Anatomy of White Matter of Cerebral Hemisphere & Limbic System

Department of human Anatomy and Embryology
Faculty of Medicine
Mansoura National University, Egypt

By

Dr. Fekry Shata

Intended Learning Outcomes (ILOs)

1. **Describe anatomy of white matter of cerebral hemisphere.**
2. **Describe anatomy of the limbic system.**

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Agenda

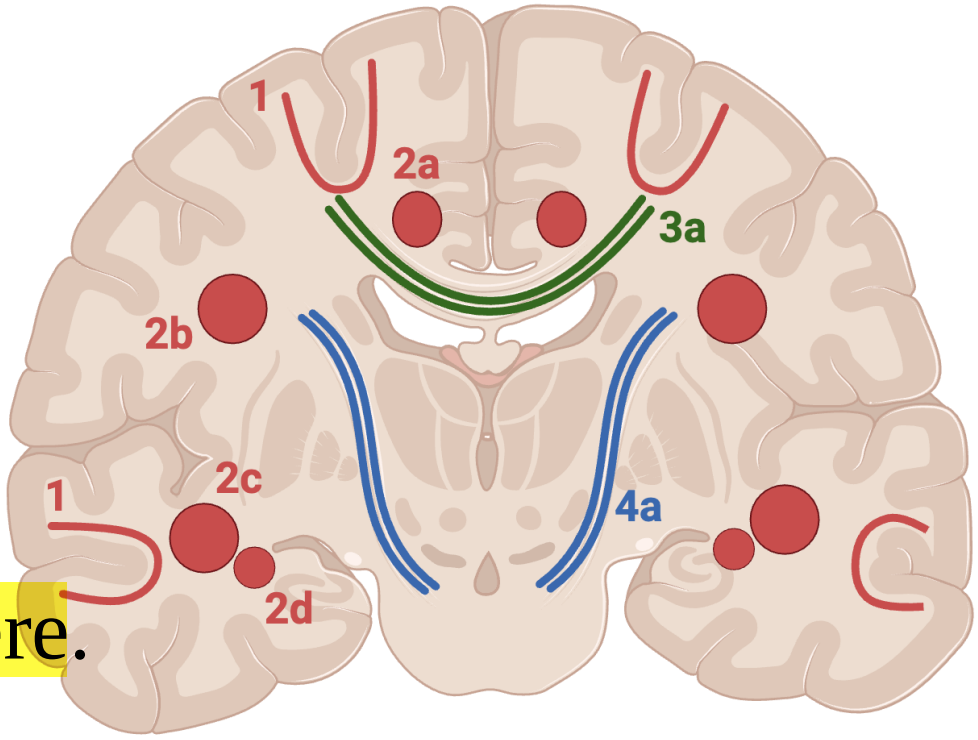
1. Anatomy of the white matter of cerebral hemisphere
2. Anatomy of the limbic system

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Anatomy of White Matter

Types كلها بتيجي MCQ

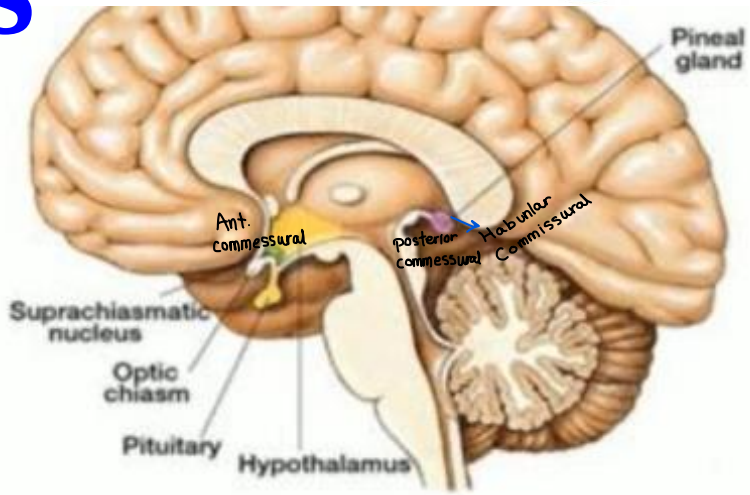
1. **Commissural fibers:** connect the **same cortical areas** of **different** cerebral hemispheres.
2. **Association fibers:** connect **different cortical areas** in the **same** cerebral hemisphere.
3. **Projection fibers:** connect the cerebral cortex with the **subcortical** areas. بيربط فوق بتحت



1) Short association fibers
2) Long association fibers
   a) Cingulum
   b) Superior longitudinal fasciculus
   c) Inferior longitudinal fasciculus
   d) Uncinate fasciculus
3) Commissural fibers
   a) Corpus callosum
4) Projection fibers
   a) Internal capsule

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

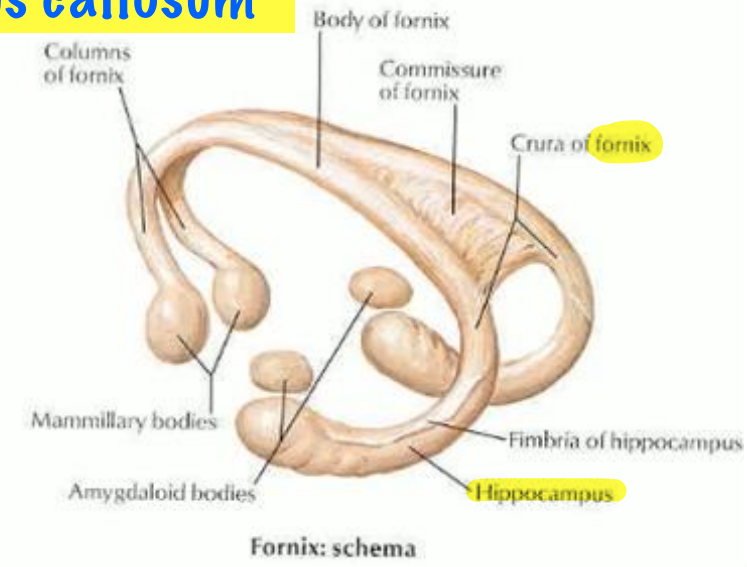
Commissural Fibers



Definition: They connect the **same cortical areas** of the **two different** cerebral hemispheres.

Types:

1. **Corpus callosum.** MCQ : Largest commissural fiber is : Corpus callosum
2. **Anterior commissure.**
3. **Posterior commissure.**
4. **Hippocampal commissure.**
5. **Habenular commissures.**



Fornix: schema

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

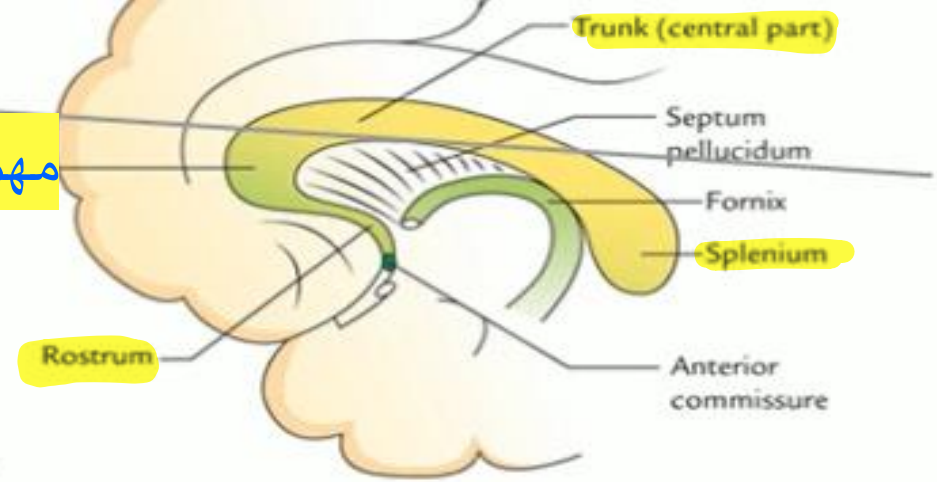
مهمة جدا جدا جدا وبتيجي Written

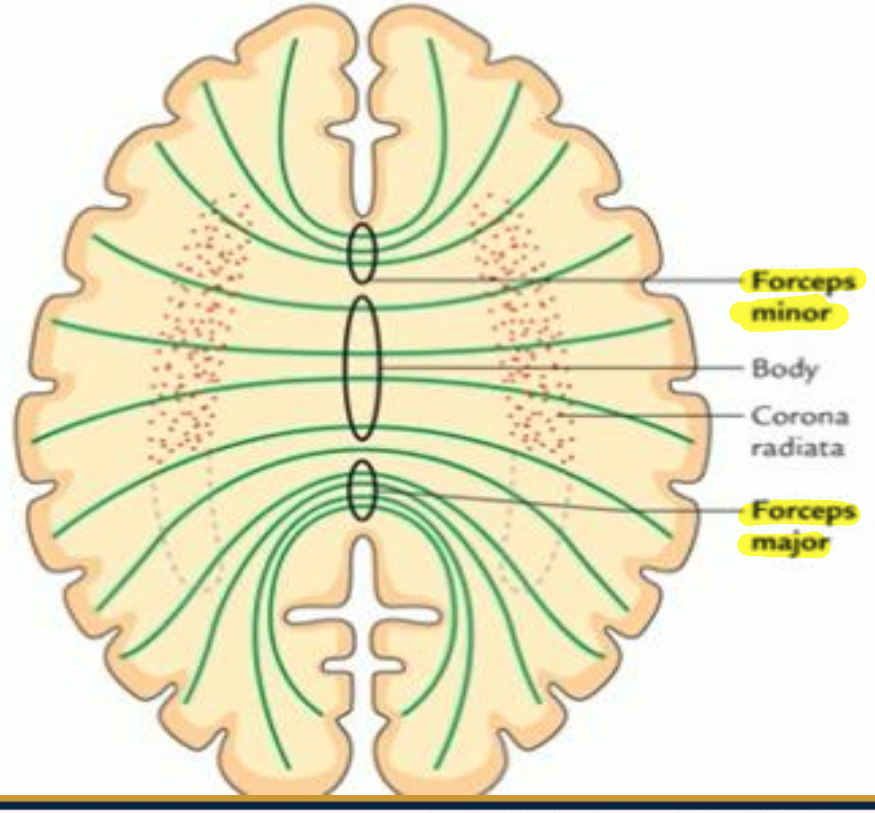
MCQ :-
1- Largest part (Commessural fiber) is :
A/ Corpus Callosum
2- Frontal lobe is connected by :
A/ Forceps minor or genu
3- Occipital lobe is connected by :
A/ Forceps major or splenium
4- Parietal lobe is connected by :
A/ radiation of corpus callosum - body
5- Temporal lobe is connected by :
A/ tapetum of corpus callosum

Corpus Callosum

Parts مهمة MCQ و SAQ

1. **Rostrum:** it is continuous with the lamina terminalis.
2. **Genu:** is the anterior end of the corpus callosum. Its fibers form the forceps minor, which connects the two frontal lobes.
3. **Splenium:** is the posterior end of the corpus callosum. Its fibers form the forceps major, which connects the two occipital lobes.
4. **Body (trunk):** is the central part of the corpus callosum. Its fibers form the radiation of corpus callosum. The posterior fibers form the tapetum, which connects the 2 temporal lobes.

