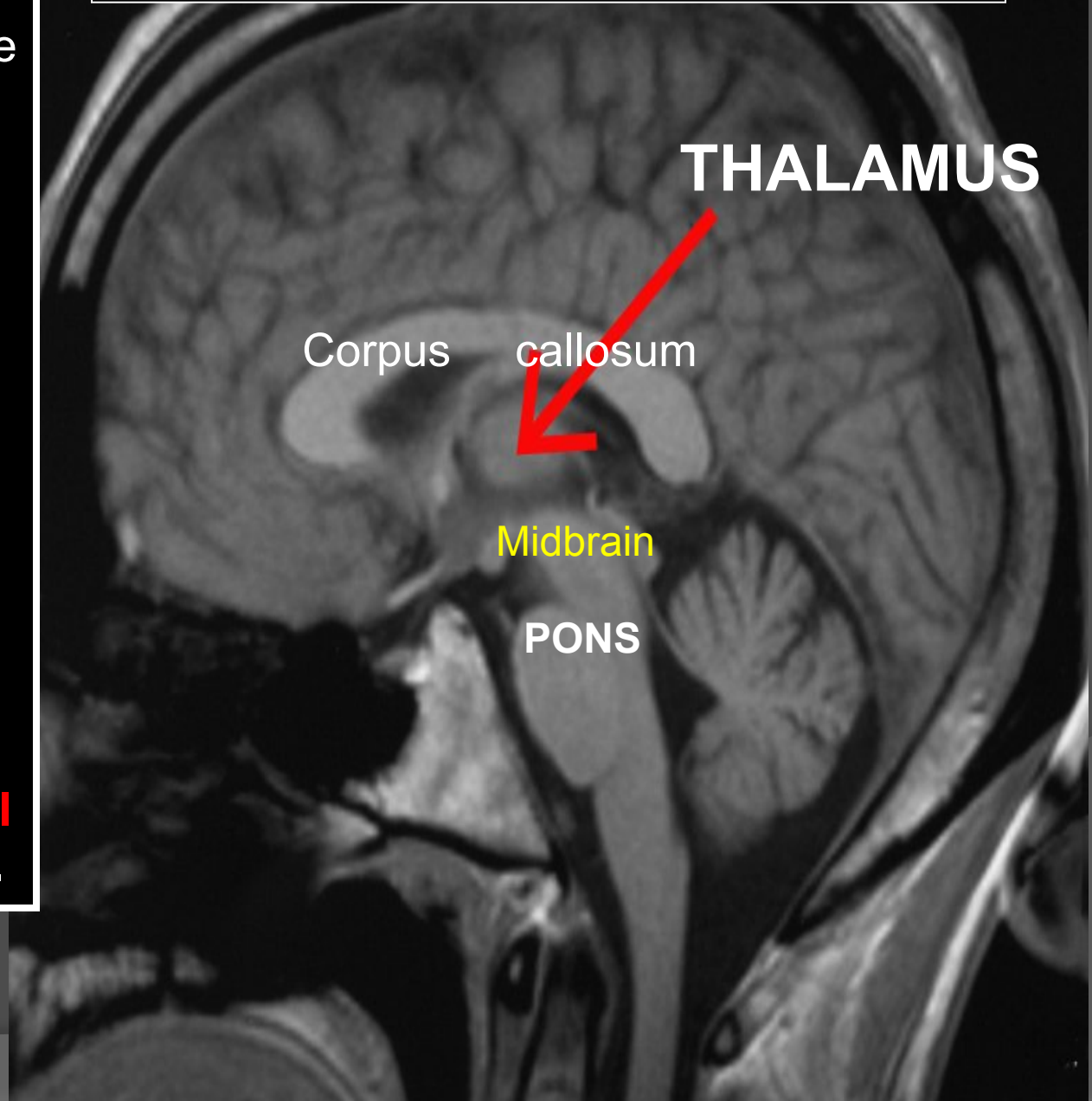
Objectives

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**.
- Together **with** the **hypothalamus** they form the **lateral wall of the 3rd ventricle**.



Thalamus

- It sends the received information to the cerebral cortex from diverse 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:

The 3rd ventricle

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: (I)

Hypothalamus, anteriorly & **Subthalamus** posteriorly.

Relations



Coronal section

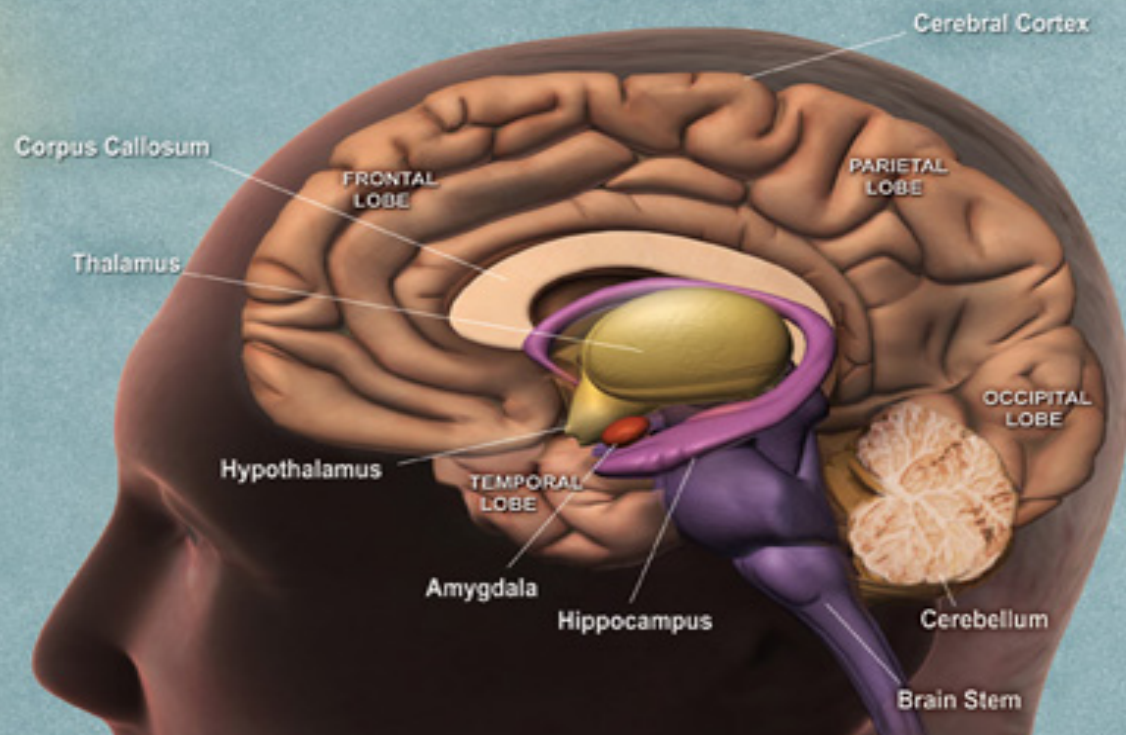
Anterior end:

Forms a projection, called the **anterior tubercle**.

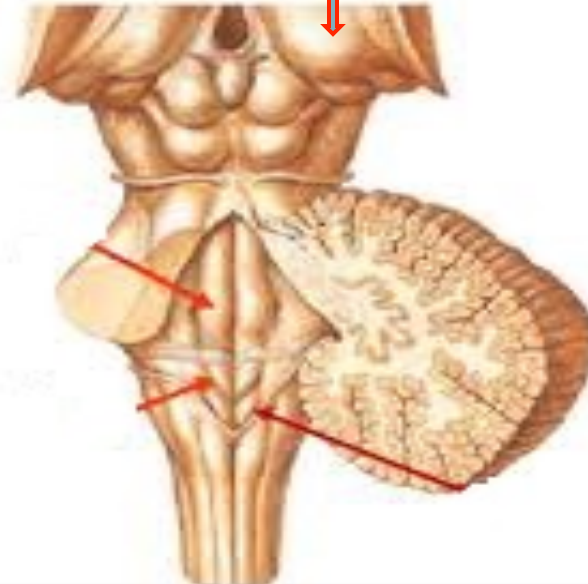
It lies just behind the **interventricular foramen**.

