

CEREBELLUM

- ⌘ Part of hind brain
- ⌘ Motor control along with motor cortex and basal ganglia

Function:

- ⌘ Timing of motor activities
- ⌘ Smooth and rapid progression of movements

Running, typing and smooth talking.

Cerebellum

Silent area of Brain

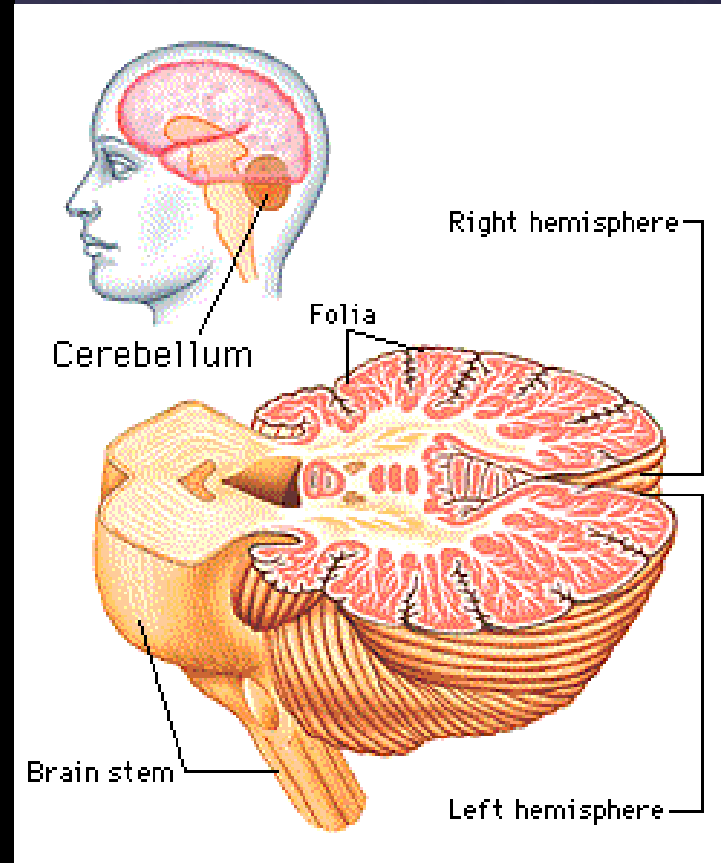
Electrical excitation of the cerebellum does not cause any
conscious sensation and motor movement

The Cerebellum

- ⌘ Located dorsal to pons and medulla
- ⌘ **Makes up 11%** of brain's mass
- ⌘ Cerebellar activity occurs **subconsciously**
- ⌘ Provides precise **timing** and appropriate **patterns** of skeletal muscle contraction.

Comparing intended and actual movement.

- ⌘ **Correction** of ongoing movements
Internal & external feedback if deviation from intended movements
- ⌘ **Motor learning**
learn from mistake- subsequent muscle contractions better correspond to intended movement.
changes in excitability of neurons.