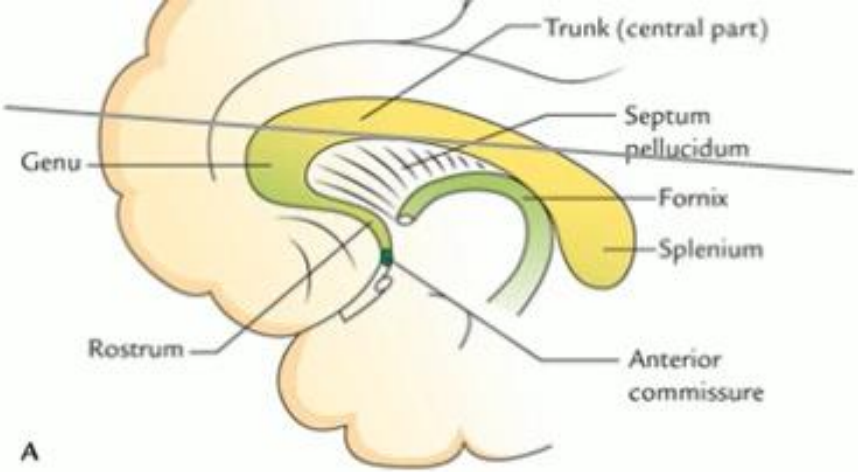


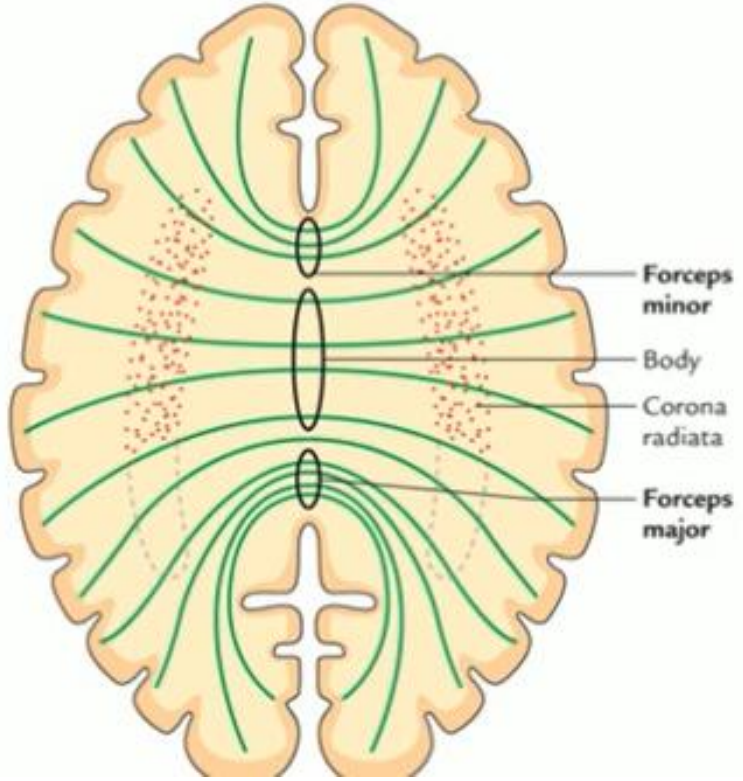


SAQ : Describe parts of corpus callosum?

Function مهمة

- Transfer of information (**memory and language**) between the 2 hemispheres.
- **Lesion: Callosal Apraxia**. The memory and language processes will not be accessible to the nondominant hemisphere causing left side disorders.





Other commissures

1. Anterior Commissure: It connects the two temporal lobes

2. Posterior Commissure: It connects: Written

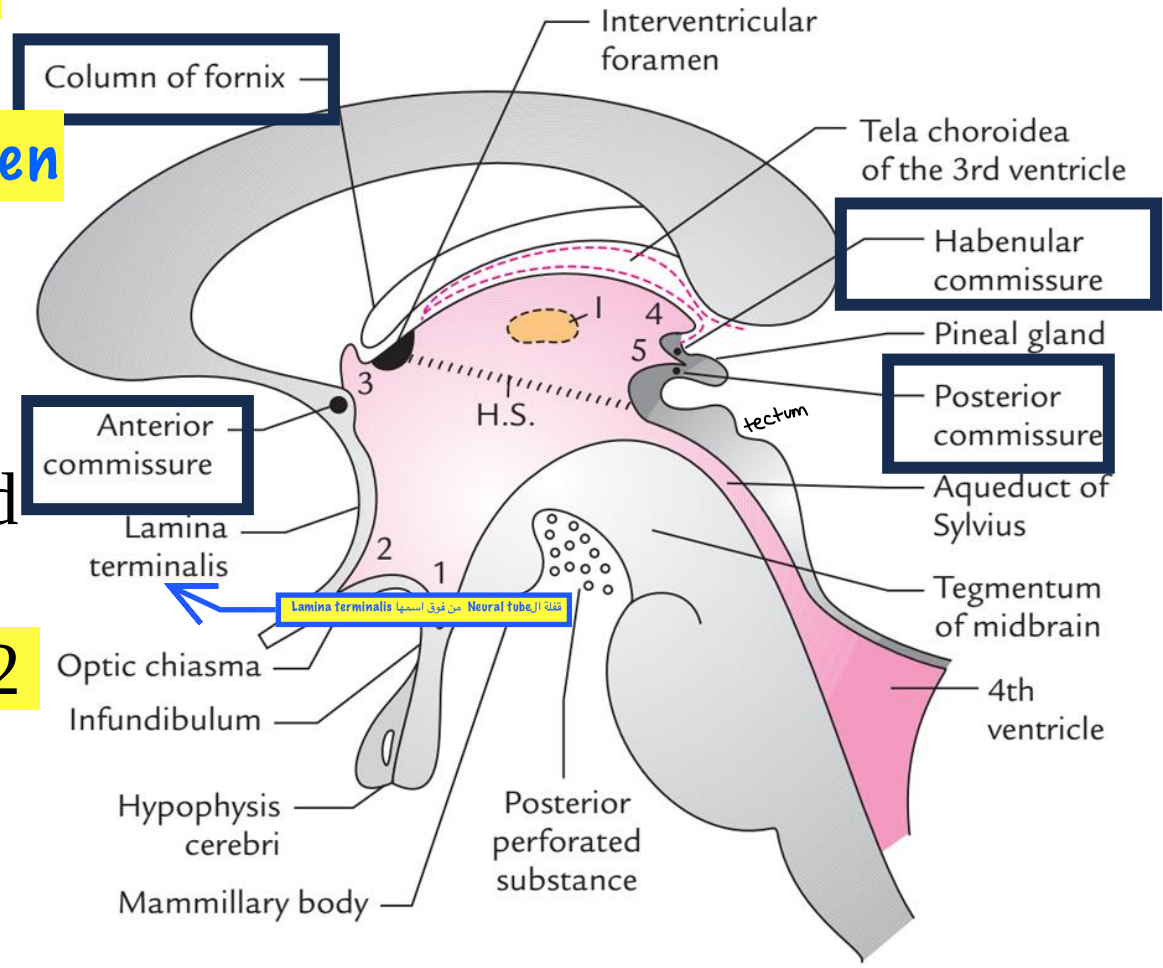
A. The two superior colliculi.

B. The pretectal nucleus and the Edinger-Westphal nuclei for the bilateral light reflex.

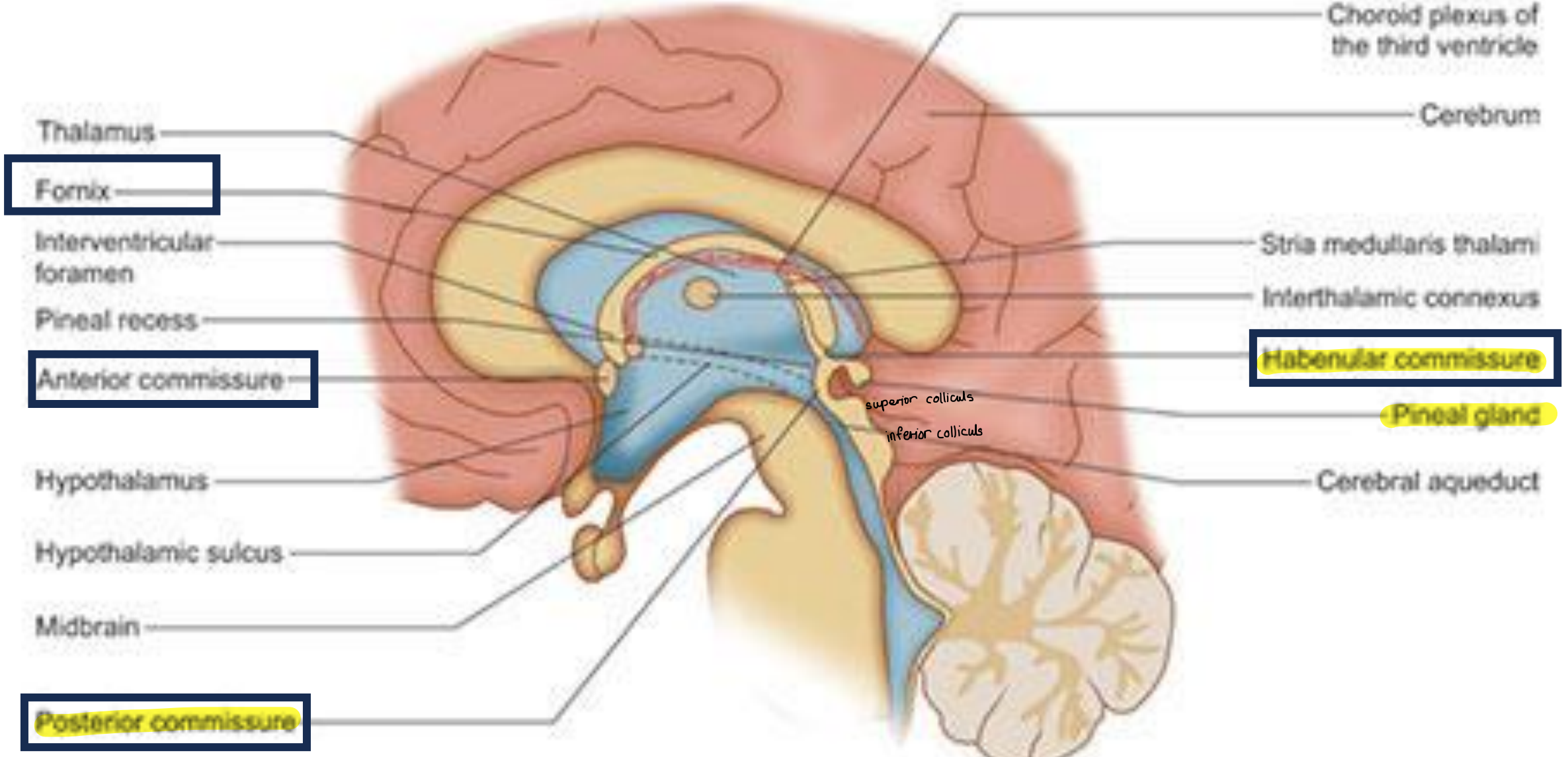
C. The two-occulomotor nuclei for the upward gaze.

3. Hippocampal Commissure: connects the 2 fornices and the 2 hippocampi MCQ

4. Habenular Commissure: connects the habenular nuclei of the two sides



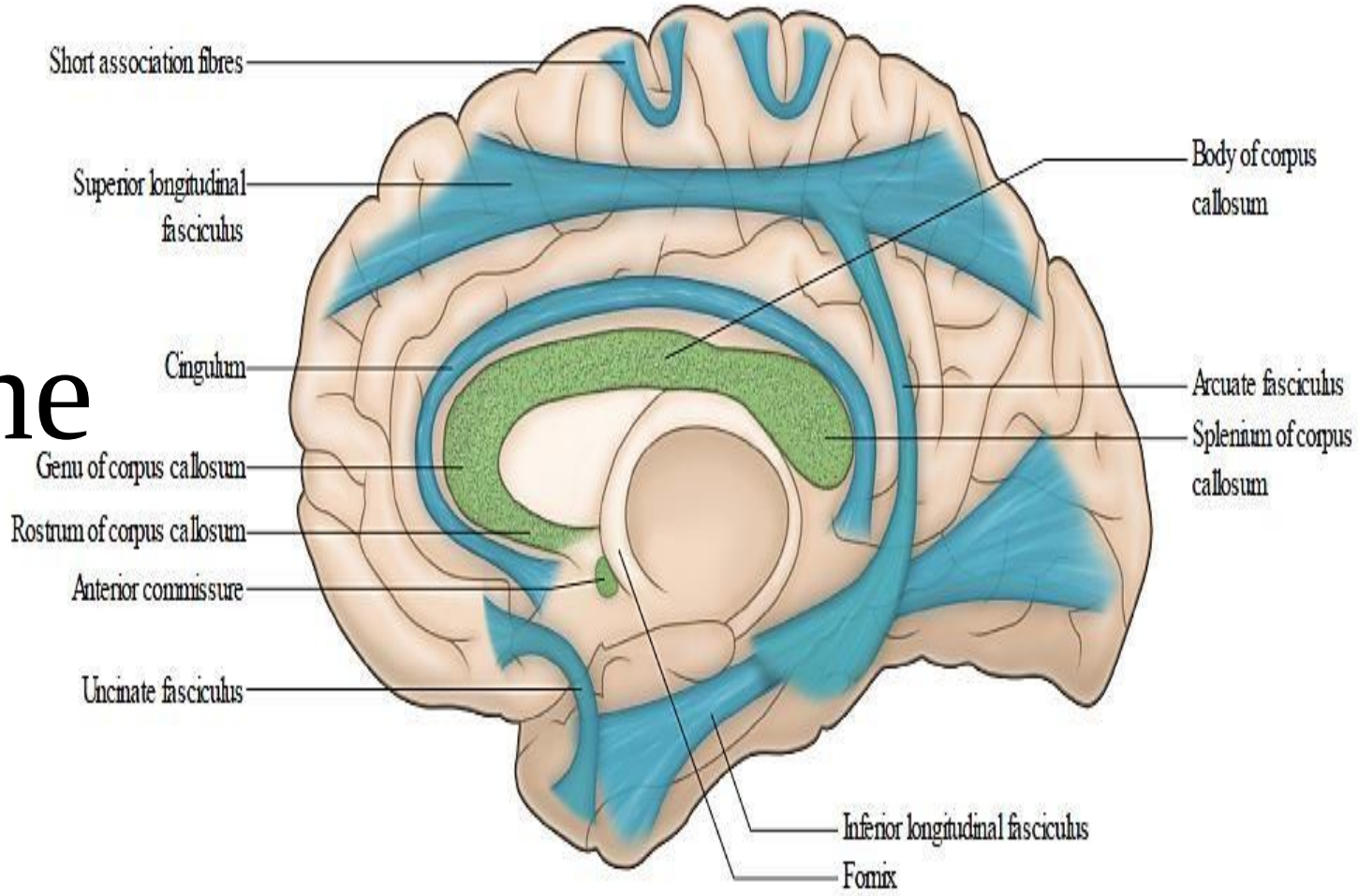
SAQ : What does posterior commissure connects ?



الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Association fibers

- **Definition:** they connect different cortical areas in the same hemisphere.



الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

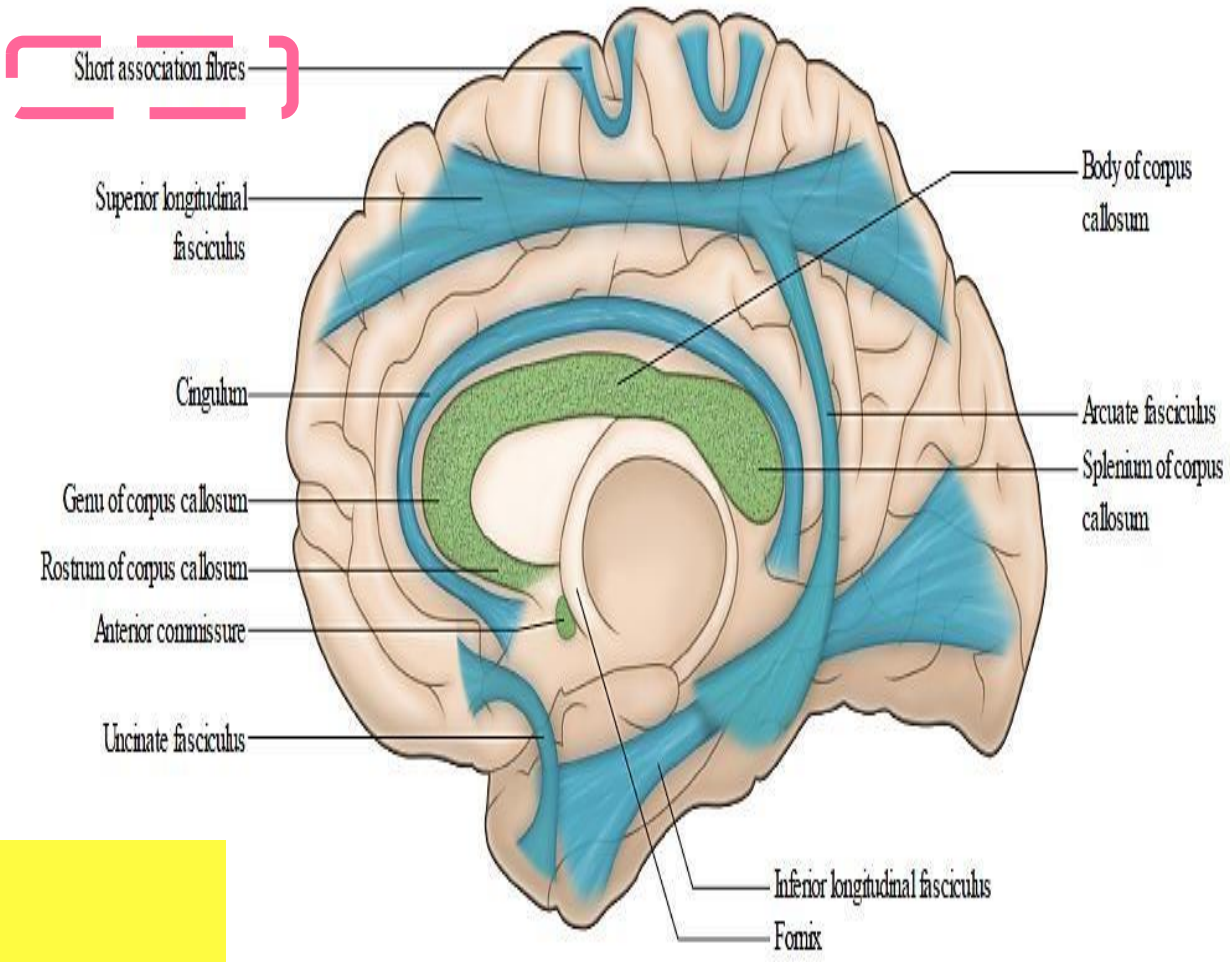
Types of association fibers

They are divided into **short** and **long** fibers:

A. Short Association Fibers:

They connect adjacent cortical areas.

(Arcuate fibers) MCQ



MCQ :

1- Arcuate fibers is :

2- Fiber connect (adjacent - distant) area is :

Association fibers

MCQ
Written وممكن يجي

B. Long Association Fibers: they connect **distant** cortical areas.

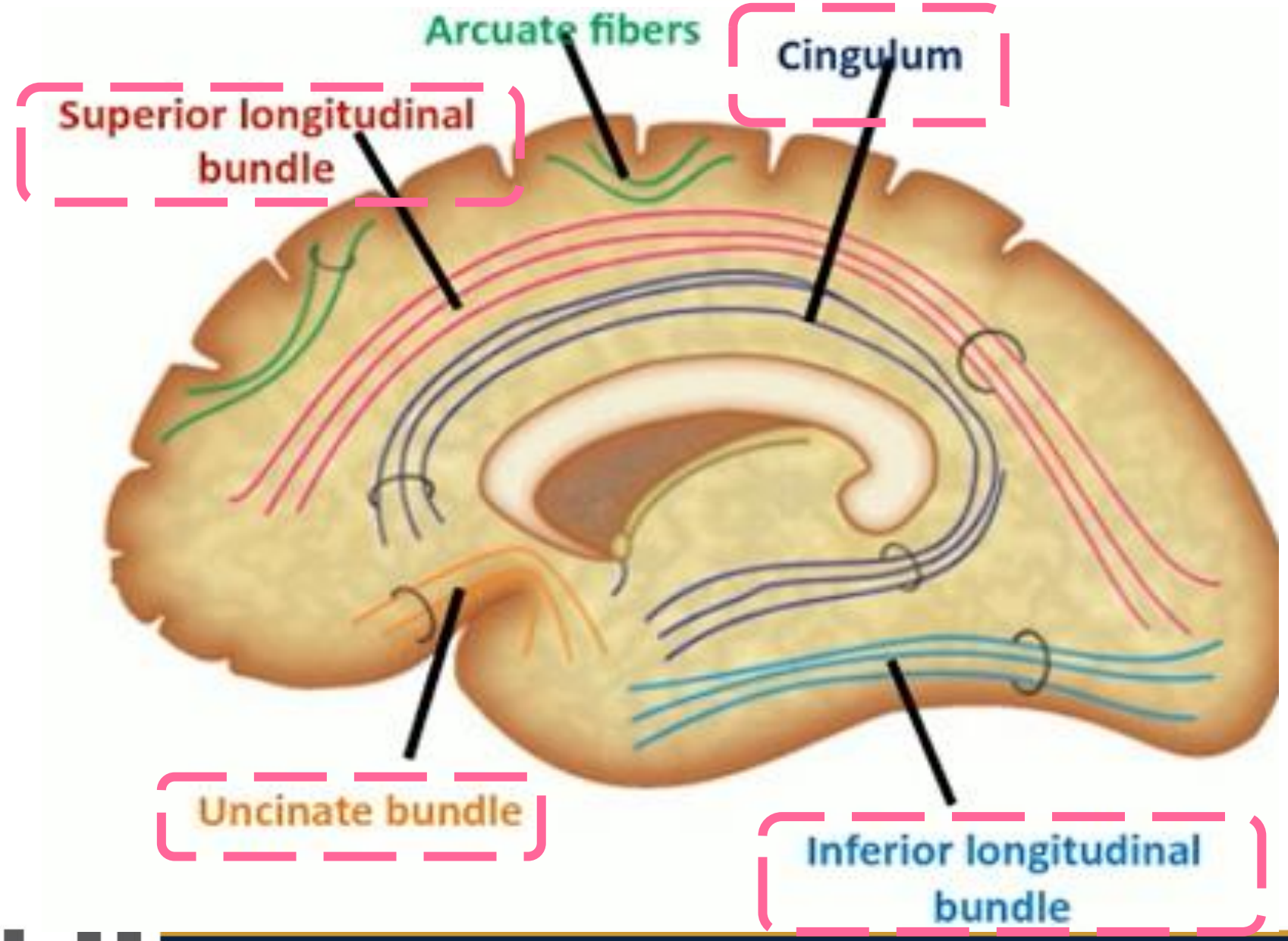
1. Superior longitudinal fasciculus (arcuate fasciculus): connects the **4 lobes together**. Largest association fiber

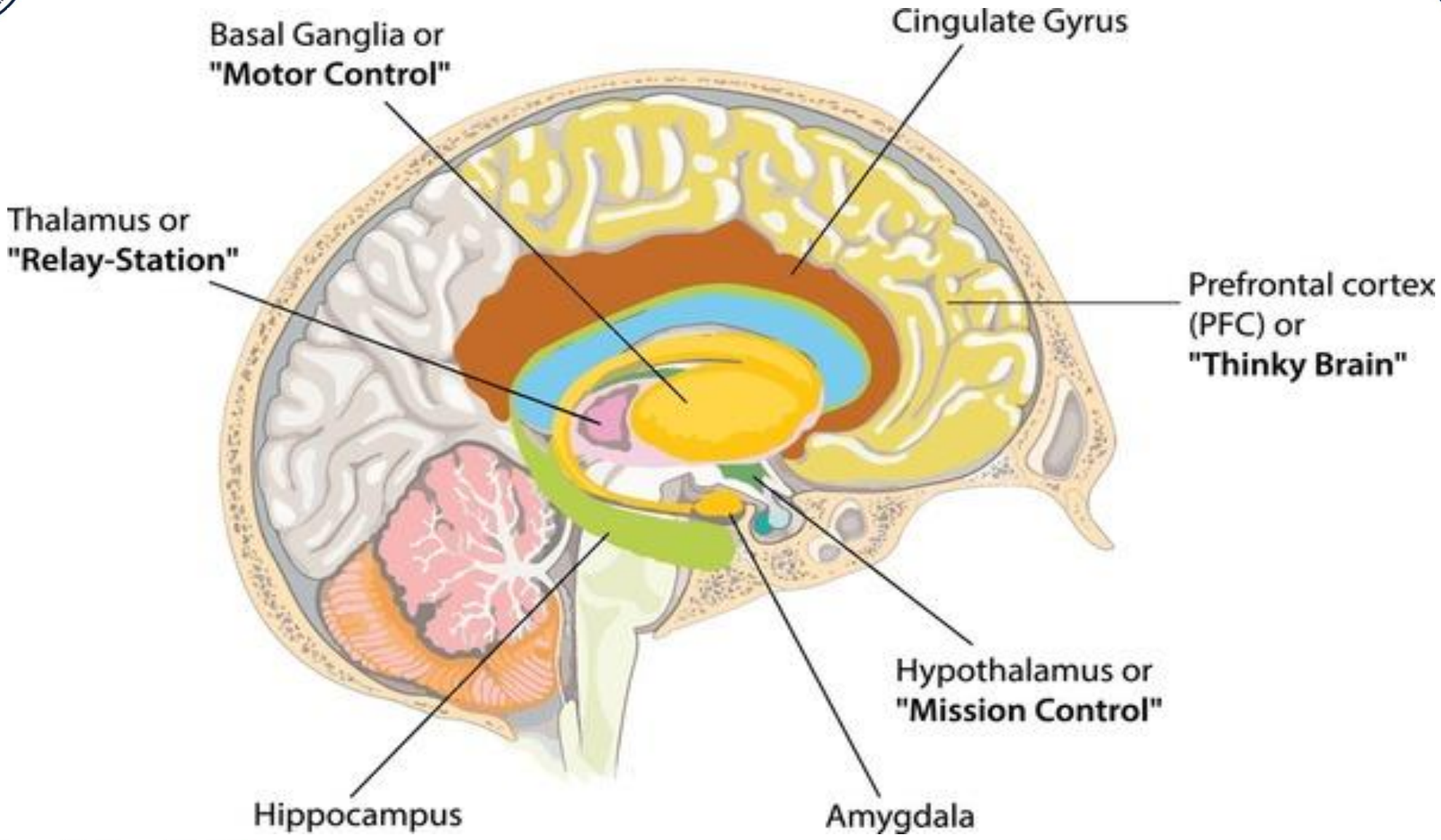
2. Inferior longitudinal fasciculus: connects the **occipital lobe with the temporal lobe**.

