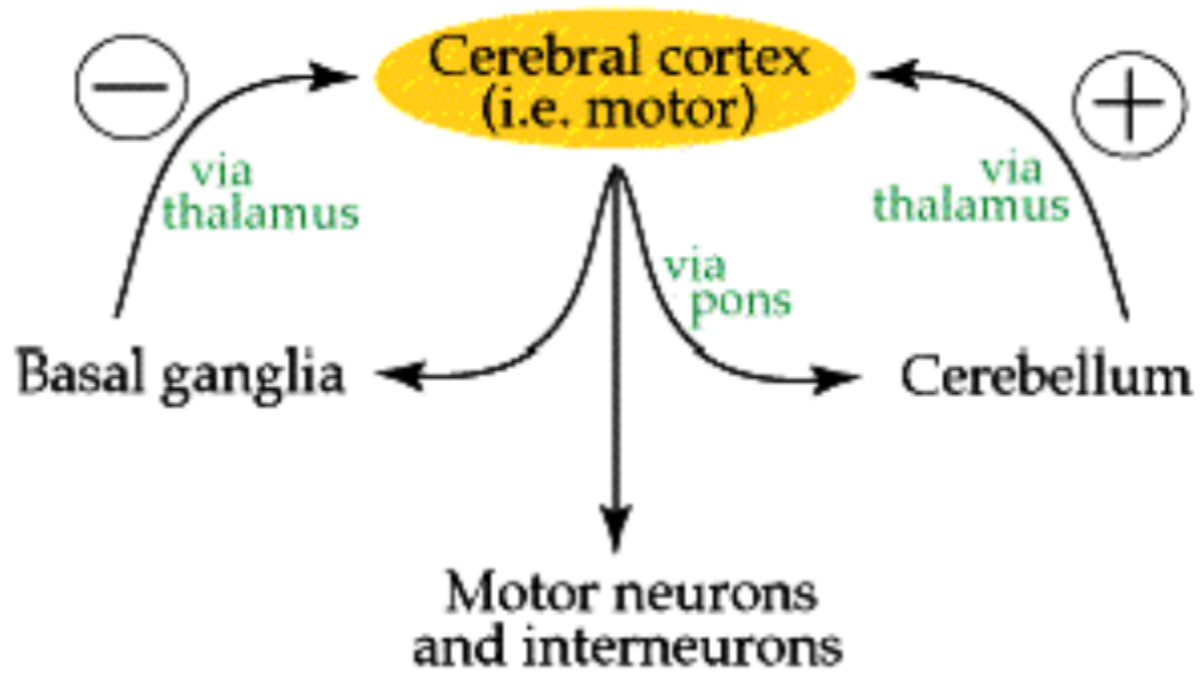


PATHWAYS OF THE CEREBELLUM AND BASAL GANGLIA



CEREBELLUM

Functions:

