



# **General Anatomy**

## **Lecture 23: Nervous System (1)**

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# NERVOUS SYSTEM

**\*\* The human nervous system is divided into two main divisions:**

- 1. Central Nervous System (CNS):** The brain & spinal cord.
- 2. Peripheral Nervous system (PNS):** The cranial nerves, spinal nerves and associated ganglia.

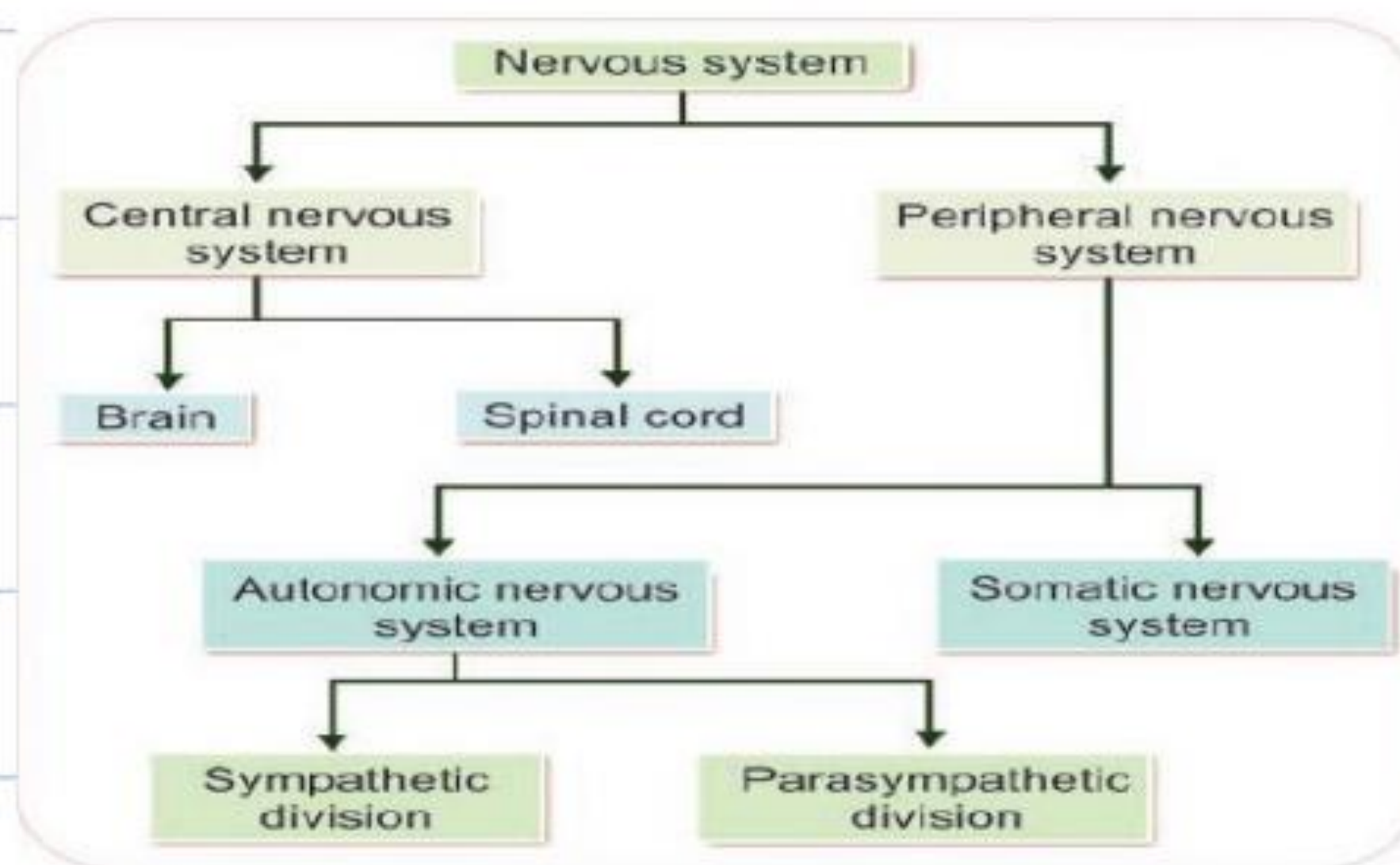
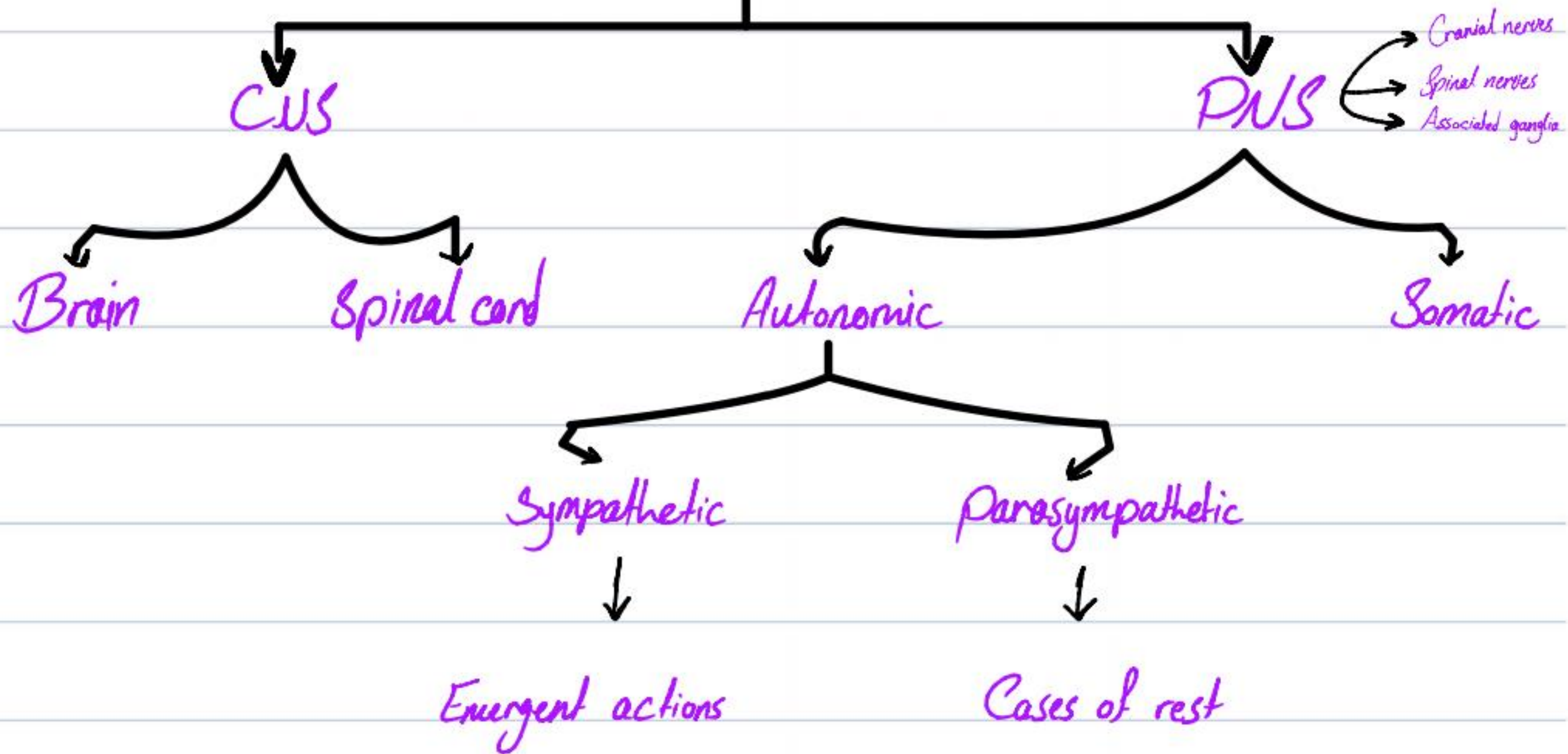
**\* The autonomic nervous system:**

- \* Is distributed within the central and peripheral nervous system.**
- \* It controls involuntary structures as the heart and smooth muscle.**
- \* It consists of sympathetic and parasympathetic parts.**





# Nervous system

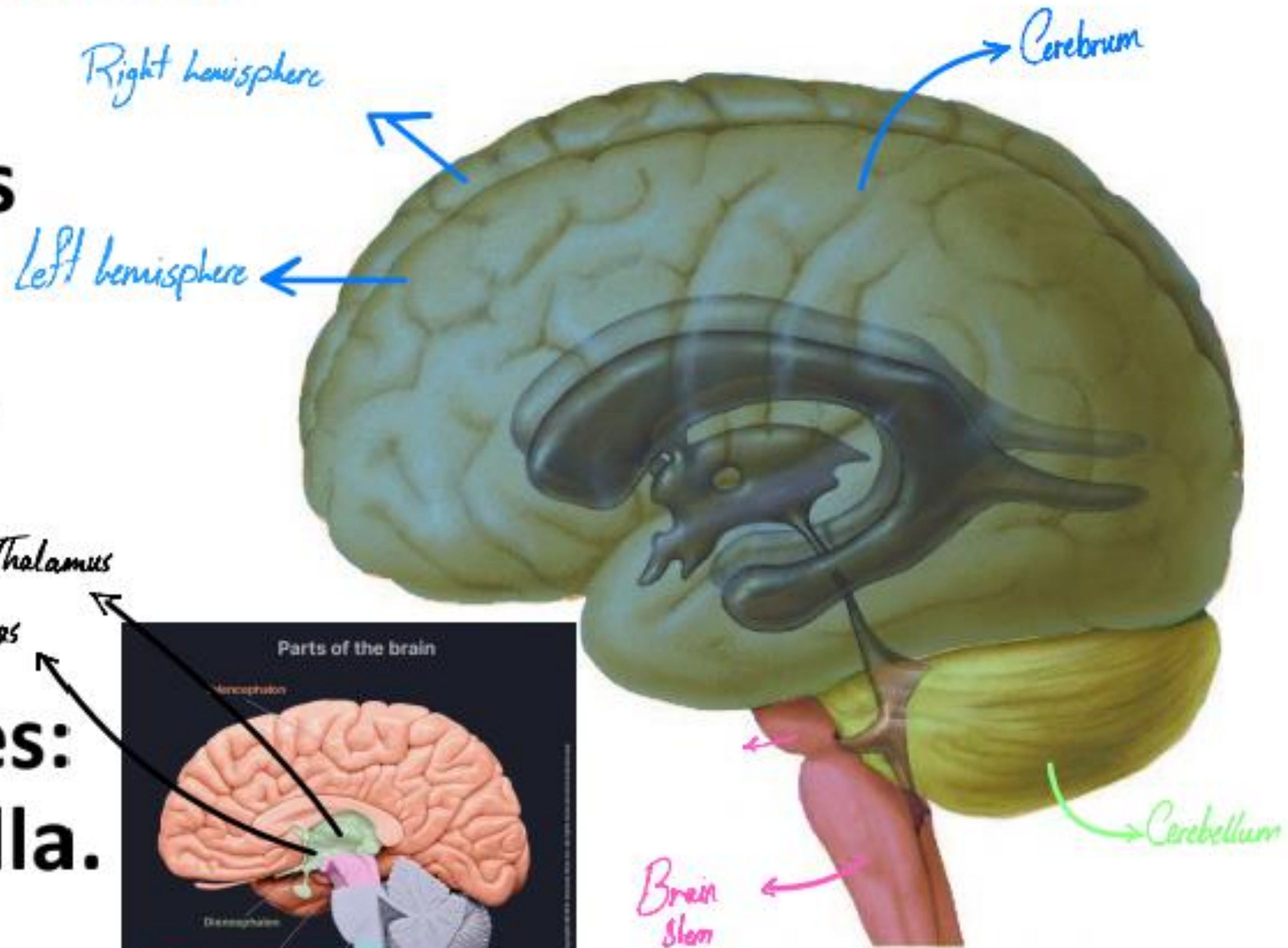




# CENTRAL NERVOUS SYSTEM BRAIN

**\*\* It is subdivided into:**

- 1. Cerebrum:** which includes cerebral hemispheres and diencephalon (thalamus & hypothalamus).
- 2. Cerebellum.**
- 3. Brain stem:** which includes: midbrain, pons, and medulla.



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**\*\* Brain is surrounded by meninges:**

**1. Dura mater:** outermost layer, fibrous and dense. *الأم الكافية*

**2. Arachnoid mater:** delicate membrane. *الأم العنكبوتية*

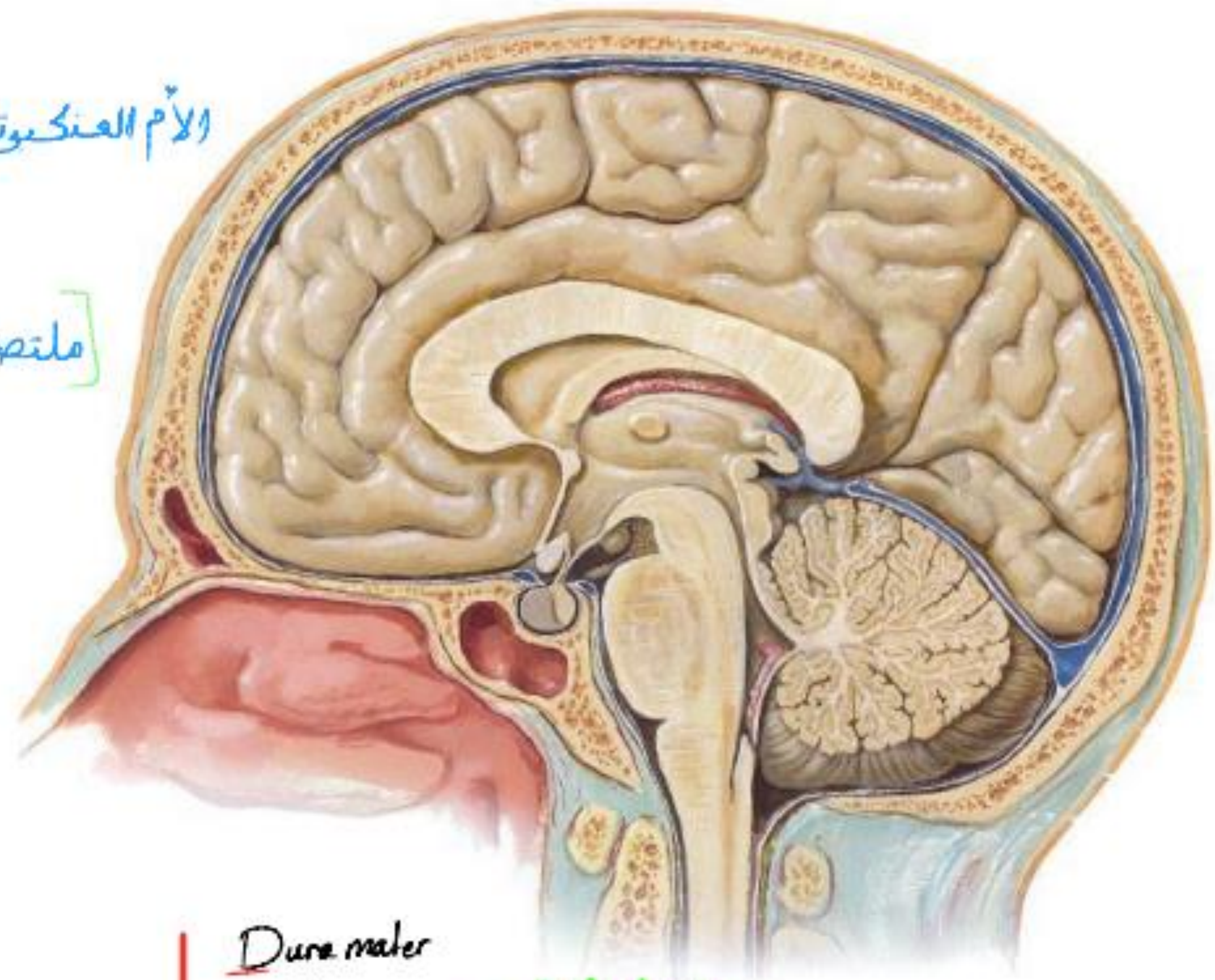
**3. Pia mater:** innermost layer, delicate vascular membrane. *الأم العنون [ملتصقة مباشرة بالدماغ]*

\* The space between arachnoid and pia matter is called **subarachnoid space**. It contains <sup>①</sup> **cerebrospinal fluid** and the <sup>②</sup> **arteries** supplying the brain.