Posterior end: Broad

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



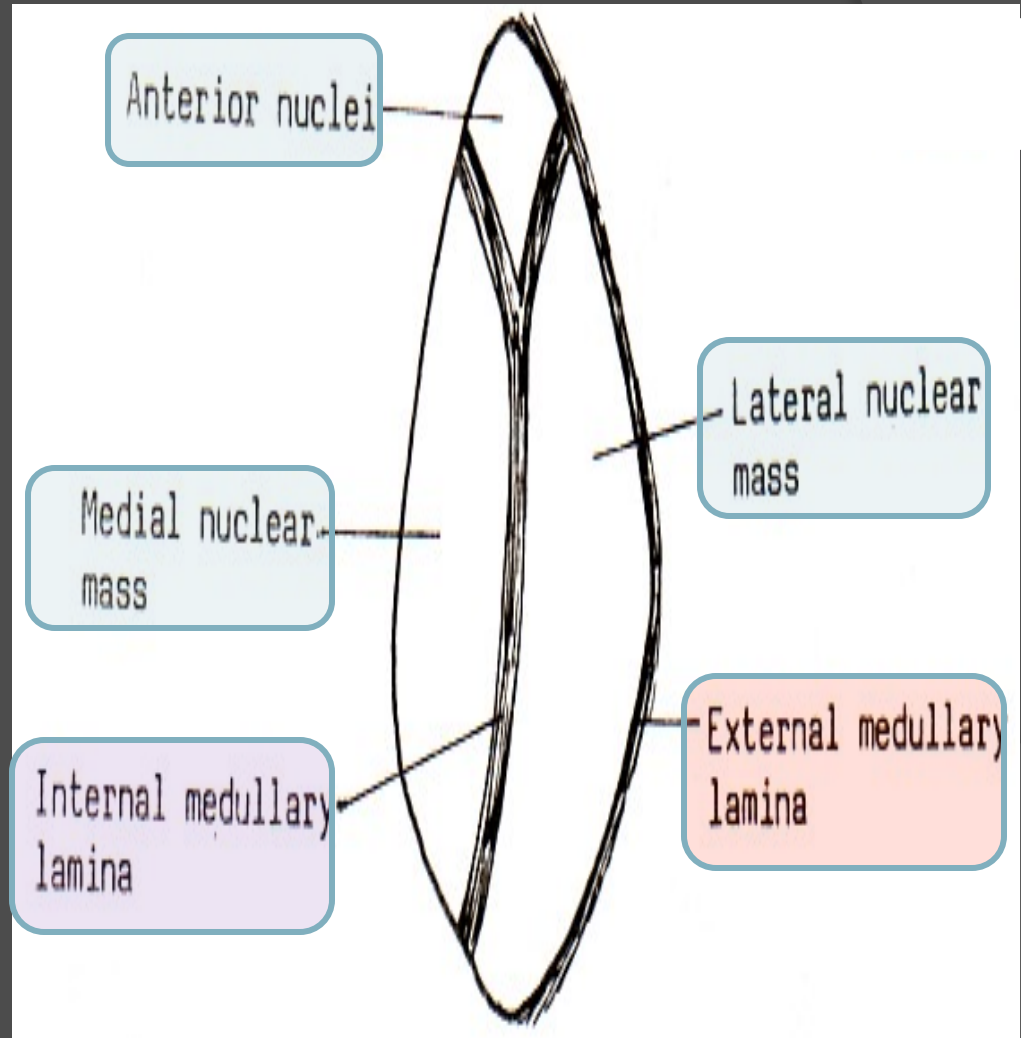
Thalamus



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 groups is subdivided into a number of named nuclei.

Internal Structure



Lateral Nuclear Group

○ It is divided into:
Dorsal & Ventral tiers

○ Dorsal tier:

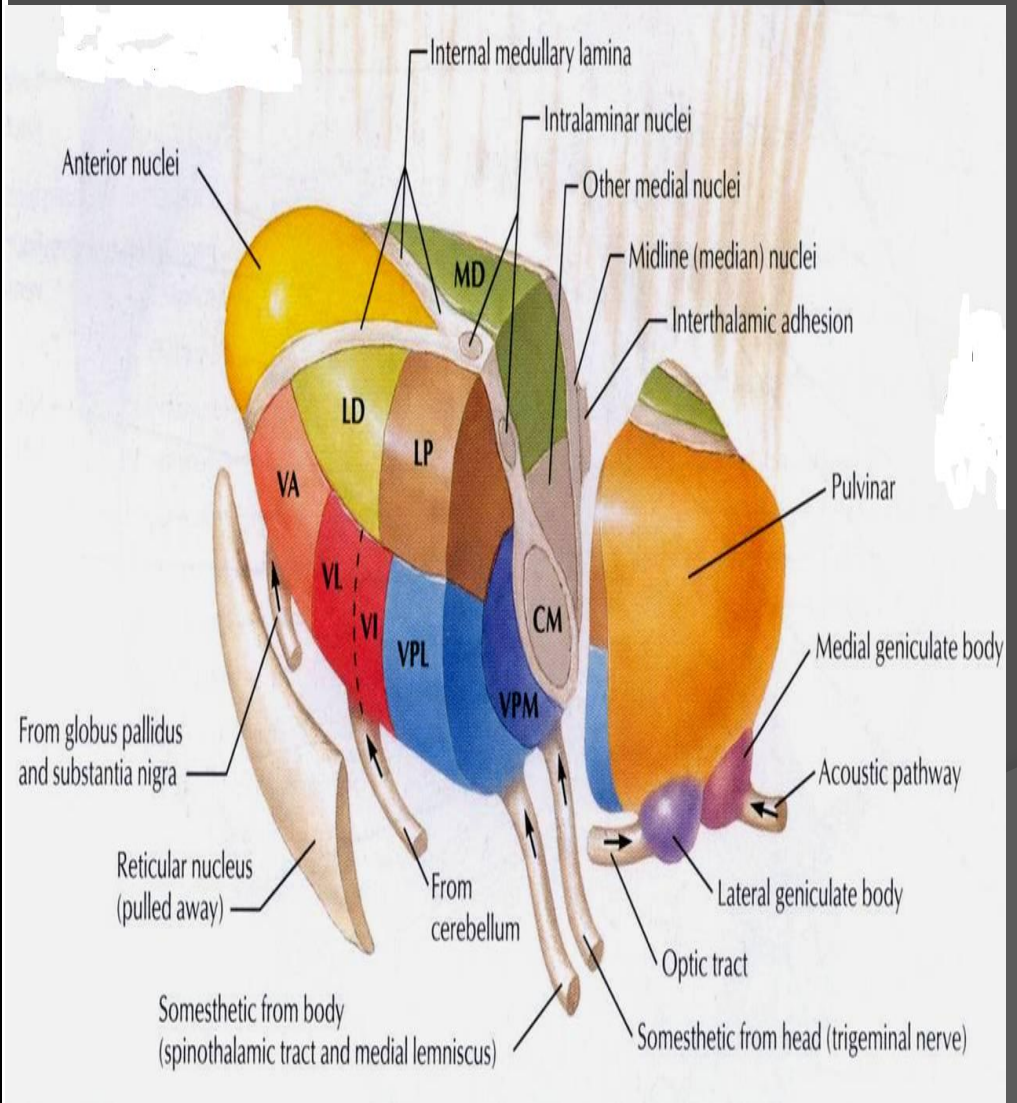
○ which contains:

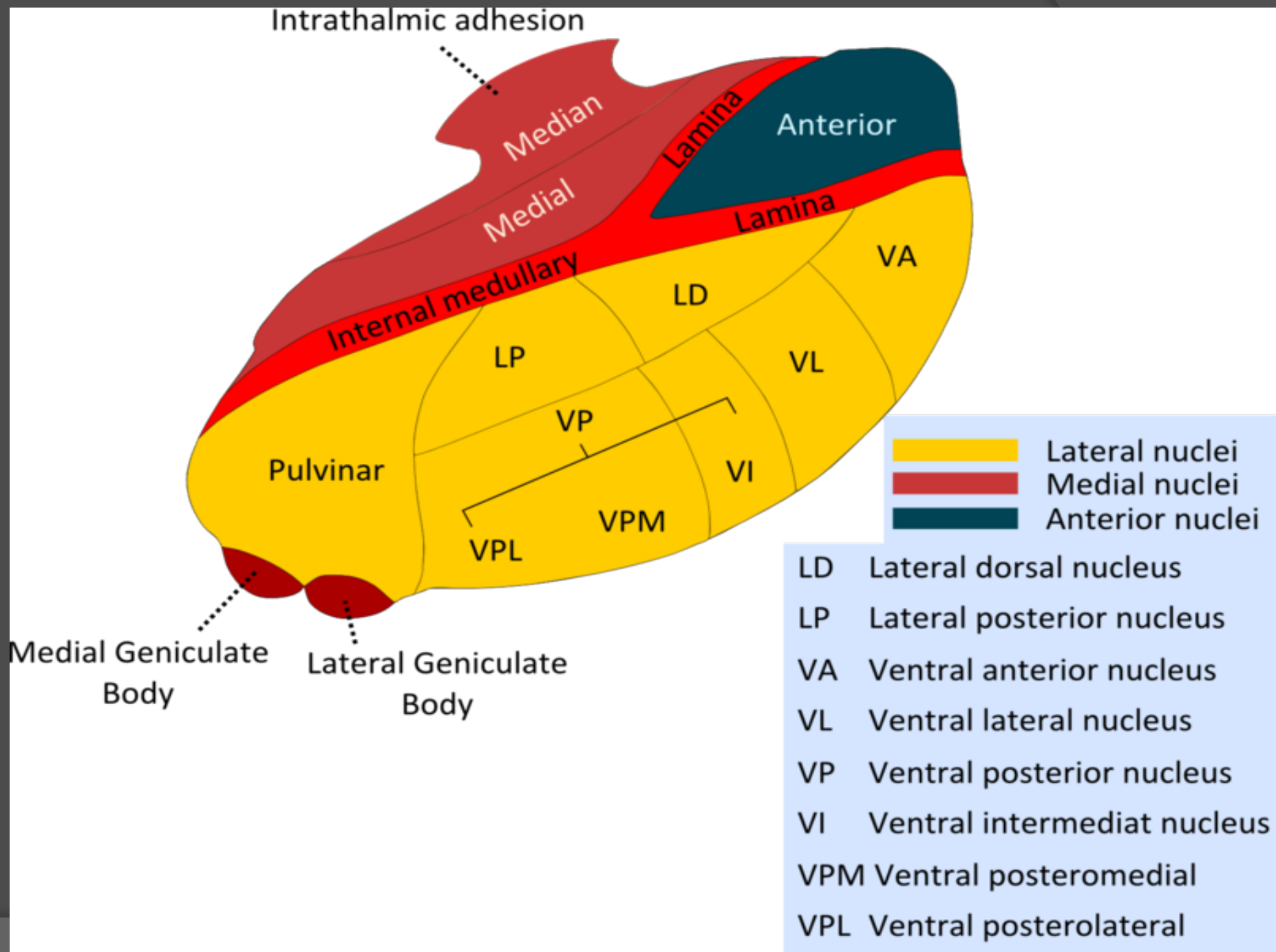
1. Lateral Dorsal (LD)&
2. Lateral Posterior (LP)
3. Pulvinar.