Maintenance of balance and posture

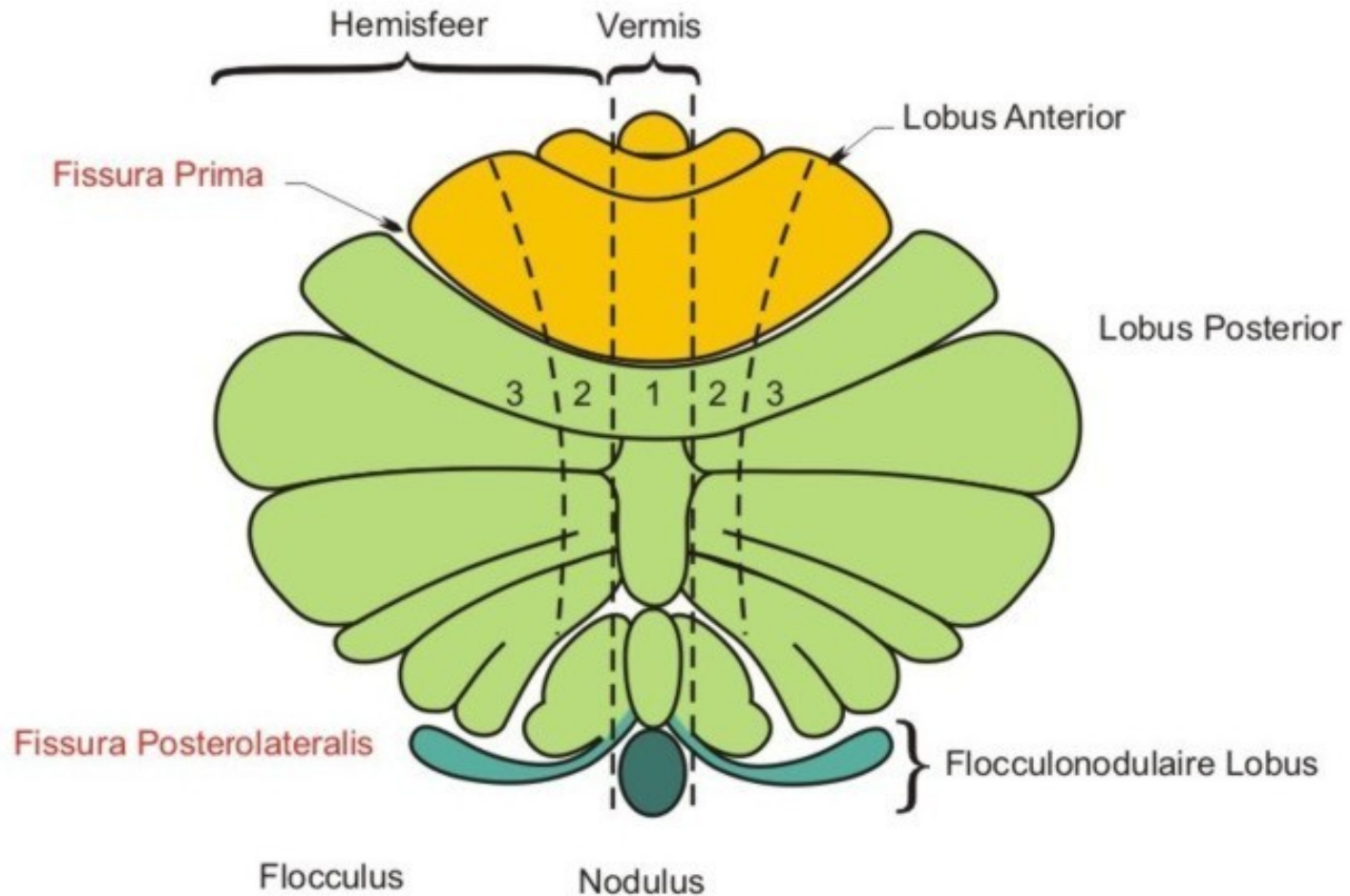
Coordination of voluntary movements

Motor learning

Cognitive functions

CEREBELLUM

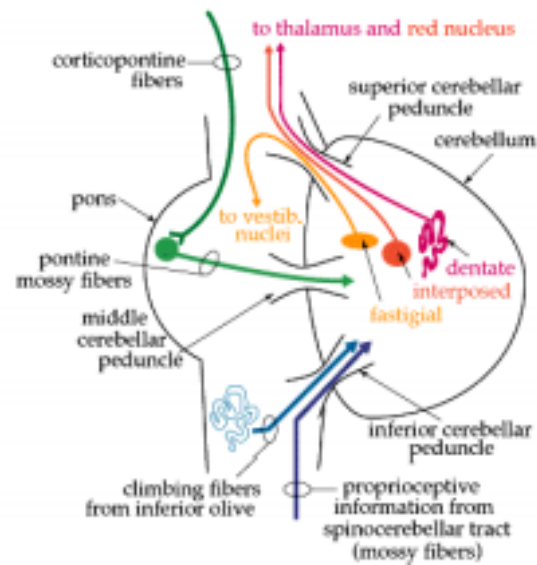
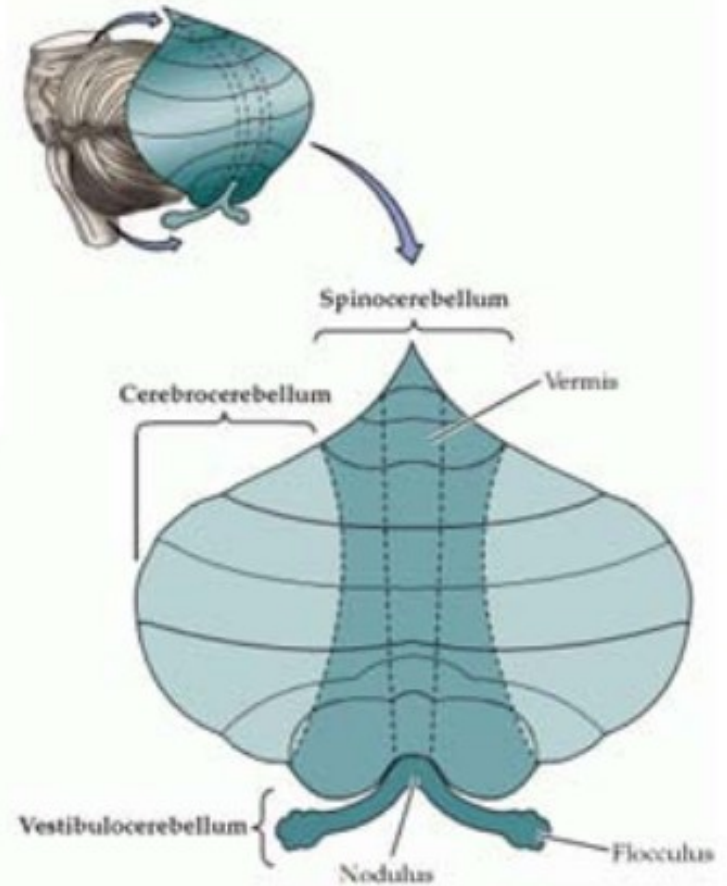
Anatomical division



CEREBELLUM

Developmental division

- ❑ **archicerebellum**
 - vestibulocerebellum
- ❑ **paleocerebellum**
 - spinocerebellum
- ❑ **neocerebellum**
 - cerebro- (ponto-) cerebellum



CEREBELLUM

Functional division

VC

- flocculonodular lobe
- vestibular ncll.

