



# **Neuroanatomy**

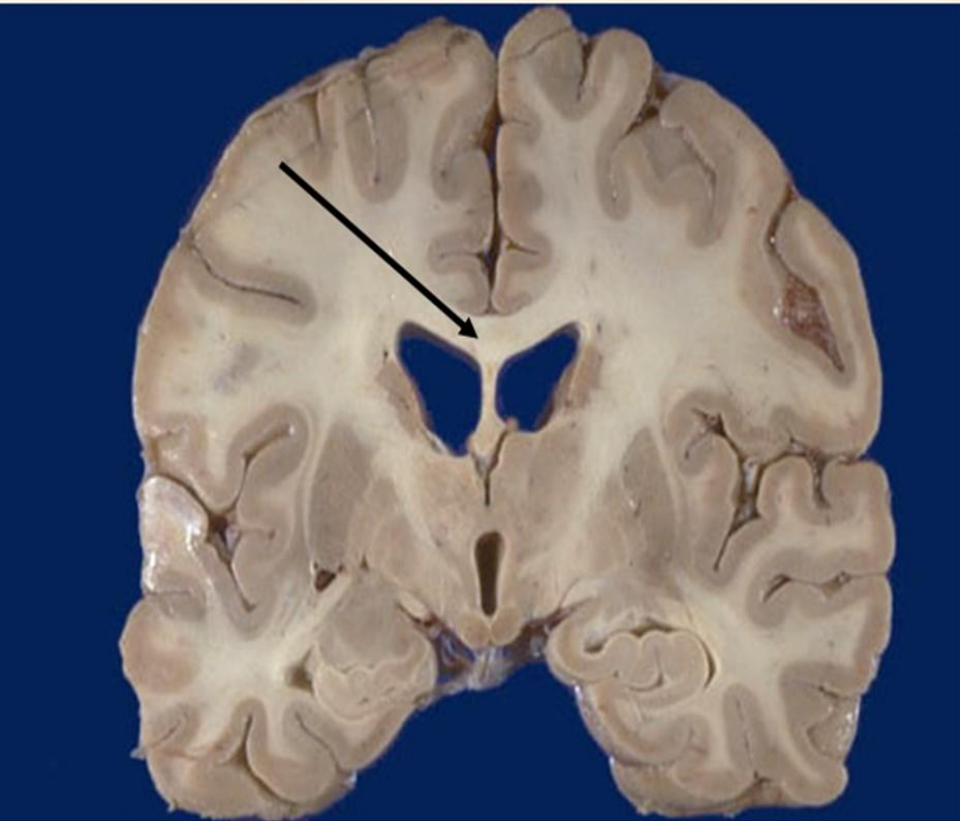
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**Faculty of Medicine**

**The University of Jordan**

**2025**



**1. cerebrospinal fluid communicates with the subarachnoid space via the.....**

- a. 4th ventricle
- b. 3rd ventricle
- c. subarachnoid granulations
- d. choroids plexus
- e. tela choroidia

**2. Regarding the speech centers, chose the correct answer**

- a. It is supplied by Anterior cerebral artery
- b. Broca's area is posterior
- c. Wernicke's area controls motor response
- d. Damage to Broca's area produces motor aphasia
- e. Damage to Wernicke's area produces expressive aphasia

**3- One of the following is not sharing in the anterior wall of the third ventricle:**

- A- anterior commissure
- B- optic chiasma
- C- lamina terminalis
- D- Anterior column of the fornix
- E- None of the above

# OBJECTIVES

- **Anatomically locate and differentiate different lobes, surfaces and fissures of the human cerebellum and vermis.**
- **Identify anatomical and physiological subdivisions of the cerebellum and vermis and their connections with the deep cerebellar nuclei.**
- **Identify and locate the cerebellar peduncles and their afferents and efferents connection with the cerebrum and spinal cord.**
- **Histologically identify different layers of the cerebellar cortex and cells inside each and their connections with the cerebellar nuclei.**
- **Enumerate different arteries supplying different parts of the cerebellum and origin of each and the effect of their ischemic lesion.**
- **Clinically identify the effect of cerebellar lesion and its manifestations**



# The Cerebellum

It is formed of median vermis & 2 cerebellar hemispheres.

It has 2 surfaces:

- **Superior surface:** facing the midbrain & tentorium cerebelli .
- **Inferior surface:** divided into **anterior** & **posterior** parts.
- The surfaces have many parallel folds called folia

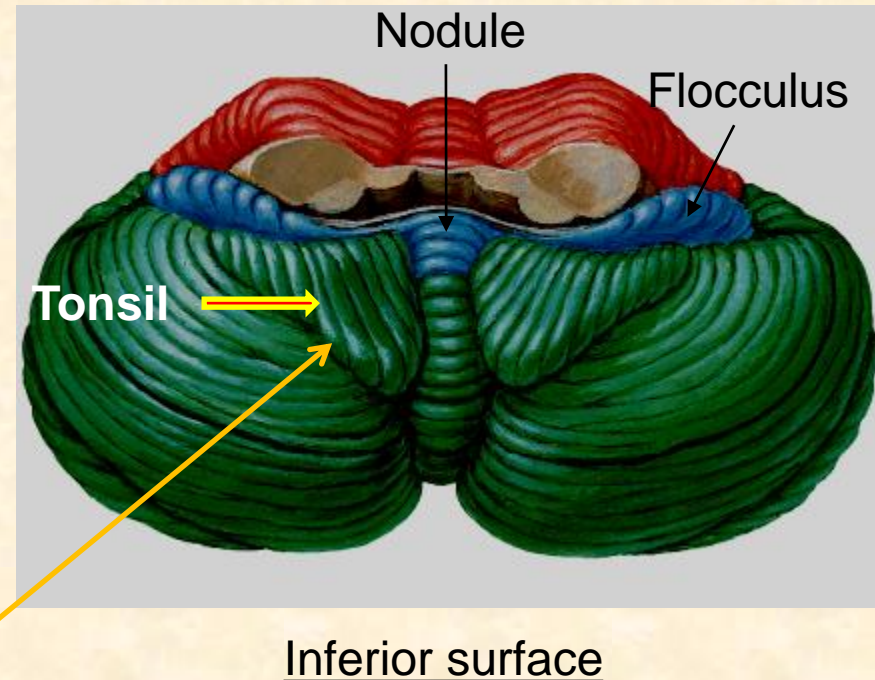
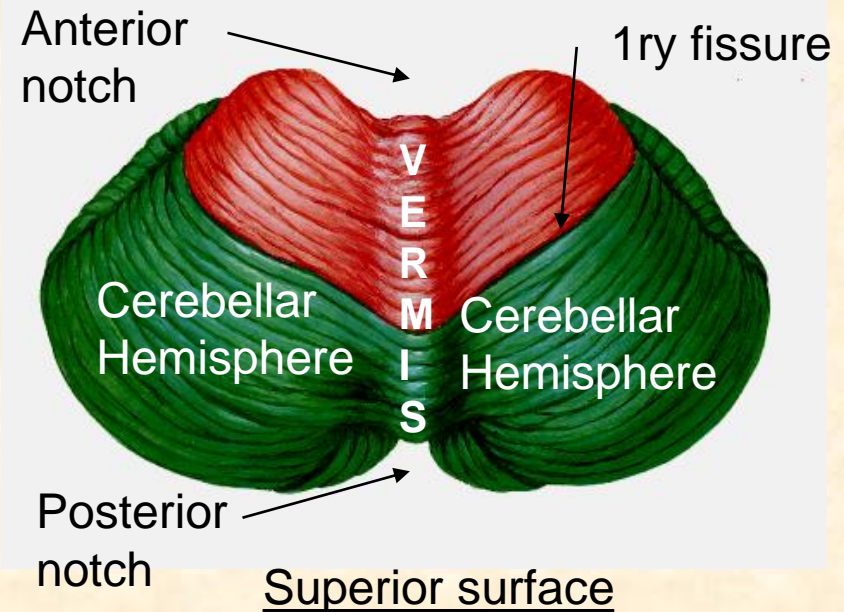
It has 2 notches:

- **Anterior notch** occupied by the brain stem.
- **Posterior notch** (vellecula) occupied by falx cerebelli.

The main fissures of the cerebellum:

- **Primary fissure:** separates the anterior & posterior lobes.
- **Horizontal fissure:** Extends between the middle cerebellar peduncles .
- **Posterolateral fissure:** Separates the flocculus & nodule from the rest of the cerebellum.
- **Cerebellar tonsil** : on either sides of uvula of inferior vermis
- **Retrotonsillar fissure** : separates tonsil from the rest of cerebellum.

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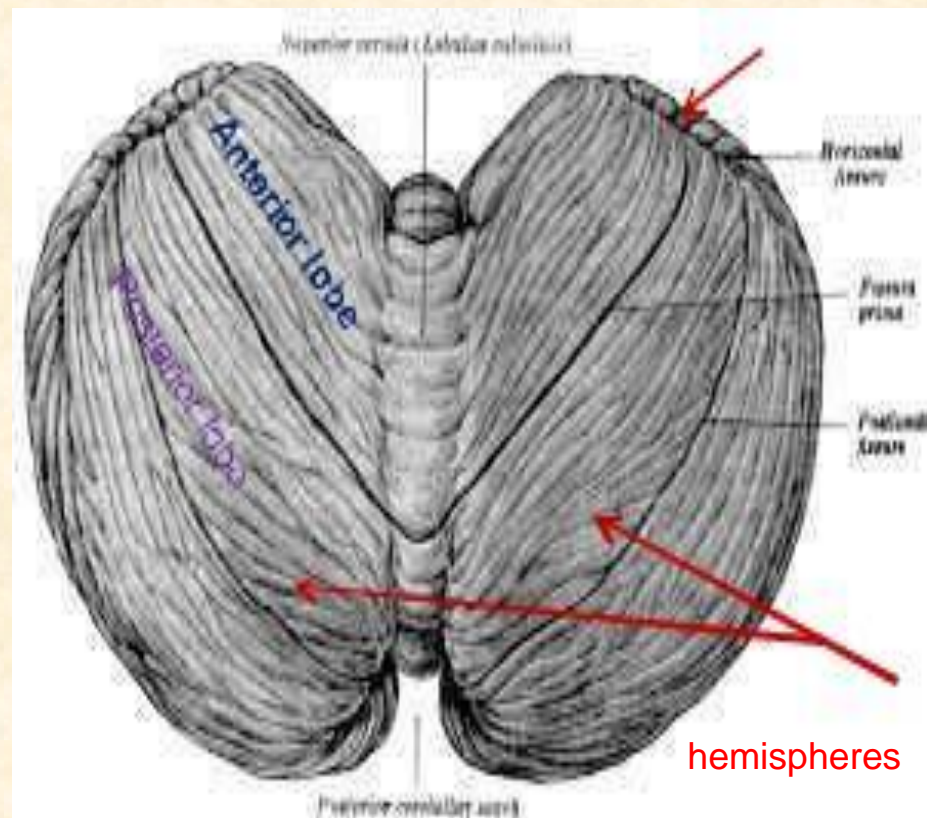
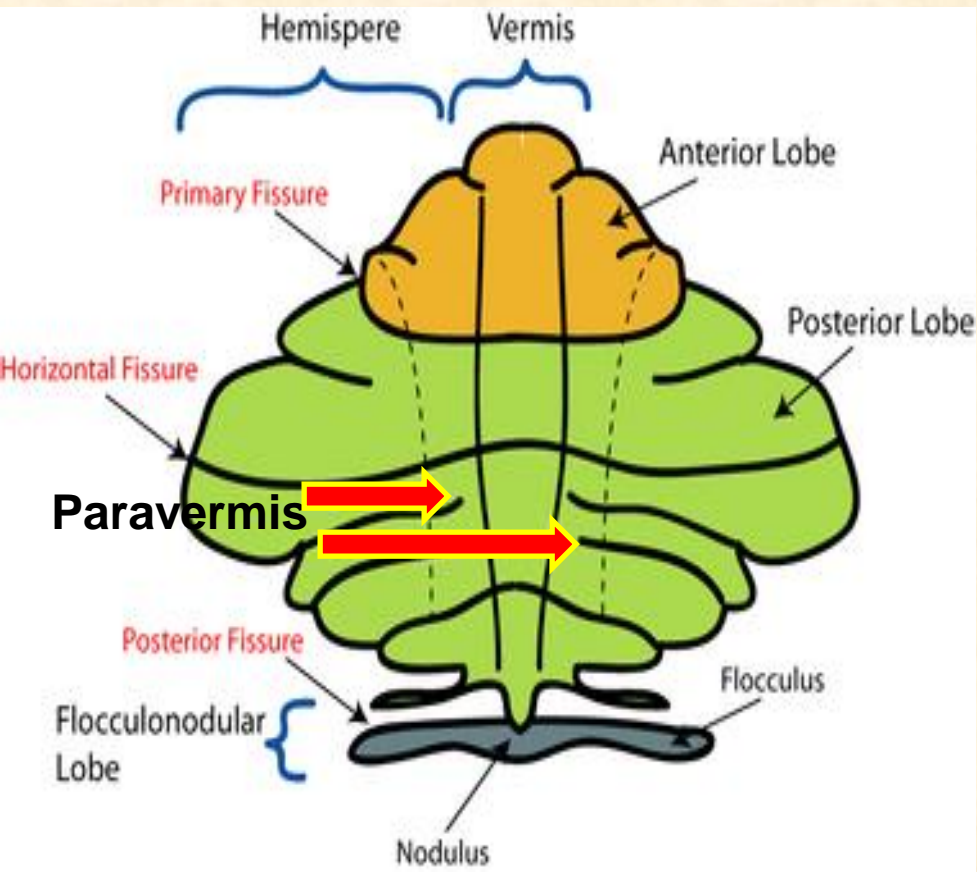
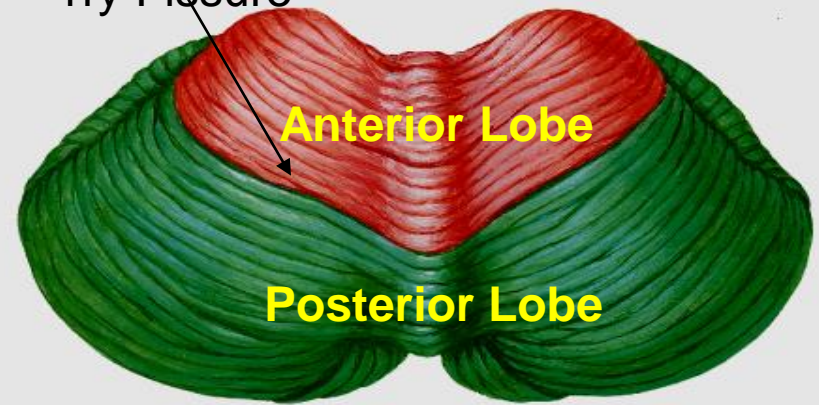