○ Ventral tier,

○ which contains :

1. Ventral Anterior (VA)
2. Ventral Lateral (VL)
3. Ventral Intermediate (VI)
4. Ventral Posterior (VP)
(PLVNT, PMVNT)
5. Lateral & Medial
Geniculate nuclei.

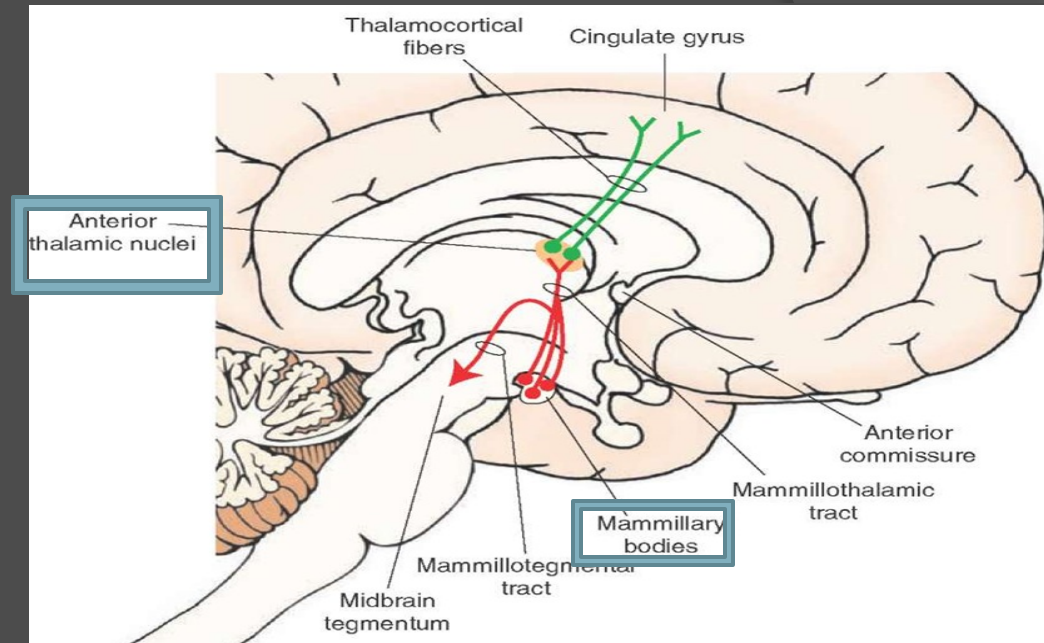




Projection of thalamic nuclei

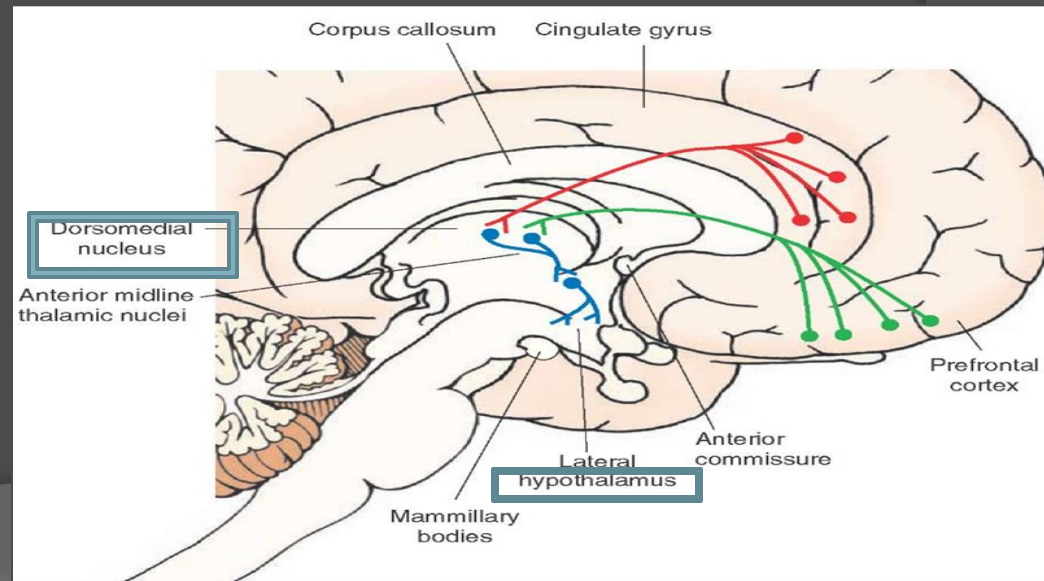
Anterior Thalamic Nucleus

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



Medial Nucleus

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



Projection of thalamic nuclei

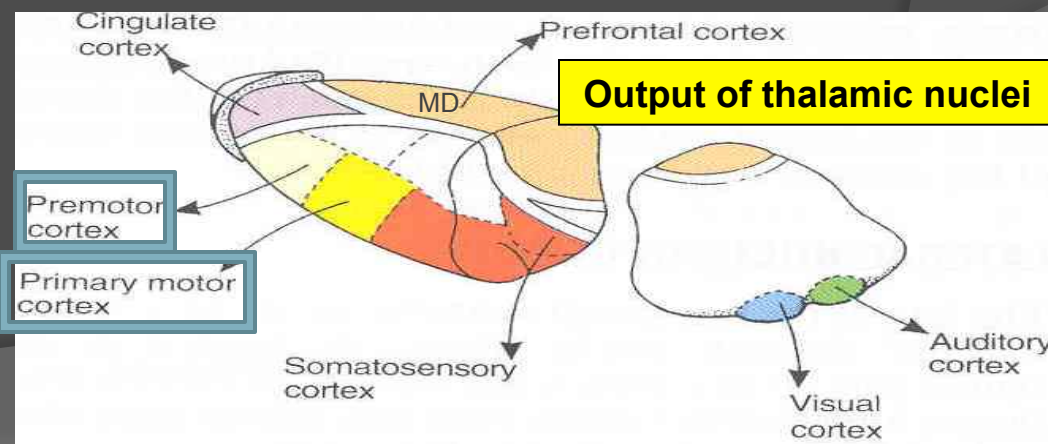
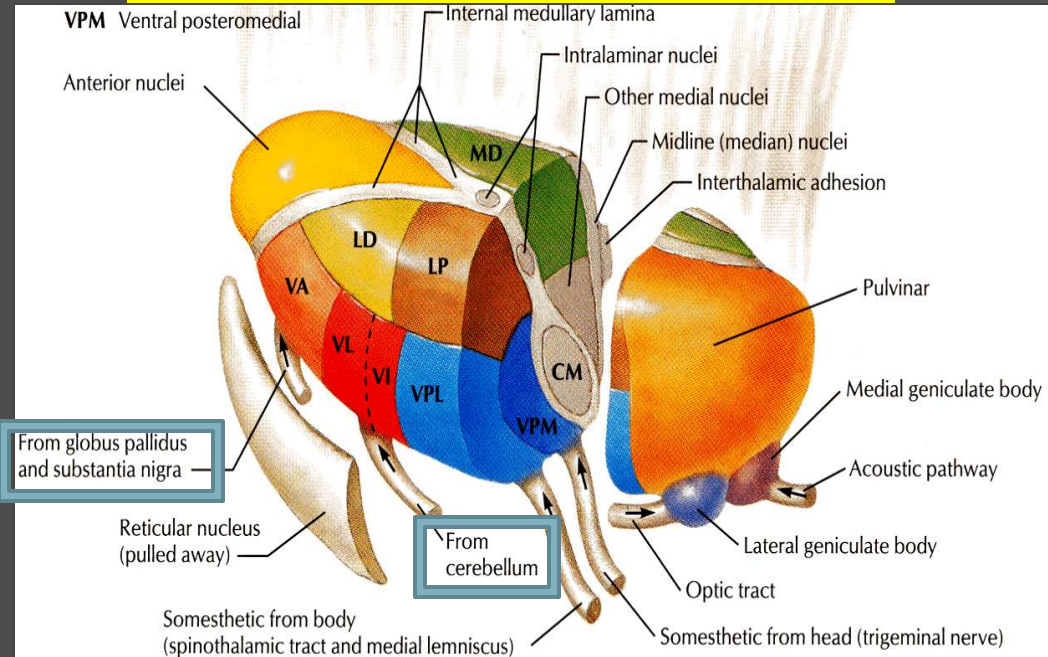
Ventral Anterior Nucleus

