MED437
KING SAUD UNIVERSITY

ANATOMY
Team 437

Thalamus and Limbic System

Lecture (18)

- Important
- Doctors Notes
- Notes/Extra explanation

Please check our Editing File

هذا العمل مبني بشكل أساسي على عمل دفعة ٤٣٦ مع المراجعة والتدقيق وإضافة الملاحظات ولا يغني عن المصدر الأساسي للمذاكرة

{وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ}

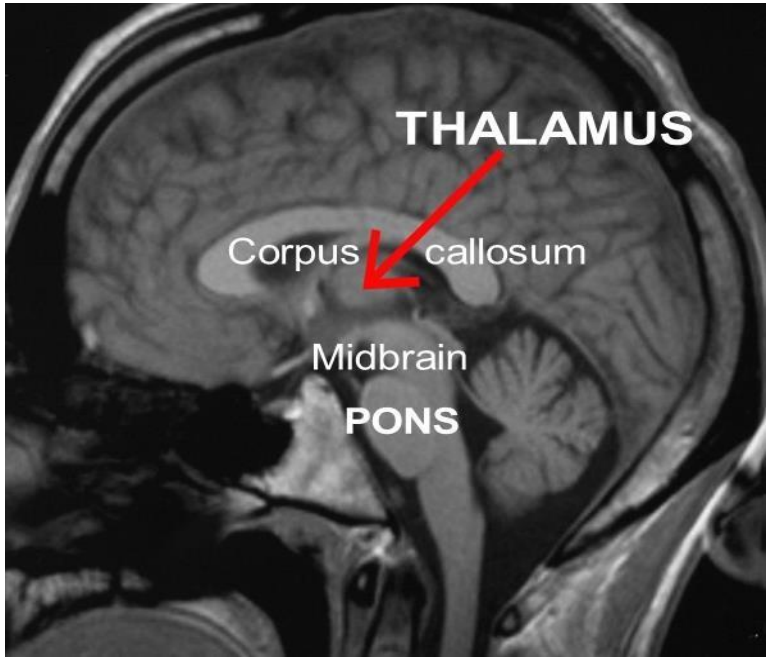
Objectives

At the end of the lecture, students should be able to:

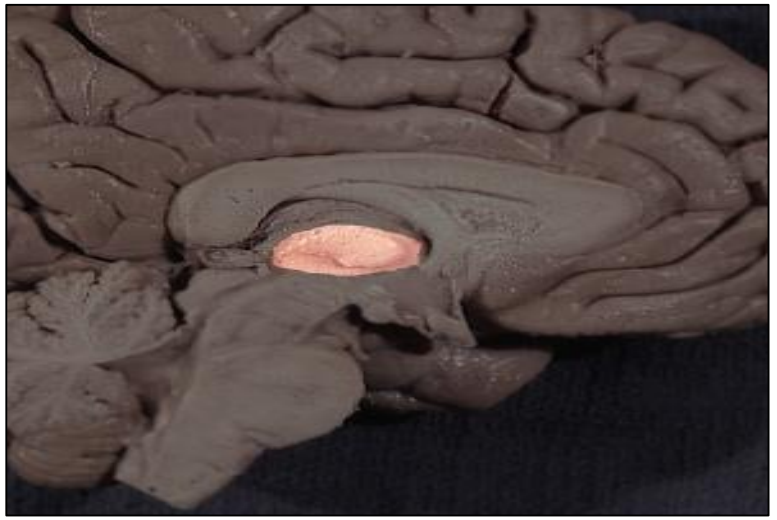
- ✓ Describe the anatomy and main functions of the thalamus.
- ✓ Name and identify different nuclei of the thalamus.
- ✓ Describe the main connections and functions of thalamic nuclei.
- ✓ Name and identify different parts of the limbic system.
- ✓ Describe main functions of the limbic system.
- ✓ Describe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

Thalamus

02:04



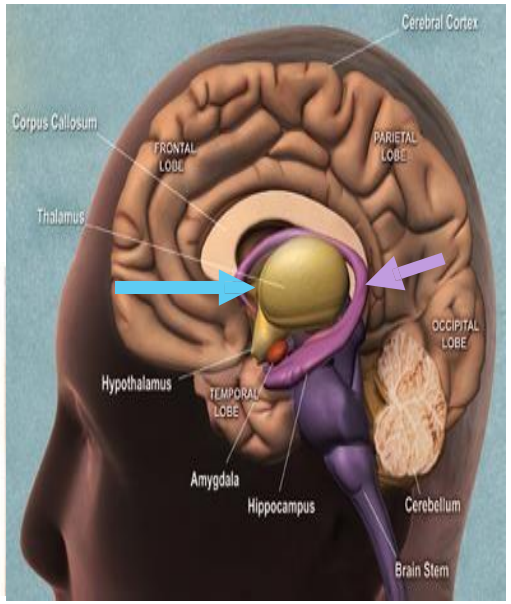
- It is the **largest nuclear mass** of the whole body.
- It is the **largest part** of the **diencephalon**
- It is formed of: two oval masses of **grey matter**.
- It is the gateway to the cortex.(the last station for sensory fibers before it project to the cortex)
- Resemble a small hen. 
- Together with the hypothalamus they form the lateral wall of the **3rd ventricle**.
- The **thalamus** 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
  3. Limbic-related brain regions



Thalamus Relations

Relation = surfaces

It has **4** surfaces & **2** ends.



Surfaces:

Superior: (S)

Lateral ventricle & fornix.

Superior: (S)

Lateral ventricle & fornix.

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** which crosses through the 3rd ventricle

Lateral:(L)

Posterior limb of the internal capsule

Ends:

Anterior end:

Forms a projection, called the **anterior tubercle**. It lies just **behind** the interventricular foramen*.

Posterior end: (Broad عريض)

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

*the foramen between the lateral ventricle and the 3ed ventricle.| another name foramina monro

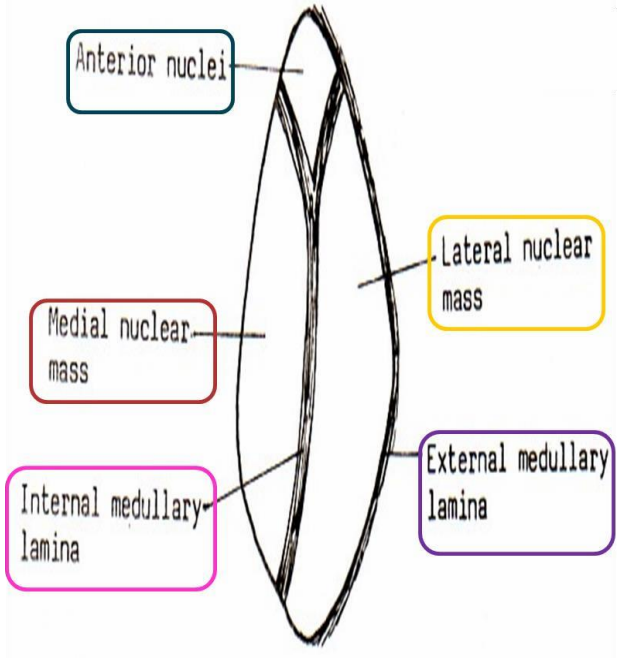
Thalamus
Internal Structure

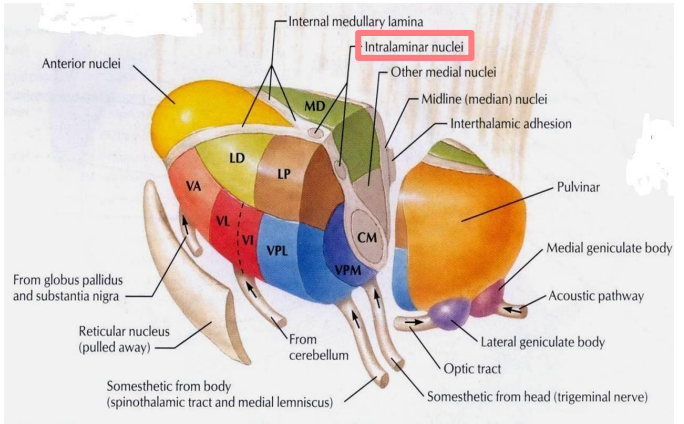
White matter:

- **External medullary lamina:** Lamina or fiber
  - 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 & lateral.**
  - Each of these group is subdivided into a number of named nuclei.

