Sensory areas

1° somatosensory A. (1, 2, 3)
1° visual A. (17)
1° auditary A. (41, 42)
1° gaustatory A. (43)
1° olfactory A. (28)

Motor areas

1° Motor A. (4)
Broca's A. (44, 45)

Association A

* Somatosensory ass. A. (5, 7)
* visual Ass. area (18, 19)
* Facial recognition A (20, 21, 37)
* Wernicks area (22)
* auditary ass a.
* orbitofrontal ass. area
* Premotor A.

- **O B J E C T I V ES:**
- **Describe structural function of basal nuclei**
- Describe the structure and functions of the cerebellum.
- Describe the structures and functions of the brain stem.

• Basal Nuclei

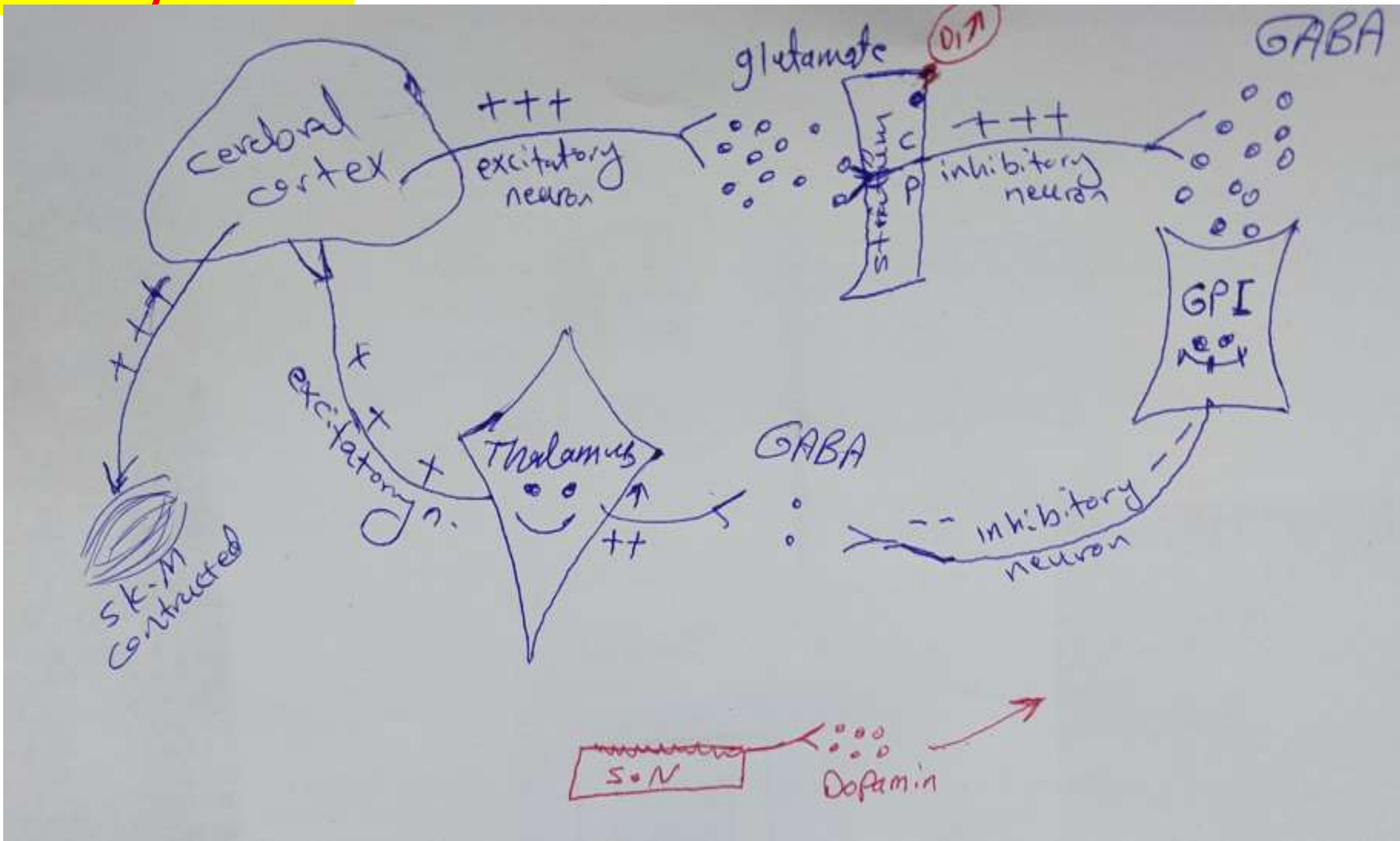
are three nuclei (masses of gray matter) located deep within each cerebral hemisphere .

