

بسم الله الرحمن الرحيم

Cerebellum Anatomy Study Sheet

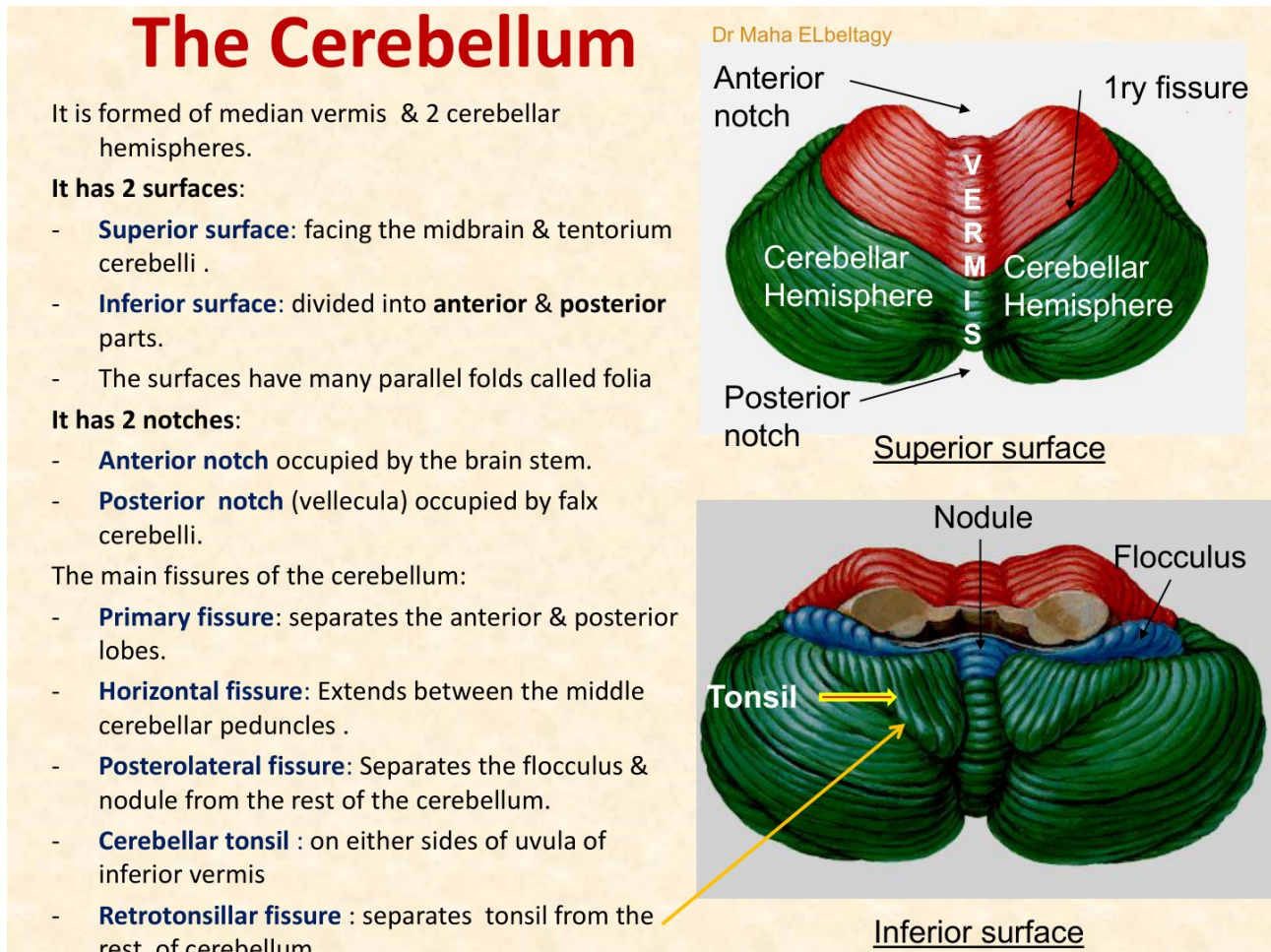
Based on the lecture slides of Dr. Maha ELbeltagy, University of Jordan (2025)

Comprehensive, slide-based review with selected lecture figures and a few public-licensed reference images.