& Anatomical

& Functional

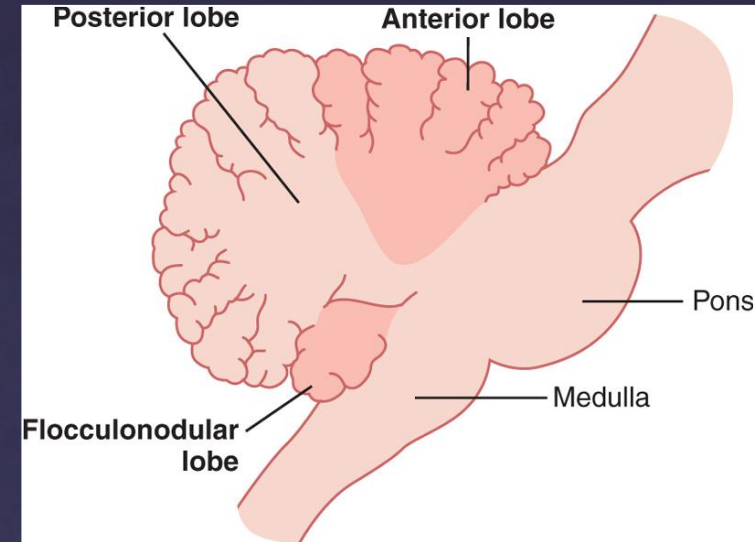
Divisions of Cerebellum

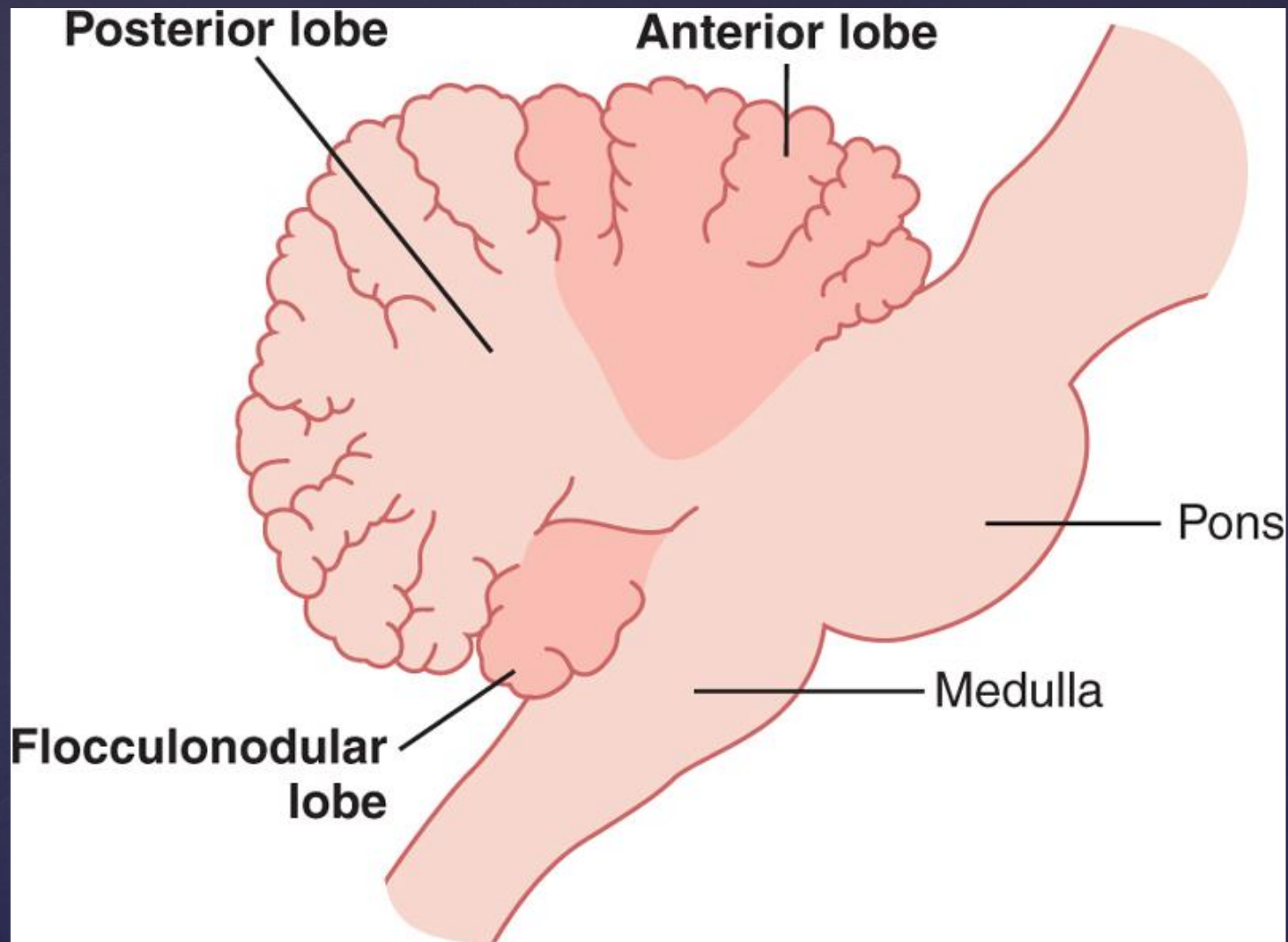
Anatomical Divisions

Horizontal lobes

- (1) *anterior lobe* .