Caudate nucleus + Putamen= **corpus striatum**

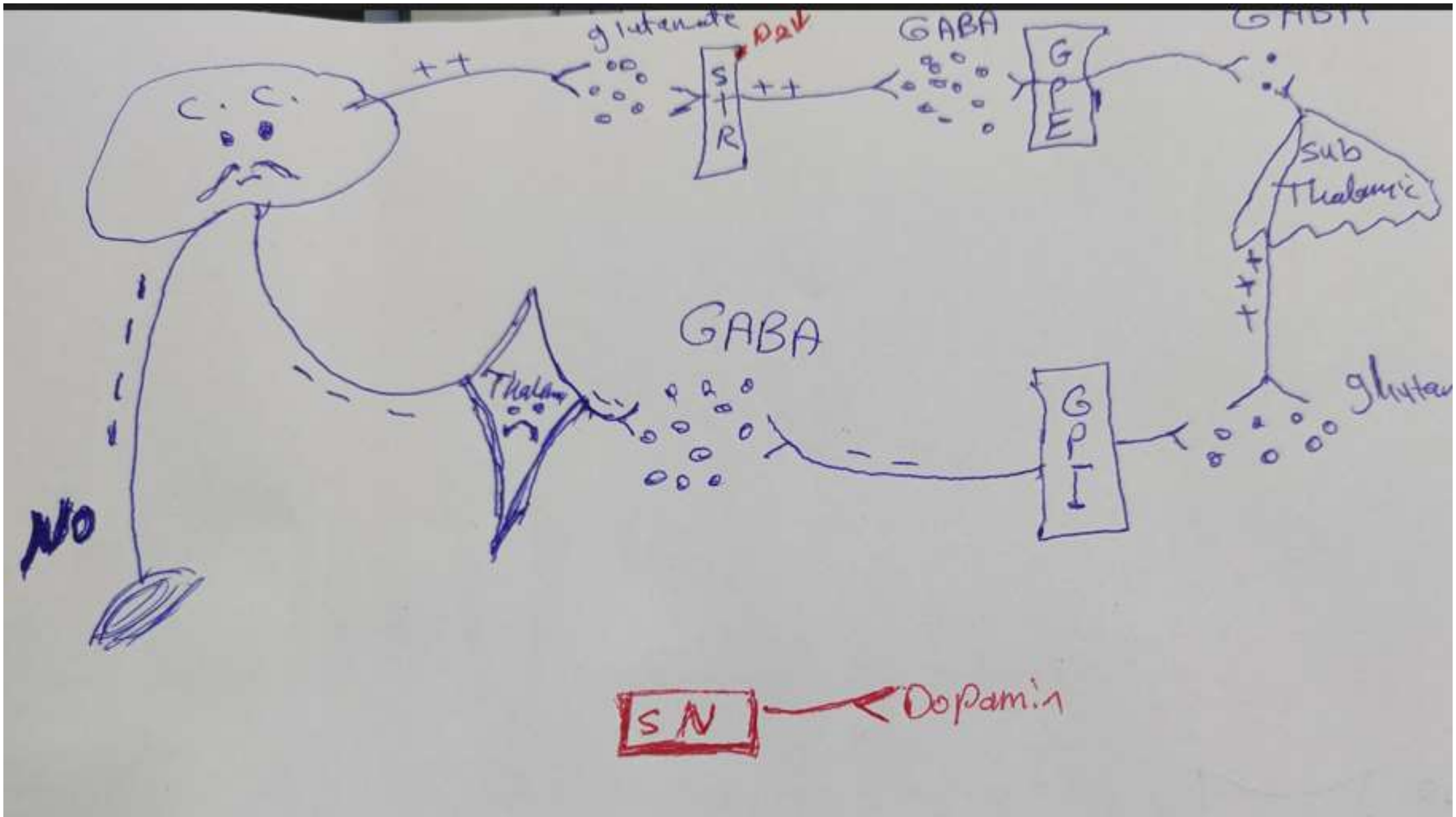
Globus pallidus : interna, externa

substantia nigra of the midbrain , thalamus , subthalamus

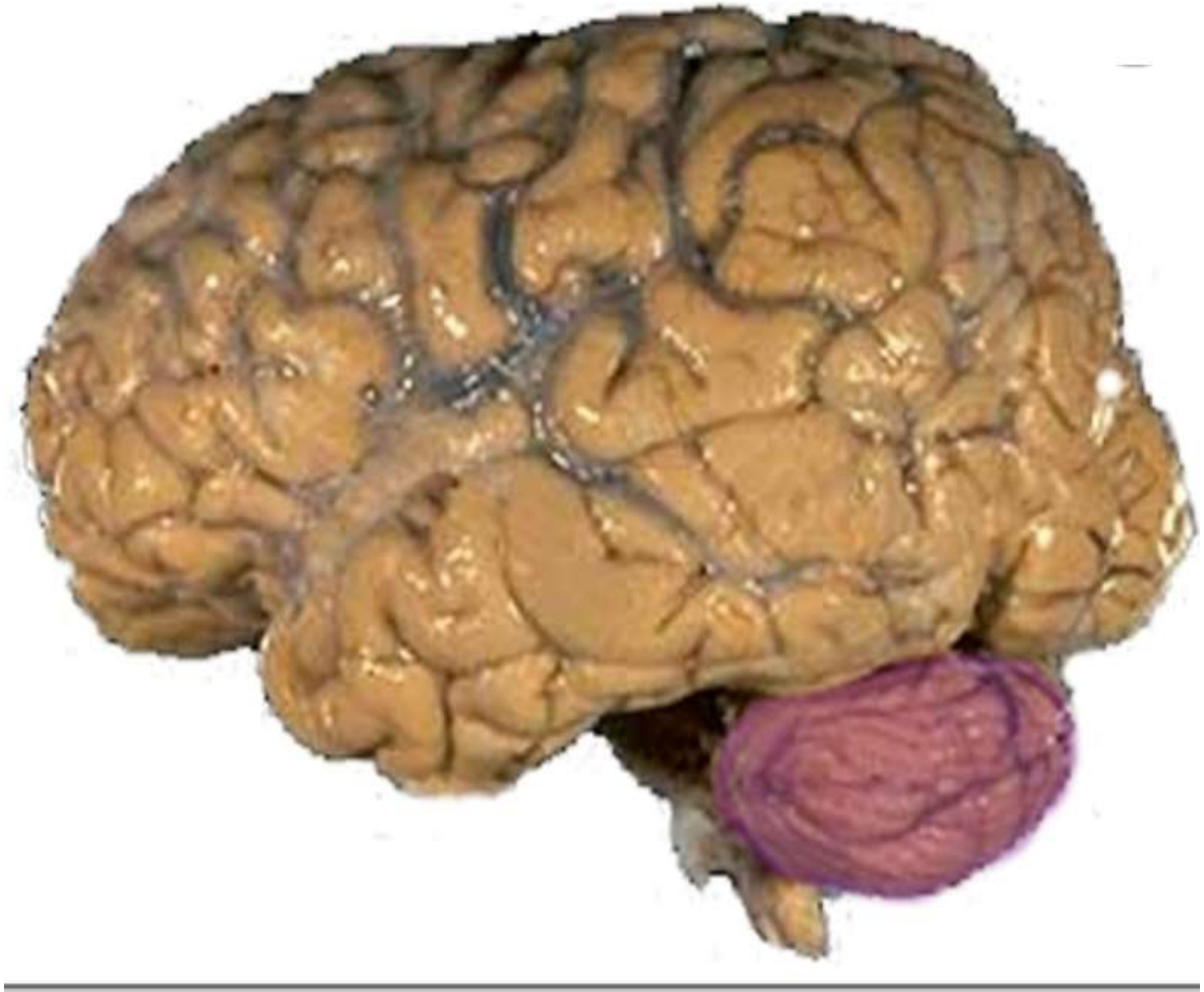
Direct pathway Parkinsonism ?

