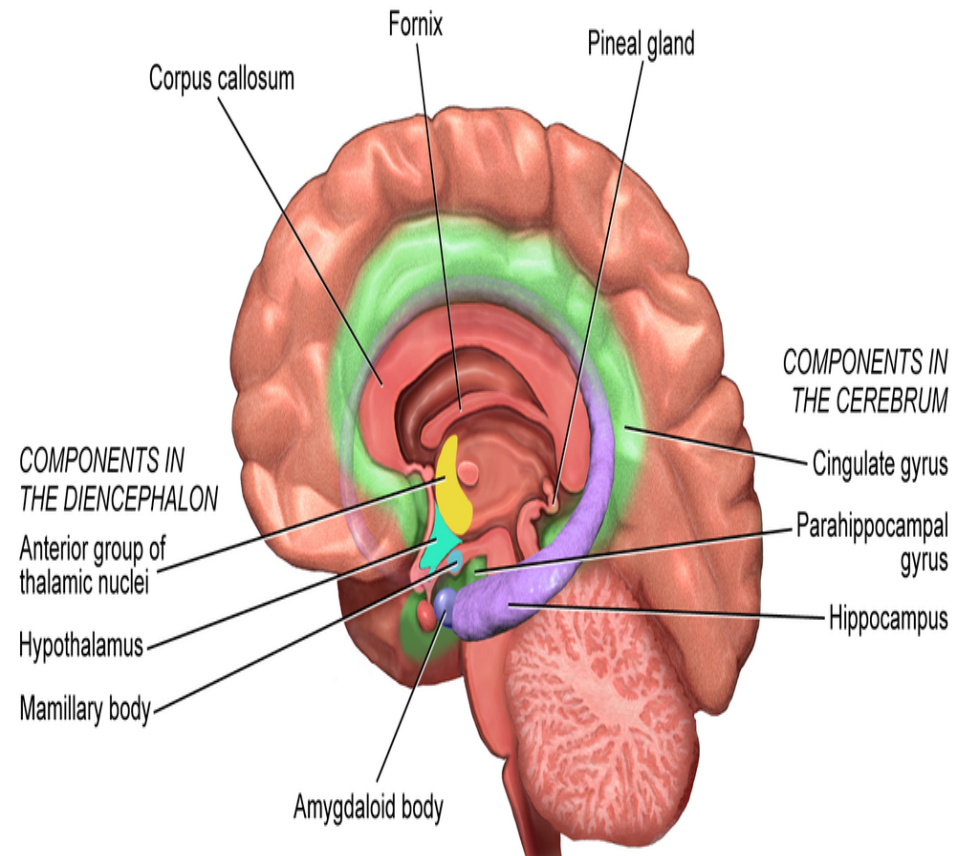
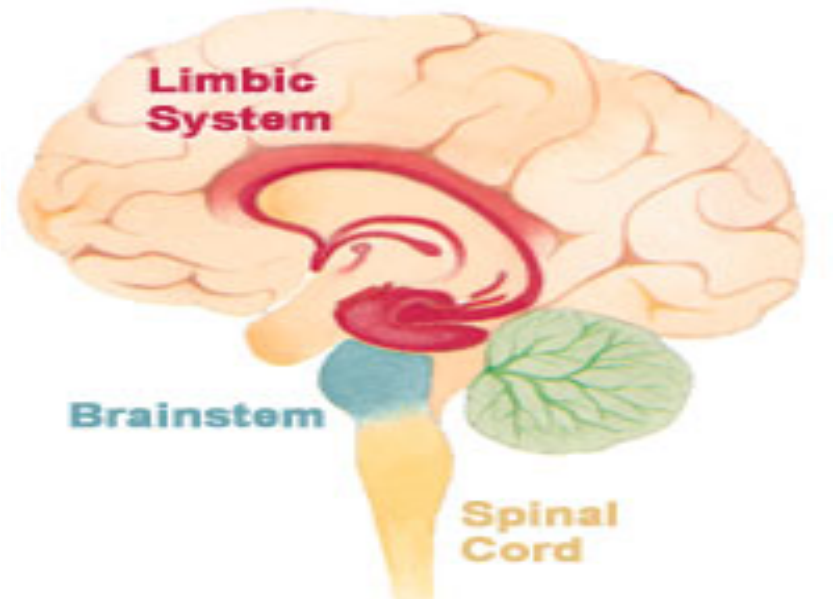


The Limbic System



Thalamus & Limbic System



Prof. Saeed Abuel Makarem &
A.prof. .Sanaa Alshaarawy

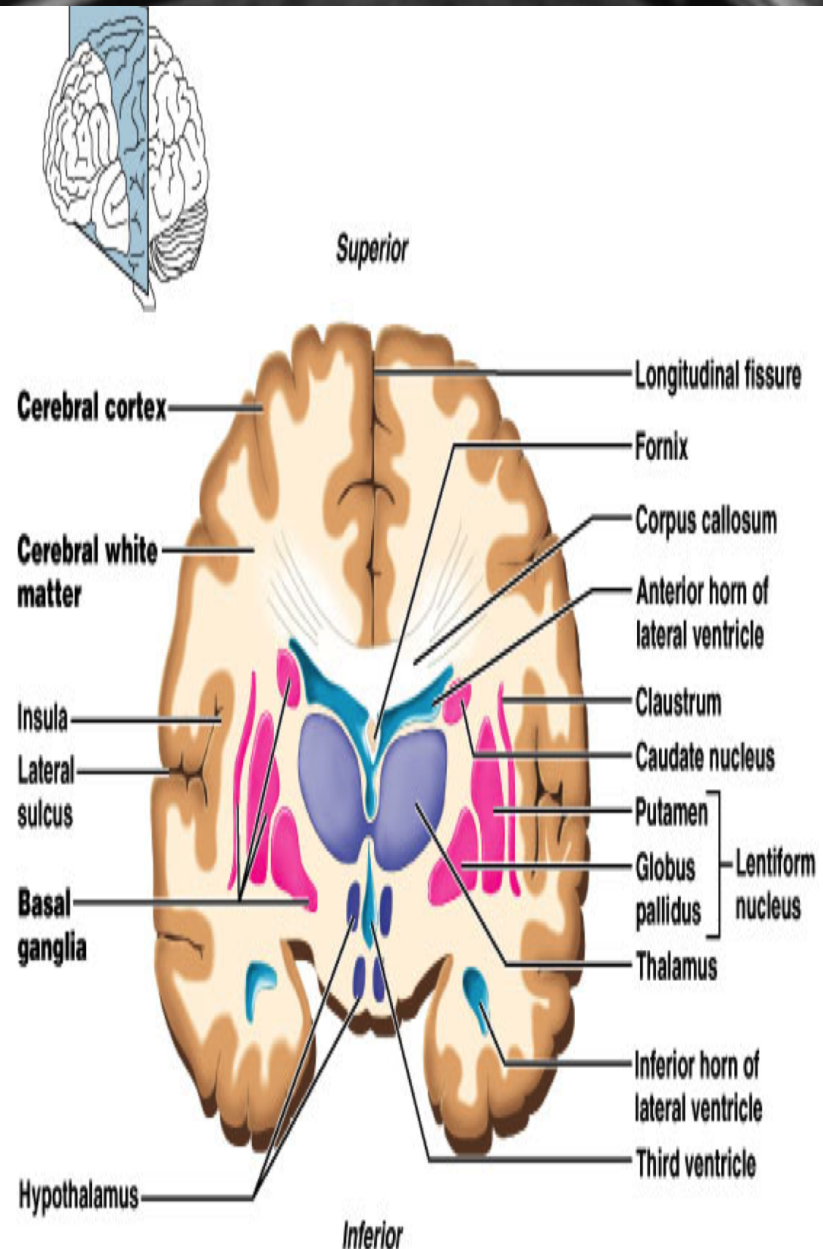
Objectives

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 **2 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.**