*Has a relation with limbic system





IMPORTANT

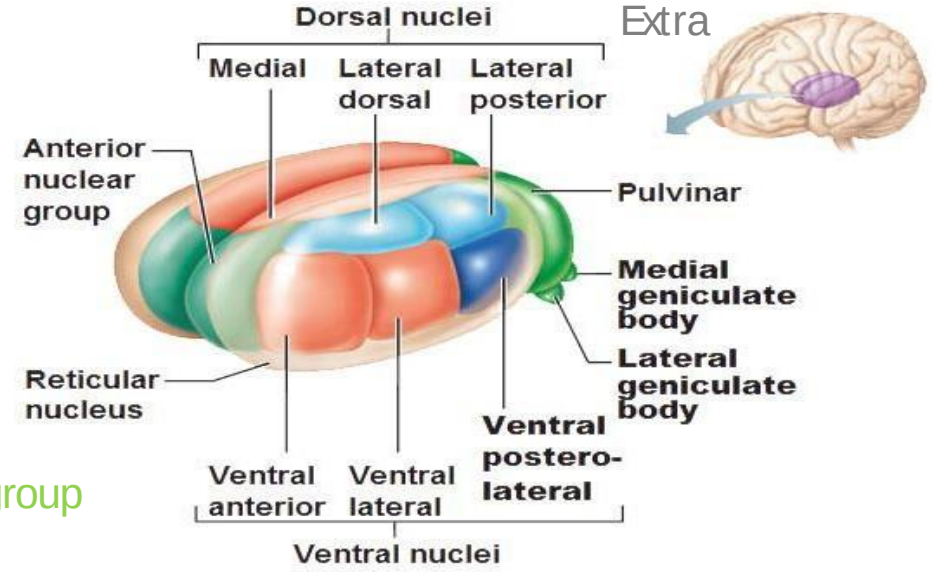
Thalamus
Lateral Nuclear Group

Lateral Nuclear Group is divided into: **Dorsal** & **Ventral tiers**

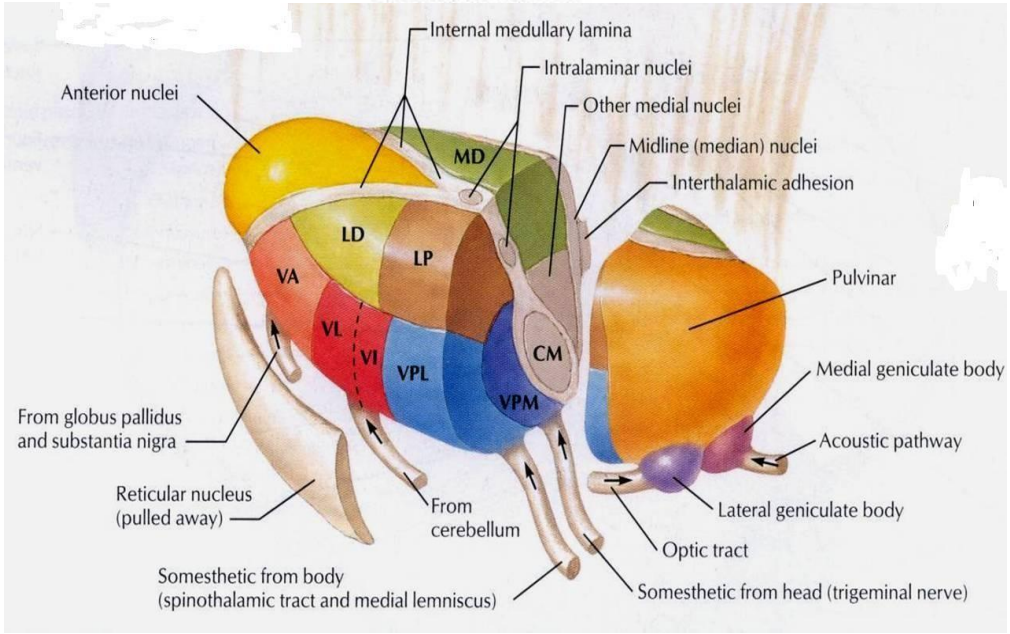
Dorsal Tier	Ventral Tier
1. Lateral Dorsal (LD)	1. Ventral Anterior (VA)
	2. Ventral Lateral (VL)
2. Lateral Posterior (LP)	3. Ventral Intermediate (VI)
	4. Ventral Posterior (VP) (lateral: PLVNT & medial: PMVNT)
3. Pulvinar	5. Medial geniculate nuclei
	6. Lateral geniculate nuclei

VL and VI are the same (have the same function)