\* The space between dura and arachnoid is called **subdural space**. It contains a <sup>①</sup> **thin film of fluid** & **cerebral veins**. <sup>②</sup>

PAD

(From inner to out)





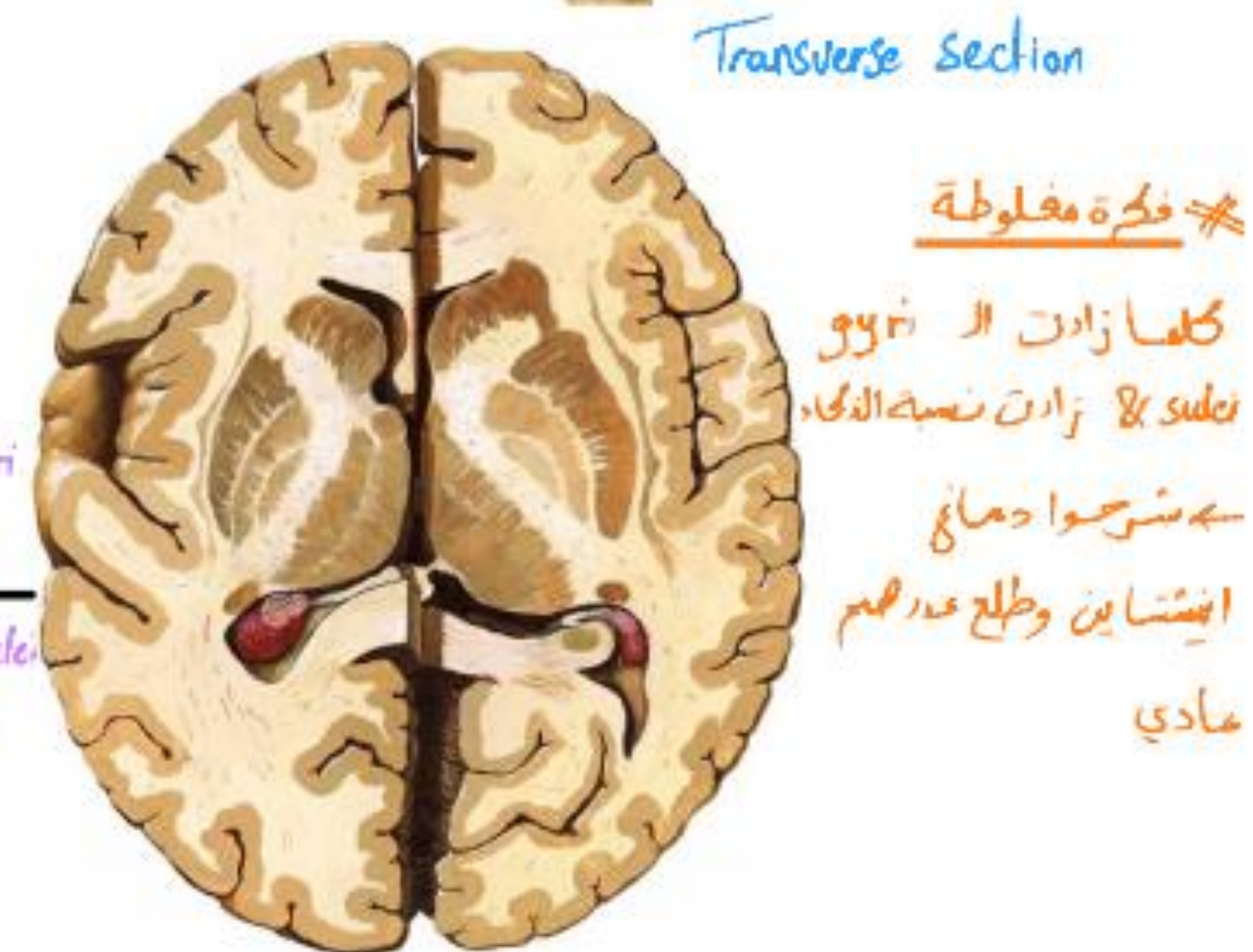
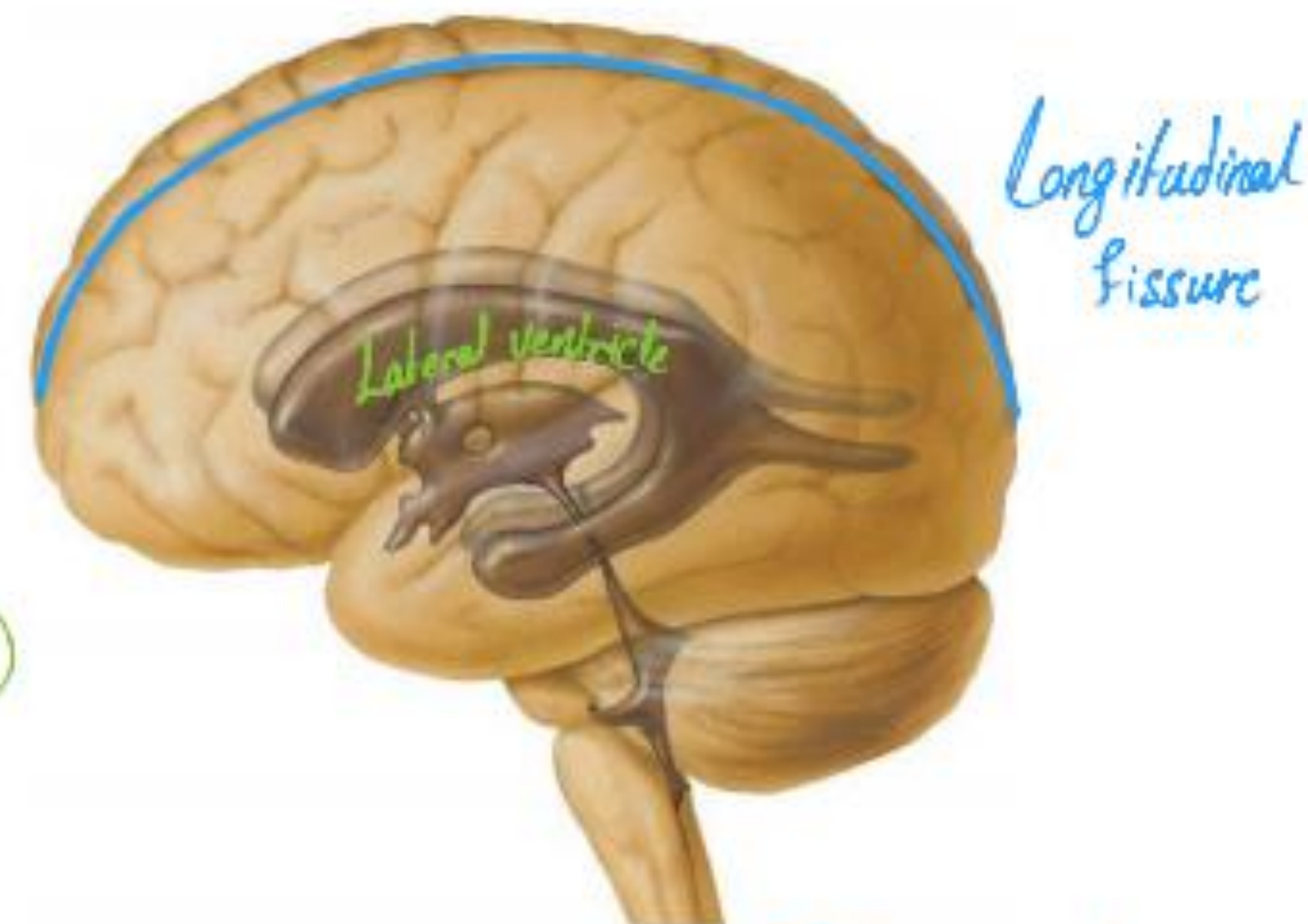
# Cerebral Hemispheres

\*\* There are two cerebral hemispheres separated by a **longitudinal fissure**.

\*\* Each hemisphere contains a cavity called the **lateral ventricle**.

\*\* The surface of cerebral hemisphere is composed of **grey matter** called **cerebral cortex** & it shows numerous **sulci and gyri**.

\*\* Within the hemisphere lies the **white matter**.



السطح الداخلي → Axon of nerve cells

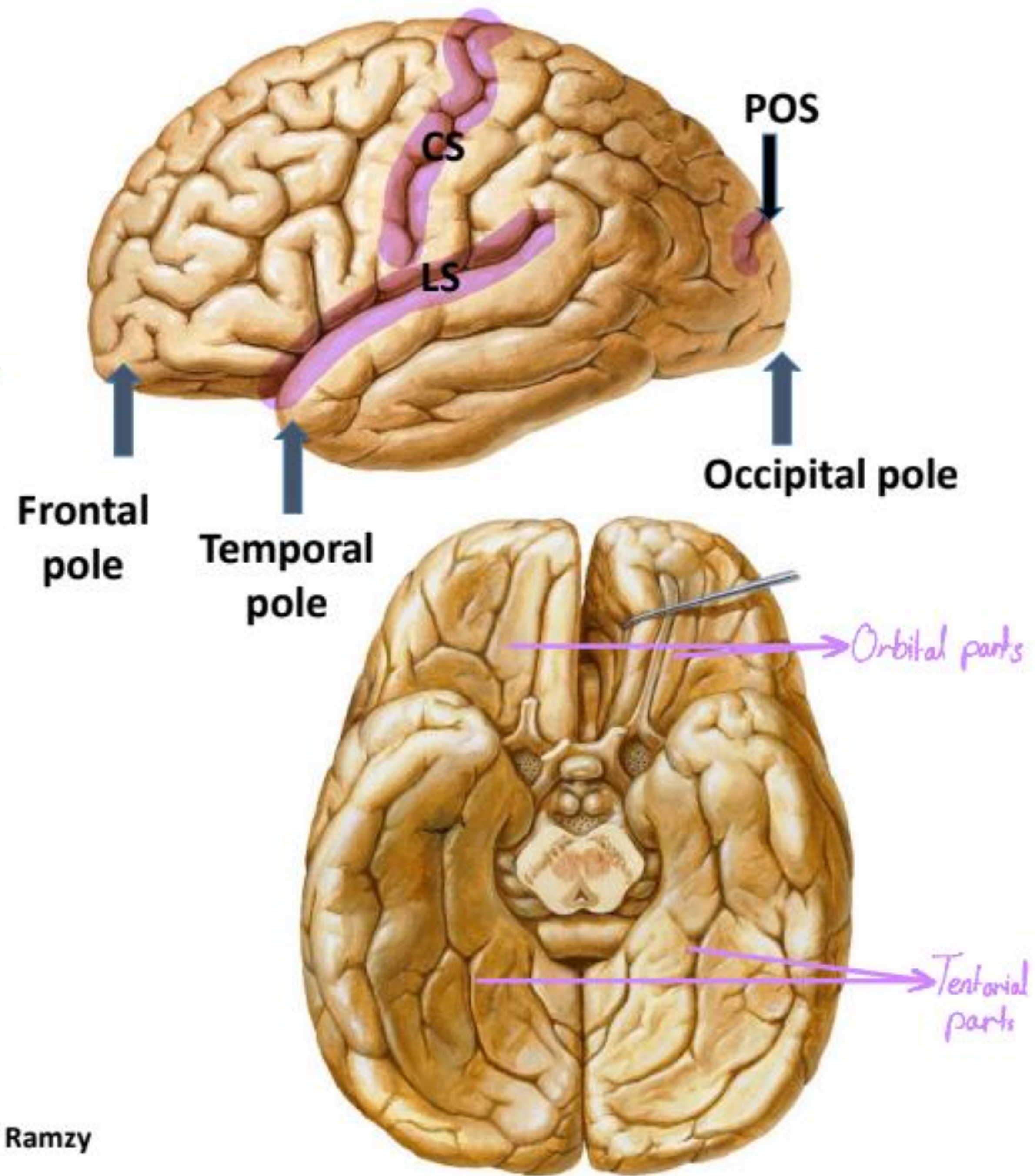


**\*\* Each hemisphere has:**

**\* 3 poles:** frontal, *anteriorly*  
temporal, and occipital *posteriorly*

**\* 3 surfaces:** Superolateral, *convex*  
medial and inferior. The  
latter is divided into  
orbital and tentorial  
parts.

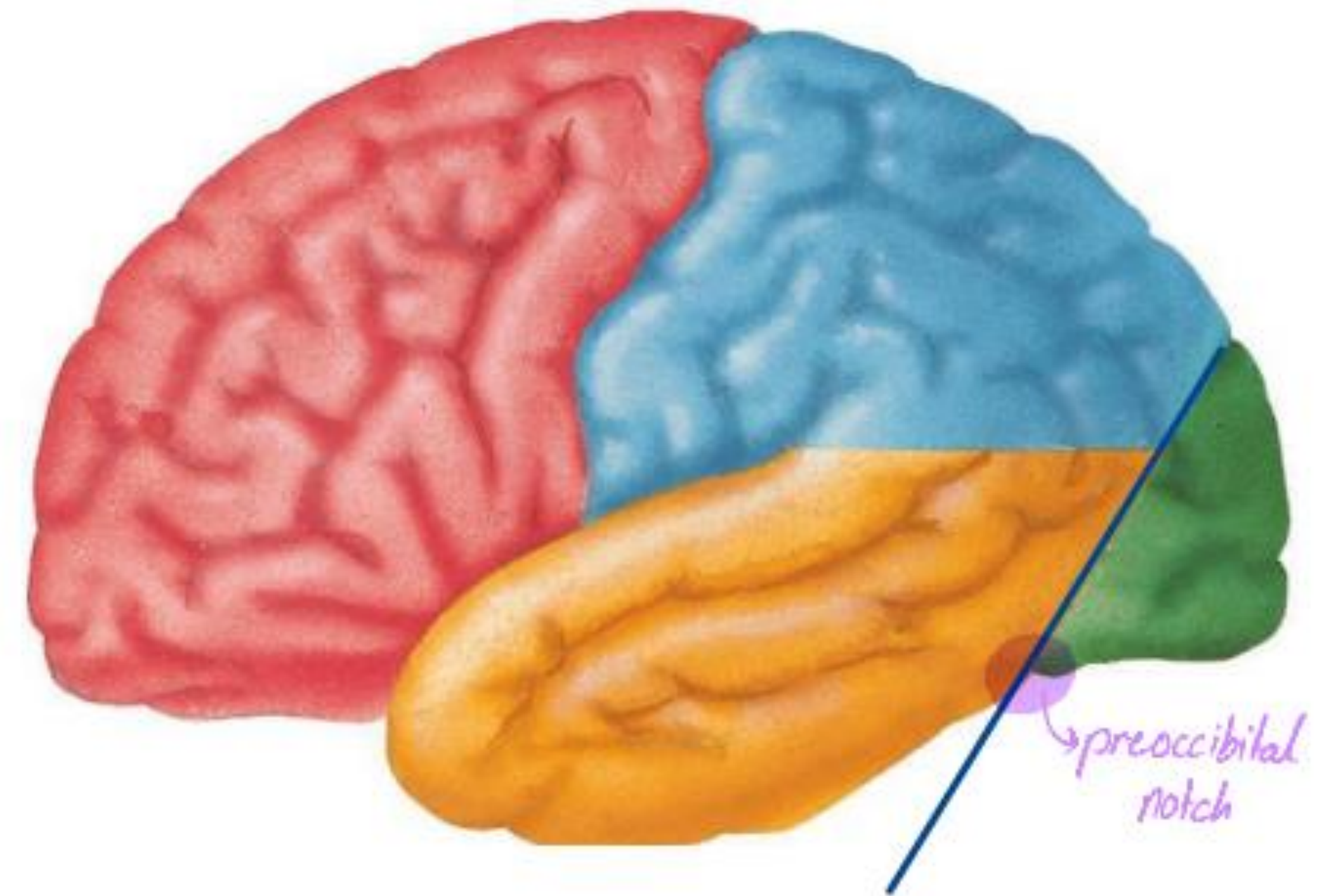
**\* 3 main sulci:** Central  
sulcus (CS), Lateral sulcus  
(LS) & Parieto-occipital  
sulcus (POS).