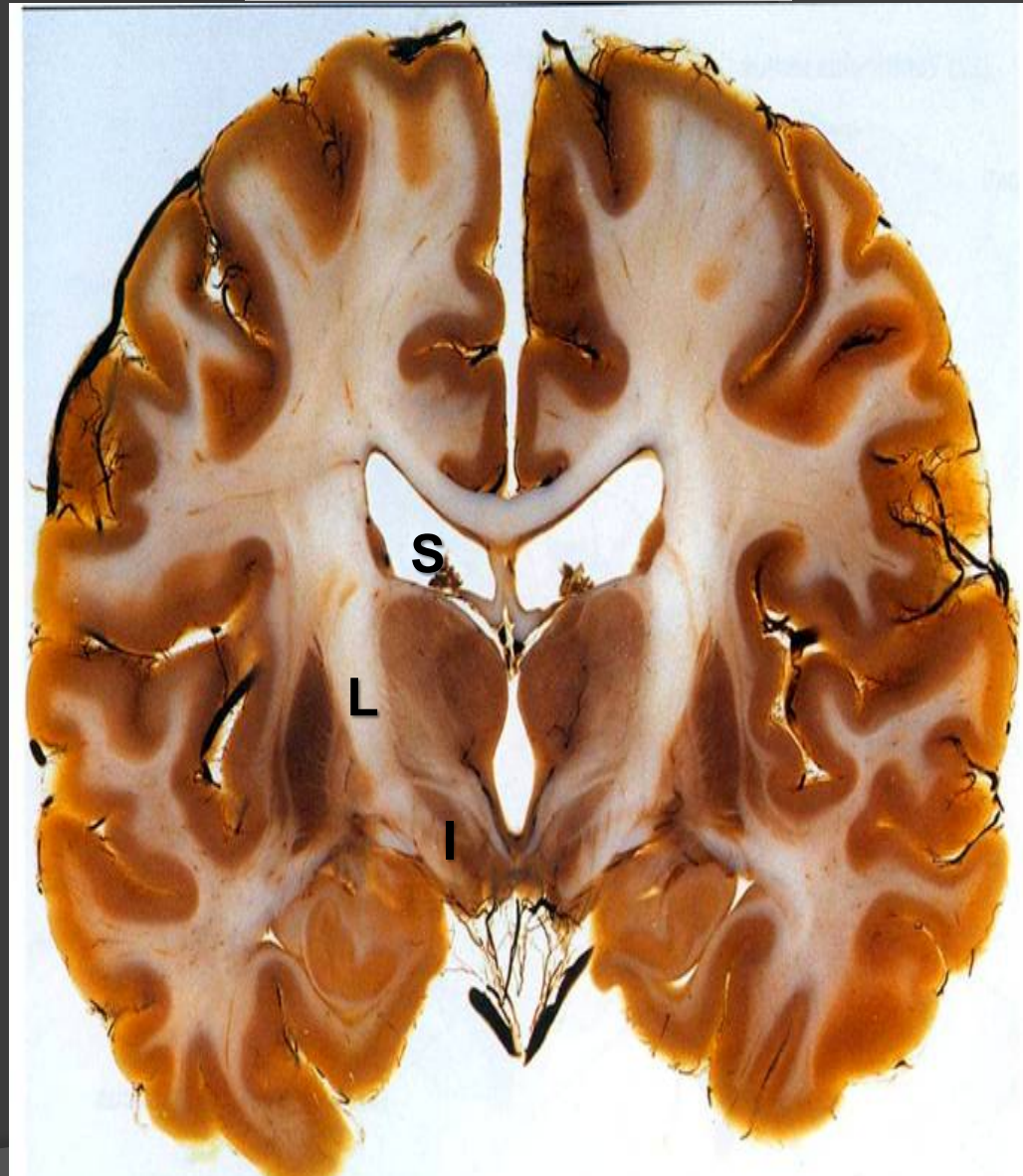
Superior: (s)

Lateral ventricle and fornix.

Inferior: (I)

Hypothalamus, anteriorly & Subthalamus posteriorly.

Relations



Coronal section

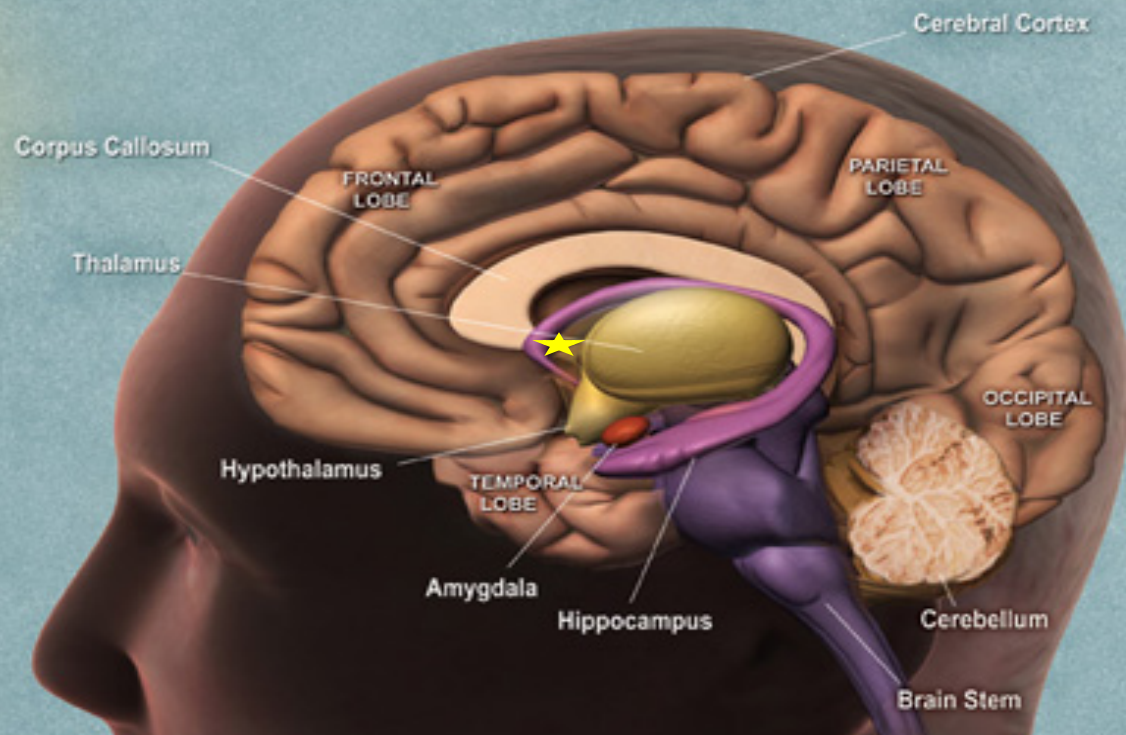
Anterior end:

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**.



