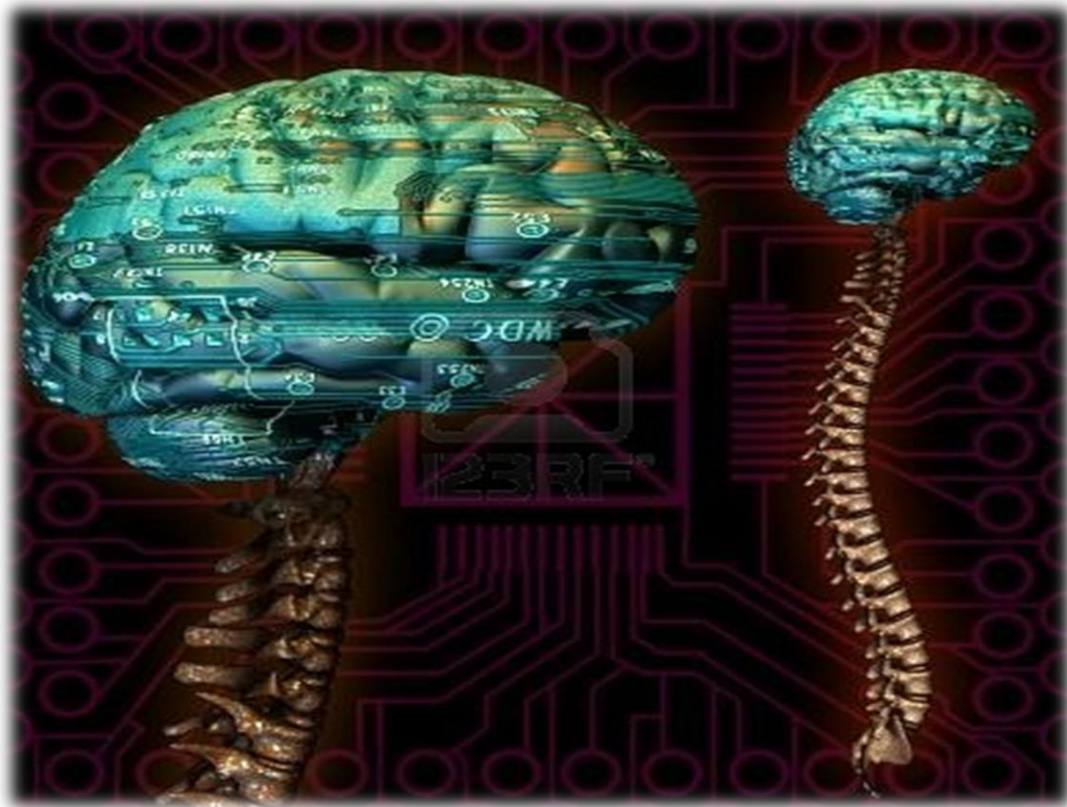




# CNS Block



## LECTURE ( 16 )

### THE CEREBELLUM ITS RELEVANT CONNECTIONS

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Reviewe & MCQs by: May H. Alorainy 🐾

[If there is any mistake please feel free to contact us:](#)

[Anatomyteam32@gmail.com](mailto:Anatomyteam32@gmail.com)

Both - Black

Male Notes - BLUE

Female Notes - GREEN

Explanation and additional notes - ORANGE

Very Important note - Red





# Objectives:

Describe the external features of the cerebellum (lobes, fissures).

Describe briefly the internal structure of the cerebellum.

List the name of cerebellar nuclei.

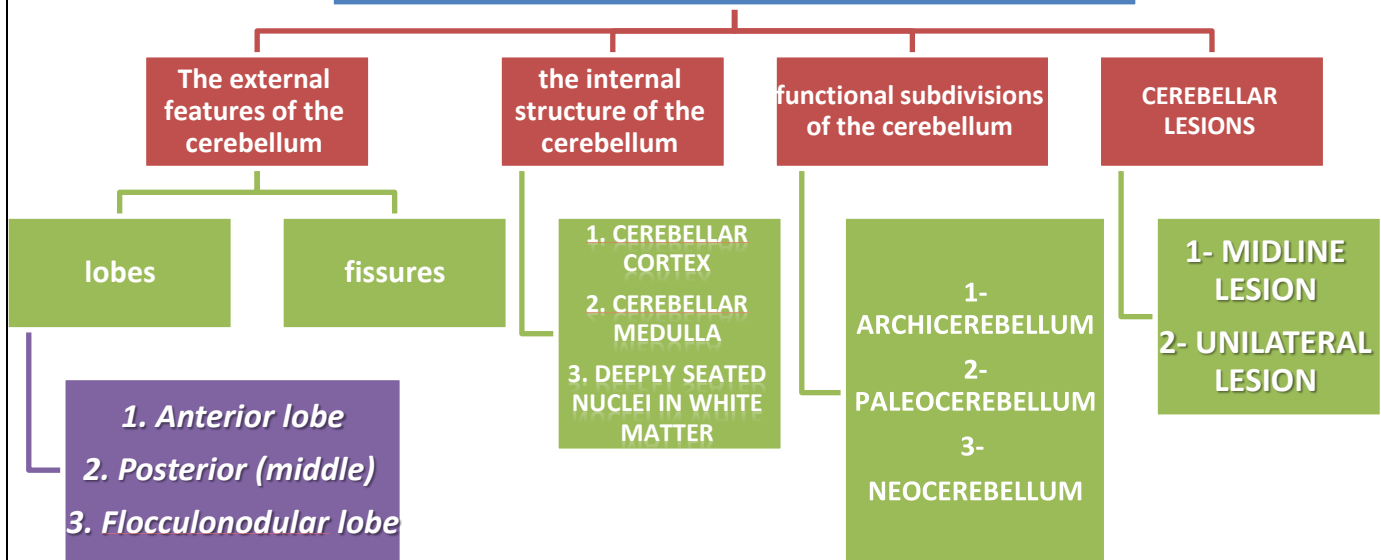
Relate the anatomical to the functional subdivisions of the cerebellum.