Extra



tier =group



Thalamus
Projection of Nuclei

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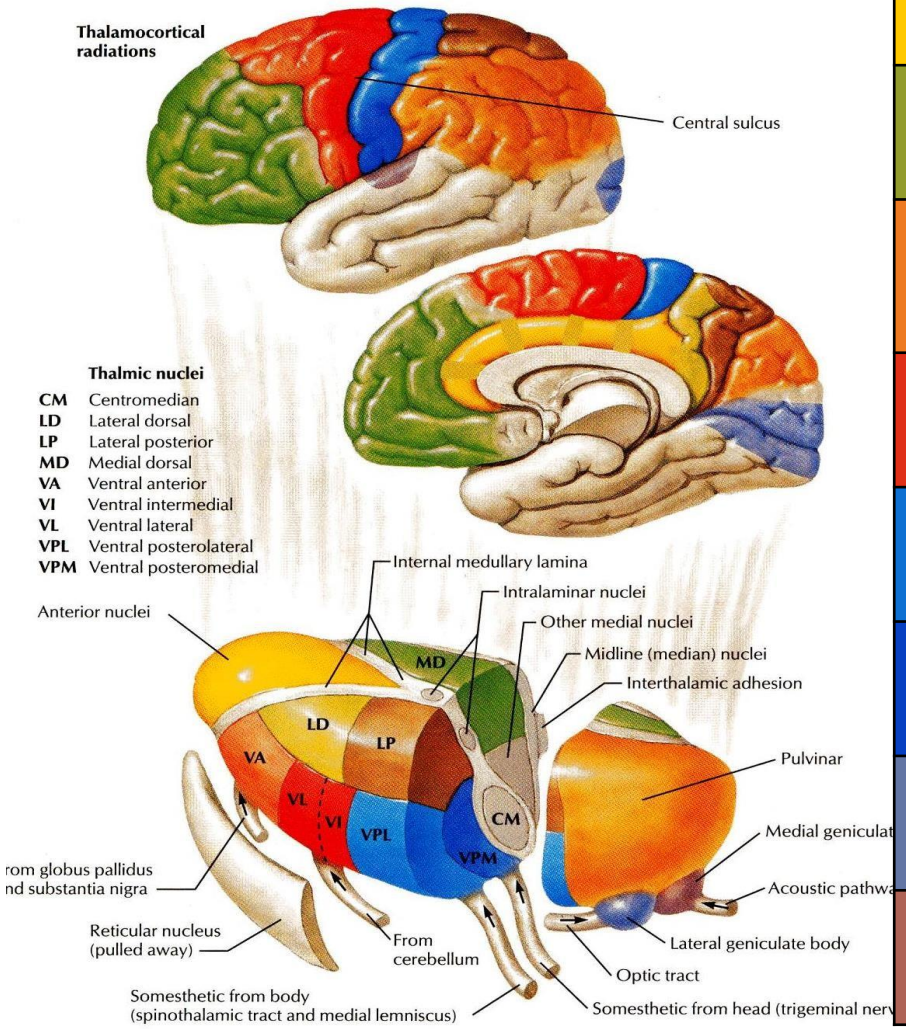
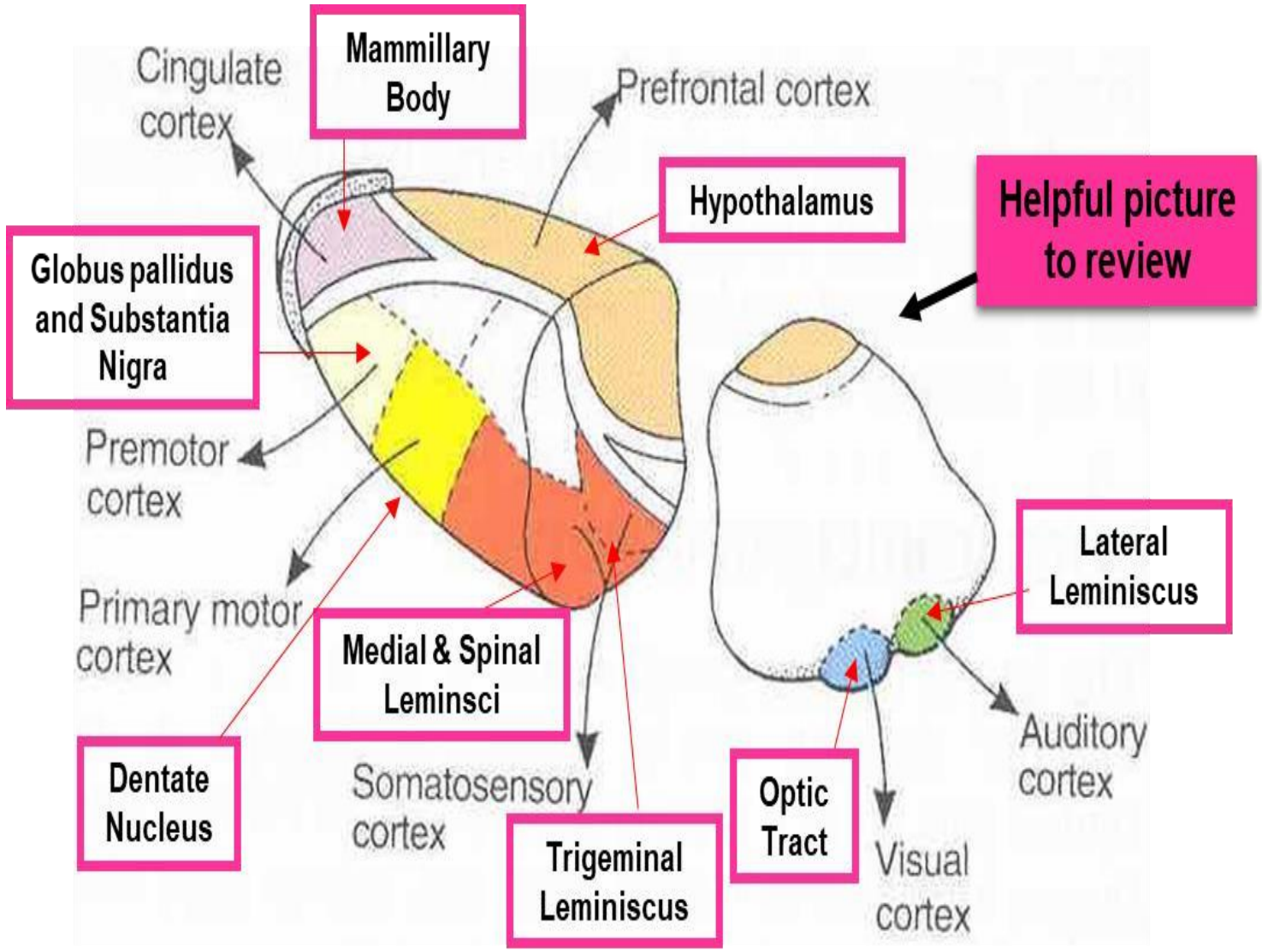
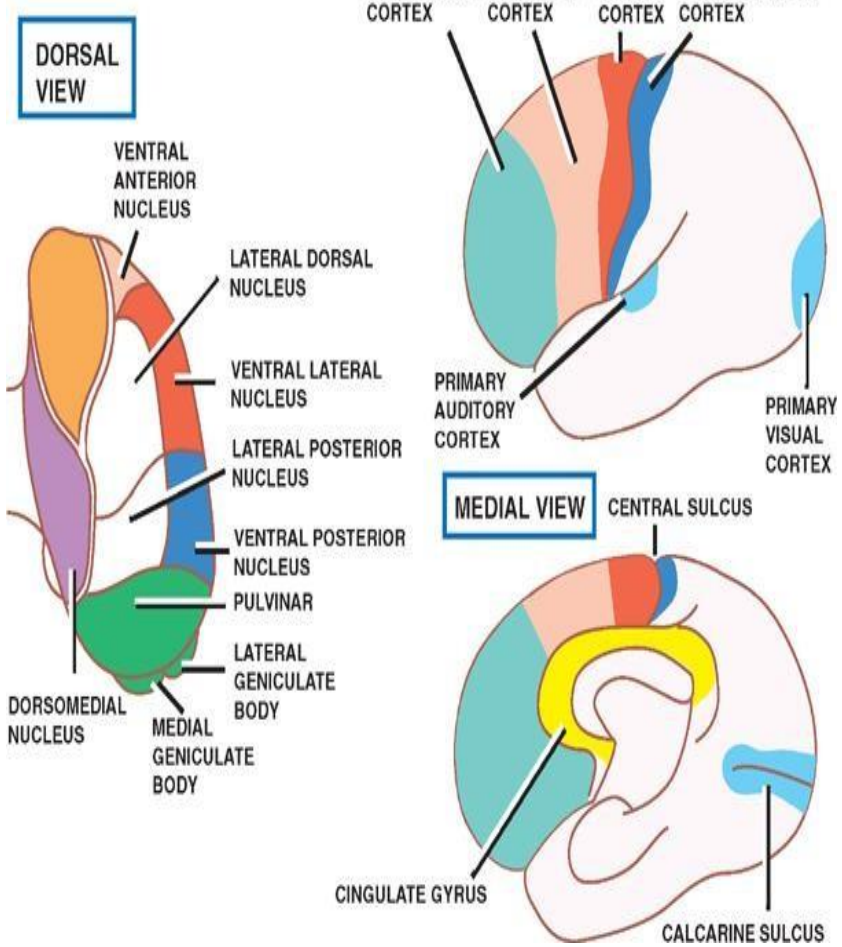