- (2) *posterior lobe* and
- (3) *flocculonodular lobe*

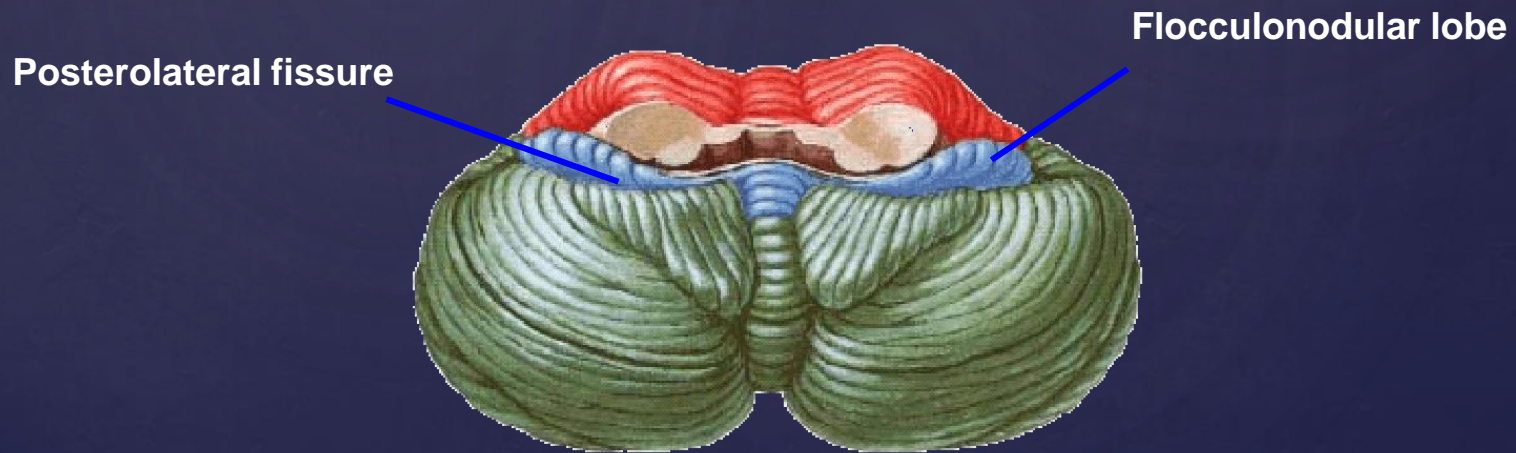
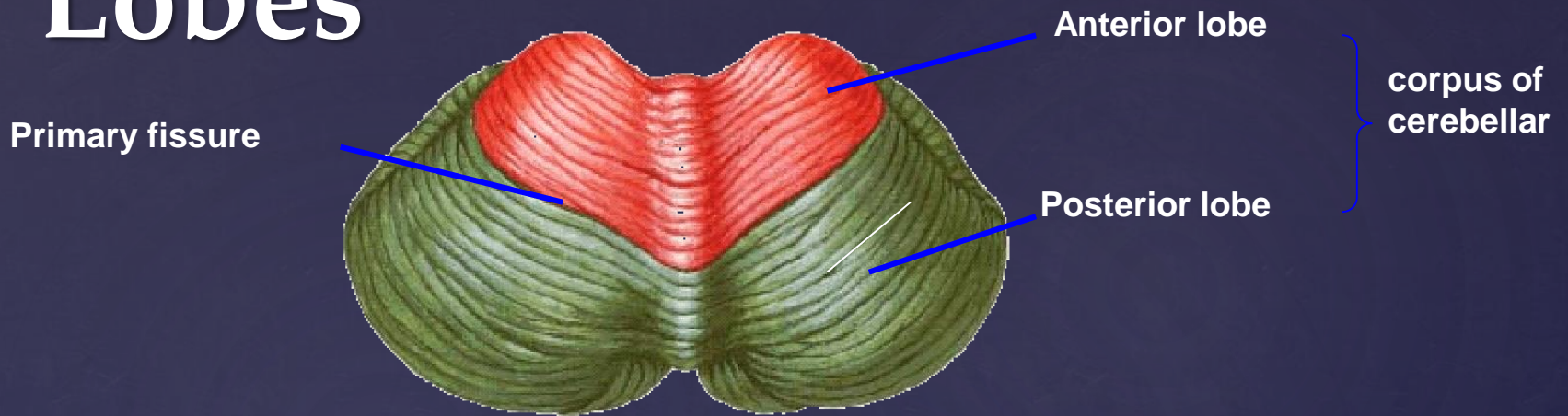
∞ 3 lobes separated by 2 horizontal fissures