## **\*\* 4 lobes:**

- 1. Frontal lobe:** lies anterior to central sulcus and superior to lateral sulcus.
- 2. Parietal lobe:** lies posterior to central sulcus and superior to lateral sulcus till parieto-occipital sulcus.
- 3. Occipital lobe:** lies posterior & inferior to parieto-occipital sulcus and an imaginary line extending from the sulcus to the pre-occipital notch (5 cms in front of occipital pole).
- 4. Temporal lobe:** lies below the lateral sulcus.

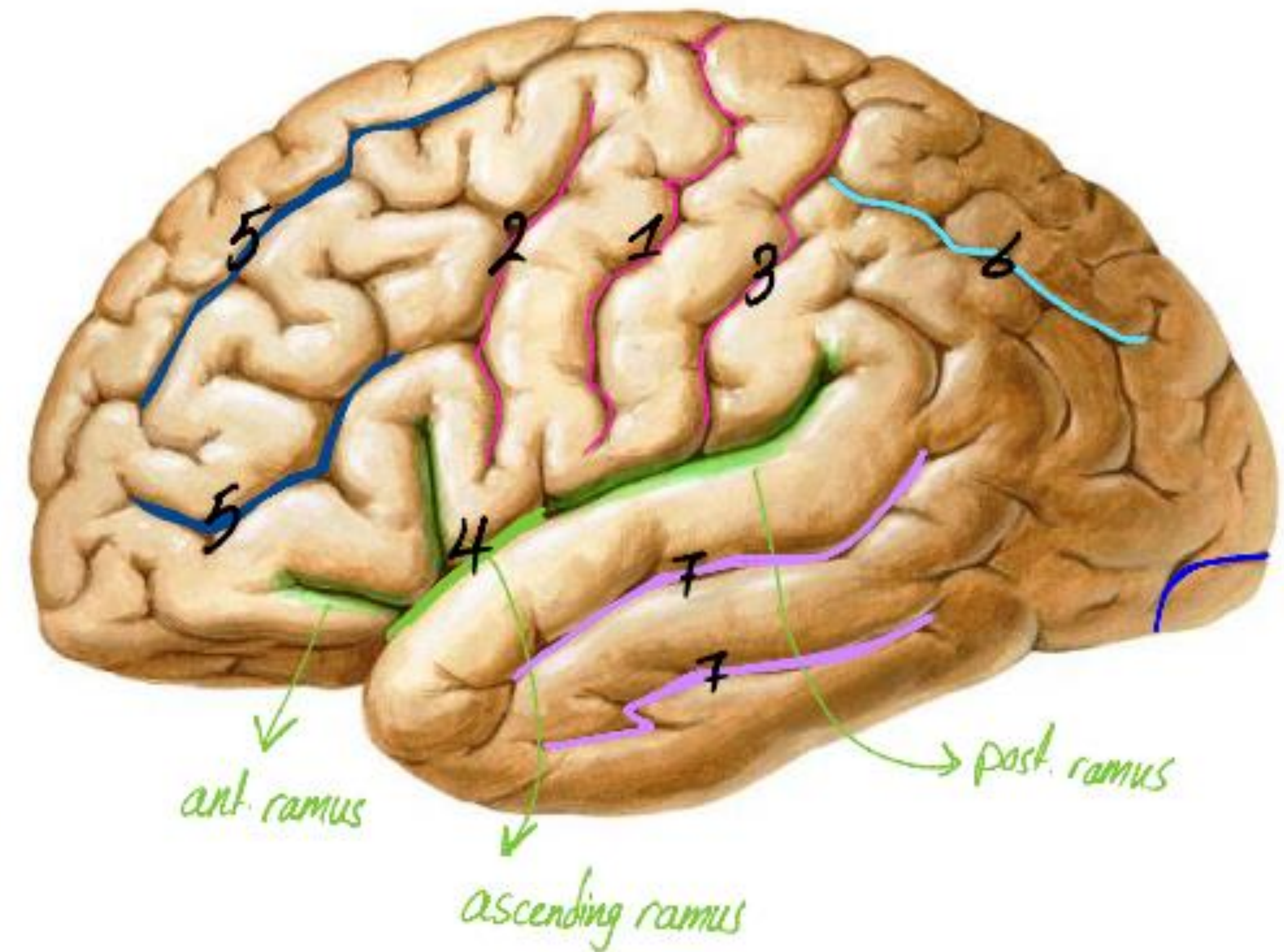




# Sulci and gyri on surperolateral <sup>\*\*</sup> surface of cerebral hemisphere

## \*\* Sulci:

1. Central. *Specialized with* Reaching the upper border
2. Pre-central. Has  $\left\{ \begin{array}{l} \text{Pre-central sulcus anteriorly} \\ \text{Post-central sulcus posteriorly} \end{array} \right\}$  Parallel
3. Post-central.
4. Lateral sulcus and its 3 <sup>= Branch</sup> rami: anterior, ascending & posterior.
5. Superior frontal sulcus & inferior frontal sulcus. *Divide the frontal lobe into 3 gyri*
6. Intra-parietal sulcus. *Divide the parietal lobe into 2 gyri*
7. Superior and inferior temporal sulci. *Divide the temporal lobe into 3 gyri*
8. Lunate sulcus.   
↳ *Crescentic shaped* 🌙





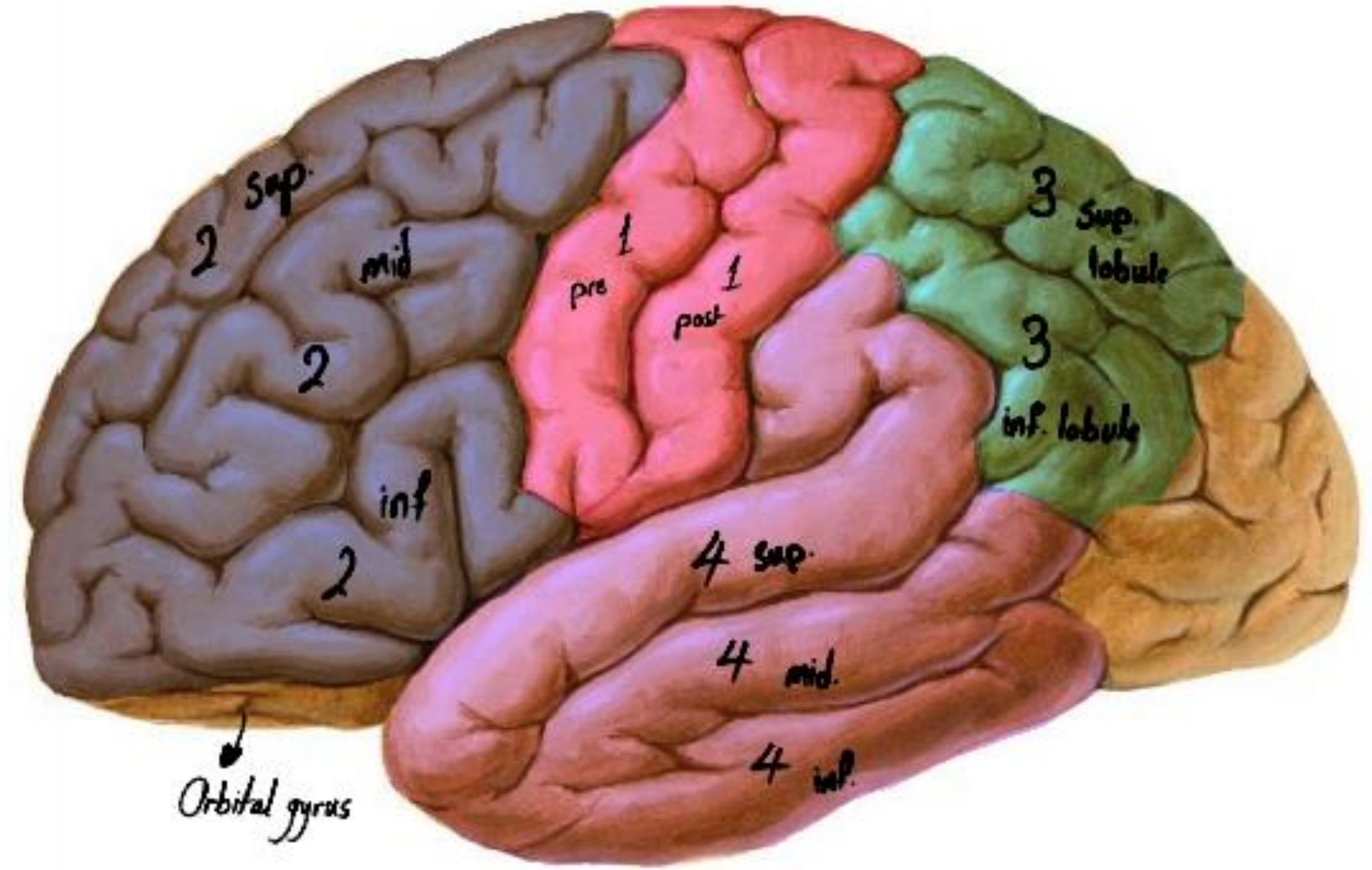
## **\*\* Gyri:**

**1. Precentral & post central gyri.**

**2. Superior, middle & inferior frontal gyri.**

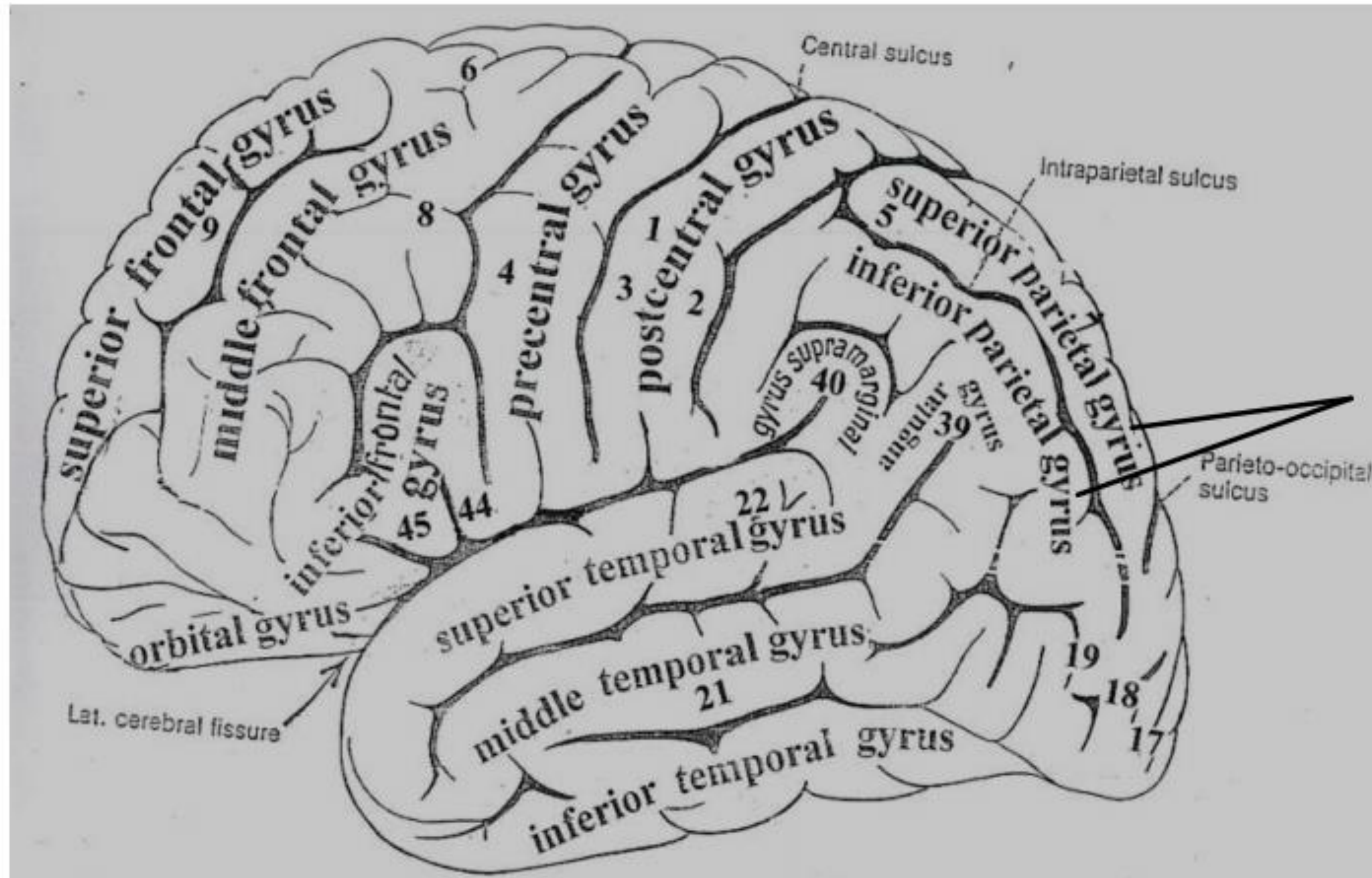
**3. Superior & inferior parietal lobules.**

**4. Superior, middle & inferior temporal gyri.**





# Sulci and gyri on surperolateral surface of cerebral hemisphere



الأصبع الأمامي  
Lobule

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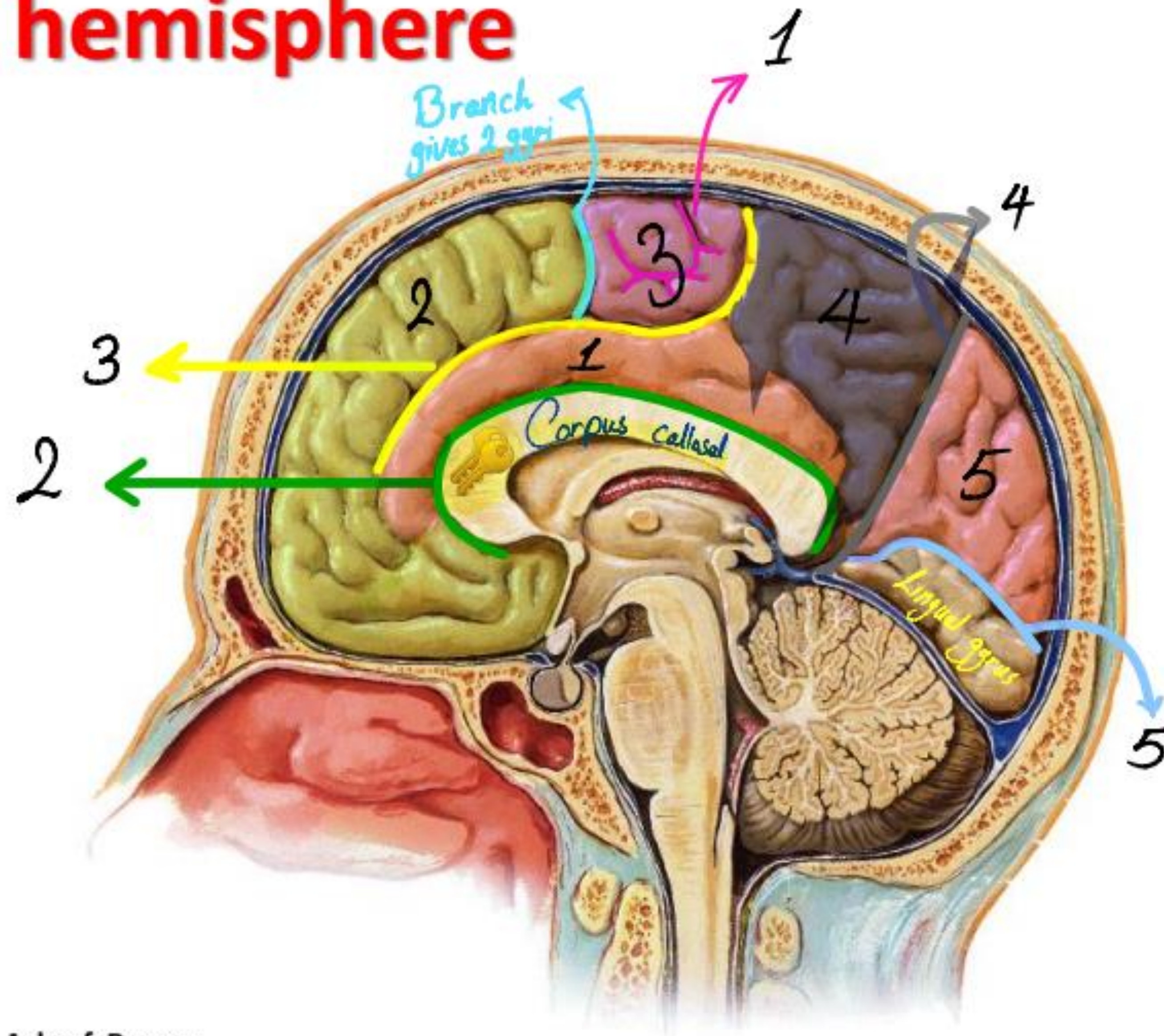
# Sulci and gyri on medial surface of cerebral hemisphere