## Lobes of the cerebellum: (Horizontal division)

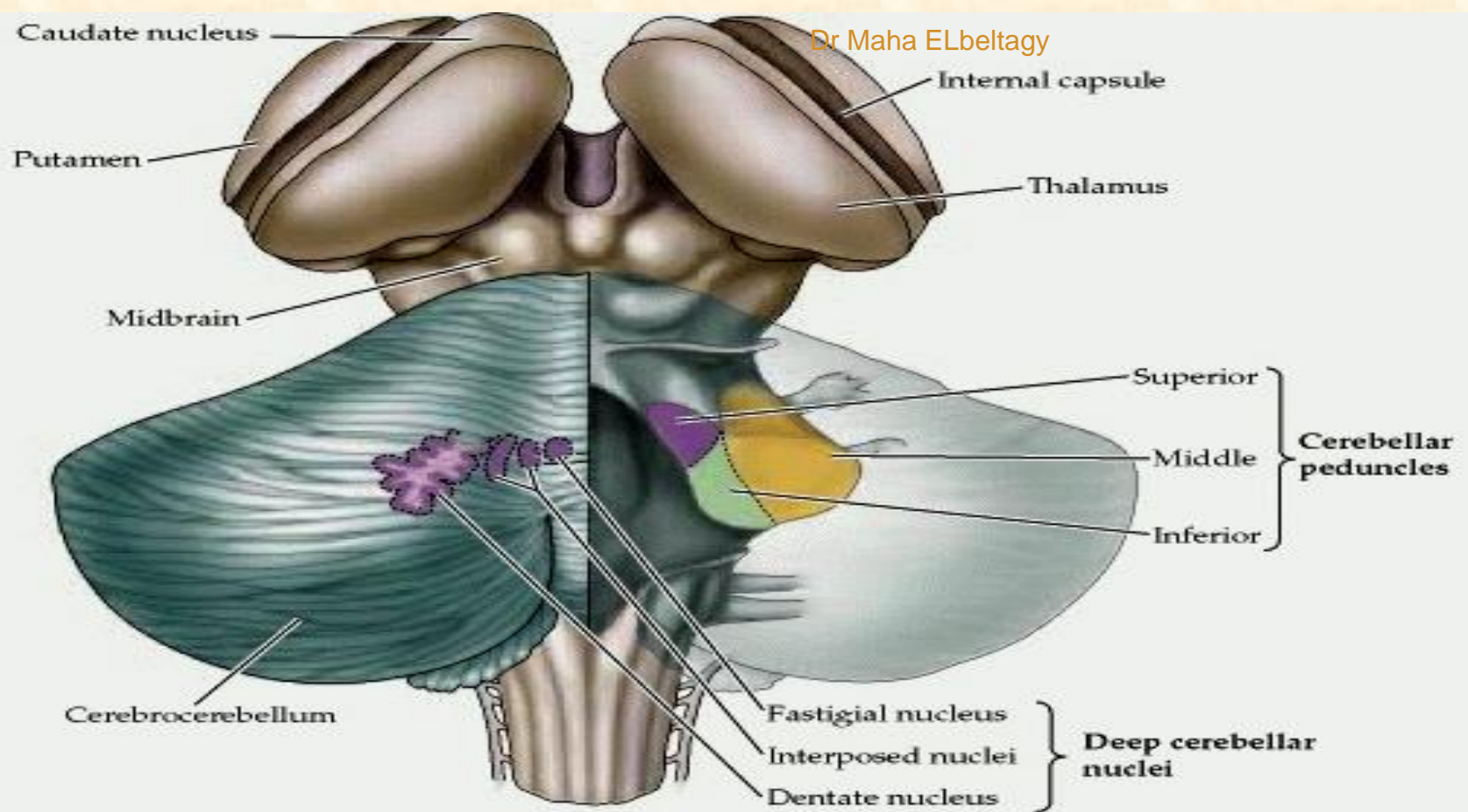
- **Anterior lobe:** in front of the primary fissure.
- **Posterior lobe:** behind the primary fissure.
- **Flocculo-nodular lobe:** Consists of the flocculus & nodule .

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1ry Fissure







## Cerebellar nuclei:

- Dentate nucleus
- Interposed nuclei: Emboliform - Globose
- Fastigial

***"Don't Eat Greasy Food"***

## Arbor vitae

In latin “ *tree of life*” it is the white matter of cerebellum.

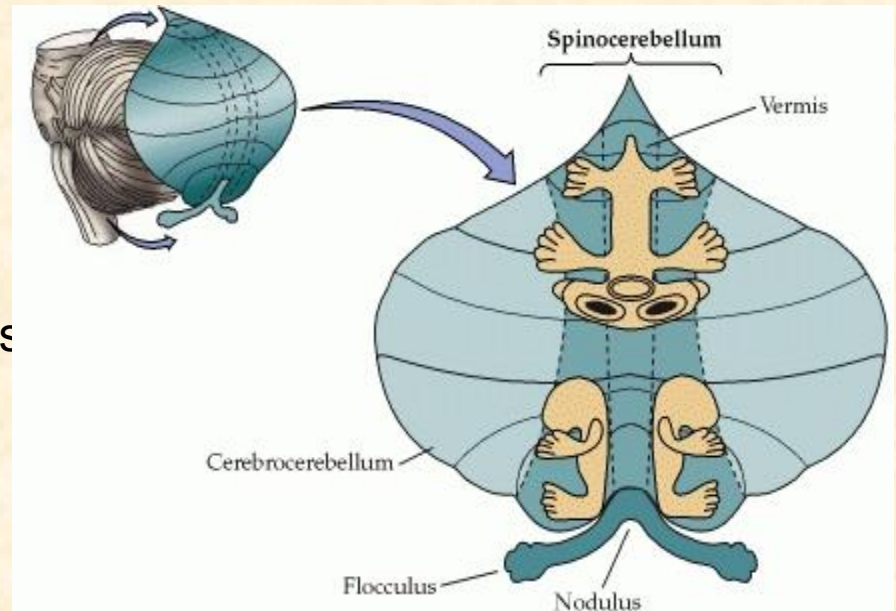
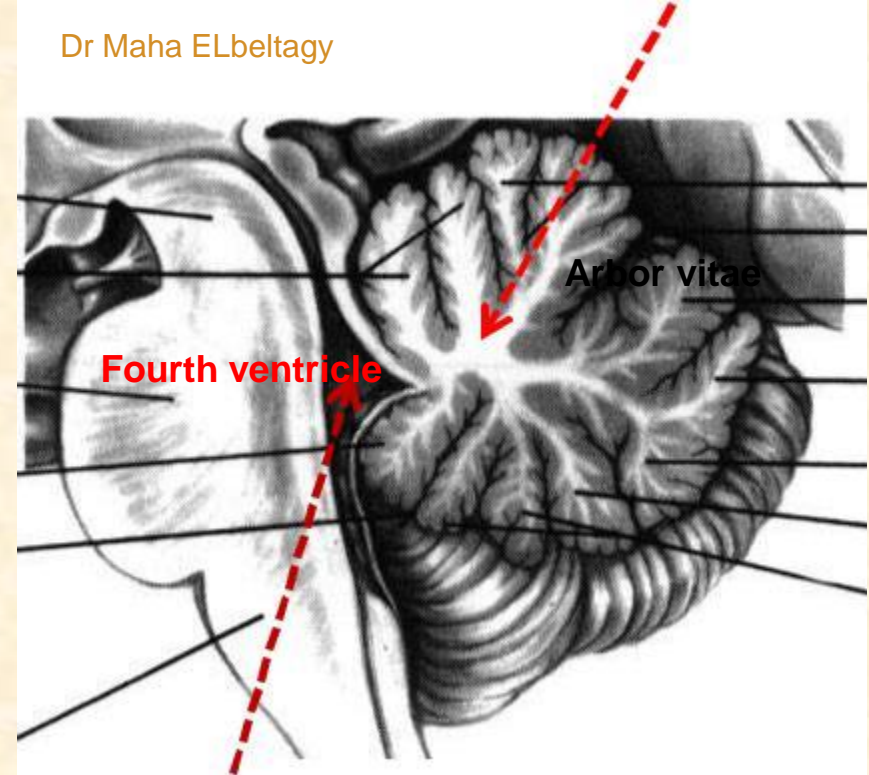
- It is so called because of the tree like appearance.
- It brings sensory and motor sensation to and from cerebellum

## Vertical subdivisions of the cerebellum

**1- vermis** (central part on superior and inferior surfaces) represents head, neck, trunk, shoulders and hips). Projects to **Fastigial N**

**2- Paravermis** (lateral to vermis) represents muscles of upper and lower limbs  
Projects to **Globose and Emboliform N**