Describe the important connections of each subdivision.

Describe briefly the main effects in case of lesion of the cerebellum.



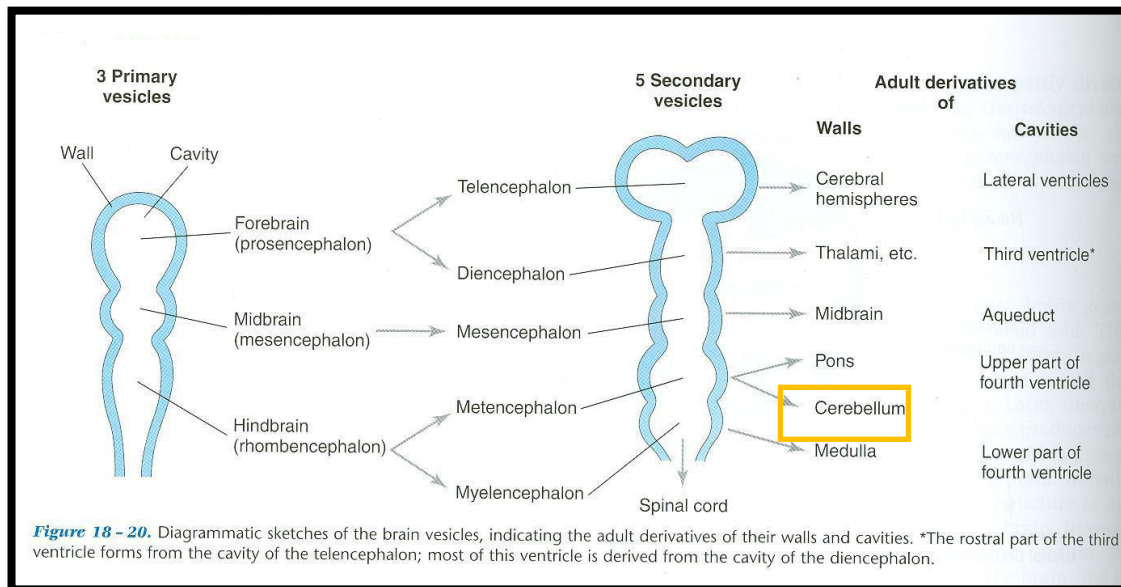
# Mind Map





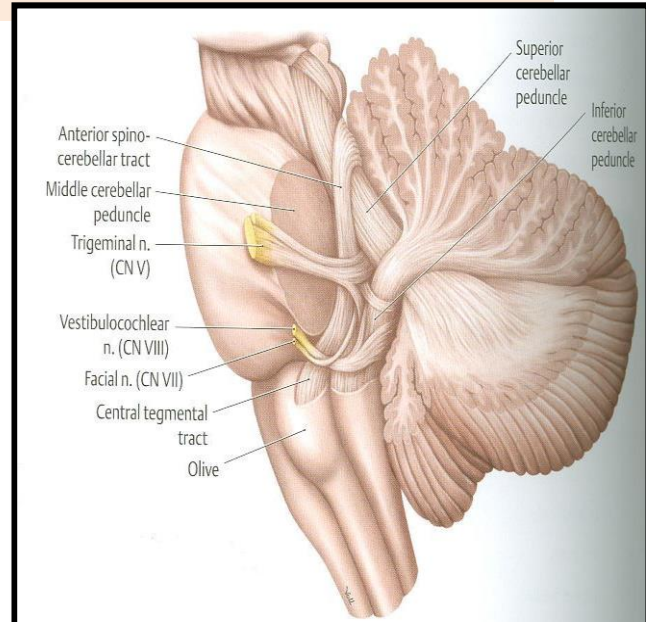
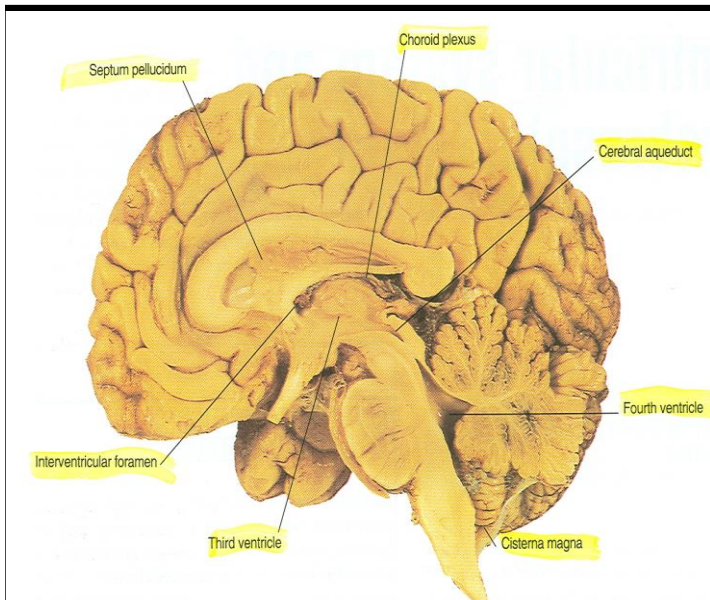
## Just recall

### The cerebellum develops from the cranial 1/3 of the neural tube





# THE CEREBELLUM



**ORIGIN:** from hindbrain, separated from pons & medulla by fourth ventricle.

**CONNECTION TO BRAIN STEM:** by inferior, middle & superior cerebellar peduncles.

We can differentiate between the upper and lower surfaces of cerebellum by :