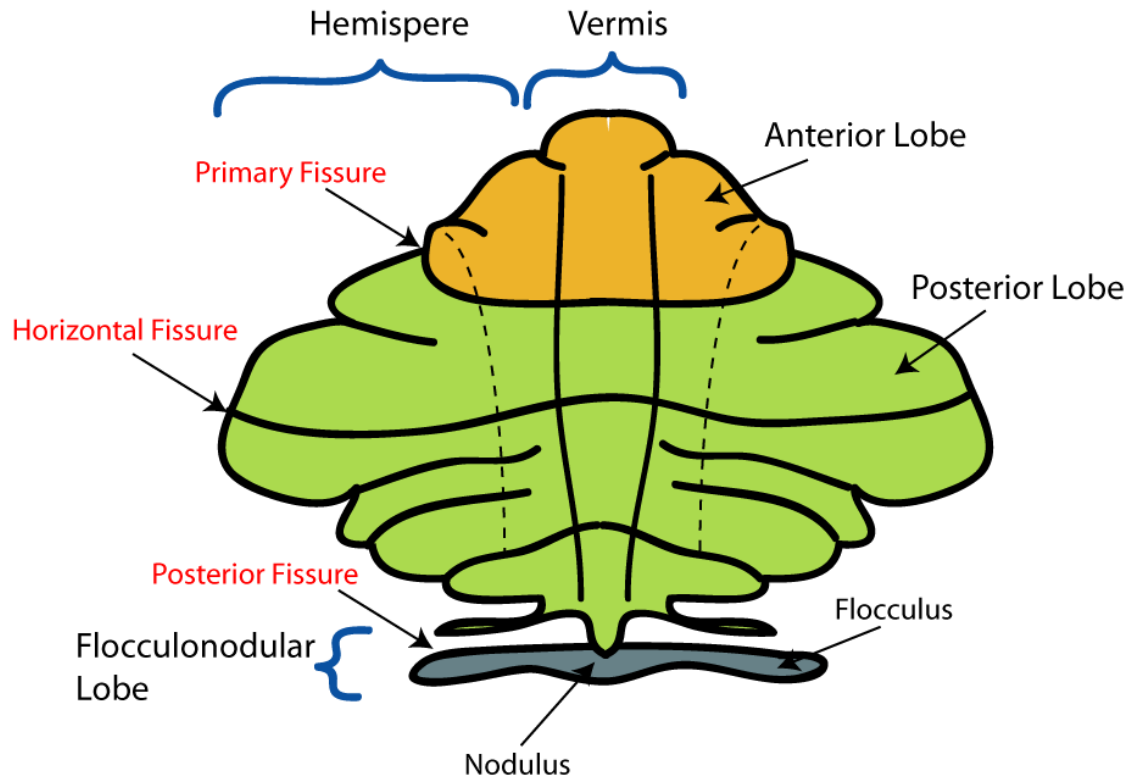
قال صلى الله عليه و سلم : "والله في عون العبد ما كان العبد في عون أخيه"

2. Gross anatomy and surface features

- The cerebellum consists of a median vermis plus two cerebellar hemispheres.
- It has a superior surface facing the midbrain and tentorium cerebelli, and an inferior surface divided into anterior and posterior parts.
- The surface is thrown into many parallel folds called folia.
- The anterior notch is occupied by the brainstem.
- The posterior notch (vellecula) is occupied by the falx cerebelli.
- Main fissures: primary fissure (separates anterior and posterior lobes), horizontal fissure, posterolateral fissure, and retrotonsillar fissure.



Lecture slide, p. 3: gross anatomy, surfaces, notches, and main fissures



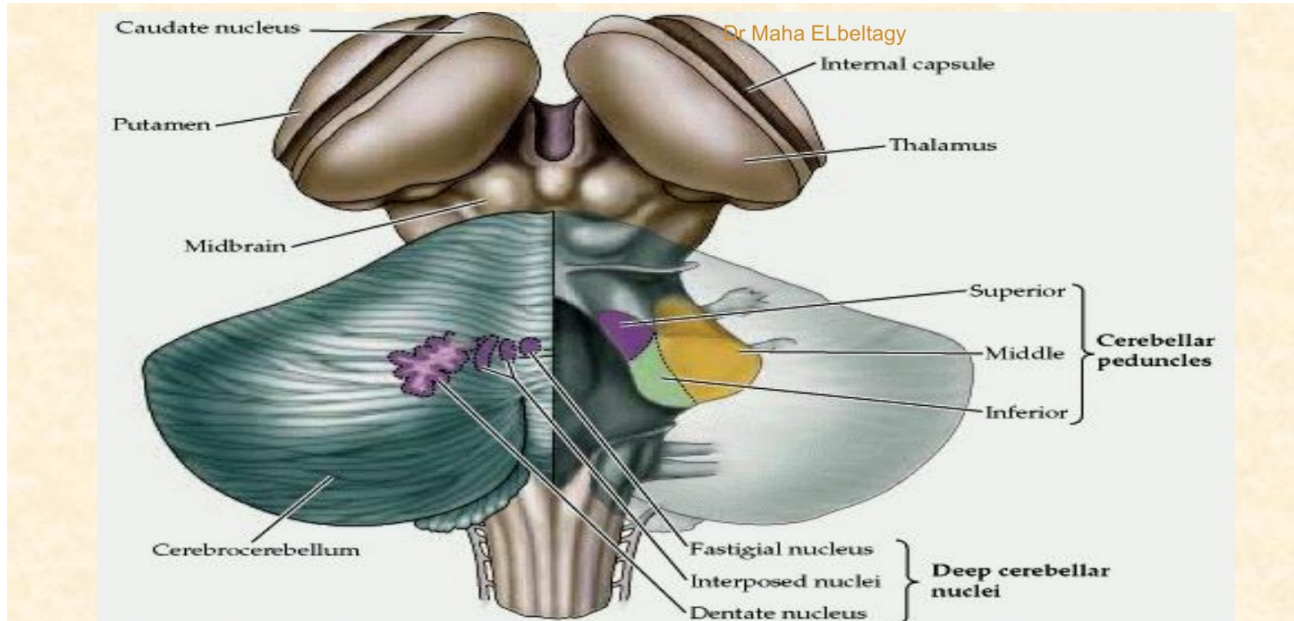
Wikimedia Commons diagram of cerebellar subdivisions (CC BY-SA 3.0).



