

THE CEREBELLUM & ITS RELEVANT CONNECTIONS

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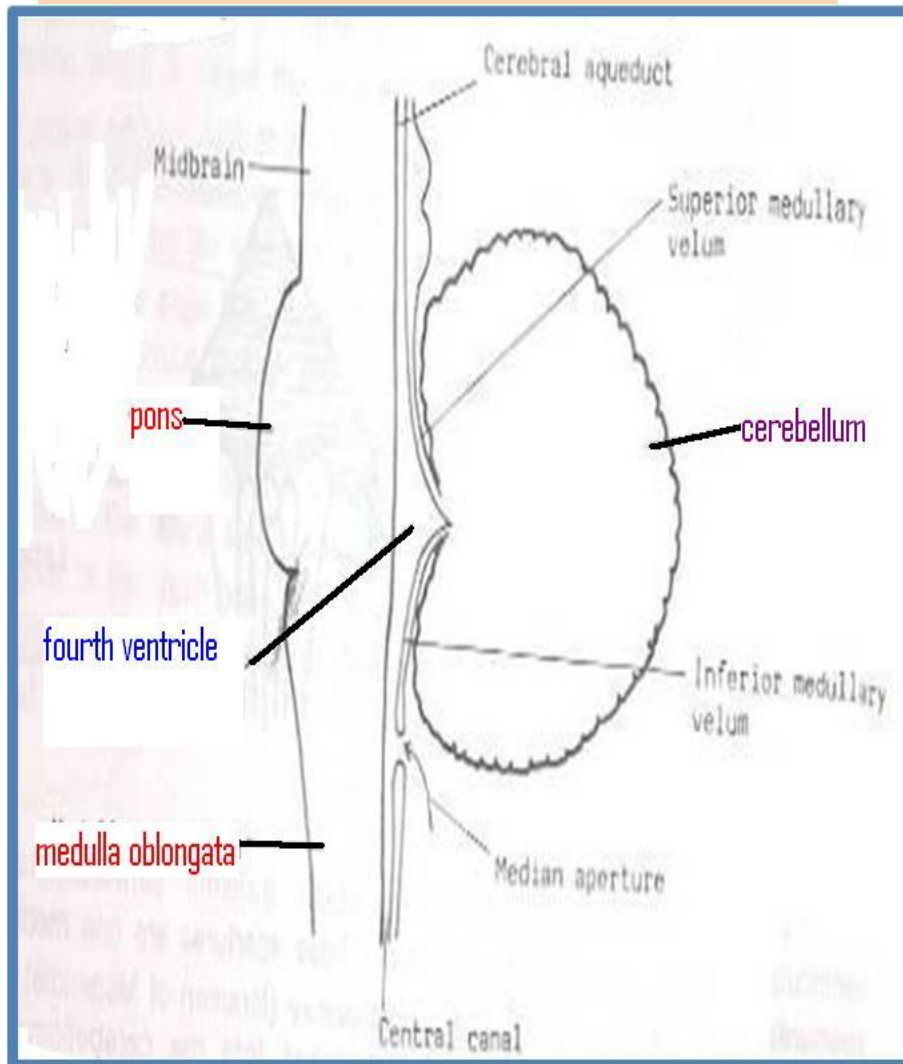
***Prof. Ahmed Fathalla Ibrahim
Professor of Anatomy***

OBJECTIVES

At the end of the lecture, students should:

- 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.*

CEREBELLUM

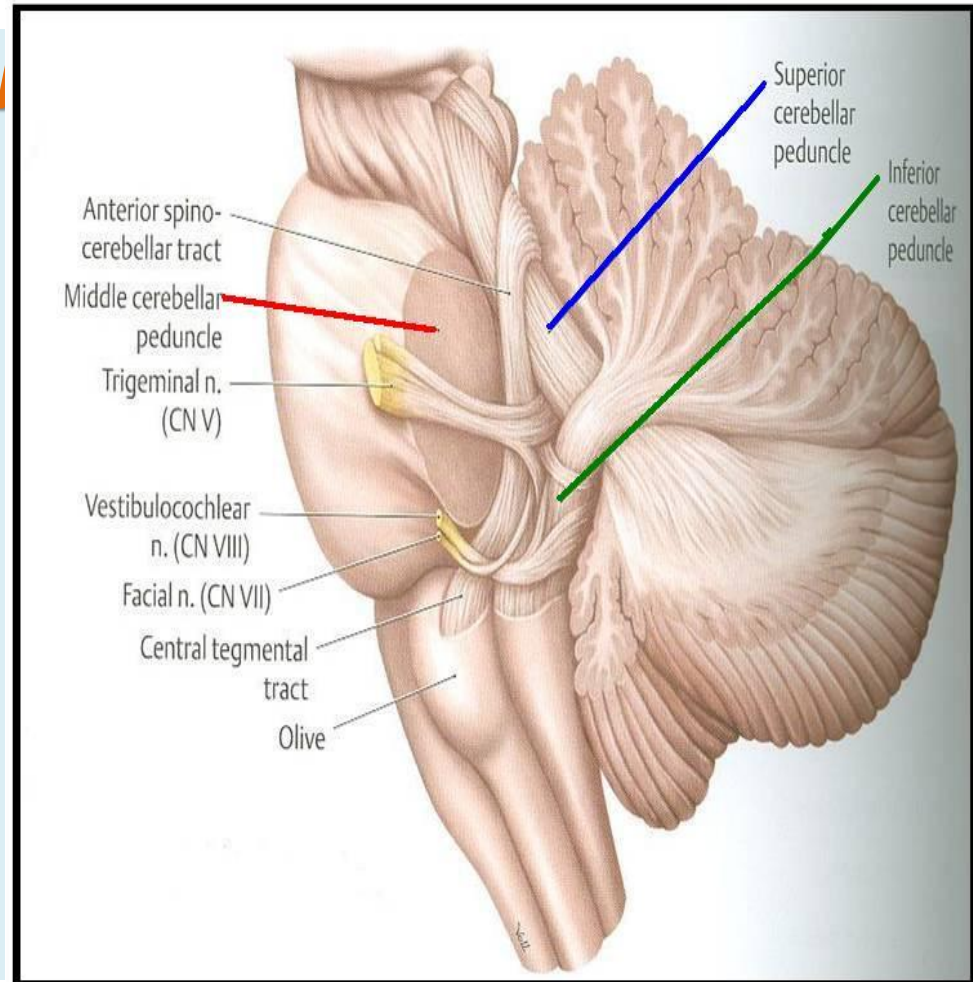


- **ORIGIN :**
- *From Hindbrain.*
- **POSITION :**
- *lies behind **Pons & Medulla** Separated from them by **Fourth ventricle.***

