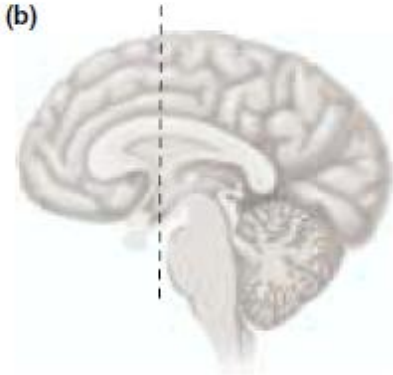
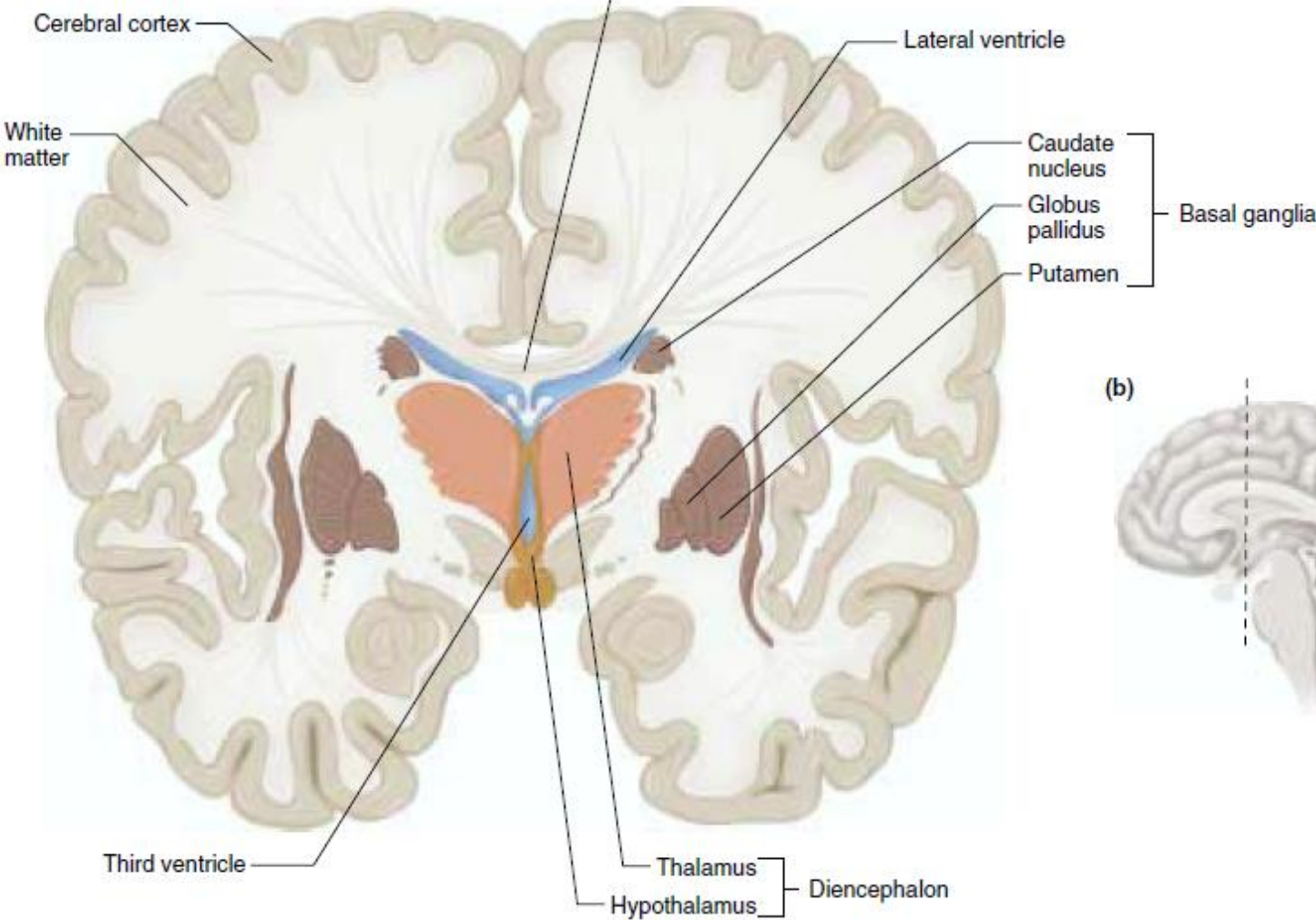