يمكن زمني يصلحني بعد العداوه و اقول يا ليلي يا عيني اما براوه

3. Lobes, nuclei, and arbor vitae

- The anterior lobe lies in front of the primary fissure.
- The posterior lobe lies behind the primary fissure.
- The flocculonodular lobe consists of the flocculus and the nodule.
- Cerebellar nuclei: dentate nucleus, interposed nuclei (emboliform and globose), and fastigial nucleus.
- Mnemonic from the slide: "Don't Eat Greasy Food".



Cerebellar nuclei:

- Dentate nucleus
- Interposed nuclei: Emboliform - **G**lobose
- Fastigial

"Don't Eat Greasy Food"

Arbor vitae

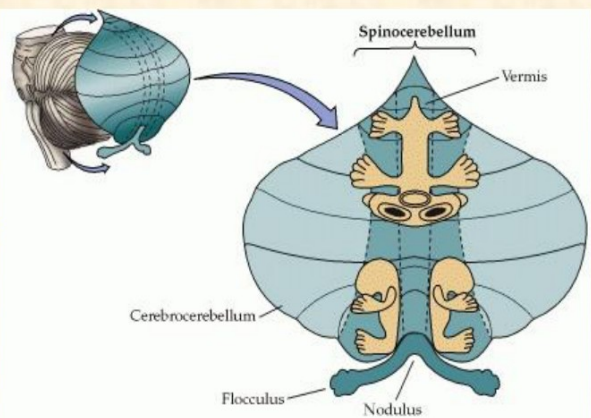
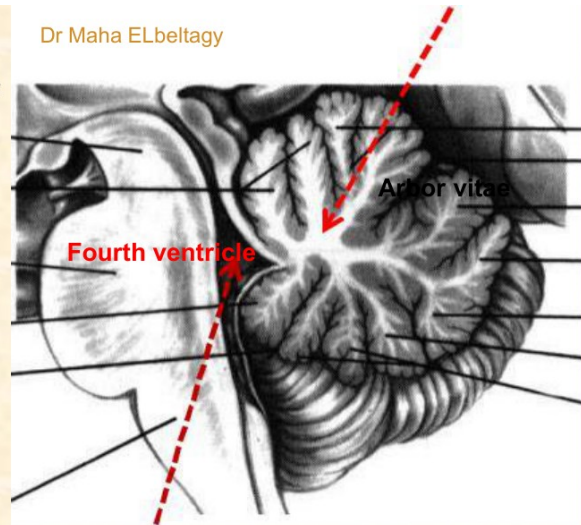
In Latin “ *tree of life*” it is the white matter of cerebellum.

- 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**

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Lecture slide, p. 6: arbor vitae and vertical subdivisions

Arbor vitae

- Arbor vitae is the white matter of the cerebellum and has a tree-like appearance.
- Vertical subdivisions: vermis (projects to fastigial nucleus), paravermis (projects to globose and emboliform nuclei), and the lateral hemispheres (project to the dentate nucleus).

4. Cerebellar peduncles and connections

- 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.

Peduncle	Main connection	Take-home point
SCP	Cerebellum - midbrain	Major efferent route
MCP	Cerebellum - pons	Major afferent route from pontine nuclei
ICP	Cerebellum - medulla	Mixed afferent / efferent route

Cerebellar peduncles:

Superior cerebellar peduncle (SCP):

Connects the cerebellum with the midbrain.

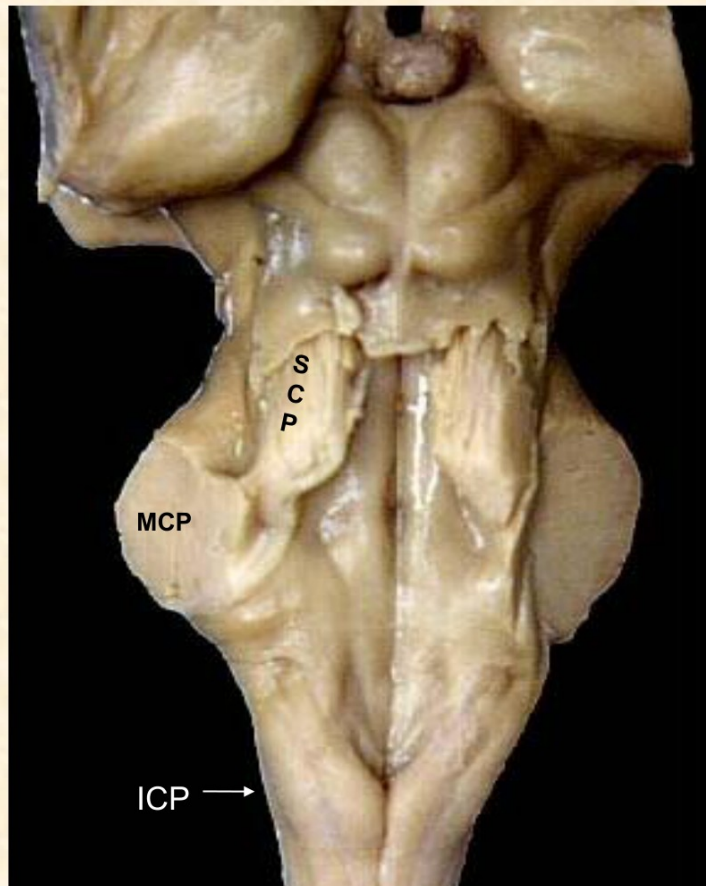
Middle cerebellar peduncle (MCP):

Connects the cerebellum with the pons.