SC - median zone

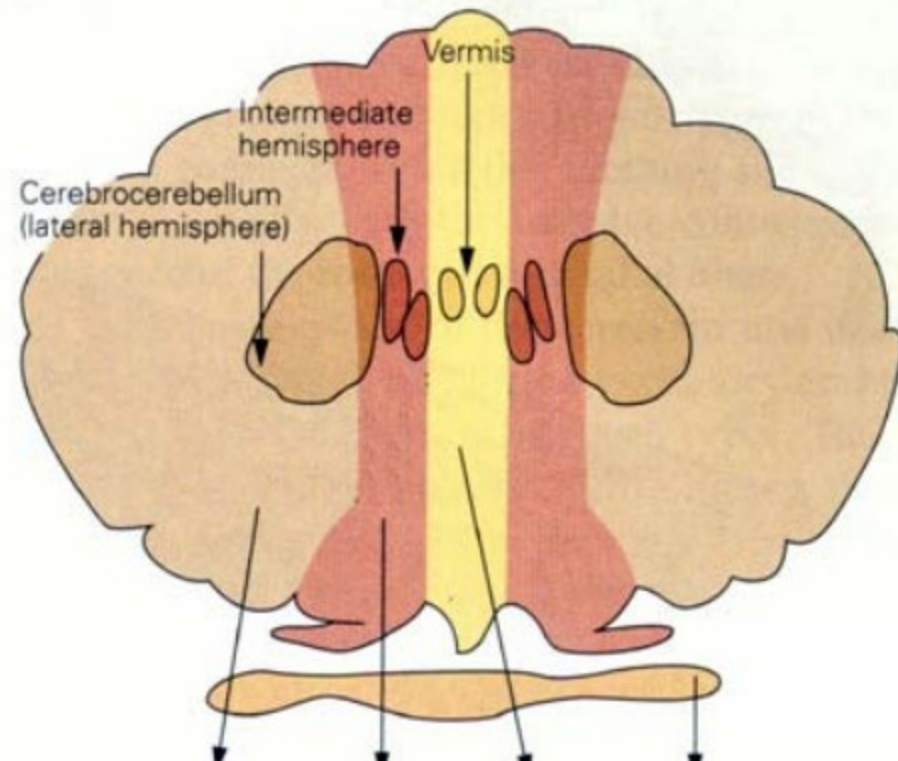
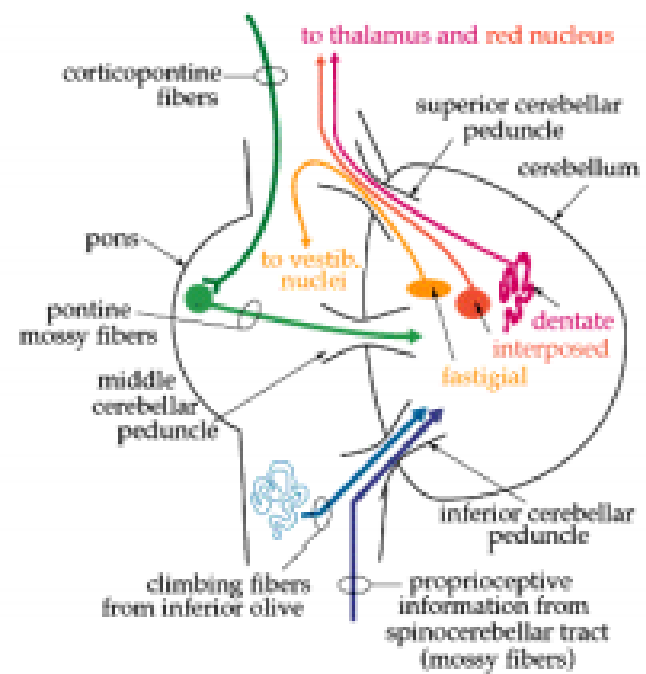
- vermis
- ncl. fastigii