## \*\* Sulci:

1. Central.
2. Callosal.
3. Cingulate.
4. Parieto-occipital. *POS*
5. Calcarine.

## \*\* Gyri:

1. Cingulate gyrus.
2. Medial frontal gyrus.
3. Paracentral lobule.
4. Precuneus.
5. Cuneus. *اللي شكلها زي العنلق*





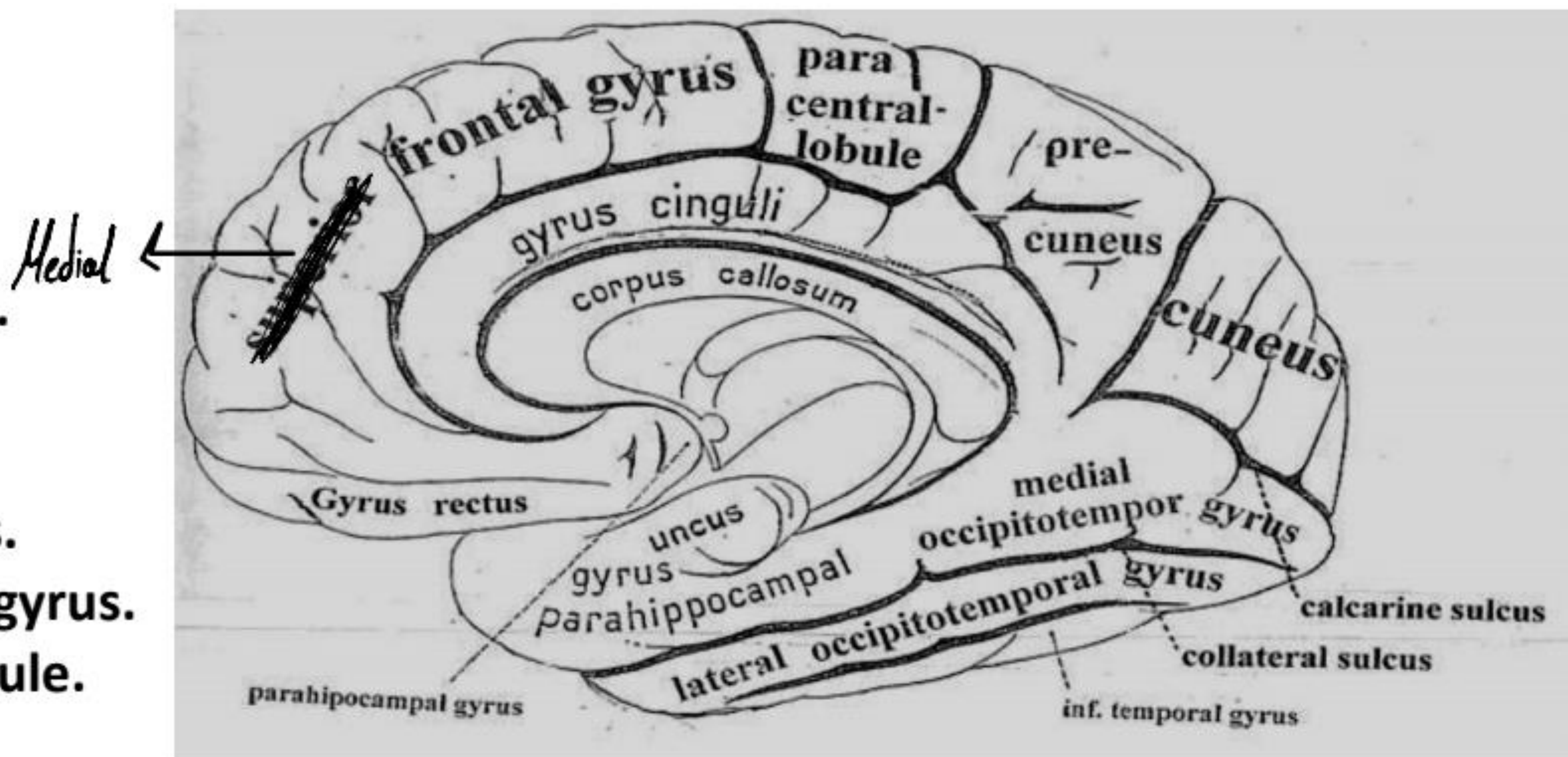
# Sulci and gyri on medial surface of cerebral hemisphere

## \*\* Sulci:

1. Central.
2. Callosal.
3. Cingulate.
4. Parieto-occipital.
5. Calcarine.

## \*\* Gyri:

1. Cingulate gyrus.
2. Medial frontal gyrus.
3. Paracentral lobule.
4. Precuneus.
5. Cuneus.





# Sulci and gyri on inferior surface of cerebral hemisphere

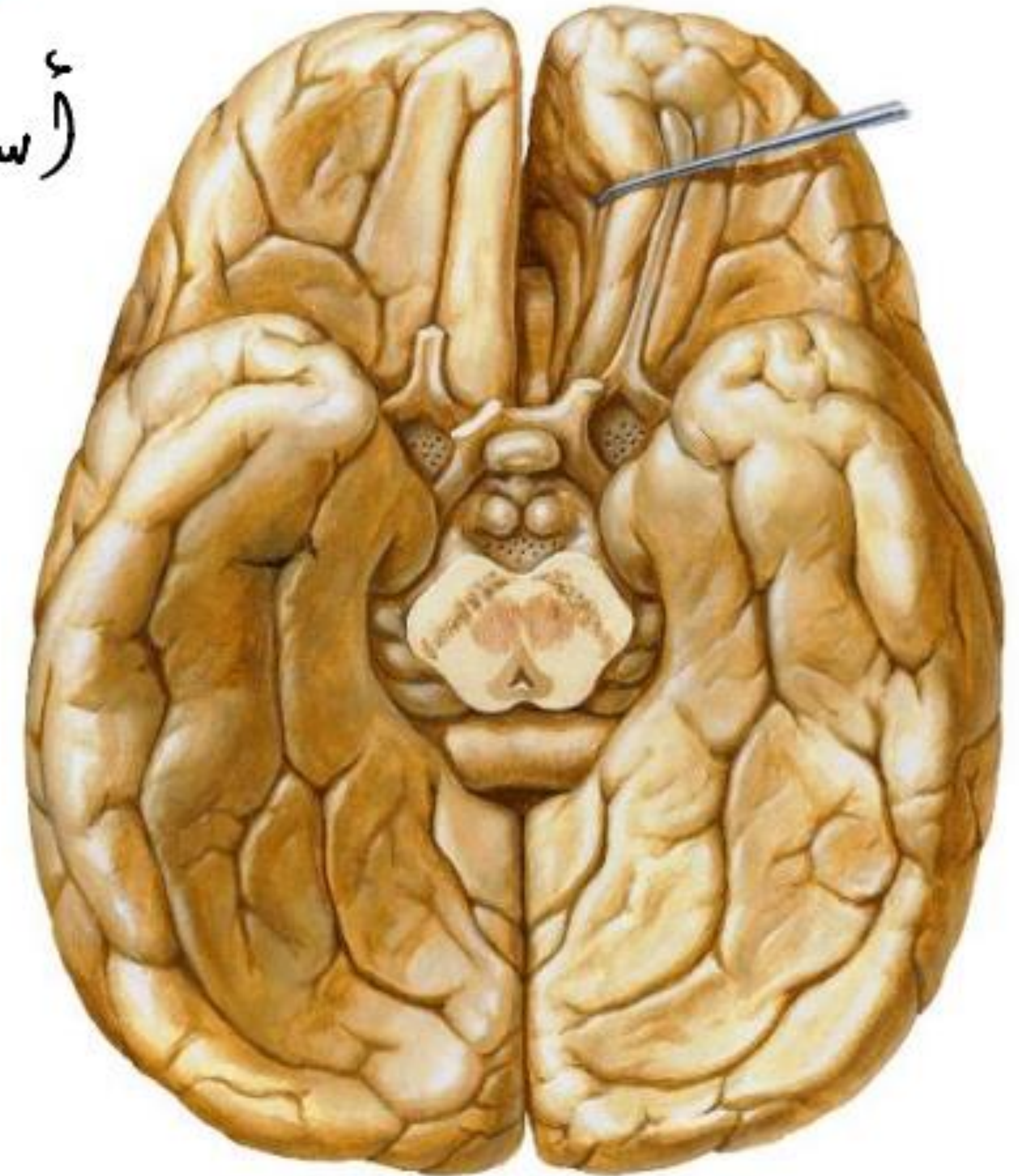
## \*\* Sulci:

1. Olfactory sulcus.
2. H-shaped orbital sulcus.
3. Occipito-temporal.
4. Collateral sulcus.
5. Rhinal sulcus.

## \*\* Gyri:

1. Gyrus rectus.
2. Anterior, posterior, medial and lateral orbital gyri.
3. Lateral occipito-temporal.
4. Medial occipito-temporal.
5. Uncus & parahippocampal gyri.

أسامي صريحة عليكو





# Important Functional Cortical Areas <sup>Always in gyri</sup>

## A. Frontal Lobe

### 1. Primary motor area:

1 **\*\* Site:** It occupies the precentral gyrus and anterior part of paracentral lobule.

2 **\*\* Body** is represented **upside down**.

3 **\*\* Representation** is for movement (**skilled movements have large area**).

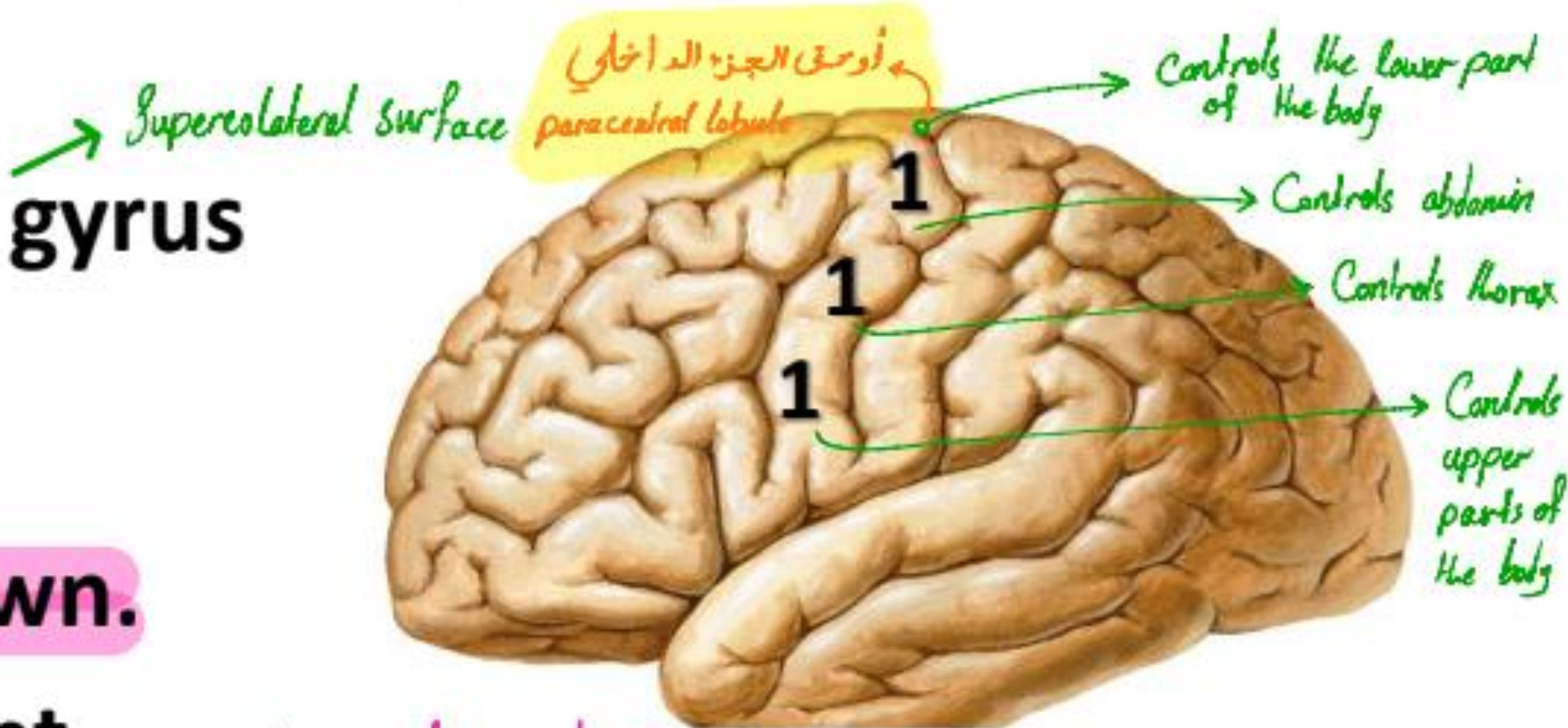
4 **\*\* Controls** the movements of the opposite half of the body.

5 **\*\* Lesion:** contralateral hemiplegia.

سؤال حاي  
لا معالجة

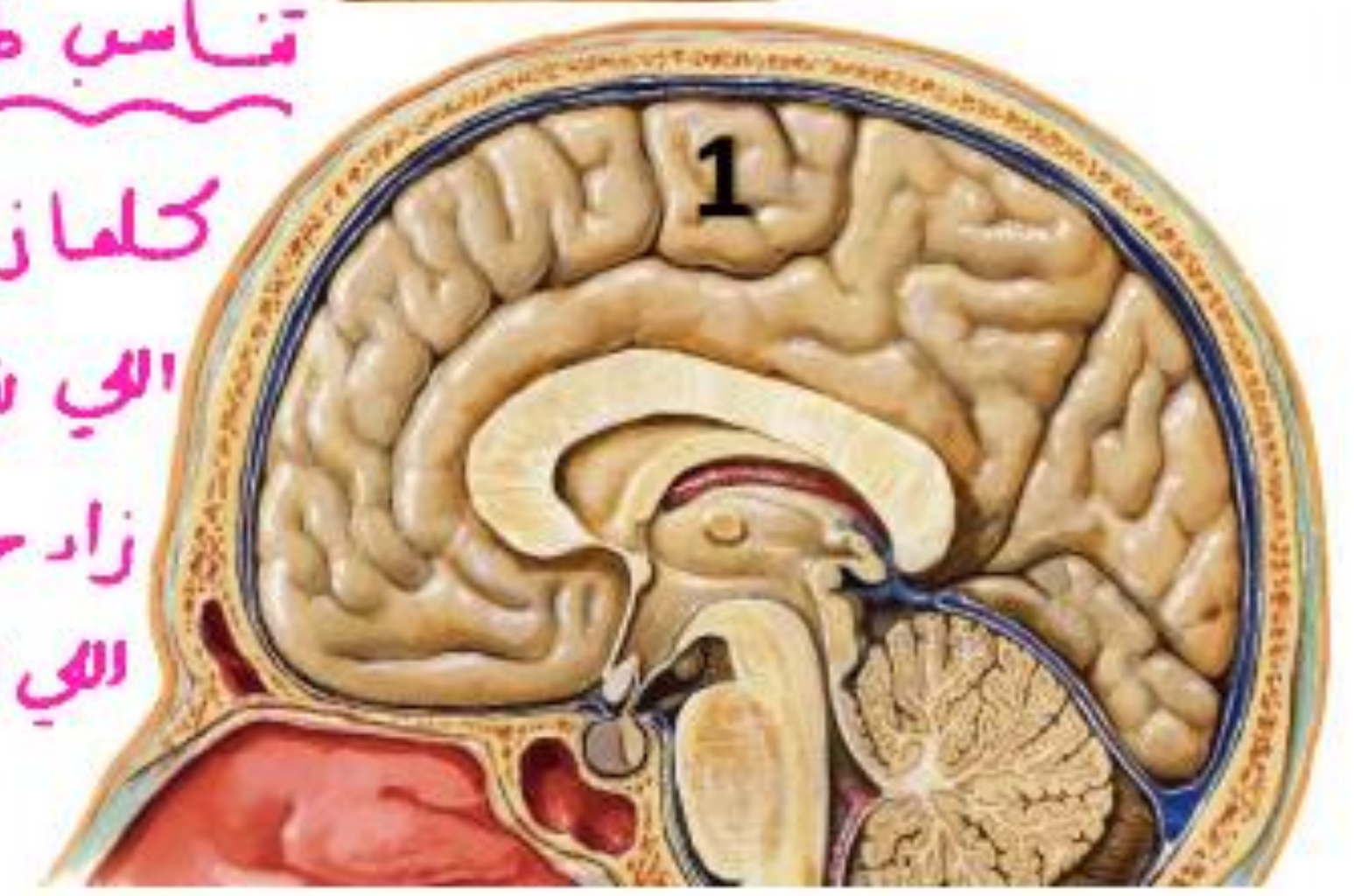
شلال نصفي

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تناسب طردي  
كلما زادت الحركات

التي يتعملهم العضلة  
زاد حجم المنطقة  
التي تتحكم فيها





## \* Examples for point 3:

→ Thumb : يعمل حركات تحتاج مرونة

للكتابة - للعزف - etc...