THE CEREBELLUM

❑ **CONNECTION TO BRAIN STEM:**
STEM:

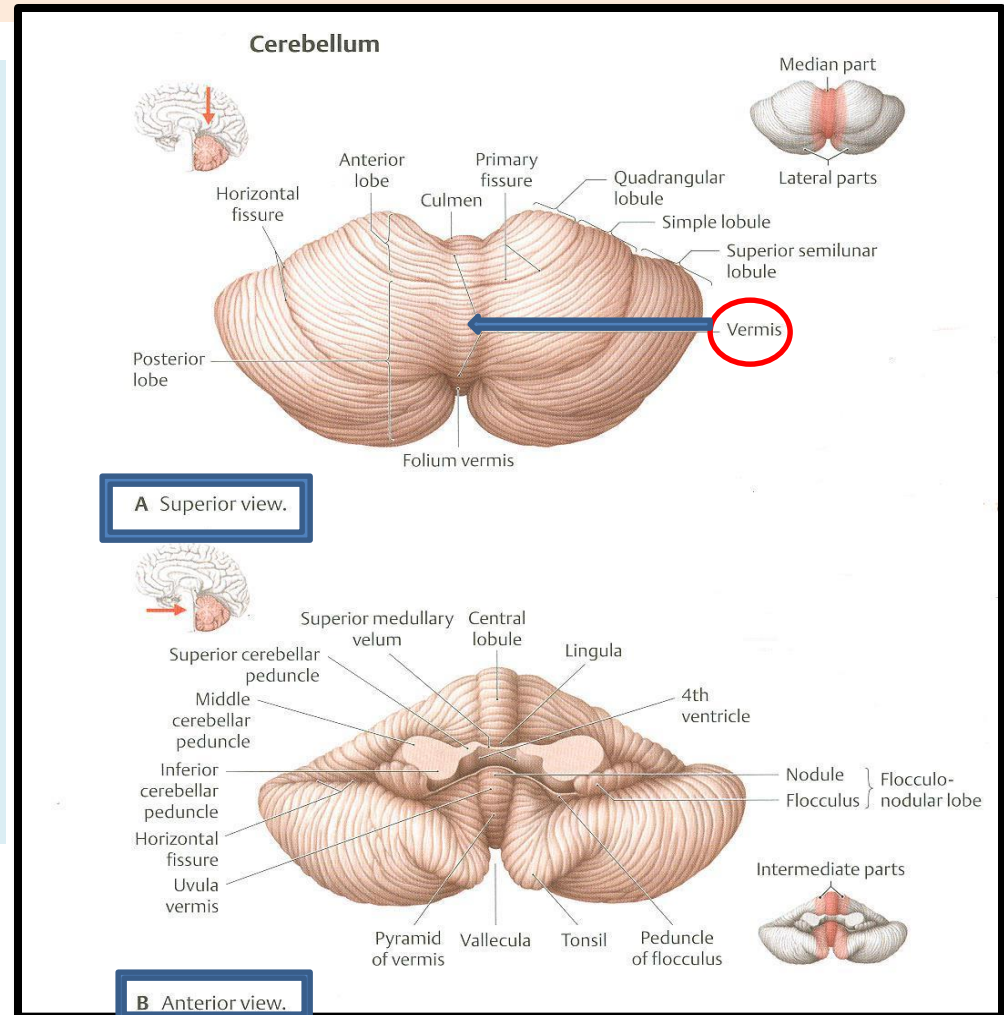
❑ **by Inferior, Middle & Superior Cerebellar Peduncles.**



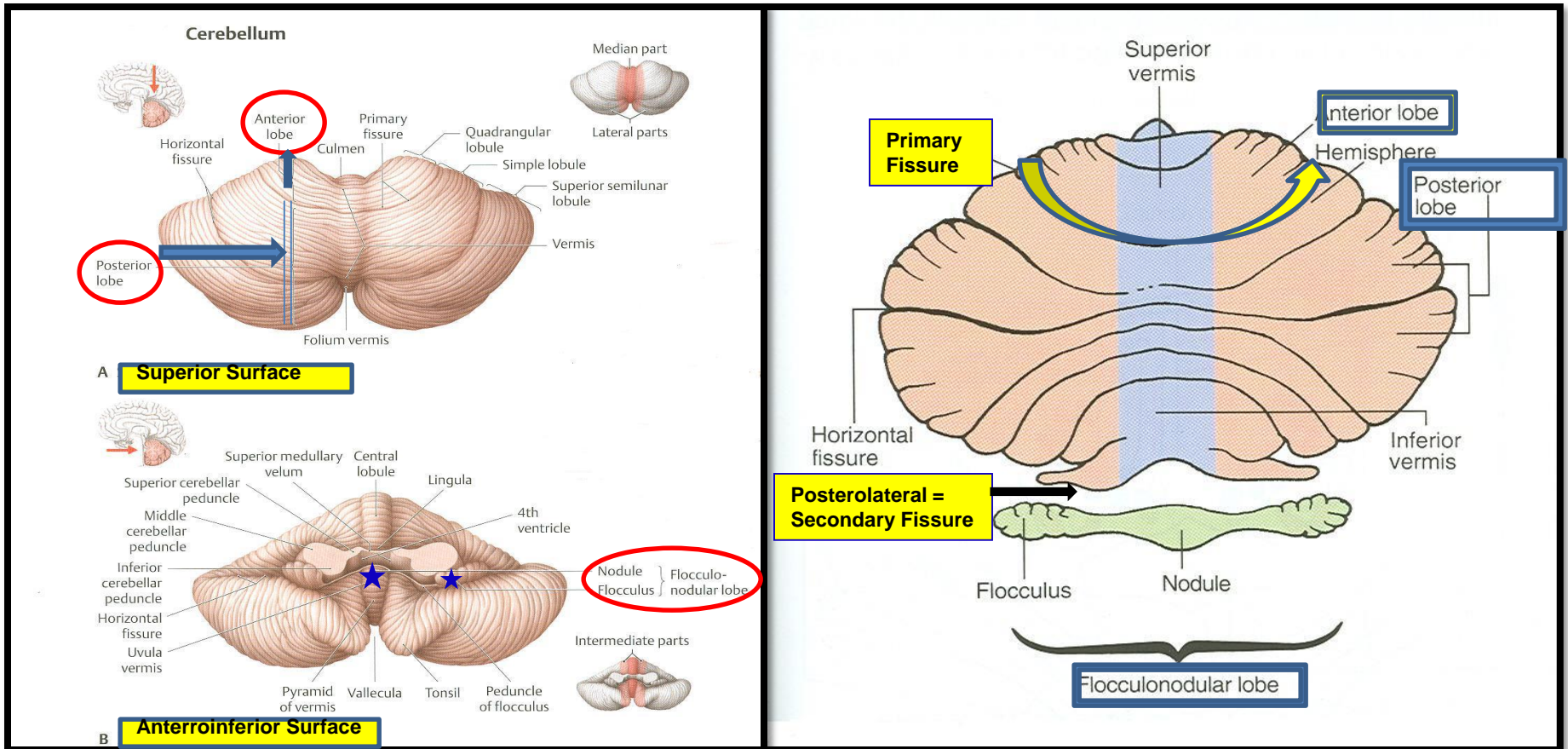
EXTERNAL FEATURES

❑ *It consists of two Cerebellar Hemispheres joined in midline by the **Vermis**.*

