CNS

Doctor 2021

Anatomy
## Sheet (1)

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CEREBELLUM

As you know the brain is divided into:

1. Forebrain: the largest includes:
   a. Diencephalon: includes thalamus, hypothalamus, epithalamus and subthalamus.
   b. Telencephalon: the cerebral cortex includes the cortex, the subcortical white matter and the nuclei within.
2. Midbrain.
3. Hindbrain: includes medulla oblongata and pons anteriorly and <u>cerebellum</u> posteriorly. It has a cavity known as the 4th ventricle its tent-like with floor made by pons and medulla oblongata and roof by the cerebellum. The hind brain is located in the posterior cranial fossa.
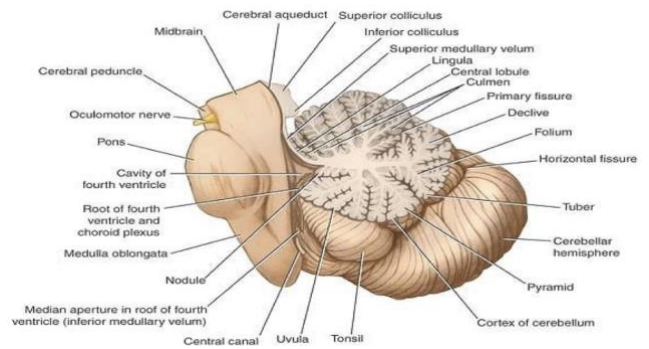
Dura mater is composed of two layers: inner and outer, sometimes they split forming spaces for the dural venous sinuses. And they form folds:

1. Falx cerebri: it leaves the outer layer and descends in the longitudinal fissure, it divides the right and left hemispheres of cerebrum.
2. Falx cerebelli: divides the right and left cerebellar hemispheres.
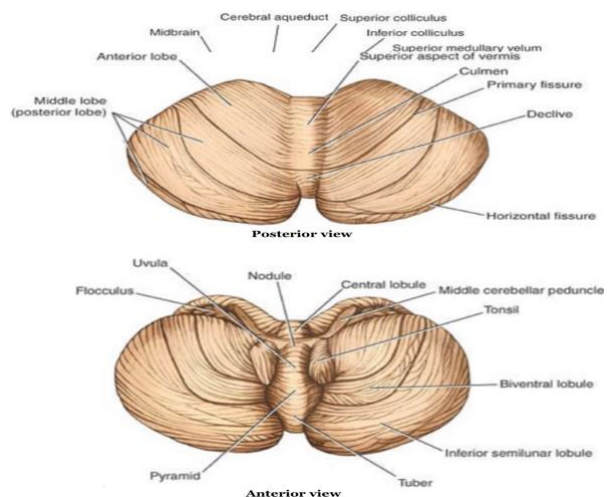3. Tentorium cerebelli: divides the cerebrum above from the cerebellum below.
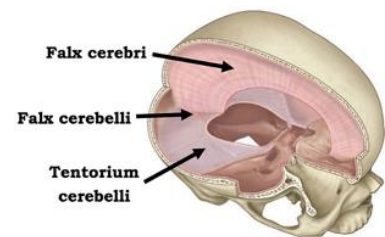
• **Cerebellum is located below tentorium cerebelli within posterior cranial fossa.**

• **Formed of 2 hemispheres connected by the vermis (يعني الدودة عشان شكلها) in midline.**

• **Gray matter is external.**

• **White matter is internal, contain several deep nuclei with the largest is the dentate nucleus.**
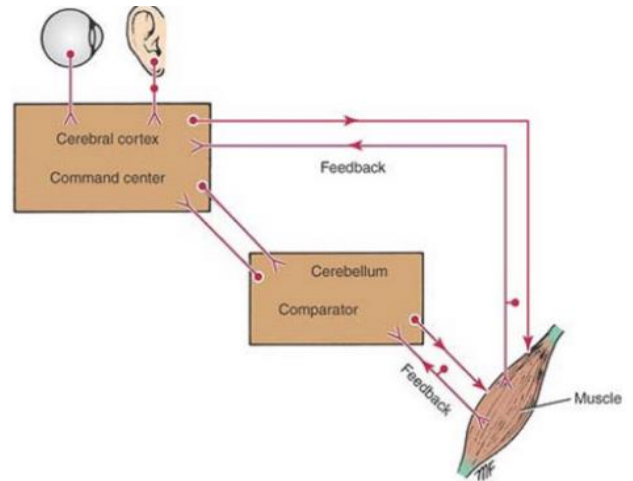
Functions of cerebellum

 (overview, we will talk more about it later)

It is like a calculator for the motor activity (neuromuscular coordination), for that it needs connections.