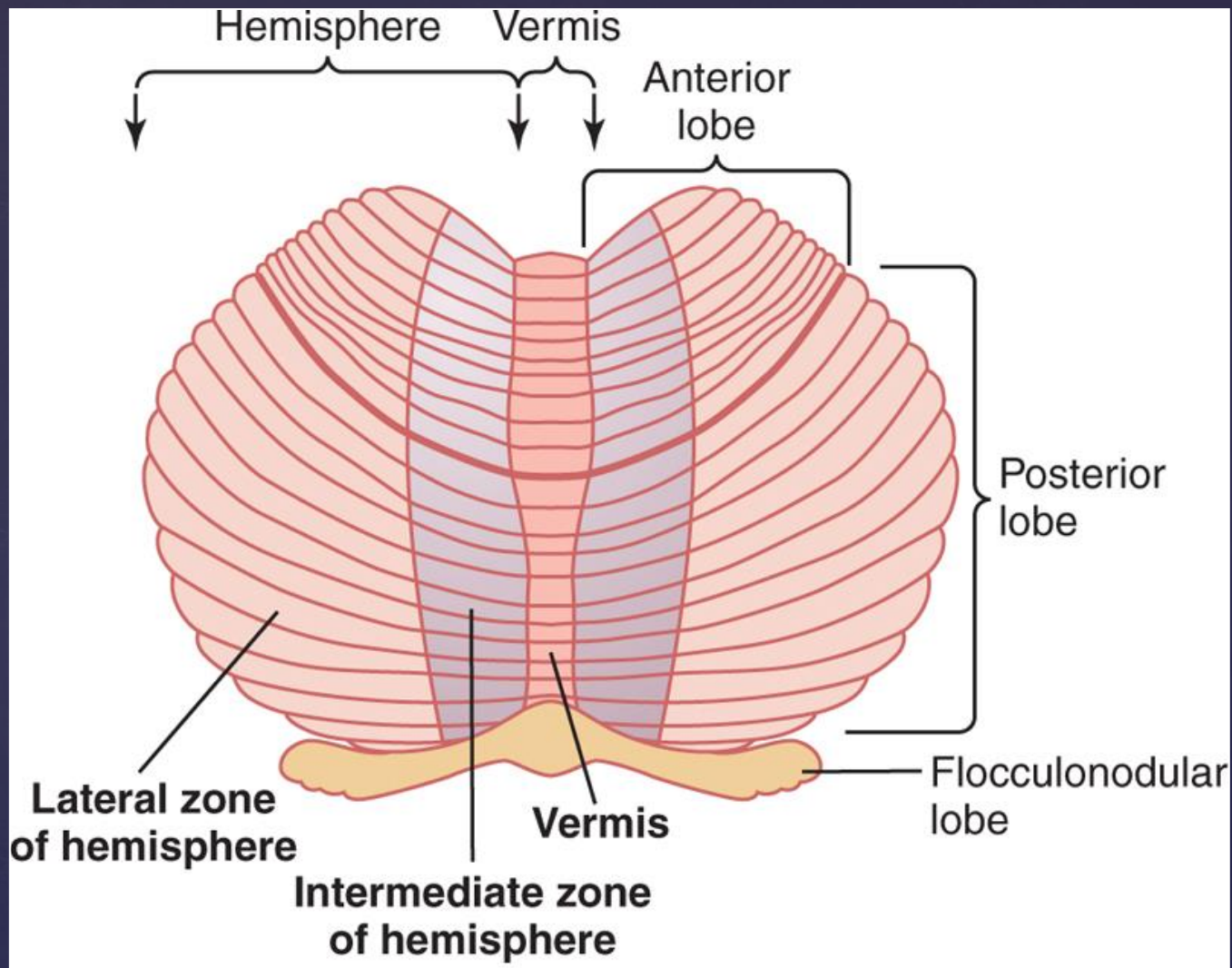




Anatomical lobes of the cerebellum

Lobes



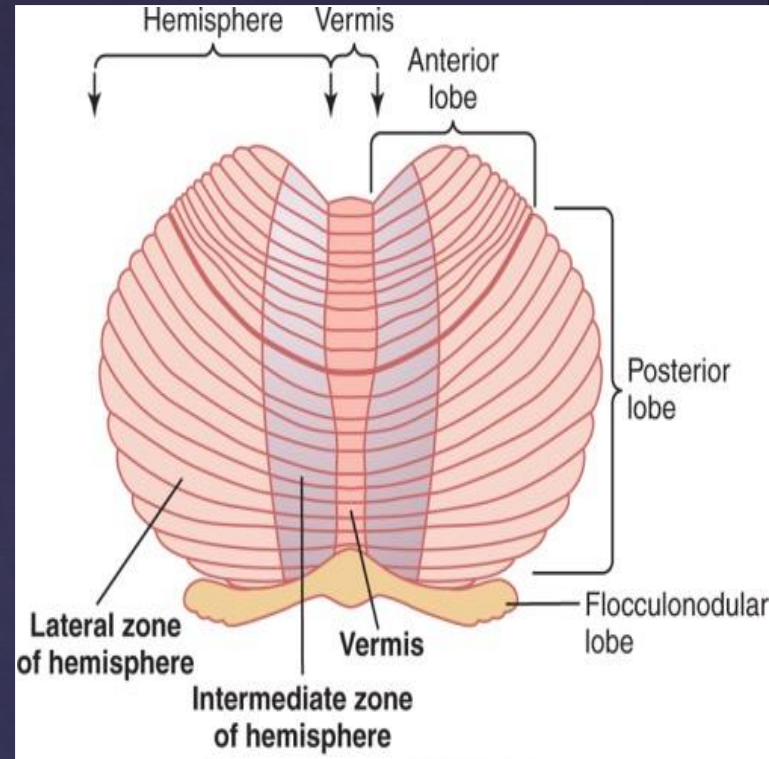


Functional parts of the cerebellum

Functional Divisions:

Longitudinal Lobes

1. **Vermis:** Narrow central region
2. **Right Cerebellar Hemispheres**
3. **Left Cerebellar Hemispheres**



↳ Each Cerebellar Hemisphere is divided by Longitudinal imaginary line → Lateral & intermediate zone

Three Physiological Divisions

Vestibulo-Cerebellum

Spino-Cerebellum

Cerebro-Cerebellum

Physiological Divisions

Contd....

Flocculonodular Lobe

Control of Equilibrium

1. Vestibulo-Cerebellum

Contd....

Intermediate Zone:

Movements
of Limbs:

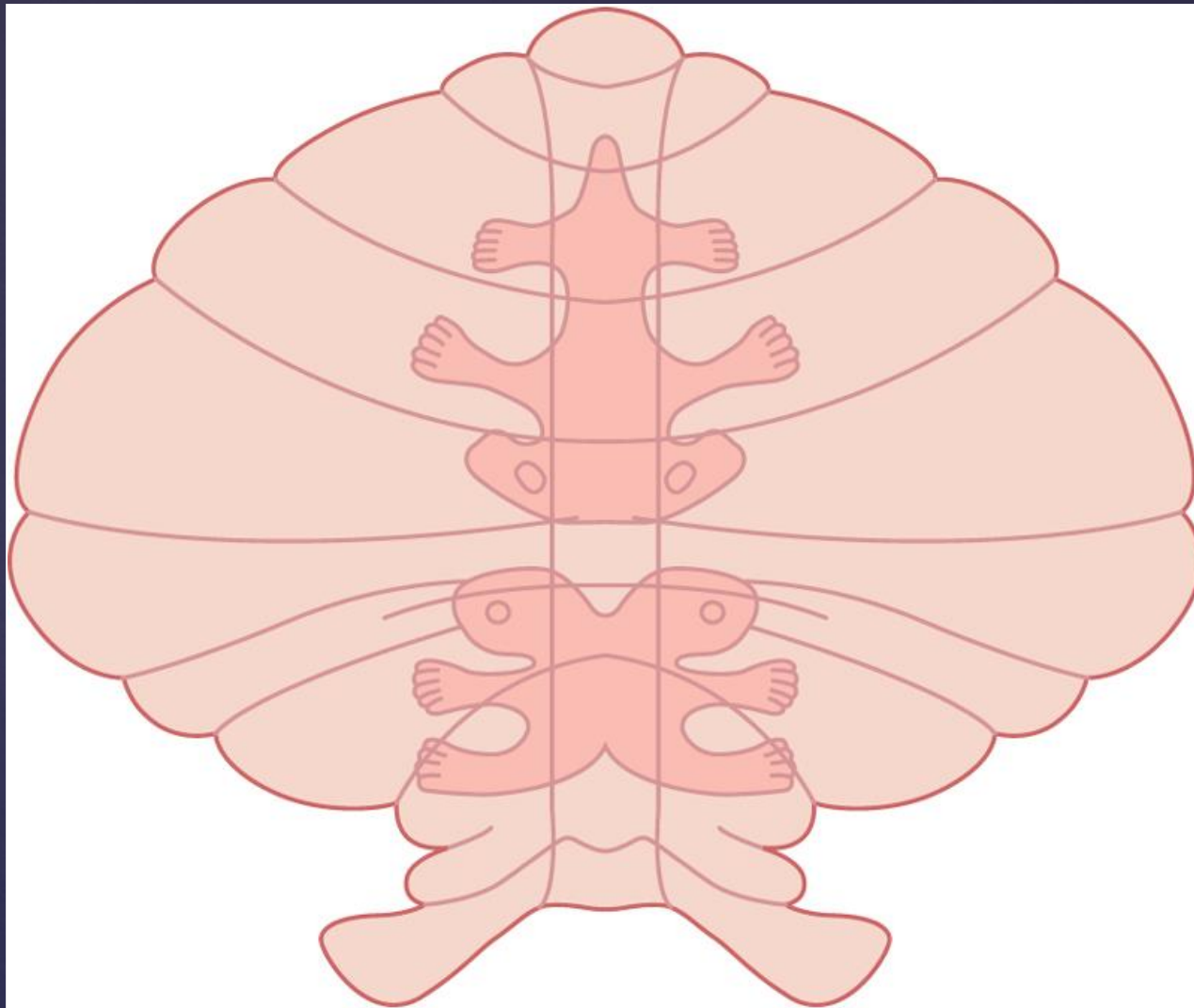
Especially
Hands,
Fingers, Feet
& Toes

Vermis:

Movements of

- Trunk
- Shoulders
- Neck
- Hips

Spino-Cerebellum



Hall: Guyton and Hall Textbook of Medical Physiology, 12th Edition

Somatosensory projection areas in the cerebellar cortex.

Topographic representation receive signals from respective parts as well as from corresponding topographic motor areas in cerebral cortex and brain stem while sending back motor signals to respective topographic area of cerebral cortex and brain stem.

Lateral Zones

Planning and coordination of body's rapid sequential motor activities that occur one after another within fraction of a second receive input signals from premotor area, somatosensory area and sensory association areas.

Cerebro-Cerebellum

Contd....

You cant lick your elbow.

Input Signals:

- i. From other parts of brain
(corticopontocerebellar,
olivocerebellar, reticulocerebellar,
and vestibulocerebellar)

- ii. From Periphery -- spinocerebellar

Neuronal Circuit Of Cerebellum

Contd....

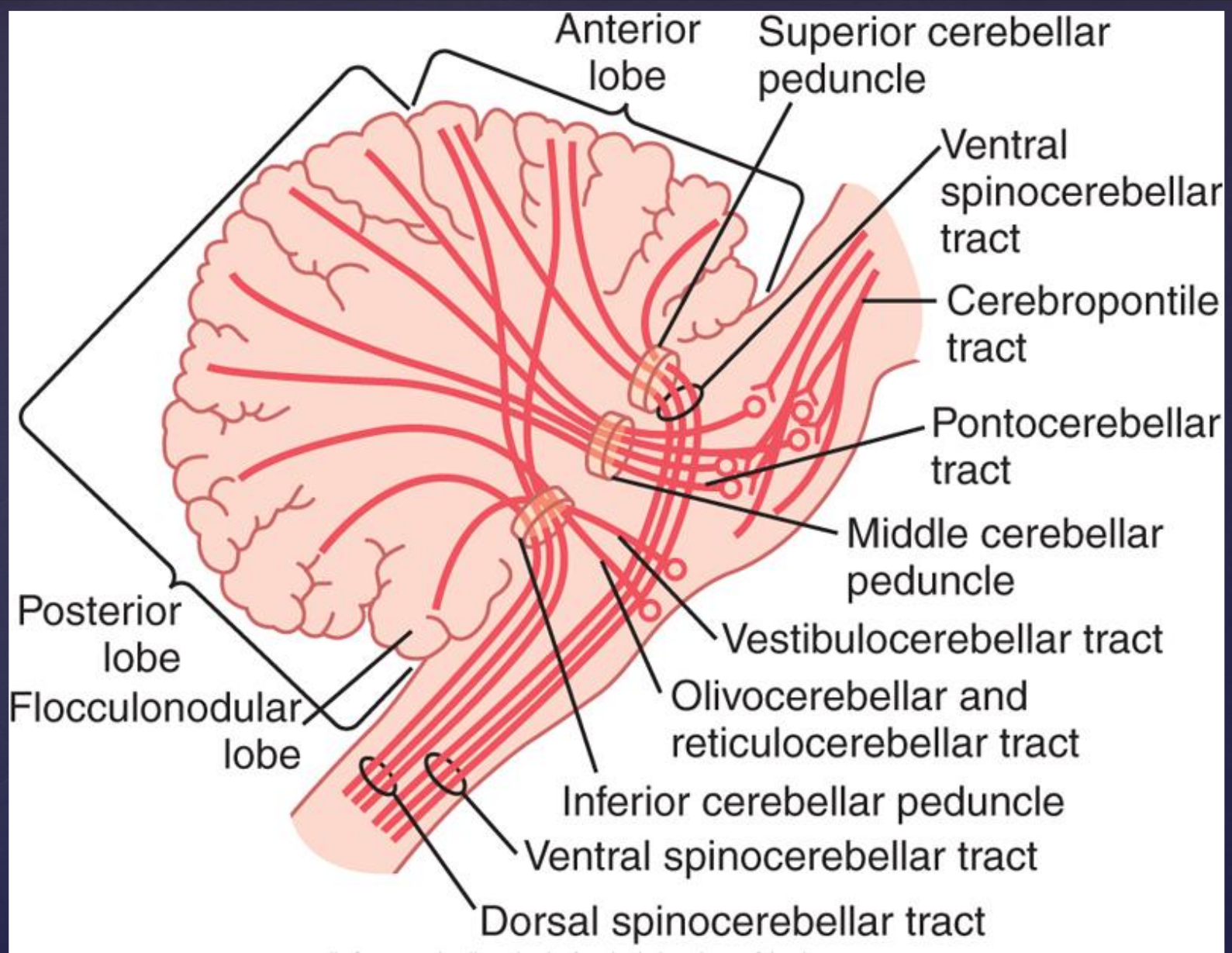
Neural circuit....