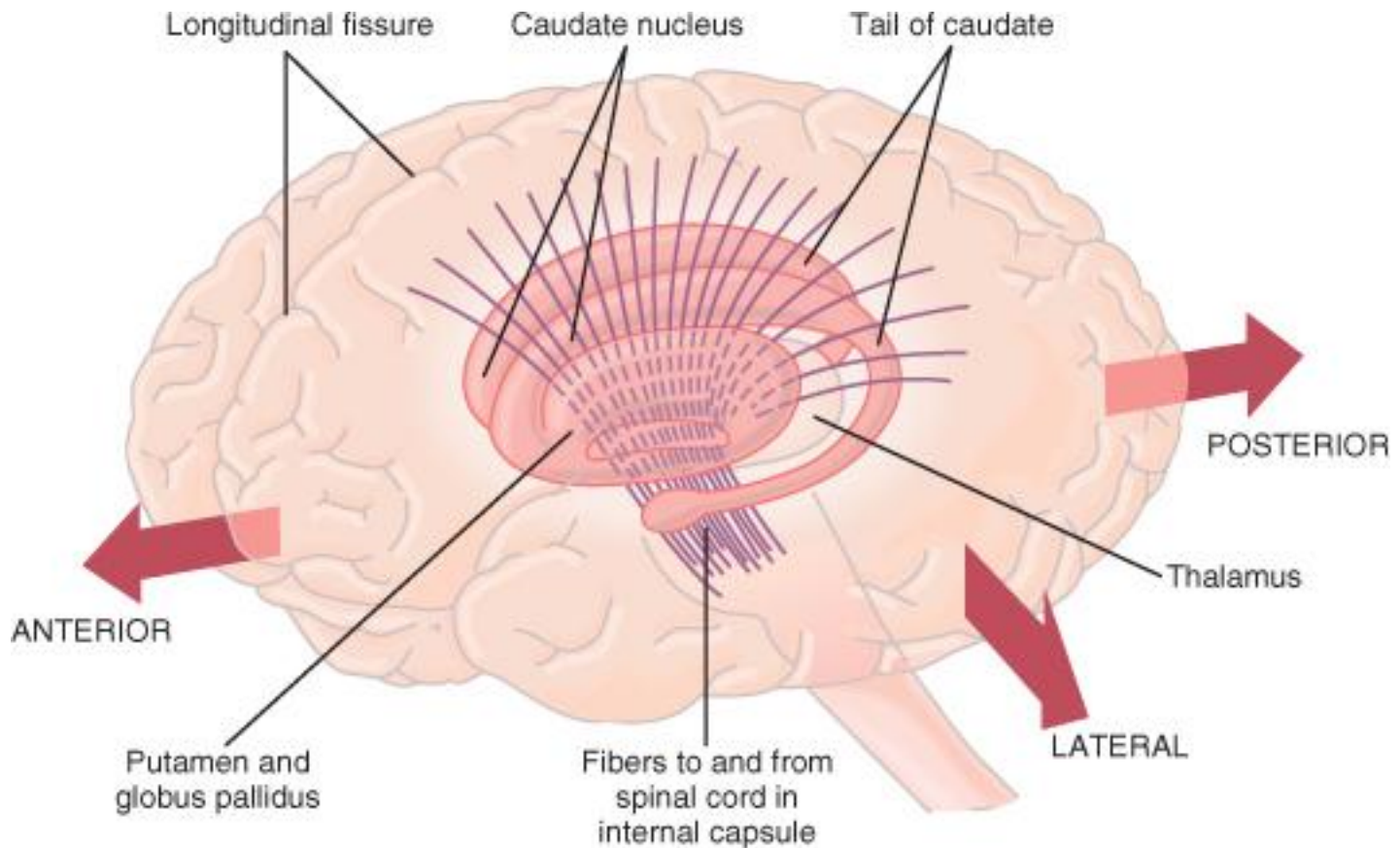
Human Physiology, Motor System

Dr. Shahid Javed
MBBS; PhD

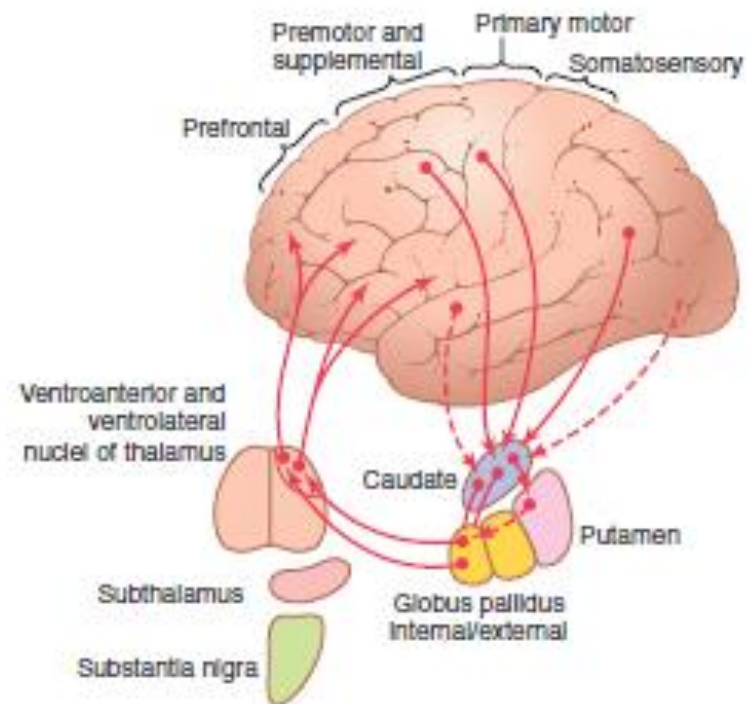
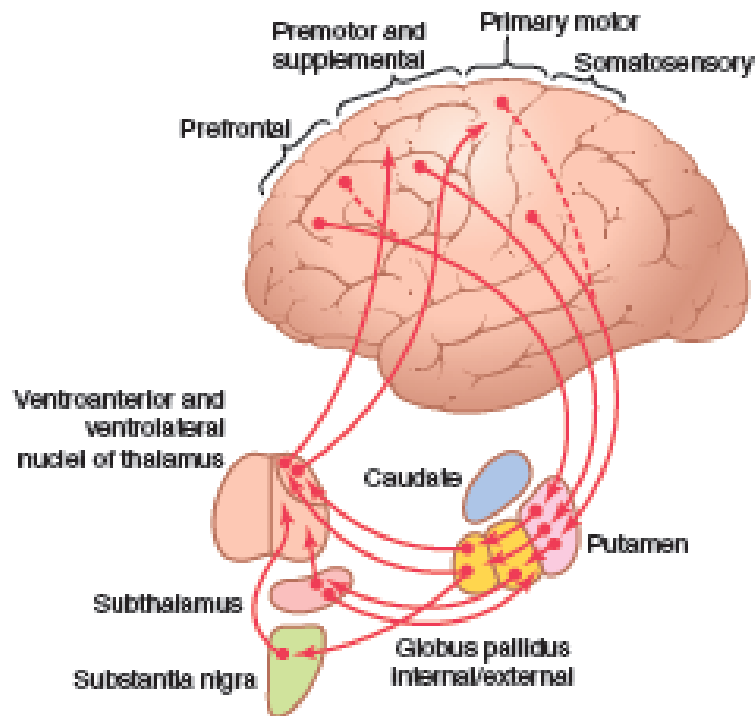
Basal Ganglia