• **Maintenance of posture and balance.**

• **Maintains muscle tone.**

• **Coordinates voluntary motor action.**

The cerebellum functionally is divided into three parts:

1. Spino-cerebellum: cerebellum receives huge input from the spinal cord (Ant & Post spinocerebellar tracts), modality is unconscious proprioception (muscle-Joint Sense). So, cerebellum is informed about the exact current position of the body in space.

2. Vestibulo-cerebellum: cerebellum receives data from the inner ear "vestibule", data here is related to the relation of the body with gravity (sense of balance), important for coordination of skeletal muscles.

3. Cerebro-cerebellum: for cross-talk between cerebrum and cerebellum, remember we said that before skeletal muscle movements, the cerebral cortex consults areas in CNS related to the motor activity, one of them is cerebellum. The cortex (frontal lobe specifically) function is for the intention of movements, planing and personality (frontal lobe is named as the motor lobe or to be more general "executive تمثيلي lobe"). After the cerebellum received input from the cerebral cortex it then sends feedback again to the cortex via the thalamus through the motor nuclei (VA, VL) not the sensory nuclei (VPM, VPL, medial and lateral geniculate).

Anatomy of cerebellum

Three lobes:

1. **Anterior lobe.**

2. **Posterior lobe.**

3. **flocculonodular lobe.**


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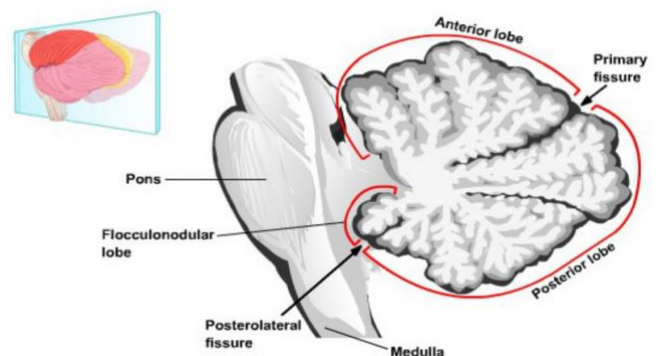
Two main fissures:

- **The primary fissure: separates the posterior lobe from the anterior lobe.**

- **The posterolateral fissure: (uvulonodular fissures) separates the flocculonodular lobe from the posterior lobe.**

Cerebellar cortex = organized into groups of folia (folium is singular, small raised ridges similar to gyri in cerebrum) **= further divided into 10 lobules and 3 lobes.**
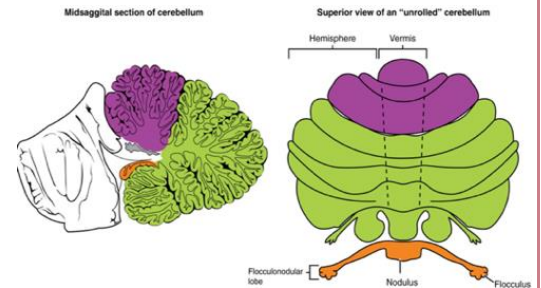
Major anatomical divisions (reflecting _functional_ regions):

1. **Vermis** (between the two cerebellar hemispheres).

2. **Intermediate zone** (intermediate hemispheres) on either side of the vermis.

3. **Lateral hemispheres.**
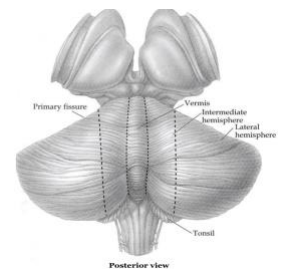
No clear morphological borders between the intermediate zone and the lateral hemisphere that are visible from a gross specimen.

The picture to the right shows the somatotropic arrangement (homunculus) for muscle joint sense.
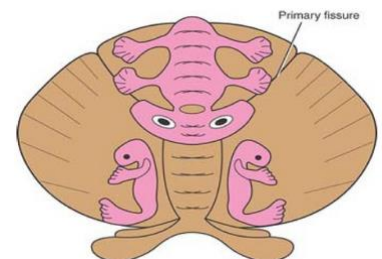
- **Vermis: influences the movements of the long axis of the body (neck, shoulders, thorax, abdomen and hips)** (vermis is on the midline of the cerebellum and is related to the midline structures of the body).

- **Intermediate zone: control muscles of the distal parts of the limbs (hand and feet).**

- **Lateral zone: concerned with planning of sequential movements of the entire body.** (e.g. speech)

The cerebellum is composed of an outer covering of gray matter called the cortex and inner white matter.