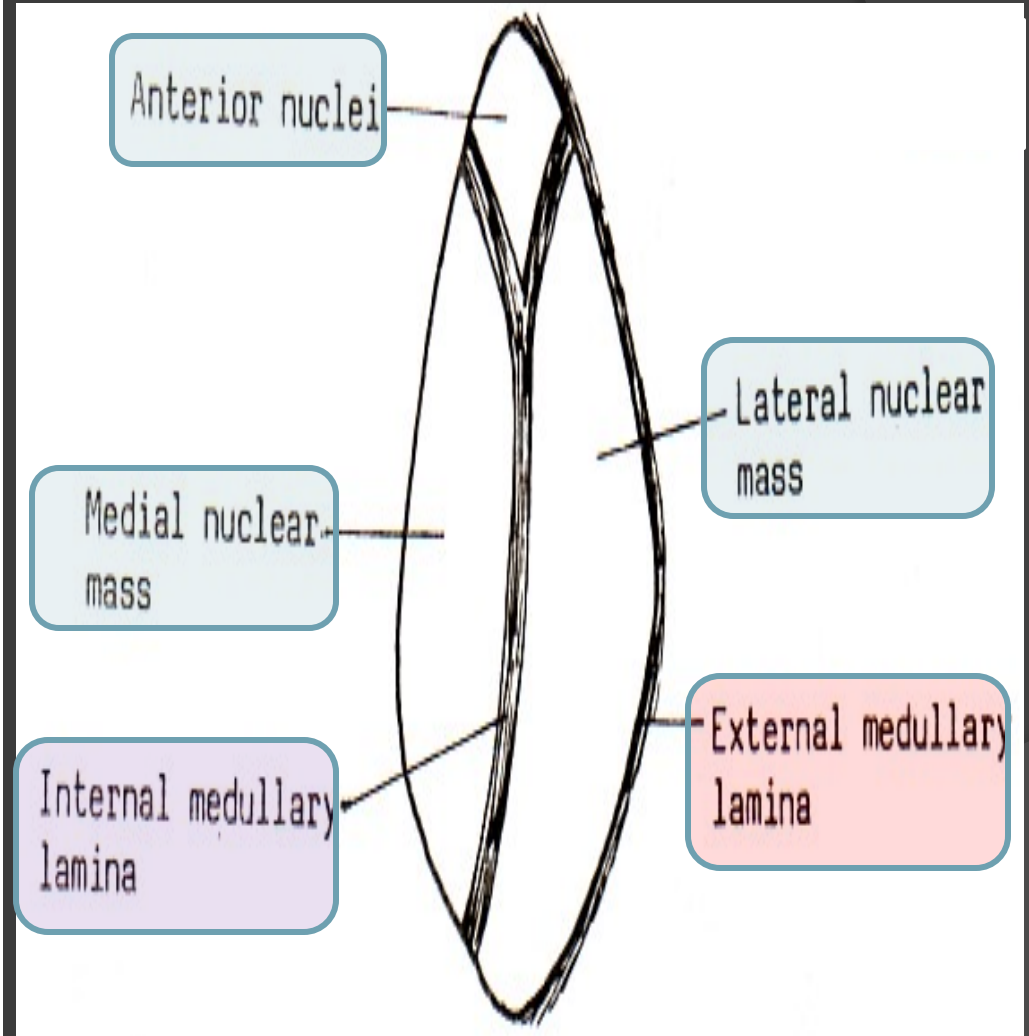
Thalamus



○ 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:**

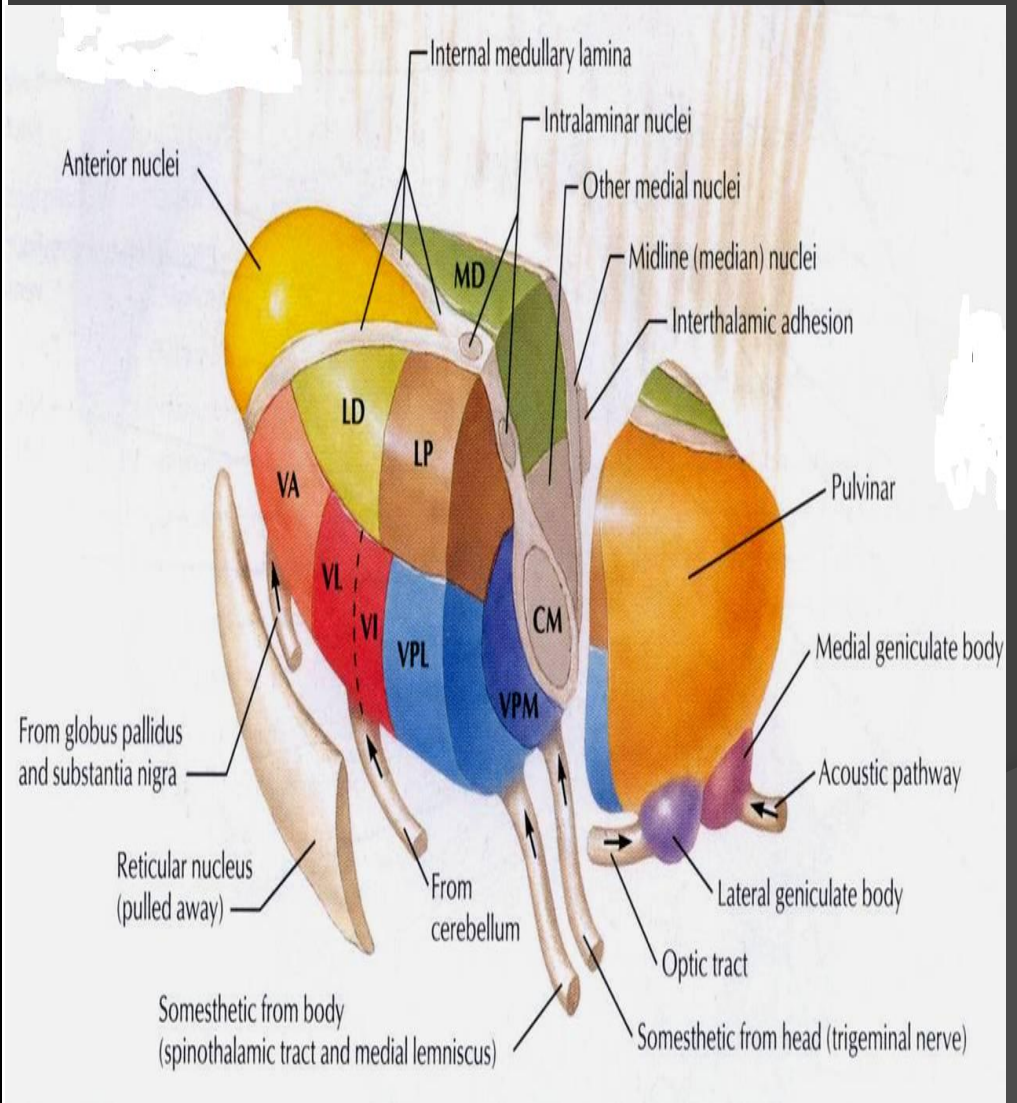
○ which contains:

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

○ **Ventral tier,**

○ which contains :

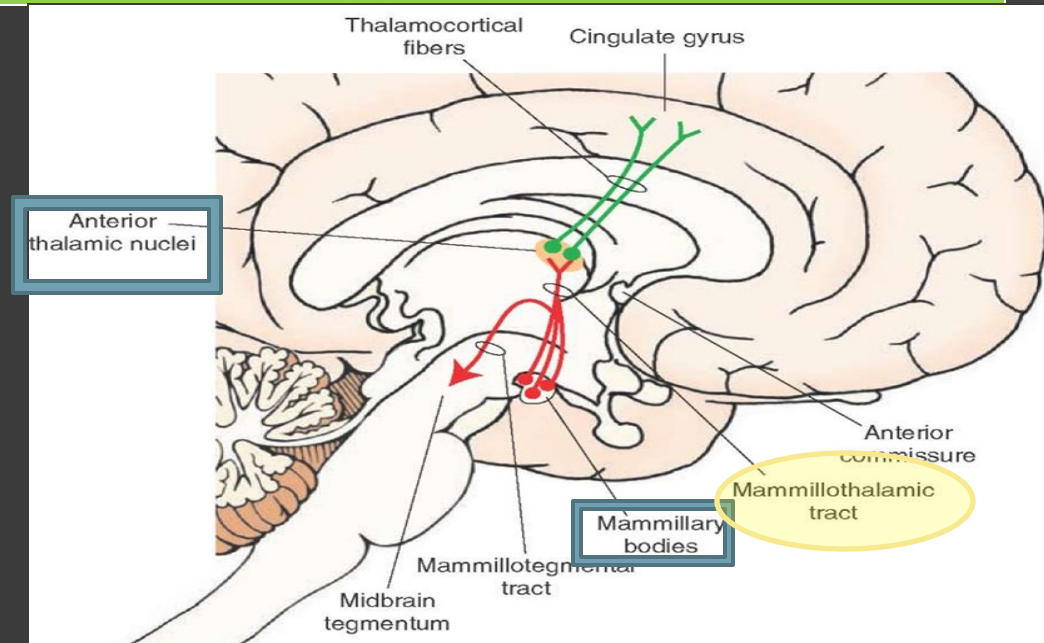
1. **Ventral Anterior (VA)**
2. **Ventral Lateral (VL)**
3. **Ventral Intermediate (VI)**
4. **Ventral Posterior (VP)
(PLVNT, PMVNT)**
5. **Lateral & Medial
Geniculate nuclei.**