**3- Rest of cerebellar hemispheres**  
Project to **Dentate N**





# Cerebellar peduncles:

## Superior cerebellar peduncle (SCP):

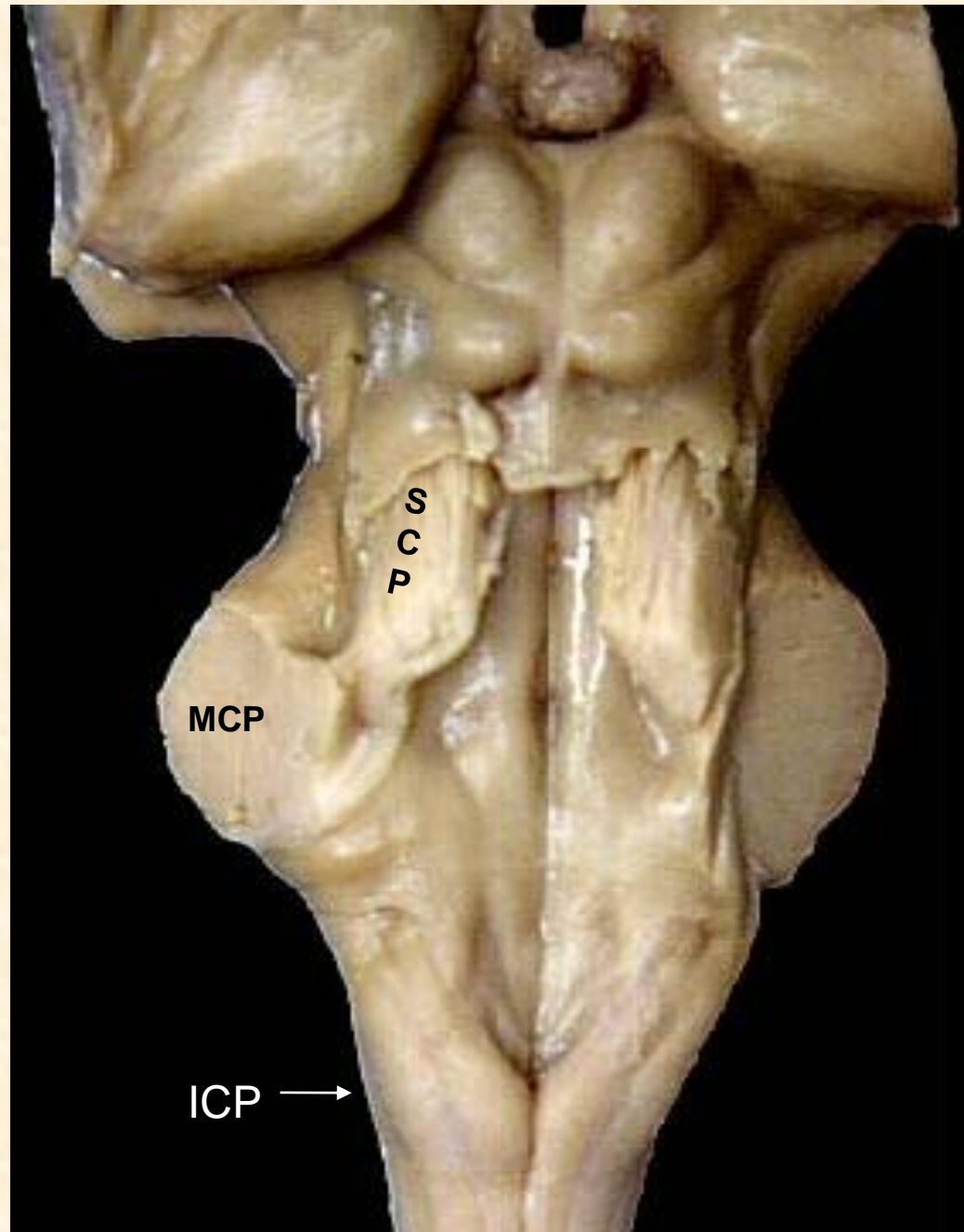
Connects the cerebellum with the midbrain.

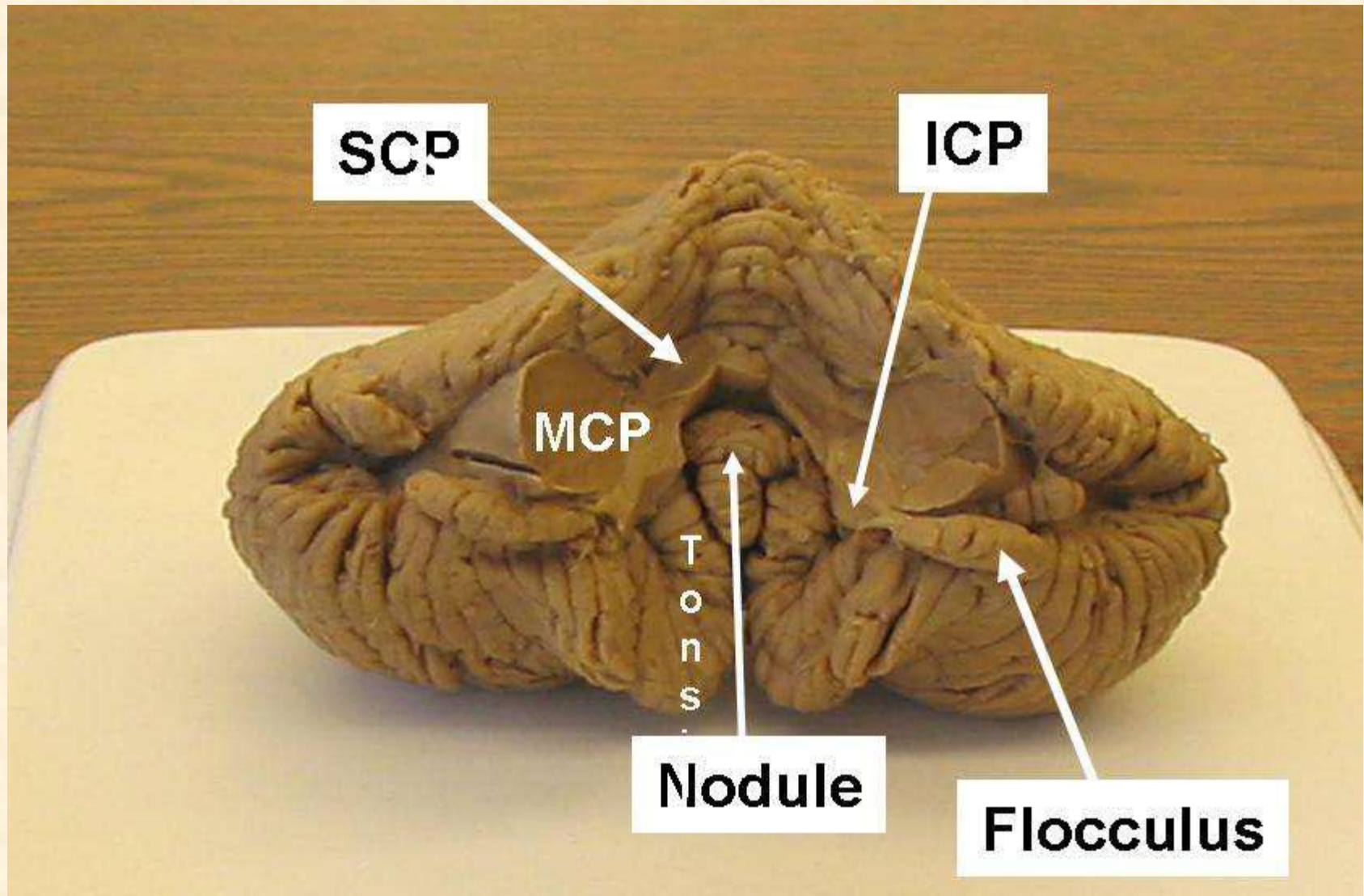
## Middle cerebellar peduncle (MCP):

Connects the cerebellum with the pons.

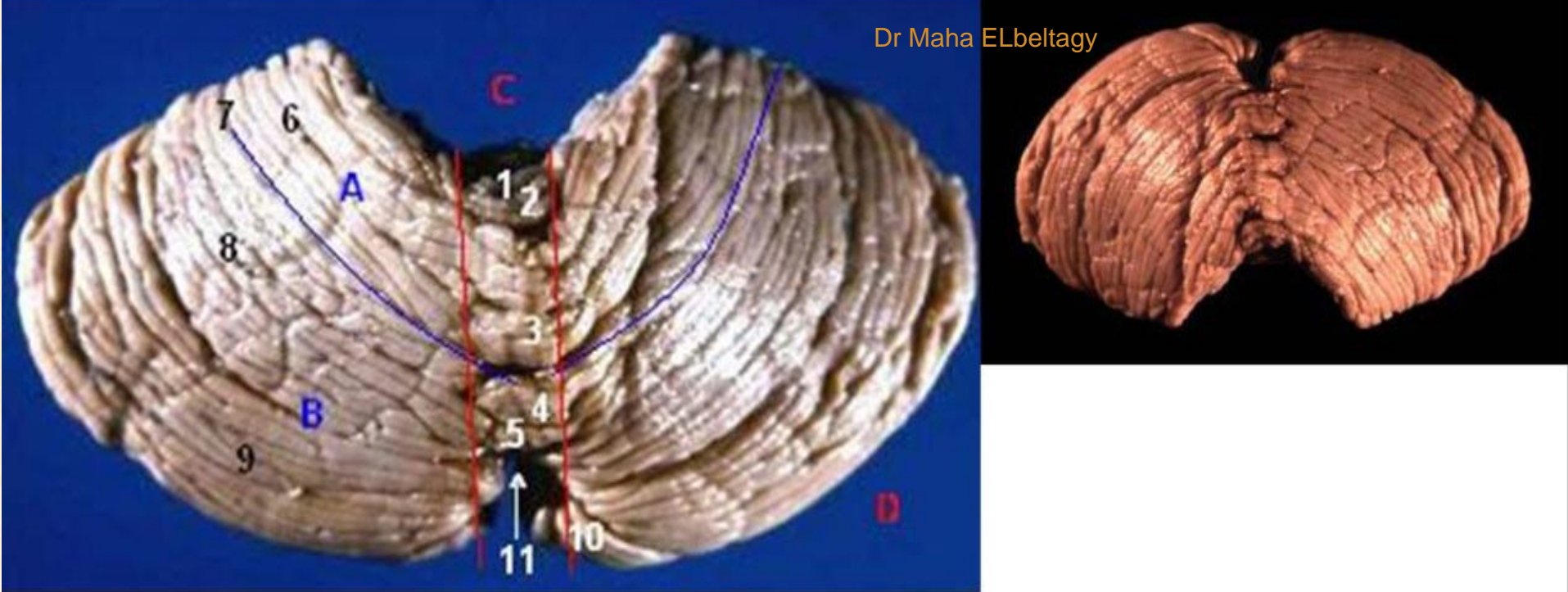
## Inferior cerebellar peduncle (ICP):

Connects the cerebellum with the medulla oblongata.









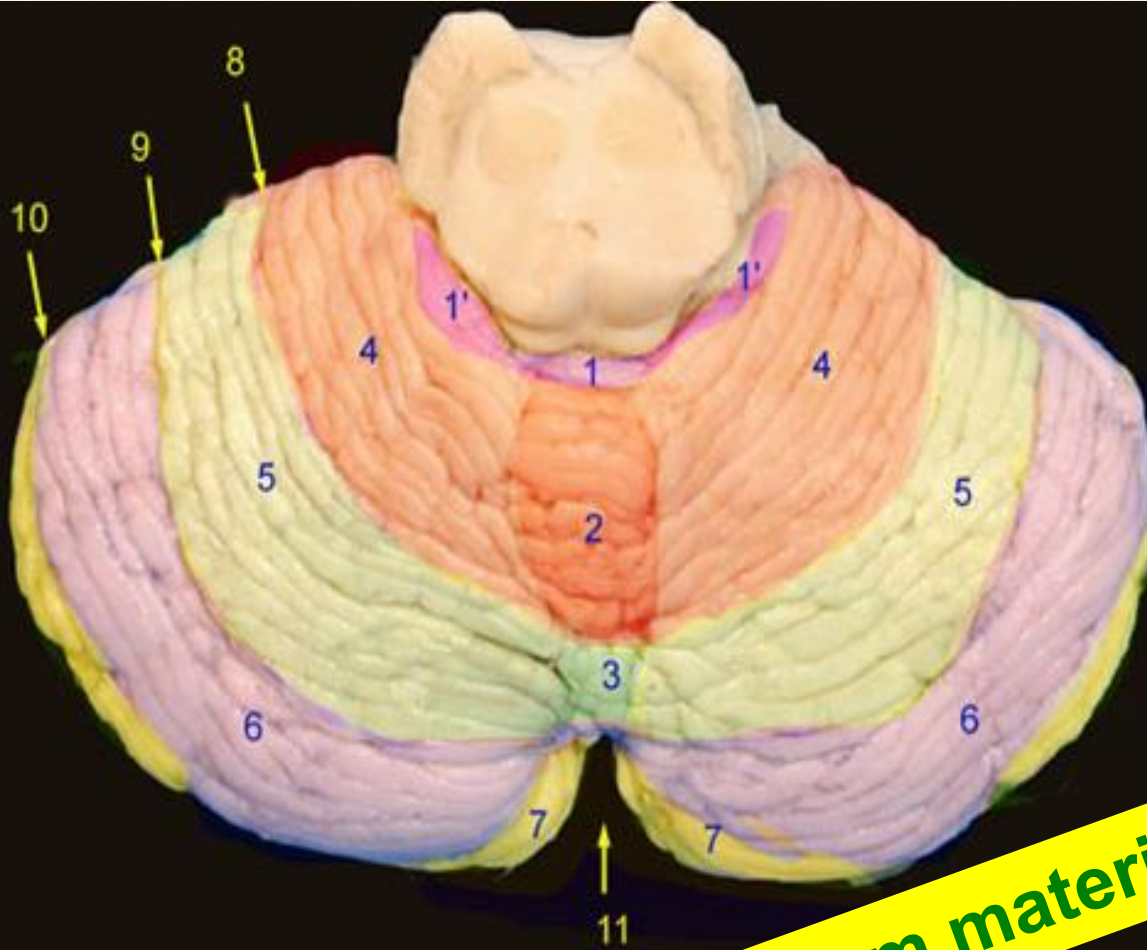
### **an cerebellum - posterior view**

- 1-Lingula cerebelli
- 2-Lobulus centralis
- 3-Culmen
- 4-Declive
- 5-Folium vermis
- 6-Lobulus quadrangularis anterior, Pars anterior
- 7-Fissura prima
- 8-Lobulus simplex, Lobulus quadrangularis posterior
- 9-Lobulus semilunaris superior
- 10-Lobulus semilunaris inferior
- 11-Tuber vermis