- **Afferent:** Globus pallidus body.
- **Efferent:** Premotor cortex.

Ventral Lateral Nucleus

- **Afferent:** Dentate Nucleus
- **Efferent:** primary motor cortex.

Input of Ventral Thalamic Nuclei



Projection of thalamic nuclei

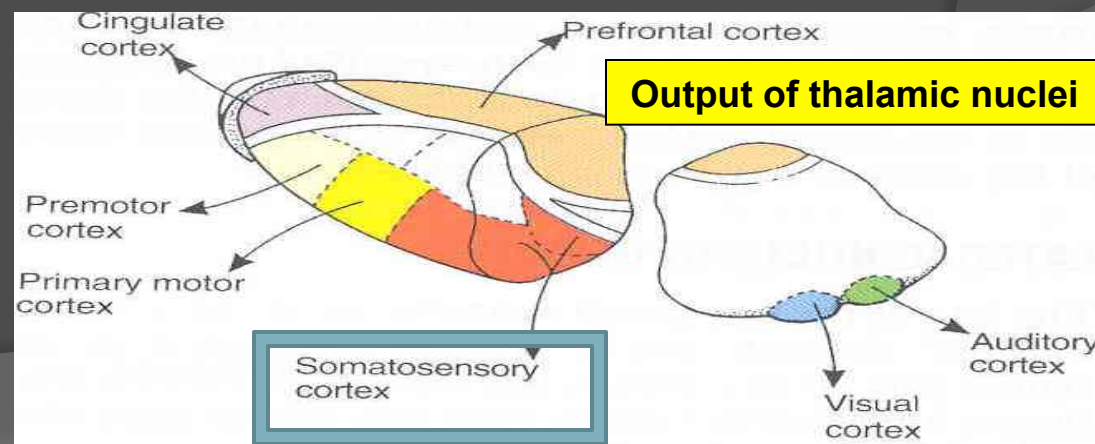
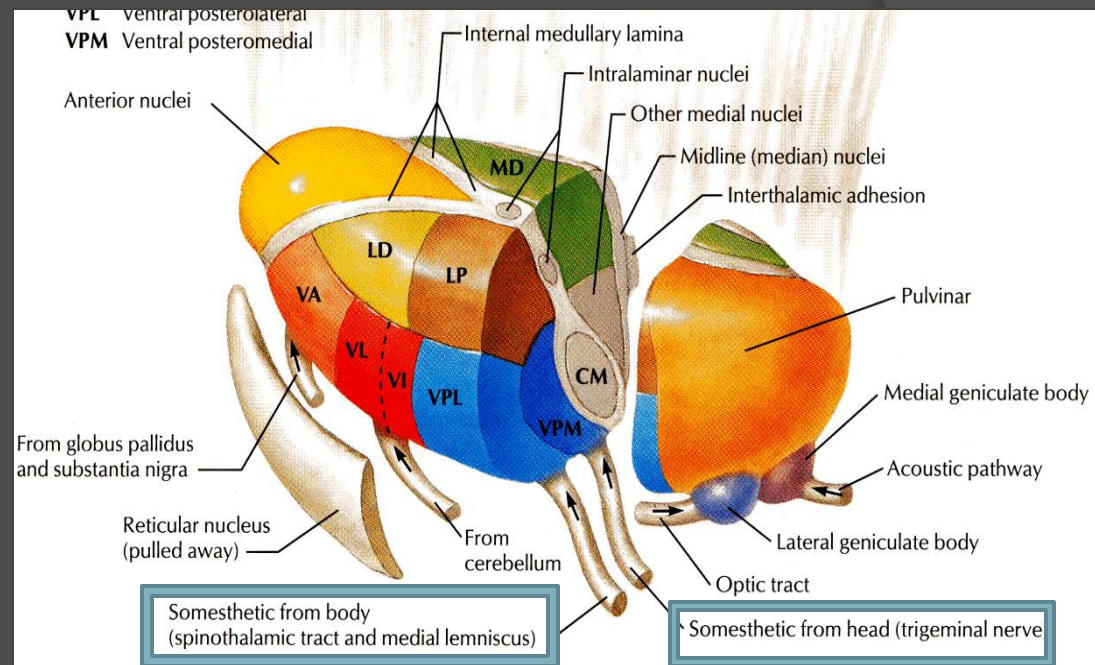
Ventral Posterior Lateral Nucleus

- **Afferent:** Medial and spinal lemnisci.
- **Efferent:** Sensory cortex.

Ventral Posterior Medial Nucleus

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

Input of Ventral Thalamic Nuclei



Projection of thalamic nuclei

➤ **Lateral geniculate body :**

➤ **Afferent :** optic tract.

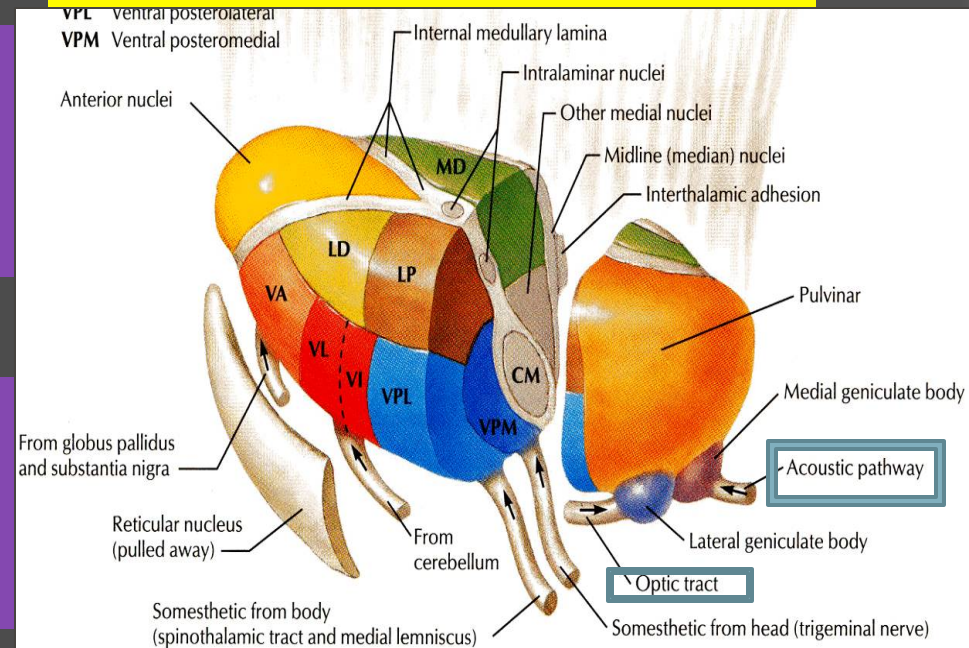
➤ **Efferent :** visual cortex

➤ **Medial geniculate body :**

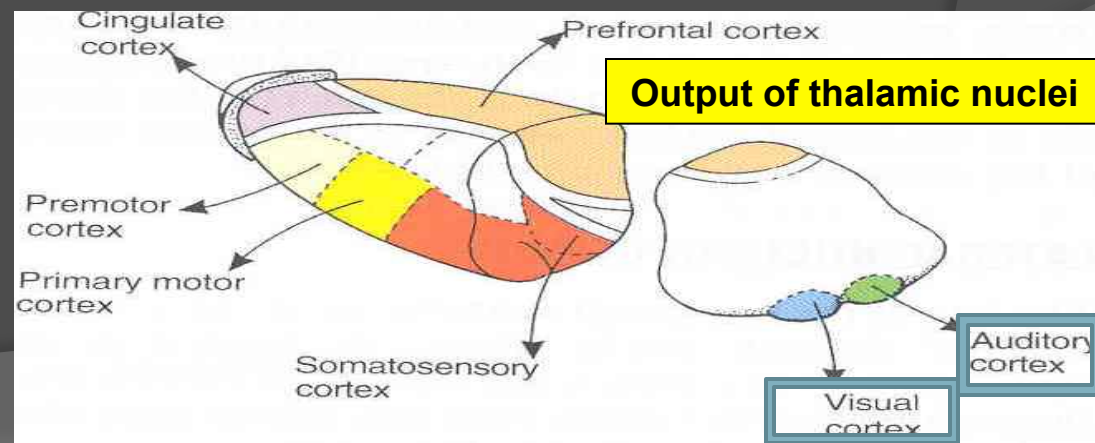
➤ **Afferent :** lateral lemniscus.