فبكون حجم المنطقة التي يتحكم فيه بال Primary motor area كبير

← العضلة صغيرة حجمًا

بس ما دخل ... هي بتعمل حركات مهارية كثيرة

# والمهم هون أن حجم المنطقة المتحركة بالعضلة هي كبيرة

→ Muscles of Back :

عضلات bulky ثوي ... كبيرة جدًا في الحجم

إلا أنها بتعمل حركات محدودة في flexion & extension

فبكون حجم المنطقة التي يتحكم فيها صغيرة



## Explanation for point 4 & 5 :-

4) Function of primary motor area → Contralateral control

∴ Primary motor area in right hemisphere controls left half of the body  
voluntary movements.

والعكس صحيح

5) Lesion هنا خالدًا تتبع بسبب جلطة = Thrombus

لو صابت الجلطة the primary motor area in the left hemisphere

بعاني الريف من شلل نصفي بالأطراف اليمين

Contralateral hemiplegia



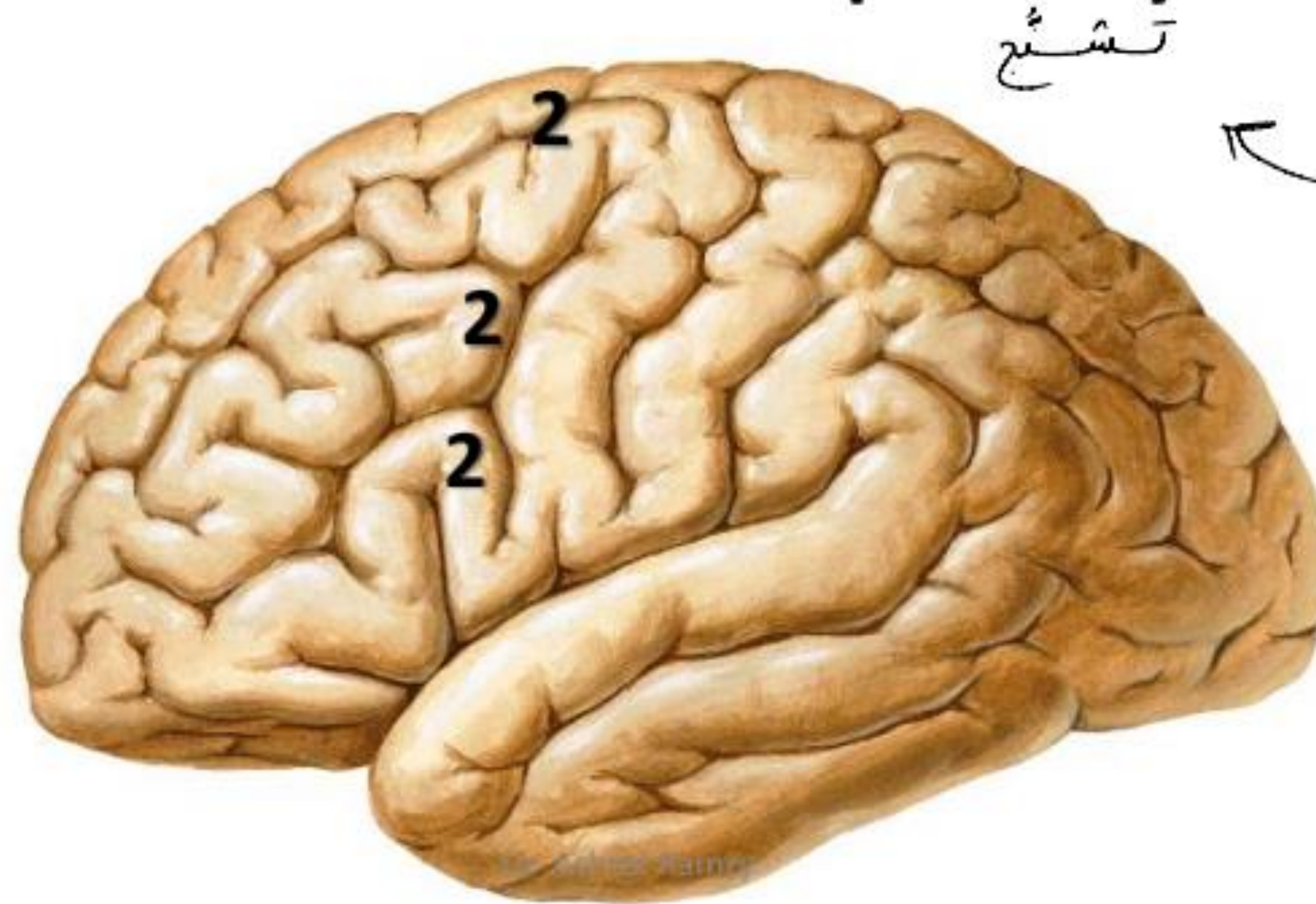
## 2. Premotor area: (anterior to the precentral sulcus)

\*\* **Site**: Lies in superior, middle, and inferior frontal gyri.

\*\* **Function**: 1. plans the movements and stores it. *بتخطيط ال design يتابع ال movements ويتخزنه*  
2. it adjusts posture. *بتنظيم وضع الجسم حسب الوضع اللازم للحركة*

\*\* **Lesion**: awkward movements and spasticity of muscles.

بـيـحصل حركات غير مبررة



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مثلا : أنت واقف جنب طاولة وعازن تمسك القلم اللي عليها 1)

لازم تعمل ← extension of elbow أمد ايدي

← extension of digitorum أفتح صوابي

← approximation to the pencil أقرّب ايدي للقلم

← flexion of digitorum أضخم صوابي

← flexion of elbow أوسعب ايدي

\* حـ صـ ل Consequence of actions

الدماغ / السلطة التشريعية →

كل الخطة دي بتعملها الـ Premotor area

ومن ثم بتديها للـ Primary motor area عشان تنفذه

العضلات / السلطة التنفيذية →



### 3. Frontal eye field:

مش موجودة بال inf.

\*\* Site: Lies in superior and middle frontal gyri.

\*\* Function: responsible for voluntary movements of eye.

زي ما قلنا سابقاً حسب

UPSIDE DOWN الـ

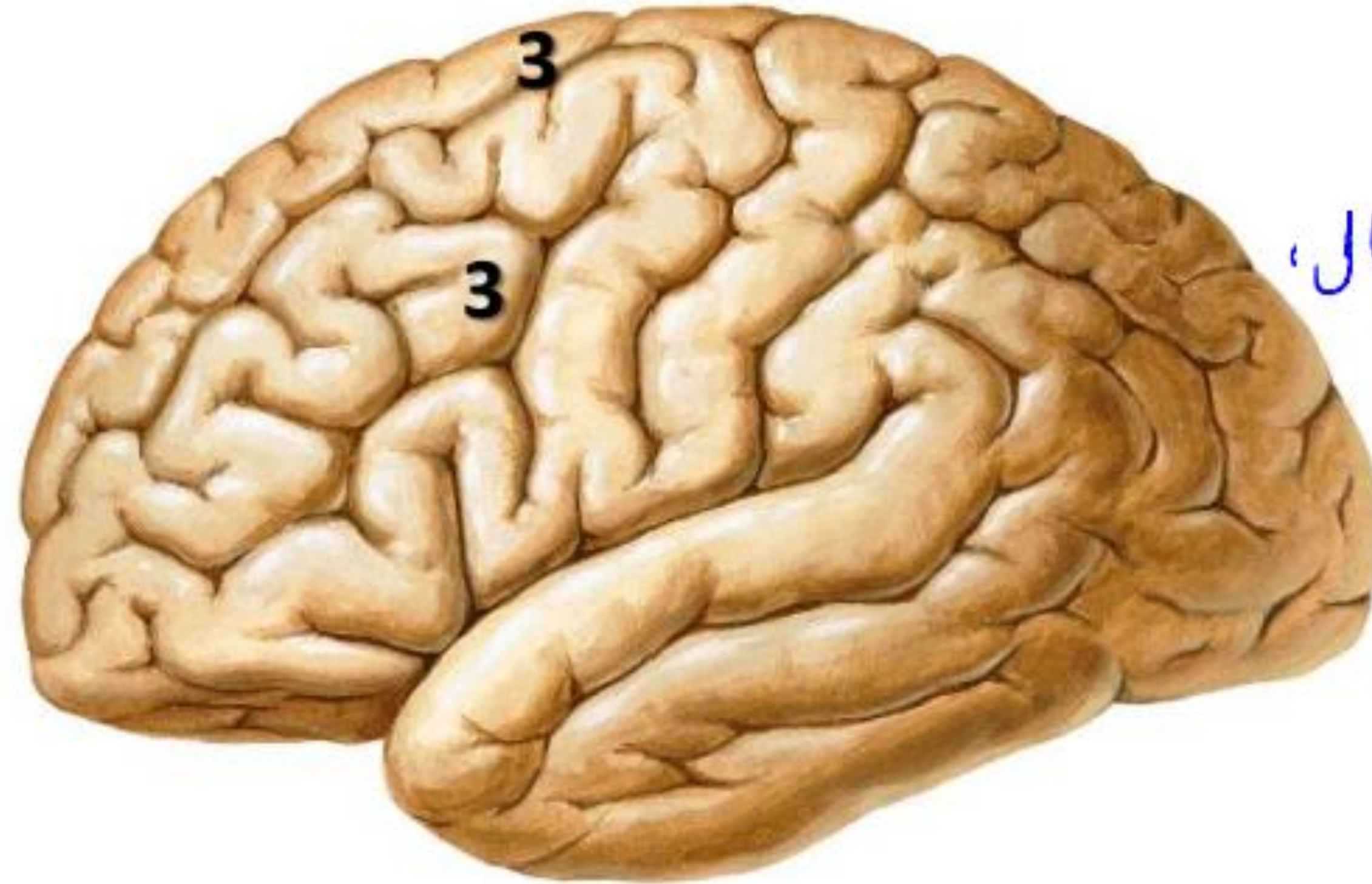
جزء سفلي من الـ

Primary motor area

هو اللي يتحكم

بحركة العين لأنها

عُلوية



تدي أوامر

← تبص يمين ، شمال ،

فوق ، تحت



\* النسخة الأيسر  
Dominant part ⇒ Right

## 4. Broca's Area (Motor speech area):

\*\* **Site:** it lies in inferior frontal gyrus between the rami of lateral sulcus. It is present only in the dominant hemisphere (usually the left).

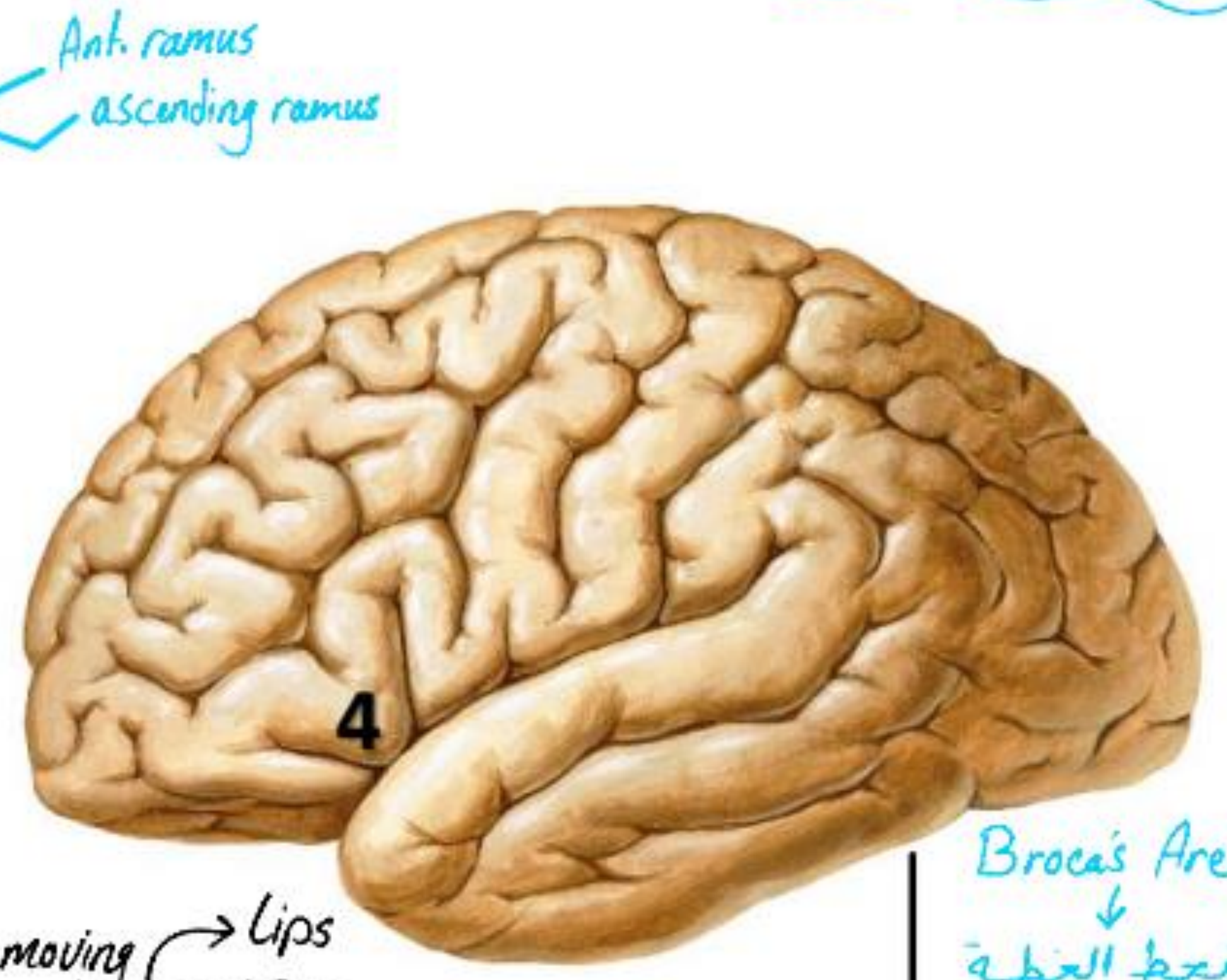
للي بكتب  
باليمين

\*\* **Function:** It programs and coordinates a sequence of muscle contractions to produce words & sentences.

تبعط Design عشان تنطق الجمل المفهومة

\*\* **Lesion:** motor or expressive aphasia.