3. Uncinate fasciculus: forms an arch around the stem of the lateral sulcus and connects the **frontal lobe with the temporal lobe**.

4. Cingulum: lies in the cingulate gyrus. It is the fiber bundle of the limbic lobe. It connects the **cingulate gyrus with the parahippocampal gyrus and ends in the uncus.** Limbic lobe بيعمل ال

SAQ : Enumerate long association fibers ?

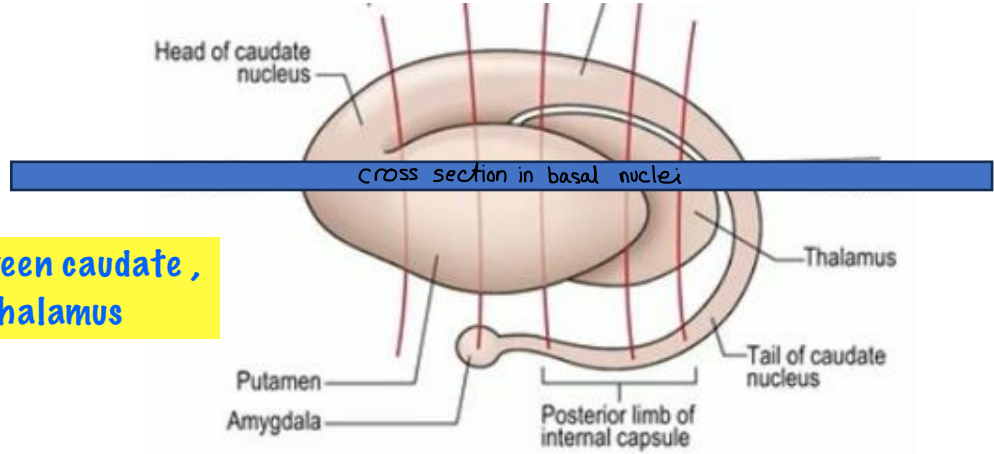

Arcuate fibers
Cingulum
Superior longitudinal bundle
Uncinate bundle
Inferior longitudinal bundle

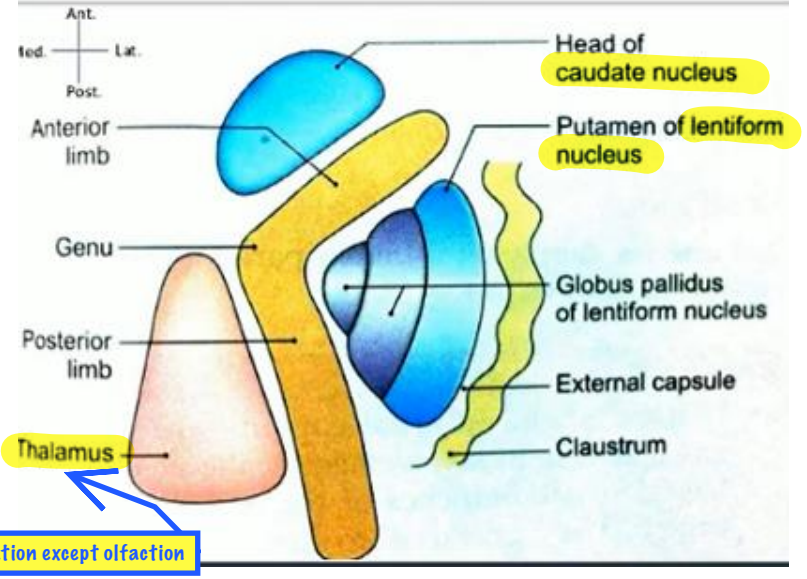

Basal Ganglia or
"Motor Control"
Cingulate Gyrus
Thalamus or
"Relay-Station"
Prefrontal cortex
(PFC) or
"Thinky Brain"
Hypothalamus or
"Mission Control"
Hippocampus
Amygdala

Projection fibers

- **Definition**: they **connect the cerebral cortex with the subcortical areas** and form a compact bundle called the **internal capsule** Located between caudate , lentiform & thalamus
- **Types:** they are divided into ascending and descending fibers:

1. **Ascending** projection fibers: are mainly thalamocortical fibers.
2. **Descending** projection fibers: such as corticospinal and corticobulbar fibers

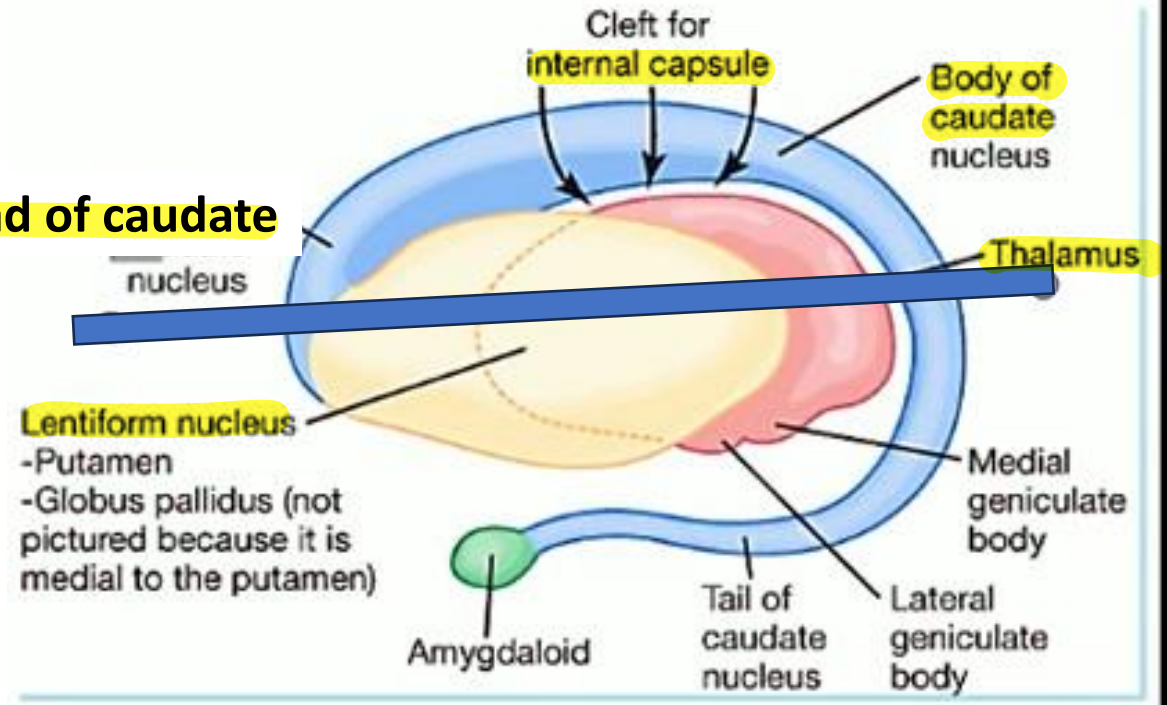


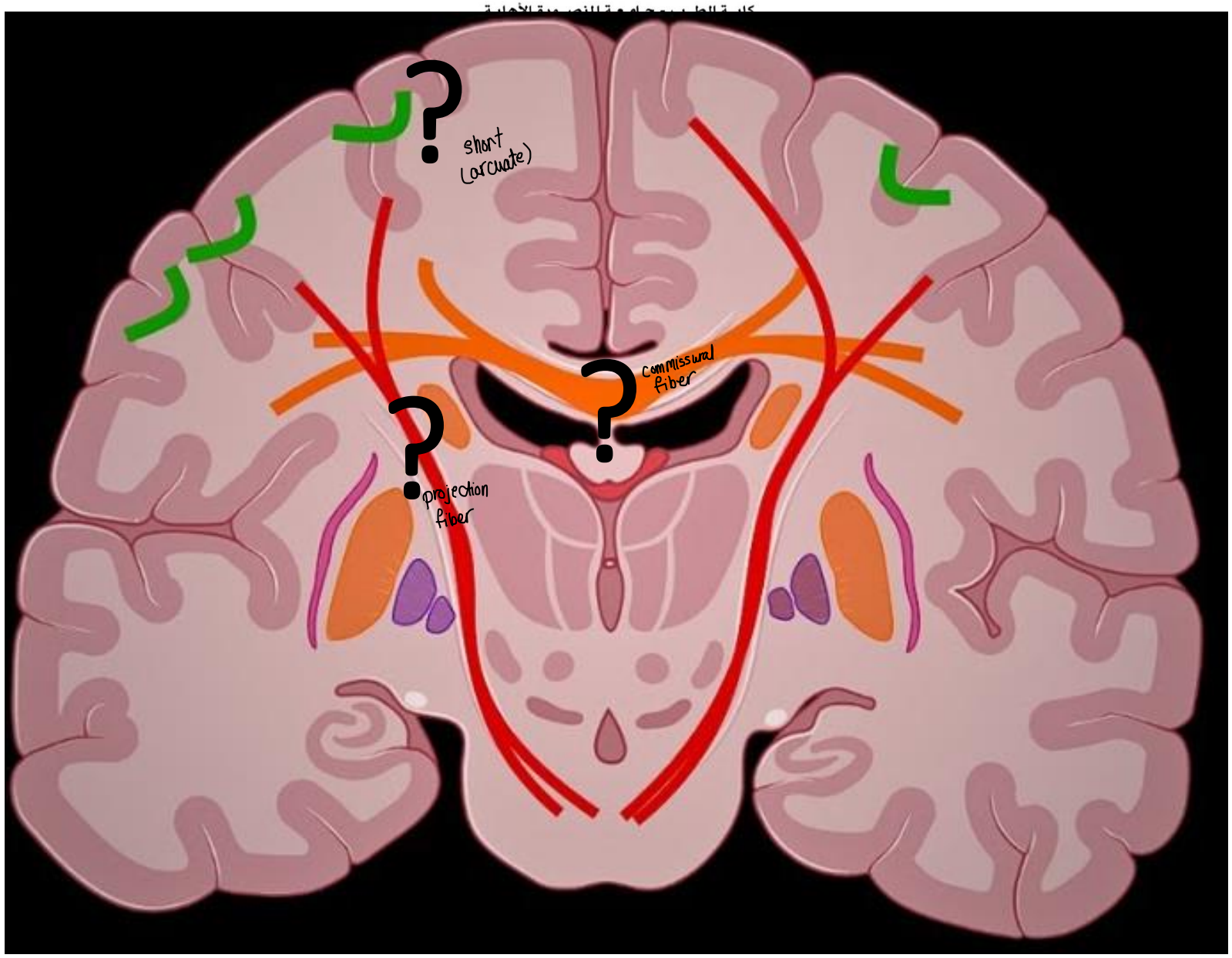


All sensory pass here so it's called : relay station of for sensation except olfaction

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

بتيجي سؤال identify





الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Quiz

1. Fibers which connect the cerebral cortex with the subcortical areas

a. Long association
b. Short association
c. Commissural
d. Projection
e. Forceps minor