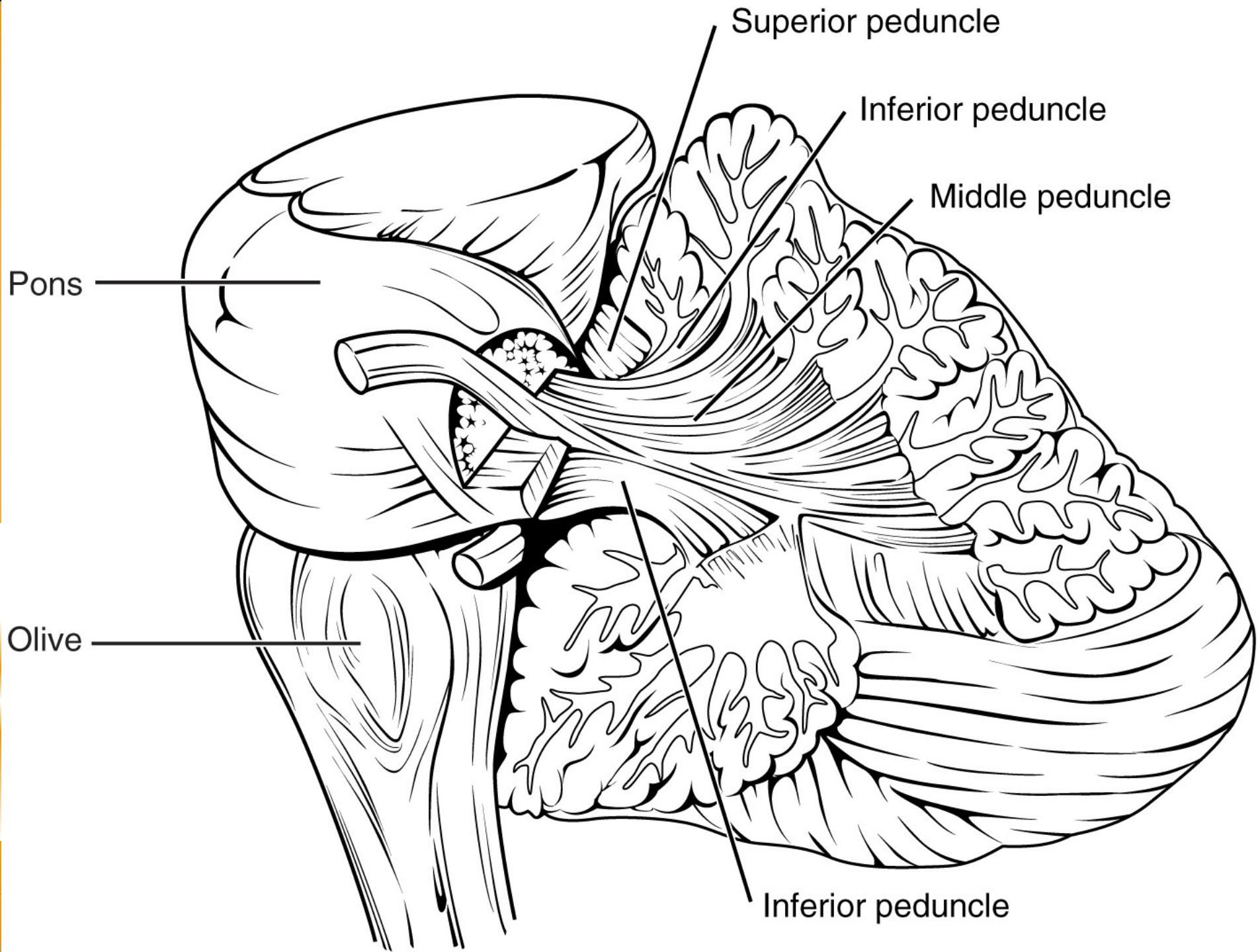
SC - paramedian zone

- intermediate cortex
- ncll. emboliformis et globosus