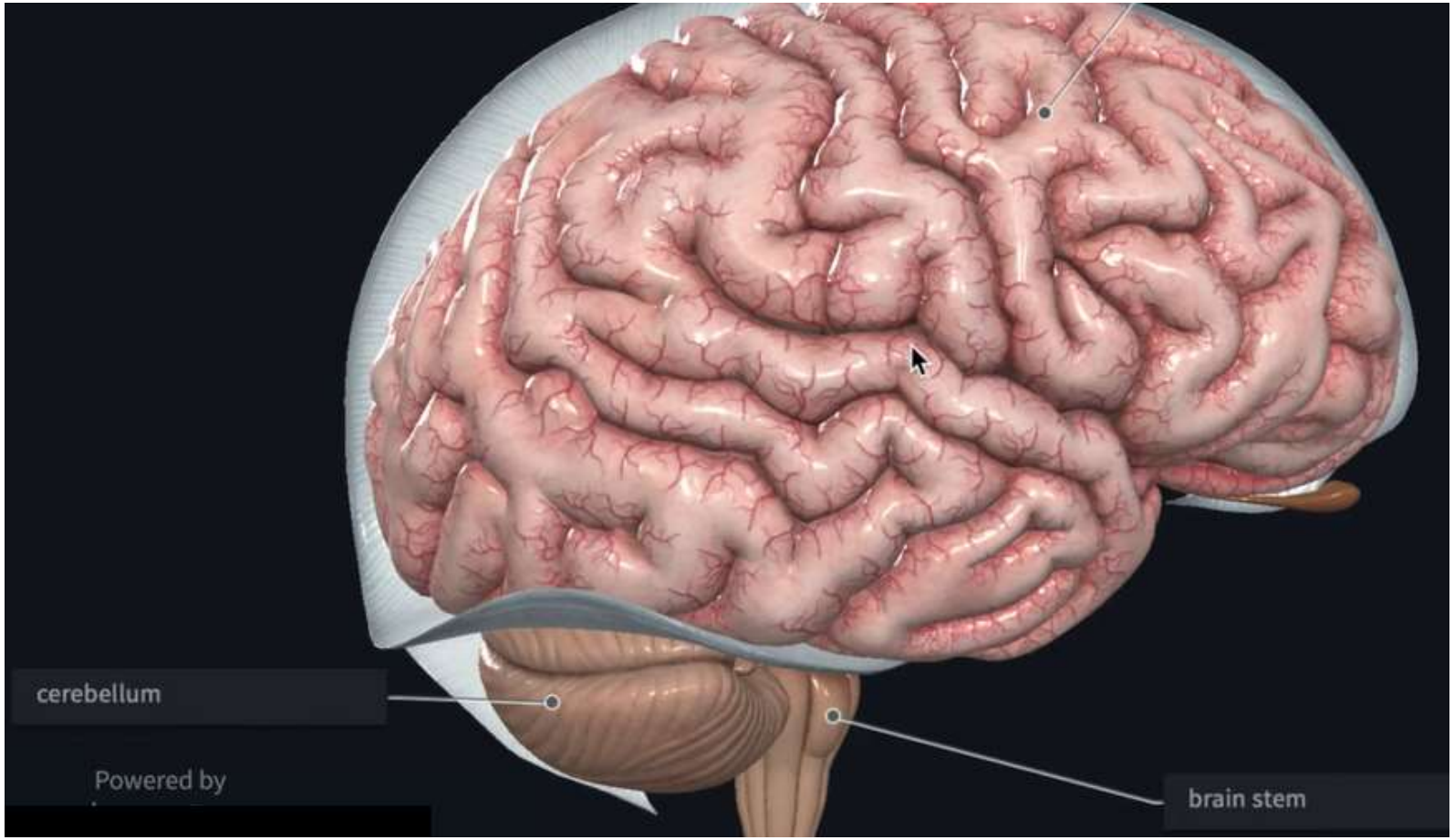


Indirect pathway

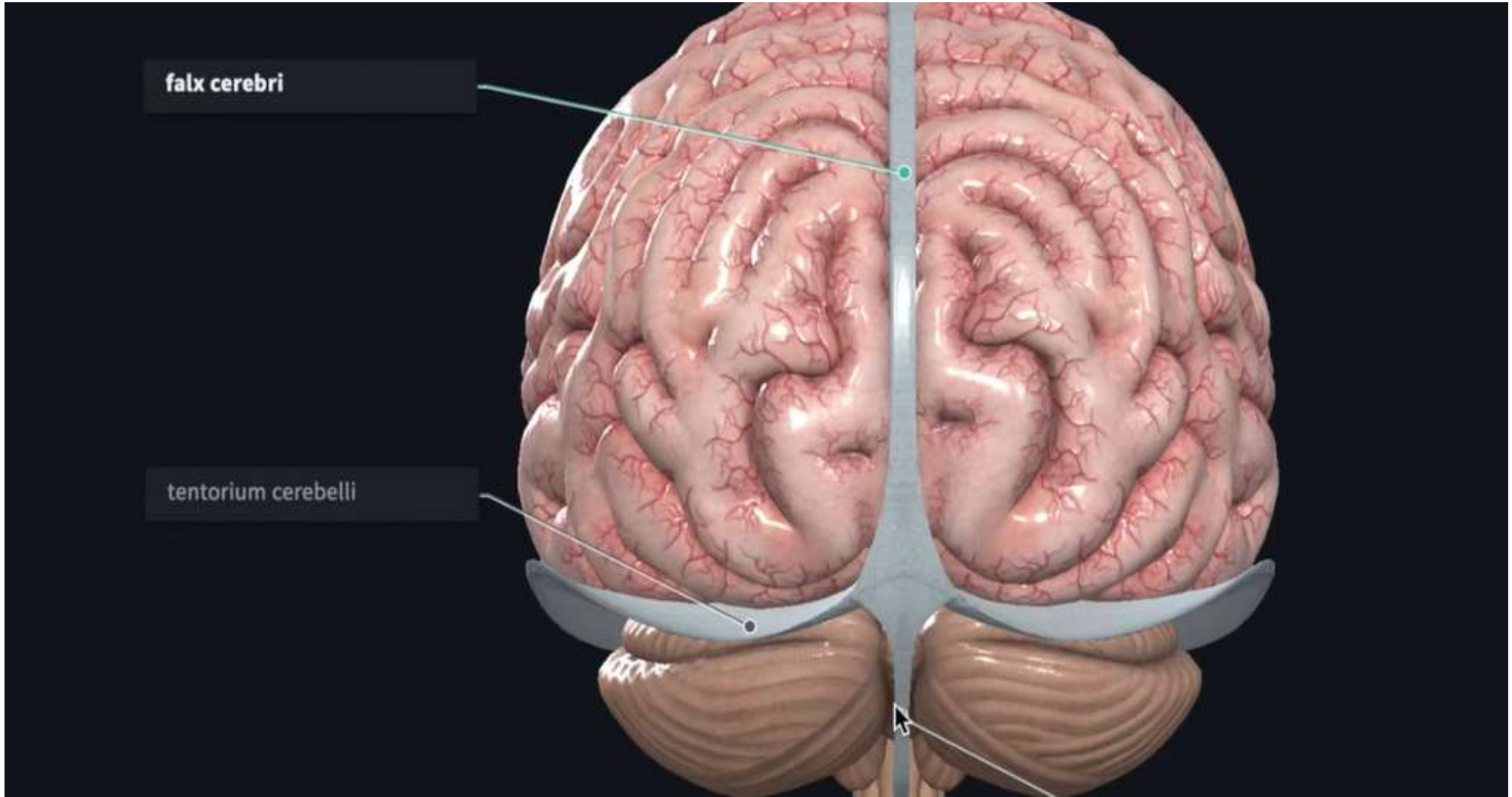


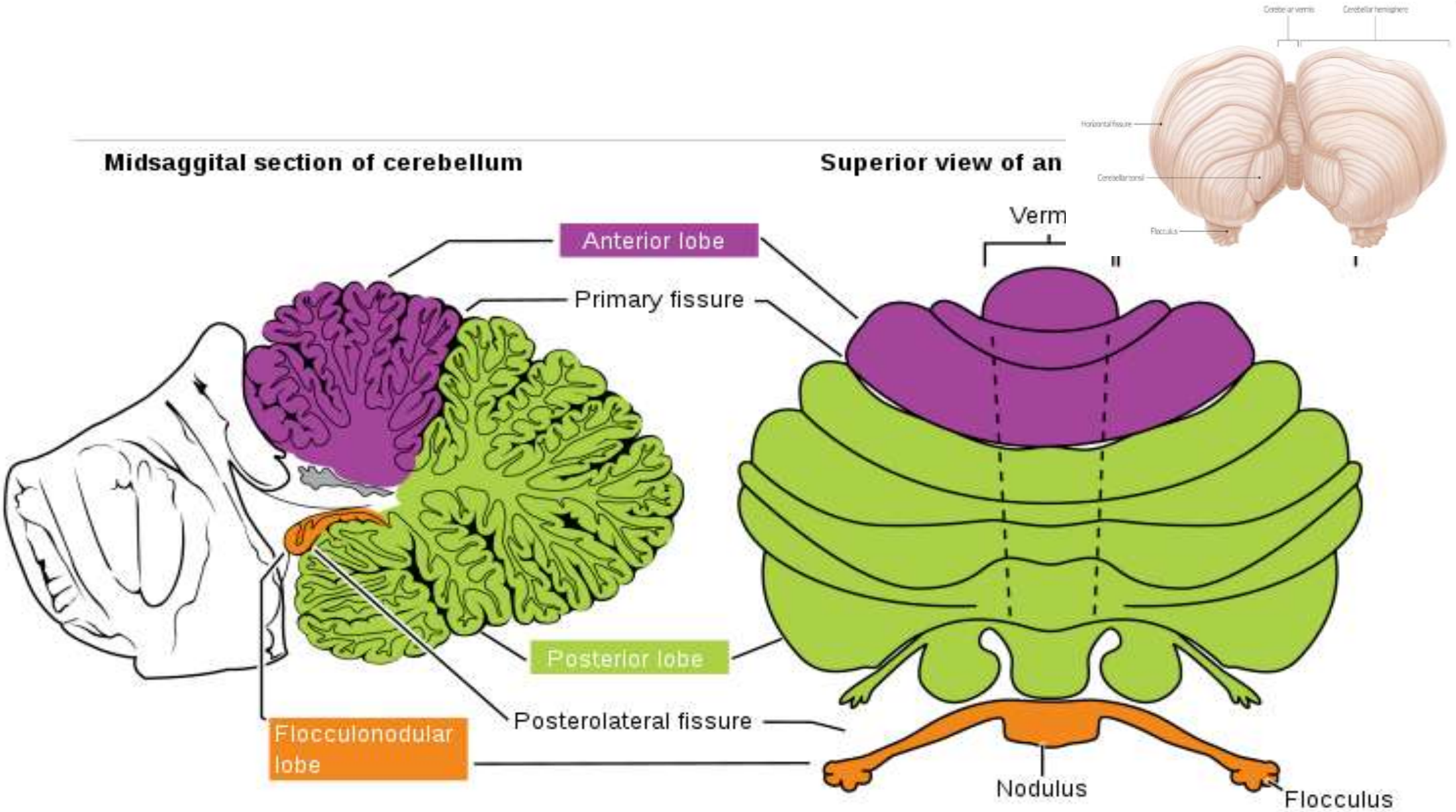
Cerebellum




cerebellum
Powered by
brain stem

Falx cerebri ，falx cerebelli tentorium cerebelli




Midsaggital section of cerebellum
Superior view of an
Verm
Anterior lobe
Primary fissure
Posterior lobe
Posterolateral fissure
Flocculonodular lobe
Nodulus
Flocculus

The cerebellum is posterior to the medulla and pons and inferior to the posterior portion of the cerebrum

A deep groove known as the **transverse fissure**, along with the **tentorium cerebelli**, which supports the posterior part of the cerebrum, separates the cerebellum from the cerebrum.

The **cerebellum**, second only to the cerebrum in size, occupies the inferior and posterior aspects of the cranial cavity

the cerebellum has a highly folded surface that greatly

increases the surface area of its outer gray matter cortex, allowing for a greater number of neurons.

The cerebellum accounts for about a tenth of the brain mass yet contains nearly half of the neurons in the brain.

In superior or inferior views, the shape of the cerebellum resembles a butterfly. The central constricted area is the **vermis** (worm), and the lateral “wings” or lobes are the **cerebellar hemispheres** .

Each hemisphere consists of lobes separated by deep and distinct fissures. The **anterior lobe** and **posterior lobe** govern subconscious aspects of skeletal muscle movements.

The **flocculonodular lobe** on the inferior surface contributes to equilibrium and balance.

The superficial layer of the cerebellum, called the **cerebellar cortex**, consists of gray matter in a series of slender, parallel folds called **folia** (leaves). Deep to the gray matter are tracts of