**Not an exam material**



# ***Cerebellar lobules - Superior view***

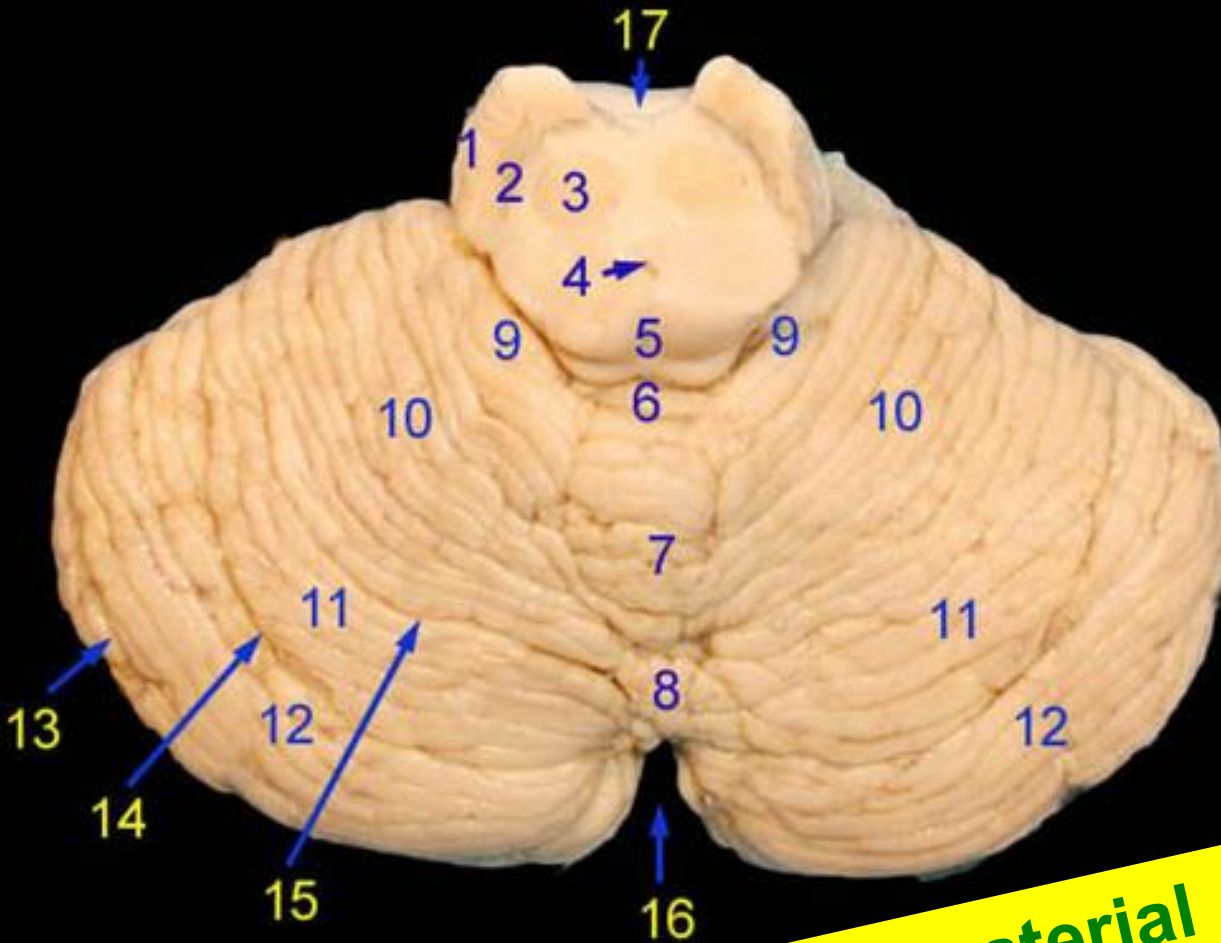


## ***Cerebellar lobules - superior view***

- 1. Central Lobule
- 1' Wing of the central lobule
- 2. Culmen
- 3. Declive
- 4. Quadriangular lobule
- 5. Simple lobule
- 6. Superior semilunar lobule
- 7. Inferior semilunar lobule
- 8. Primary fissure
- 9. Superior posterior fissure
- 10. Horizontal fissure
- 11. Posterior cerebellar incisure

**Not an exam material**

# ***Cerebellar lobules - Superior view***



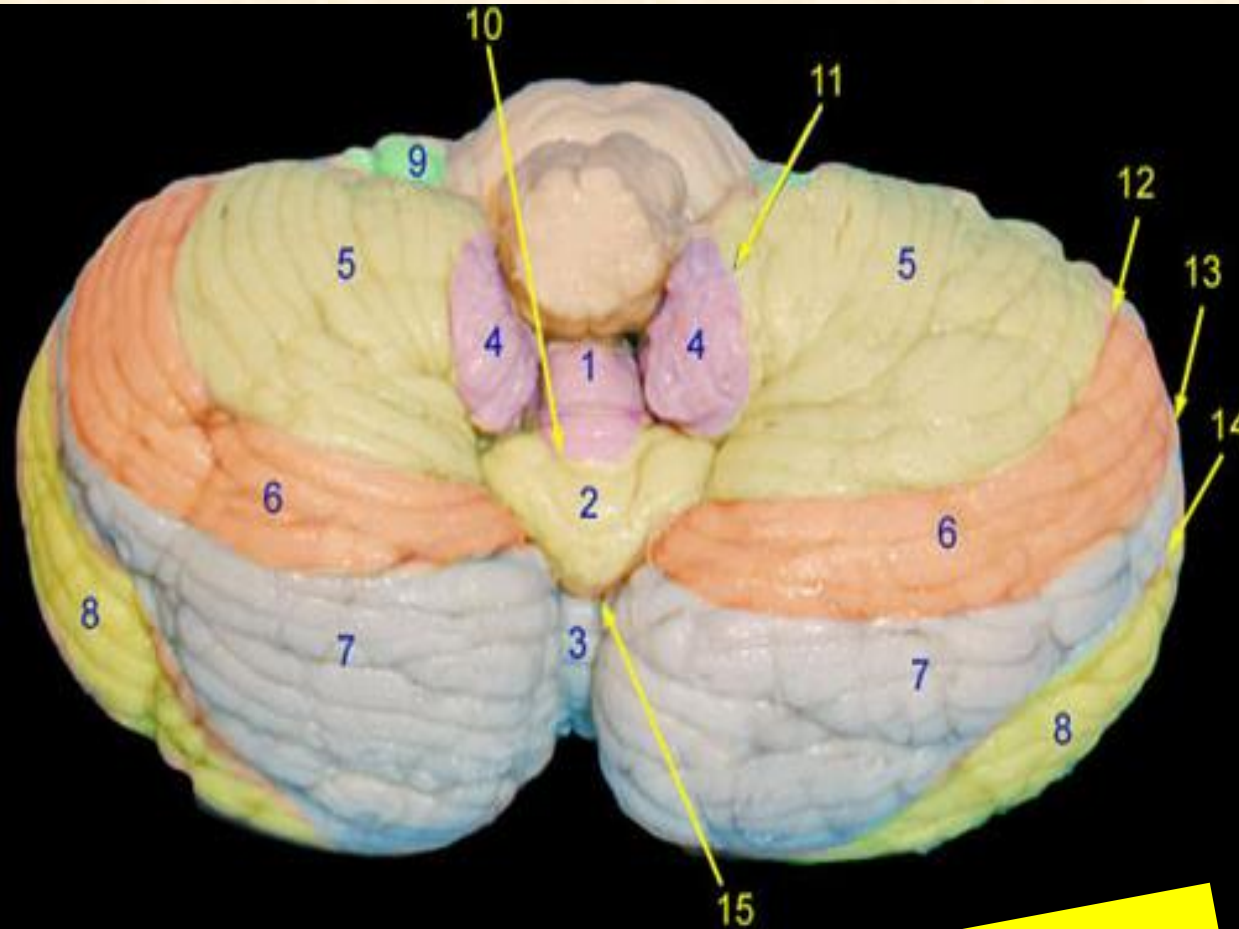
***Cerebellum - superior view***

1. Crus cerebri
2. Substantia nigra
3. Red nucleus
4. Cerebral aqueduct
5. Tectum
6. Central lobule
7. Culmen
8. Declive
9. Wing of the central lobule
10. Quadrangular lobule
11. Simple lobule
12. Superior semilunar lobule
13. Horizontal fissure
14. Superior posterior fissure
15. Primary fissure
16. Posterior cerebellar incisure
17. Interpeduncular fossa