لعدم القدرة  
على الكلام



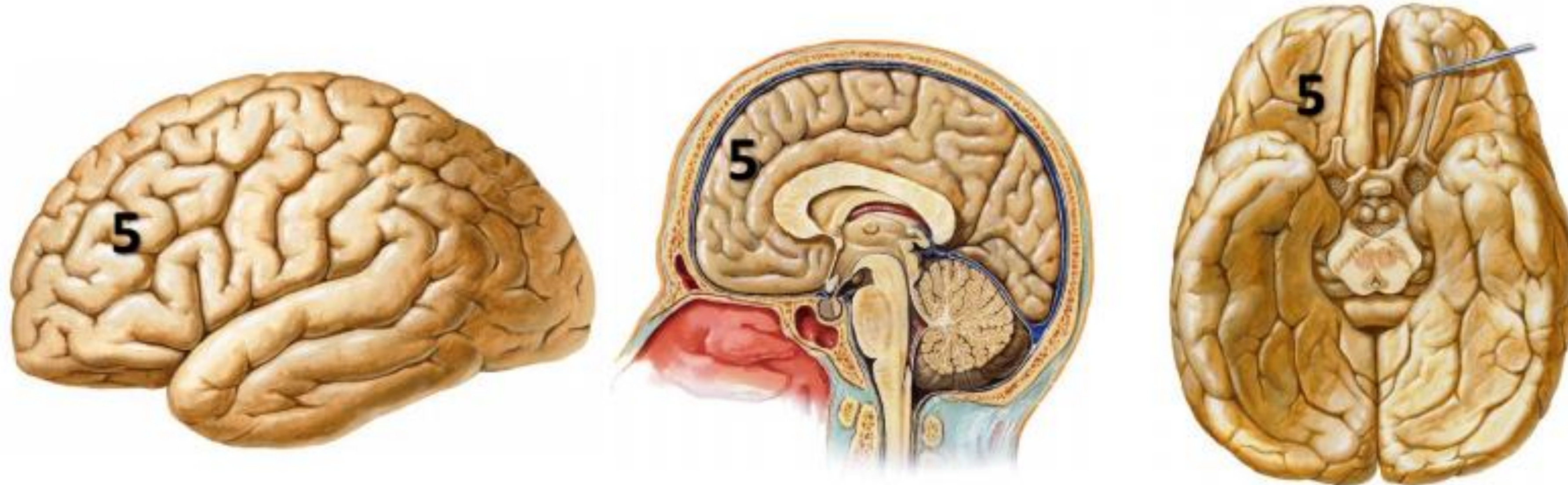
by moving  
→ Lips  
→ Tongue  
→ Larynx & Vocal cords

Broca's Area  
↓  
تبعط العظة  
&  
Primary motor area  
↓  
تنفذ الحركات



## 5. Prefrontal area:

- \*\* **Site:** It occupies: **The remaining** of superior, middle and inferior frontal gyri, orbital gyri and medial frontal gyrus.
- \*\* **Function:** It has a role in expression of emotions, behavior and personality.
- \*\* **Lesion:** changes in behavior, personality and mood.





# B. Parietal Lobe

Sensations

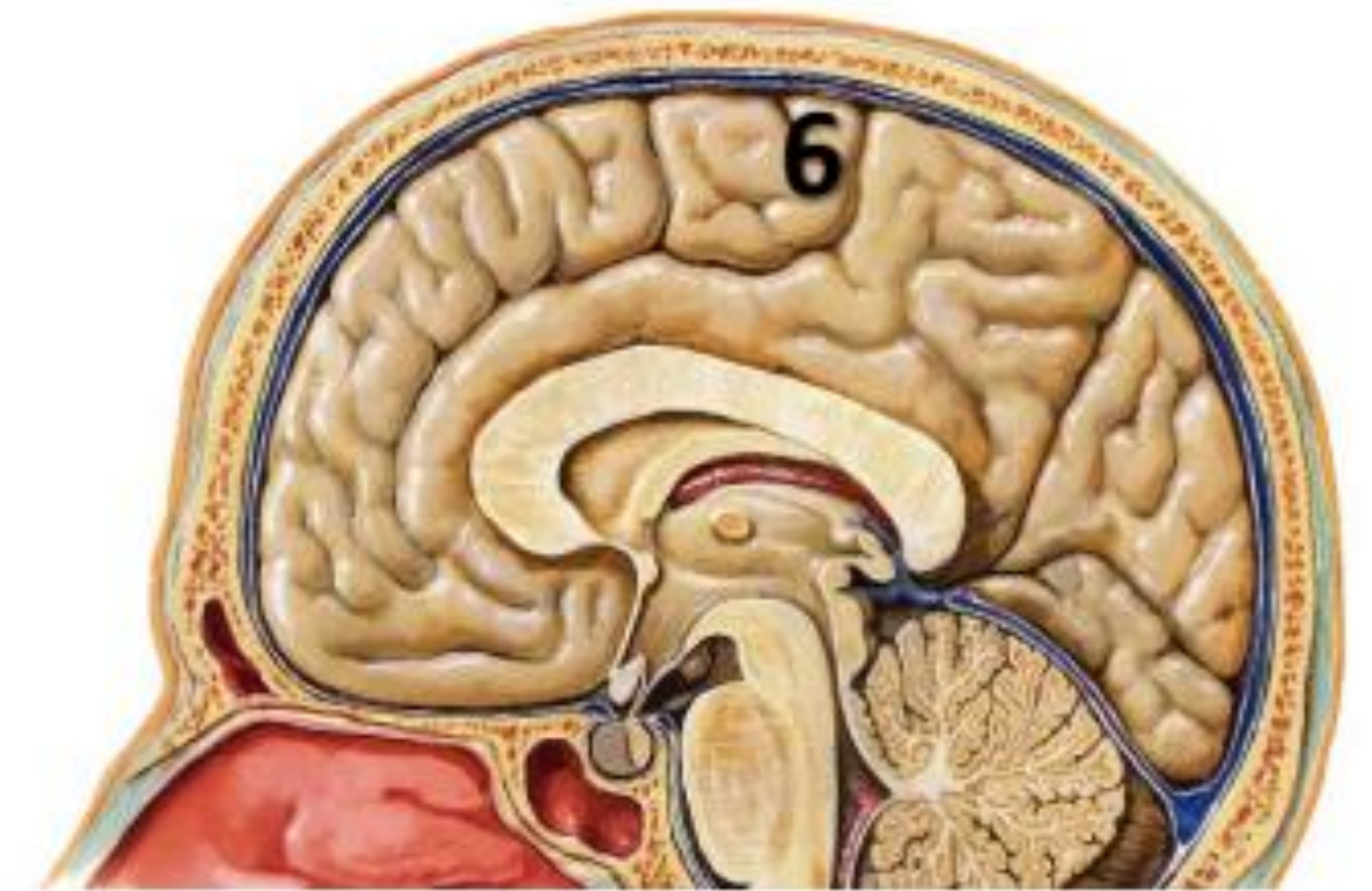
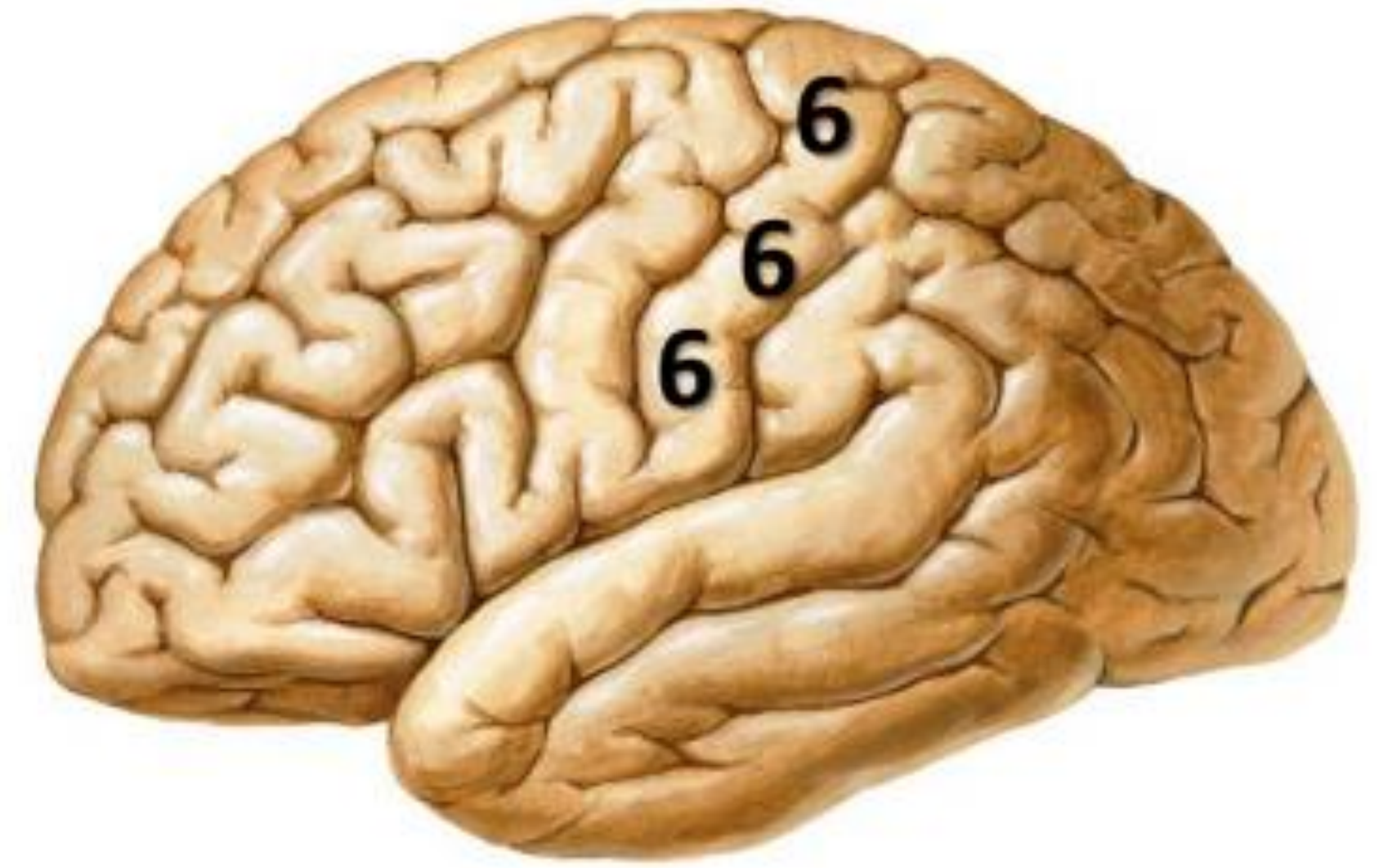
## 6. Primary sensory area:

**\*\* Site:** it occupies post central gyrus and posterior part of paracentral lobule.

**\*\* It receives impulses from thalamic nuclei.**

كل الأحاسيس والمشاعر غير لازم توصل الـ thalamus  
ماعد الـ Smell

**\*\* Lesion:** contralateral sensory disturbances.





**7. Stereognosis:** = Recognize the object without seeing it

**\*\* Site:** superior parietal lobule.

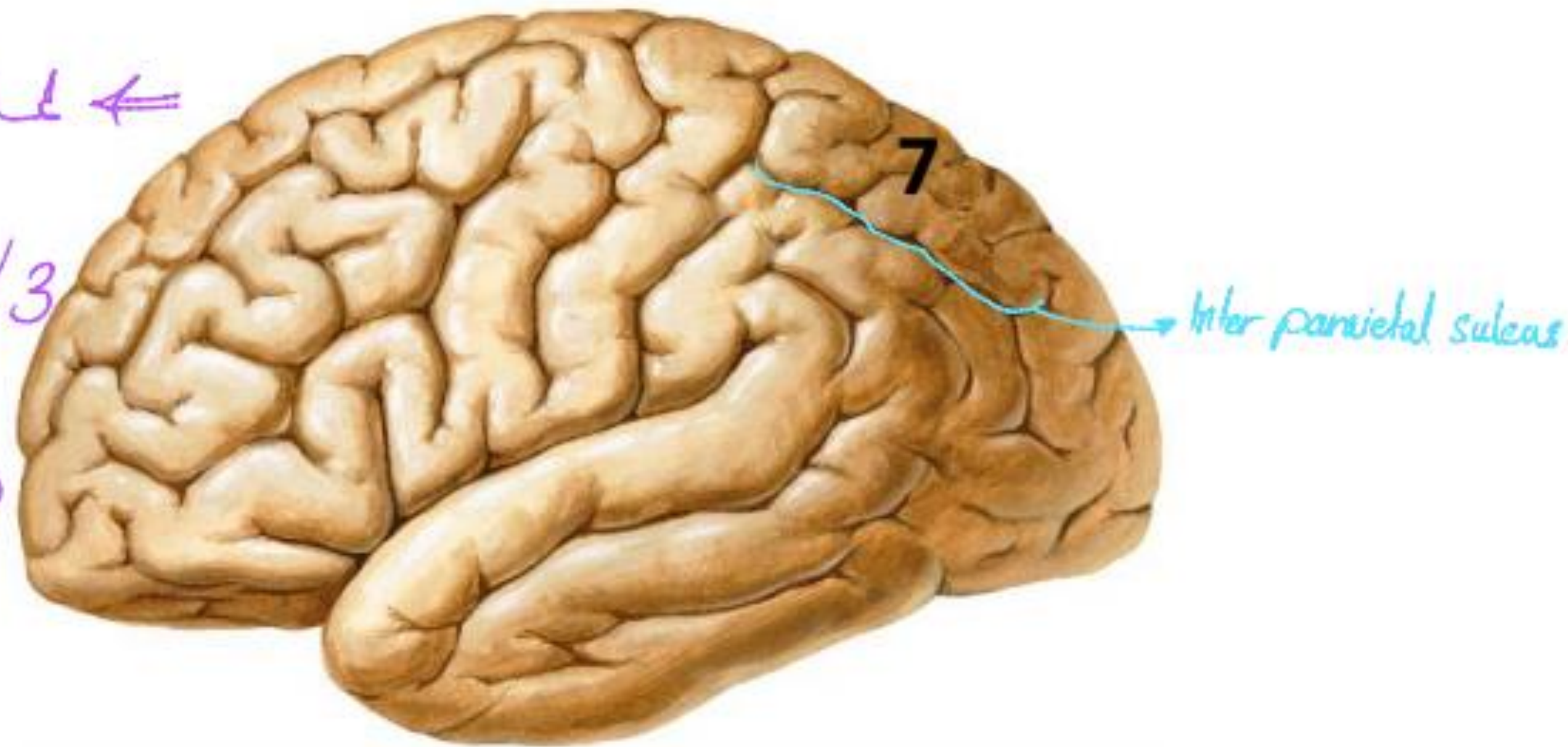
**\*\* Lesion:** <sup>Not</sup> Astereognosis: inability to recognize familiar objects without vision.