Answer: d

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Quiz

2. Fibers which connect the two frontal lobes

a. Long association

b. Short association

c. Forceps major

d. Projection

e. Forceps minor

Answer: e

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

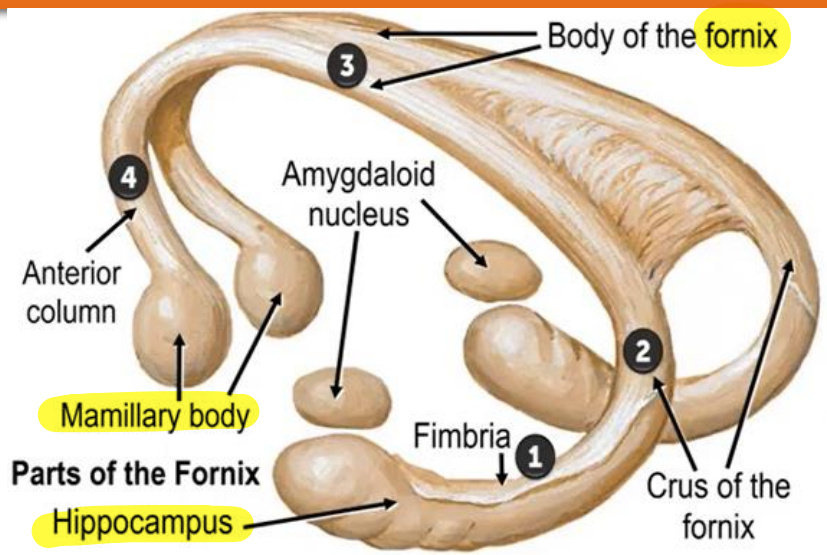
Anatomy of Limbic System

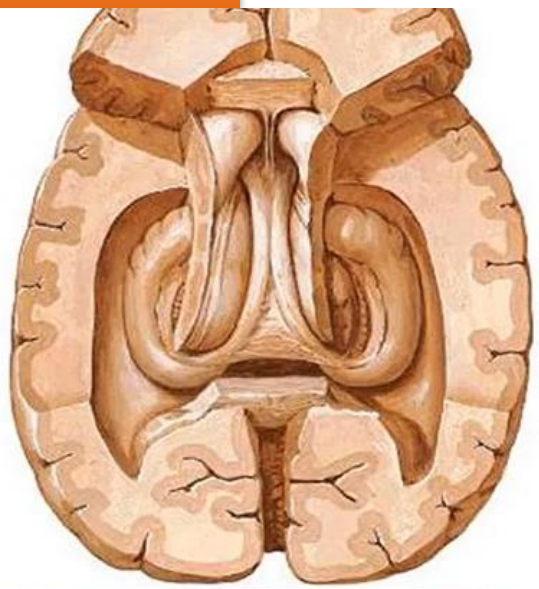
الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

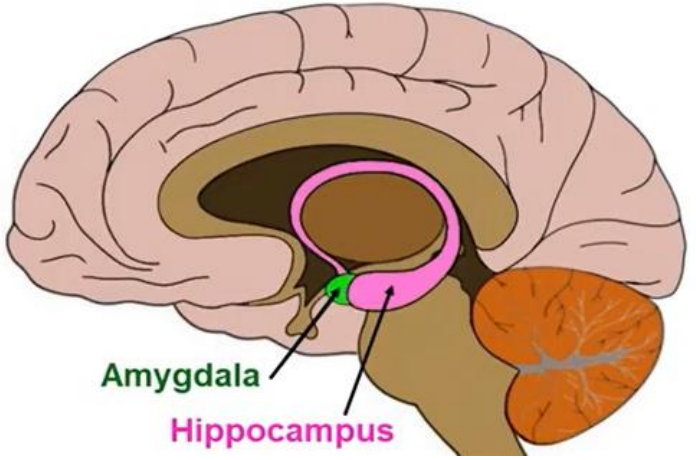
Components of the Limbic System

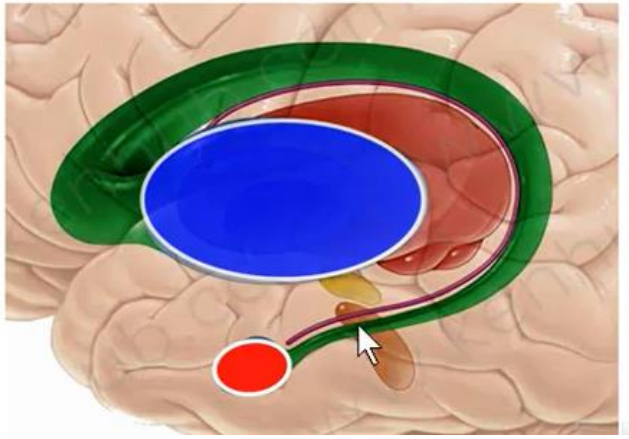
A. Nuclei.

B. Fiber bundles connecting the nuclei.







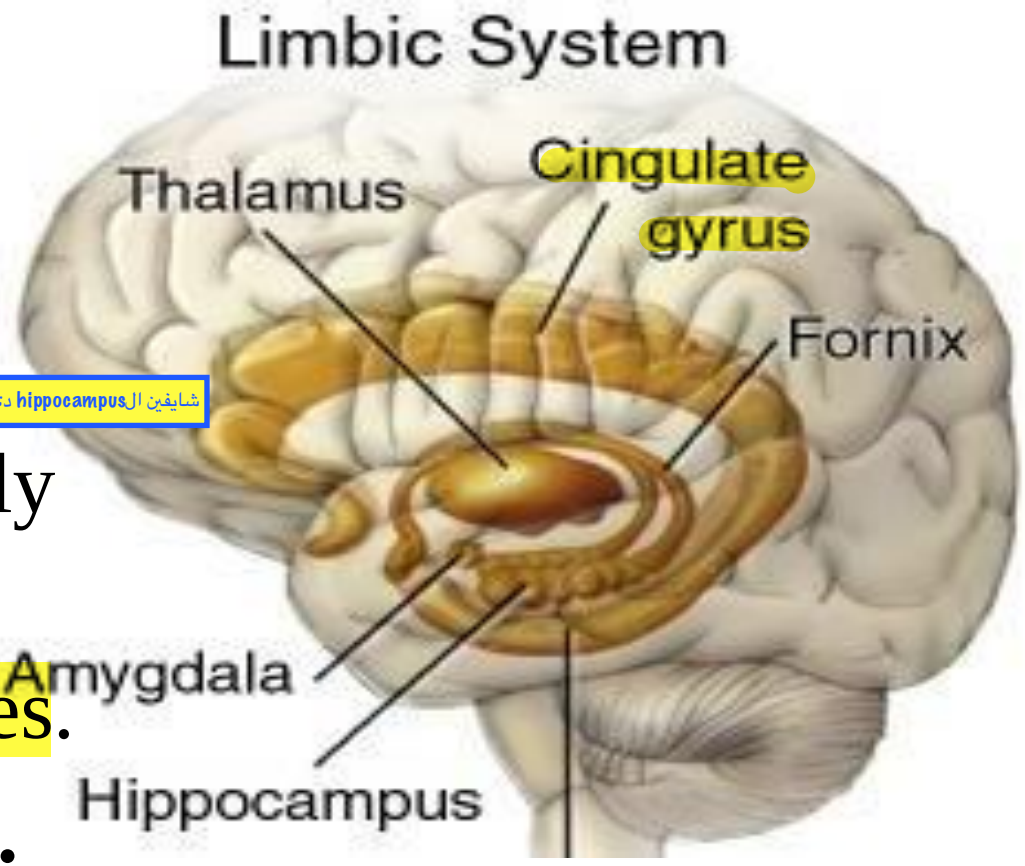


ال8 حفظ بيجي Written و MCQ

Nuclei of the Limbic System

1. **Limbic lobe:** formed of the cingulate gyrus, parahippocampal gyrus and the uncus.
2. **Hippocampus:** is continuous externally with the parahippocampal gyrus.
3. **Hypothalamus:** the mammillary bodies.
4. **Anterior and medial thalamic nuclei.**

شايفين الhippocampus دي مهمة جدا .. وهيا المسؤولة عن الذاكرة ولما نبعد عن المشتتات هتشتغل أحسن 😉