**Not an exam material**



# *Cerebellar Lobules (inferior view)*

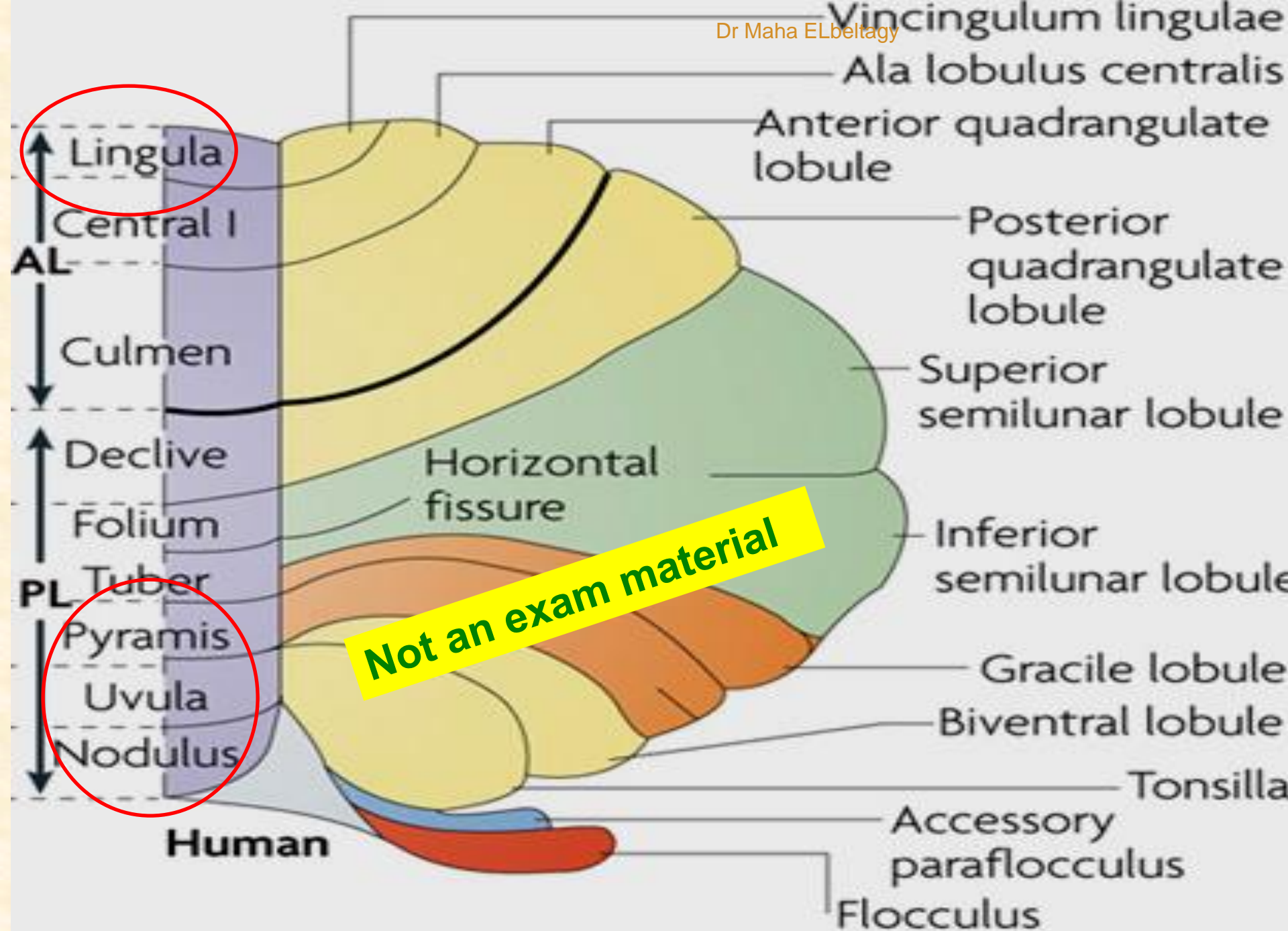


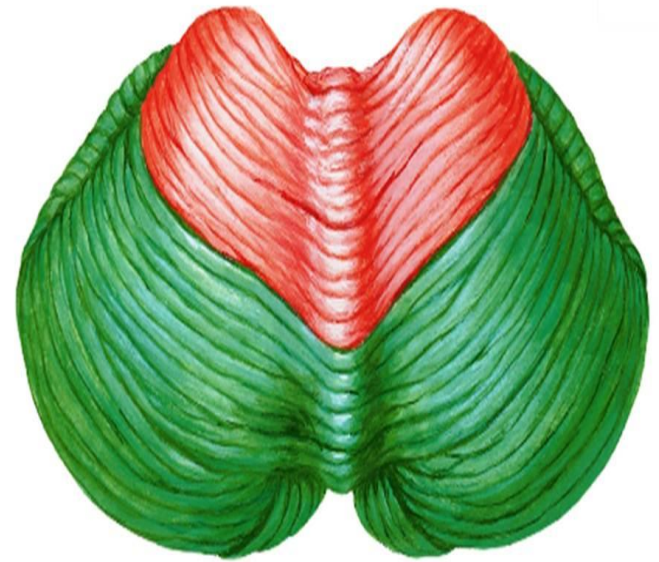
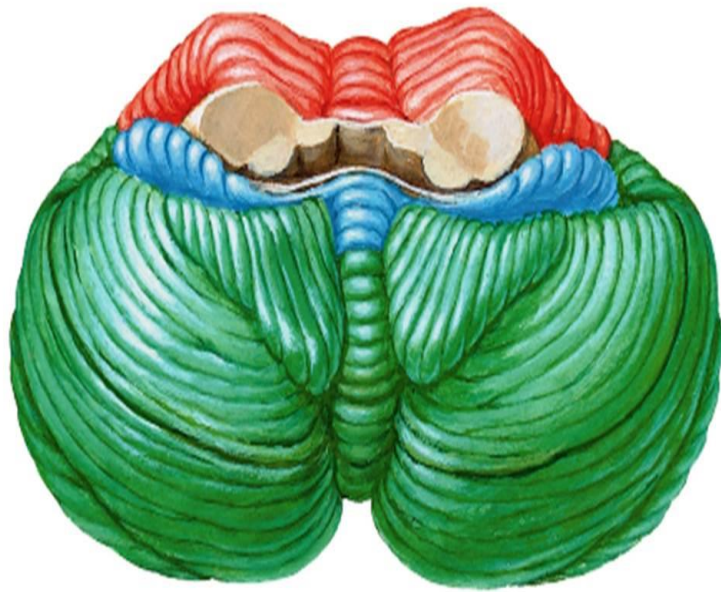
*Cerebellar lobules - inferior view .*

- 1.Uvula
2. Pyramis
- 3.Tuber vermis
- 4.Tonsils
5. Biventer lobule
6. Gracile lobule
7. Inferior semilunar lobule
8. Superior semilunar lobule
9. Flocculus
10. Secondary fissure
11. Retrotonsillar fissure
12. Inferior anterior fissure
13. Inferior posterior fissure
14. Horizontal fissure
15. Postpyramidal fissure

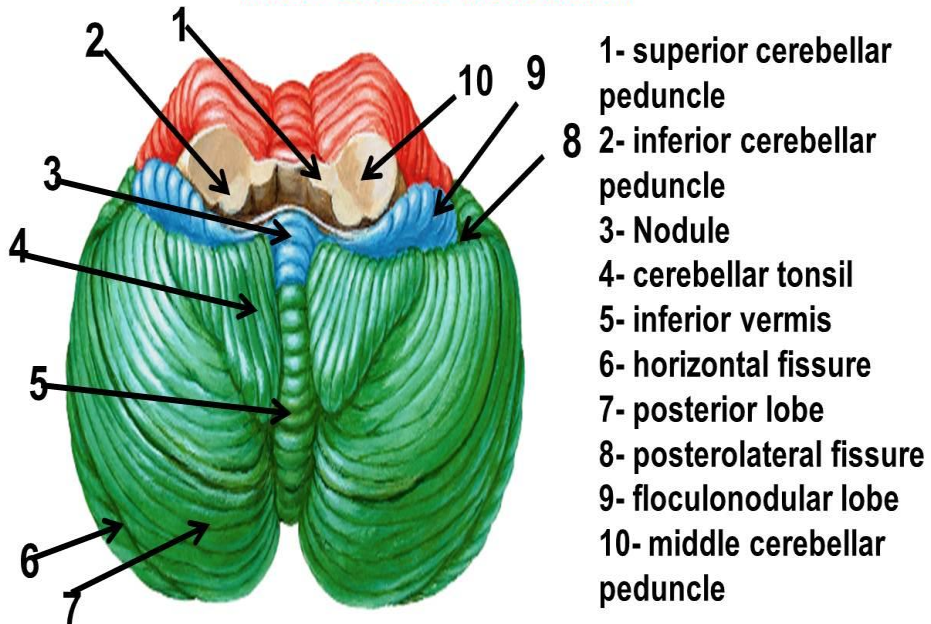
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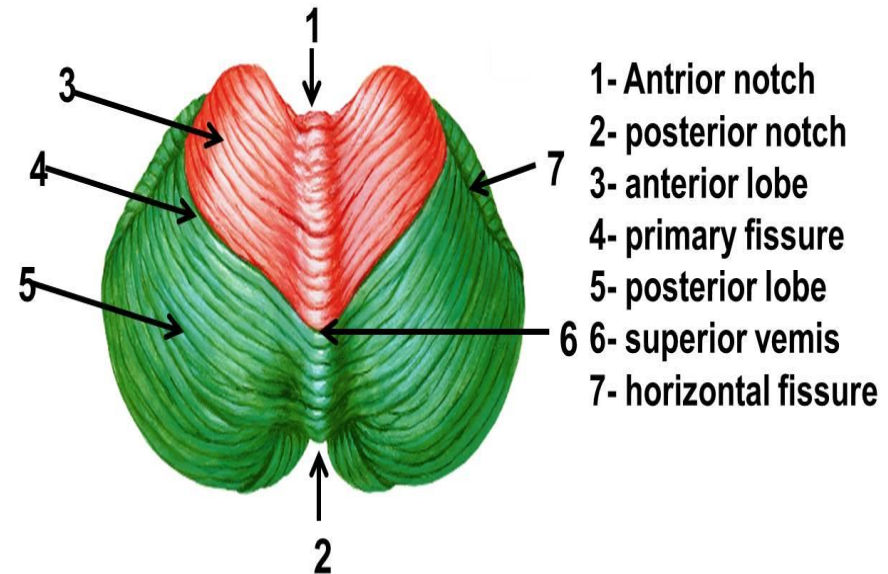




### Inferior surface of the cerebellum



### superior surface of the cerebellum





# Structure of the cerebellum

## 1- Cerebellar Cortex

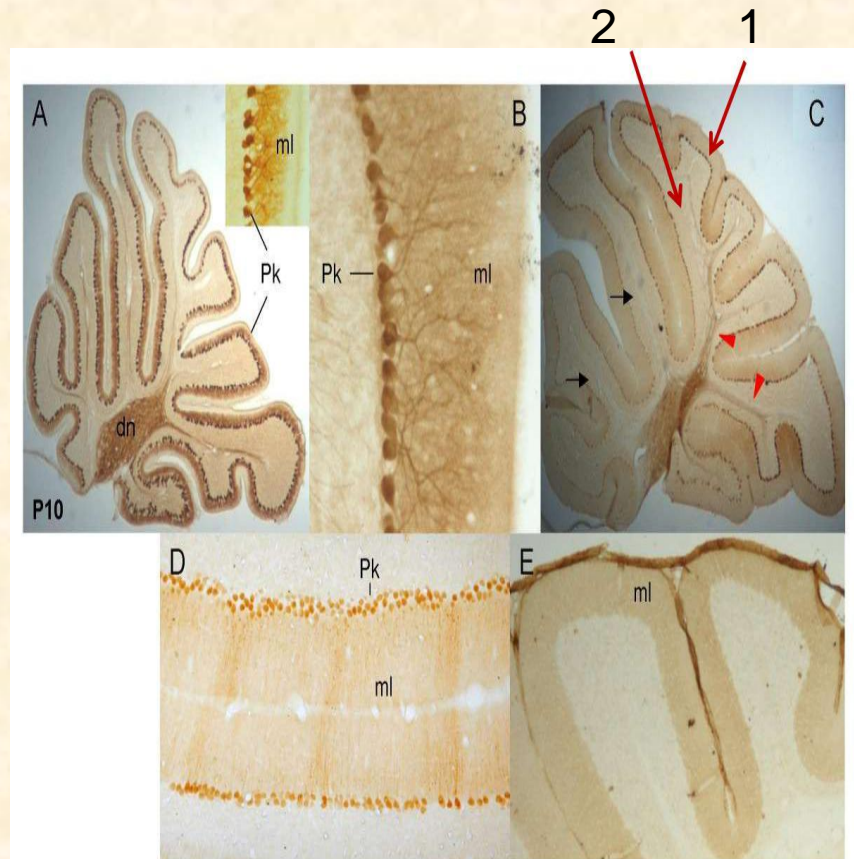
***Outer Molecular Layer*** (stellate and basket cells)

***Middle Purkinje Cell Layer***  
(inhibitory to all other cells)

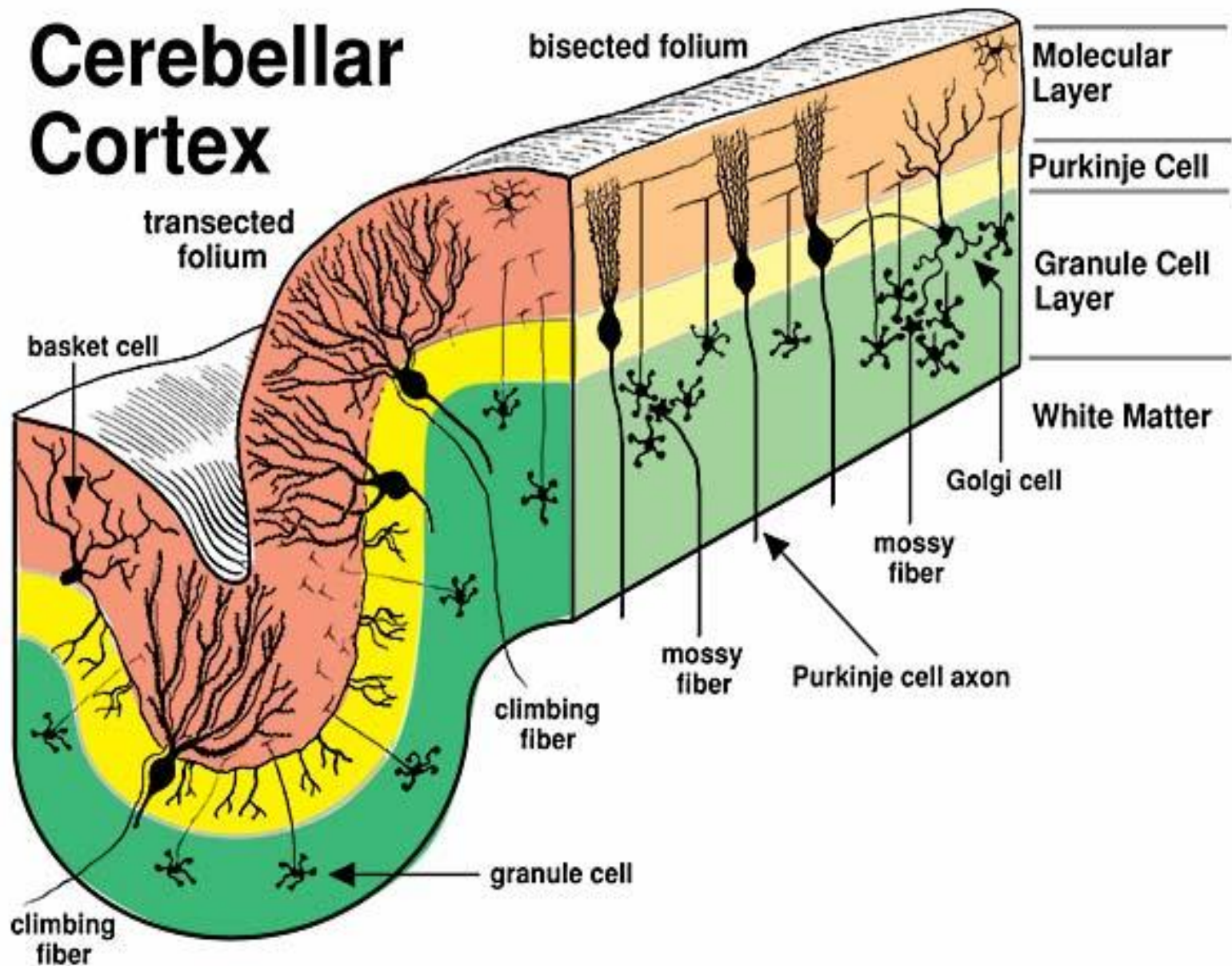
***Inner Granular Layer***  
Include 2G cells (granule and golgi)  
Granule cells are the only (excitatory to all other cells).