❑ *Its surface is highly convoluted forming **Folia**, separated by **Fissures**.*



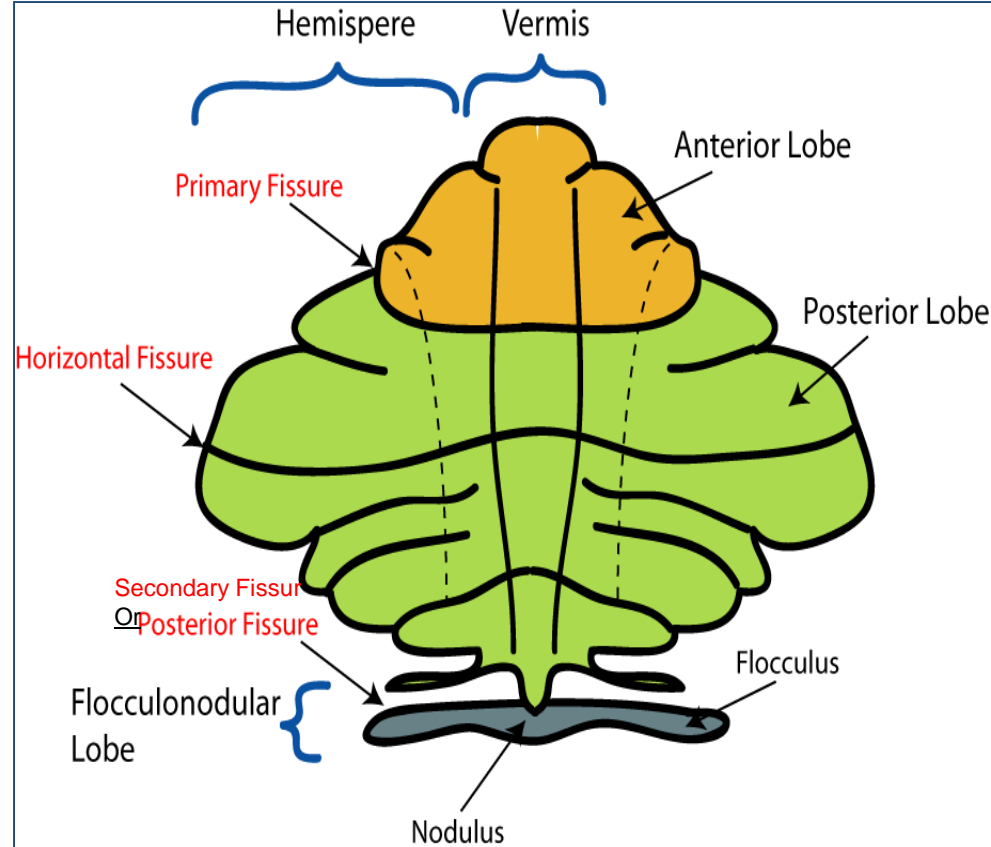
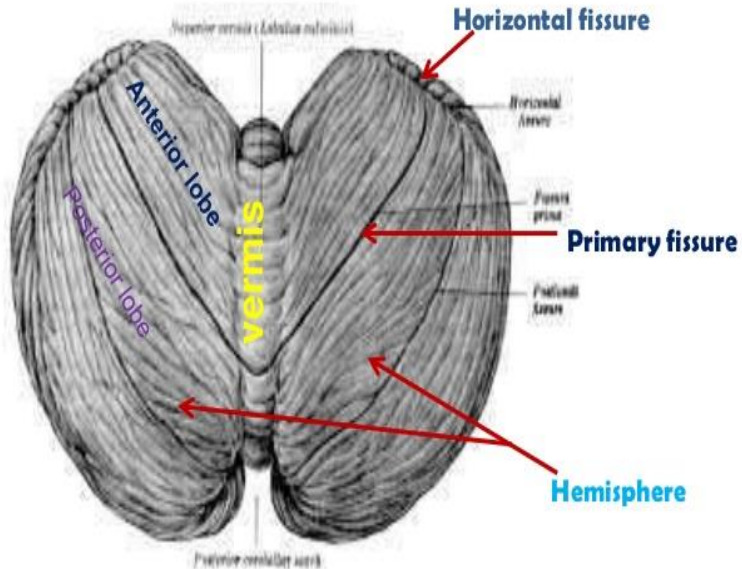
ANATOMICAL SUBDIVISION



- 1. Anterior lobe:** in front of primary fissure, on the superior surface.
- 2. Posterior (middle) lobe:** behind primary fissure (Between Primary & Secondary fissures = posterolateral).
- 3. Flocculonodular lobe:** in front of secondary (Posterolateral) fissure, on the inferior surface.