Projection of Anterior & Medial thalamic nuclei

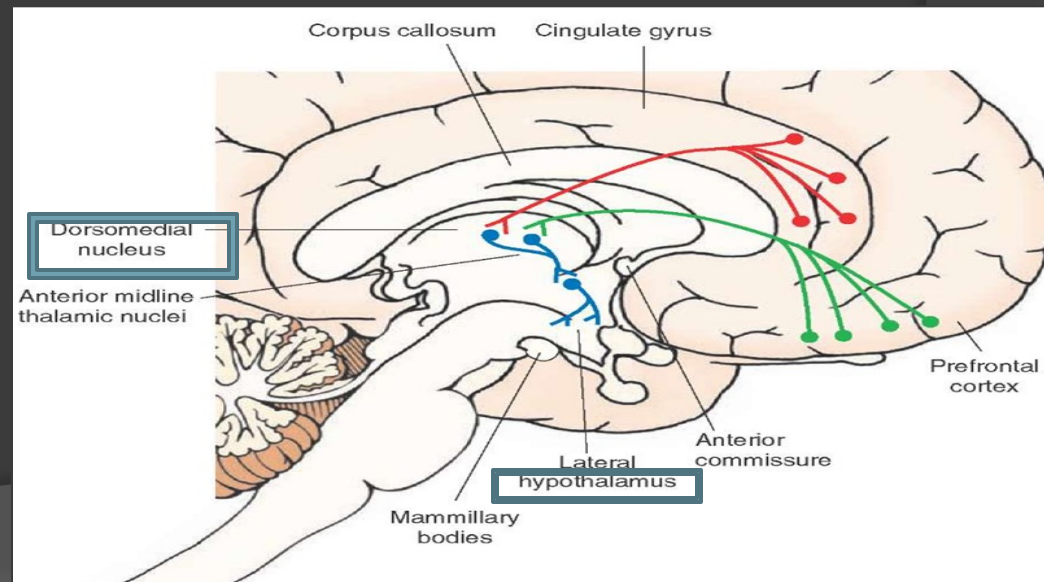
Anterior Thalamic Nuclei

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



Medial Thalamic Nuclei

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



Projection of Lateral thalamic nuclei

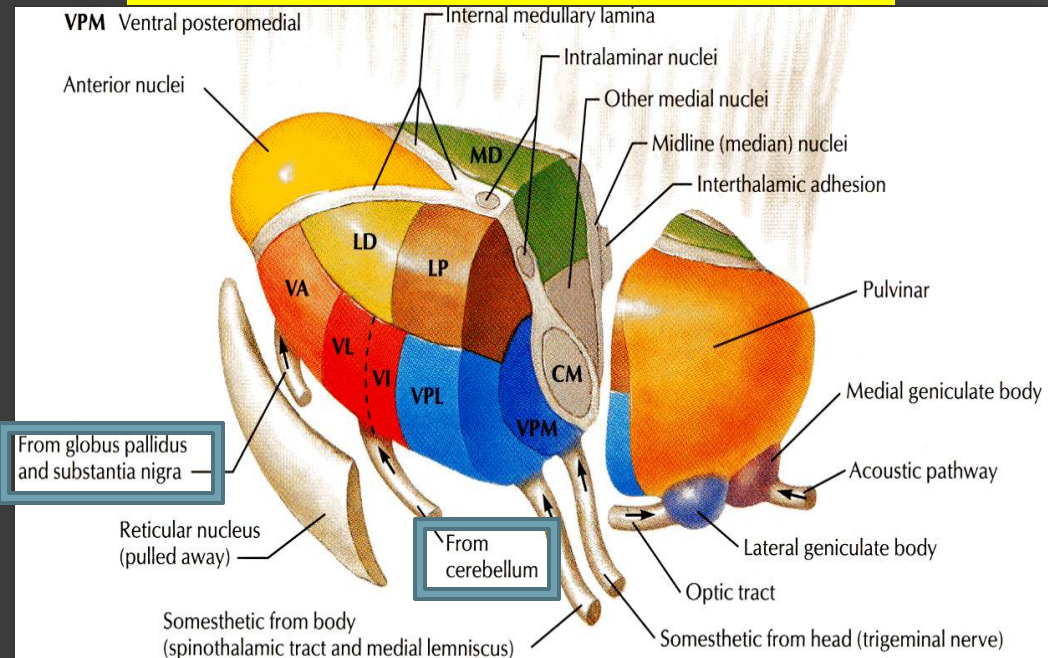
Ventral Anterior Nucleus

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

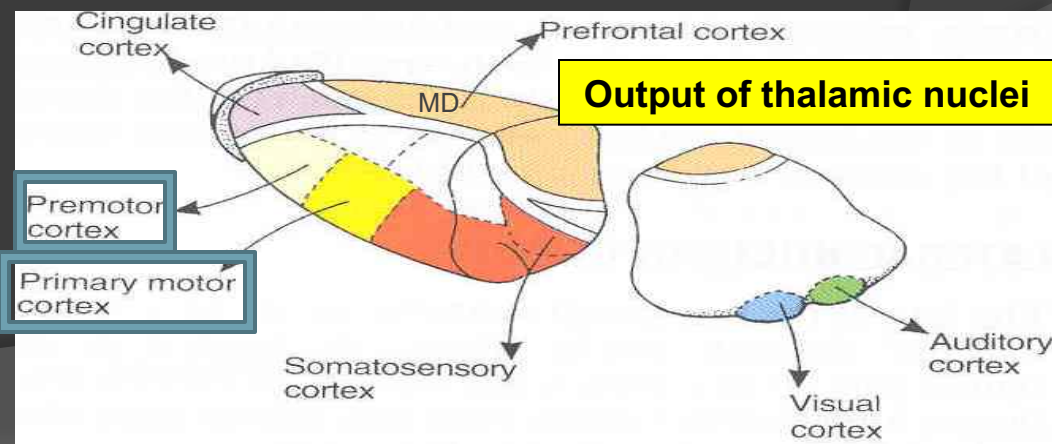
Ventral Lateral Nucleus

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

Input of Ventral Thalamic Nuclei



Output of thalamic nuclei



Projection of Lateral thalamic nuclei

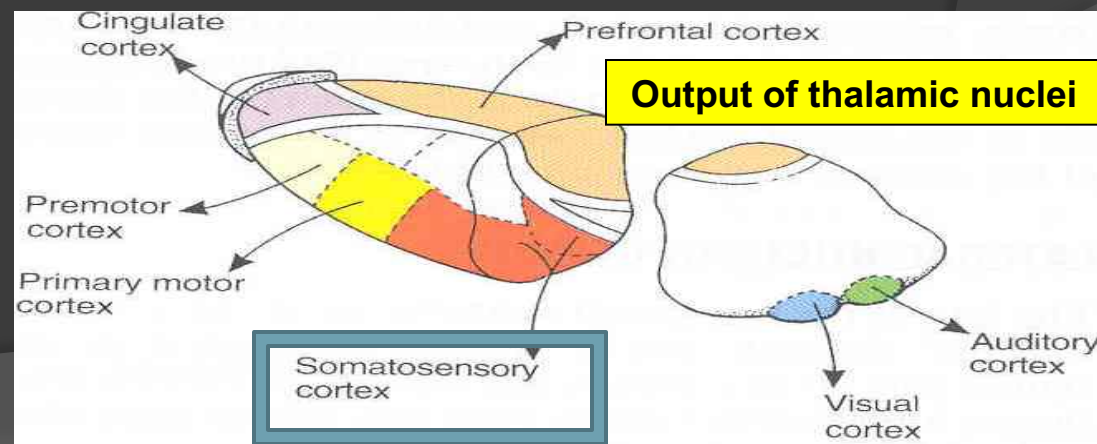
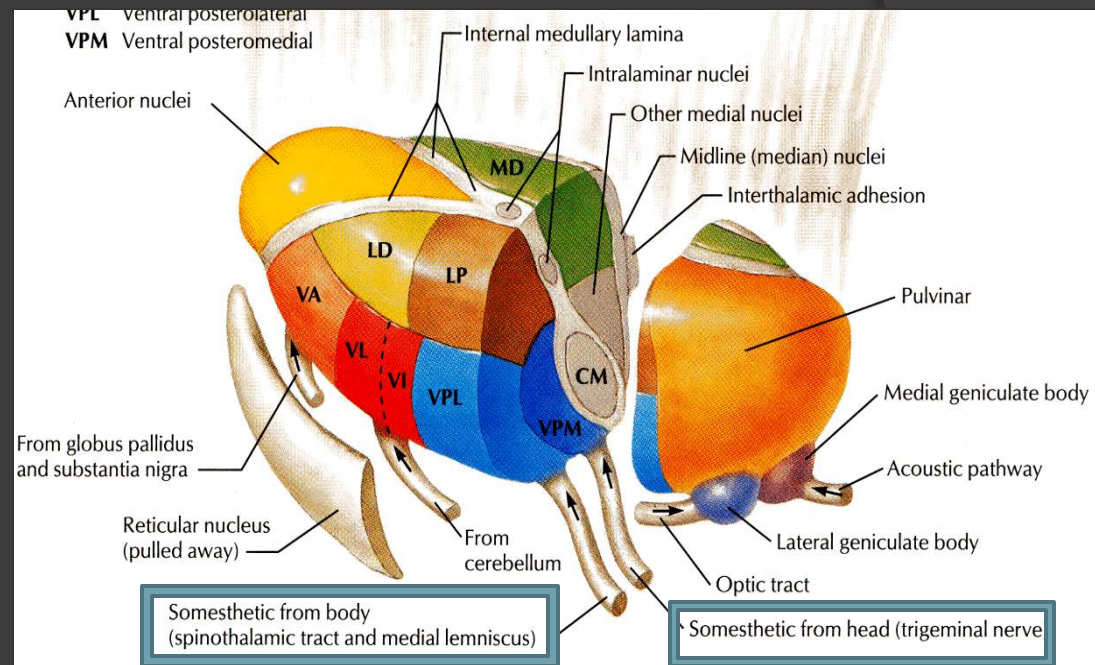
Ventral Posterior Lateral Nucleus

- **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 Lateral thalamic nuclei

➤ **Lateral geniculate body :**

➤ **Afferent :** optic tract.

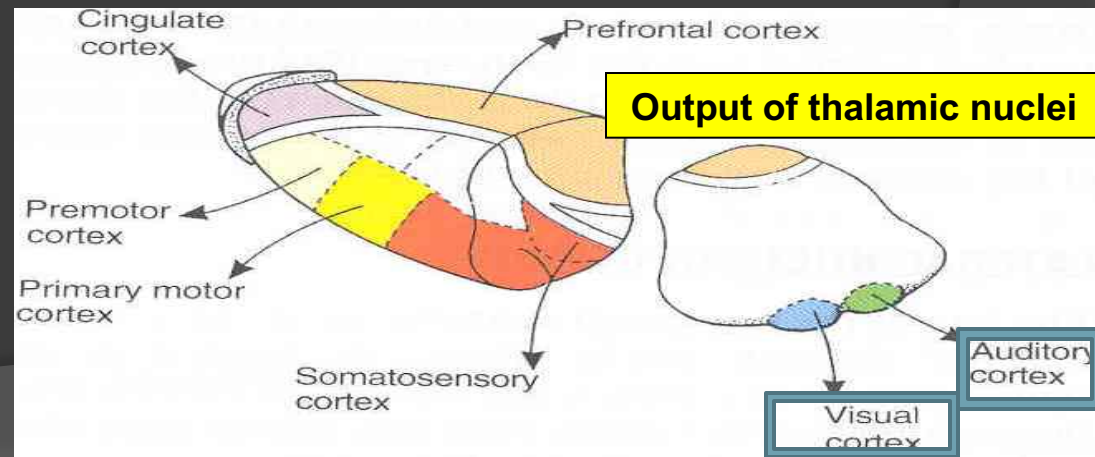
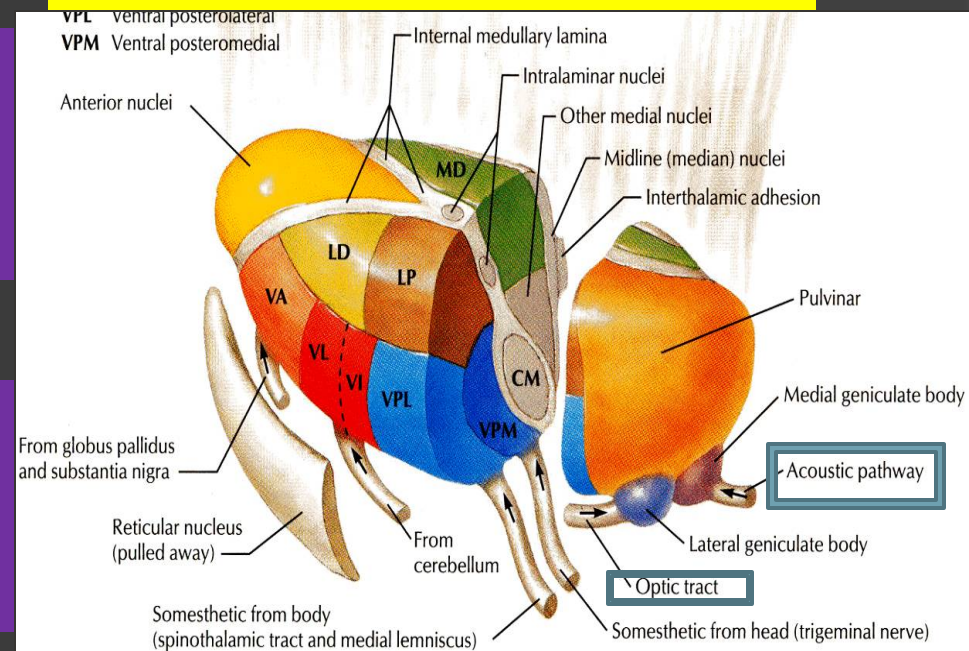
➤ **Efferent :** visual cortex