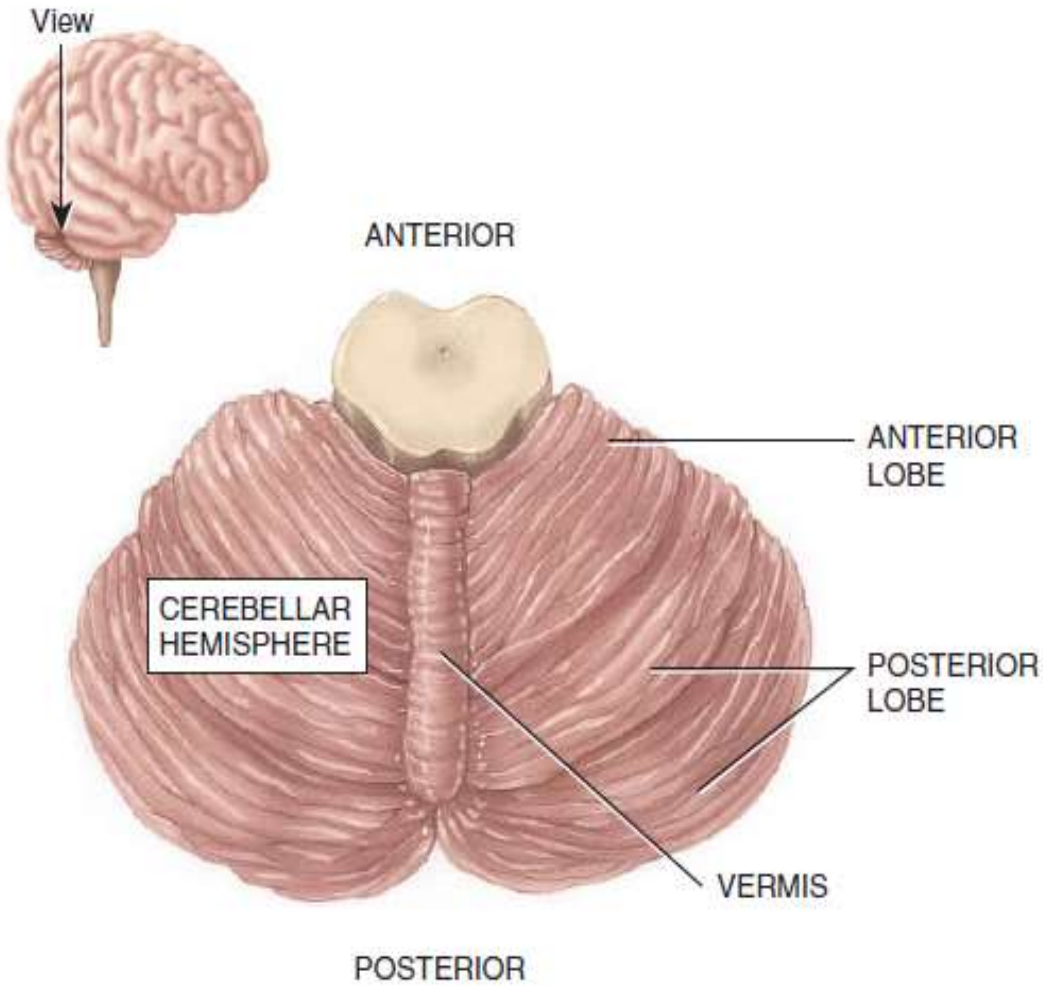
white matter called **arbor vitae** (tree of life) that resen

. Even deeper, within the white matter, are the

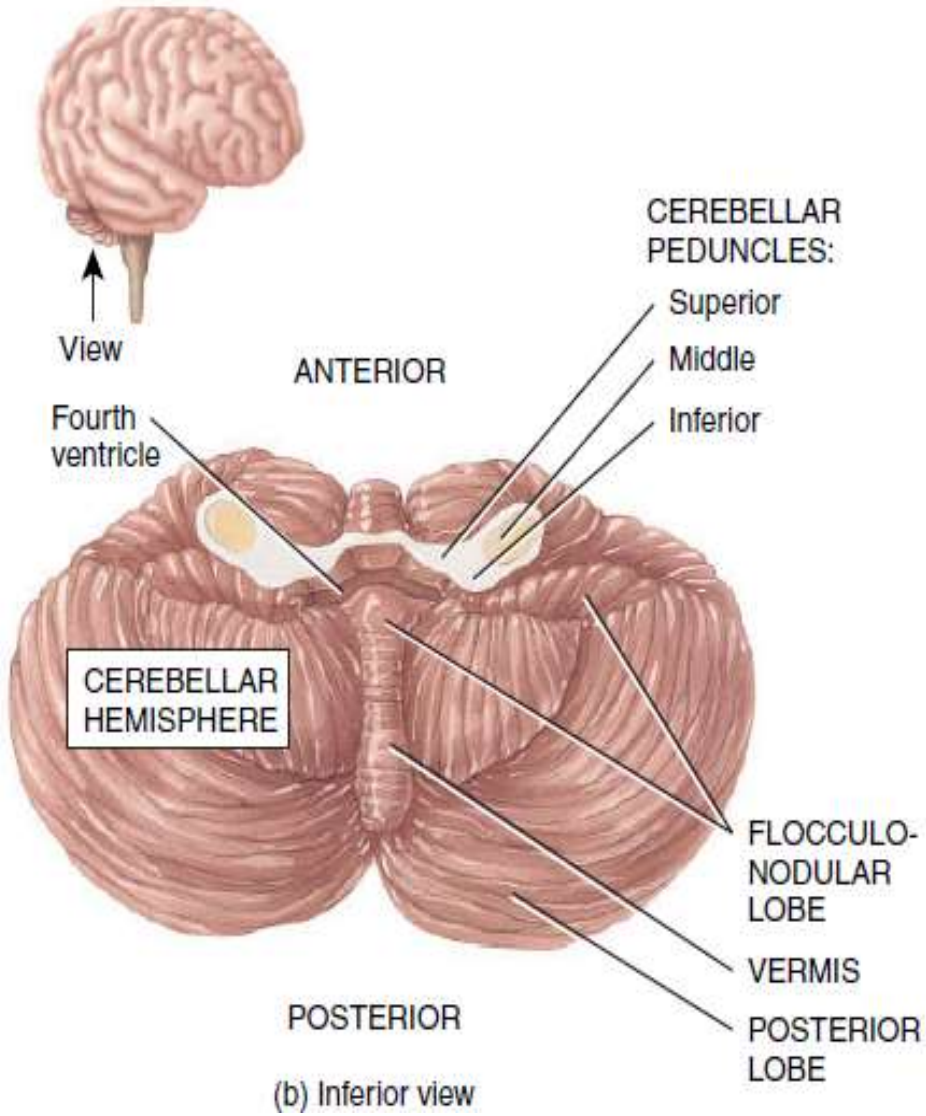
cerebellar nuclei, regions of gray matter that give ris

to axons carrying impulses from the cerebellum

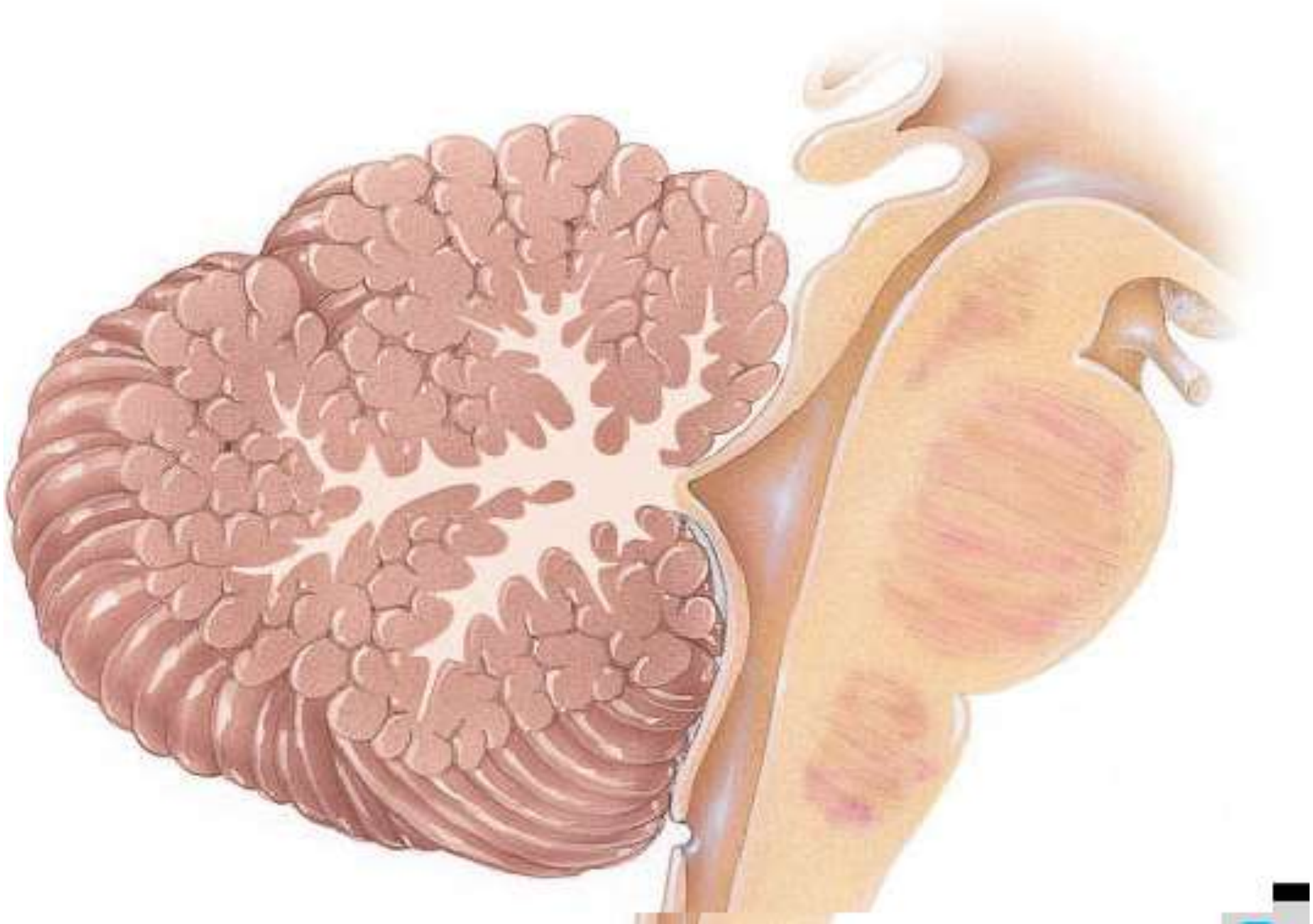
to other brain centers.