Output Signals:

- i. **From vermis** → **Fastigial Nuclei** → medullary and pontile nuclei of brainstem
(equilibrium and postural attitudes of body)
- ii. **Intermediate zone** → **interposed nucleus** → C. Cortex → thalamus → basal ganglia, red nucleus and reticular formation
(coordinates reciprocal contractions of agonist and antagonist muscles)
- iii. **Cerebellar cortex** → **dentate nucleus** → thalamus → C. cortex
(coordinates motor activity by cerebral cortex)

Input Pathways to Cerebellum

Contd....



Principal afferent tracts to the cerebellum.

A. Input Pathways from Brain:

Three peduncles:

Superior cerebellar peduncle: Midbrain

Middle cerebellar peduncle : Pons

Inferior cerebellar peduncle : Medulla

i) Cortico-Ponto-Cerebellar pathway:

Origin: Primary motor cortex

Premotor cortex (Sensory cortex)

To: Pons

Through: Middle cerebellar peduncle

To: Contralateral cerebellar hemisphere

Contd....

ii) Olivocerebellar Tract

Inferior olive → Inferior cerebellar peduncle →

all parts of cerebellum

excited in olive by fibers

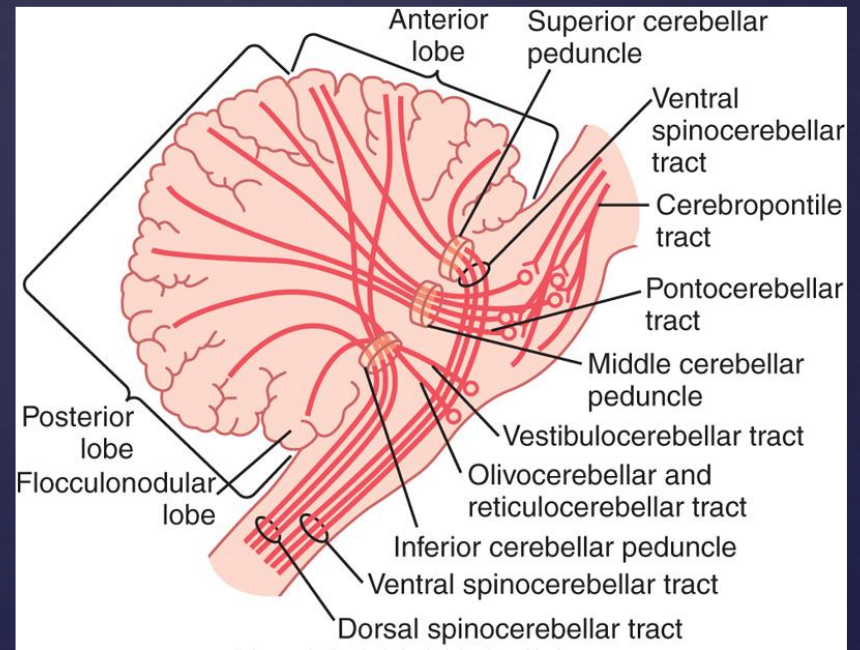
from-

Motor Cortex

Basal Ganglia

Reticular Formation

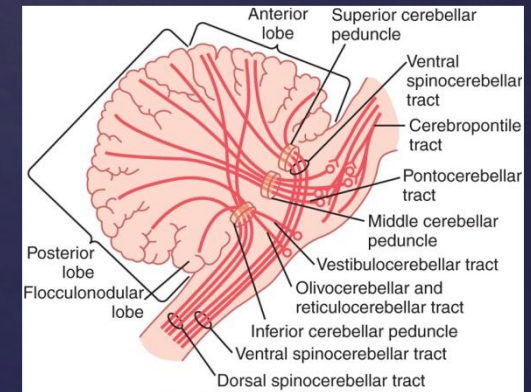
Spinal Cord



Contd....