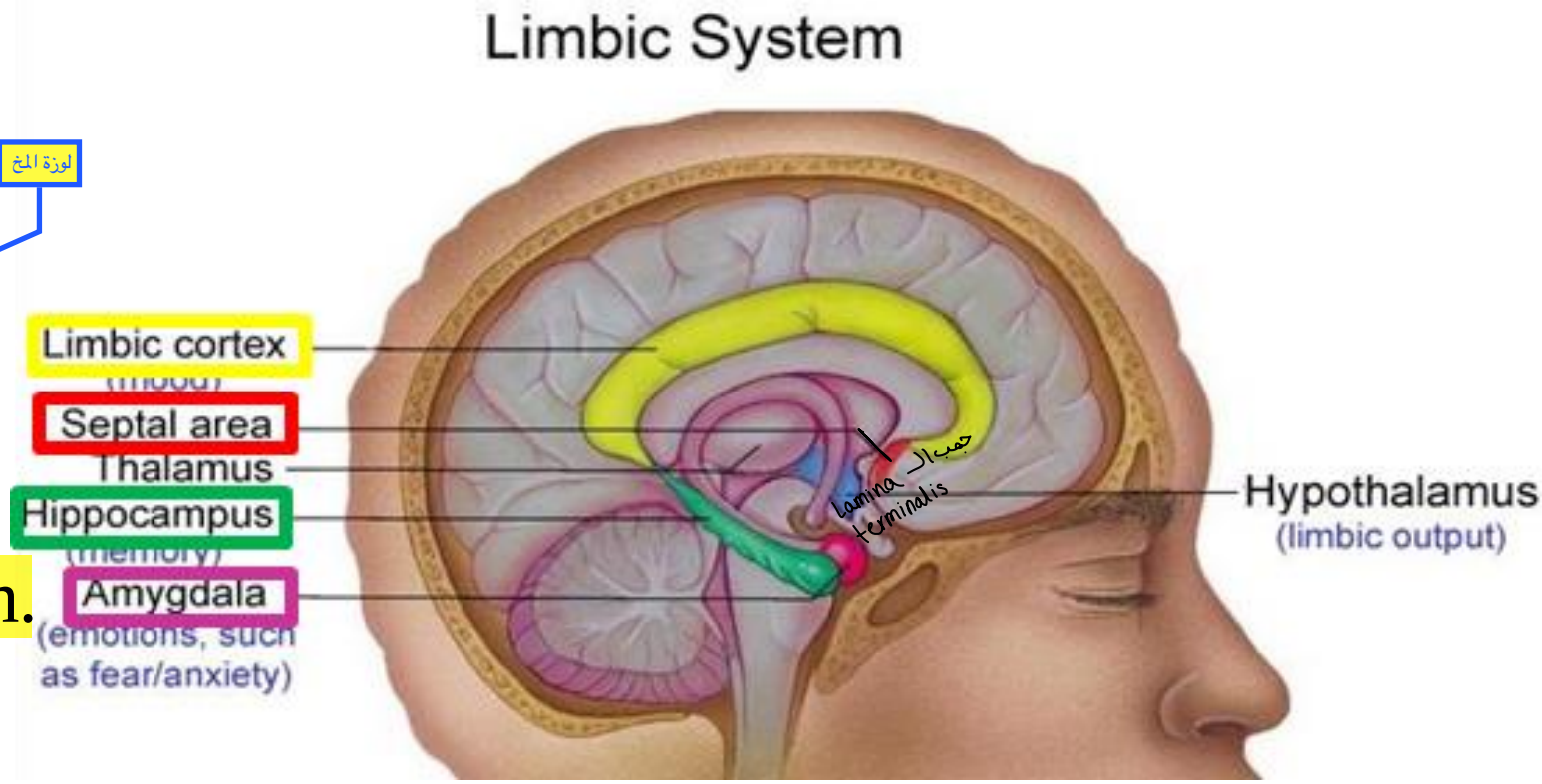
Nuclei of the Limbic System

5. The prefrontal cortex (personality center).

6. Amygdaloid nucleus (amygdala).

7. Septal area (medial olfactory area):below the rostrum.

8. Habenular nucleus.



Fiber Bundles of the Limbic System

1. Cingulum: fiber bundle of the limbic lobe.

2. Fornix: Arises from the hippocampus and terminates in the mamillary body. Formed of 4 parts: Written

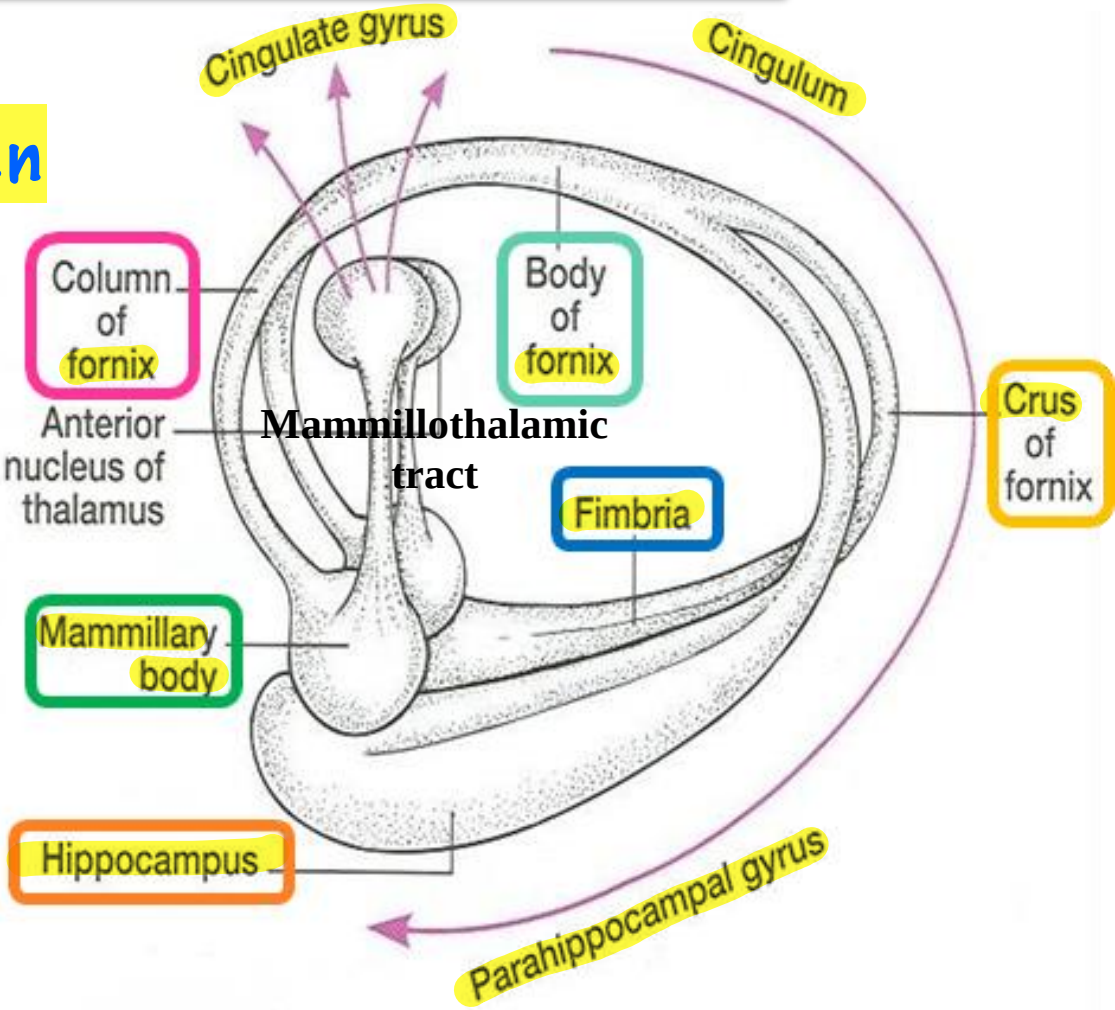
A. Fimbria: nerve fibers on the medial border of the hippocampus.

B. Crus of the fornix: is the continuation of the fimbria.

C. Body of the fornix: fused two crura of the fornix.

D. Anterior column of the fornix: each one terminates in the mamillary body.

ليه علاقة بردو بالذاكرة
ويعتبر جزء من الhypothalamus



SAQ : Enumerate components of the fornix ?

Fiber Bundles of the Limbic System

بتوصل الhypothalamus بالthalamus

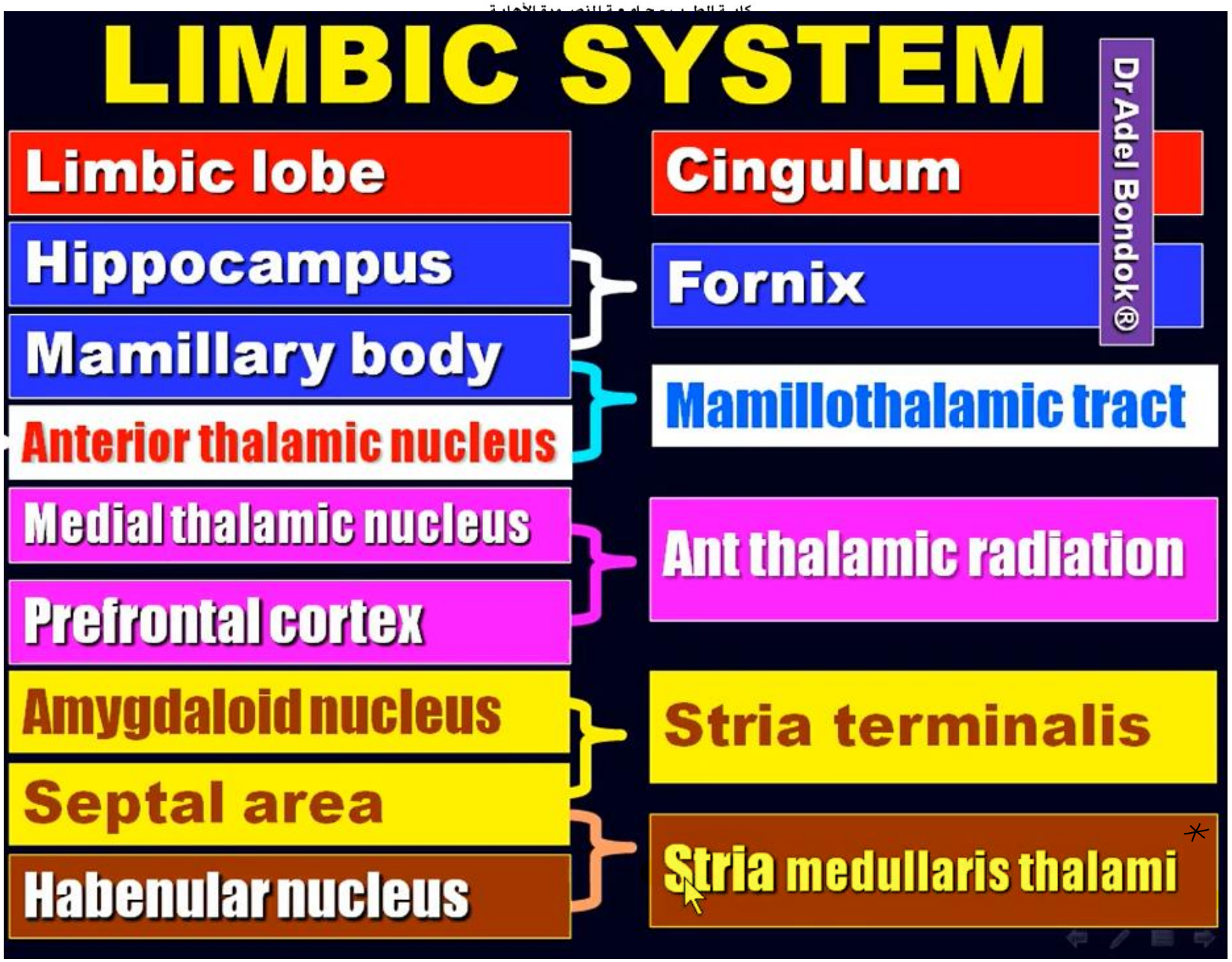
3. **Mammillothalamic tract:** connects the anterior thalamic nucleus with mamillary body

4. **Anterior thalamic radiation:** connects the medial thalamic nucleus with personality center

5. **Stria terminalis:** it begins in the amygdaloid nucleus and ends in the septal area.

6. **Stria medullaris thalami:** begins in the septal area and in the habenular nucleus.

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

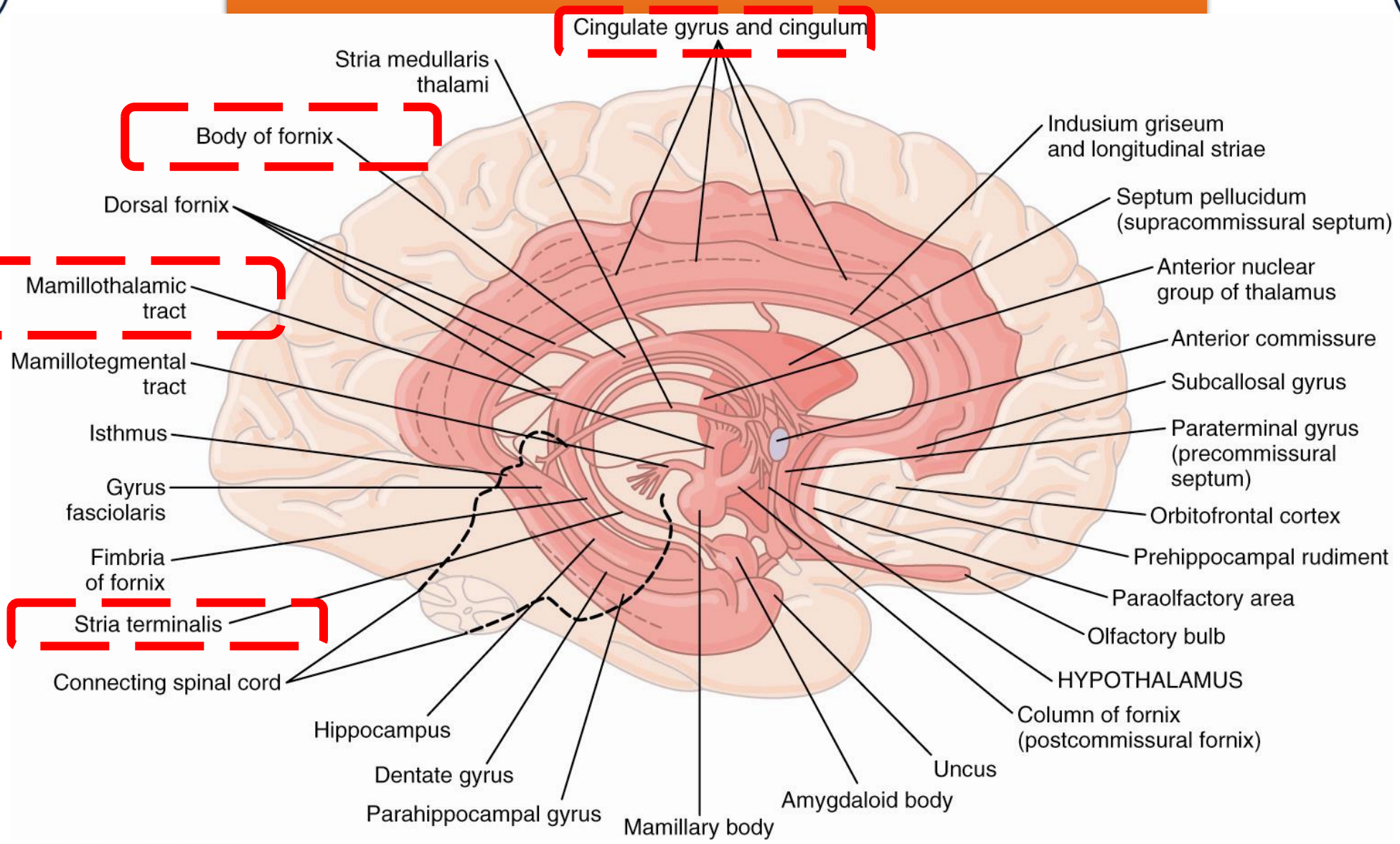


يطلع منها أسئلة MCQ كتير
بس غالبا بيجي سؤال واحد
في الامتحان
اطبع السلايد في دماغك