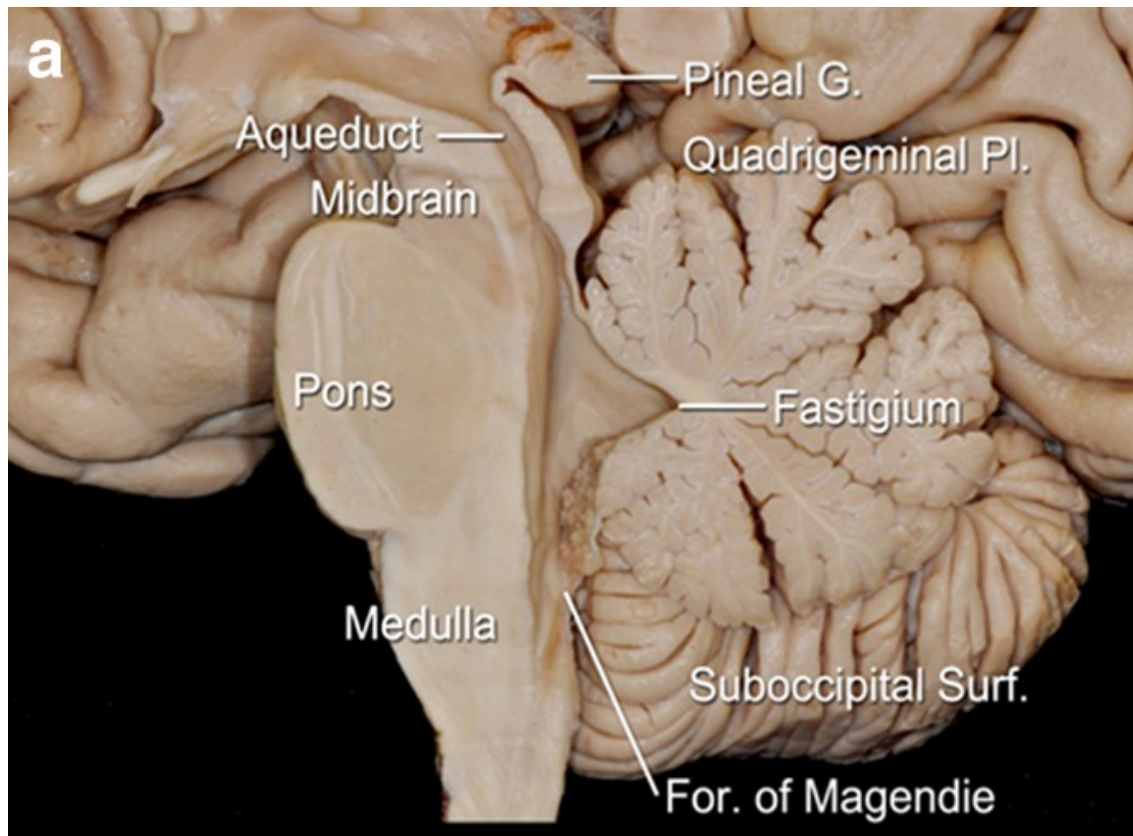
Inferior cerebellar peduncle (ICP):

Connects the cerebellum with the medulla oblongata.

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Lecture slide, p. 7: peduncles on the ventral brainstem



Wikimedia Commons midline brainstem-cerebellum view (CC BY 4.0).

Fibers entering and leaving the cerebellum

- SCP: ventral spinocerebellar, trigemino-cerebellar (from mesencephalic nucleus), and tecto-cerebellar fibers enter; cerebello-rubral, cerebello-thalamic, and cerebello-reticular fibers leave.
- MCP: pontocerebellar fibers enter (cortico-ponto-cerebellar pathway to dentate nucleus).
- ICP: posterior spinocerebellar, cuneocerebellar, olivo-cerebellar, reticulo-cerebellar, vestibulo-cerebellar, trigemino-cerebellar, and anterior external arcuate fibers enter; cerebello-olivary, cerebello-vestibular, and cerebello-reticular fibers leave.

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Fibres entering and leaving through cerebellar peduncles

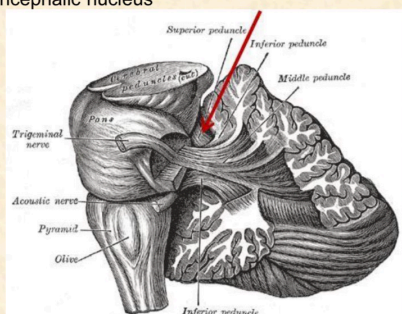
Superior cerebellar peduncle (major efferent)

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)



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Middle cerebellar peduncle (afferent)

Pontocerebellar fibres (cortico-ponto-cerebellum) to dentate nucleus)

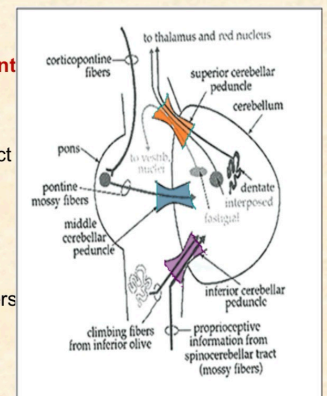
Inferior cerebellar peduncle (afferent)