PHYSIOLOGICAL ANATOMY



NEURONAL CIRCUIT AND FUNCTIONS



Putamen Circuit

Functions:

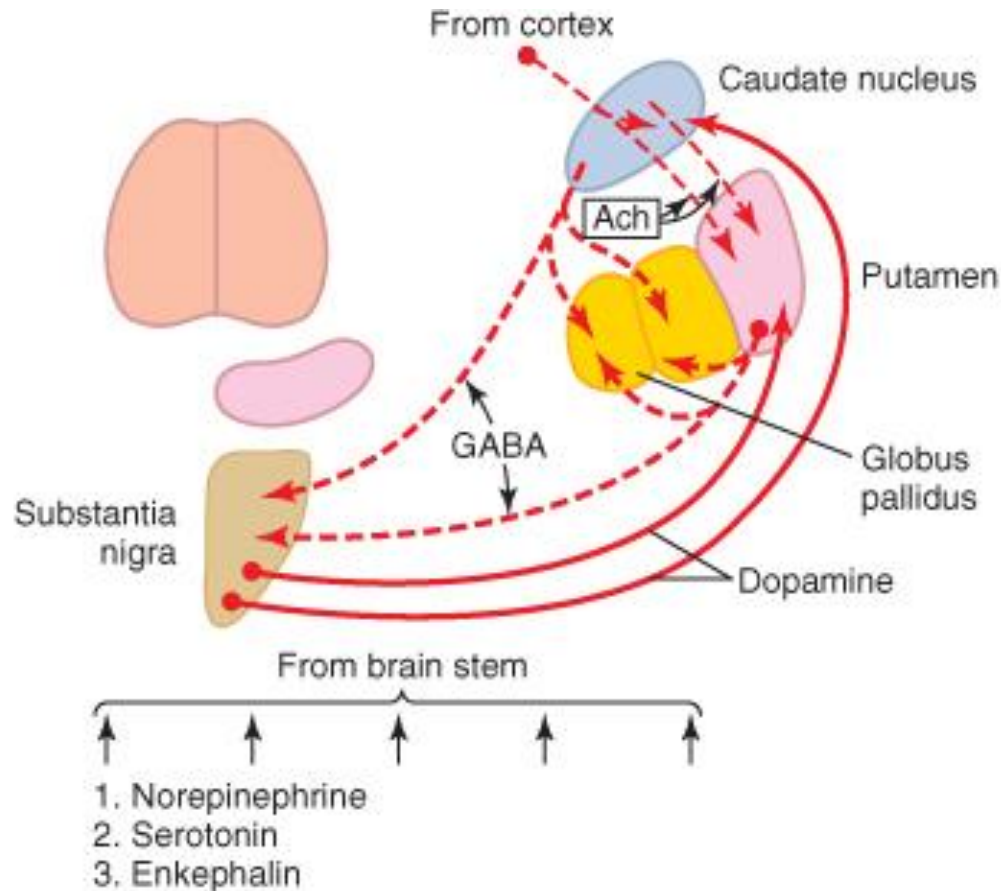
1. Writing letters of alphabets
2. Skilled movements

Caudate Circuit

Functions it control:

- 1) Cognitive control of sequences of movements e.g. a person seeing a lion approach & then responding
- 2) Change the timing & to scale the intensity of movements

Functions of specific neurotransmitter substances in the basal ganglia system



CLINICAL ABNORMALITIES

- 1) Athetosis – lesion in globus pallidus
 - writhing movements of hands, arm, neck or face
- 2) Hemiballismus- lesion in subthalamus
 - flailing movements of an entire limb
- 3) Chorea- lesion in putamen
 - flicking movements in the hands, face or other parts of body