The superior and inferior vermis

The superior vermis is continuous with the cerebellar hemisphere

The inferior vermis is not continuous with the cerebellar hemisphere

We can differentiate between the anterior and posterior surfaces of cerebellum by notches

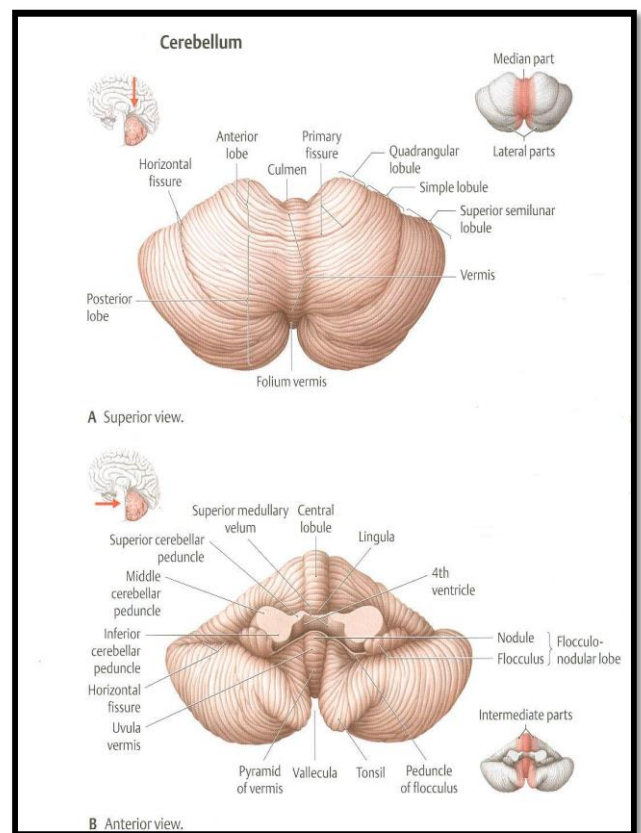






# EXTERNAL FEATURES

- ❑ It consists of two **cerebellar hemispheres** joined in midline by the **vermis**.
- ❑ Its surface is **highly convoluted forming folia separated by fissures**.



when we see to the cerebellum and cerebrum we will find they are similar,

But in cerebrum there is basal nuclei and in cerebellum it is called cerebellar nuclei

Both, their surfaces are highly convoluted but

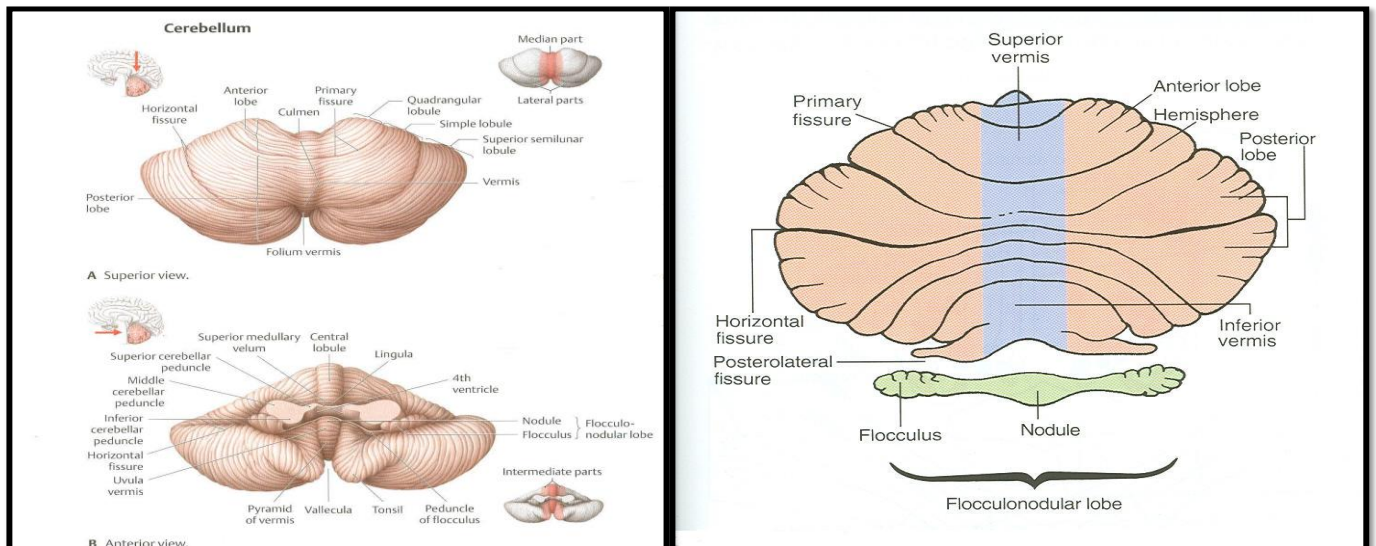
In cerebellum they are forming folia separated by fissures