## 2- Corpus Medullare (Medullary Center)

## 3- Deep Cerebellar Nuclei



# Cerebellar Cortex



# White matter of the cerebellum

• **Consists of three types of nerve fibres in the white matter**

## A. Mossy fibres (afferent)

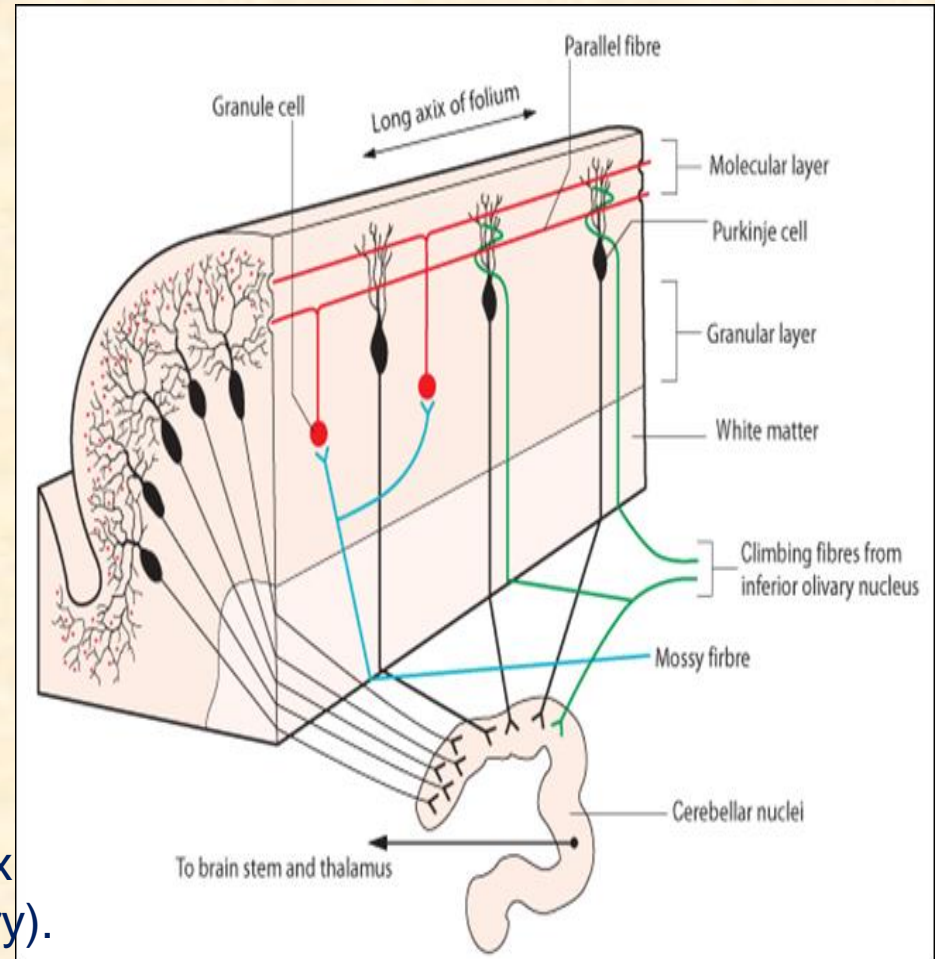
They end in the granular layer first then purkinje layer (indirect activation of purkinje).

## B. Climbing fibres (afferent)

They end directly in purkinje (direct activation) or molecular layer (olivocerebellar tracts mainly)

## C- Axons of purkinje cells (efferent)

The only axons to leave cerebellar cortex to end in deep cerebellar nuclei (inhibitory). These fibers then projects to brain stem nuclei, thalamus and cerebral cortex.





# Functional Subdivisions of The Human Cerebellum

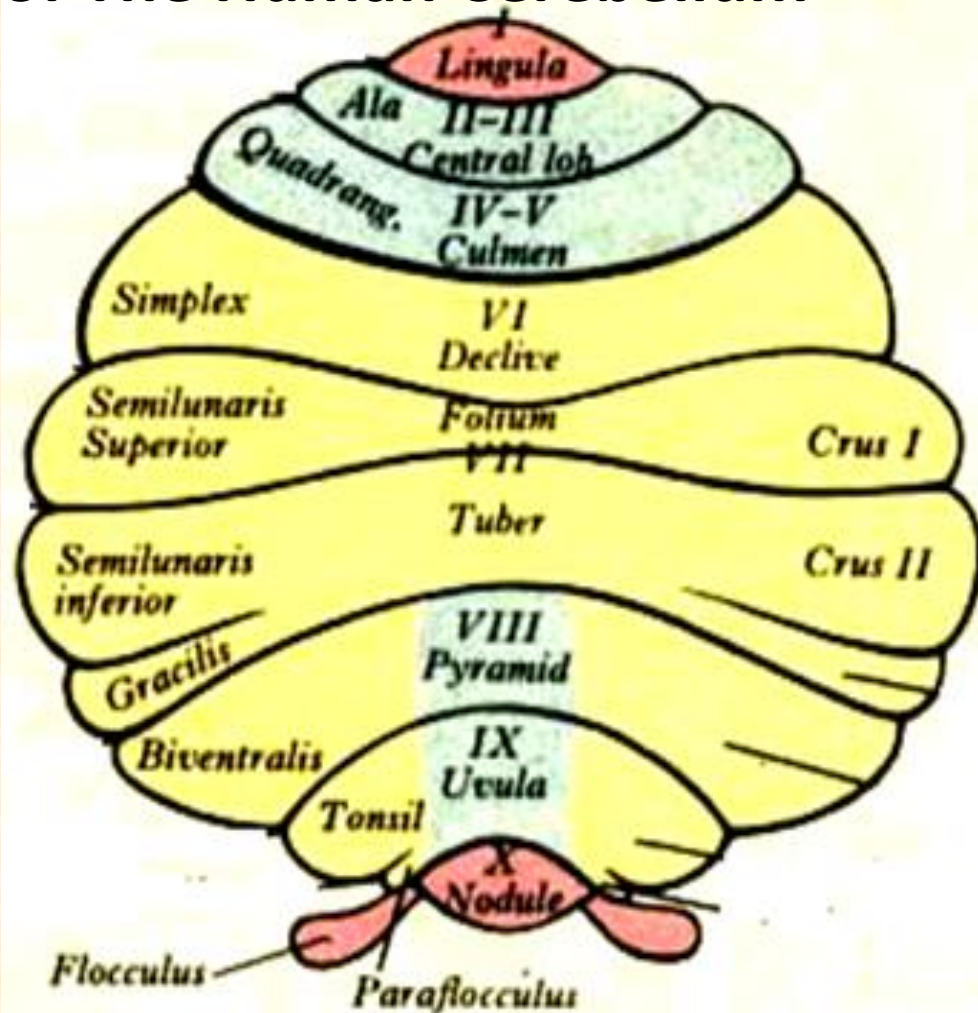
## Archicerebellum (Vestibulo-cerebellum):

- **Flocculo-Nodular Lobe, Lingual Lobule**
- It receives **afferent** Fibres From vestibular apparatus of internal ear **Via vestibulo-cerebellar tracts either directly from vestibular ganglia or from vestibular nuclei.**
- Purkinje neurons of each lobe project its inhibitory axons directly to ipsilateral vestibular nuclei

## Efferent: vestibular nuclei give rise to:

- **Vestibulospinal tracts** to antigravity extensor muscles.
- **Vestibulo-ocular** fibers
- Vestibulo-cerebellar
- Vestibulo-cortical

**Function: Equilibrium, Vestibulo-Ocular Reflex (VOR).**



- Archicerebellum ('Vestibulocerebellum')
- Paleocerebellum ('Spinocerebellum')
- Neocerebellum ('Pontocerebellum' and 'Tectocerebellum')

## Paleocerebellum (Spino-cerebellum):

1- Anterior lobe+ midline vermis (fastigial N)

2- surrounding paravermis + globose & emboliform nuclei.

### 1- Vermal zone of the spino-cerebellum

Purkinje neurons of each hemivermis project inhibitory axons to ipsilateral fastigial nuclei.

**Afferent** : ventral and dorsal spinocerebellar, olivo-cerebellar and cuneocerebellar tracts.

**Projects to fastigial N**

Fastigial N gives **bilateral** excitatory fibers to the **medial motor system** that controls axial and proximal limb muscles through:

**Efferent:**

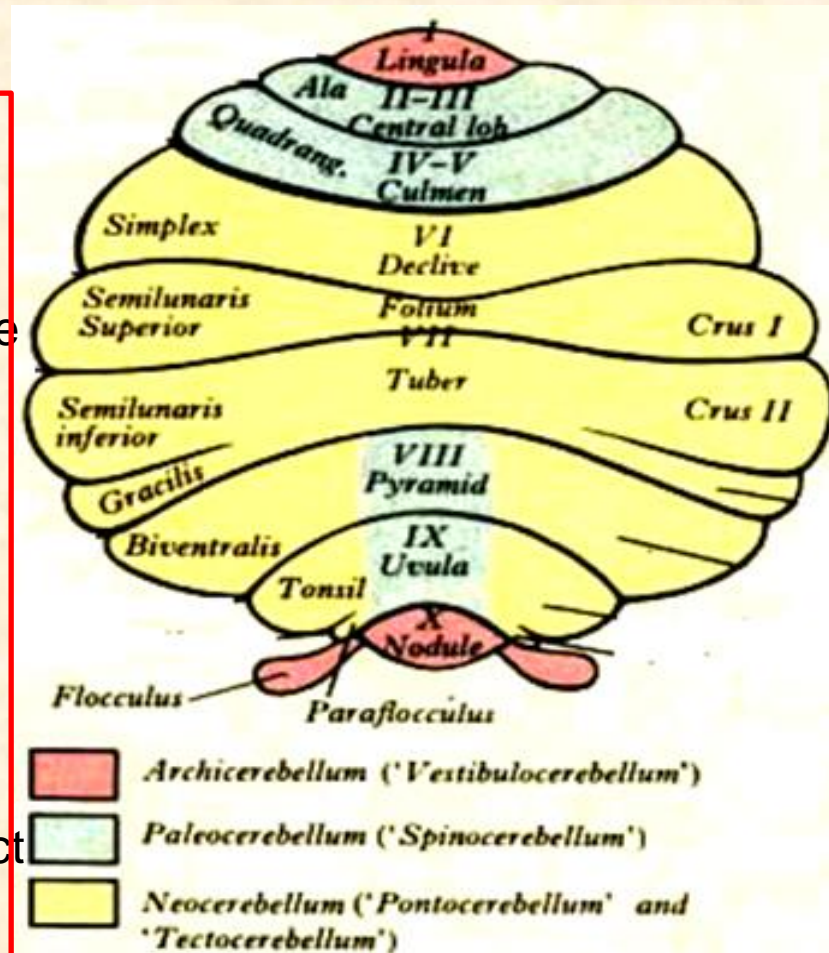
**Fastigio-Vestibulo-spinal** (ipsilateral and contralateral vestibular nuclei)

**Fastigio- Reticulo-spinal** (Ipsilateral and contralateral RF)

**Anterior cortico-spinal** (ipsilateral and contralateral VL nucleus of thalamus which project to trunk part of area 4.

**(cerebello-fastigio-thalamo-cortico-spinal)**

**Function:** Regulate muscle tone of axial and proximal limb muscles





## 2- para-vermal zone of spino-cerebellum

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**Function:** it is concerned with muscle tone (mainly flexors) and regulation of voluntary movements of the distal muscles.