	Afferent	Efferent
Anterior Thalamic Nucleus	Mammillary body Which is part from hypothalamus	Cingulate gyrus (part of limbic system)
Medial Nucleus	Hypothalamus	Frontal cortex & Prefrontal cortex
Ventral Anterior Nucleus	Globus pallidus body and substania nigra	Premotor cortex In frontal lobe
Ventral Lateral Nucleus & VI	Dentate Nucleus From cerebellum	Primary Motor Cortex In frontal lobe in precentral gyrus
Ventral Posterior Lateral Nucleus	Medial and Spinal lemnisci*	Sensory Cortex Postcentral gyrus in partial lobe
Ventral Posterior Medial Nucleus	Trigeminal Leminiscus	Sensory Cortex
Lateral Geniculate Nucleus	Optic tract	Visual Cortex In occipital lobe
Medial Geniculate Nucleus	Lateral Leminiscus	Auditory Cortex In superior temporal lobe

*Medial lemniscus: from dorsal column | Spinal lemniscus: from spinothalamic

IMPORTANT


Cingulate cortex
Mammillary Body
Prefrontal cortex
Hypothalamus
Helpful picture to review
Globus pallidus and Substantia Nigra
Premotor cortex
Primary motor cortex
Medial & Spinal Leminsci
Lateral Leminiscus
Dentate Nucleus
Somatosensory cortex
Trigeminal Leminiscus
Optic Tract
Auditory cortex
Visual cortex

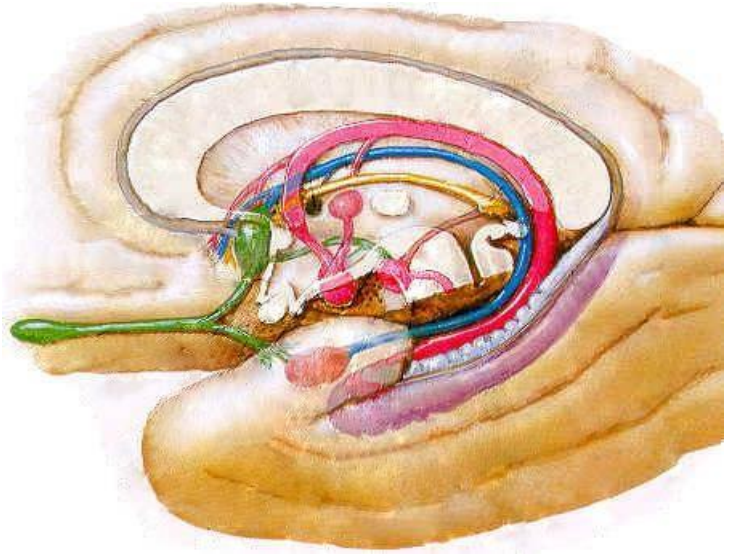

DORSAL VIEW
VENTRAL ANTERIOR NUCLEUS
LATERAL DORSAL NUCLEUS
VENTRAL LATERAL NUCLEUS
LATERAL POSTERIOR NUCLEUS
VENTRAL POSTERIOR NUCLEUS
PULVINAR
LATERAL GENICULATE BODY
MEDIAL GENICULATE BODY
DORSOMEDIAL NUCLEUS
LATERAL VIEW
PREFRONTAL CORTEX
PREMOTOR CORTEX
MOTOR CORTEX
SOMATOSENSORY CORTEX
PRIMARY AUDITORY CORTEX
PRIMARY VISUAL CORTEX
MEDIAL VIEW
CENTRAL SULCUS
CINGULATE GYRUS
CALCARINE SULCUS

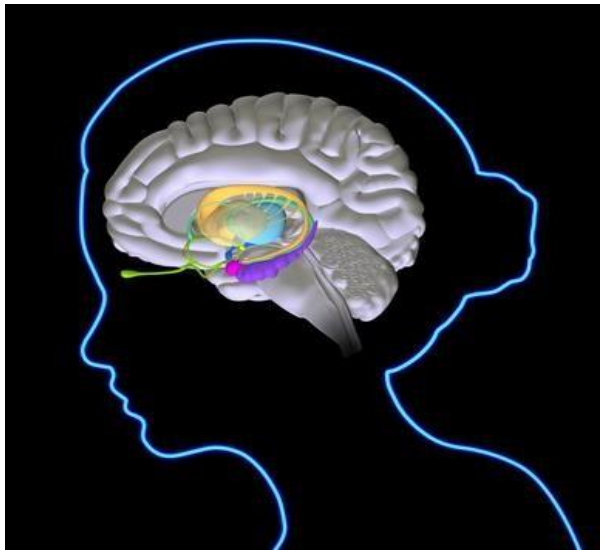
Limbic System

01:5

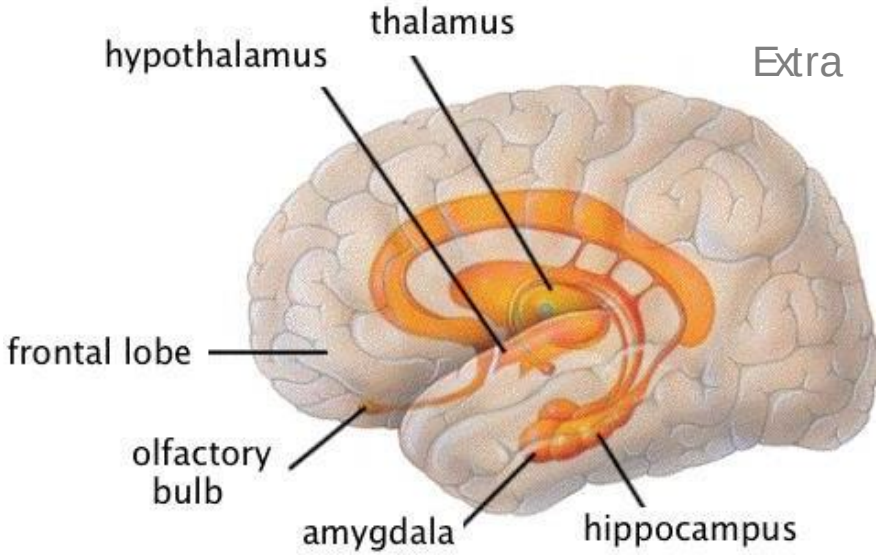
- The term "limbic" is from the Latin word **Limbus**, for "border" or "edge".
- It separates the medial surface of the cerebral cortex from the diencephalon
- It consists of a number of cortical & subcortical structures with looped connections then all project to the hypothalamus (**particularly mammillary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