In cerebrum they are forming gyrus separated by sulcus

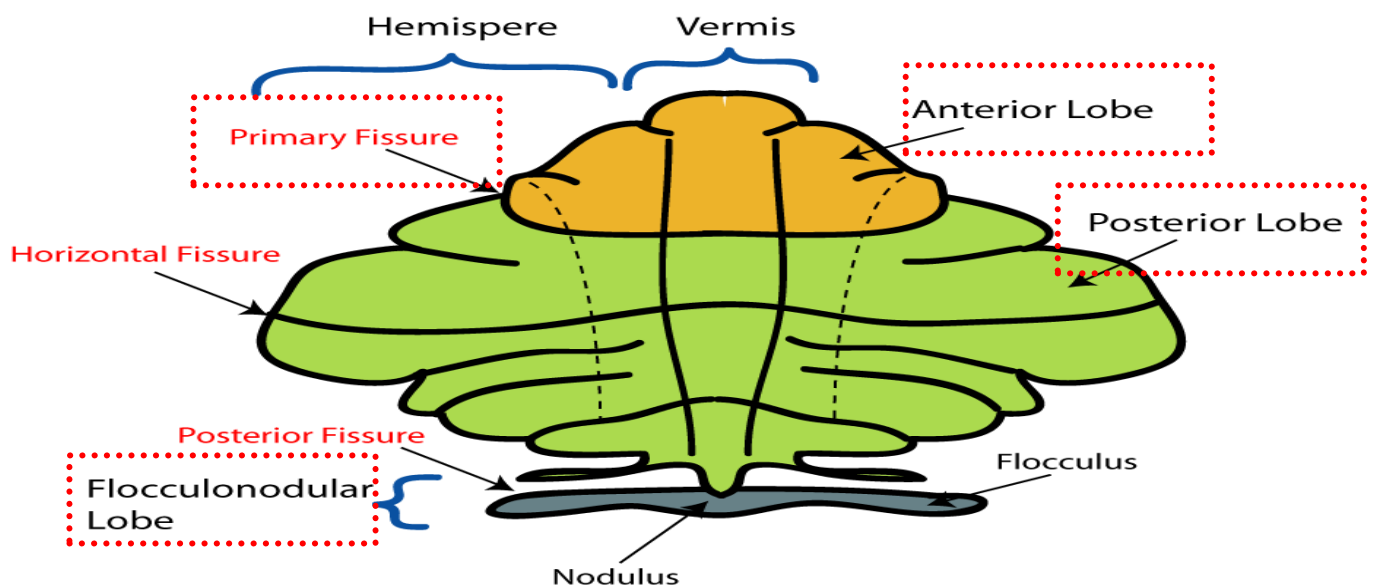




# ANATOMICAL SUBDIVISION



1. **Anterior lobe: in front of primary fissure**
2. **Posterior (middle) lobe: behind primary fissure**
3. **Flocculonodular lobe.**

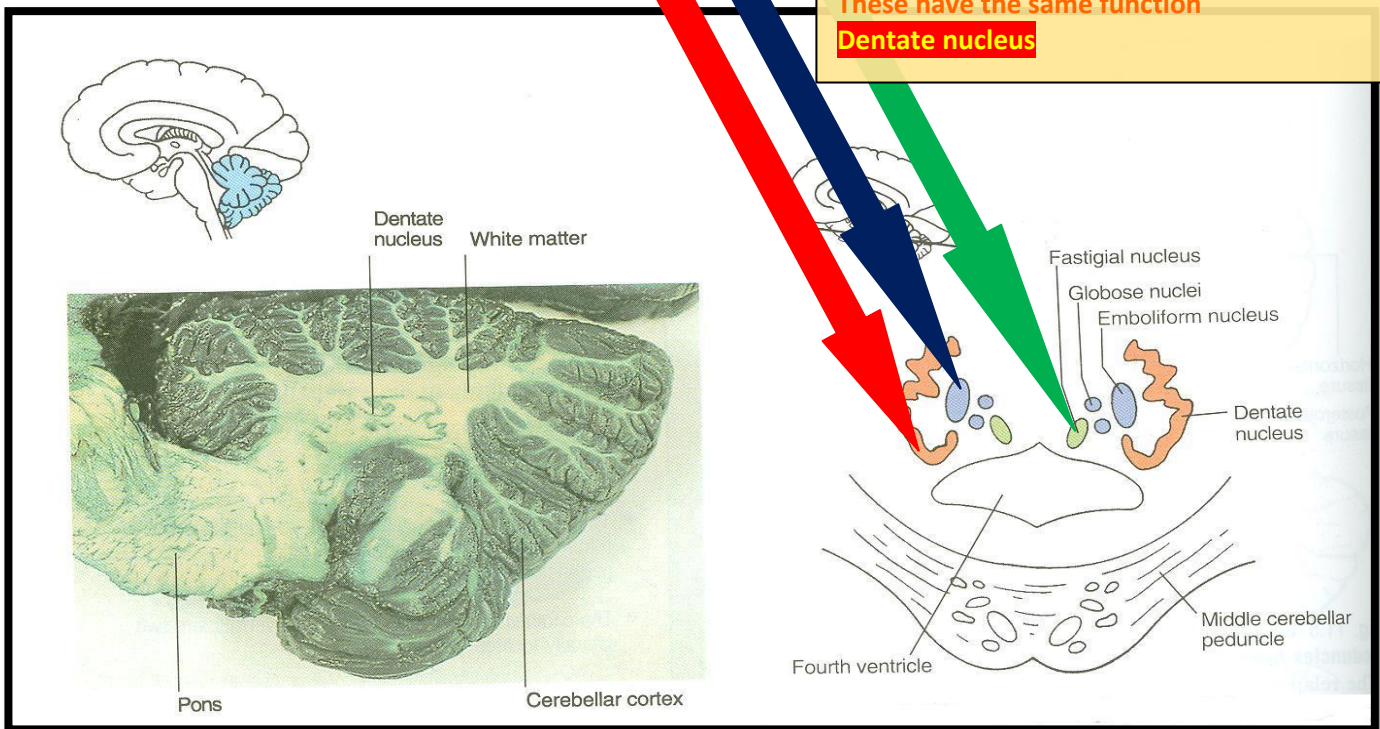


# CONSTITUENTS

1. **Outer grey matter:** cerebellar cortex.
2. **Inner white matter:** cerebellar medulla.
3. **Deeply seated nuclei in white matter ( above the roof of the fourth ventricle, lie in four pairs of nuclei ) : from medial to lateral:**