Fibres entering cerebellum (restiform body)

- Posterior spino cerebellar tract
- Cuneo-cerebellar tract
- Oligo-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



5. Cerebellar cortex and white matter

- The cerebellum is built from three main components: cerebellar cortex, corpus medullare (medullary center), and deep cerebellar nuclei.
- The cortex has three layers: molecular layer, Purkinje cell layer, and granular layer.
- Molecular layer: contains stellate and basket cells.
- Purkinje cell layer: the Purkinje neurons are inhibitory to all other cells.
- Granular layer: contains granule and Golgi cells; granule cells are the only excitatory cells in the slide summary.

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Structure of the cerebellum

1- Cerebellar Cortex

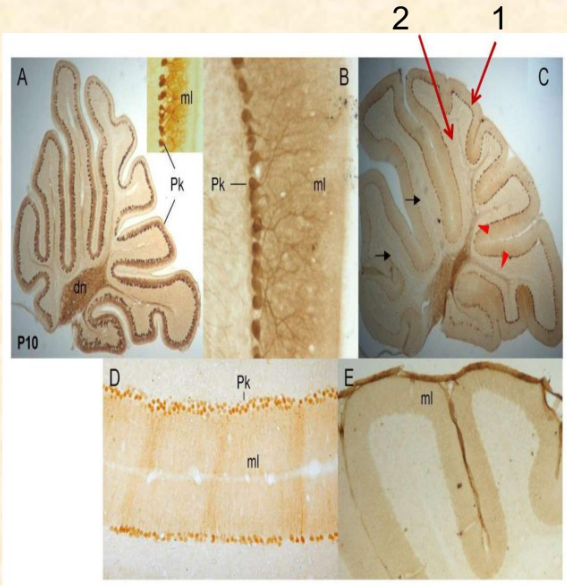
Outer Molecular Layer (stellate and basket cells)

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



The image contains five panels (A-E) illustrating the histology of the cerebellar cortex. Panel A shows a low-magnification view of the cortex with labels 'ml' (molecular layer) and 'Pk' (Purkinje cell layer). Panel B is a higher magnification of the molecular layer. Panel C shows a cross-section of the cortex with red arrows pointing to the molecular layer (labeled '1') and the Purkinje cell layer (labeled '2'). Panel D shows a high-magnification view of the granular layer with labels 'Pk' and 'ml'. Panel E shows a high-magnification view of the molecular layer with label 'ml'. The label 'P10' is visible in the bottom left of panel A.

Lecture slide, p. 11: histologic organization of the cerebellar cortex

White matter of the cerebellum

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

A. Mossy fibres (afferent)

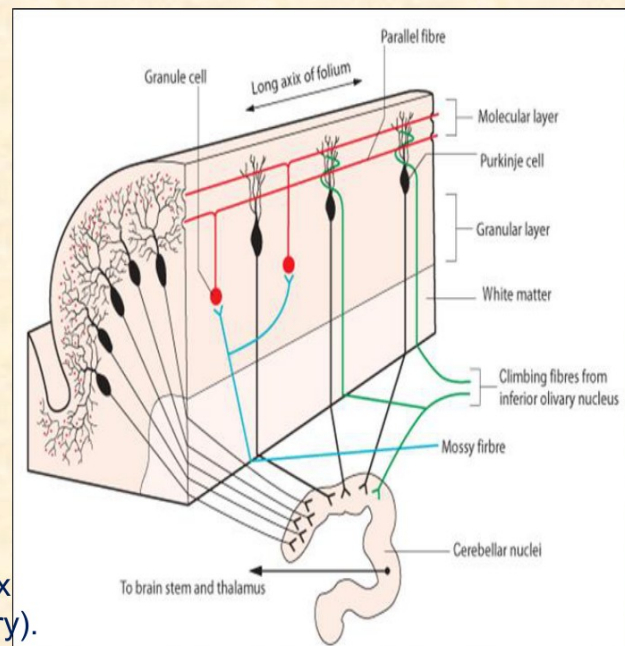
They end in the granular layer first then Purkinje layer (indirect activation of Purkinje).

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 project to brain stem nuclei, thalamus and cerebral cortex.



Lecture slide, p. 13: mossy fibers, climbing fibers, and Purkinje cell output

- Mossy fibers are afferent and relay first to the granular layer before influencing Purkinje cells indirectly.
- Climbing fibers are afferent and make direct contact with Purkinje cells (mainly olivocerebellar).
- Purkinje cell axons are the only axons leaving the cerebellar cortex; they end in the deep cerebellar nuclei and are inhibitory.