(a) Superior view



(b) Inferior view



The primary function of the cerebellum is to evaluate how well movements initiated by motor areas in the cerebrum are actually being carried out. When movements initiated by the cerebral motor areas are not being carried out correctly, the cerebellum detects the discrepancies. It then sends feedback signals to motor areas of the cerebral cortex, via its connections to the thalamus. The feedback signals help correct the errors, smooth the movements,
and coordinate complex sequences of skeletal muscle contractions. Aside from this coordination of skilled movements, the cerebellum is the main brain region that regulates posture and balance

Cerebellum

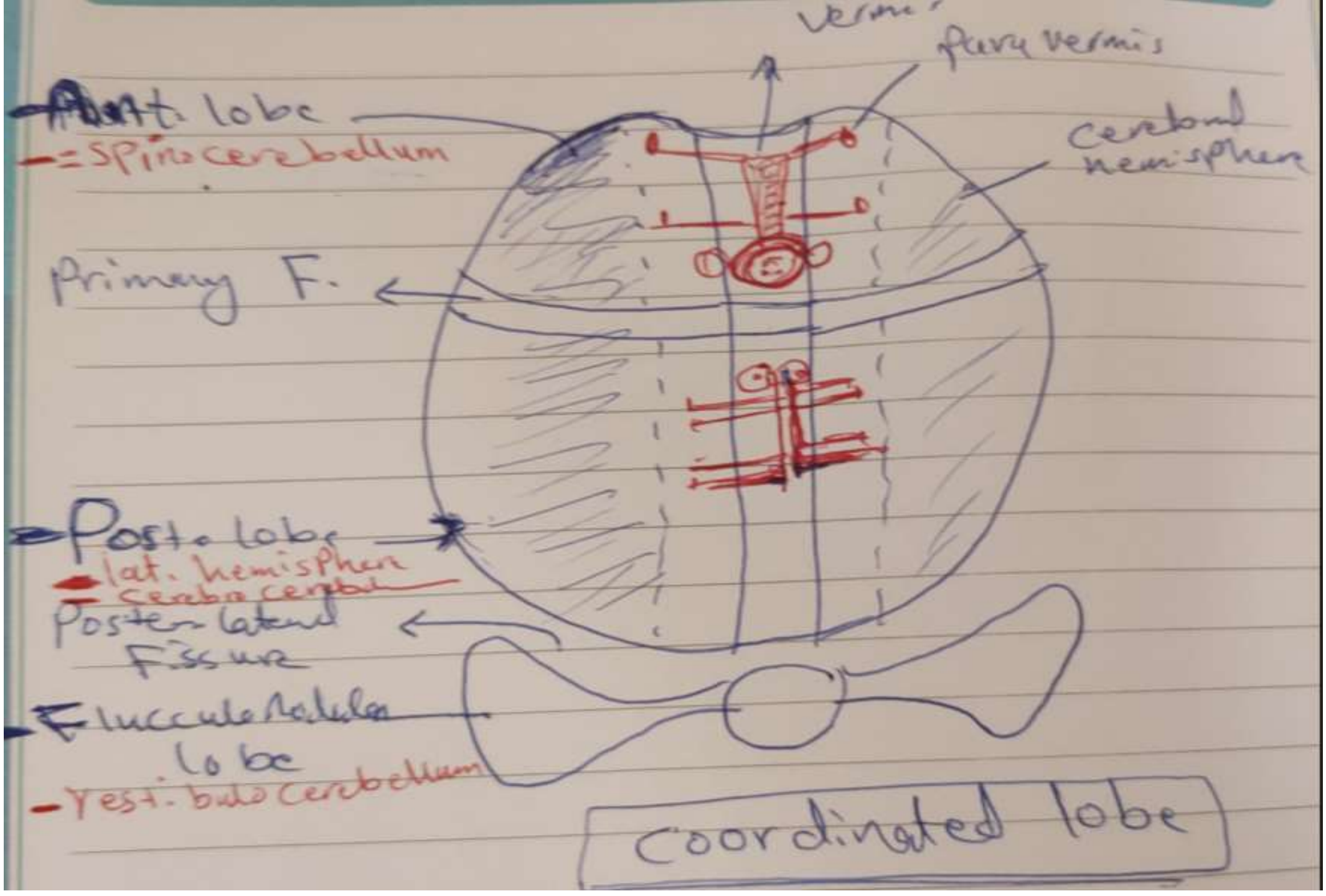
Regulation of muscle Tone

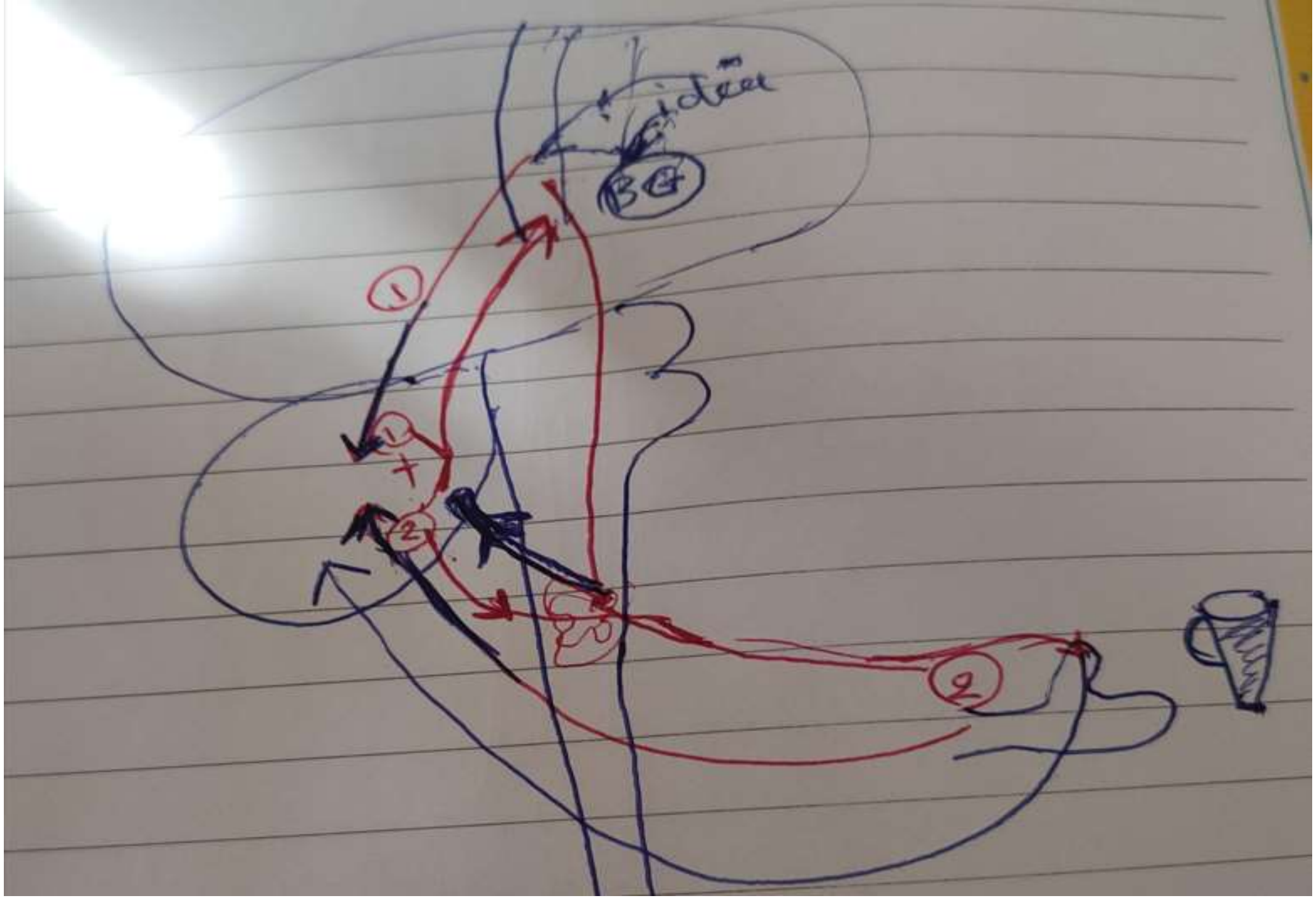
coordinates skilled Movemer

(motor learning &correct erro

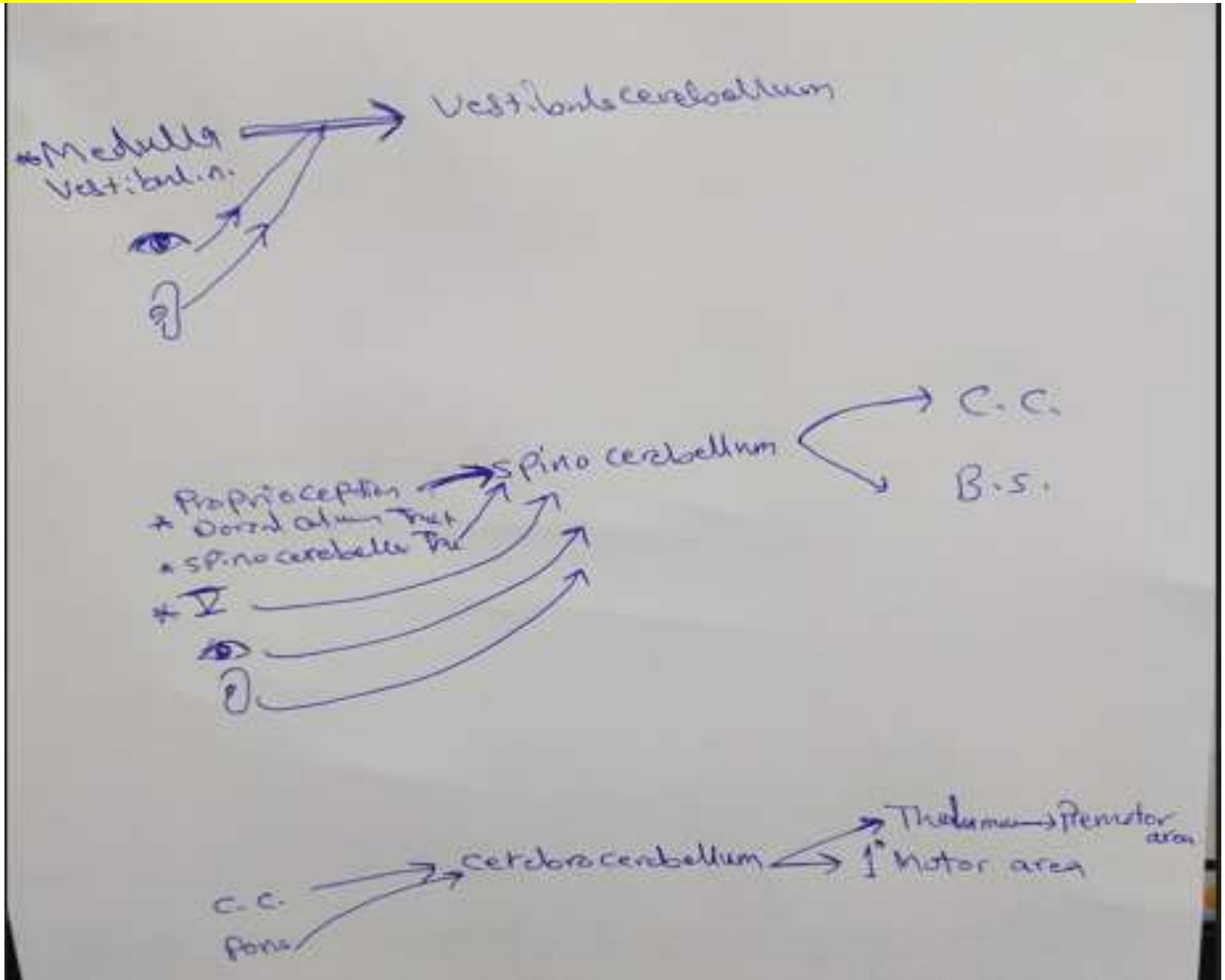
smoothen movemants)

regulates posture and balan


flocculonodular lobe
-= Vestibulocerebellum
Posterior lobe
-= Spinocerebellum
Anterior lobe
-= Cerebrocerebellum
Primary F.
Posterolateral Fissure
Vermis
Flocculonodular lobe
-Vesti. bulo Cerebellum
Coordinated lobe


Idea
BG
1
1
2
2
3
2

Functional division of cerebellar lobes



Functional subdivision of cerebellum

The cerebellum consists of three functional subdivisions.

1. The **vestibulocerebellum** is important for maintaining balance and controls eye movements. it **mainly receives its input from** the vestibular nuclei (in medulla & pons) but also from the **auditory and visual sensory input**.