iii) Vestibulocerebellar Tract

Vestibular nuclei (+ vestibular apparatus) →
Inferior peduncle → Flocculonodular lobe +
Fastigial nuclei



iv) Reticulocerebellar Tract

Reticular formation → Inferior peduncle →
Vermis

B. Input Pathways From Periphery

Two ventral + two dorsal spino cerebellar tracts

i) Dorsal spinocerebellar tracts:

Sensory Receptors:

Muscle Spindle, Golgi tendon organs, joint receptors,
Tactile receptors of skin → **spinal cord** → inferior cereb.
Peduncle → **vermis + intermediate** zone

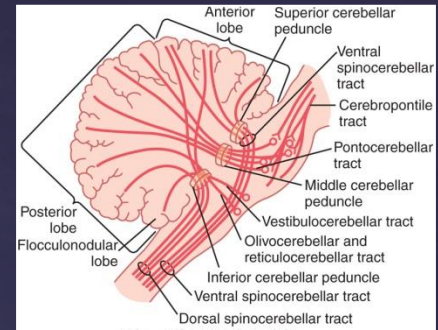
ii) Ventral Spino cerebellar tracts:

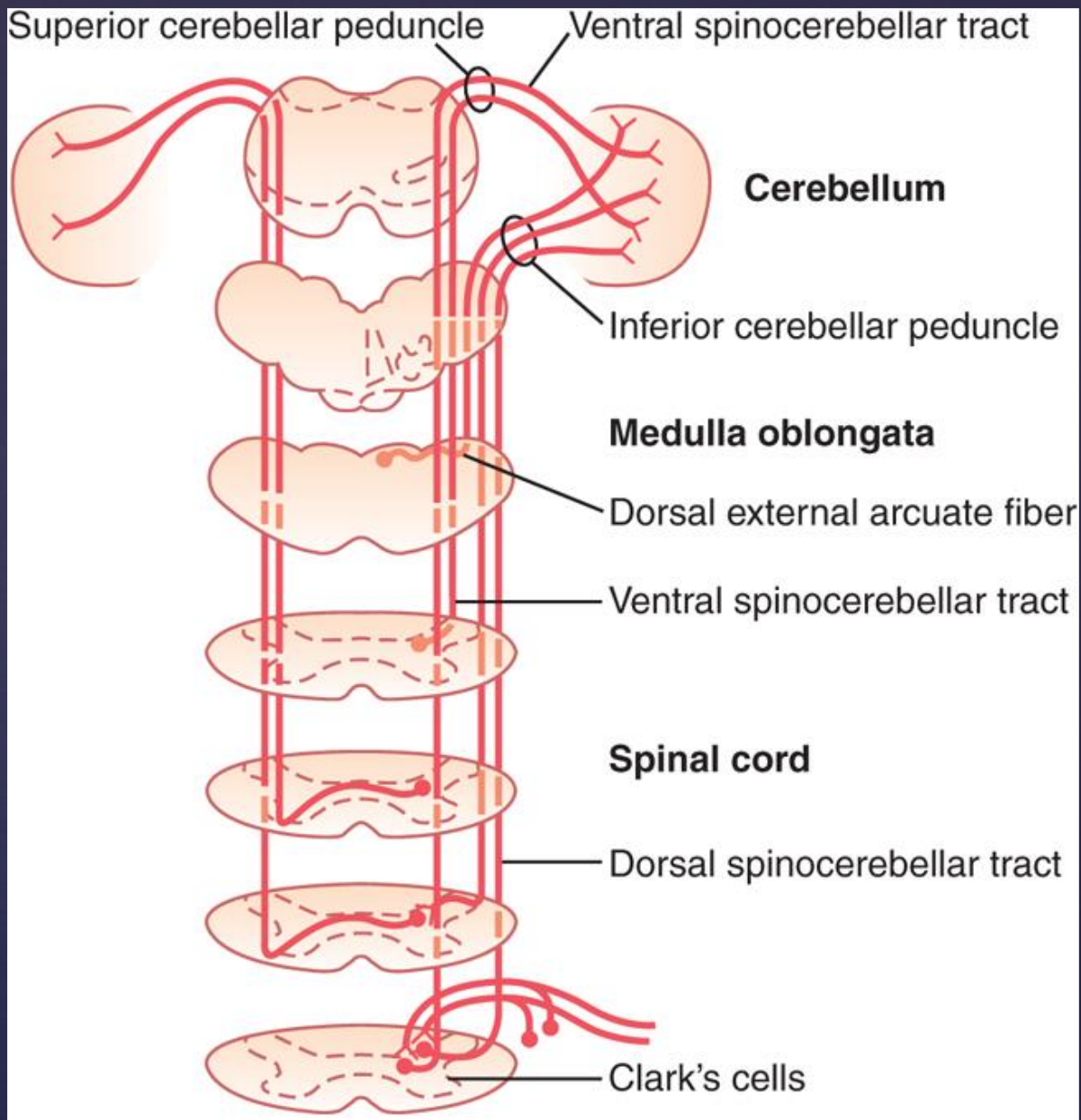
spinal cord ---superior cereb ped---cerebellar cortex

excited by-----Corticospinal tract + Rubrospinal tract
→ Ant. Horn of cord

Internal pattern + Generators in cord.

efference copy of the anterior horn motor drive.