➤ **Medial geniculate body :**

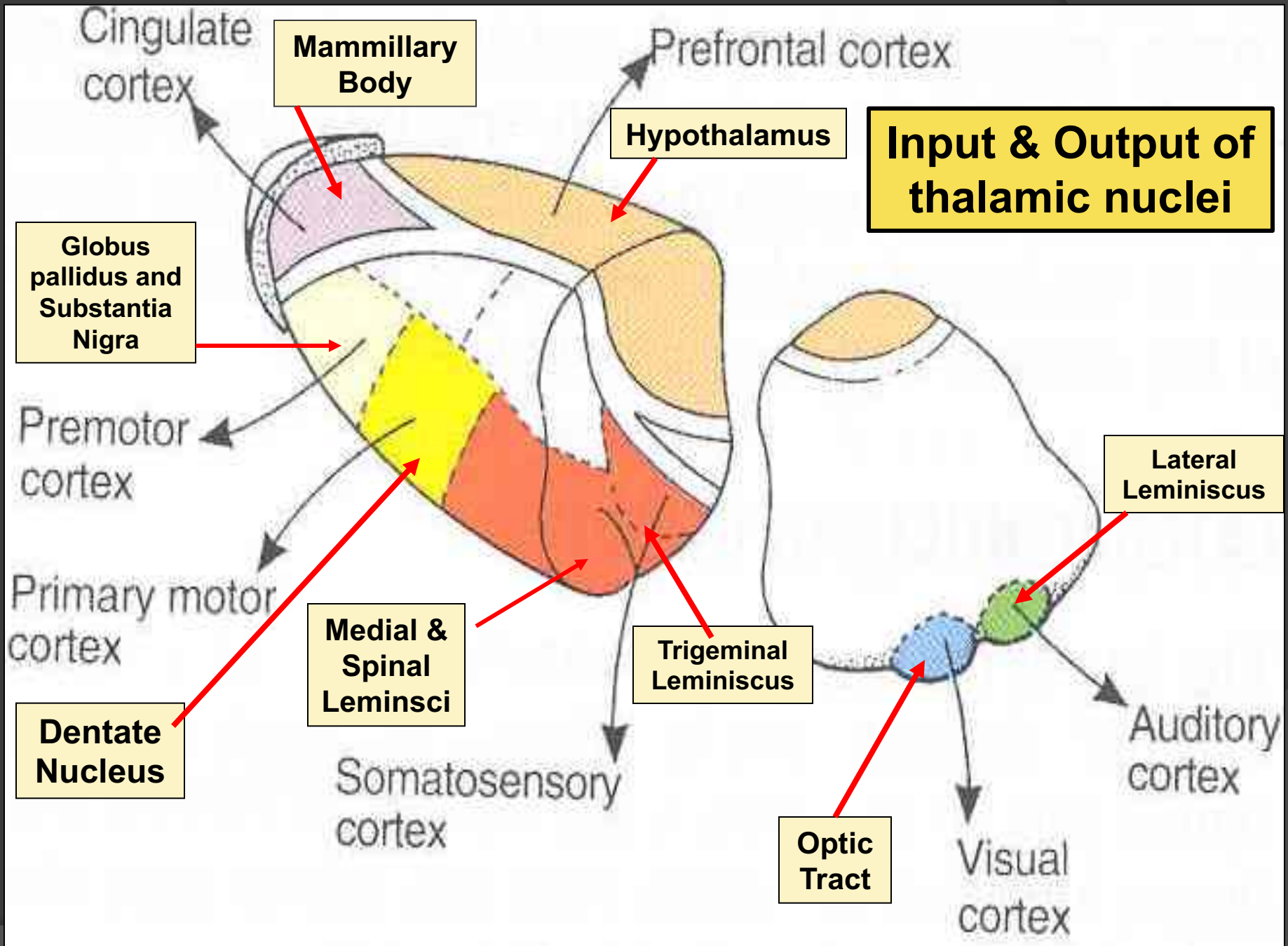
➤ **Afferent :** lateral lemniscus.

➤ **Efferent :** auditory cortex.

Input of Ventral Thalamic Nuclei



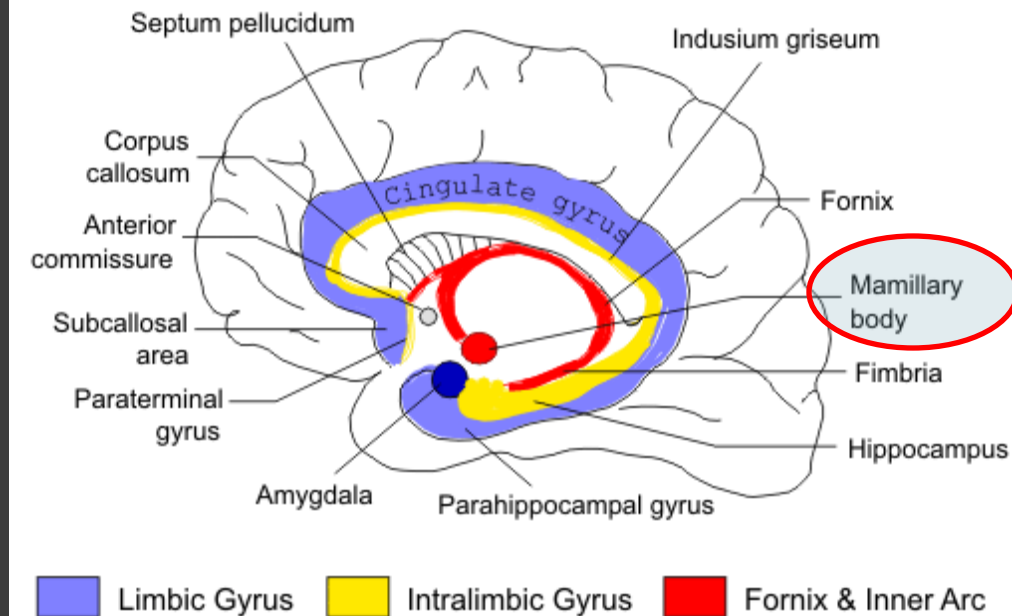
Output of thalamic nuclei



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**).