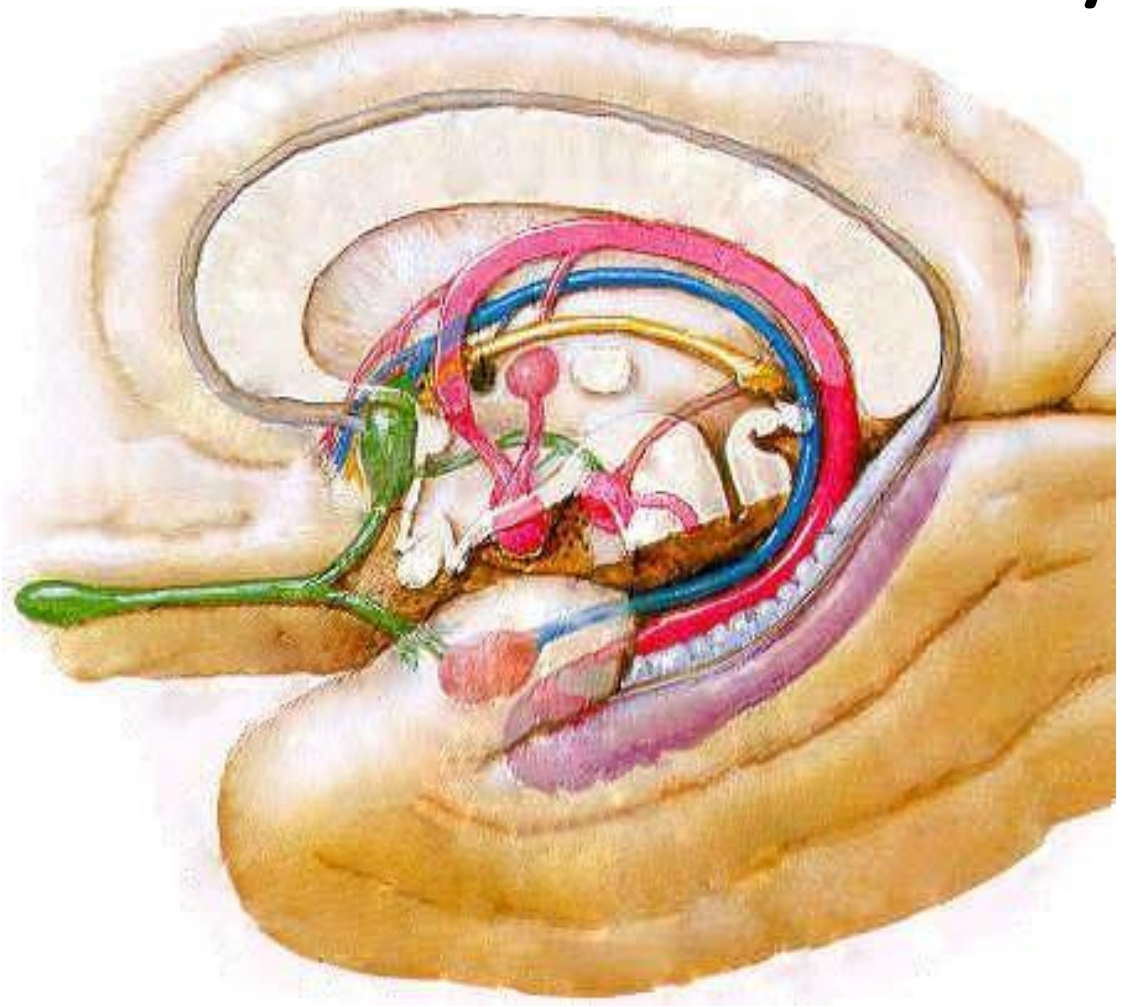
الدكتور أكد على سؤال
- Stria medallaries thalami connect :
وقال لازم يجي في الامتحان

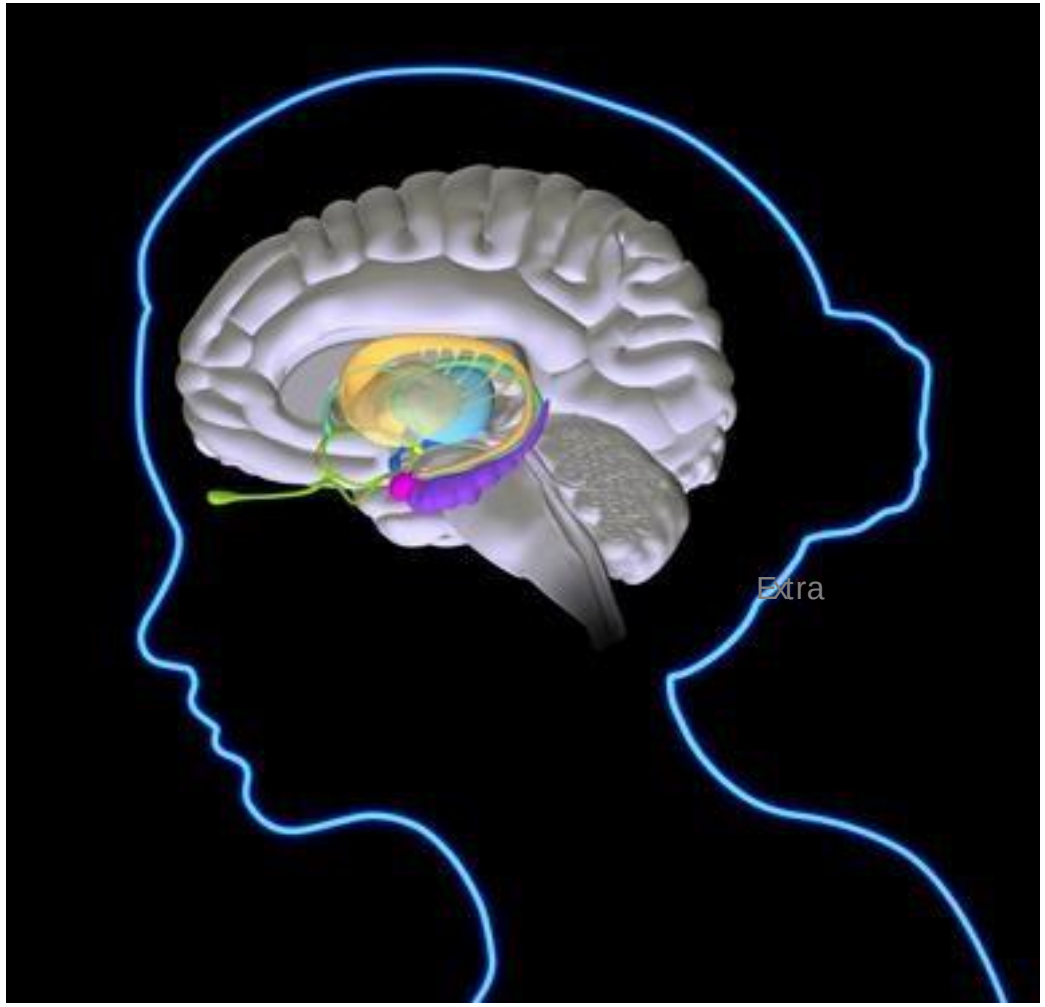
الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Location of the Limbic System