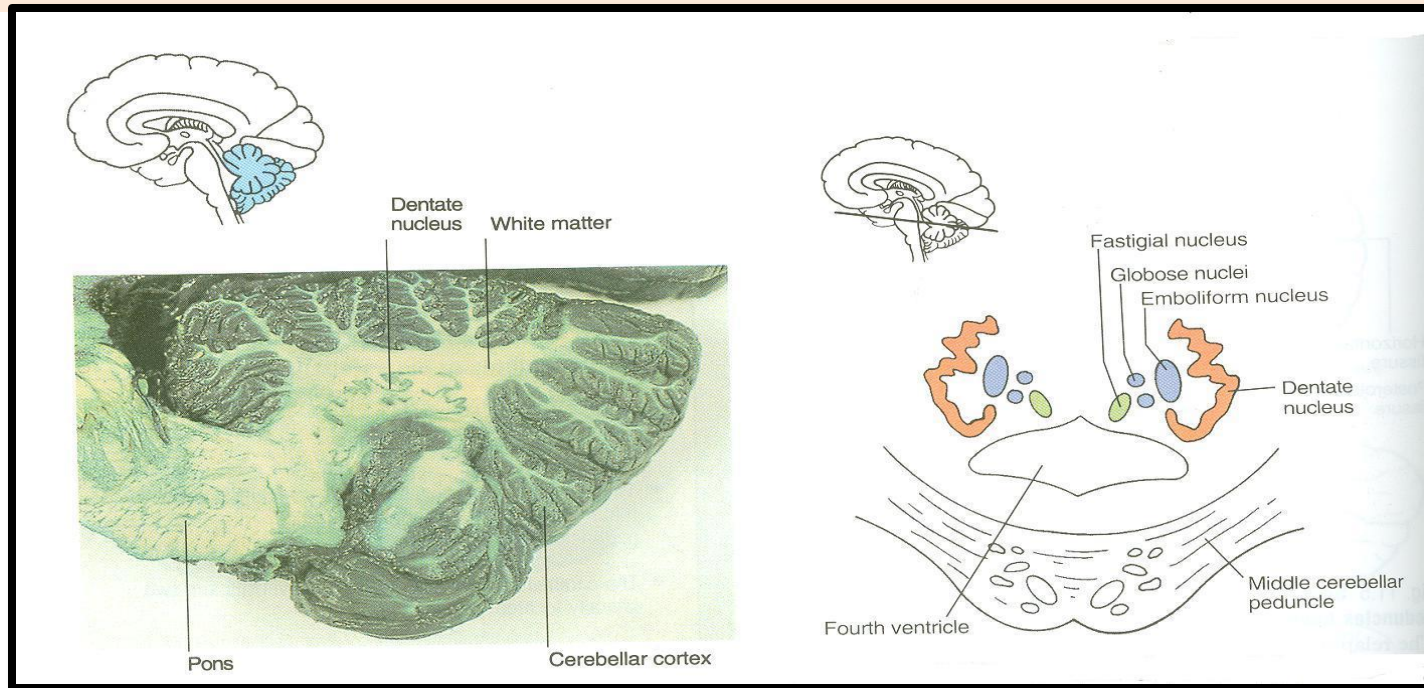
ANATOMICAL SUBDIVISION

External surface of cerebellum



CONSTITUENTS

(Internal Structure and Nuclei of Cerebellum)

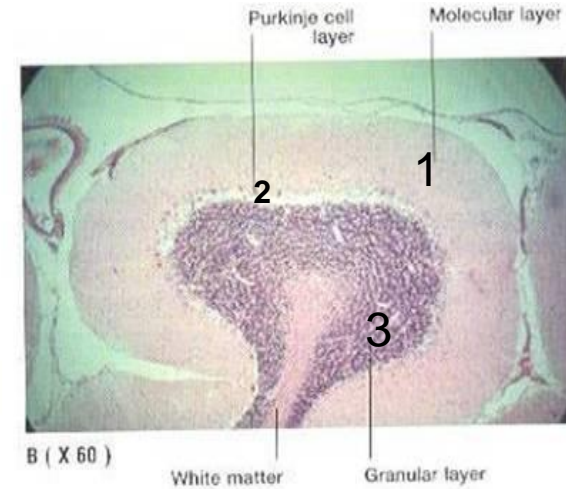
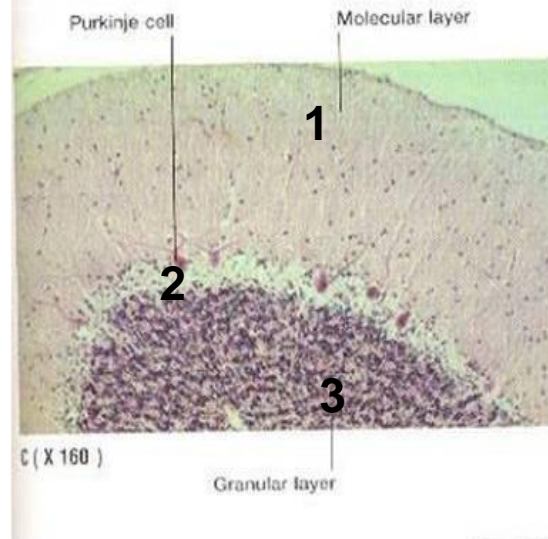
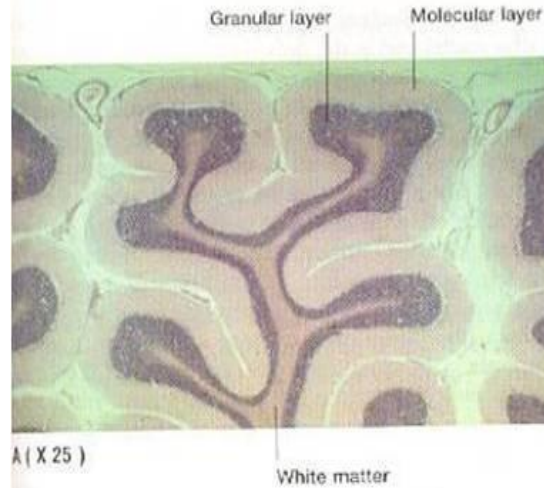


1. **Outer grey matter:** cerebellar cortex.
2. **Inner white matter:** cerebellar medulla.
3. **Deeply seated nuclei in white matter:** from medial to lateral:
 - **Fastigial nucleus.**
 - **Globose nucleus.**
 - **Emboliform nucleus.**
 - **Dentate nucleus: largest one.**

CEREBELLAR CORTEX

□ Divided into 3 layers:

1. **Outer** molecular layer
2. **Intermediate** Purkinje cell layer
3. **Inner** granular layer