If a patient has damaged this region, the result is **disturbed balance and gait.**

2. The **spinocerebellum** enhances muscle tone and coordinates skilled, voluntary movements. This brain region is especially important in ensuring the accurate timing of various muscle contractions to coordinate movements involving multiple joints.

This is achieved by **proprioceptive input** from the **dorsal column pathway of the spinal cord**, the **cranial trigeminal nerve, the visual and auditory systems, as well as the spinocerebellar (which is** somatosensory part of the sensory nervous system that relays unconscious proprioceptive information from the lower limbs and trunk of the body to the cerebellum) .

This region **sends its output** to the deep cerebellar nuclei. These then project to the **cerebral cortex, and brainstem.** This enables the region to monitor and modify the activity of the descending motor pathways.

The **spinocerebellum** essentially acts as “middle management,” comparing the “intentions” or “orders” of the higher centers with the “performance”

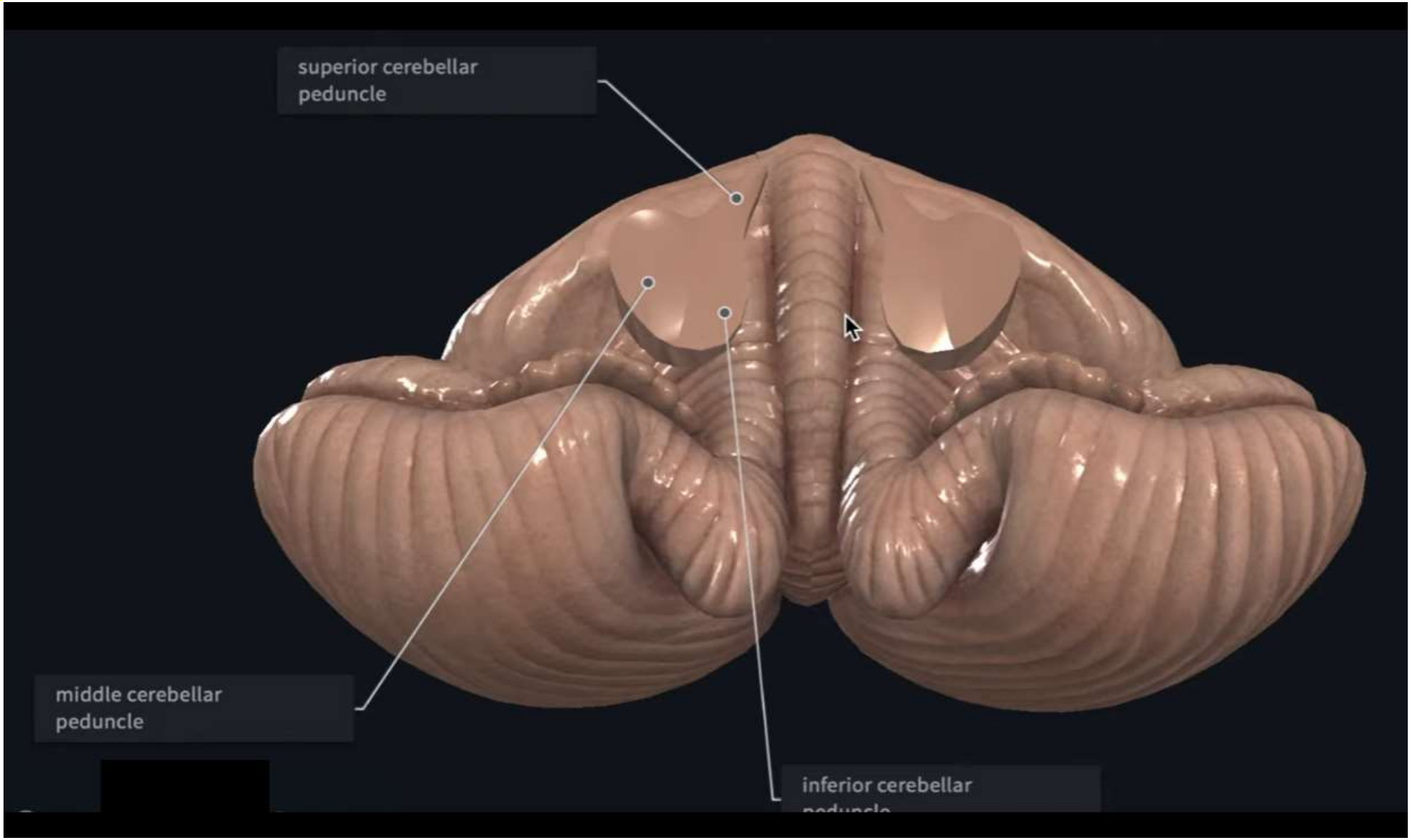
of the muscles and then correcting any “errors” or deviations

from the intended movement

• 3. The **cerebrocerebellum**. plays a role in planning and initiating

voluntary activity by providing input to the cortical motor areas. This is also the region that stores procedural memories.