It receives **afferent** proprio-ceptive impulses from Ms.& tendons **Via spino-cerebellar tracts** (dorsal & ventral), olivo-cerebellar and cuneocerebellar

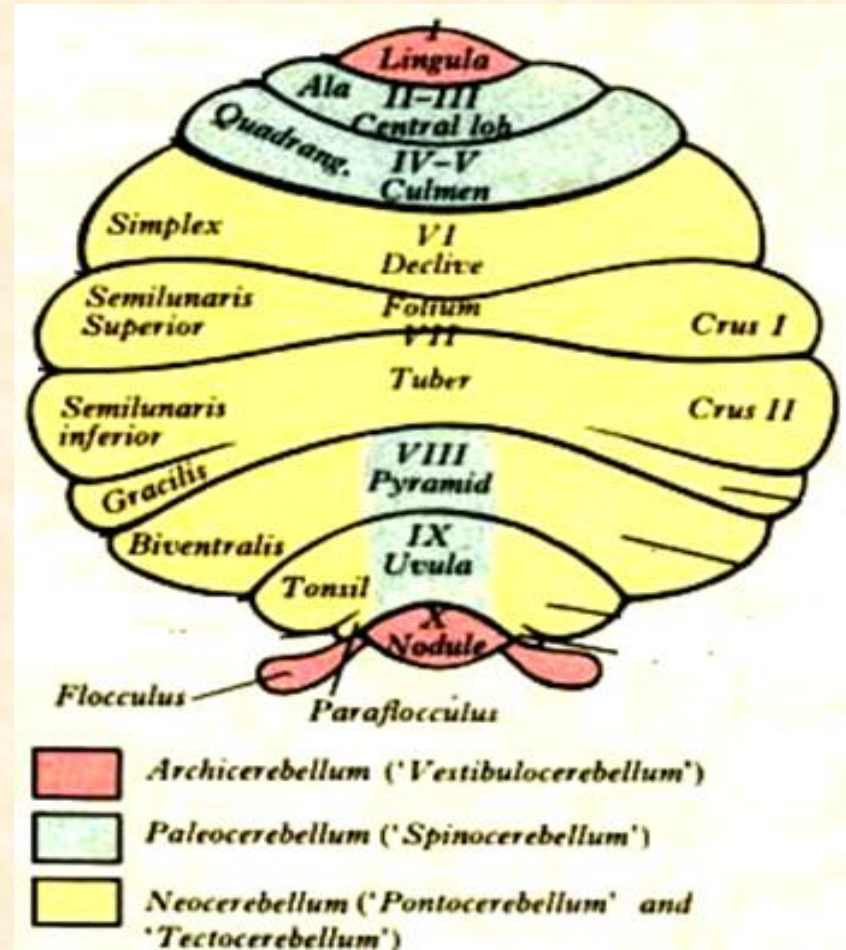
### Project to Globose-Emboliform N

- it sends **efferent** to lateral motor pathway : Contralateral VL nuclei of thalamus which project to precentral gyrus (distal limbs area) from which **lateral corticospinal fibers** arise (control distal limb muscles)

**Cerebello-Globose- Emboliform- thalamo-cortical-spinal pathway**

**Contralateral red nucleus of midbrain**  
(controlling distal limb muscles)

**Cerebello-Globose-Emboliform-Rubral-spinal pathway**





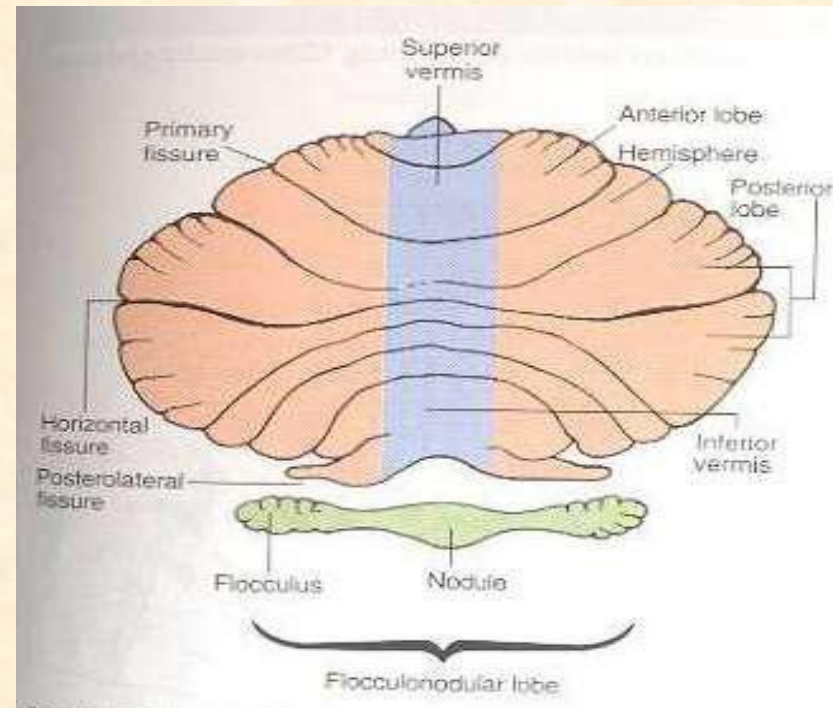
# Neocerebellum (cerebro cerebellum)

**It includes the most 2-cerebellar hemispheres + dentate nuclei.**

It receives **afferent** impulses from the **cerebral cortex+pons** Via **cerebro-ponto- cerebellar** pathway which project to dentate N. it sends **efferents** to contralateral red nucleus that projects to Vento lateral nucleus of thalamus (VL).

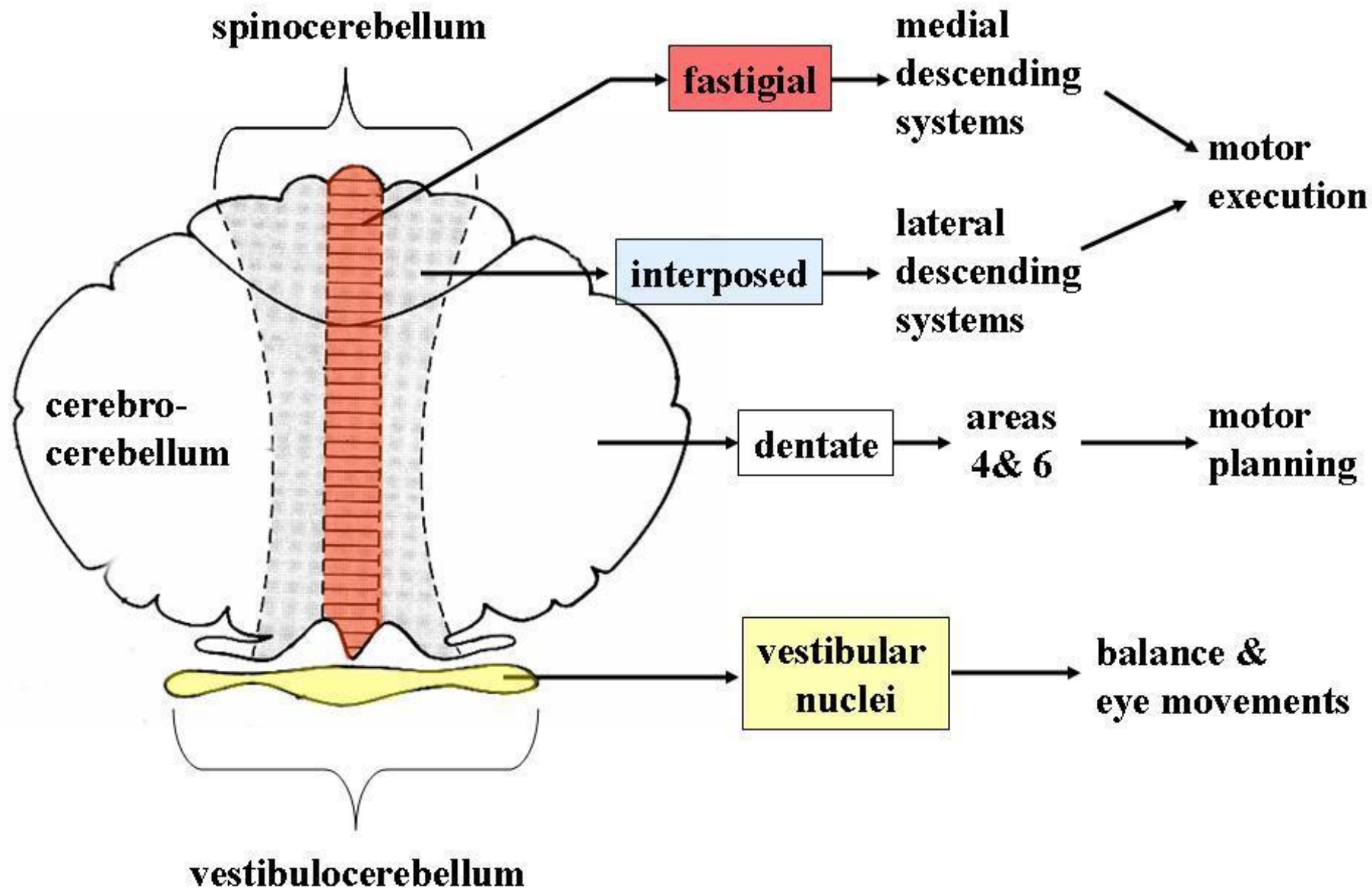
- Function:**
- 1- controls voluntary movements, planning of sequence of intended movements (even before execution of motor activity) i.e anticipation
  - 2- Regulation of force and timing Of Movement.
  - 3- Learning new complex movements

**The whole pathway**  
**Cortico-ponto-cerebellar-**  
**Dentato-rubro-thalamo-cortical**



# Cerebellar Output

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# Fibres entering and leaving through cerebellar peduncles

## Superior cerebellar peduncle (major efferent)

### Fibres entering the cerebellum

Ventral spino-cerebellar tract

Trigimino-cerebellar from Mesencephalic nucleus

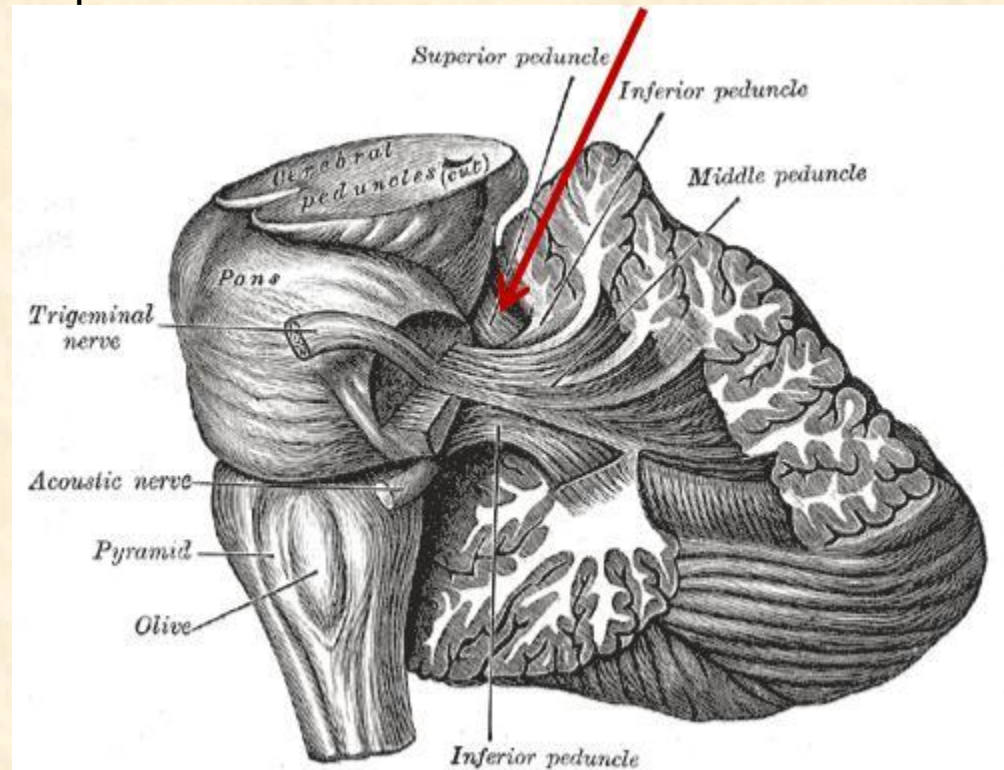
Tecto-cerebellar fibres

### Fibres leaving the cerebellum

Cerebello-rubral fibres  
**(Globose-Emboliform-rubral)**

Cerebello-thalamic fibres  
**(Dentato-thalamo-cortical)**

Cerebello-reticular fibres  
**(Fastigeal nucleus)**





**Middle cerebellar peduncle (afferent**  
**Pontocerebellar fibres**  
**(cortico-ponto-cerebellum) to dentate**  
**nucleus)**