\* وظيفتها تخليك تميز الاشئ بدون ماتشوفه

← لما تحط ايديك بجيبك وهي فيها

3/4 حاجات حتقدر تميز ايه

هم بدون ماتطلع ايديك وتشوفهم



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# C. Occipital Lobe

## 8. Visual areas:

### A. Primary visual area:

**\*\* Site:** above and below calcarine sulcus & extends till lunate sulcus on lateral surface.

**\*\* Function:** receives visual stimuli.

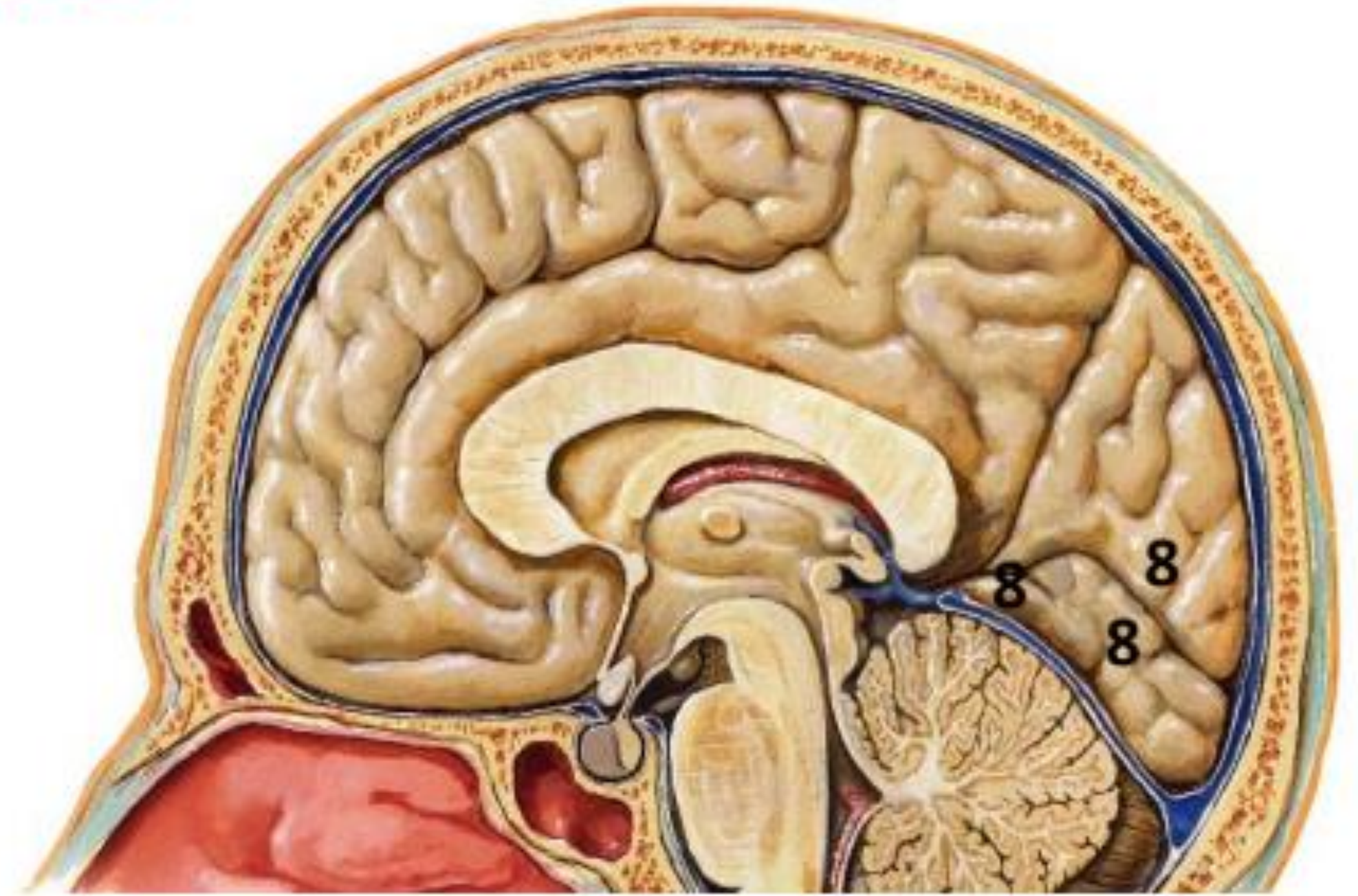
### B. Secondary visual area:

**\*\* Site:** around primary visual area.

**\*\* Function:** stores visual experience to identify objects & discriminate colors.

اللى بتفهمك اللي بتشوفه وتخزنه

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← وظيفتها تفهمني معنى الكلام  
اللي بقوله +  
اللي بسمعه

# D. Temporal Lobe

\* One of rare areas that  
can be found in 2 lobes

## 9. Sensory speech area (Wernicke's area):

\*\* **Site:** it lies in superior temporal gyrus and extends to parietal lobe. It is present in dominant hemisphere only. →

دائماً بتوع ال  
Speech  
موجودين بال  
Dominant

\*\* **It receives** input from the visual & auditory areas.

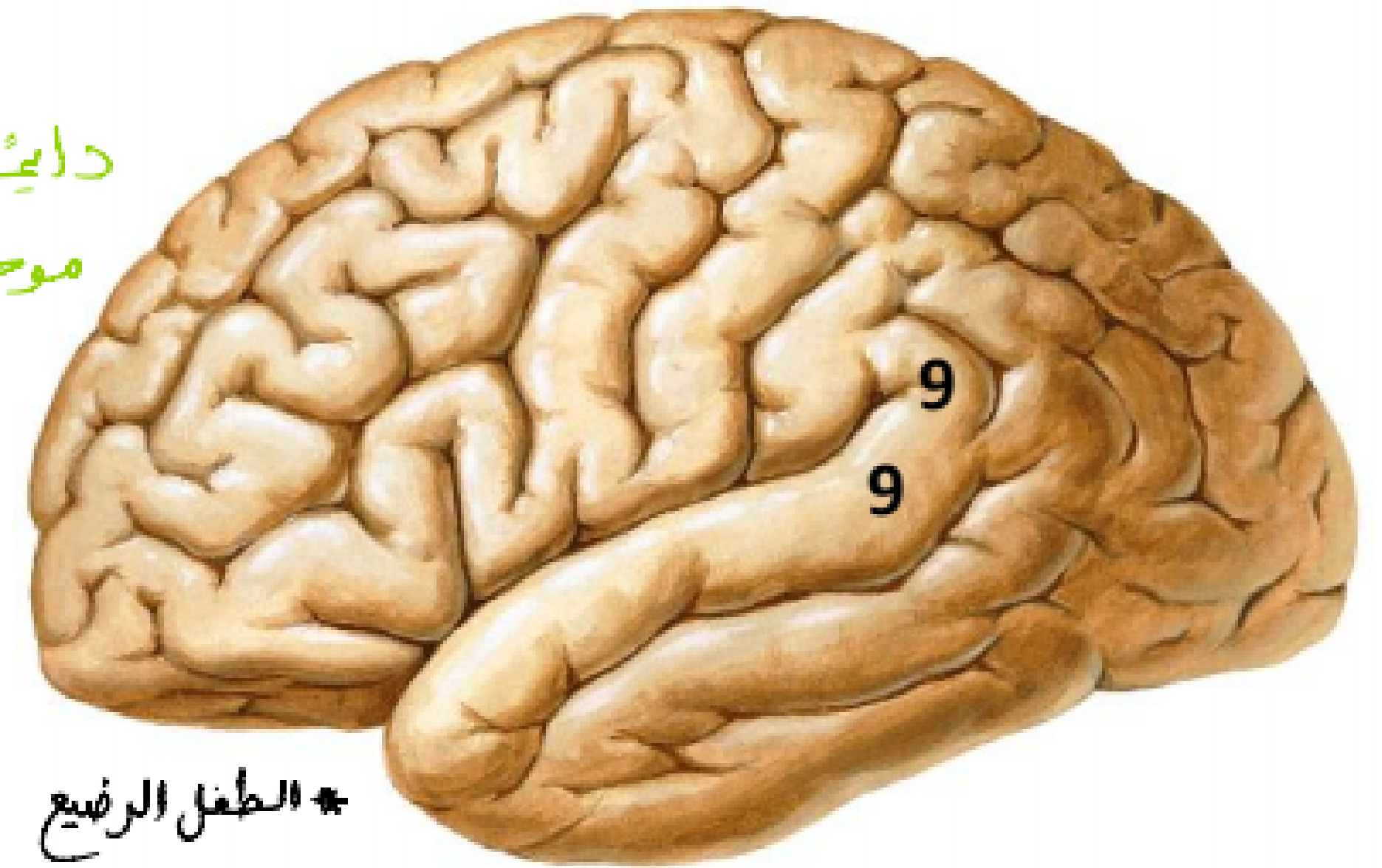
\*\* **Function:** understanding of visual & auditory information (written and spoken words).

أولاً ما نشو ان بتكون ال Data فيها = Zero

\*\* **Lesion:** sensory aphasia: patient is unable to understand written or spoken words.

بسمع وبقراء بس ما بفهم

← ممكن تقرأ فارسي بس ما تفهم معناه  
← أو تعيد نفس العكس اللي سمعته وانك مش فاهم معناه



\* الطفل الرضيع  
كيف بعقفا وجه  
أبوه وبخزونه  
وبصير يعرفه؟!  
بواسطة ال

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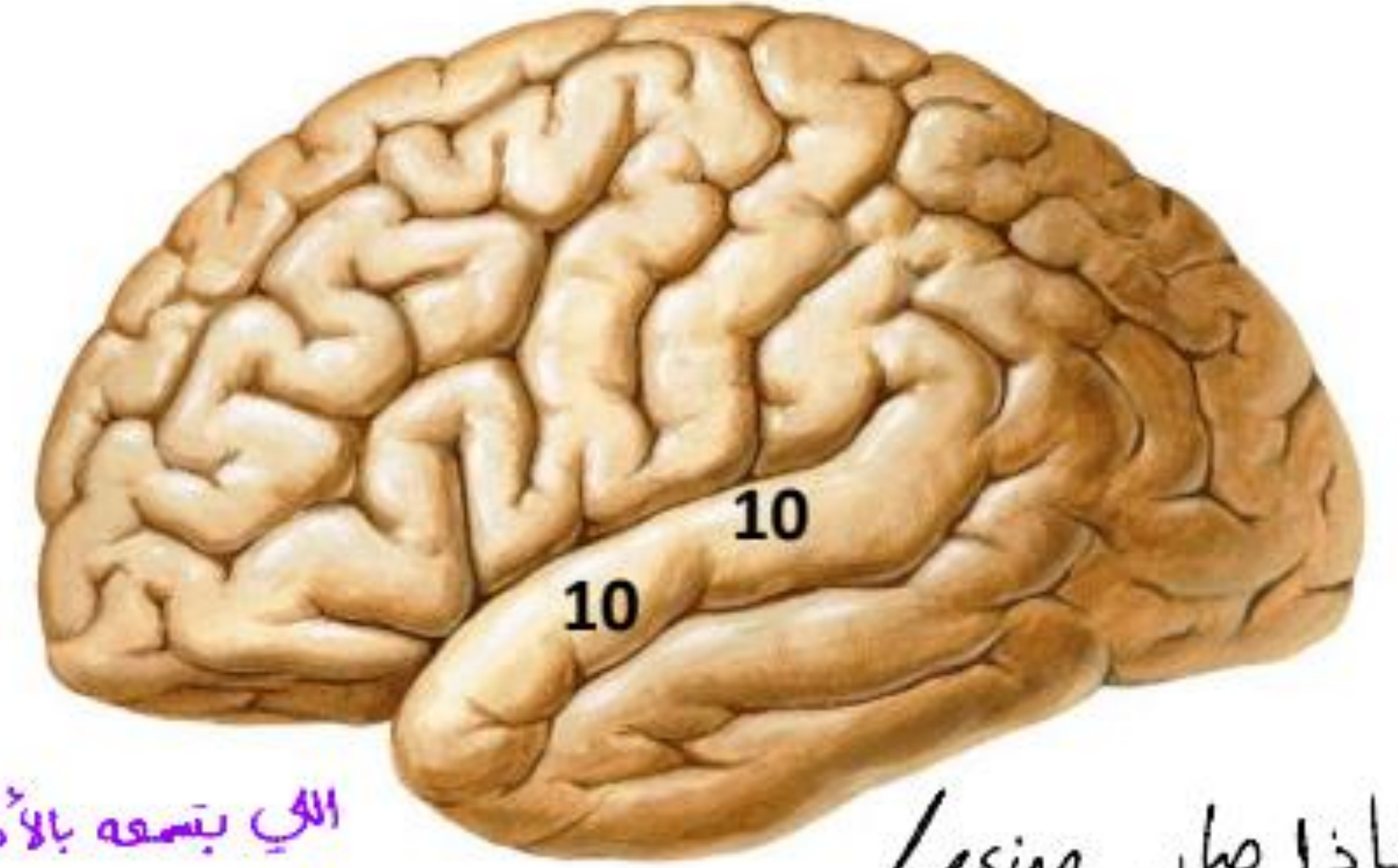
Sensory speech area



## 10. Auditory areas:

### A. Primary auditory area:

- \*\* **Site:** present in inferior lip of lateral sulcus and adjacent part of superior temporal gyrus.
- \*\* **Function:** auditory stimuli are received.
- \*\* **Lesion:** impaired hearing (**not complete loss** because cochlea is bilaterally represented).



### B. Secondary auditory area:

- \*\* **Site:** surrounds primary auditory area.
- \*\* **Function:** stimuli are interpreted.
- \*\* **Lesion:** inability to interpret sounds.

التي يتسعه بالأذن اليمنى بروج لل 2 auditory areas

الموجودين بال

Right & Left hemisphere

والعكس صحيح

عشان تميز الصوت

بدون ما تشوف

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مصدره (صوت معا غير، زامل، صبر للناس...)