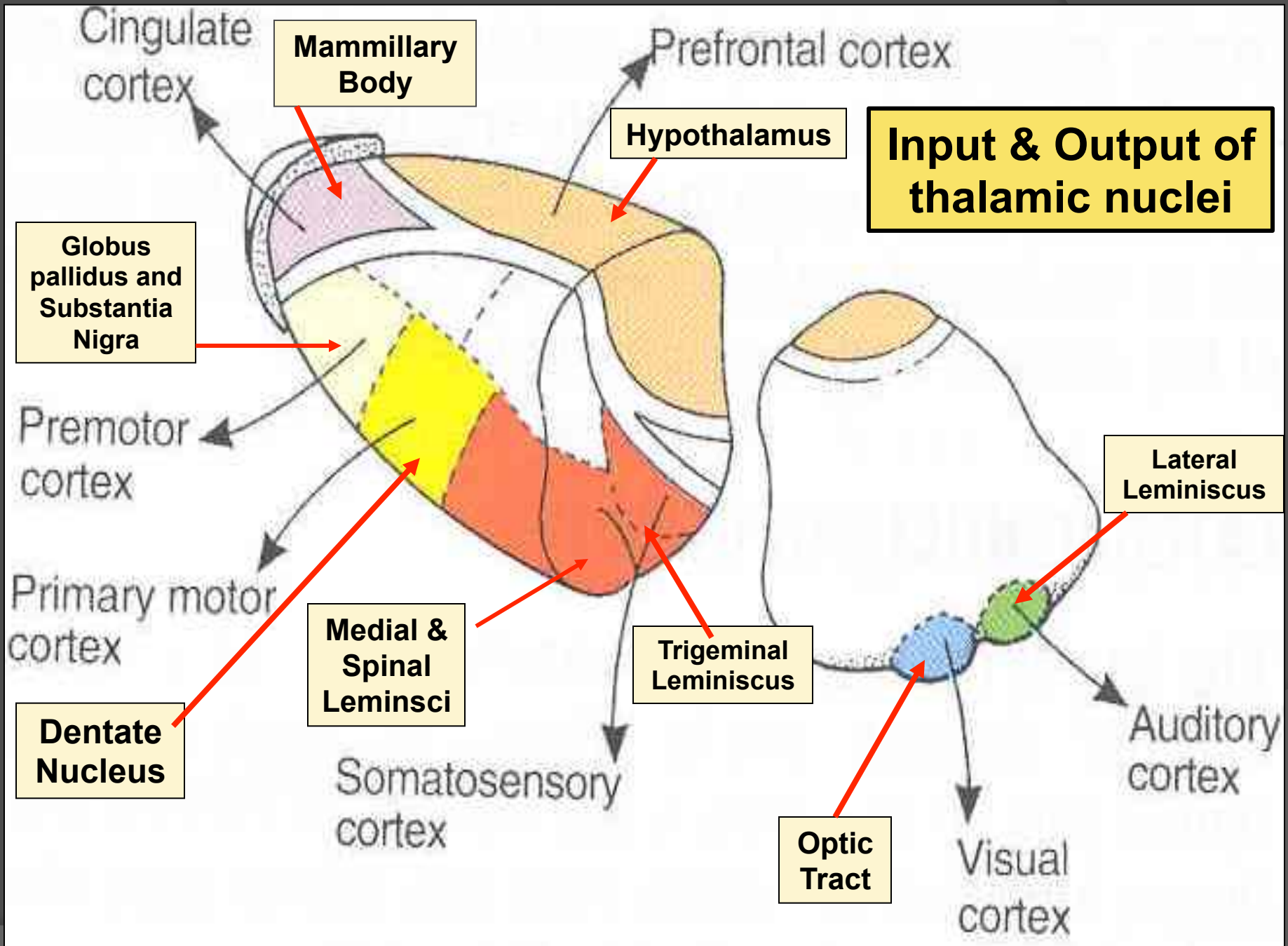
➤ **Efferent :** auditory cortex.

Input of Ventral Thalamic Nuclei



Output of thalamic nuclei





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 (particularly **mammillary bodies**).



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. Hippocampus

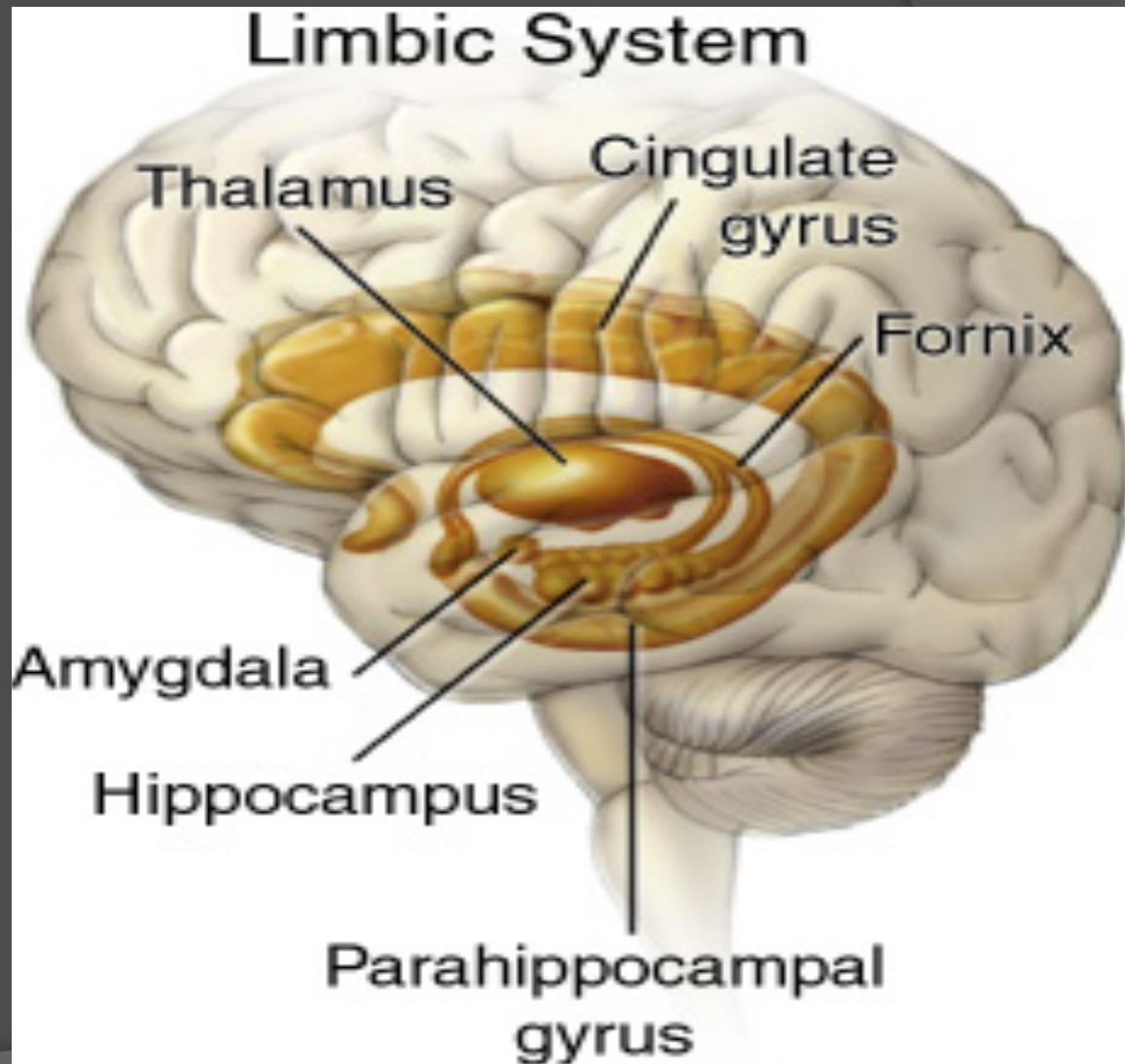
3. Amygdala, &

4. Septal area.

• These structures **form connections** between the hypothalamus, thalamus and cerebral cortex.