Cerebellar peduncles



Three paired **cerebellar peduncles** attach the cerebellum to the brain stem & cerebrum

These bundles of white matter consist of axons that conduct impulses between the cerebellum and other parts of the brain.

The **superior cerebellar peduncles** contain axons that extend from the cerebellum to the midbrain and to several nuclei of the thalamus.

The **middle cerebellar peduncles** are the largest peduncles; their axons carry impulses for voluntary movements from the pontine nuclei (in pone) into the cerebellum.

From cerebral cortex to pontine n. then cross to opposite side then descend to the cerebellum

The **inferior cerebellar peduncles** consist of (1) axons of the **spinocerebellar tracts** that carry sensory information into the cerebellum

from proprioceptors in the trunk and limbs; (2) axons from

the vestibular apparatus of the inner ear and from the vestibular

nuclei of the **medulla and pons** that carry sensory information

into the cerebellum from proprioceptors in the head; (3) axons

from the inferior olivary nucleus of the medulla that enter the

cerebellum and regulate the activity of cerebellar neurons

(4) axons that extend from the cerebellum to the vestibular nuclei

of the medulla and pons; and (5) axons that extend from the

cerebellum to the reticular formation.

Sign of Cerebellar damage DANISH

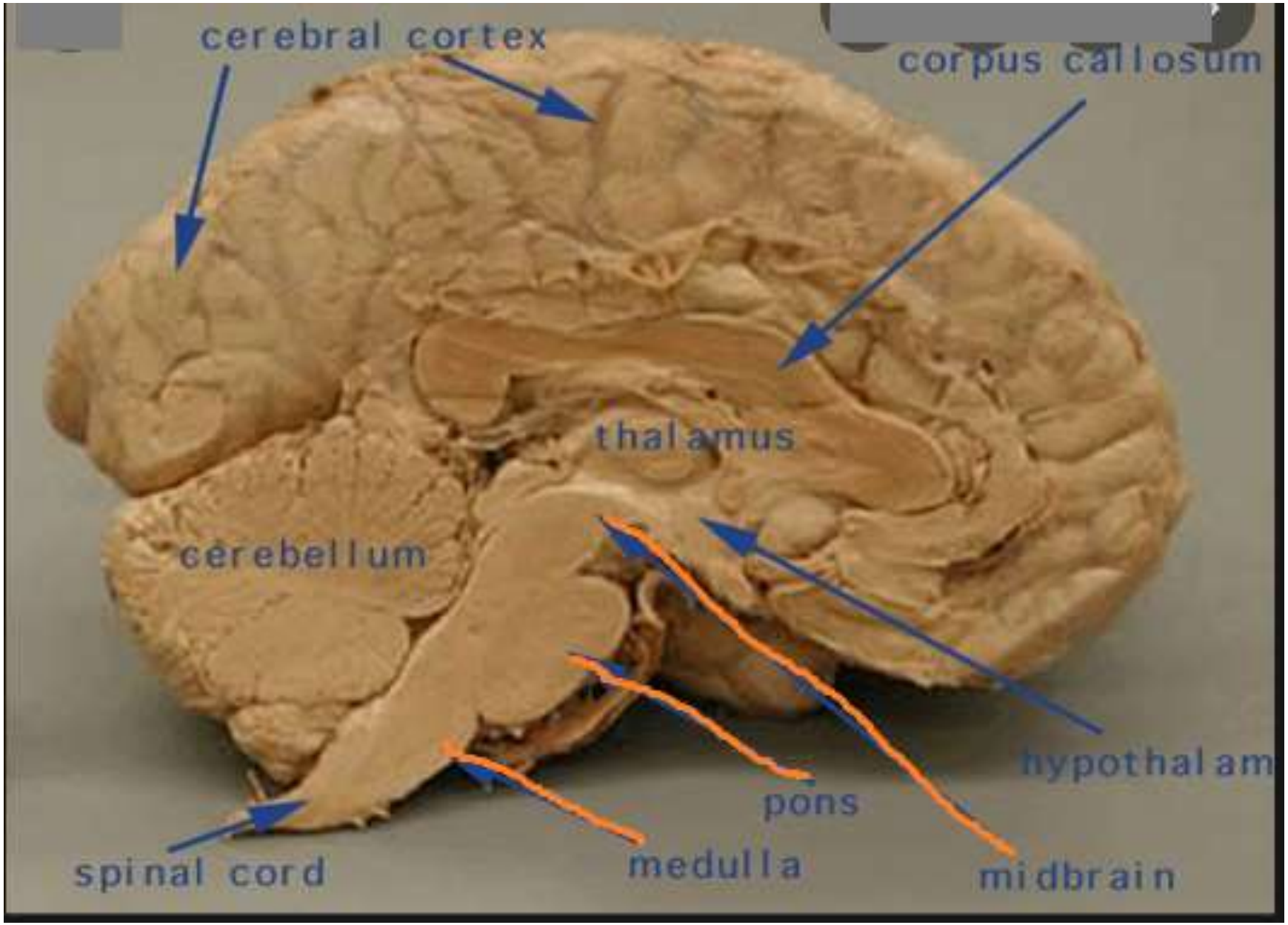
- Dysdiadochokinesia - the lack of ability to perform **rapidly alternating movements**. Ask the patient to quickly supinate and pronate both forearms simultaneously. Movements will be slow and incomplete on the side of the cerebellar lesion.

- **Ataxia** – loss of ccordination of body movement or loss of balance or **voluntary movement disturbance** involves tremor with fine movements eg writing or buttoning the clothes. Finger to nose test is performed to examine the coordination of the muscle movements, testing tip of the nose with the index finger test the movements are not properly coordinated, and tremor is observed at the end of the movement, called intention tremor. A similar test can be performed on the lower limbs ask patient to place the heel of one foot against the shin of the opposite leg.

Ataxic gait

- Nystagmus (coarse) - Ataxia of ocular muscles, a rhythmical oscillation of the eyes. To provoke nystagmus, the patient should rotate eyes horizontally
- Intention tremor
- Dysarthria/Scanning speech - speech is slurred and syllables are separated from one another.
- Hypotonia - the muscles lose resistance to palpation due to diminished influence of the cerebellum on gamma motor neurons. The patient walks with a broad-based gait and leans toward the affected side.

Brain stem


cerebral cortex
corpus callosum
thalamus
cerebellum
hypothalam
pons
spinal cord
medulla
midbrain

Brain stem

• Medulla Oblongata

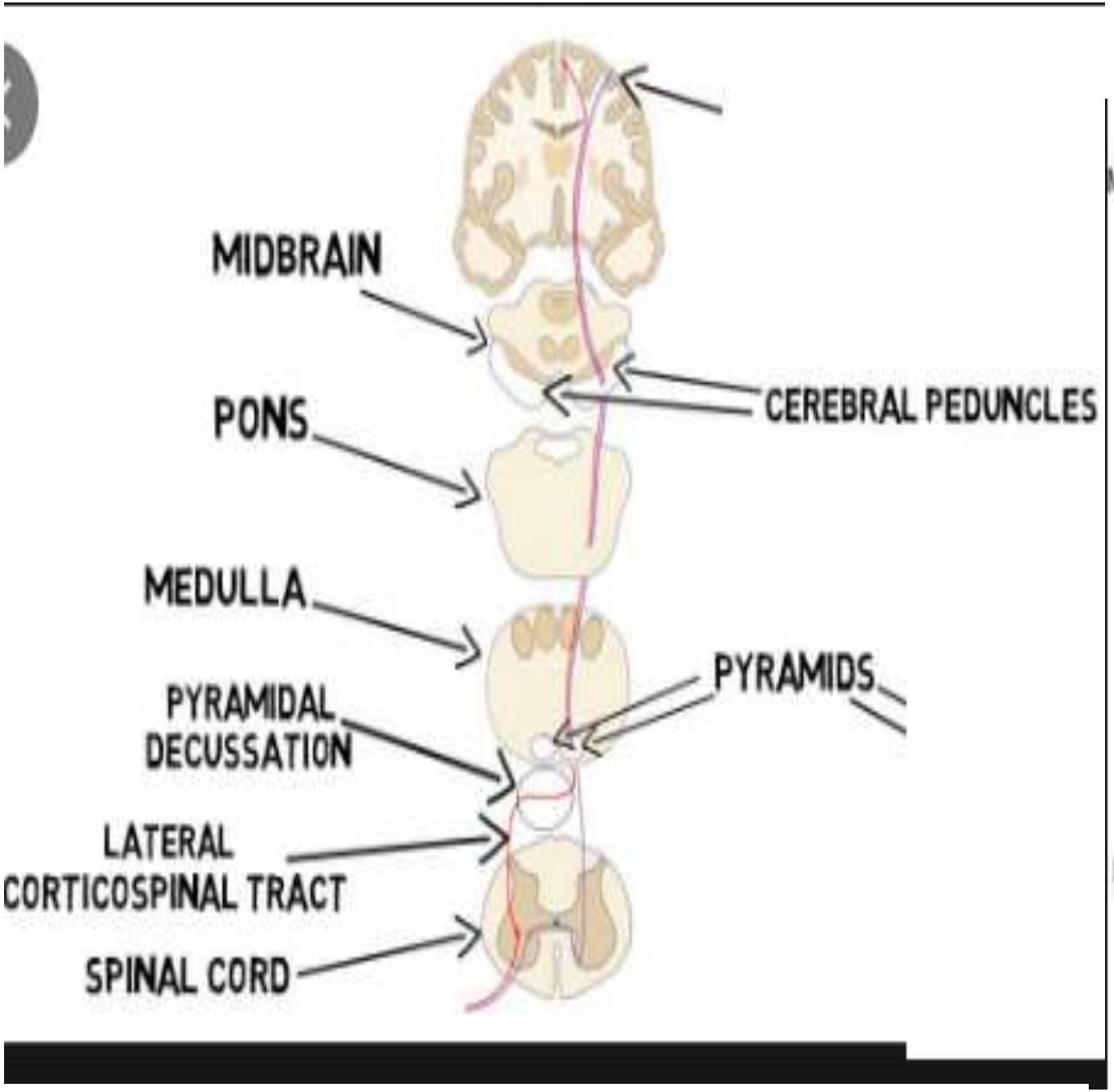
is continuous with the superior part of the spinal cord