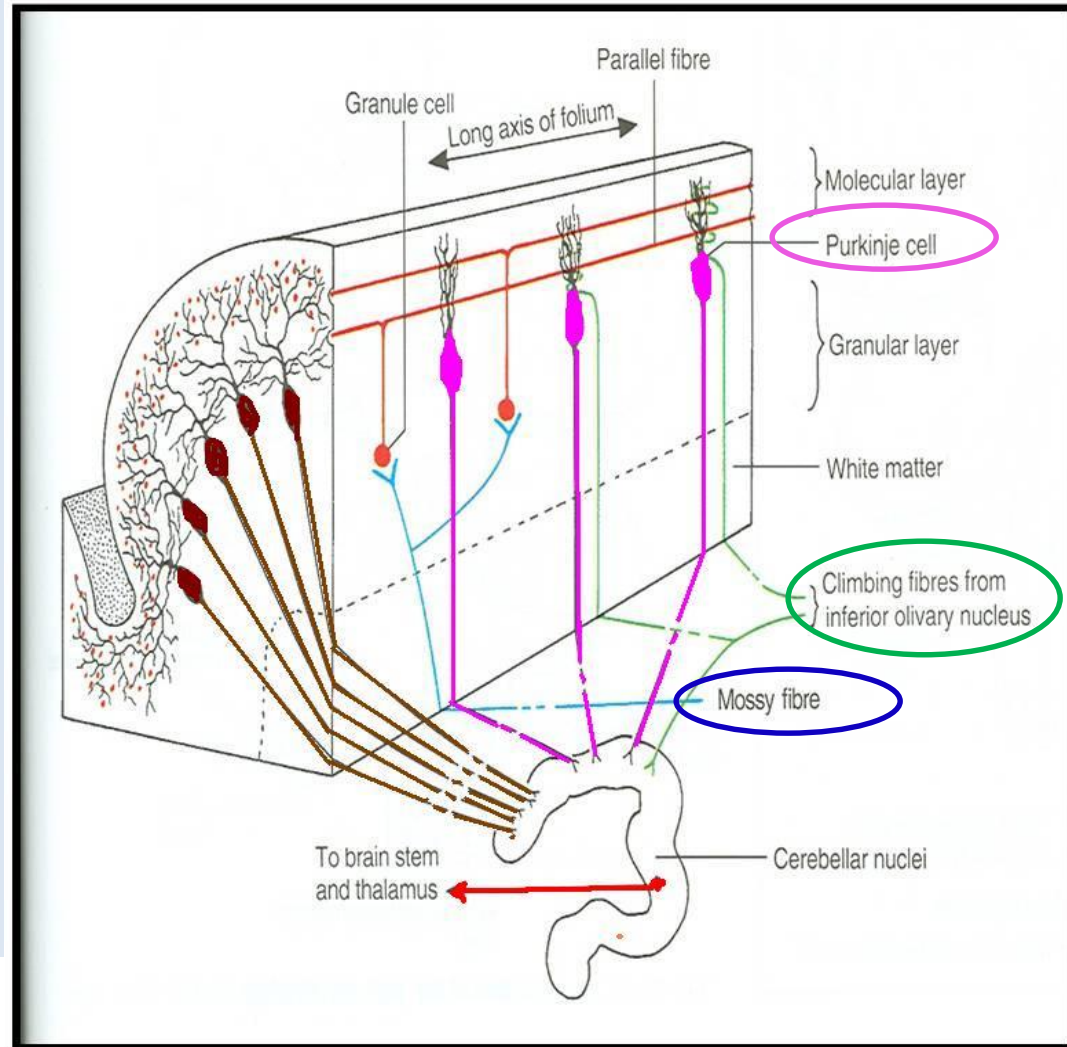


Transverse sections of cerebellar folia showing the layers of the cerebellar cortex.

CEREBELLAR MEDULLA

AFFERENT FIBRES:

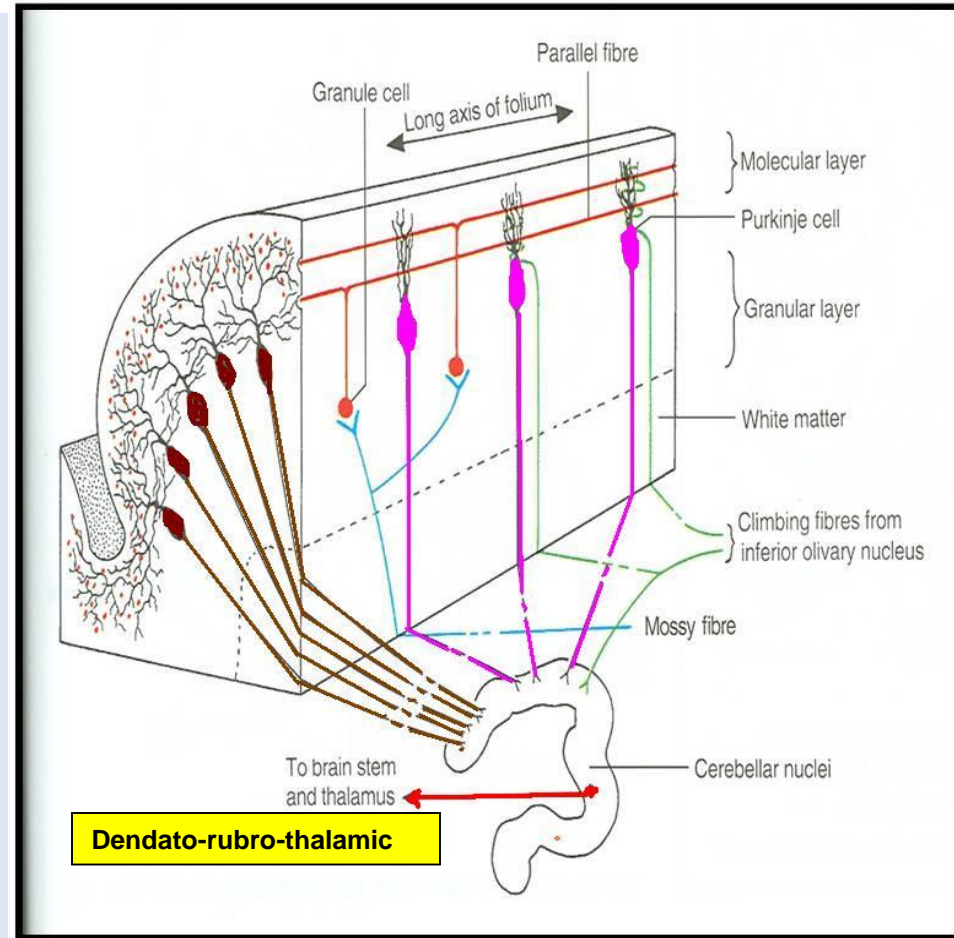
- **Climbing fibres:** from *inferior olivary nucleus*, relay to **purkinje cells**
- **Mossy fibres:** rest of fibres:
 1. From vestibular nuclei
 2. From spinal cord
 3. From pons
 - They relay to **granule cells** which in turn relay to **purkinje cells**.
 - Finally all afferent fibres passing through the medulla relay to purkinje cells in the cortex.



CEREBELLAR MEDULLA

□ Axons of Purkinje 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, specially **Dentate nucleus**.
2. Some of axons leave cerebellum as efferent fibres.