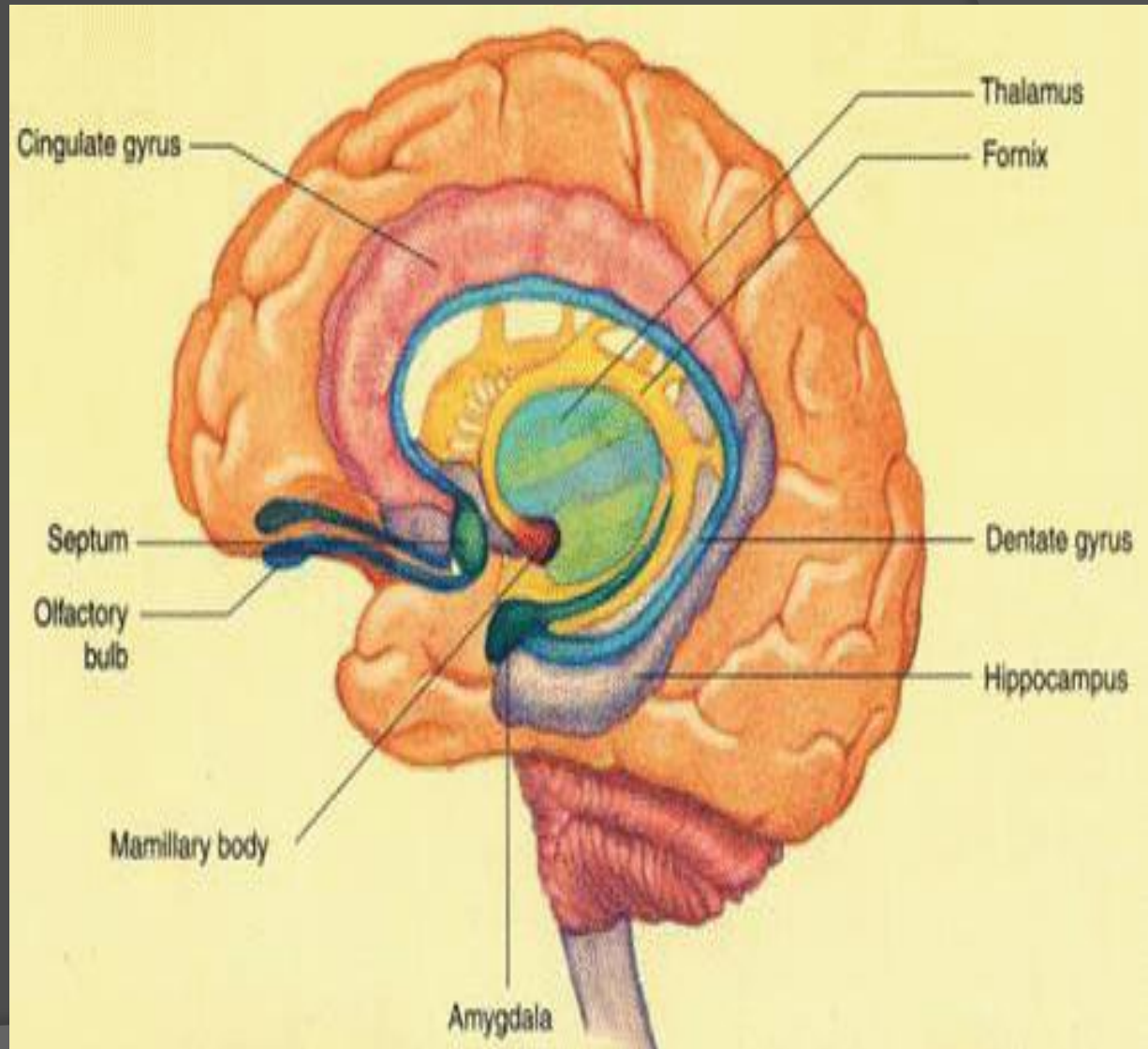
• The **hippocampus** is **important** in memory and learning, while the **limbic system itself** is important in the **control** of the emotional responses.

The limbic system is a set of brain structures including



CORTICAL STRUCTURES

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

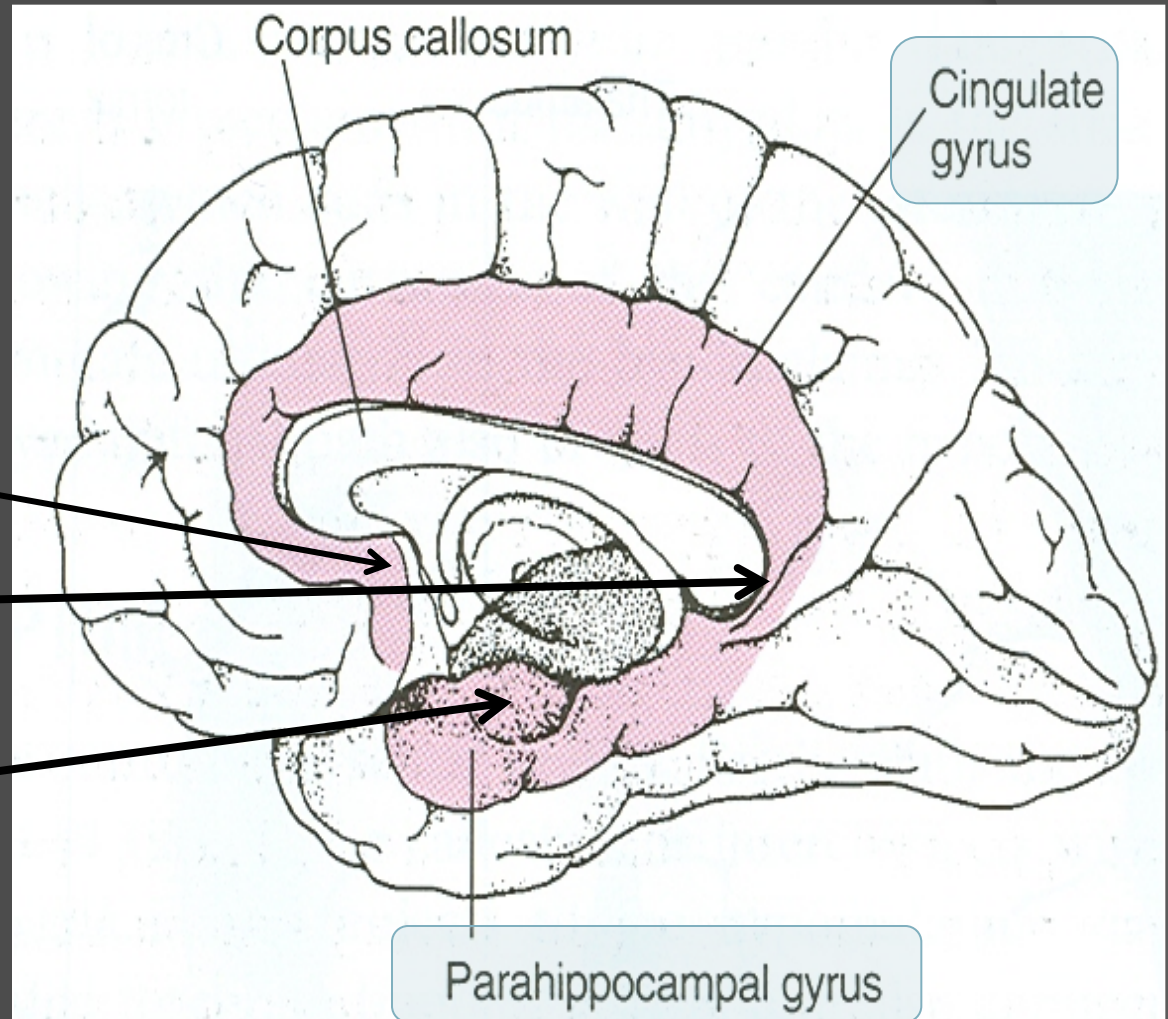


LIMBIC LOBE

- ◎ **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:

Formation,
Organization, and
Storing of **memories**.