Embedded in the white matter of each hemisphere three masses of gray matter forming the intracerebellar nuclei.

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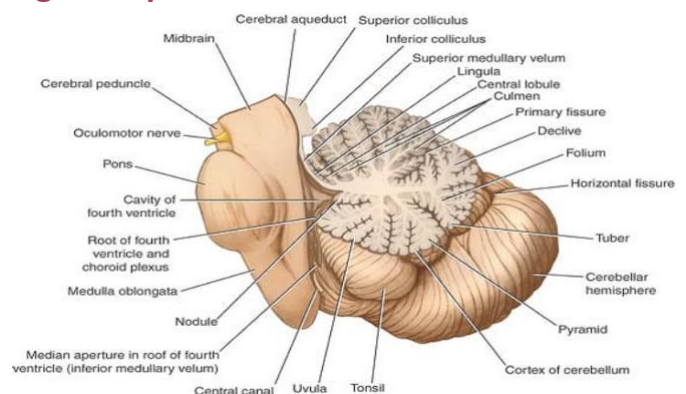
Each ridge or gyrus in cerebellar cortex is called a folium, with a branched appearance (tree-like) **called the <u>arbor vitae</u> (white matter).**

Within the white matter are the deep cerebellar nuclei (gray matter), 4 nuclei (**D**on't **E**at **G**reasy **F**ood).

1. Dentate nucleus (المسنَّنة): the largest and most lateral one.
2. Emobliform nucleus
3. Globose nucleus
   Globose and Emobliform are related functionally and called interposed nuclei.
4. Fastigial nucleus: the most medial one.
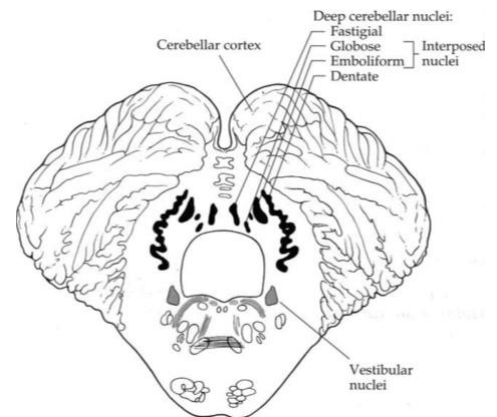
Structure of cerebellar cortex (divided into three layers)

**1. Molecular layer:** outer most layer, contains:
- **Stellate cells.**
- **Basket cells.**
- **Axons of granule cells (parallel fibers)** (coming from the inner most layer).
- **Dendrites of Purkinje cells** (from the second layer).

2. Purkinje cell layer:
- **large neuronal cell bodies (Purkinje cells).**
- **Flask shaped cells.**

3. Granular layer:
- **Small neurons called granular cells.**
- **Golgi cells: (Inhibitory,** modulatory**).**
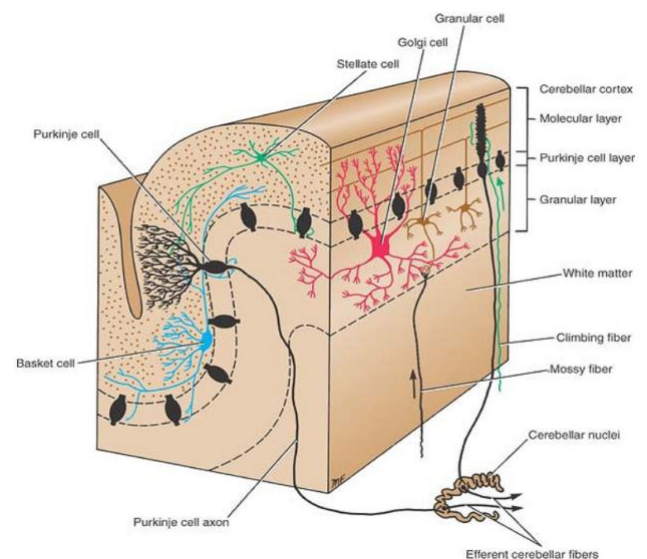
The fibers which enter the cerebellum (afferent) are:

1. Climbing fibers (from the olive).
2. Mossy fibers.

They both synapse with the dendrites of the purkinje cells, the climbing fibers synapse directly, and the mossy fibers synapse indirectly passing through the granular layer (mossy fibers first activate the granular cells which then stimulate purkinje cells).

The major output from the cerebellum is out through the purkinje cells (climbing and mossy give input).