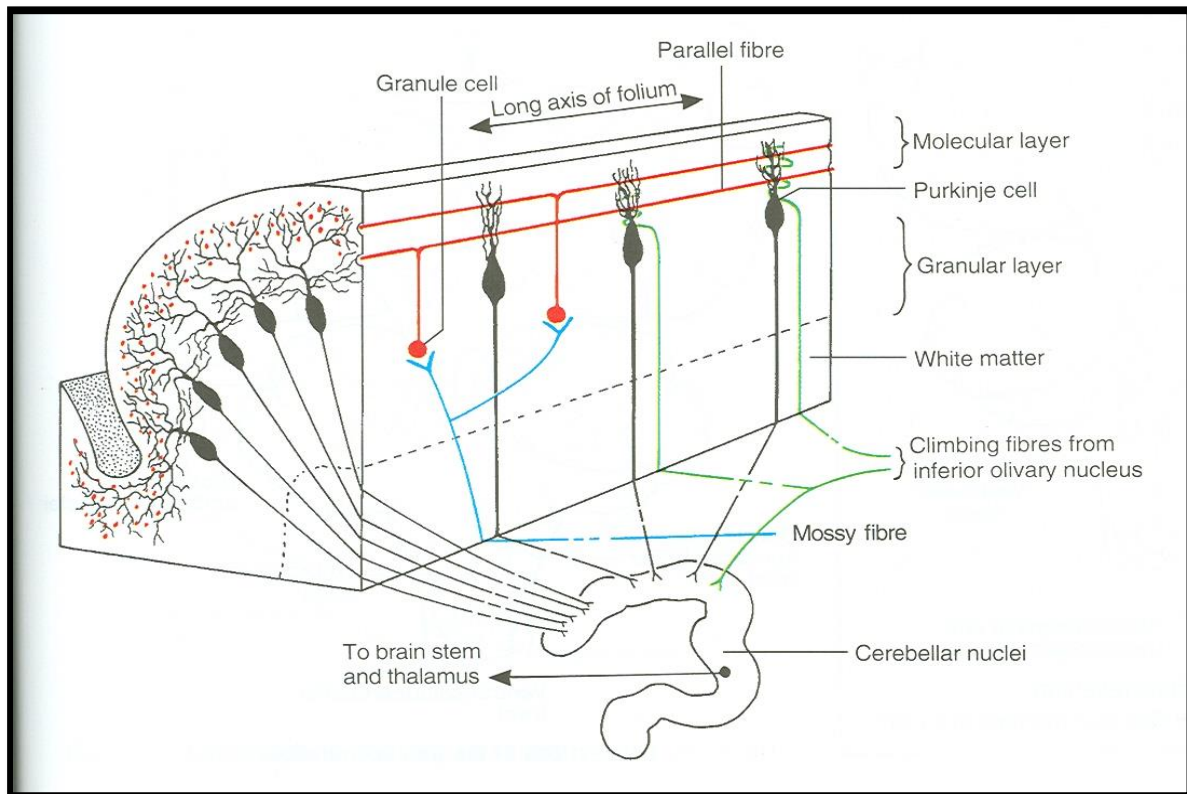
- **Fastigeal nucleus: smallest one.**
- **Globose nucleus.**
- **Emboliform nucleus.**
- **Dentate nucleus: largest one.**

Anatomically it is divided into four nuclei :  
 Fastigeal nucleus  
 Globose nucleus  
 Emboliform nucleus  
 Dentate nucleus  
 But functionally it is divided into three nuclei:  
**Fastigeal nucleus**  
**Globose nucleus**  
**Emboliform nucleus**  
 These have the same function  
**Dentate nucleus**





# CEREBELLAR CORTEX



❑ **Histologically it is divided into 3 layers:**

1. **Outer molecular layer ( fiber-rich )**
2. **Intermediate Purkinje cell layer**
3. **Inner granular layer ( which is dominated by the granule cell )**



# CEREBELLAR MEDULLA

## AFFERENT FIBRES:

- ❑ **Climbing fibres:** from *inferior olivary nucleus* (the *inferior olivary nucleus has a strong relationship with cerebellum most of its fibers go to the cerebellum* ) , relay to purkinge cells ( *directly to be faster* )
- ❑ **Mossy fibres: rest of fibres:**
  1. *From vestibular nuclei*
  2. *From spinal cord*
  3. *From pons*
  - **They relay to granule cells which in turn relay to purkinge cells** ( *not directly* )



# CEREBELLAR MEDULLA

- ❑ Axons of purkinge cells are the only axons to leave the cortex to medulla:
  1. The great majority of axons do not leave cerebellum & end in deep cerebellar nuclei.
  2. Some of axons leave cerebellum as efferent fibres.