6. Functional subdivisions

Subdivision	Main structures	Input / output	Function
Archicerebellum (Vestibulocerebellum)	Flocculonodular lobe; lingula lobule	Input: vestibular apparatus via vestibulocerebellar tracts. Output: ipsilateral vestibular nuclei.	Equilibrium and vestibulo-ocular reflex (VOR)
Paleocerebellum (Spinocerebellum)	Anterior lobe + midline vermis; paravermis + globose/emboliform nuclei	Inputs: dorsal and ventral spinocerebellar, olivocerebellar, and cuneocerebellar tracts. Outputs: fastigial and interposed nuclei to vestibular, reticular, thalamic, and rubral pathways.	Regulates muscle tone; controls axial, proximal, and distal limb muscles
Neocerebellum (Cerebrocerebellum)	Lateral cerebellar hemispheres + dentate nucleus	Input: cerebral cortex and pons via cerebro-ponto-cerebellar pathway. Output: contralateral red nucleus and VL thalamus.	Planning, timing, anticipation, and learning complex movements

Functional Subdivisions of The Human Cerebellum

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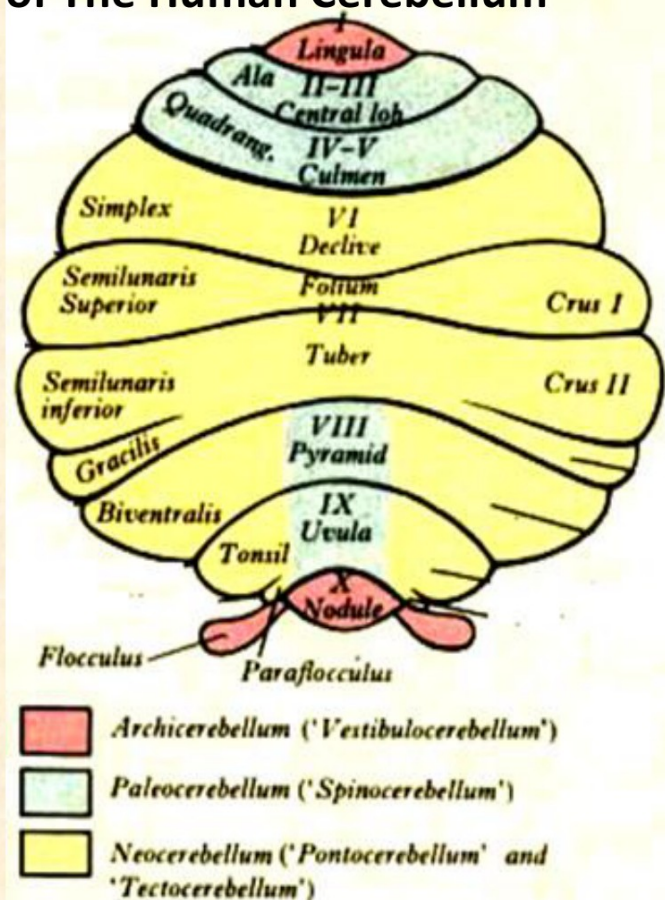
Archicerebellum (Vestibulo-cerebellum):

- **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).



Lecture slide, p. 14: archicerebellum / vestibulocerebellum

Paleocerebellum (Spino-cerebellum):

- 1- Anterior lobe+ midline vermis (fastigeal N)
- 2- surrounding paravermis + globose & emboliform nuclei.

1- Vermal zone of the spino-cerebellum

Purkinje neurons of each hemivermis projects inhibitory axons to ipsilateral fastigeal nuclei.

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

Projects to fastigeal N

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

Efferent:

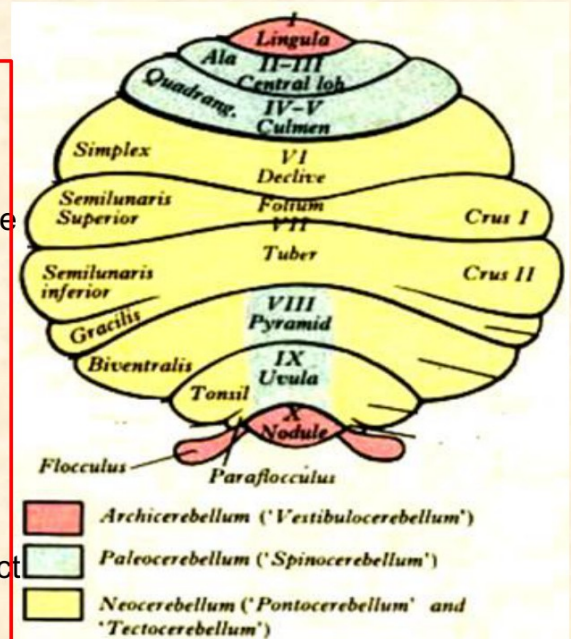
Fasigeo-Vestibulo-spinal (ipsilateral and contralateral vestibular nuclei)

Fastigeo- 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-fastigeo-thalamo-cortico-spinal)

Function: Regulate muscle tone of axial and proximal limb muscles



2- para-vermal zone of spino-cerebellum

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

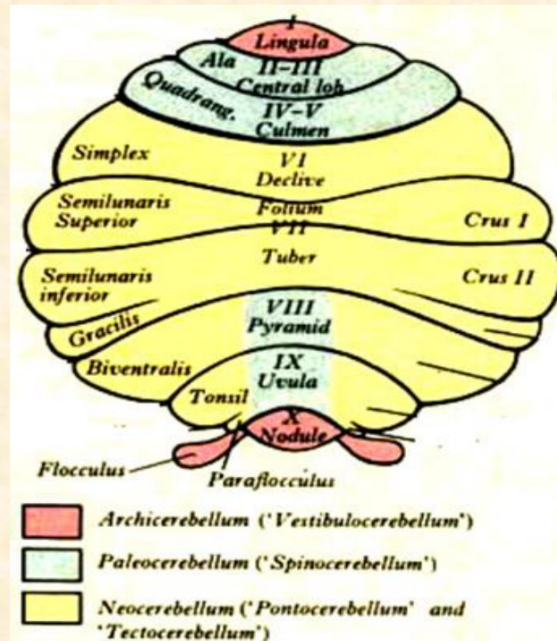
Project to Globose-Emboliform N

- 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 (cerebrocerebellum)