The Limbic System



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

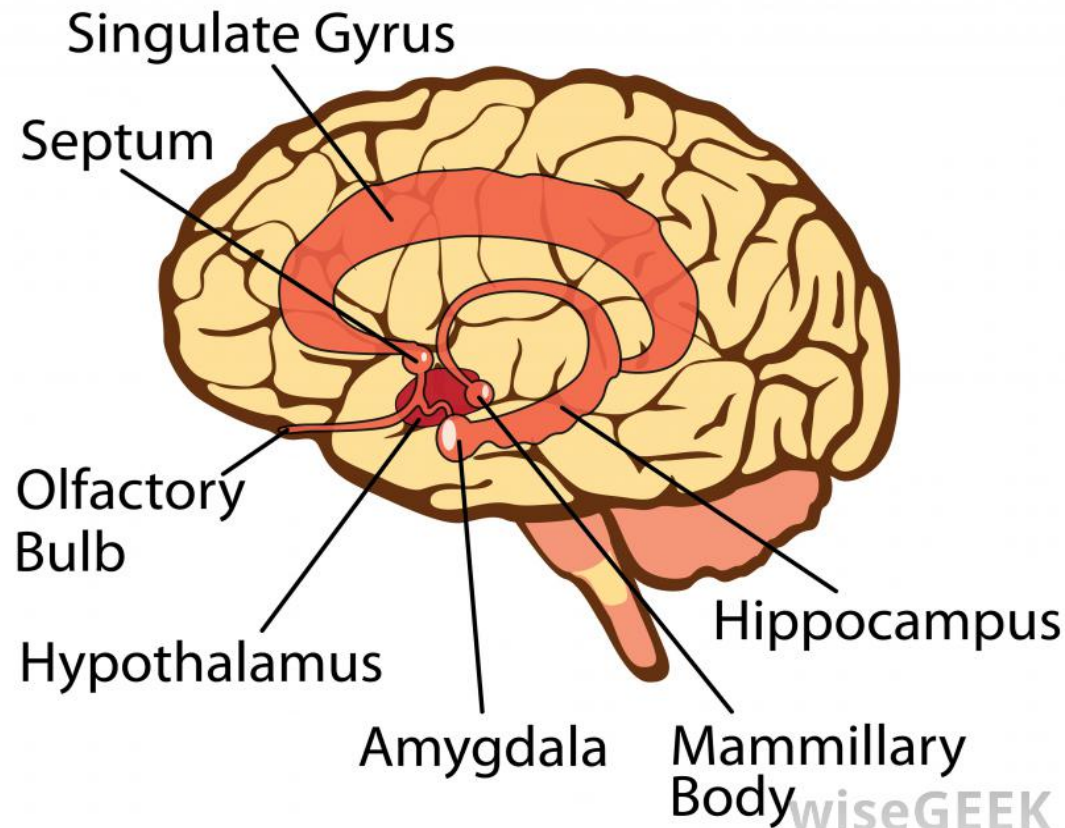
**Pleasure
sensation**

OLFACTION



The limbic system is a set of brain structures including

LIMBIC SYSTEM STRUCTURES



The limbic system is composed of four main structures:

1. Limbic cortex (Lobe).

2. Hippocampus

3. Amygdala, &

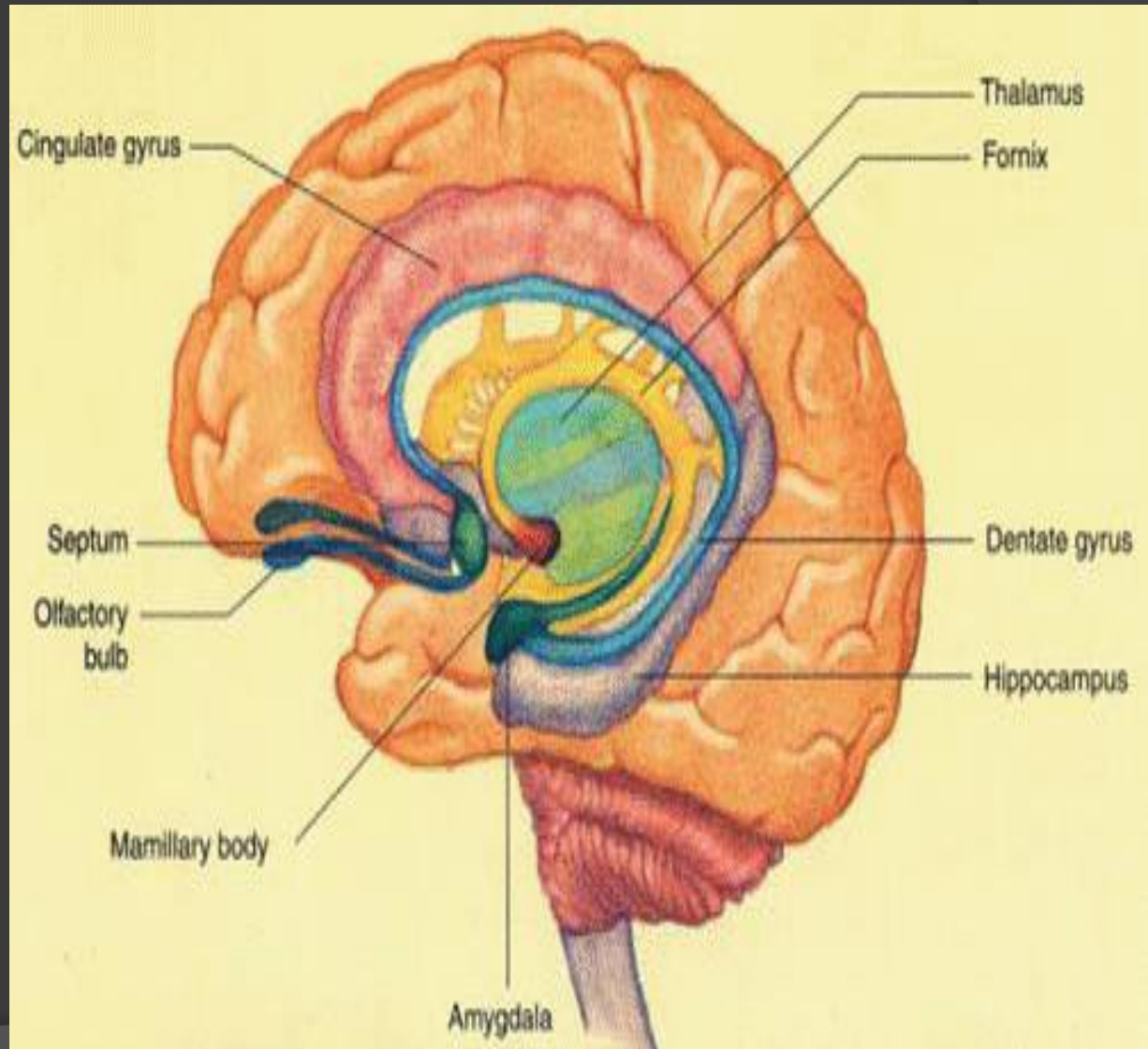
4. Septal area.

• 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.

CORTICAL STRUCTURES

1. **Limbic lobe.**
2. **Hippocampal formation.**
3. **Septal areas.**
4. **Prefrontal area (Olfactory cortex).**

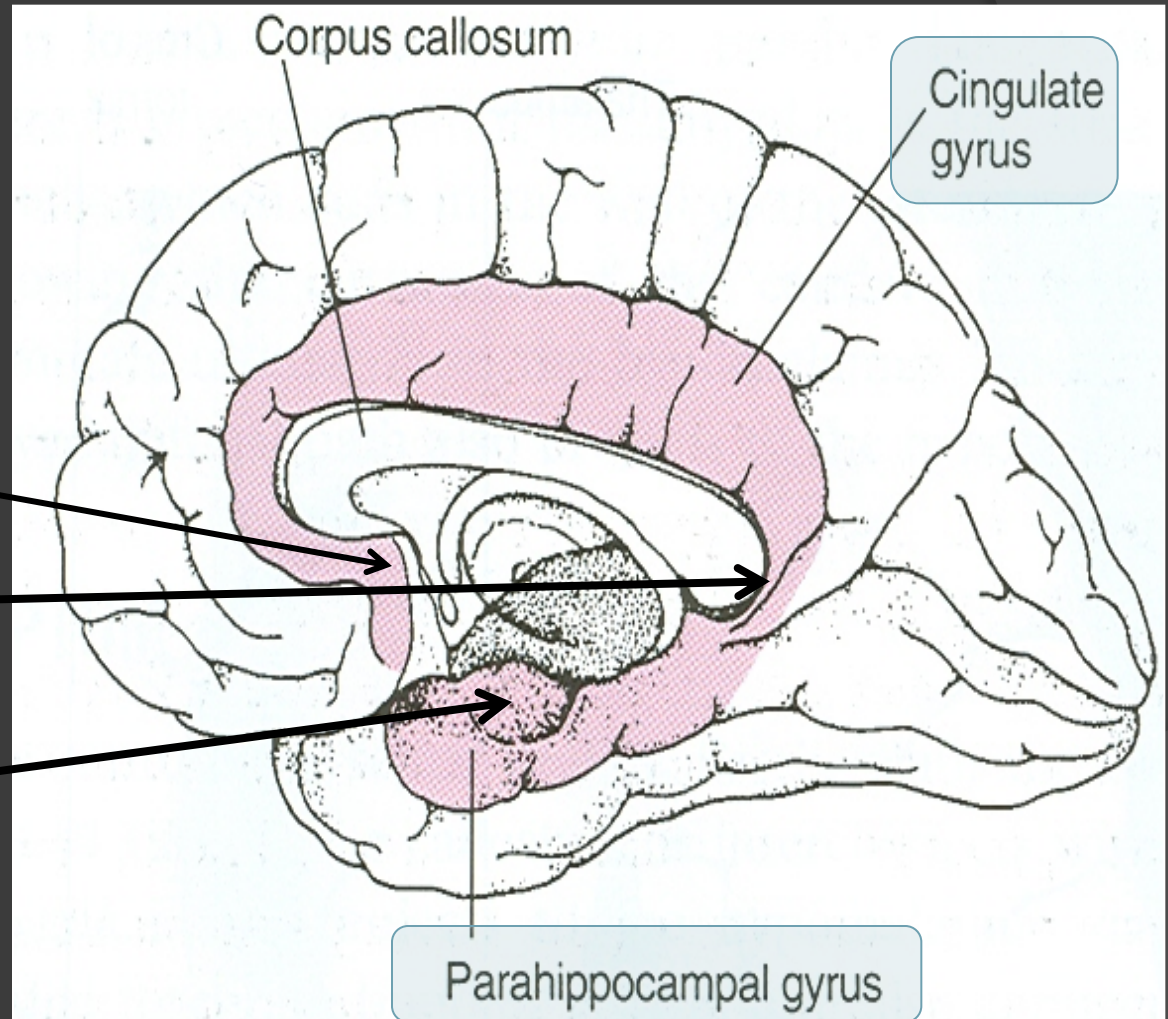


LIMBIC LOBE

- **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**

- It connects emotions and senses, such as **smell** and **sound**, to memories.