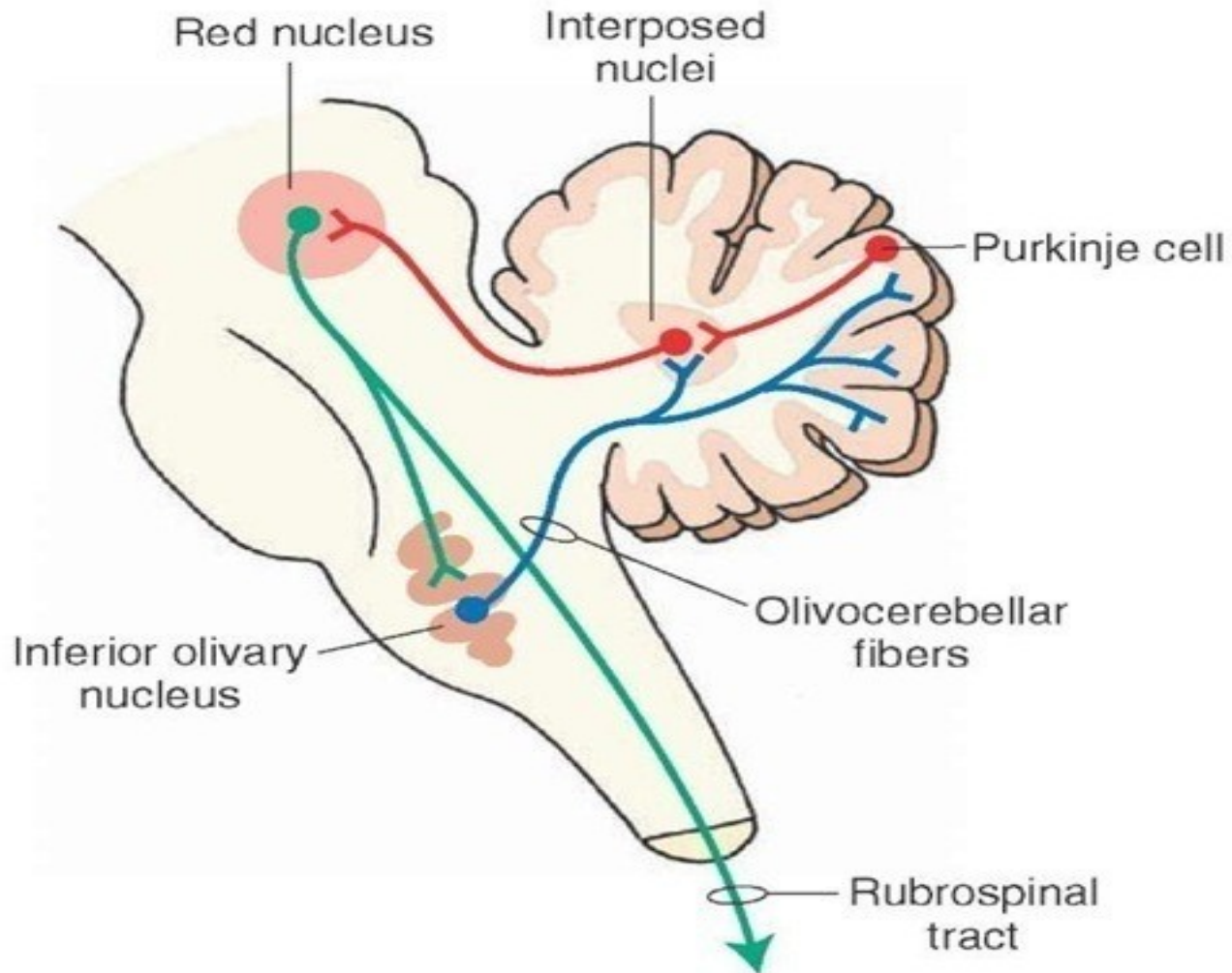
CC - lateral zone

- cortex cerebellar hemispheres