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

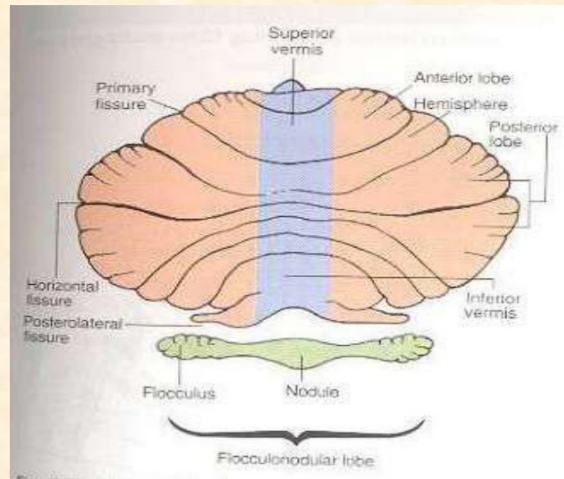
(even before execution of motor activity) i.e anticipation

2- Regulation of force and timing Of Movement.

3- Learning new complex movements

The whole pathway

**Cortico-ponto-cerebellar-
Dentato-rubro-thalamo-cortical**



Lecture slide, p. 17: neocerebellum / cerebrocerebellum

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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

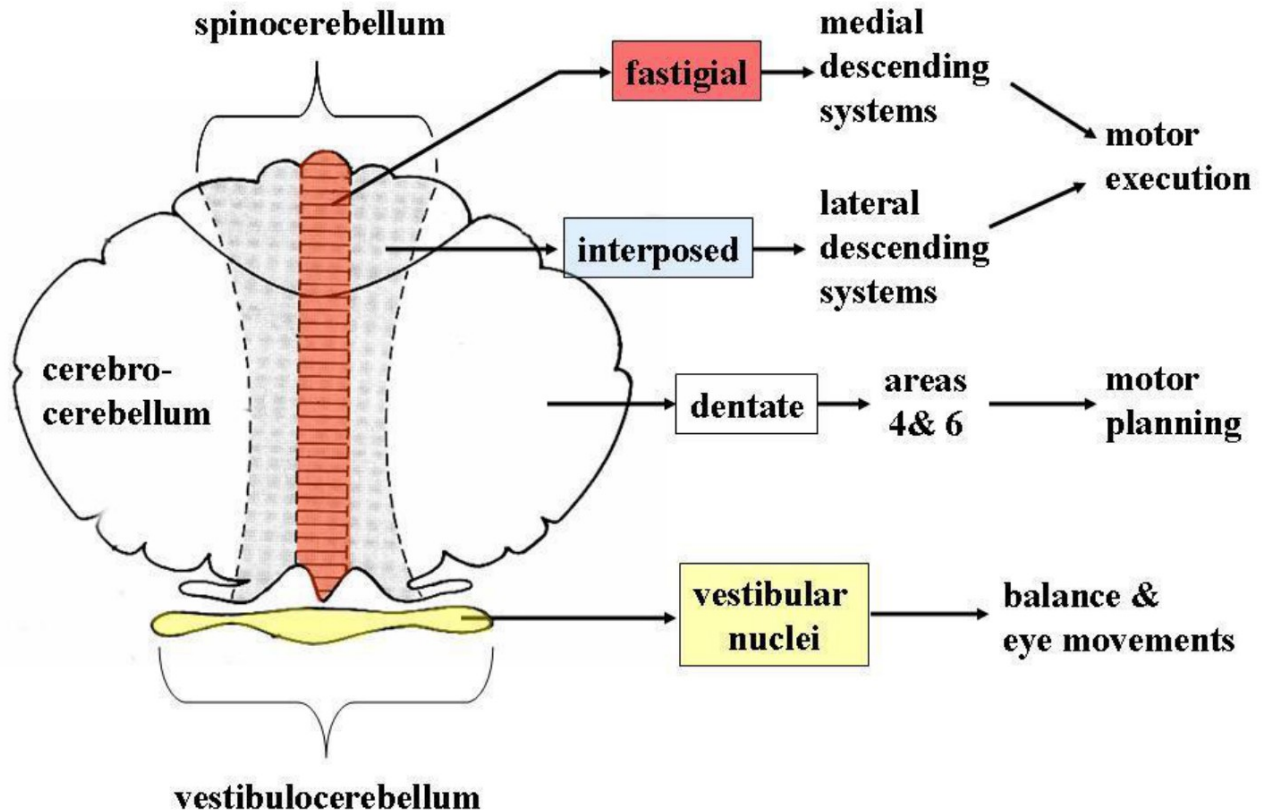
Cerebellum	Basal ganglia
Receive cortico-ponto-cerebellar from contralateral cerebral cortex	Receives cortico-striate fibres from ipsilateral cerebral cortex
Projects to VL nucleus of the contralateral thalamus projects directly to areas 4,6	Projects to VA nucleus of the ipsilateral thalamus which projects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

7. Cerebellar output, blood supply, and lesions

Cerebellar output map

- Fastigial nucleus -> medial descending systems -> motor execution.
- Interposed nuclei -> lateral descending systems -> motor execution.
- Dentate nucleus -> areas 4 and 6 -> motor planning.
- Vestibular nuclei -> balance and eye movements.