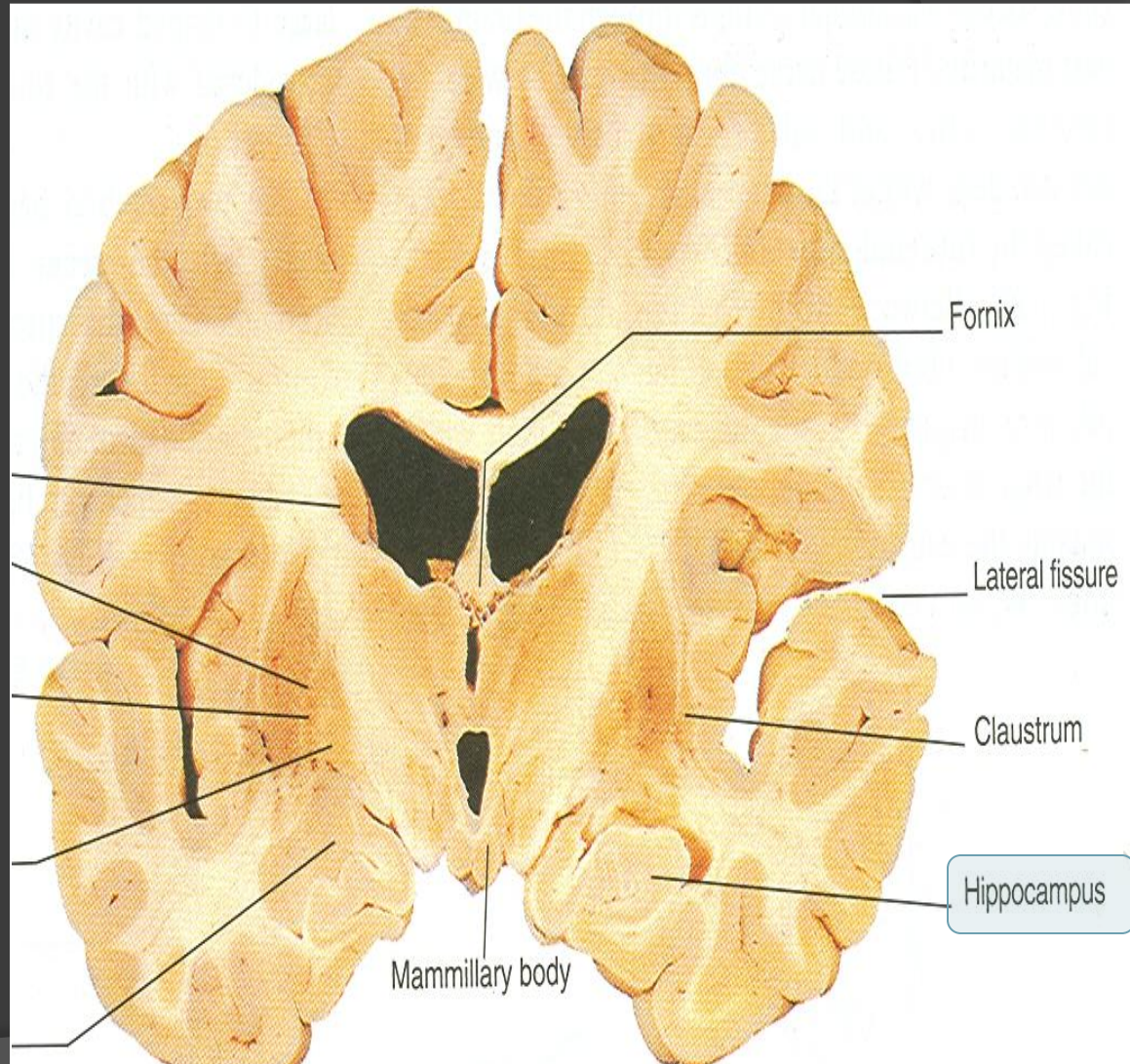
It is a horseshoe paired structure, one in each cerebral hemisphere.

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

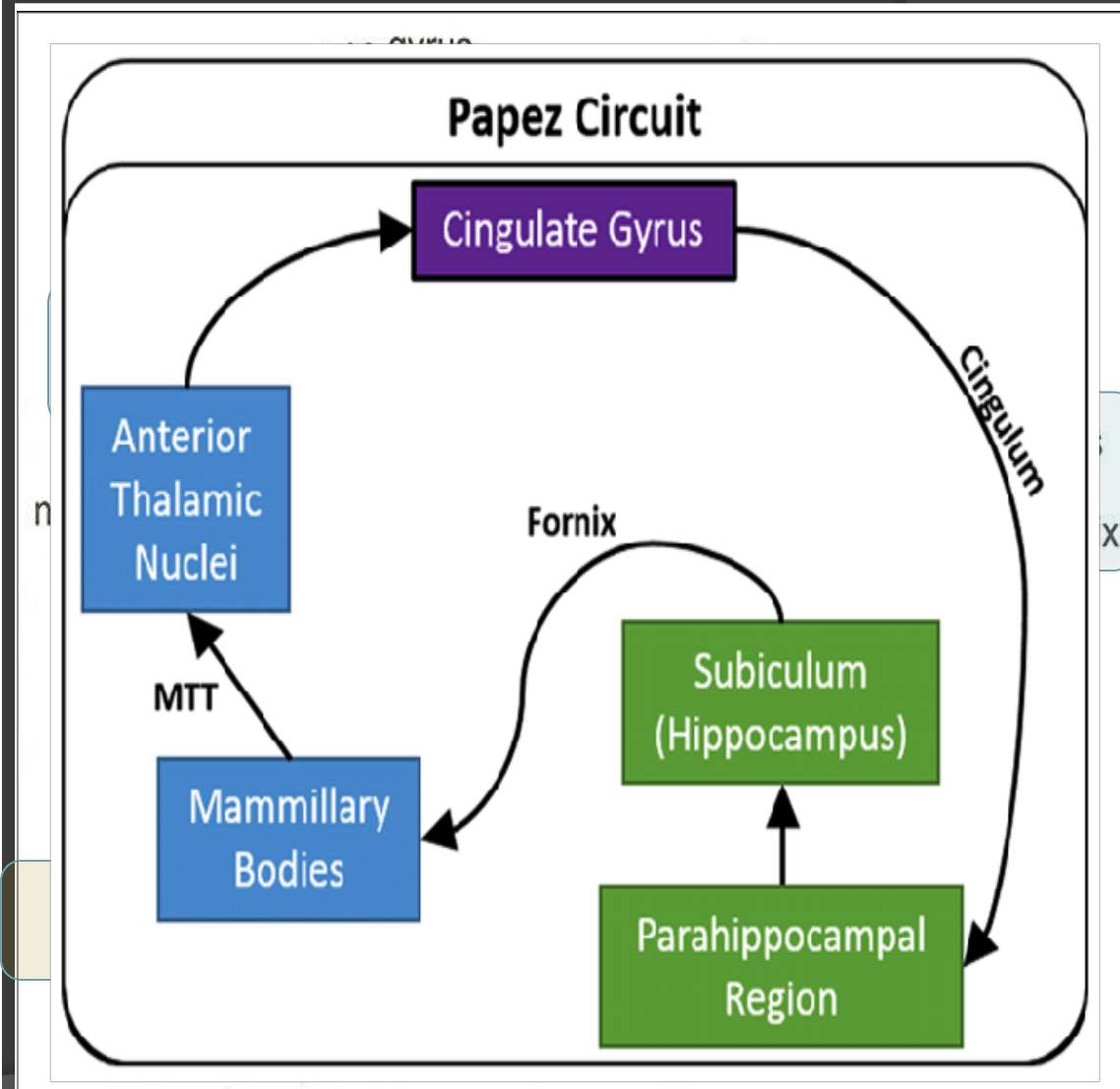
- Its principal efferent pathway is called the: **FORNIX**:

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

It consists of:

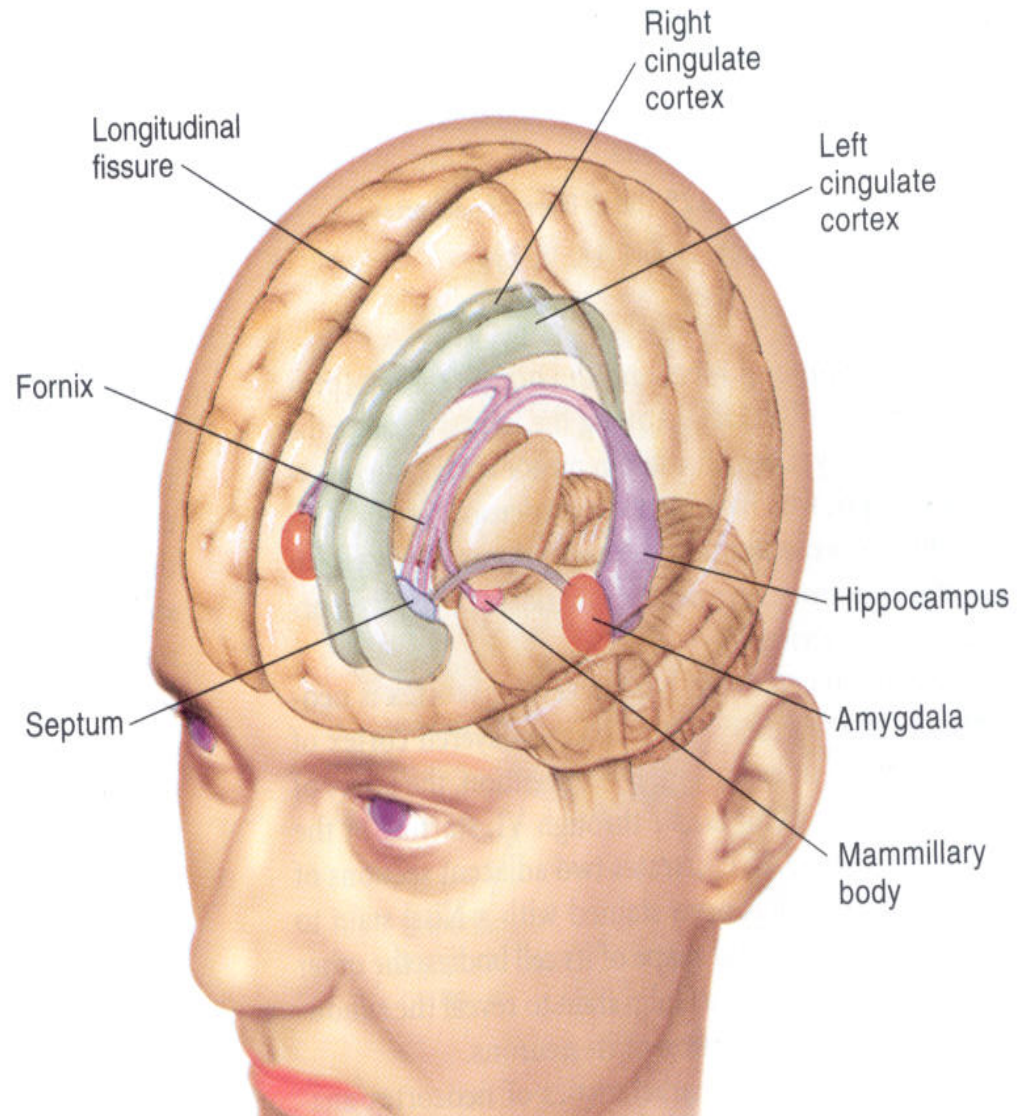
- 2 Fimbria,*
- 2 Crus,*
- 1 Body &*
- 2 Column.*

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



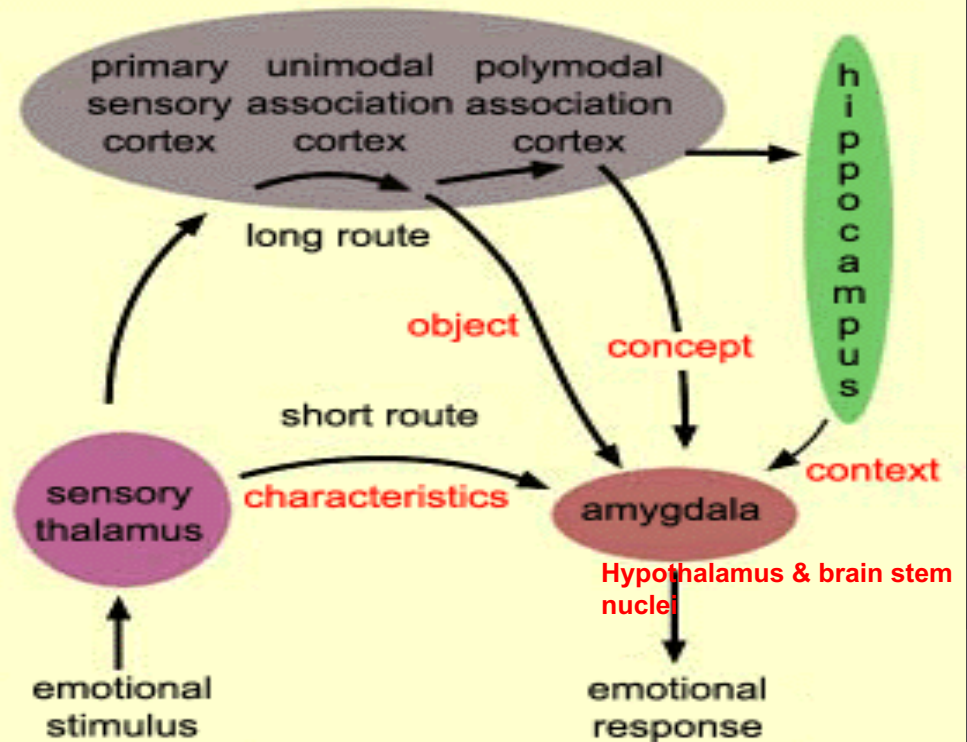
AMYGDALA

- **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 ; aggression &**
- **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 (**reduced emotional expression**).



Septal nuclei

Site:

Located anterior to the **interventricular septum** (septum pellucidum) and anterior to **hypothalamus**.

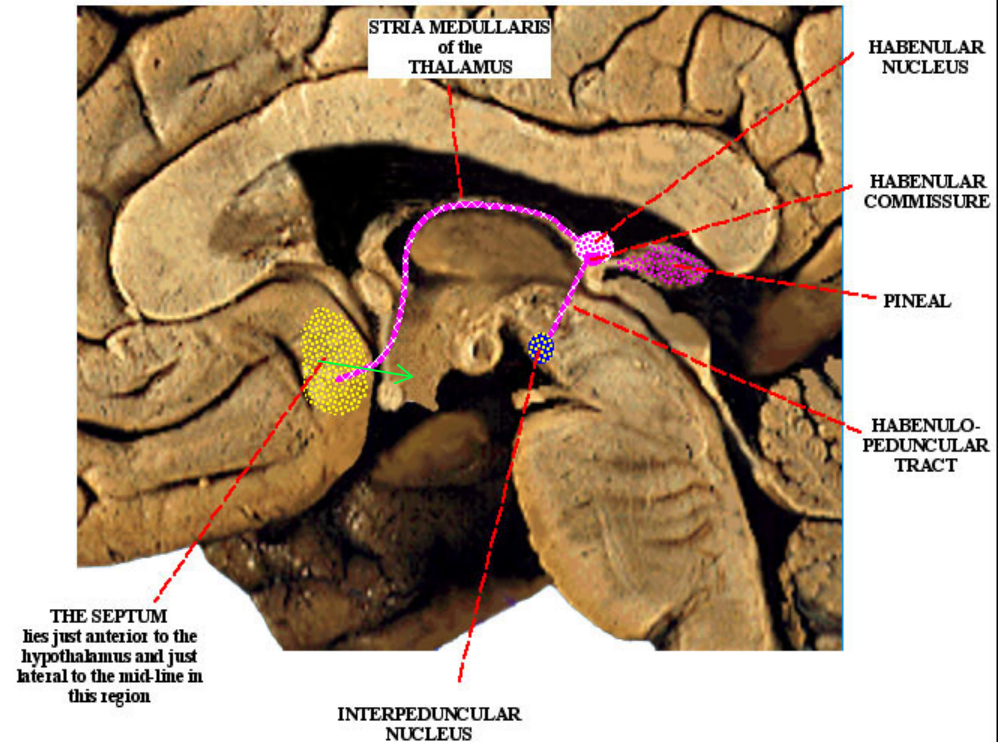
Main connections:

It sends projections:

1. To Hypothalamus
2. To Habenular nuclei (lie in epithalamus of diencephalon).

Function:

It is the **pleasure** zone.



Lesions associated with limbic lobe disorders

○ Korsakoff's psychosis :

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

○ **Inability to remember recent events and long-term memory gaps**

- (**anterograde amnesia**= inability to gain new memories).
- (**Retrograde** = loss of retained old memories occurred before the injury).

○ 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 abnormal behavior & inappropriate actions and feelings).

healthy brain

advanced alzheimer's





THANK YOU