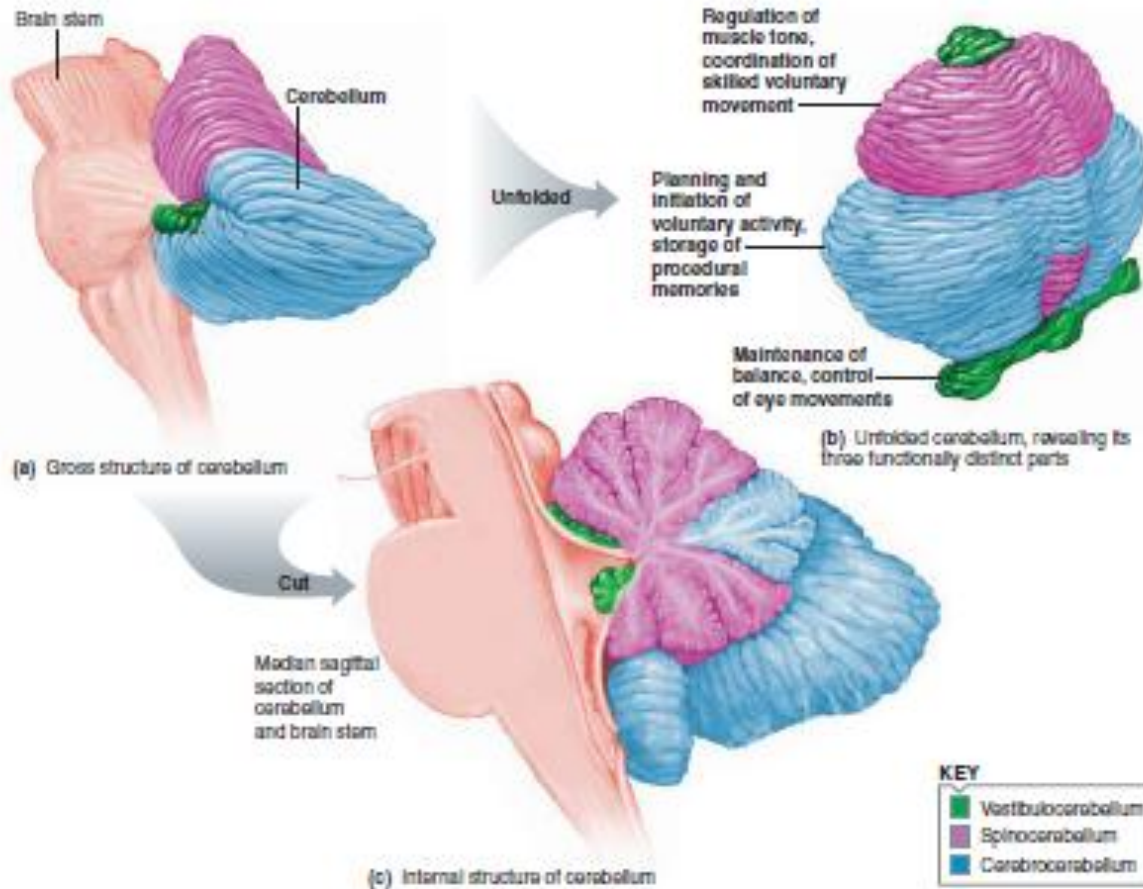
Parkinson's disease

- Etiology
- Characterized by:
 - Rigidity
 - Involuntary tremors
 - Akinesia → difficulty in initiating movements
- Treatment
 - l-dopa
 - l-deprenyl
 - Transplanted fetal dopamine cells

Huntington's disease

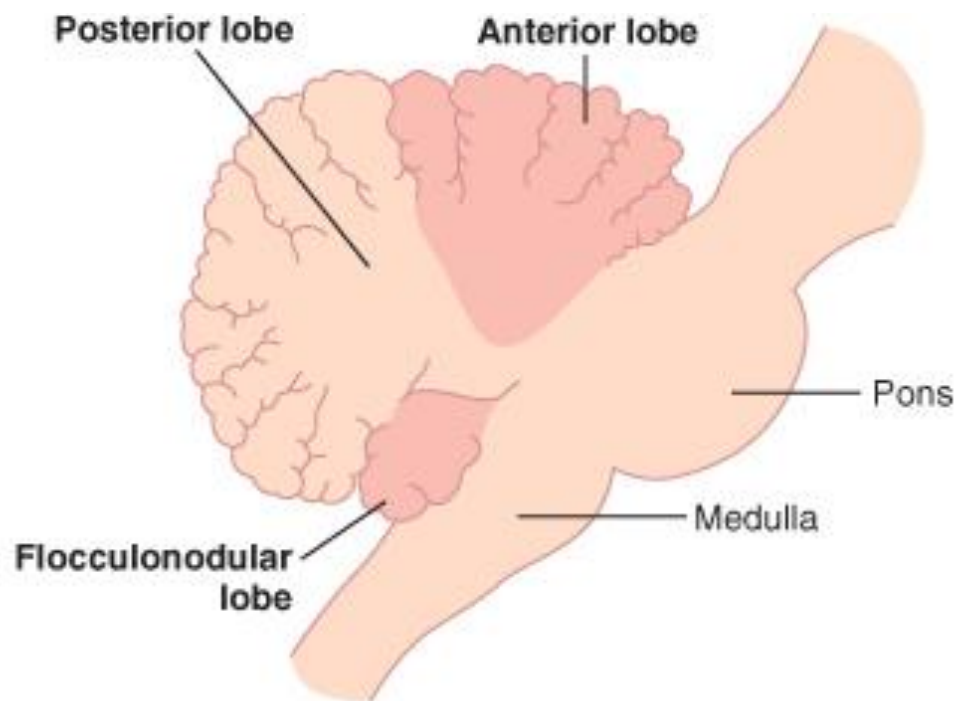
- Hereditary disorder
- Etiology
loss of cell bodies of GABA secreting and acetylcholine secreting neurons
- Flicking movements in individual muscles and then progress to entire body
- dementia