فإذا صار Lesion

بوحدة بتضل الثانية عشان  
هيك قلنا بتخف مش بروج تمامًا

impaired ✓ aphasia X

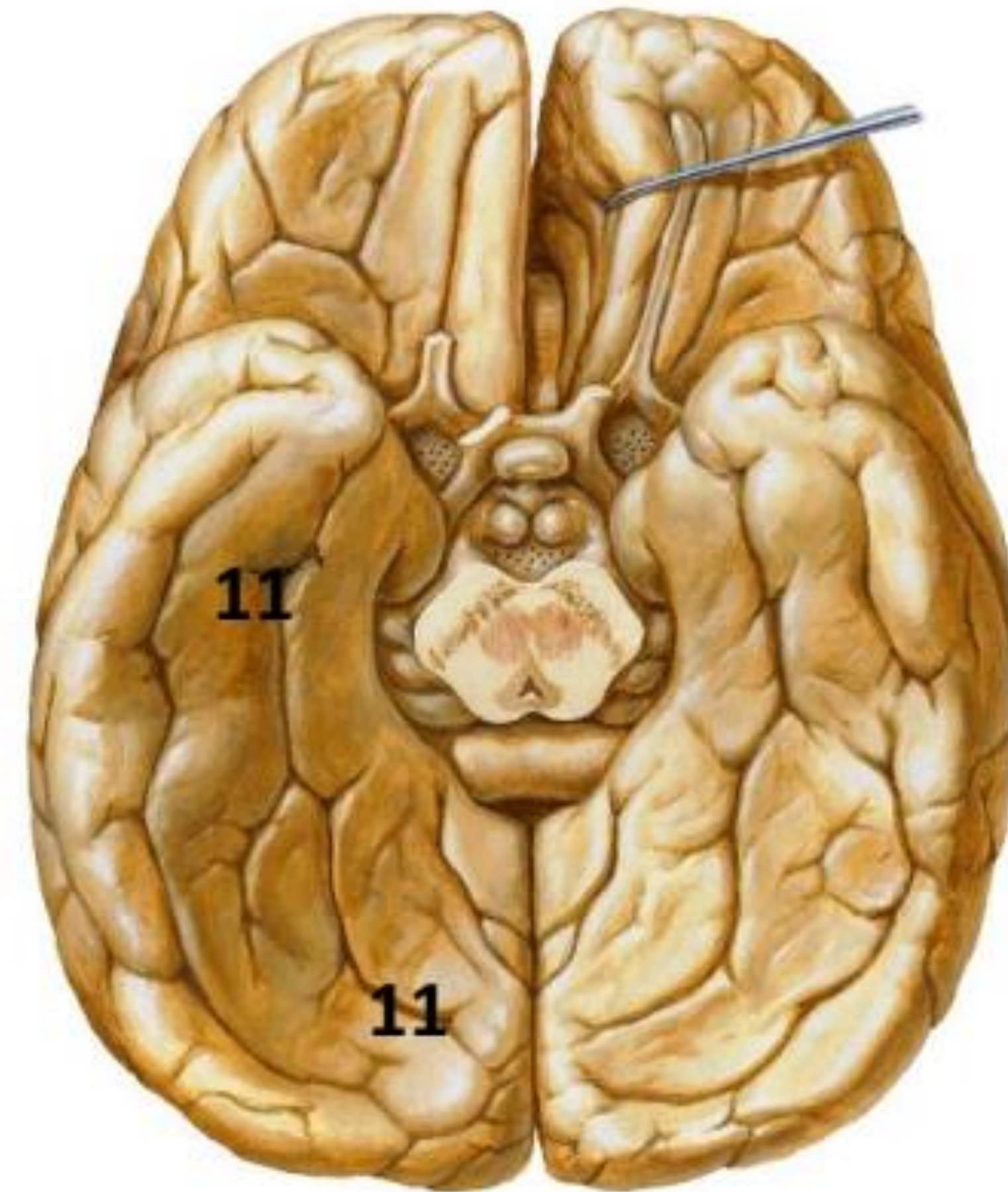
حدة السمع تقل ولكن لا تُفقد تمامًا



## **11. Face recognition area:**

**\*\* Site:** on inferior surface of temporal & occipital lobes.

**\*\* Lesion:** bilateral lesion leads to prospagnosia i.e: inability to recognize people by their faces.

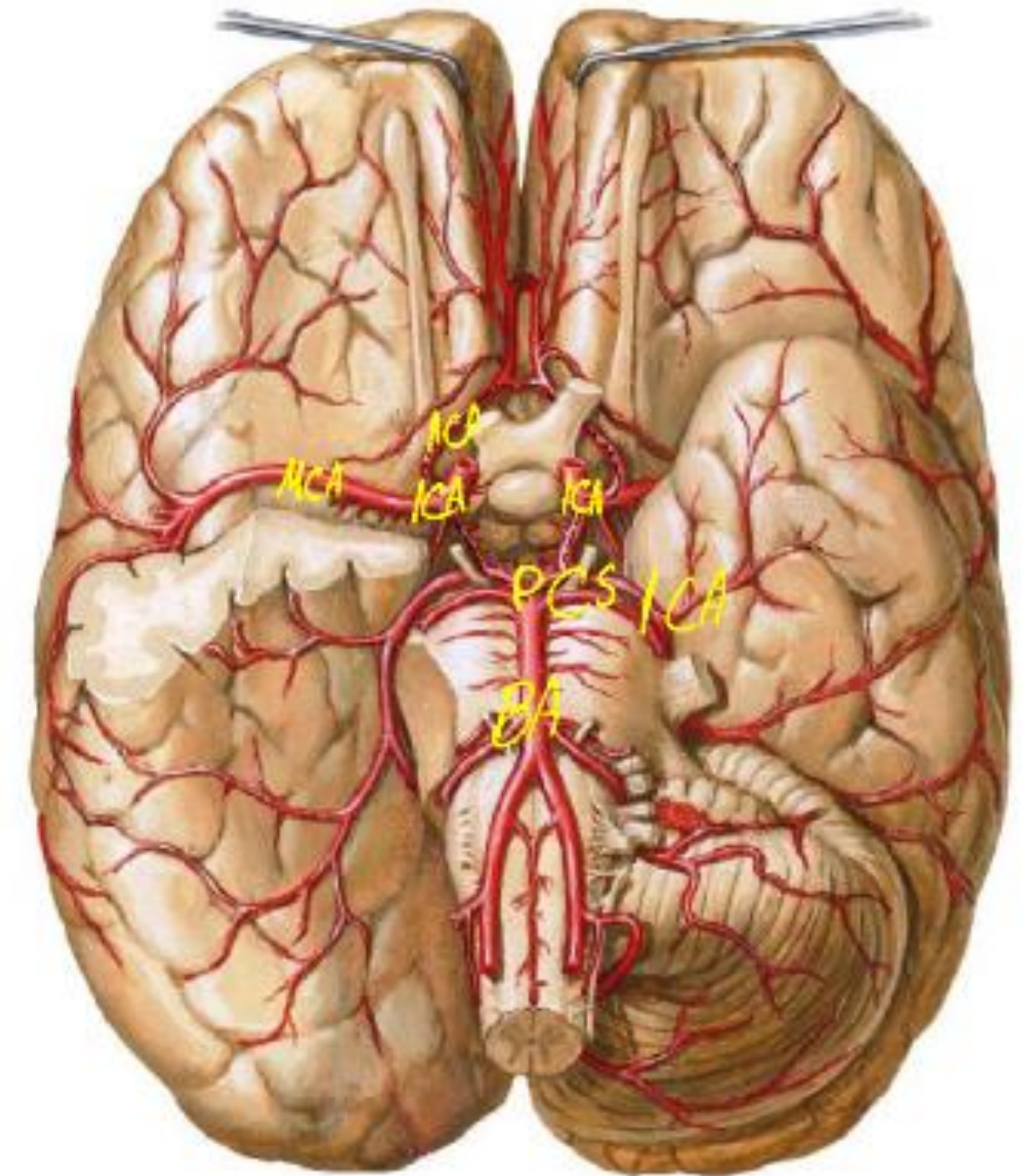




# Blood supply of cerebral hemispheres

**\*\* Cerebral hemispheres are supplied by:**

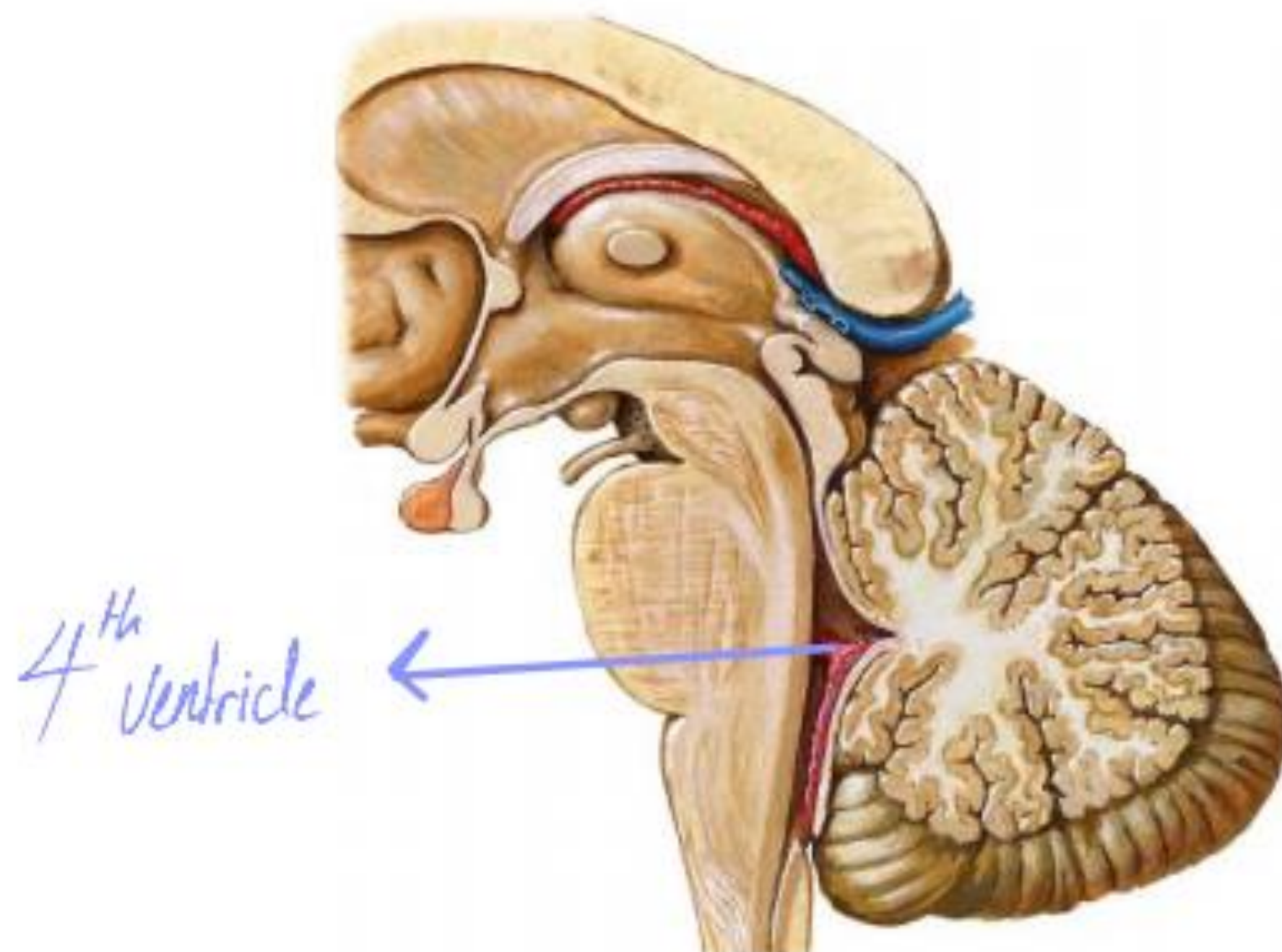
- 1. Anterior & middle cerebral arteries:** which are branches of internal carotid artery.
- 2. Posterior cerebral artery:** a branch of basilar artery.



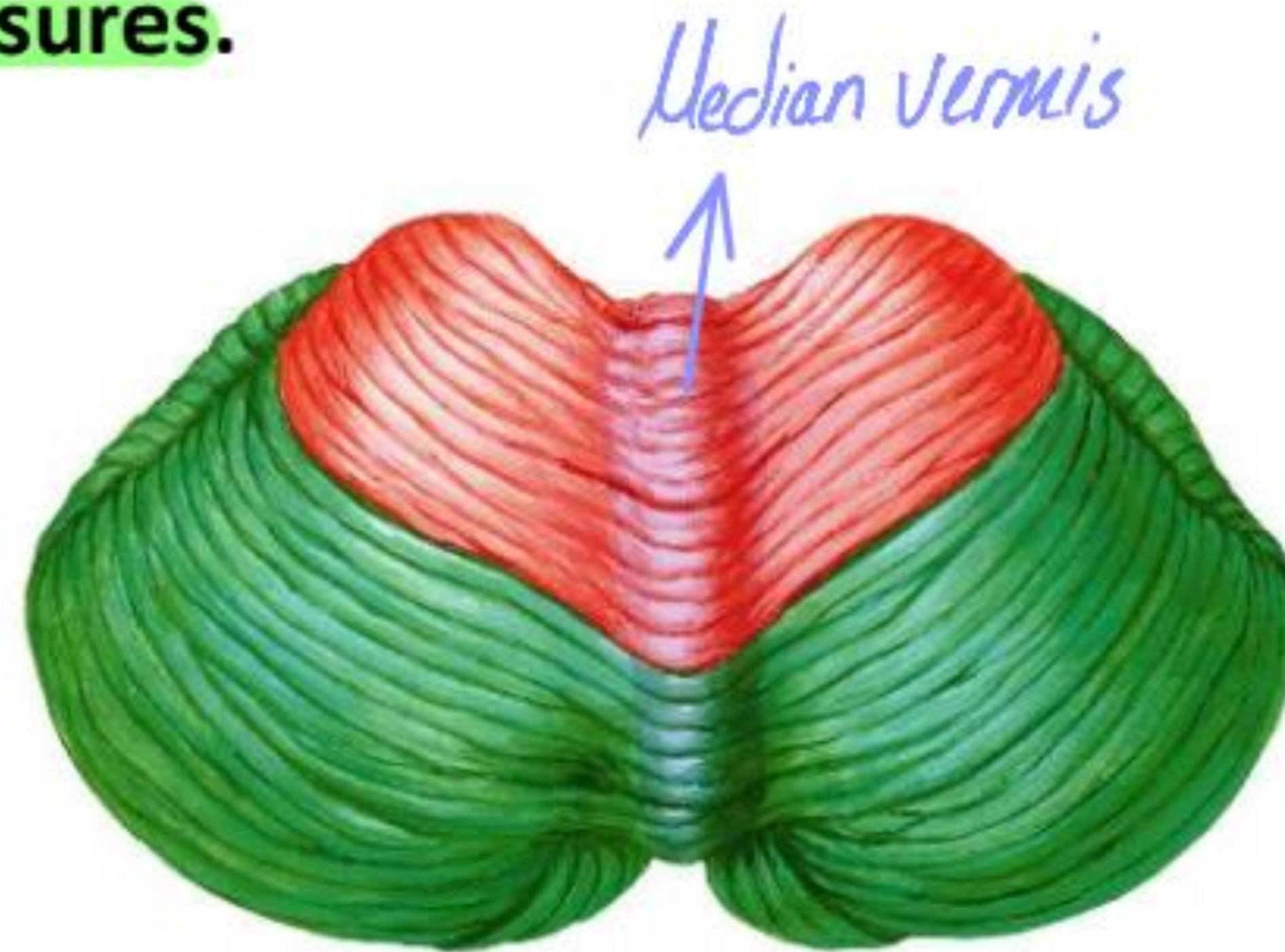


# Cerebellum

- \*\* It lies in posterior cranial fossa, posterior to pons & medulla separated from them by the cavity of 4<sup>th</sup> ventricle.
- \*\* It is formed of 2 cerebellar hemispheres joined by a median vermis.
- \*\* Its surface shows numerous fissures.



Sagittal section



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**\*\* It is connected to mid brain via superior cerebellar peduncle, to pons via middle cerebellar peduncle and to medulla via the inferior cerebellar peduncle.**

**\*\* Functions: one cerebellar hemisphere controls muscular activity of the same side of the body.**

*Ipsilateral*

*The 3 parts of brainstem; are connected to the cerebellum by means of 3 Cerebellar peduncle*

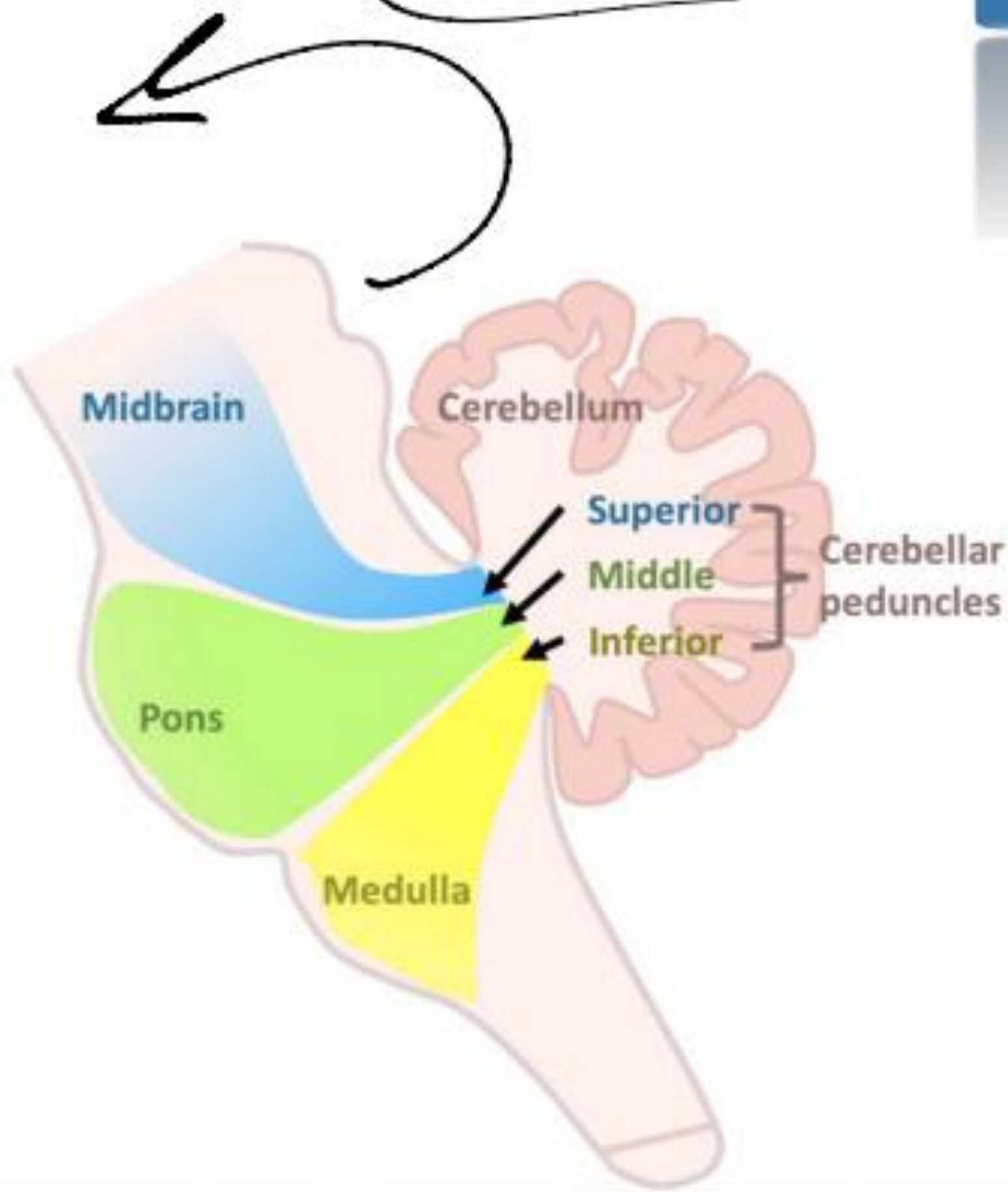


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*في كمان  
Cerebellum  
sphere*



توضیح



THANK  
YOU

Done by:-

Jana Salah

Dr Ashraf Ramzy