## EFFERENT FIBRES:

- ❑ Most of efferent fibres are axons of deep cerebellar nuclei.
- ❑ Main efferents go to:
  1. *Vestibular nuclei*
  2. *Red nucleus*
  3. *Ventral lateral nucleus of thalamus*



# FUNCTIONAL SUBDIVISIONS OF THE CEREBELLUM

The cerebellum is often regarded as consisting of three functional subdivisions, based upon phylogenetic **النشوء**, anatomical and functional considerations

**ARCHICEREBELLUM**

ARCH means the oldest

**PALEOCEREBELLUM**

**NEOCEREBELLUM**

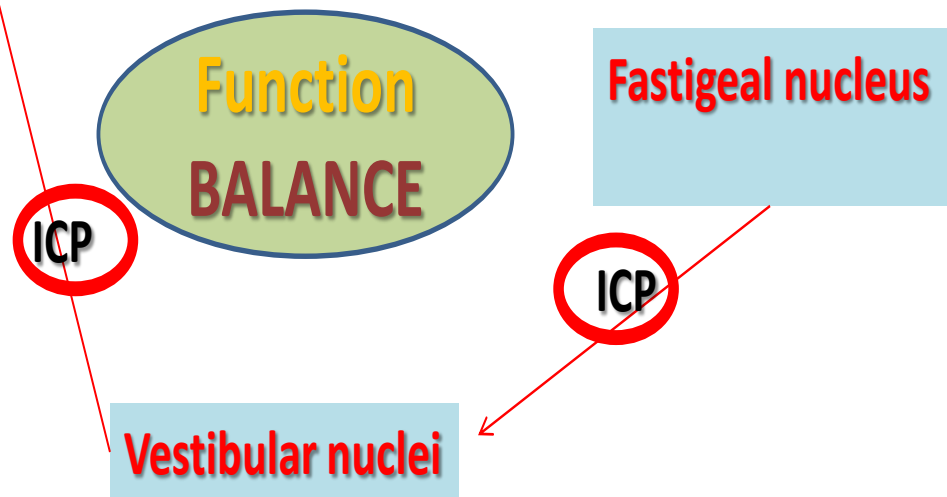




# ARCHICEREBELLUM

Purkinje cells of flocculonodular lobe

ICP = inferior cerebellar peduncles



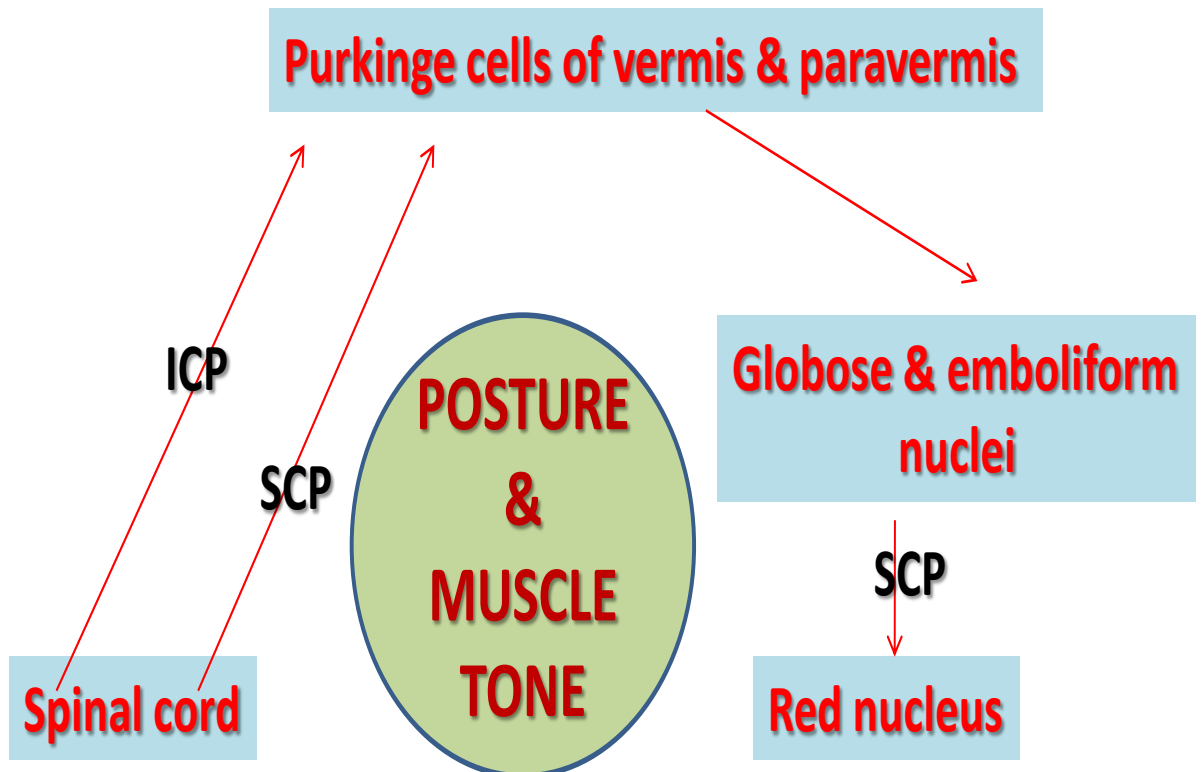
- ❑ Part of cerebellum: **flocculonodular lobe**
- ❑ Nuclei: **fastigeal**
- ❑ Afferents: from vestibular nuclei (through ICP)
- ❑ Efferents: to vestibular nuclei (through ICP)
- ❑ Function: controls balance