Cerebellar Output Dr. Maha ELbeltagy



Lecture slide, p. 18: major cerebellar output pathways

Blood supply

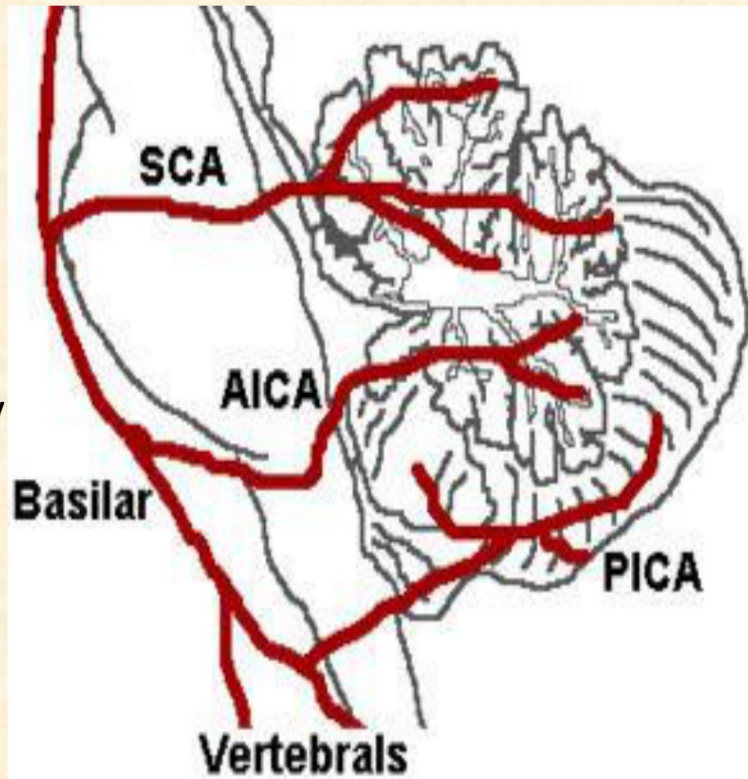
- Superior cerebellar artery (SCA) - from the basilar artery.
- Anterior inferior cerebellar artery (AICA) - from the basilar artery.
- Posterior inferior cerebellar artery (PICA) - from the vertebral artery.

Blood Supply of the Cerebellum

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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



Lecture slide, p. 21: cerebellar arterial supply

Lesion syndromes

- Ataxia means incoordination of movement; common signs include decomposition of movement, dysmetria, past-pointing, dysarthria, dysdiadochokinesia, rebound phenomenon, gait ataxia, truncal ataxia, intention tremor, hypotonia, and nystagmus.
- Archicerebellar lesions are associated with medulloblastoma.
- Paleocerebellar lesions cause gait disturbance; heel-shin testing may be abnormal.
- Neocerebellar lesions cause hypotonia, upper limb ataxia, tremor, and dysmetria; finger-to-nose testing is often used.
- Vermis tumors in children can cause truncal ataxia, frequent falling, and inability to stand unsupported.

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)

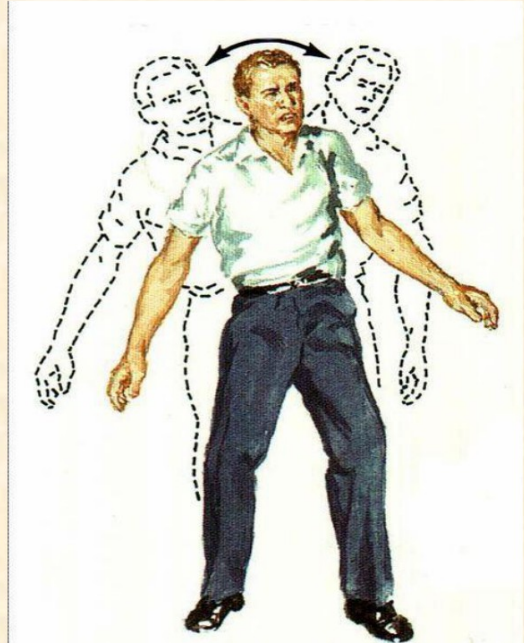
Paleocerebellar Lesion: gait

Disturbance, tested by heel shin test

Neocerebellar Lesion: hypotonia, upper

Limb ataxia , tremor, dysmetria.

Tested by finger to nose test.



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.



8. One-minute recall

- Think in layers: cortex, white matter (arbor vitae), deep nuclei.
- Think in parts: vermis, paravermis, hemispheres.
- Think in lobes: anterior, posterior, flocculonodular.
- Think in function: balance, posture/tone, and planning of movement.
- Think in outputs: vestibular nuclei, fastigial system, interposed nuclei, and dentate-thalamic pathway.

End of study sheet

Thanks for using this sheet.

If you found it helpful, please share it with your friends



Visca Barça, Visca Catalunya