**Inferior cerebellar peduncle (afferent**  
**Fibres entering cerebellum**  
**(restiform body)**

Posterior spino cerebellar tract

Cuneo-cerebellar tract

**Oливо-cerebellar fibres**

**Reticulo-cerebellar**

**Vestibulo-cerebellar fibres**

Trigemino-cerebellar fibres

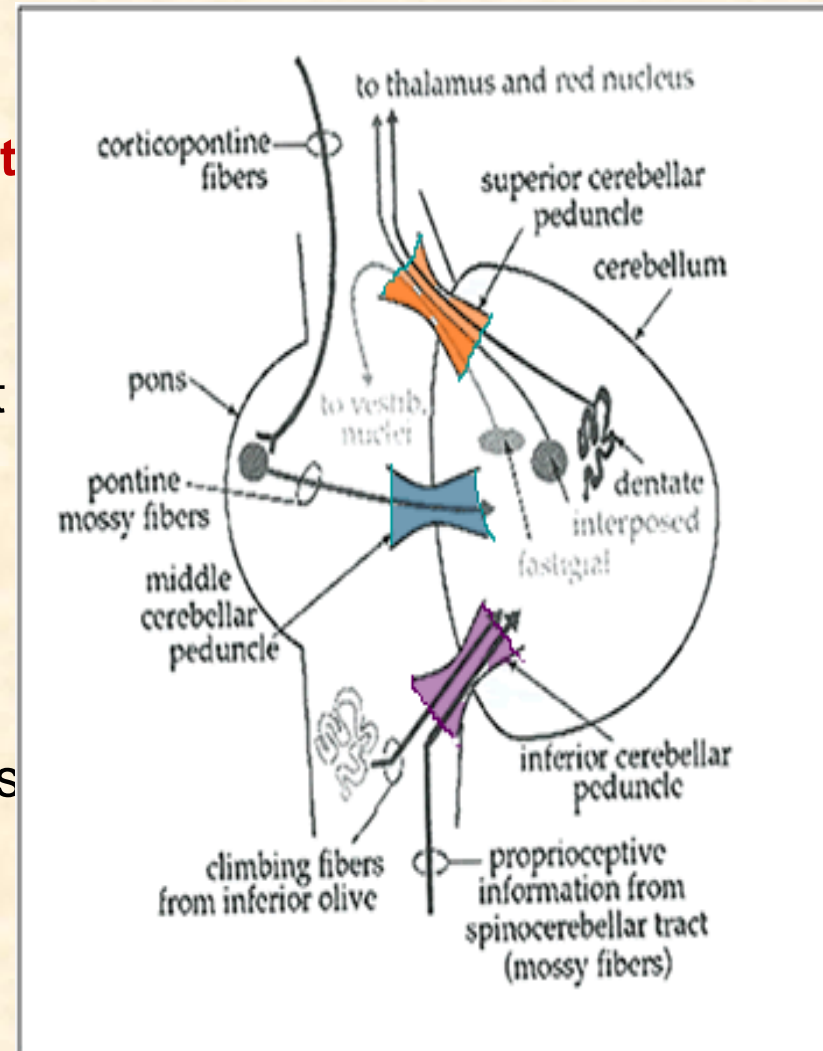
Anterior external arcuate fibers

**Fibres Leaving the cerebellum**  
**(juxta-restiform body)**

**Cerebello-olivary fibres**

**Cerebello (Fastigio)-vestibular fibres**

**Cerebello (Fastigio)- reticular fibres**

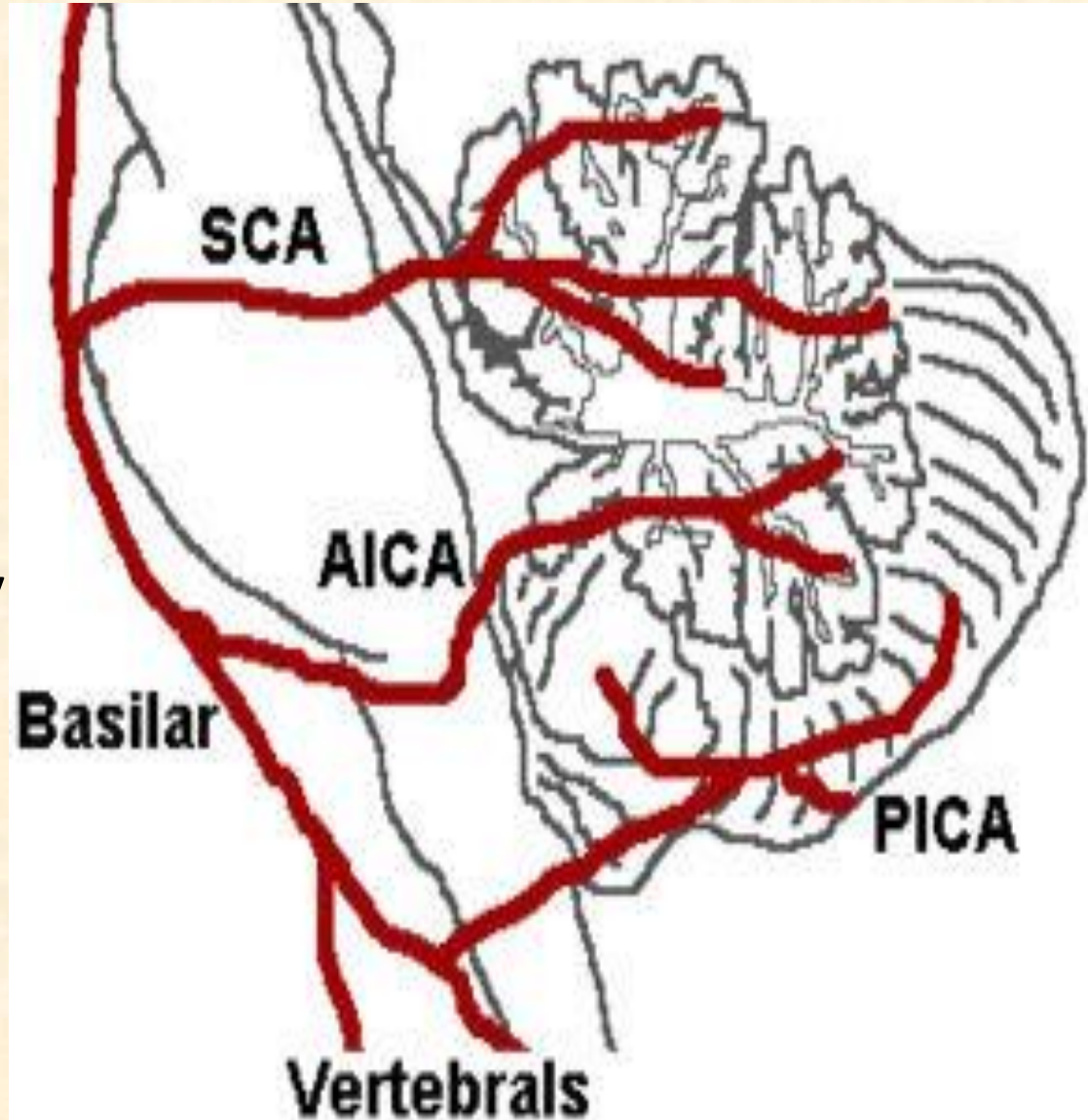


# Blood Supply of the Cerebellum

It is supplied by 3

cerebellar arteries

- **Superior cerebellar artery:** from the basilar artery
- **Anterior inferior cerebellar artery:** from the basilar artery
- **Posterior inferior cerebellar artery:** from the vertebral artery





# Basal ganglia and cerebellum

**Cerebellum and basal nuclei are the 2 major subcortical centers which affect cortical activity**

**Both receive input from cortex**

**Both project output to the cortex via the thalamus**

Cerebellum	Basal ganglia
Receive cortico-ponto-cerebellar from contralateral cerebral cortex	Receives cortico-striate fibres from ipsilateral cerebral cortex
Projects to VL nucleus of the contralateral thalamus projects directly to areas 4,6	Projects to VA nucleus of the ipsilateral thalamus which projects first to SMA then to areas 4,6
Controls movement of the ipsilateral half of the body	Controls movement of the contralateral half of the body



# Cerebellar lesion Syndromes

## **Ataxia:** *incoordination of movement*

- *decomposition of movement*
- *dysmetria, past-pointing*
- *dysarthria*
- *dysdiadochokinesia*
- *rebound phenomenon of Holmes*
- *gait ataxia, truncal ataxia*
- *Intention Tremor Hypotonia, Nystagmus*

## **Archicerebellar Lesion:**

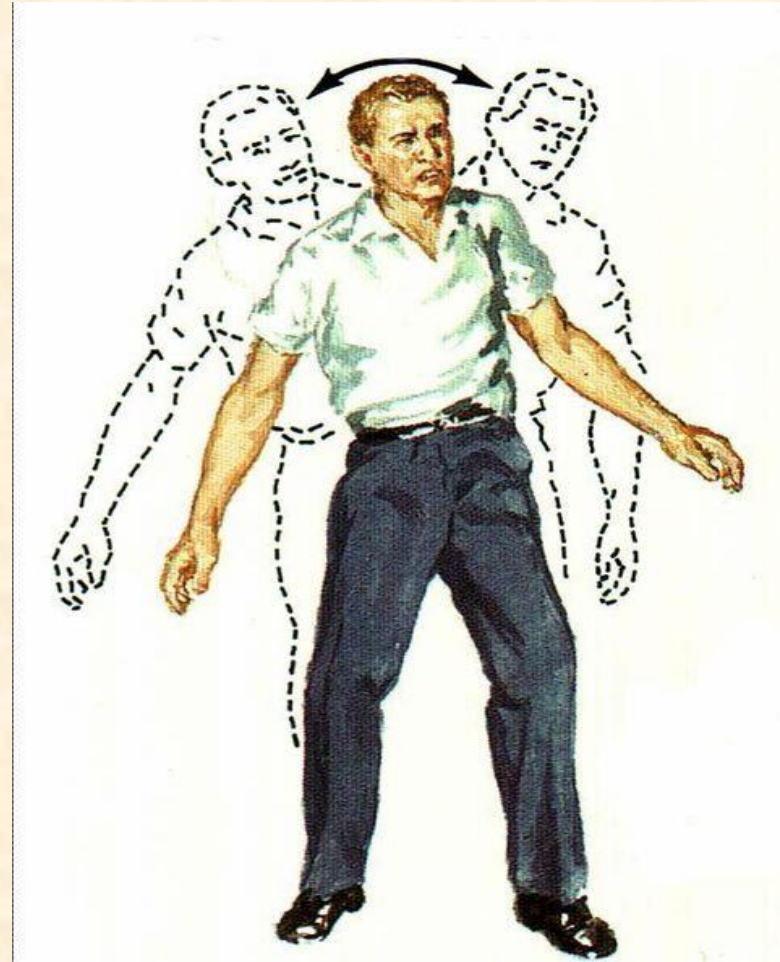
**Medulloblastoma (see later)**

## **Paleocerebellar Lesion:** *gait*

*Disturbance, tested by heel shin test*

## **Neocerebellar Lesion:** *hypotonia, upper Limb ataxia , tremor, dysmetria.*

*Tested by finger to nose test.*





Gait ataxia with  
"tandem" gait



Finger-finger test  
(intention tremor)



Dysdiadochokinesis



Postural test for position  
sense



Rebound phenomenon



Dysmetria (hypermetria)



Test for gaze-evoked nystagmus



Saccades; gaze-evoked and rebound nystagmus

# Cerebellar Medulloblastoma

## Cerebellar Medulloblastoma

### *Cerebellar tumors on vermis*

- Truncal Ataxia
- Frequent Falling

The child in this picture:

- would not try to stand unsupported
- would not let go of the bed rail if she was stood on the floor.



Cerebellar medulloblastoma



**THANK YOU**