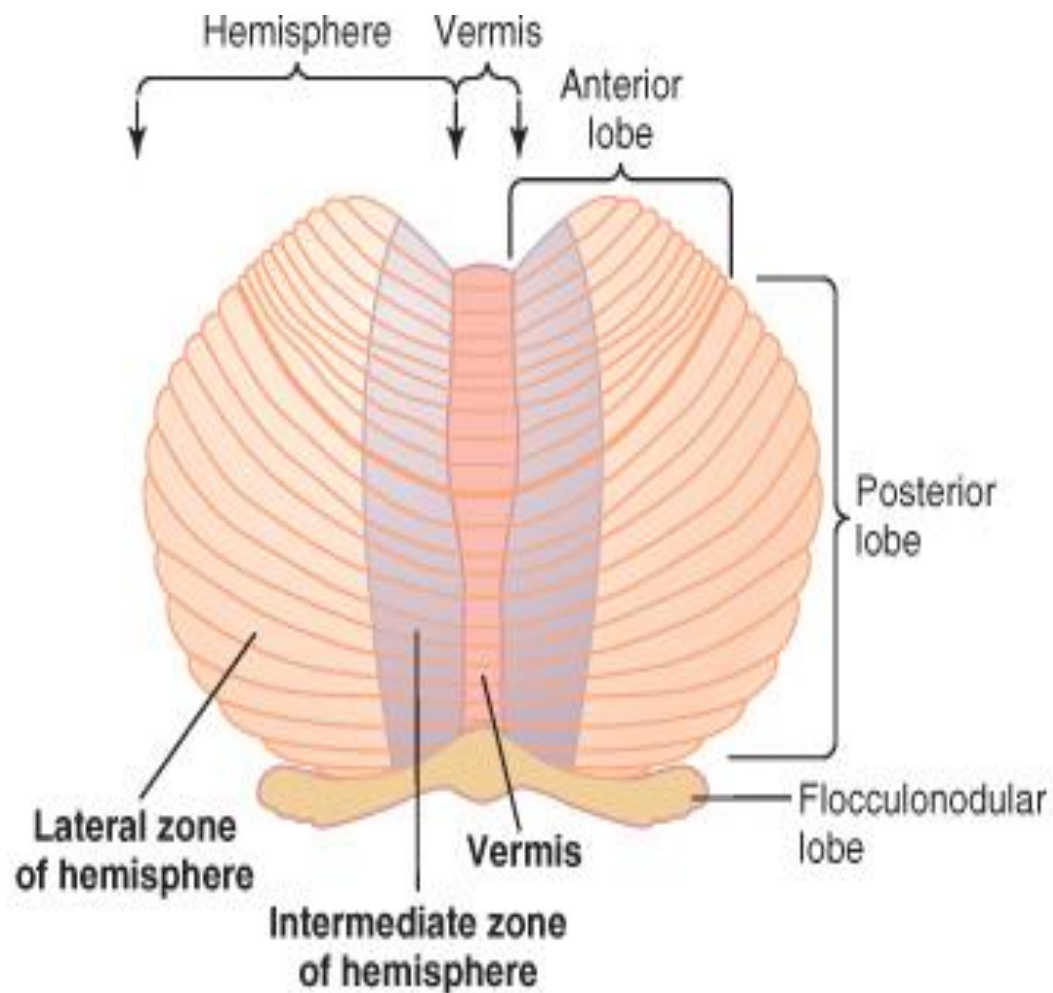
Cerebellum

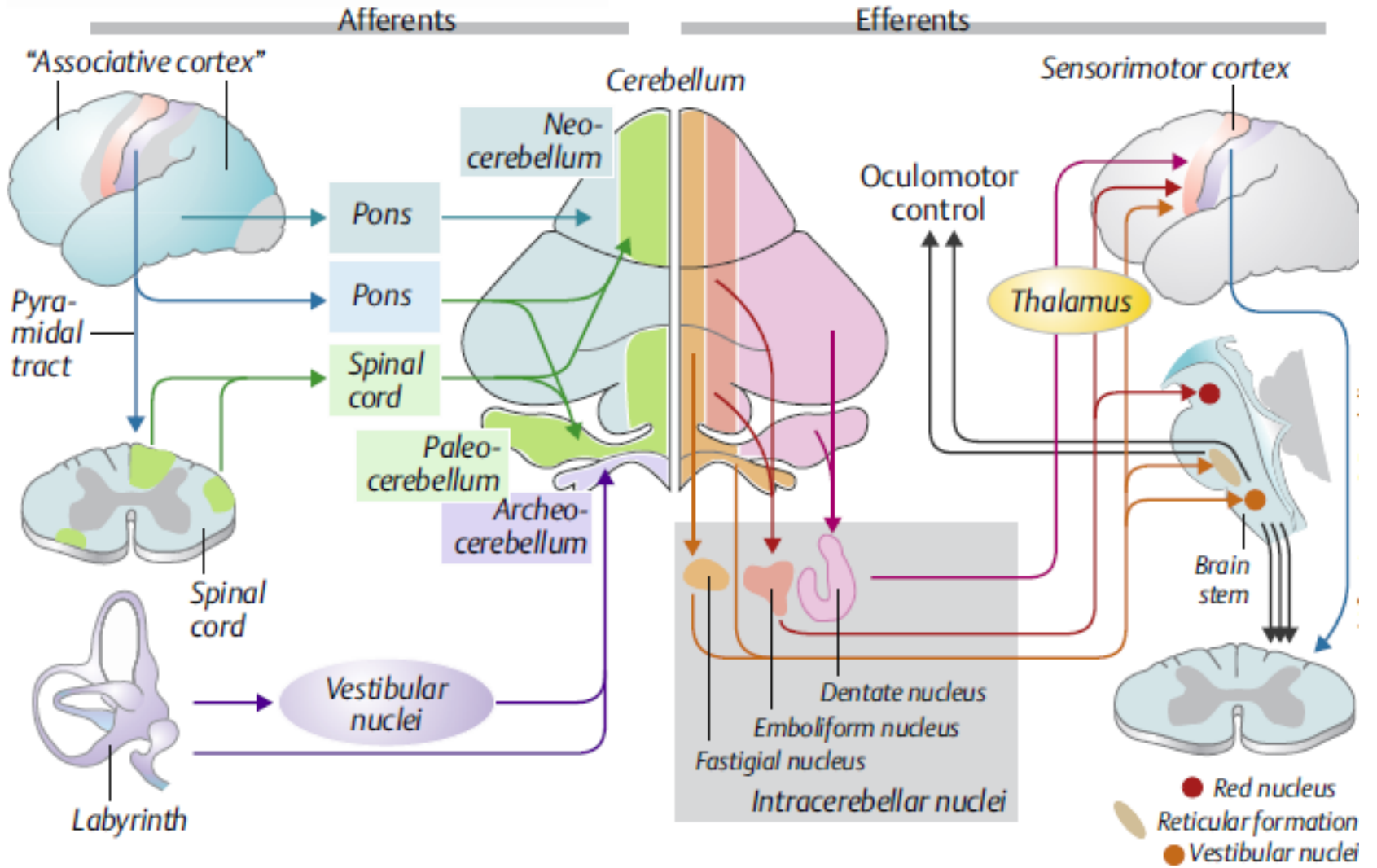


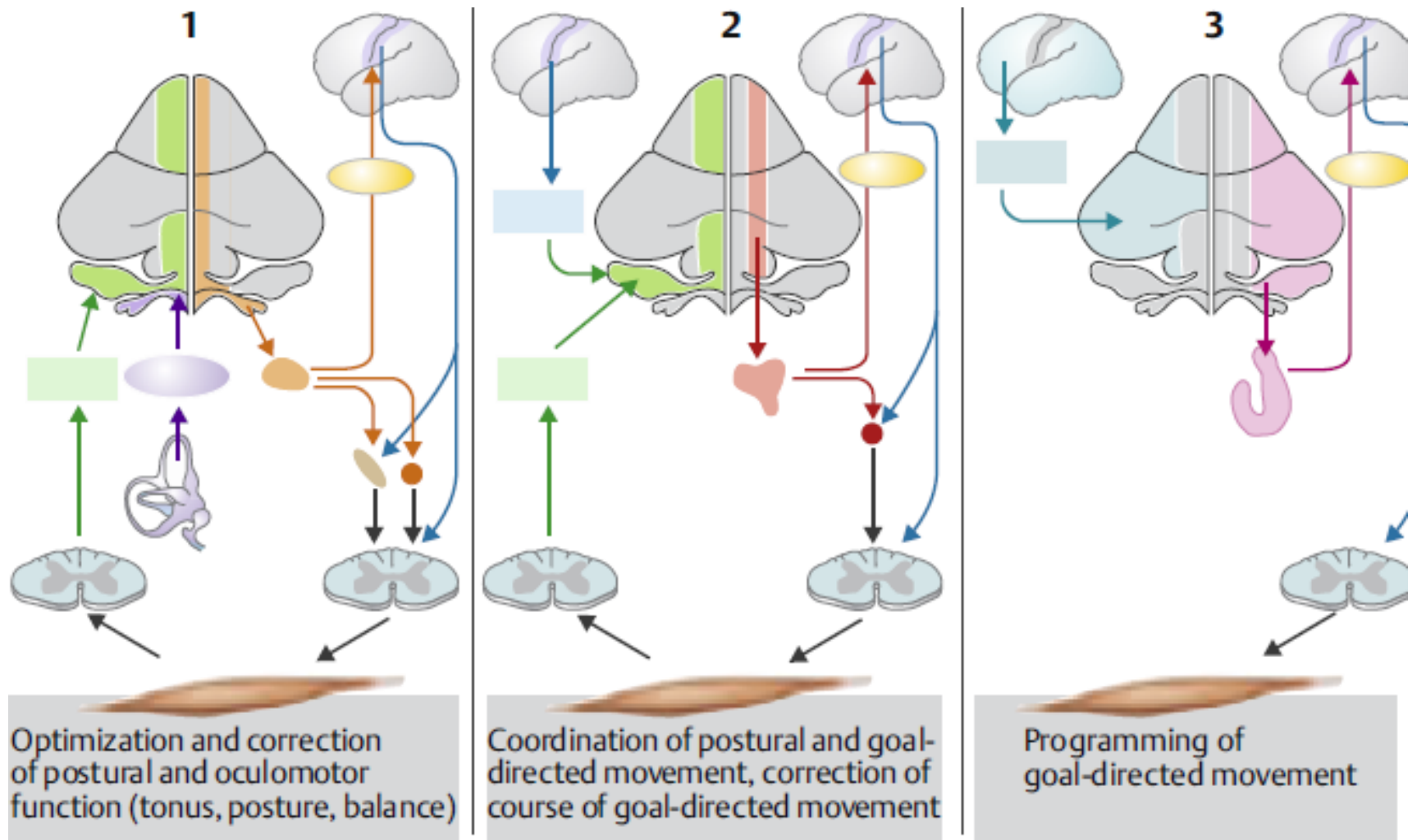
PHYSIOLOGICAL ANATOMY

1. Anatomical divisions
2. Functional divisions
3. Topographical representation in Cerebellum

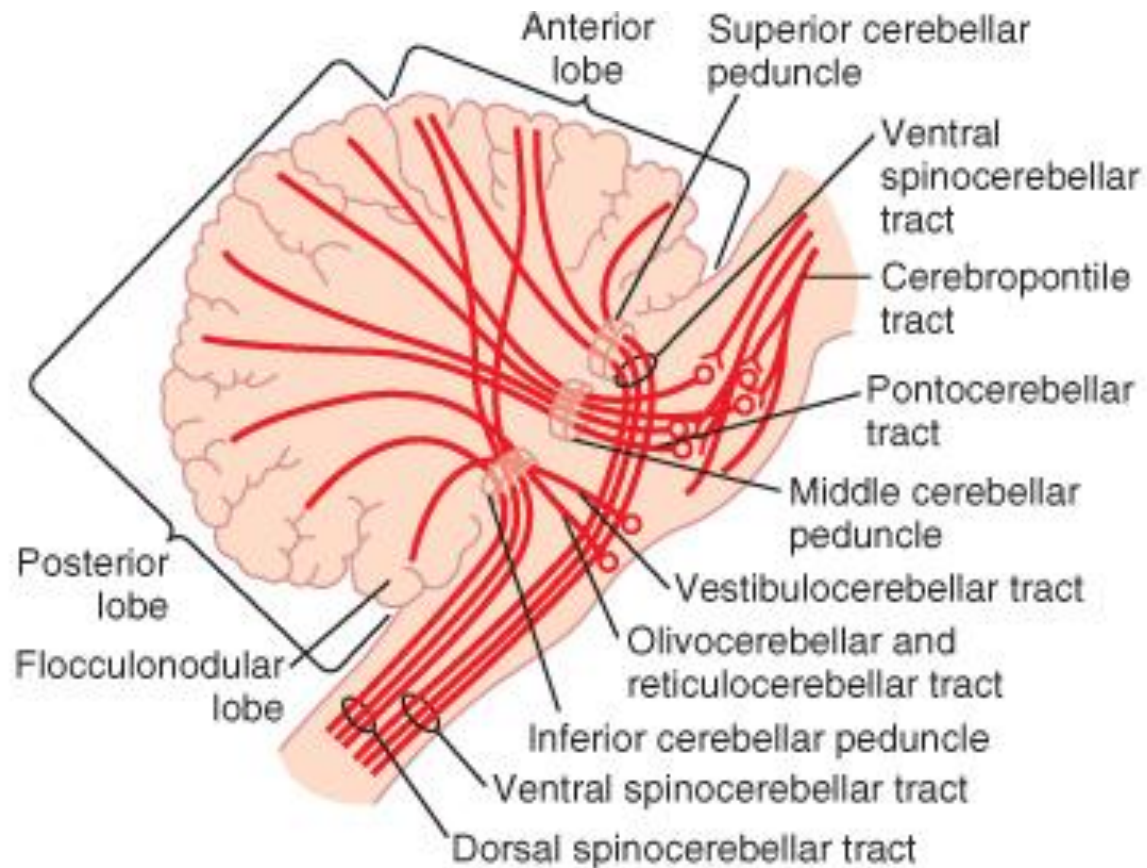








NEURONAL CIRCUIT OF CEREBELLUM: Inputs



Dorsal Spinocerebellar Tracts

- Sensations
 - Mainly from muscle spindle