CEREBELLAR MEDULLA

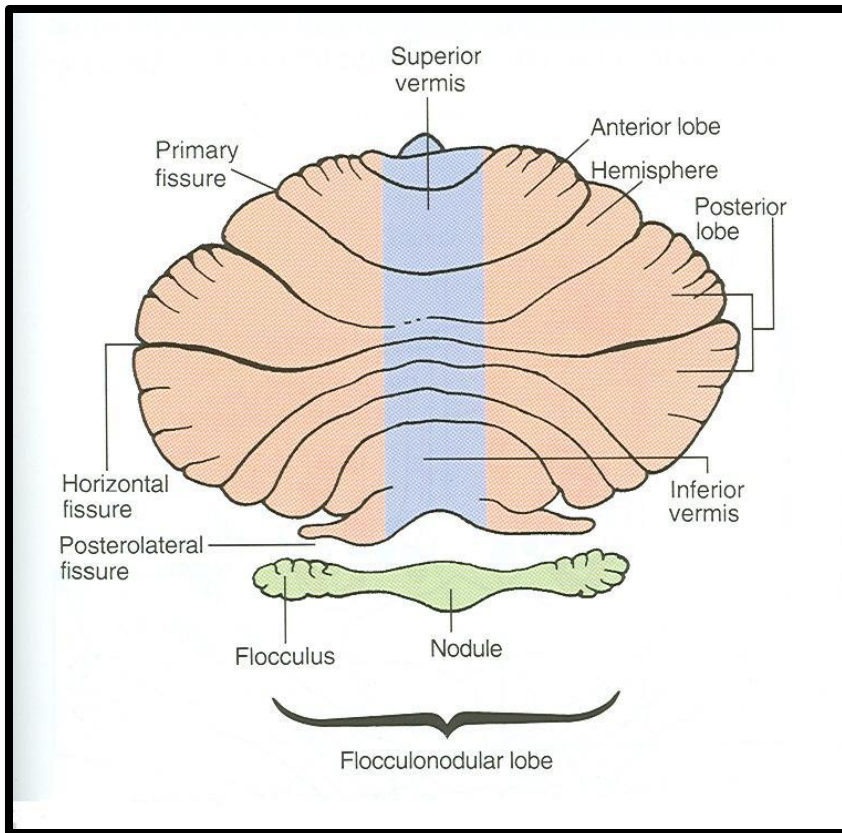
EFFERENT FIBRES:

- ❑ ***Most efferent fibres are axons of deep cerebellar nuclei.***
- ❑ ***Main Efferents go to nuclei of brainstem & thalamus :***
 1. ***Vestibular nuclei (cerebello-vestibular tract).***
 2. ***Red nucleus (Dendato-rubro-thalamic tract).***
 3. ***Ventral lateral nucleus of thalamus (Dendato-thalamic tract).***

**FUNCTIONAL SUBDIVISIONS
OF
THE CEREBELLUM**

ARCHICEREBELLUM

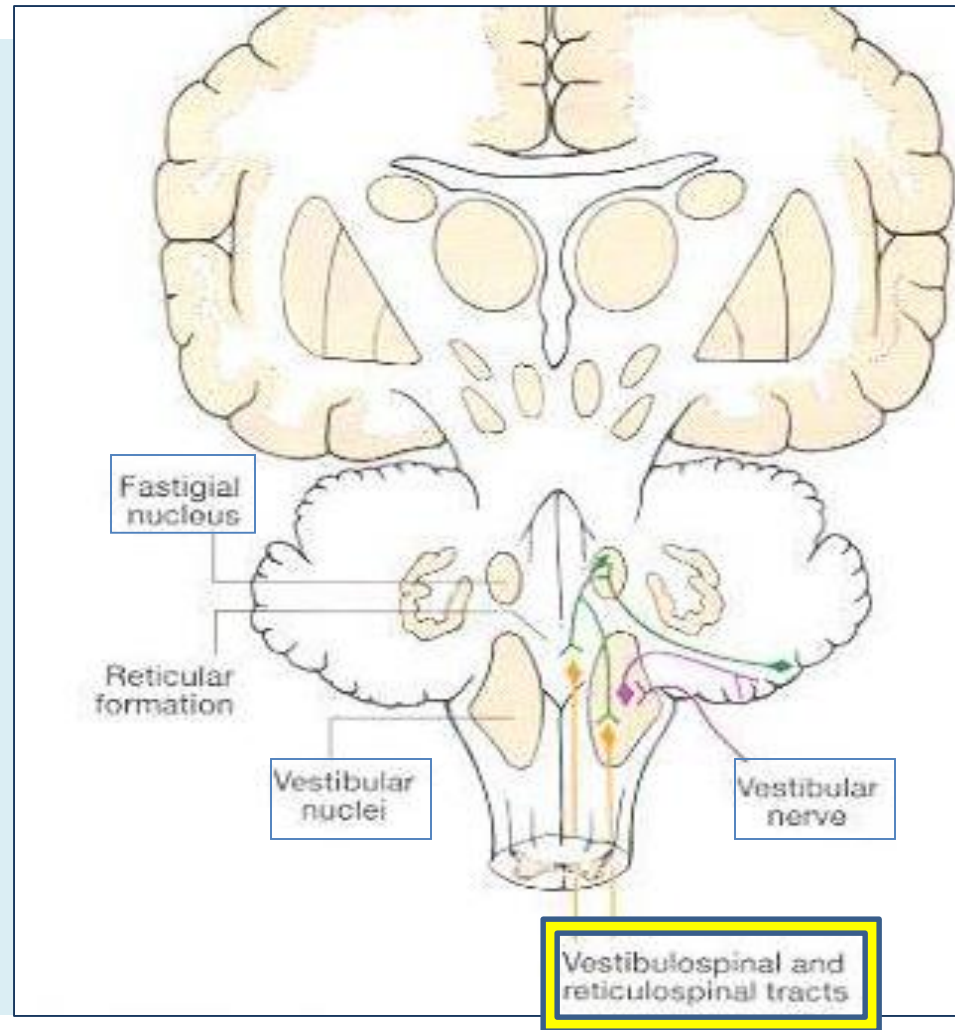
- Vestibular Part of cerebellum:
Flocculo-nodular lobe.



Green = Archi-cerebellum,
Blue = Paleo-cerebellum.
Pink = Neo-cerebellum.