Only on the girl's slides





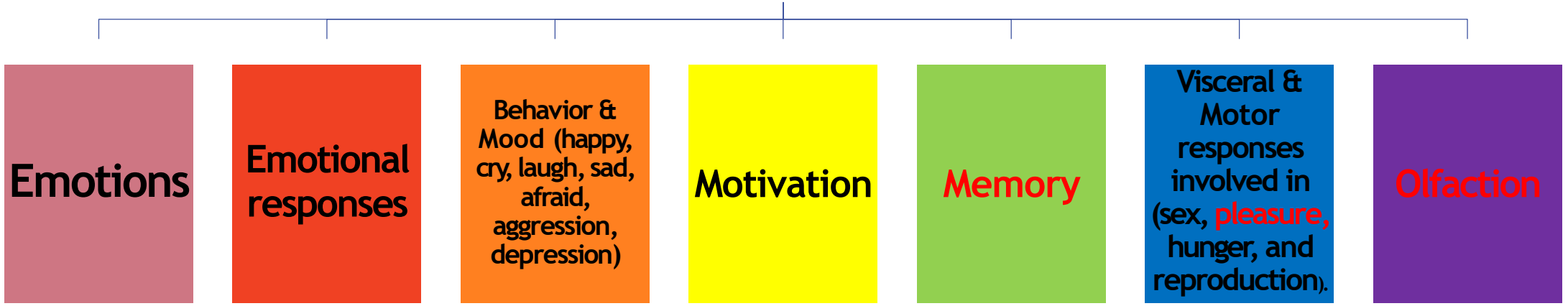
Extra



Limbic System

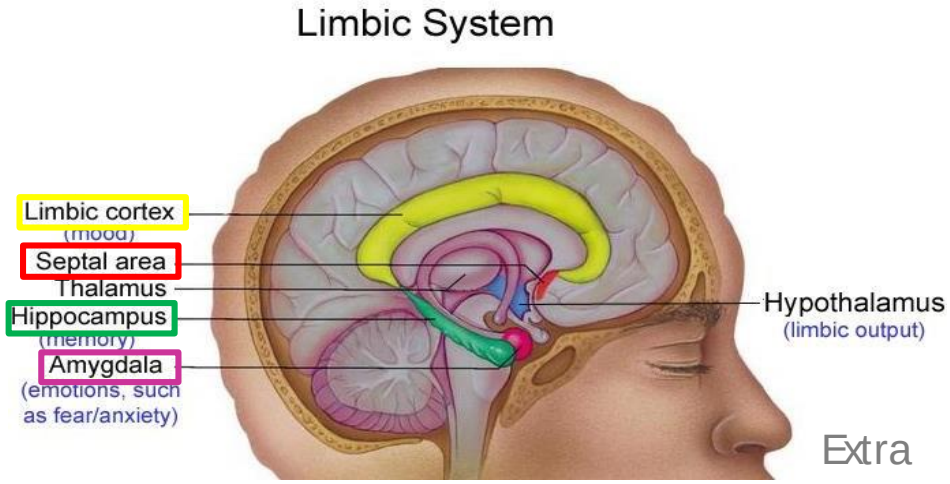
What is the function of the limbic system?

It controls a variety of functions including:



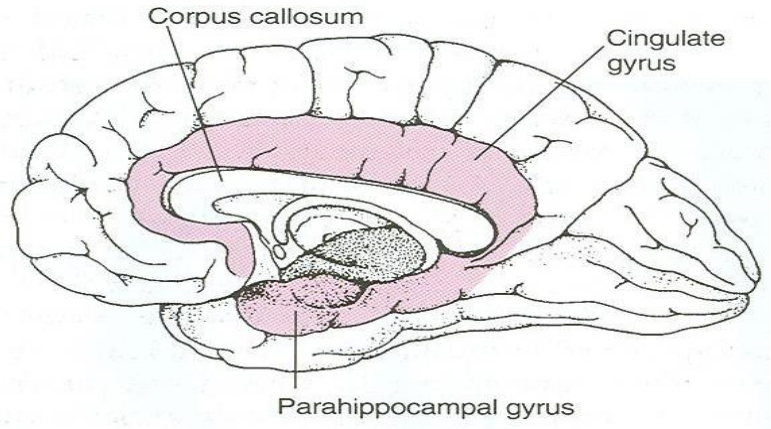
These are the general functions of the limbic system but certain parts are more responsible for certain things, ex: hippocampus and memory

Limbic System



Extra

- The limbic system is composed of four main structures:
  1. **Limbic cortex (lobe)**
  2. **Amygdala.**
  3. **Hippocampus** (As RAM o computer)
  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.



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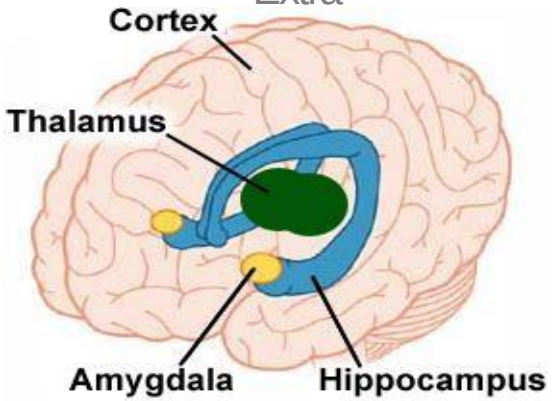
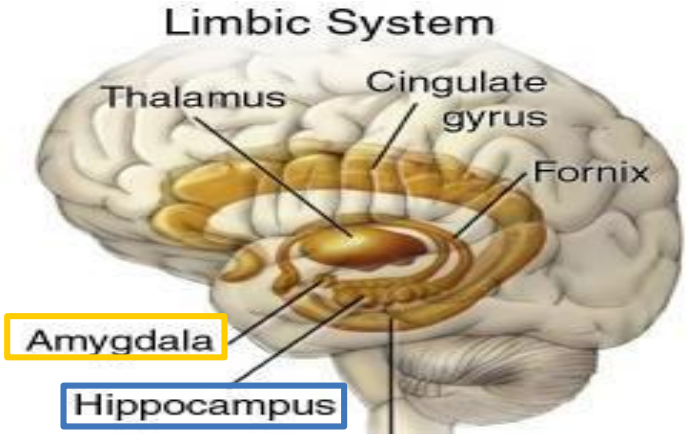


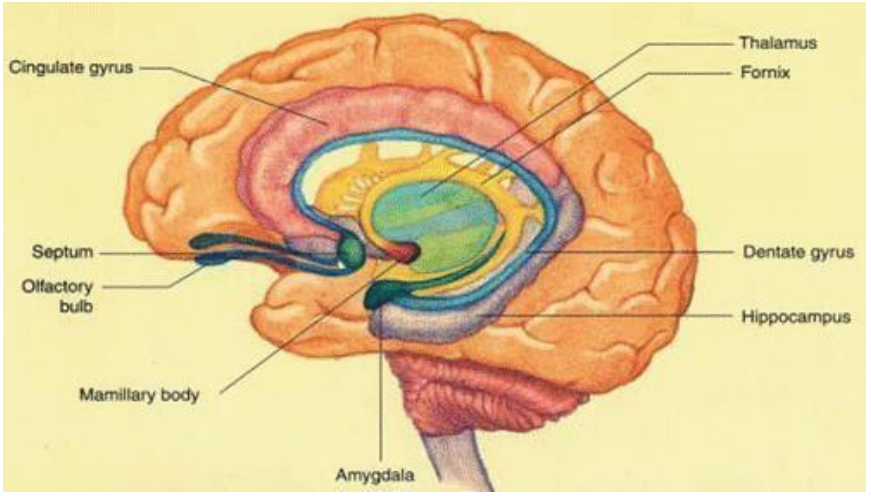


Limbic System

CORTICAL STRUCTURES

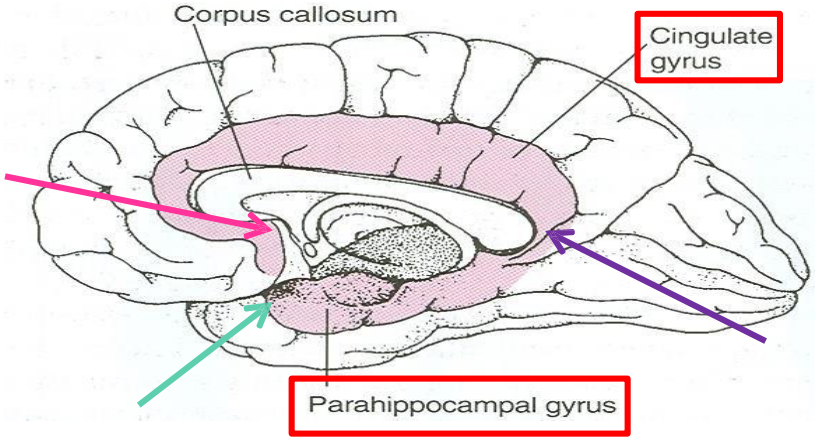
1. Limbic lobe.
2. Hippocampal formation.
3. Septal areas (Fornix, connecting the hippocampus with mammillary bodies and septal nuclei).
4. Prefrontal area (olfactory cortex).