 - To a lesser extent from Golgi Tendon organs, joint receptors and tactile receptors of the skin
- Remains on the same side
- Enter into Cerebellum through inferior cerebellar peduncle
- Ends in Vermis and intermediate zone of the same side
- Cerebellum controls following functions in response of these signals
 - Muscle contractions
 - Degree of tension on muscle tendon
 - Position and rate of movements of the parts of the body
 - Forces acting on the surface of the body

Ventral Spinocerebellar Tracts

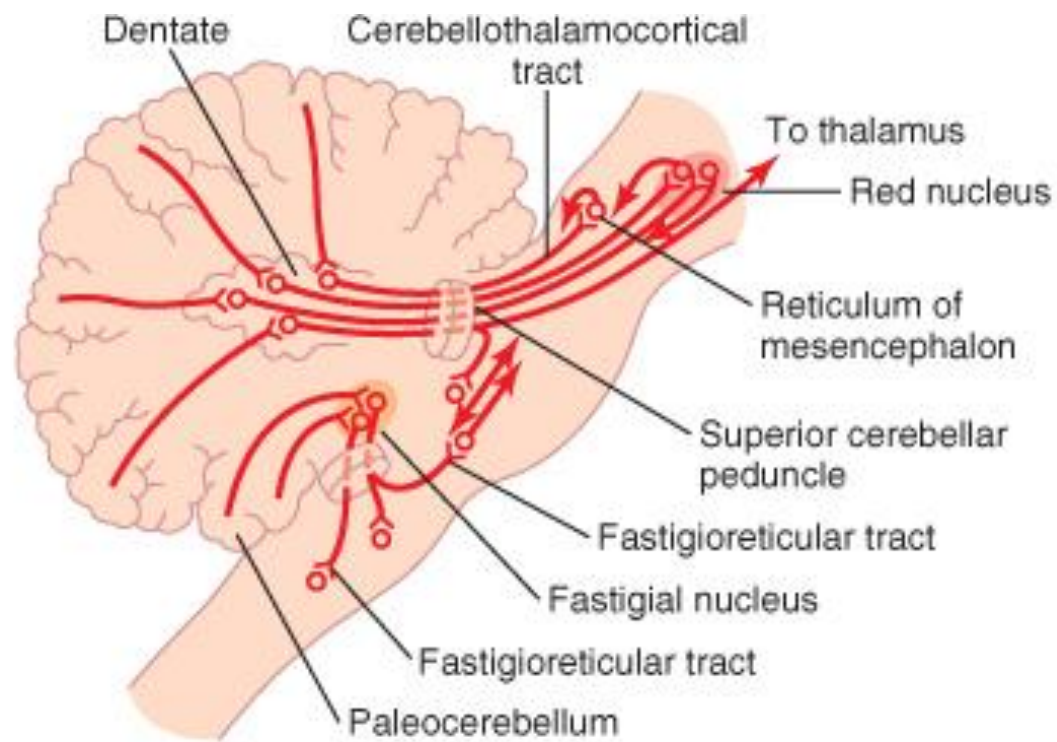
- Sensations
 - Less information from peripheral receptors
 - Mostly carry information from lower motor neurons in anterior horn of the Spinal cord which are excited by
 - Corticospinal tracts
 - Rubrospinal tracts
- Anterior horn motor drive
- Few fibers cross to opposite side, few remain on the same side to terminate in both sides of the Cerebellum
- Enter through Superior Cerebellar Peduncle