# PALEOCEREBELLUM

ICP = inferior cerebellar peduncles

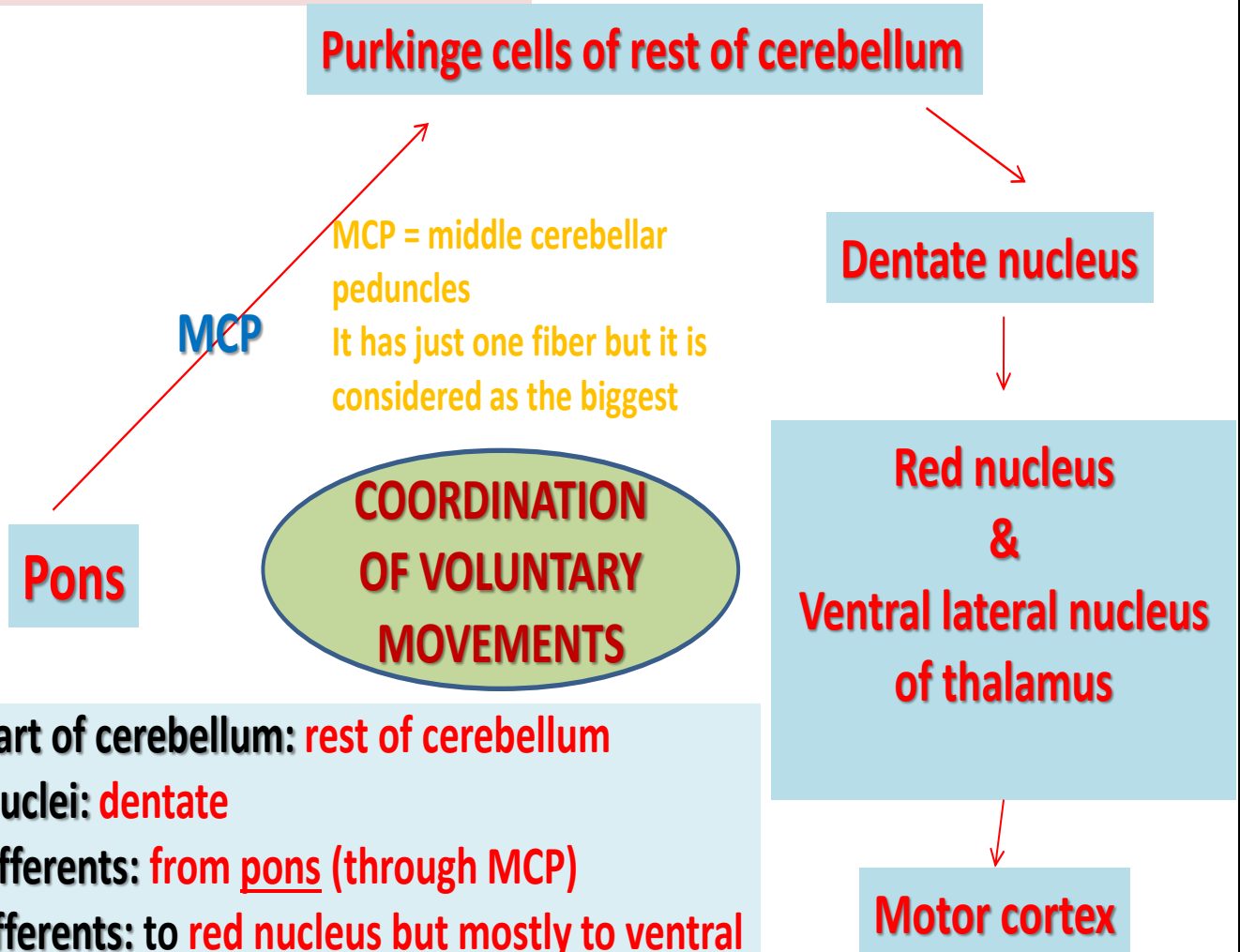
SCP = superior cerebellar peduncles



- ❑ Part of cerebellum: **vermis & paravermis**
- ❑ Nuclei: **globose & emboliform**
- ❑ Afferents: from **spinal cord** (dorsal & ventral spinocerebellar tracts through ICP & SCP, respectively)
- ❑ Efferents: to **red nucleus** (through SCP)
- ❑ Function: influences **posture & muscle tone**



# NEOCEREBELLUM



- ❑ Part of cerebellum: **rest of cerebellum**
- ❑ Nuclei: **dentate**
- ❑ Afferents: **from pons (through MCP)**
- ❑ Efferents: to **red nucleus** but mostly to **ventral lateral nucleus of thalamus** (through SCP) then to motor cortex
- ❑ Function: **coordination of voluntary movements**



	<b>ARCHICEREBELLUM</b>	<b>PALEOCEREBELLUM</b>	<b>NEOCEREBELLUM</b>
<b>Part of cerebellum</b>	flocculonodular lobe	vermis & paravermis	rest of cerebellum
<b>Nuclei</b>	fastigial	globose & emboliform	dentate
<b>Afferents</b>	vestibular nuclei (through ICP)	spinal cord (dorsal & ventral spinocerebellar tracts through ICP & SCP, respectively)	pons (through MCP)
<b>Efferents</b>	vestibular nuclei (through ICP)	to red nucleus (through SCP)	to red nucleus but mostly to ventral lateral nucleus of thalamus (through SCP) then to motor cortex
<b>Function</b>	controls balance	influences posture & muscle tone	coordination of voluntary movements
<b>Notes</b>	ICP = inferior cerebellar peduncles ARCH means the oldest	ICP = inferior cerebellar peduncles SCP = superior cerebellar peduncles	MCP = middle cerebellar peduncles It has just one fiber but it is considered as the biggest





# CEREBELLAR LESIONS

- **MIDLINE LESION:** Loss of postural control AND REFLEX AND TONE
- **UNILATERAL LESION:** “Cerebellar ataxia” causes **ipsilateral:**
  1. **Incoordination of arm:** intention tremor (on performing voluntary movements)
  2. **Incoordination of leg:** unsteady gait
  3. **Incoordination of eye movements:** nystagmus
  4. **Slowness of speech:** dysarthria

**SENSORY ATAXIA** is loss of sensory input into the control of movement, that means when the patient close his eyes he will fall due to the loss of coordination .