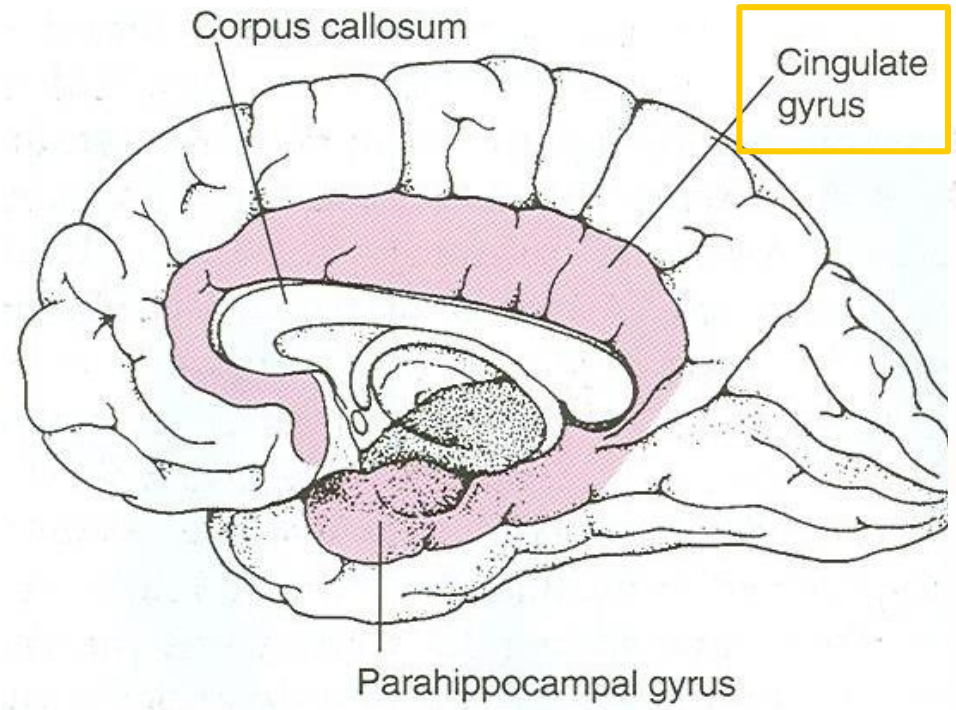


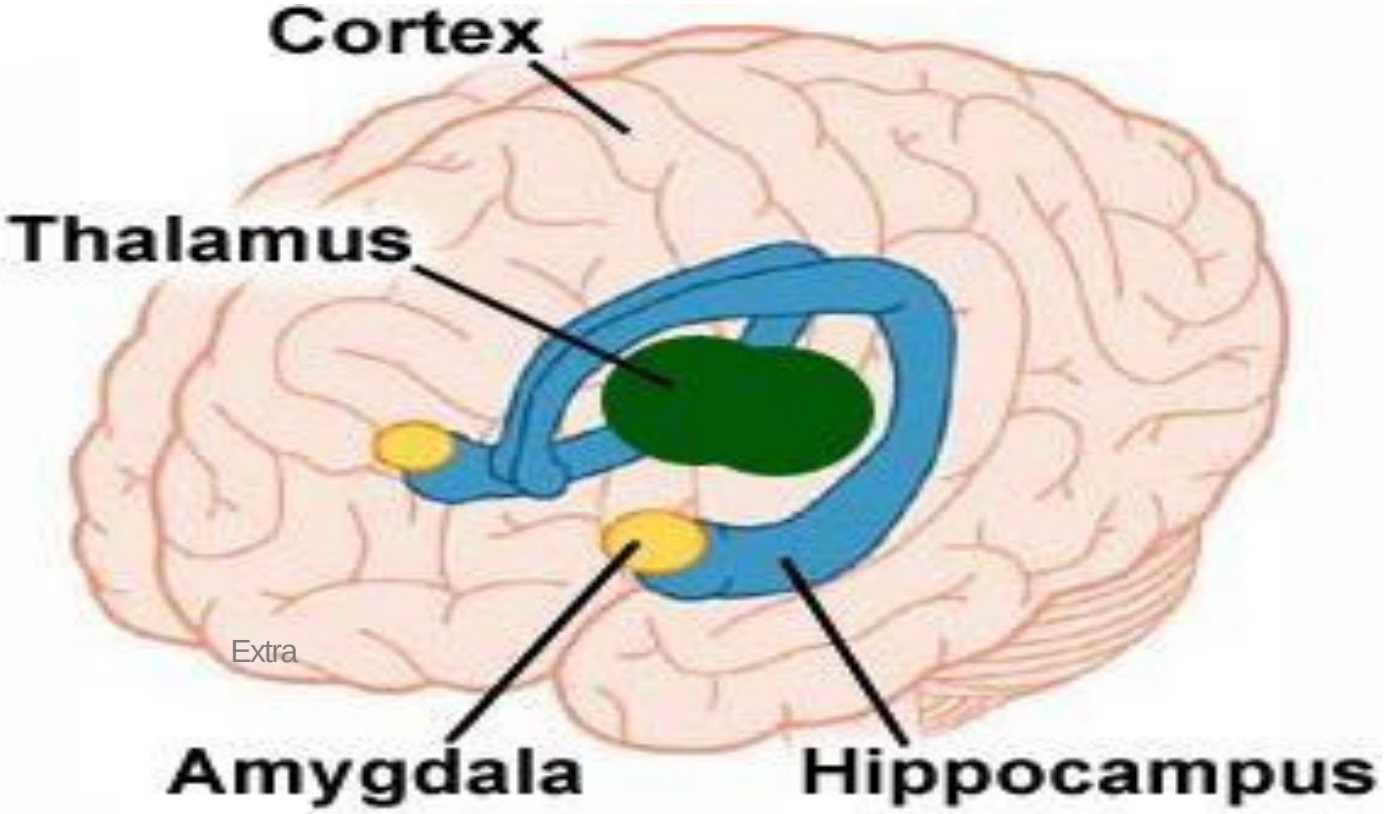
Limbic System





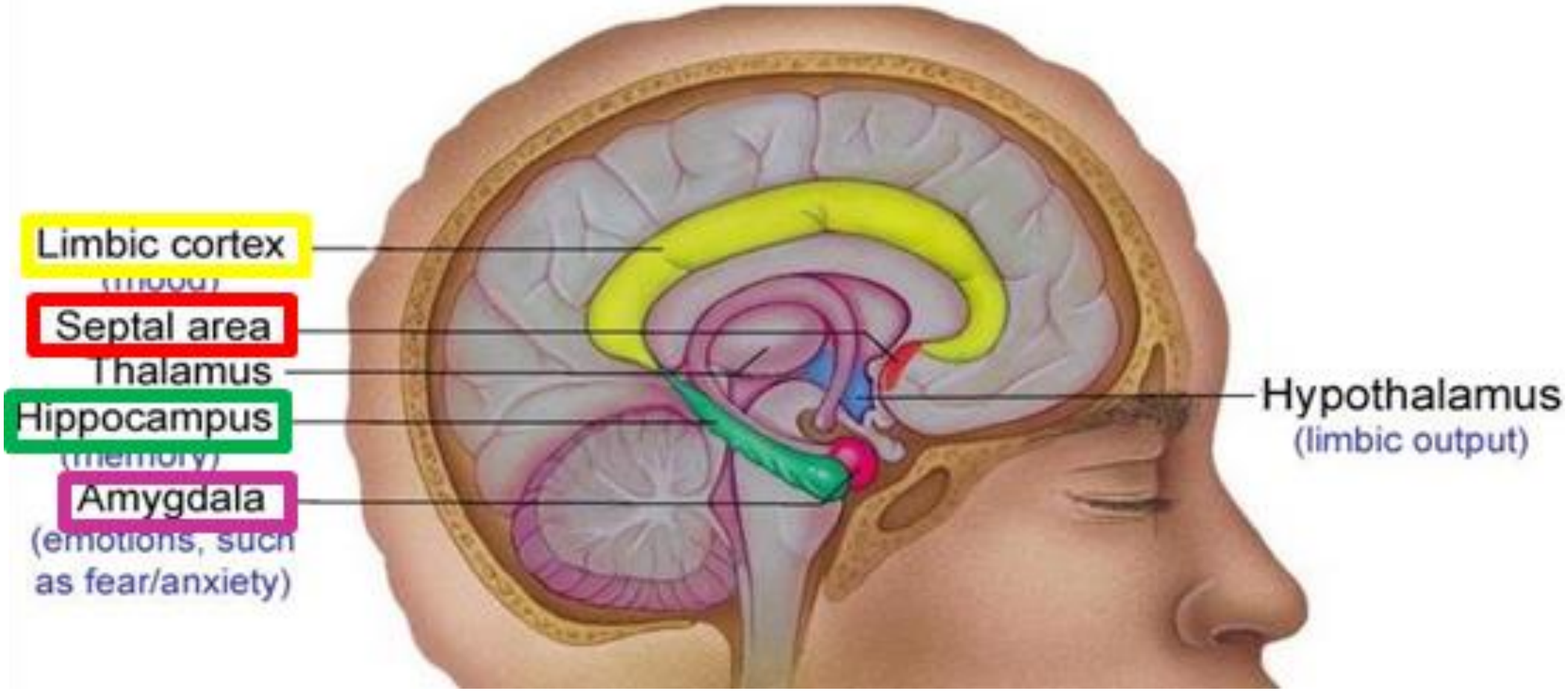
Limbic System

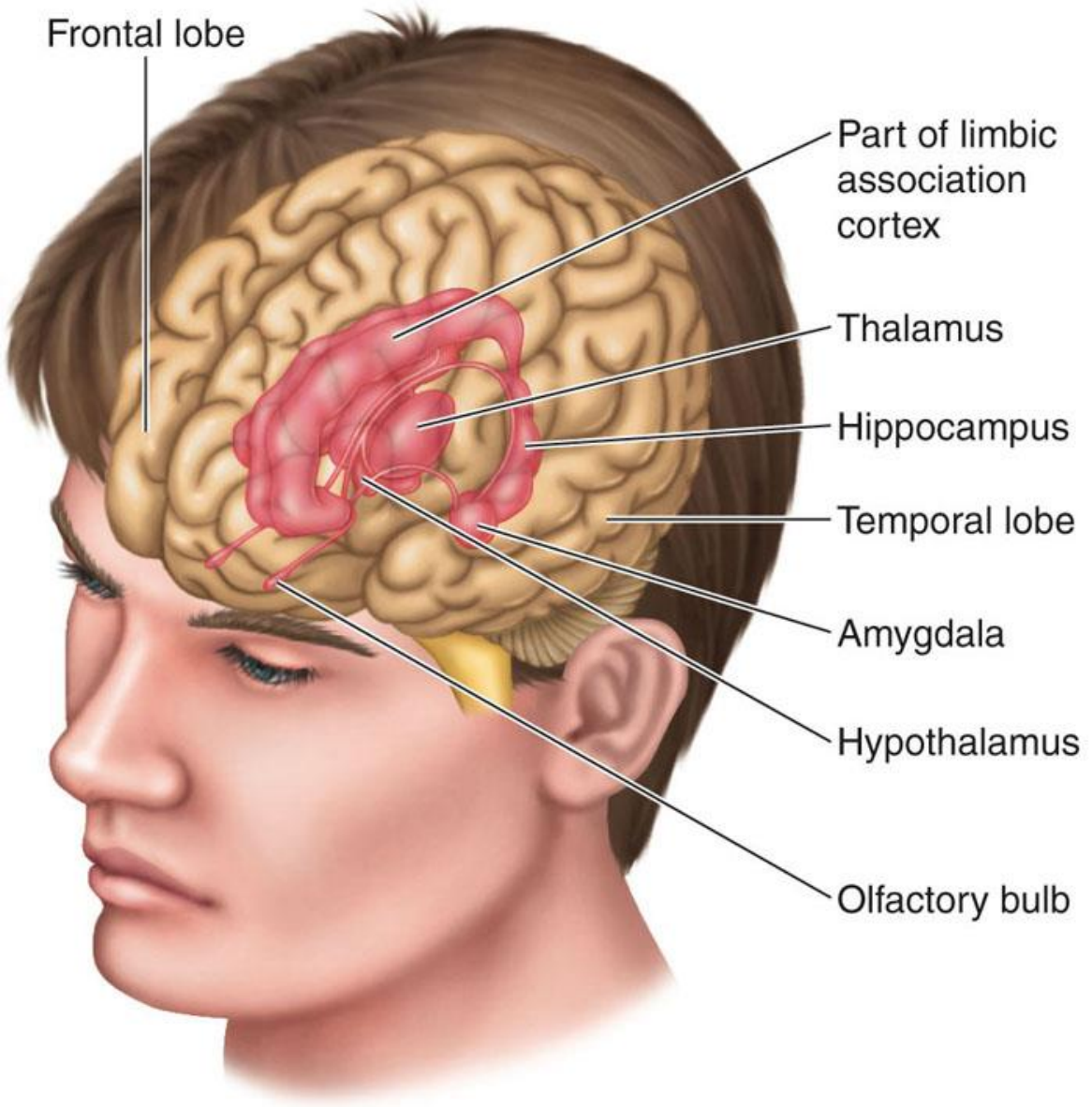




Extra

Limbic System




Frontal lobe
Part of limbic association cortex
Thalamus
Hippocampus
Temporal lobe
Amygdala
Hypothalamus
Olfactory bulb

Functions of the Limbic System

What is the function of the limbic system?

It controls a variety of functions

وظيفة الuncus

Emotions

Behavior & Mood (happy, cry, laugh, sad, afraid, aggression, depression)

Visceral & Motor responses involved in sex, pleasure, hunger, and reproduction

Memory

Part	Function
• Amygdala	aggression & fear
• Cingulate gyrus	autonomic functions
• Hippocampus	recent memory
• Mamillary body	long memory
• Prefrontal cortex	personality

Olfaction

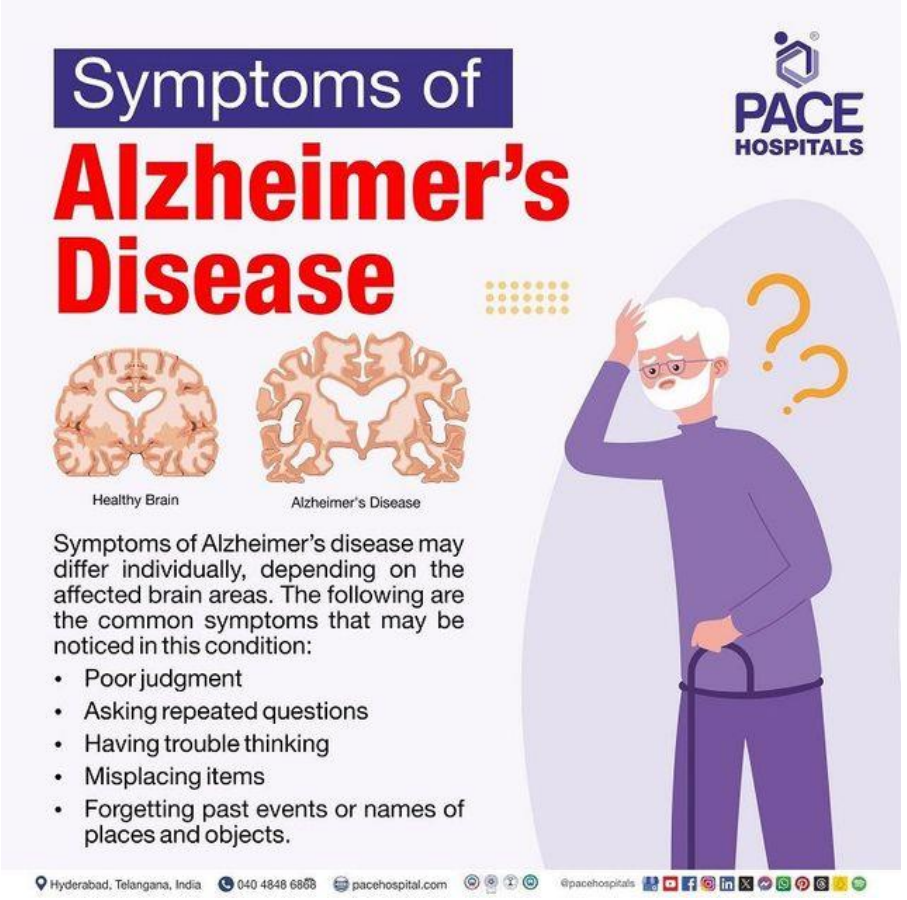
Functions of the Limbic System

1. **Recent memory**: the hippocampus has a role in remembering recent events.
2. **Emotional behavior**: it plays a role in feeling, feeding, aggression, anger, fear, sadness, pleasure and emotions associated with sexual behavior.
3. **Olfaction**: the uncus is a primary olfactory area.

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Clinical Problems of the Limbic System

- Leads to psychiatry disorders e.g.
  Schizophrenia, depression and senile dementia
- Lesions in **Hippocampus**:
  loss of recent memory, in Alzheimer's disease there is extensive degeneration of hippocampus
- Lesions in **Amygdaloid** nucleus:
  loss of aggressive behavior, fear and anger



Quiz

1. Recent memory is the function of:

a. Amygdaloid nucleus
b. Hippocampus
c. Septal area
d. Mamillary body
e. Anterior thalamic nucleus

Answer: b

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

Quiz

2. Aggression and fear is the function of:

a. Amygdaloid nucleus
b. Hippocampus
c. Septal area
d. Mamillary body
e. Anterior thalamic nucleus

Answer: a

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg

References for further readings

- Oxford Handbook of Clinical Medicine (3rd edition).
- Gray’s anatomy for students
- The Clinical Practice Of Neurological and Neurosurgical Nursing Fourth Edition.

الطريق الدولي الساحلي - منطقة 15 مايو - مدينة جمصة - محافظة الدقهلية
International Coastal Road - 15th of May District - Gamasa City - Dakahlia Governorate
medic@mansnu.edu.eg


الحمد لله
Thank You
Thank You