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

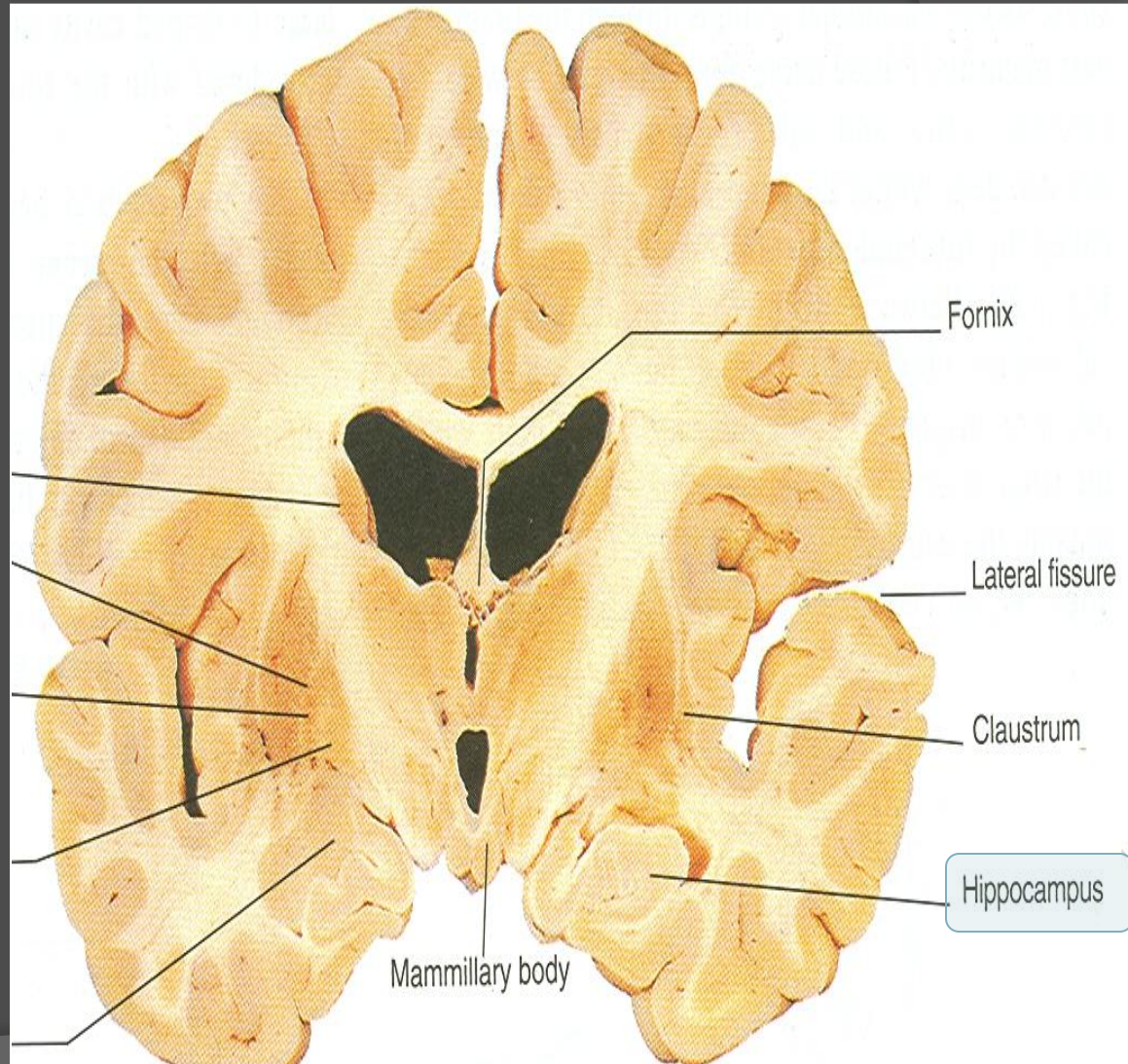
It is a horseshoe paired structure, one in each cerebral hemisphere.

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 (infolding) inferomedial part of 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:

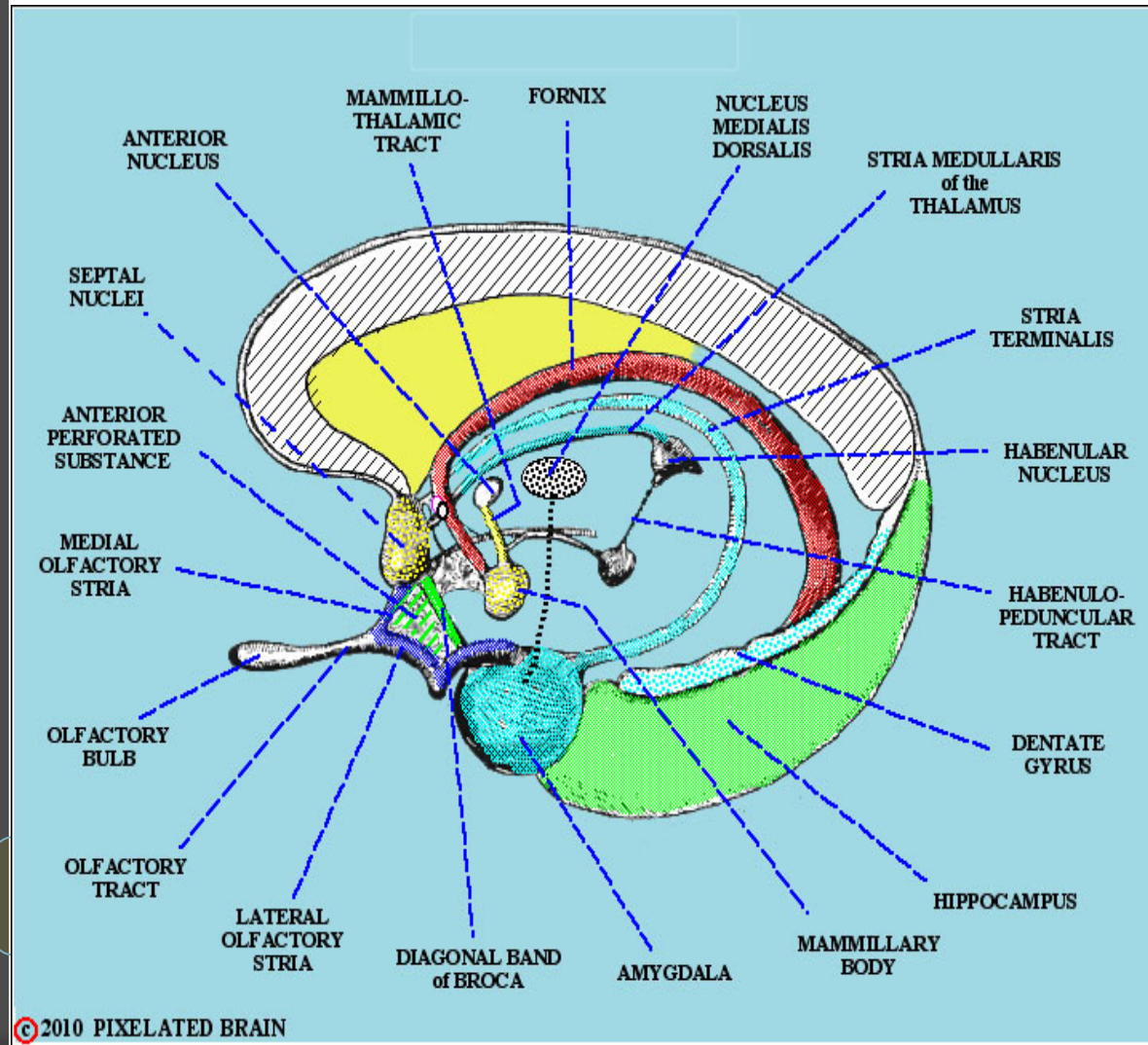
FORNIX:

It is C-shaped group of fibers connecting the hippocampus with mammillary body and then to the anterior nuclei of thalamus.