## SUMMARY

- ❑ **Anatomically**, the cerebellum is divided into: anterior, posterior & flocculonodular lobes.
- ❑ **Developmentally & functionally**, it is divided into: archi-paleo- & neocerebellum.
- ❑ **Archicerebellum (flocculonodular lobe)** is the oldest part of cerebellum, related to *fastigial* nucleus, connected to **vestibular nuclei** & concerning for **control of body balance**.
- ❑ **Paleocerebellum (vermis & paravermis)** is related to *globose & emboliform* nucleus, connected to **spinal cord & red nucleus** & concerning for **regulation of posture & muscle tone**.
- ❑ **Neocerebellum (most of human cerebellum)** is related to *dentate* nucleus, connected to pons, thalamus. Its final destination is to **motor cortex**. It is concerned with **coordination of voluntary movements**.
- ❑ Cerebellar lesions lead to **ipsilateral incoordination (ataxia)**.



## Notes from Dr. Sanaa Alshaarwy's lecture:

- Superior view of cerebellum shows ONLY ONE fissure → **primary fissure**.
- Horizontal fissure is present on the sides of cerebellum and divides it into superior and inferior aspects.
- Flocculonodular lobe appears ONLY in anteroinferior view.
- Secondary fissure = posterolateral fissure.
- Globose and emboliform nuclei are intermediate in position.
- Dentate nucleus is the largest and can be seen by naked eye.
- Climbing fibers in the cerebellar medulla arise from **inferior olivary nucleus** which is located in rostral medulla.
- Main efferent fibers from cerebellum going to:
  1. **Vestibular** nuclei → through cerebello**vestibular** fibers.
  2. **Red nucleus** and then to **ventral lateral nucleus of thalamus** → cerebello**rubrothalamic** fibers.
- **Regarding the functional subdivision of the cerebellum, Dr. Sanaa focused a lot on the name, function and nuclei of each division.**
- **Archicerebellum:** Vestibular nerve sends impulses to vestibular nuclei → sends impulses through vestibulocerebellar fibers → sends impulses to flocculonodular lobe to reach the **fastigial nucleus** → impulses are sent through efferent fibers to vestibular nuclei & reticular formation in brainstem → sends impulses to spinal cord via vestibulospinal tract and reticulospinal tract.
- **Paleocerebellum:** Red nucleus forms rubrospinal tract through which impulses are sent to spinal cord.
- **Neocerebellum:** Dentate nucleus receives impulses from pons through pontocerebellar fibers → dentate nucleus sends fibers to red nucleus and VL nucleus of thalamus → to motor cortex → cerebral cortex sends tracts to spinal cord (corticospinal).
- Neocerebellum is called cerebral part of cerebellum because it reaches cerebral cortex.
- Lesions of the midline are involving **paleocerebellum**.
- In unilateral lesions of cerebellum, **tremors occur during tension** NOT during rest as in Parkinsonism.



# Quiz

**1. The cerebellum is separated from medulla and pons by:**

- A. Cerebellar peduncles.
- B. Cerebral Aqueduct.
- C. Fourth ventricle.
- D. Lateral ventricles.

**2. The cerebellar hemispheres are joined together by:**

- A. Velum.
- B. Vermis.
- C. Basilar groove.
- D. Corpus callosum.

**3. Which of the following is located in front of the posterolateral fissure?**

- A. Anterior.
- B. Median.
- C. Posterior.
- D. Flocculonodular.

**4. Choose the correct organization of the deep cerebellar nuclei from lateral to medial:**

- A. Globose, Dentate, Emboliform, Fastigial.
- B. Fastigial, Dentate, Emboliform, Globose.
- C. Fastigial, Globose, Emboliforme, Dentate.
- D. Dentate, Emboliform, Globose, Fastigial.

**5. In the cerebellar medulla, climbing fibers arise from?**

- A. Inferior olivary nucleus.
- B. Spinal cord.
- C. Pons.
- D. Vestibular nuclei.

**6. Which of the following fibers do not relay in the granule cells of cerebellar cortex?**

- A. Vestibular fibers.
- B. Pontine fibers.
- C. Climbing fibers.
- D. Spinal cord fibers.





**7. Which of the following nuclei is involved in the control of balance?**

- A. Fastigial.
- B. Dentate.
- C. Emboliform.
- D. Globose.

**8. The spinal part of cerebellum includes:**

- A. Flocculonodular lobe.
- B. Vermis & paravermis.
- C. Cerebellar peduncles.
- D. Anterior and posterior lobes.

**9. Efferents of paleocerebellum project to \_\_\_\_\_ through \_\_\_\_\_?**

- A. Spinal cord through ICP.
- B. Red nucleus through ICP.
- C. Spinal cord through SCP.
- D. Red nucleus through SCP.

**10. The neocerebellum coordinates voluntary movements via:**

- A. Corticospinal tracts.
- B. Spinocerebellar tracts.
- C. Spinothalamic tracts.
- D. Reticulospinal tracts.

**11. Which one of the following nuclei is related to neocerebellum?**

- A. Fastigial nucleus.
- B. Dentate nucleus.
- C. Globose nucleus.
- D. Emboliform nucleus.

**12. To which part of the CNS the flocculonodular lobe send its efferent fibers?**

- A. Red nucleus.
- B. Pons.
- C. Vestibular nuclei.
- D. Motor cortex.

**13. The largest nucleus in the cerebellum can be seen by naked eye is :**

- A. Fastigial nucleus.
- B. Globose nucleus.
- C. Dentate nucleus.
- D. Emboliform nucleus.



**14. Which part in cerebellum is concerned with coordination of movement ?**

- A. Vermis.
- B. Paravermis.
- C. Folocculonodular lobe.
- D. Neocerebellum.

Question	Answers
1	C
2	B
3	D
4	D
5	A
6	C
7	A
8	B
9	D
10	A
11	B
12	C
13	C
14	D

**GOOD LUCK**

**Anatomy Team Leaders:**

**Fahad AlShayhan & Eman AL-Bedica.**