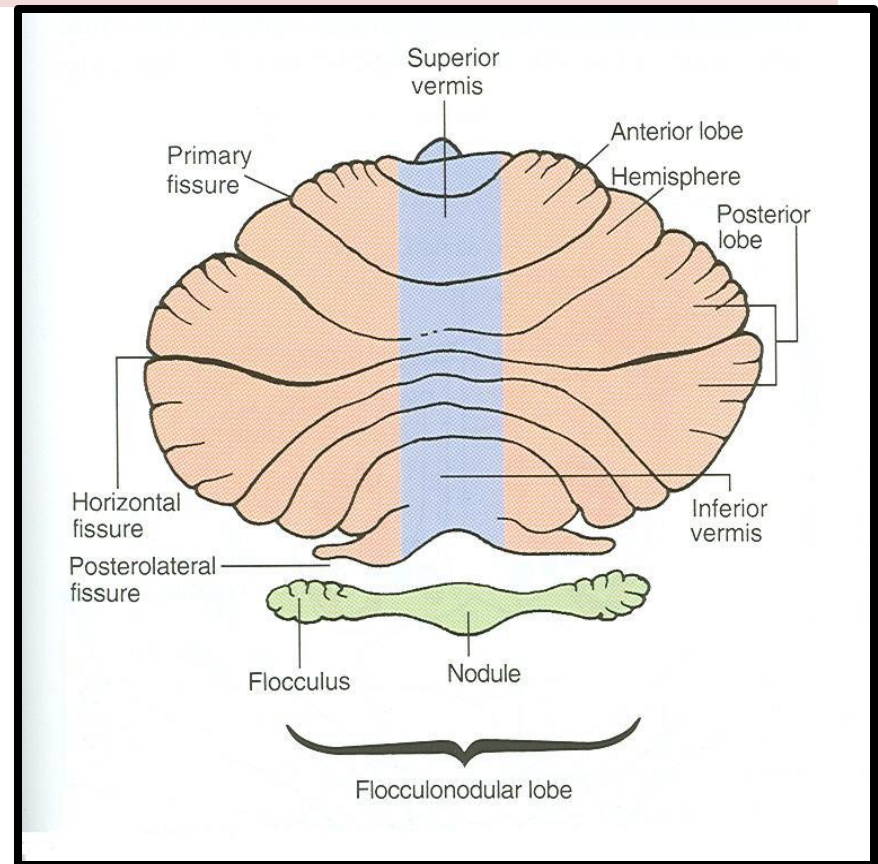
ARCHICEREBELLUM

- ❑ **Nuclei Related:** **Fastigial**
- ❑ **Afferents:** from **Vestibular nuclei** (**Vestibulocerebellar fibres**), (through **ICP**)
- ❑ **Efferents cortical** (purkinje cell) **Fibres project** : to **Fastigial nucleus**, which projects to **vestibular nuclei** (through **ICP**) + to **Reticular formation**
- ❑ **Function:** **controls body Balance** (via vestibulospinal & reticulospinal tracts).
Control of eye movement (via VO Reflex)



PALEOCEREBELLUM

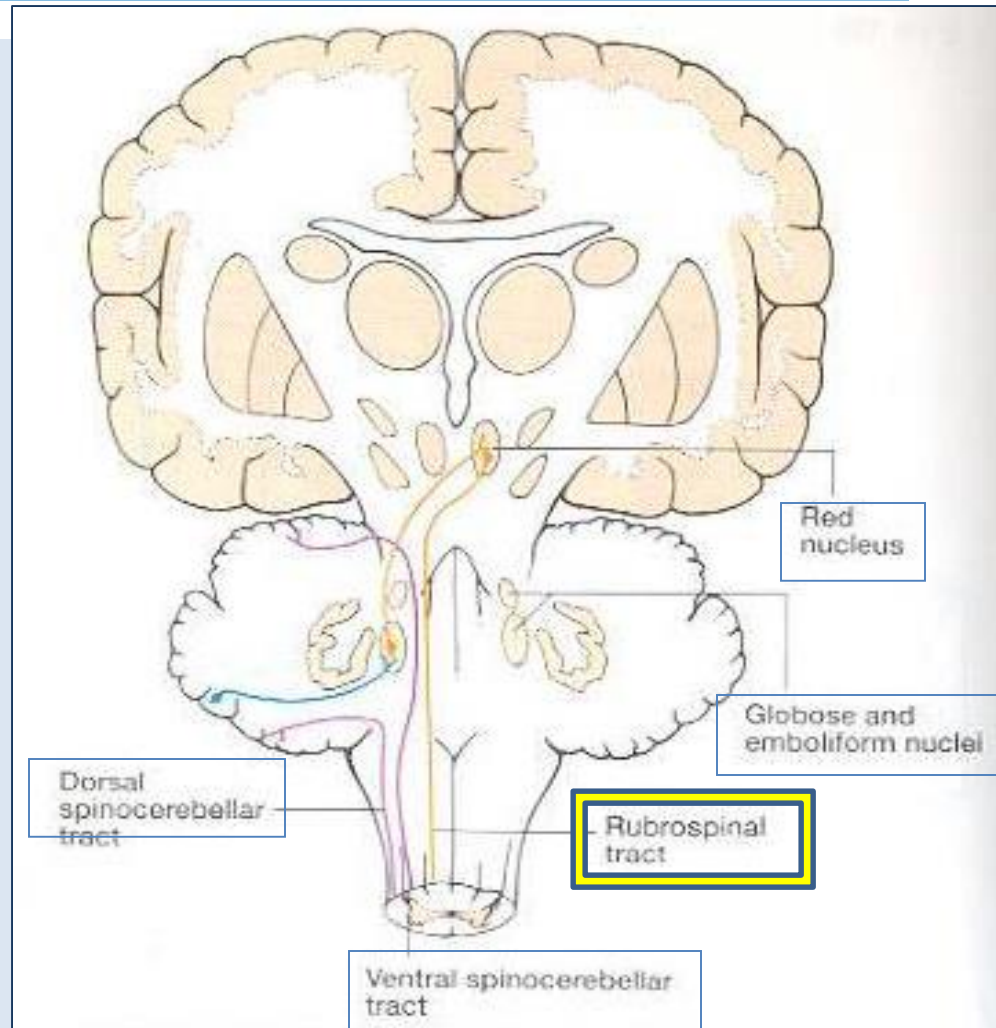
- Spinal Part of cerebellum:
Vermis & Paravermis



Green = Archi-cerebellum,
Blue = Paleo-cerebellum.
Pink = Neo-cerebellum.

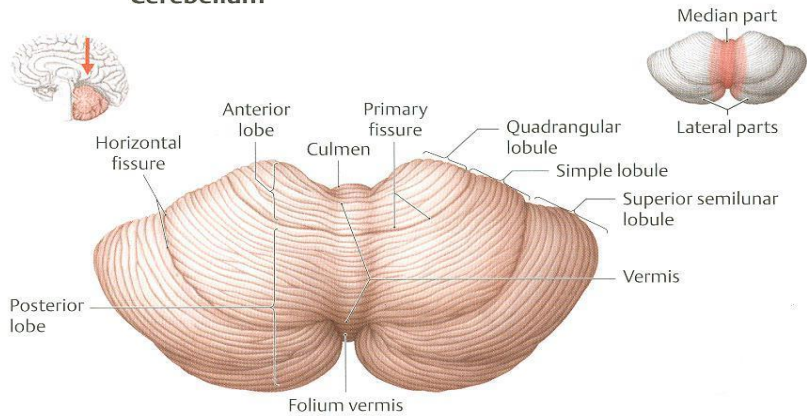
PALEOCEREBELLUM

- ❑ **Nuclei Related:** **globose & emboliform**
- ❑ **Afferents:** from **spinal cord** (dorsal & ventral **spinocerebellar tracts** through ICP & SCP, respectively)
- ❑ **Efferents :** to **globose&embliform nuclei** which project to **red nucleus** (through SCP)
- ❑ **Function:** controls **posture & muscle tone** (via Rubrospinal tract).