Spinocerebellar tracts.

↳ Outer: Grey matter (cortex)

↳ Inner: White matter

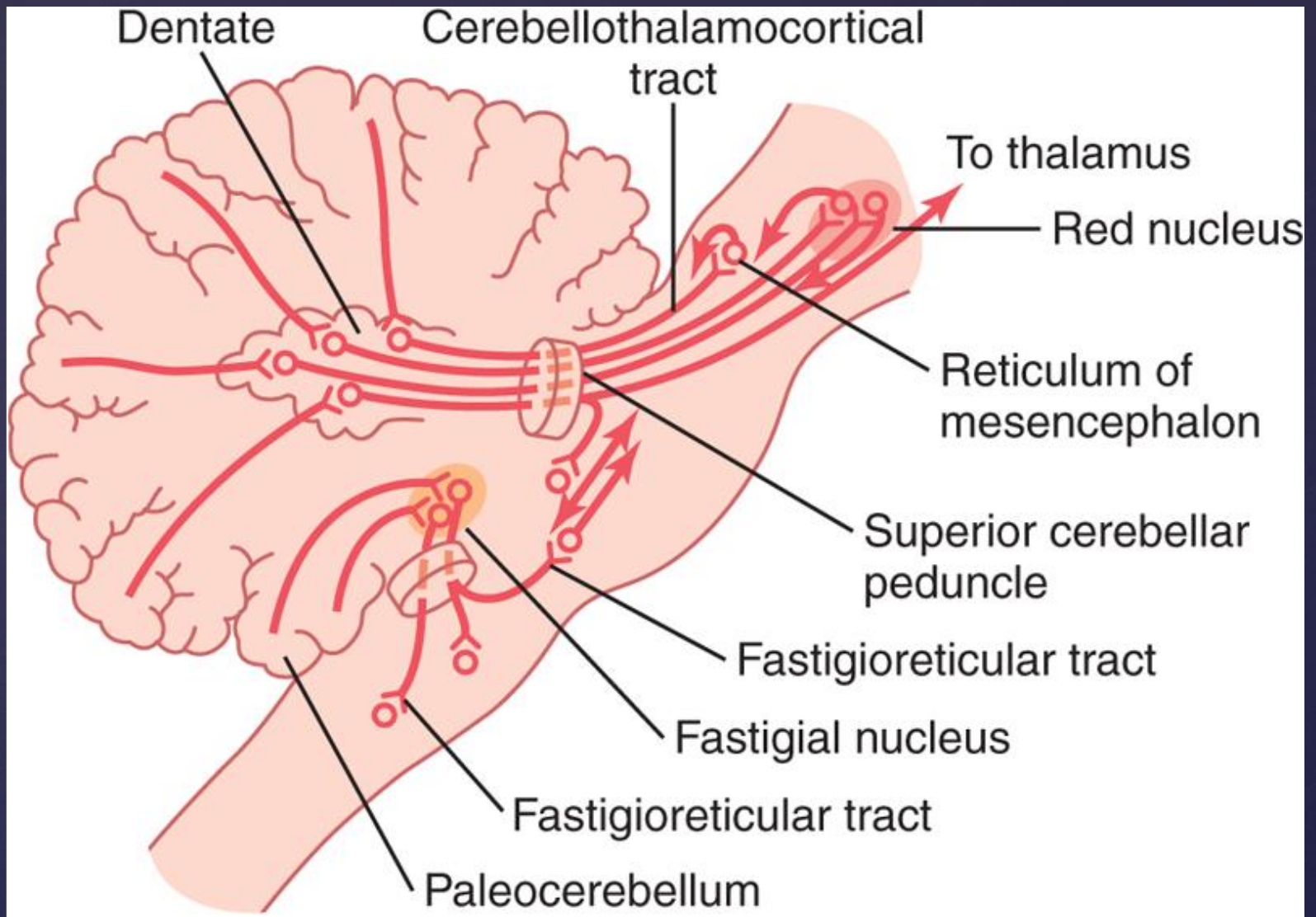
Deep cerebellar nuclei:

Groups of nerve cell bodies embedded in white matter

1. Fastigial nucleus
2. Interposed nucleus
3. Dentate nucleus

All out put signal originate (pass through) in deep nuclei → brain

Output Pathways From Cerebellum



Principal efferent tracts from the cerebellum

1. Vermis → Fastigial nuclei → Medulla & Pons

Function:

- i. + Vestibular Nuclei → **Equilibrium**
- ii. + Reticular formation → **Postural attitudes**

2. Intermediate Zone → Interposed nucleus →

- a. Thalamus → Cerebral cortex
- b. Thalamus → Basal Ganglia
- c. Red nucleus & reticular formation

Function:

Coordination and reciprocal contractions of agonist and antagonist muscles (esp. hands and fingers)

Three Major Output Pathways

Contd....

3. Lateral Zone of Cerebellum →

Dentate nucleus → Thalamus → Cerebral Cortex

Function:

Planning and coordination of sequential movements