Note: **Subcortical** structures are like amygdala and hypothalamus



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
  5. Uncus. (olfactory center)



Hippocampus

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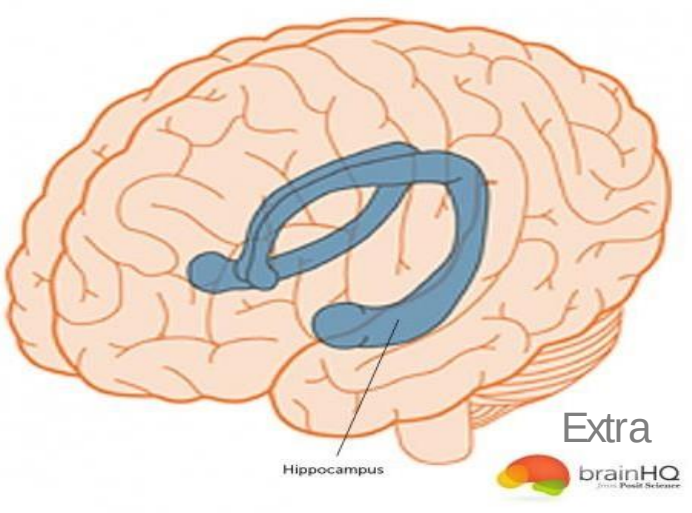
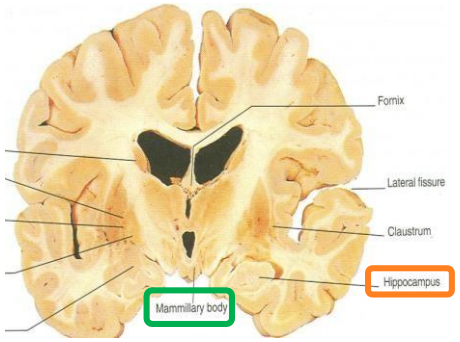


- It is a **limbic system** structure that is involved in: FOS
  - **Formation,**
  - **Organization,** and
  - **Storage** of memories.
- It is important in forming new memories and connecting emotions and senses, such as smell and sound, to memories.
- It is a horseshoe paired structure, one in each 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.

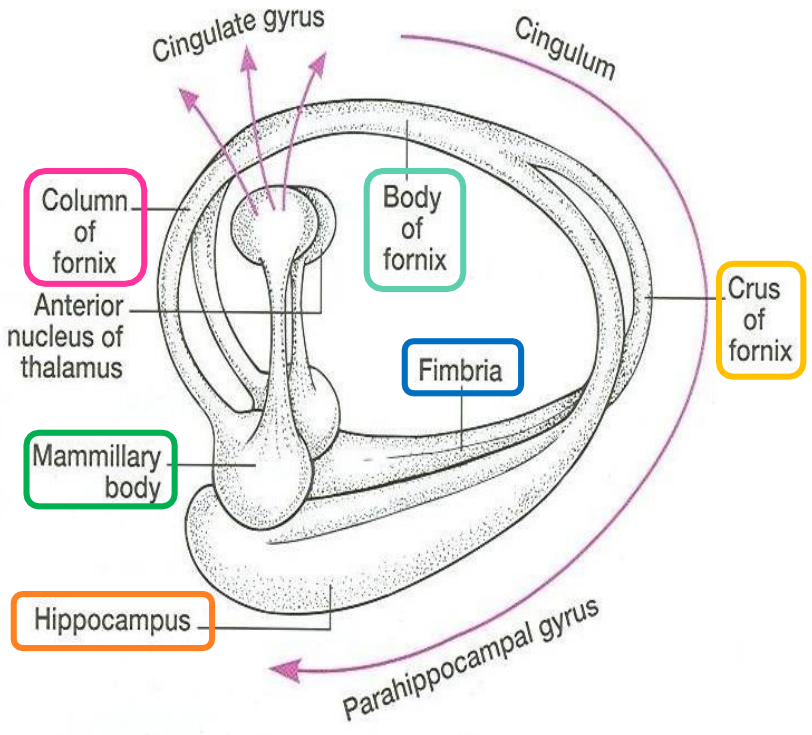
The hippocampus got its name because it looks like a seahorse

Extra:
A patient once had his hippocampus removed as a treatment for seizures.
After the surgery the seizures stopped but the patient was not able retain or make any new memories.
To learn more about this patient:
https://bigpictureeducation.com/brain-case-study-patient-hm
https://www.youtube.com/watch?v=KkaXNvzE4pk

Hippocampus

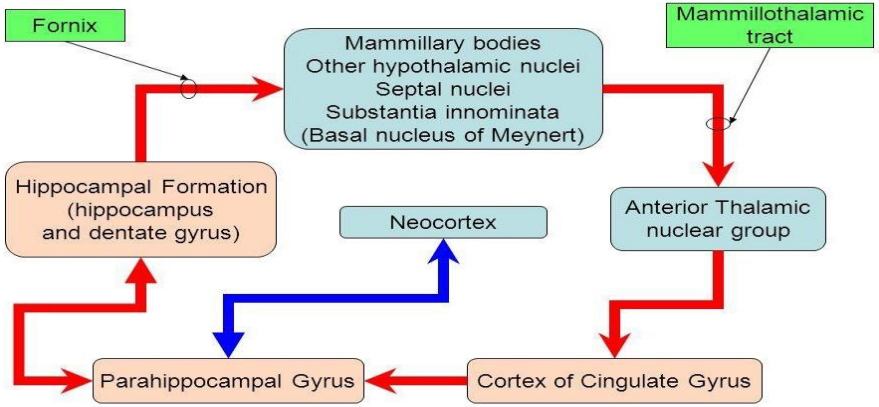


- **Site:**
  It is a scrolled (infolding) structure in the inferomedial part of the **temporal lobe.**
- FUNCTION:
  Memory (**file new memories as they occur**).
  The hippocampus & its connections are necessary for consolidation of new short-term memories.
- Its principal efferent pathway is called the **Fornix.**
- **Fornix:**
  - It is C-shaped group of fibers connecting the hippocampus with mammillary body & then to the anterior nuclei of the 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).