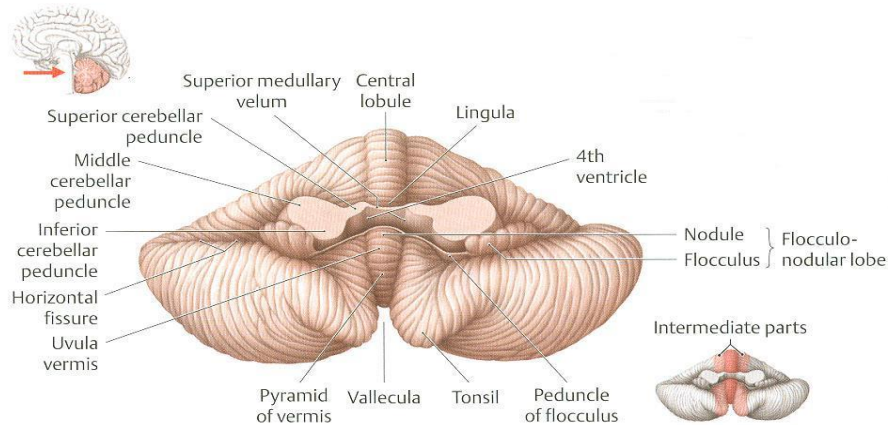


NEOCEREBELLUM

Cerebellum



A Superior view.

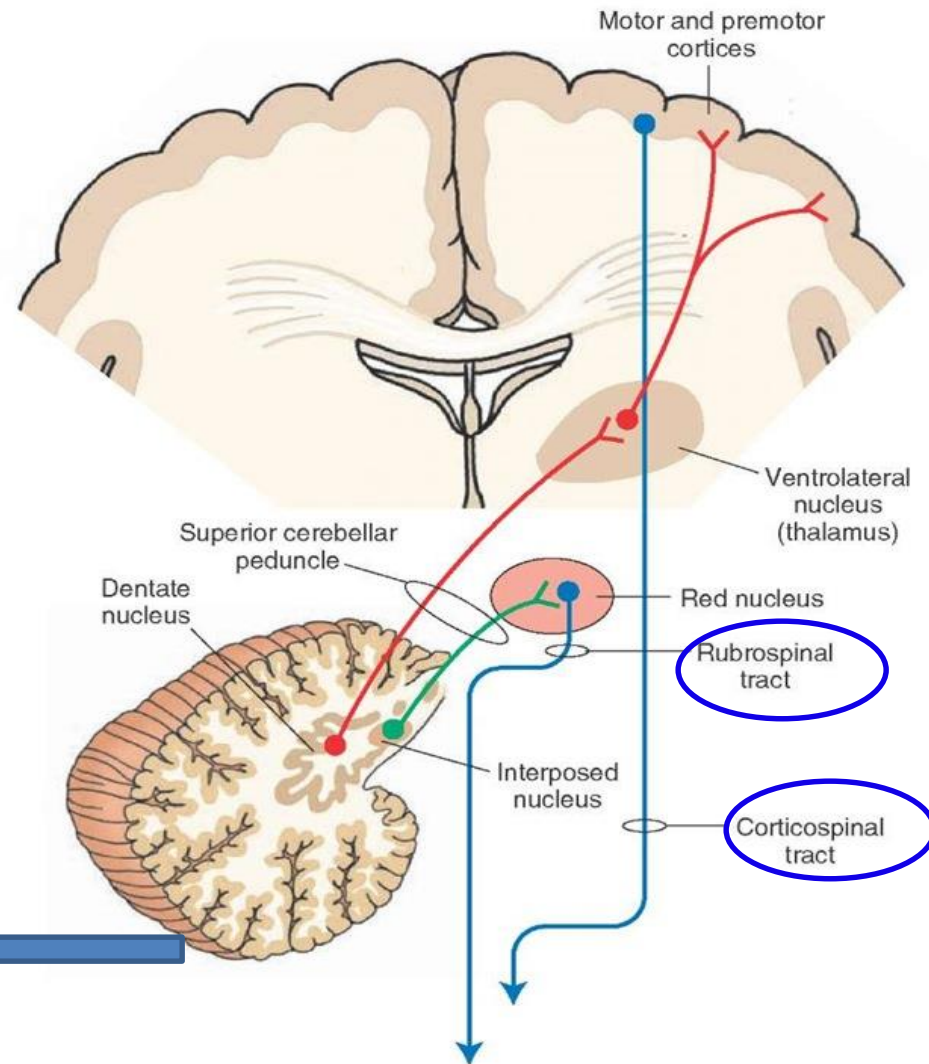


B Anterior view.

- Cerebral Part of cerebellum:
Rest of Cerebellum.

NEOCEREBELLUM

- ❑ **Nuclei Related:** **Dentate**
- ❑ **Afferents:** from **Pons** (**Pontocerebellar fibres**) (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** (via descending **Corticospinal** & corticobulbar tracts or **Rubrospinal tract**).



CEREBELLAR LESIONS

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

The image features two large, stylized yellow roses with white and light yellow petals, set against a teal background. The roses are positioned on the left and right sides of the frame, with their stems and green leaves extending across the bottom and sides. The text "THANK YOU" is written in a bold, blue, sans-serif font, centered horizontally and overlaid on the middle of the two roses. The entire composition is enclosed within a thin orange border.

THANK YOU

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**.

SUMMARY

- ❑ **Paleocerebellum (vermis & paravermis)** is related to *globose & emboliform* nuclei, connected to spinal cord & red nucleus & concerned with 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)**.

QUESTION 1

Which one of the following nuclei is related to neocerebellum?

1. Fastigeal nucleus

2. Dentate nucleus



3. Globose nucleus

4. Emboliform nucleus

QUESTION 2

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

1. Red nucleus

2. Pons

3. Vestibular nuclei 

4. Motor cortex

1. 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.

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

- a. Vermis.
- b. Paravermis.
- c. Folocculonodular lobe.
- e. Neocerebellum. ←

3. Which nucleus contributes in the balance function of cerebellum ?

- a. Dentate nucleus.
- b. Fastigial nucleus. ←
- d. Globose nucleuse.
- e. Emboliform.