It consists of:

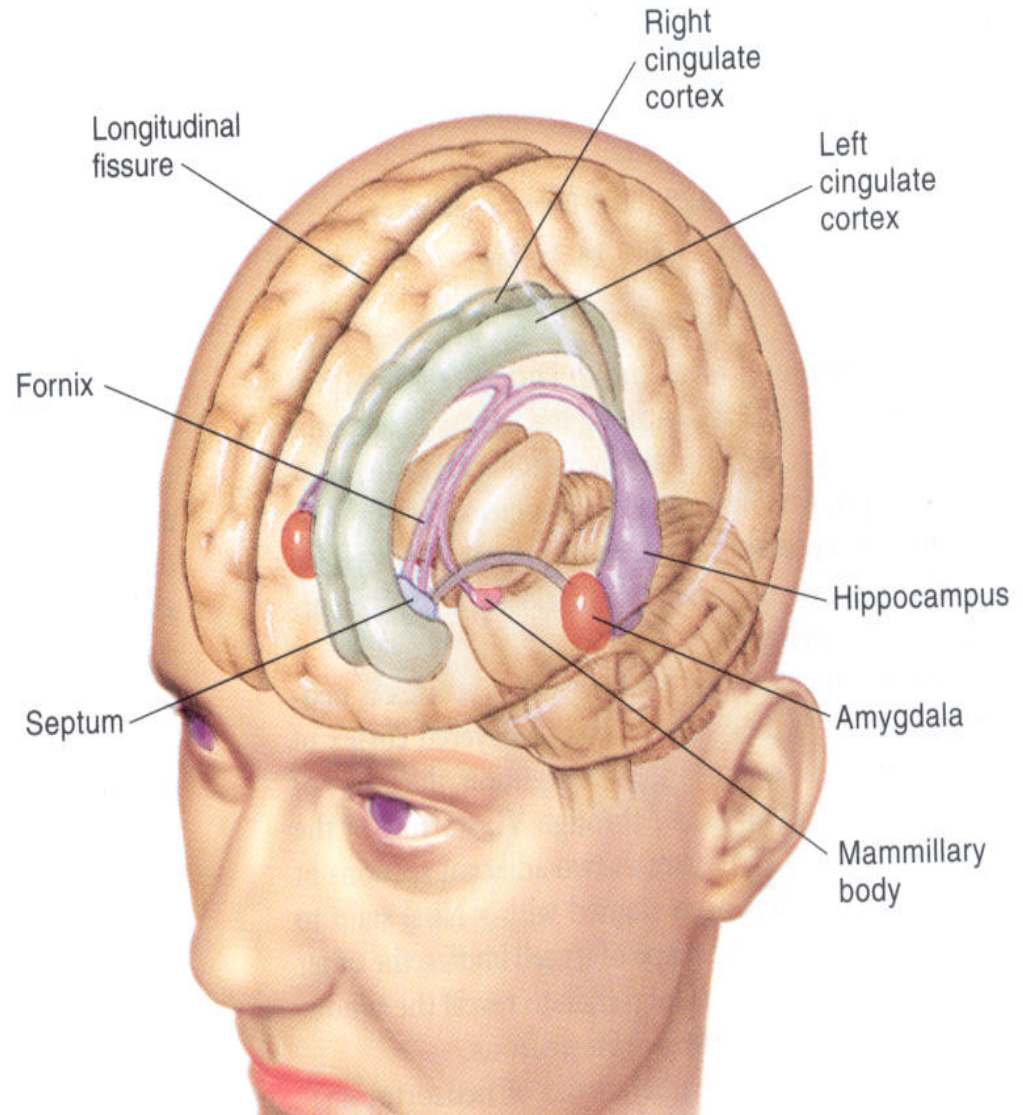
- 2 Fimbria,*
- 2 Crus,*
- 1 Body &*
- 2 Column.*

- The **Fornix** is an important component of **PAPEZ CIRCUIT** (based on connecting the hypothalamus with limbic lobe to control emotions)



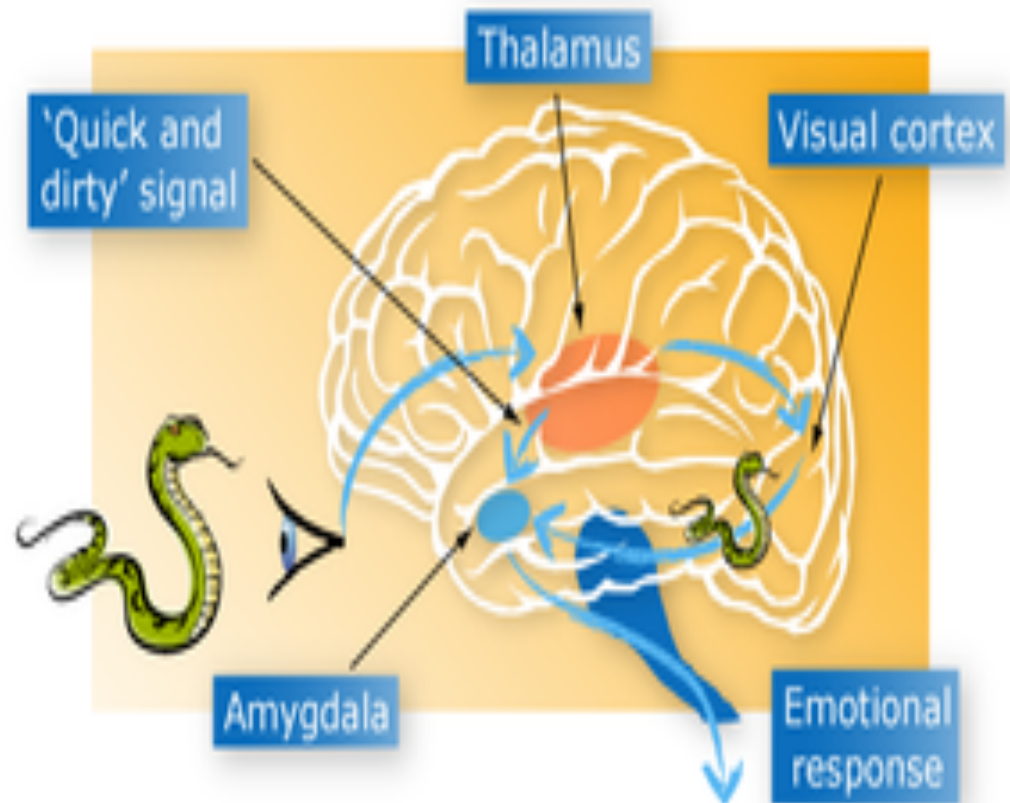
AMYGDALA

- **Site:**
- almond shaped **mass of nuclei** that **lies** near the **temporal pole**, deep within the temporal lobes ,close to the **tail of the caudate nucleus**.
- **Function:**
- It is involved in
- **Emotions** ;
- **FEAR**
- **Anger** &
- **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:

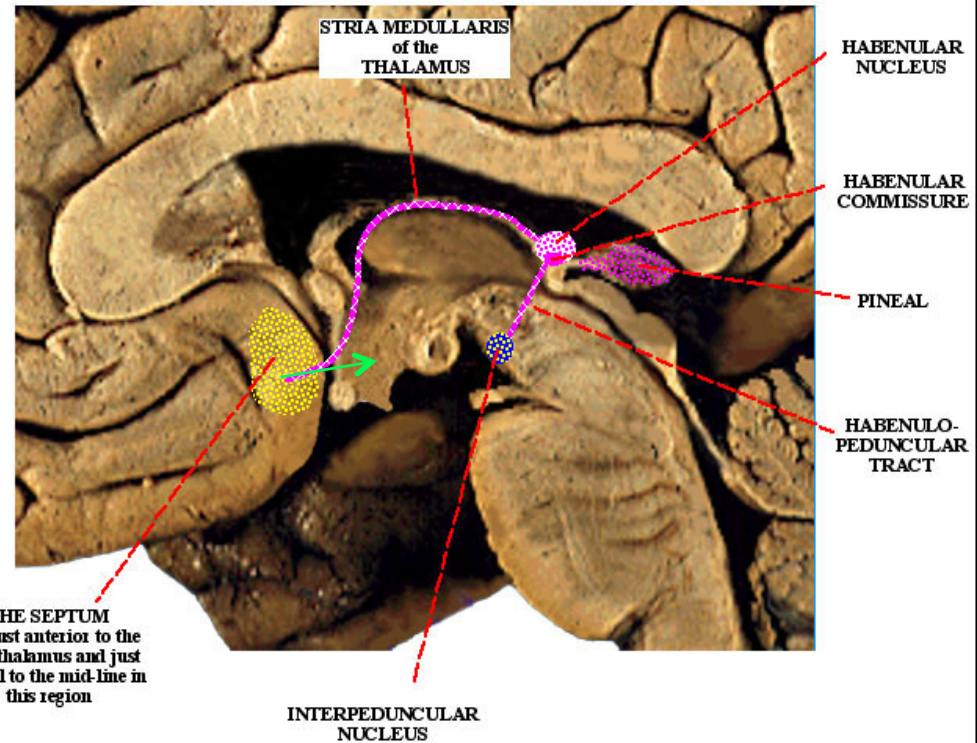
Located anterior to the interventricular septum

Main connections:

1. To Hypothalamus
2. To Habenular nuclei

Function:

It is the **pleasure** zone.



Lesions associated with limbic lobe disorders

healthy brain

advanced alzheimer's



◎ **Korsakoff's psychosis** : Korsakoff syndrome is a **chronic memory disorder** caused by severe deficiency of thiamine (vitamin B-1) & alcoholic intoxication.

◎ (**Retrograde** = = loss of new memories at the time of lesion + loss of retained old memories occurred before the injury & **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**:

hippocampus is one of the **first brain areas** to show damage in Alzheimer's disease. **Anterograde amnesia** —the inability to form and retain new memories.

◎ **Schizophrenia**. (mental disorder with inappropriate actions and feelings),



THANK YOU