IMPORTANT

Papez Circuit (Emotions)



Amygdala

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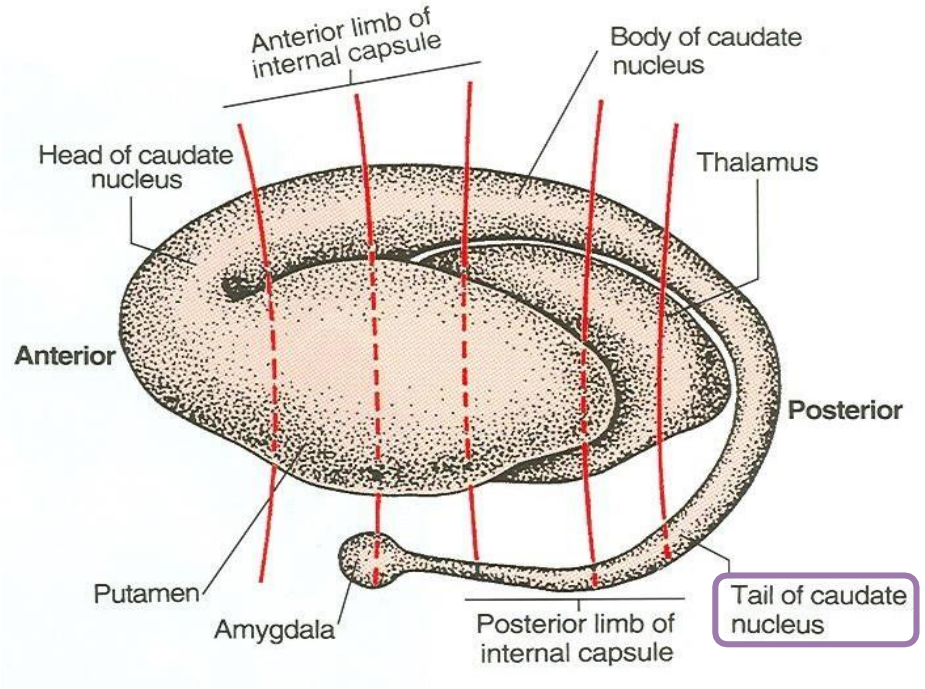
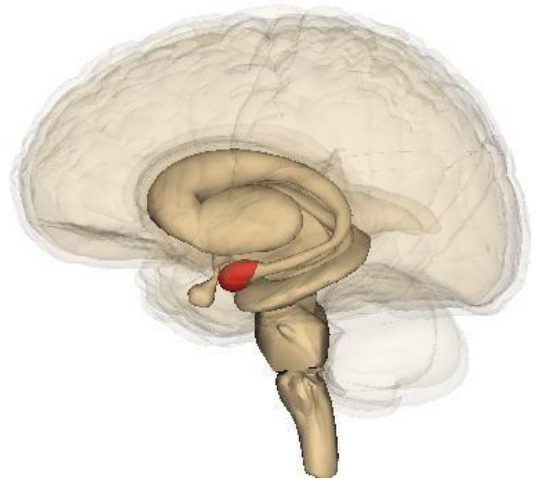


- **Site**:
  - almond shaped mass of nuclei that lies near (deep within) the temporal pole, close to the tail of the caudate nucleus.
- **Function:**
  - It is involved in
    1. Emotions
    2. FEAR
    3. Anger & (aggression)
    4. Hormonal secretions

Connections of Amygdala	
INPUTS:	**OUTPUTS:**
Association areas of **visual, auditory** & **somatosensory** cortices.	**Hypothalamus** & **Autonomic nuclei** in the brain stem,

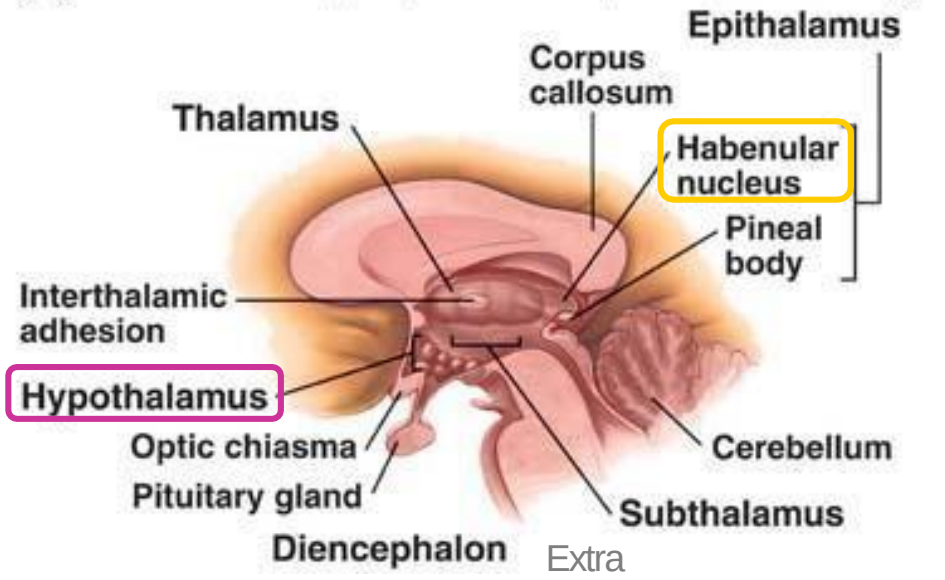


- **Lesion:** Lack of emotional responses* & docility "سهل الانقياد"

*Specifically fear and anger

Septal Nuclei

- **Site:**
  Located anterior to the **interventricularseptum** (septum pellucidum)
- **Main Connections:** it send projection to:
  1. To Hypothalamus
  2. To Habenular nuclei*
- **Function:**
  It is the **pleasure**zone.
  *located behind the thalamus



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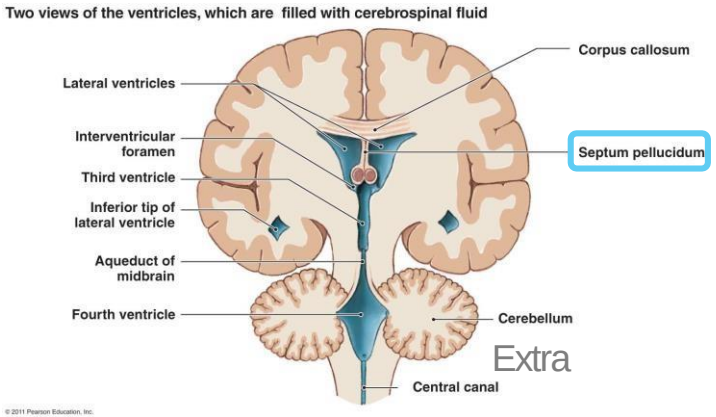