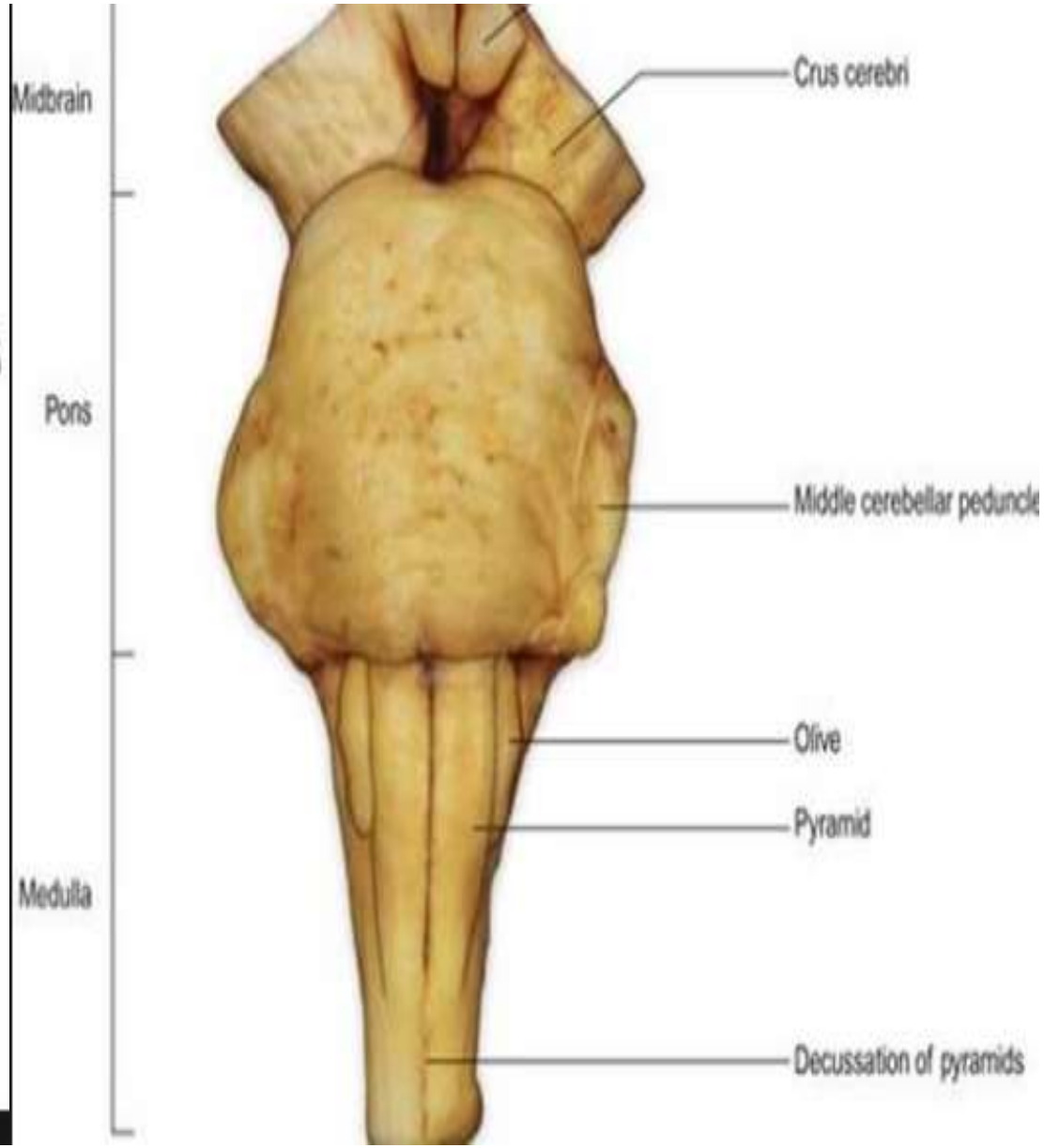
The medulla begins at the foramen magnum and extends to the inferior border of the pons, a distance of about 3 cm

The medulla's white matter contains all sensory (ascending) tracts and motor (descending) tracts that extend between the spinal cord and other parts of the brain.

medullary pyramids Some of the white matter forms bulges on the anterior aspect of the medulla. These are formed by the large **motor corticospinal tracts** that pass from the cerebrum to the spinal cord The corticospinal tracts control voluntary movements of the limbs and trunk

Just superior to the junction of the medulla with the spinal cord 90% of the axons in the left pyramid cross to the right side, and 90% of the axons in the right pyramid cross to the left side. This crossing is called the **decussation of pyramids** .


MIDBRAIN
PONS
MEDULLA
PYRAMIDAL DECUSSATION
LATERAL CORTICOSPINAL TRACT
SPINAL CORD
CEREBRAL PEDUNCLES
PYRAMIDS


Midbrain
Pons
Medulla
Crus cerebri
Middle cerebellar peduncle
Olive
Pyramid
Decussation of pyramids

Nuclei

CVS center : rate & force of heart beat , blood vessel diameter

Breath center

- **vomiting center** of the medulla causes **vomiting**, the f orcible expulsion of the contents of the upper gastrointestinal

(GI) tract through the

The **deglutition center** of the medulla promotes **deglutition** (swallowing) of a mass of food that has moved from the oral cavity o f the mouth into the pharynx (throat)

Sneezing involves spasmodic contraction of breathing muscles that forcefully expel air through the nose and mouth.

Coughing involves a long-drawn and deep inhalation and then a strong exhalation

that suddenly sends a blast of air through the upper respiratory passages.

Hiccupping is caused by spasmodic contractions of the diaphragm (a muscle of breathing) that ultimately result in the production of a sharp

- **Inferior olivary nucleus**, which receives input from the cerebral cortex, red nucleus of the midbrain, and spinal cord. Neurons of the inferior olivary nucleus extend their axons into the cerebellum, where they regulate the activity of cerebellar neurons.
- **gracile nucleus & cuneate nucleus (posterior column–medial lemniscus pathway ?)**
- **gustatory nucleus**
- **Cochlear & vestibular nuclei .**
- **five pairs of cranial nerves nuclei VIII, IX. X. XI& XII ,**

- **injury to the medulla** ??

PONS = bridg 2.5 cm

connects parts of the brain with one another. These connections are provided by bundles of axons.

• .ventral region of pons **pontine nuclei** Entering and exiting these nuclei are numerous white matter tracts, each of which provides a connection between the cortex (outer layer) of a cerebral hemisphere and that of the opposite hemisphere of the cerebellum.

The dorsal region of the pons contains ascending and descending tracts along with the nuclei of cranial nerves(V, VI, VII, VIII)

• **pontine respiratory group** control breathing

Mid brain 2.5 cm

- The aqueduct of the midbrain (cerebral aqueduct) passes connecting the third ventricle above with the fourth ventricle below.

The anterior part of the midbrain contains paired bundles of axons known as the **cerebral peduncles** consist of axons of the corticospinal, corticobulbar, and corticopontine tracts,

The posterior part of the midbrain, called the **tectum** **which contain** **superior colliculi** reflex centers for certain visual activities.

inferior colliculi -- part of the auditory pathway
-- reflex centers for the *startle reflex*

red nuclei Axons from the cerebellum and cerebral cortex form synapses in the red nuclei, which help control muscular movements.

Cranial nerve nuclei III , IV

substantia nigra

Thanks a lot