Outputs

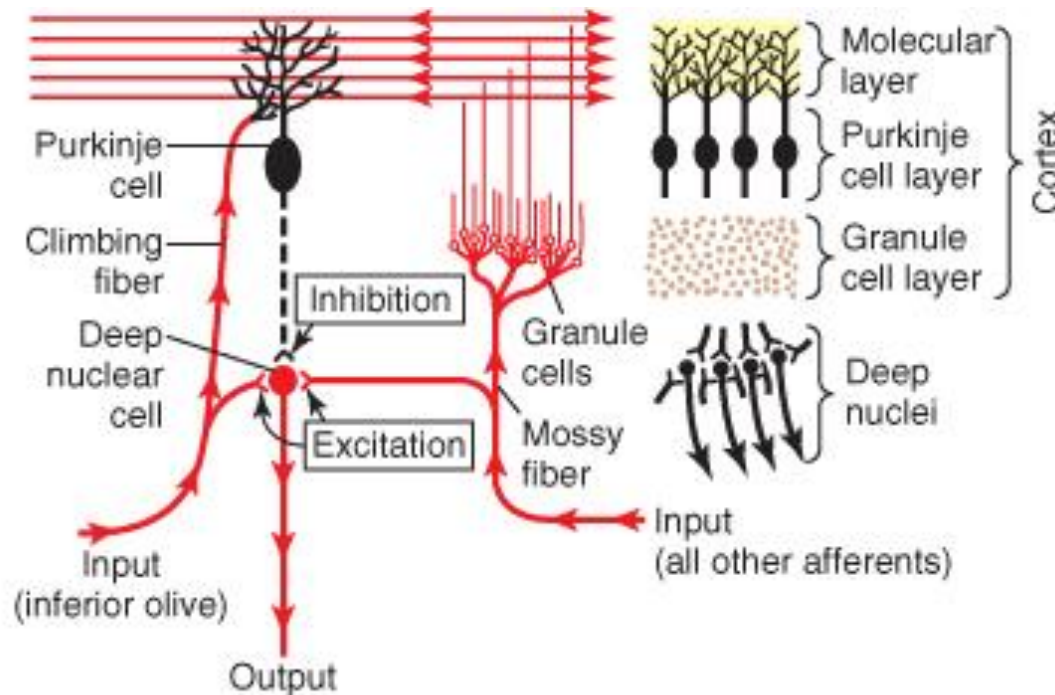
- Vermis → fastigial nucleus → brain stem (reticular formation) → fastigioreticular tract (vestibular nuclei)
- From lateral zone → dentate nucleus → VA and VL nuclei of thalamus → cerebral cortex (coordinate sequential motor activities of cerebral cortex)
- From intermediate zone → interposed nuclei → red nucleus

reticular formation of midbrain

thalamus (coordinate reciprocal contractions of agonists and antagonists of limbs)



The Purkinje Cell & The Deep Nuclear Cell – Functional Unit Of Cerebellar Cortex



How This Functional Unit Works

- 1) Purkinje cells & deep nuclear cells fire continuously under normal resting condition
- 2) Balance between excitation & inhibition at the deep cerebellar nuclei – Damping Function
- 3) Other inhibitory cells in cerebellum: Basket cells & Stellate cells (in molecular layers for lateral inhibition)
- 4) Turn on/turn off & turn off/turn on signals from the cerebellum
- 5) Purkinje cells learn to correct motor errors – role of climbing fibers

FUNCTIONS OF CEREBELLUM

It performs its functions at three major levels

1. Spinocerebellum (Paleocerebellum)
2. Cerebrocerebellum (Neocerebellum or Pontocerebellum)
3. Vestibulocerebellum (Archicerebellum)

Spinoc-erebellum

- Consists of vermis and intermediate zone
- It coordinates movements of distal portions of limbs and make smooth contractions of agonists and antagonists muscles for purposeful movements

CEREBRO-CEREBELLUM

- Planning of sequential movements
 - Two way communications between Cerebral Cortex with lateral zone of Cerebellum
 - It controls what will be happening during the next sequential movement a fraction of a second later
- Timing Function
- Extra motor functions in auditory and visual phenomena

VESTIBULO-CEREBELLUM

- Function of Flocculonodular lobe and Vermis
- The Vestibulocerebellum originated at the same time that the vestibular apparatus in the inner ear developed
- Control equilibrium of postural movements

CLINICAL ABNORMALITIES OF CEREBELLUM

. *Dysmetria*

- Ataxia
- Past pointing

2. *Failure of progression in repetitive movements*

- Dysdiadochokinesia
- Dysarthria

3. *Cerebellar Tremors*

- Intention tremors
- Kinetic tremors
- Static tremors
- Cerebellar nystagmus

4. *Exaggerated Reflexes*