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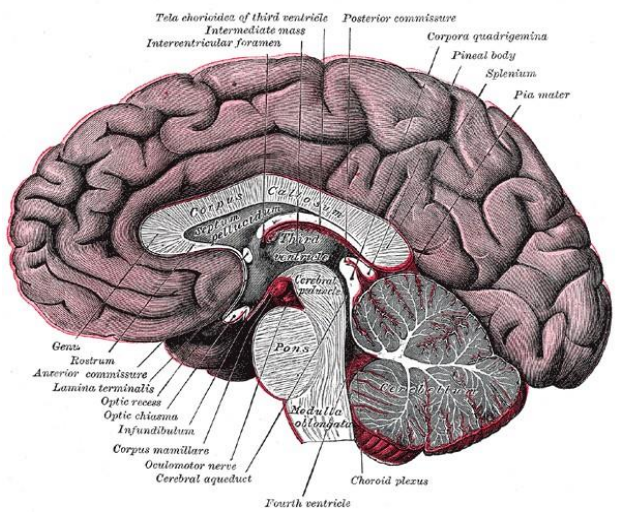
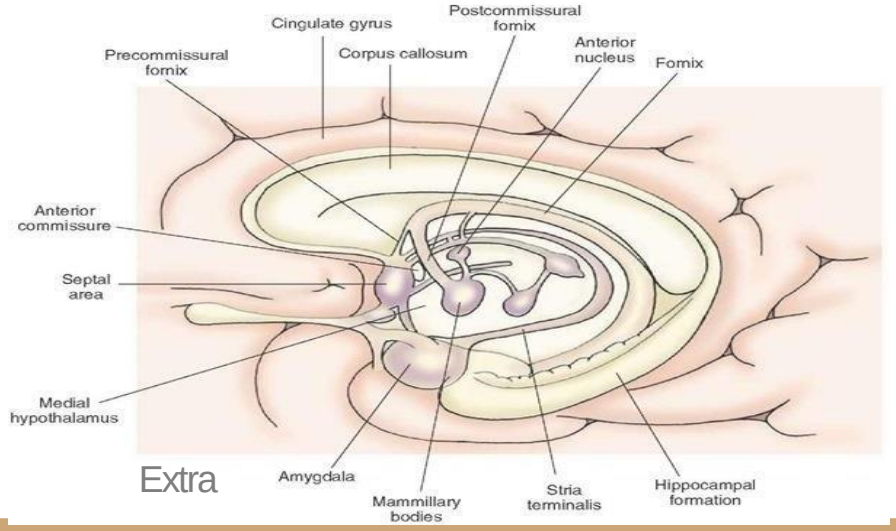
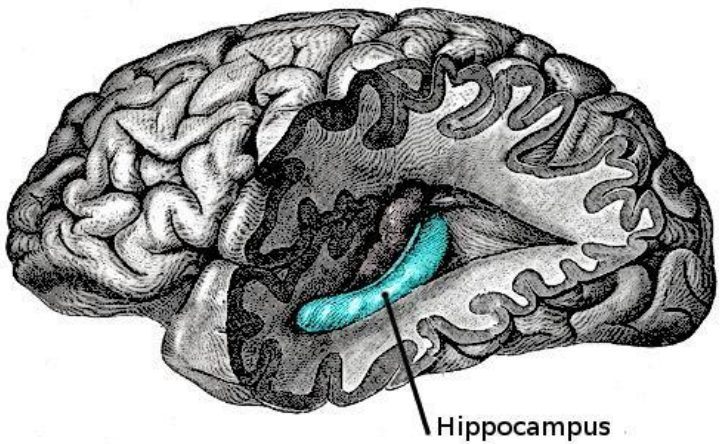




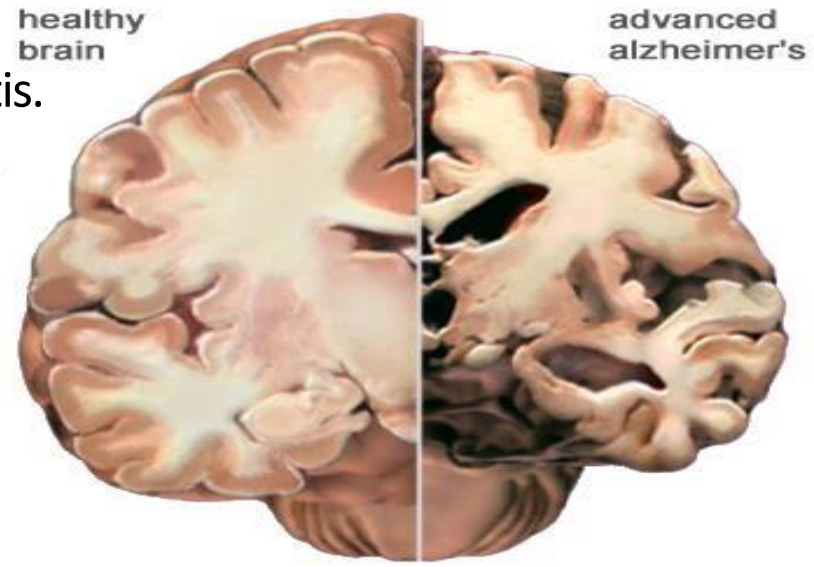
Extra

Lesions Associated with Limbic Lobe Disorders

1. **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 with loss of retained old memories occurred before the injury & anterograde amnesia = inability to gain new memories)



1. **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 (virus) encephalitis.
2. **Alzheimer's disease**:
   - The **hippocampus** is one of the first brain areas to show damage in Alzheimer's disease. (anterograde)



3. **Schizophrenia:**
   - mental disorder with inappropriate actions and feelings.
4. **Anterograde amnesia**
   - the inability to form and retain new memories.

Summary

Thalamus & limbic system

Thalamic Internal structures

- External medullary lamina -> consists of thalamocortical & corticothalamic fibers.
- Internal medullary lamina -> divides the thalamus into anterior , medial & lateral nuclear groups.

Thalamic Relations

Superior surface-> lateral ventricle, fornix

Inferior surface-> hypothalamus, subthalamus

Medial surface-> 3rd ventricle

Lateral surface-> internal capsule

Anterior end-> anterior tubercle

Posterior end-> pulvinar, superior colliculus, geniculate bodies

The limbic system

Composed of : limbic cortex , amygdala , hippocampus & septal area.

Memories -> Hippocampus

Fear & Anger ->Amygdala

Hormonal secretions ->Amygdala

Pleasure -> Septal Area

Thalamic Lateral nuclear group

- Ventral tier -> lateral dorsal , lateral posterior & pulvinar.
- Dorsal tier -> ventral anterior , ventral lateral , ventral intermediate , ventral posterior (medial & lateral) , medial geniculate nucleus , lateral geniculate nucleus.

MCQs

(1) Which one of these is NOT cortical structure?

A) Limbic lobe.
B) Hippocampal formation
C) Septal areas
D) Amygdala

(2) Which one of these is a function of the limbic system?

A) Memory
B) Speech
C) Behavior
D) A and c

(3) what is true about the amygdala?

A) Almond shaped mass
B) Lies far away from the temporal pole
C) Close to the tail of the caudate nucleus
D) A and c

(4) What is anterograde amnesia?

A) The inability to make new memories
B) The inability to retain old memories
C) Both a and b
D) None of the above

(5) Which of the following is a part of the dorsal tier of the lateral nuclear group?

A) Ventral Intermediate
B) Ventral Posterior
C) Medial geniculate nuclei
D) Lateral posterior

(6) Which area is responsible for pleasure?

A) Amygdala
B) Septal area
C) Hippocampus
D) Limbic cortex

(7) Syndrome is caused by severe deficiency of ?

A) Vitamin B1
B) Vitamin A
C) Vitamin B12
D) Irons

(8) FORNIX concects?

A) Mammillary body with cingulate gyrus
B) Mammillary body with fimbria
C) Hippocampus with fimbria
D) Hippocampus with mammillary

(9) The efferent of the ventral anterior nucleus goes to ?

A) Somatosensory area
B) Premotor cortex
C) Sensory cortex
D) Auditory cortex

(10) Pulvinar lies above the?

A) Superior colliculus
B) Inferior colliculus
C) The 3rd ventricle
D) Hypothalamus

Answers

(1) D
(2) D
(3) D
(4) A
(5) D
(6) B
(7) A
(8) D
(9) B
(10) A

SAQ

(1) Limbic system is composed of four main structures mention 3 only?

- Limbic cortex
- Amygdala.
- Hippocampus

(2) The limbic lobe includes 5 parts, mention 2?

- Subcallosal area
- Cingulate gyrus

(3) The amygdala has four functions mention them all?

- FEAR
- Emotions
- Anger
- Hormonal secretions

Good luck
Special thank for team436 ❤

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