- ncl. dentatus

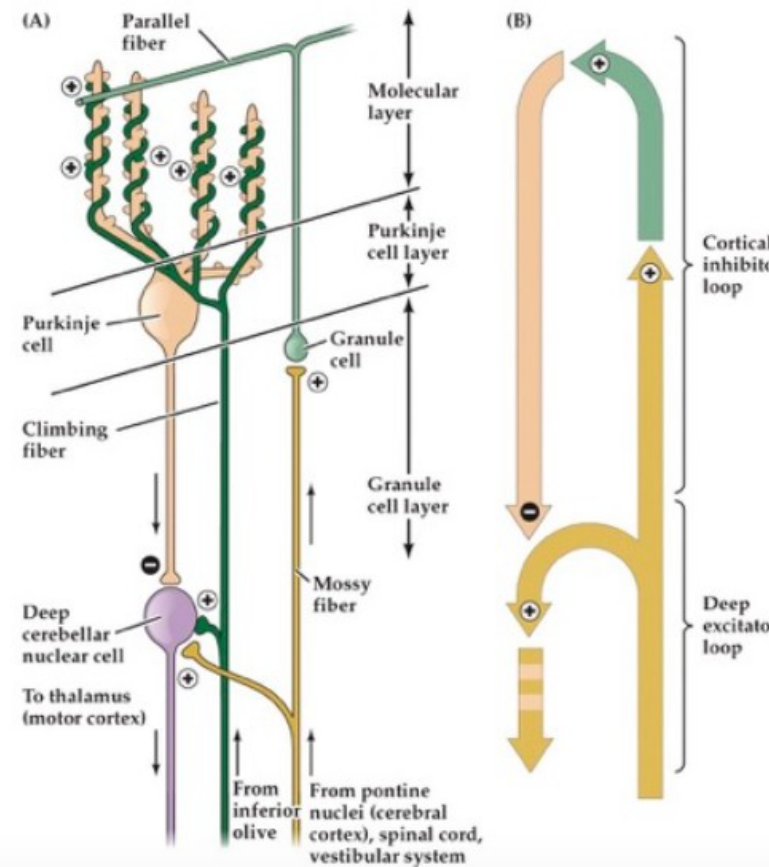
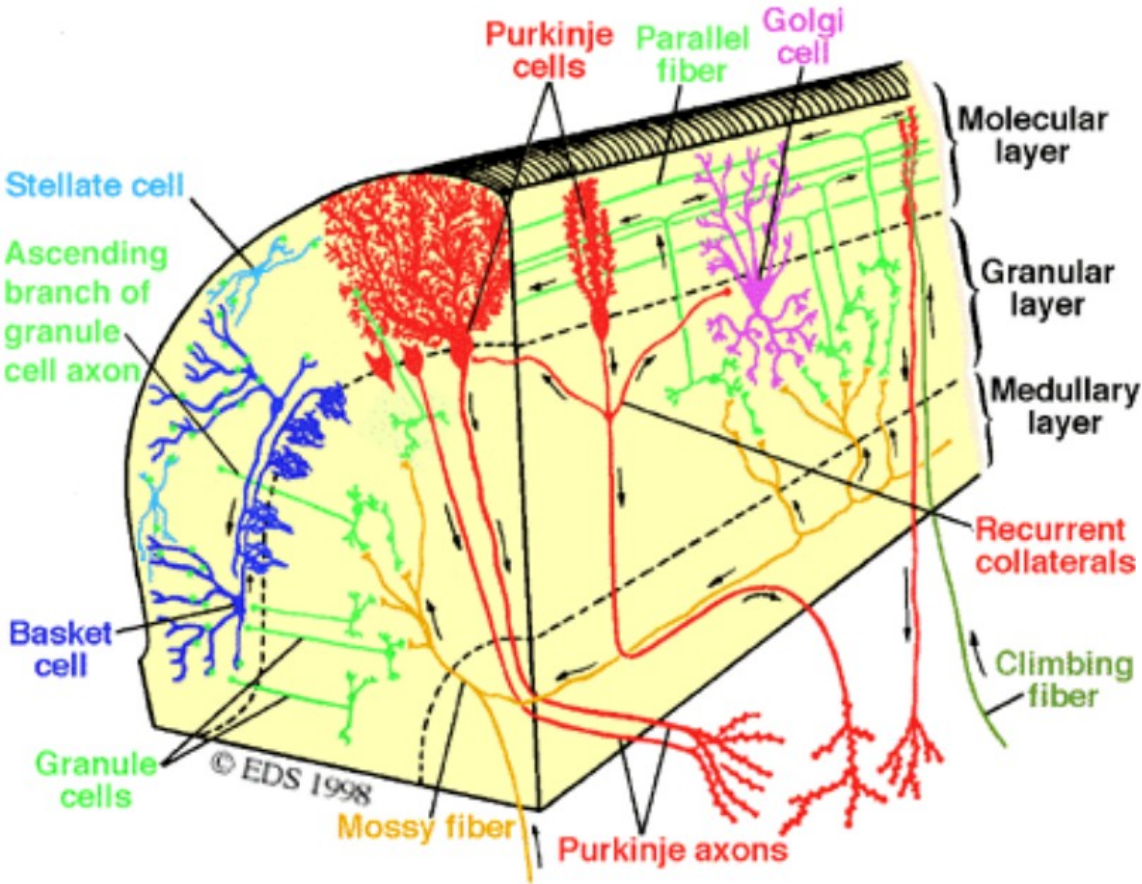


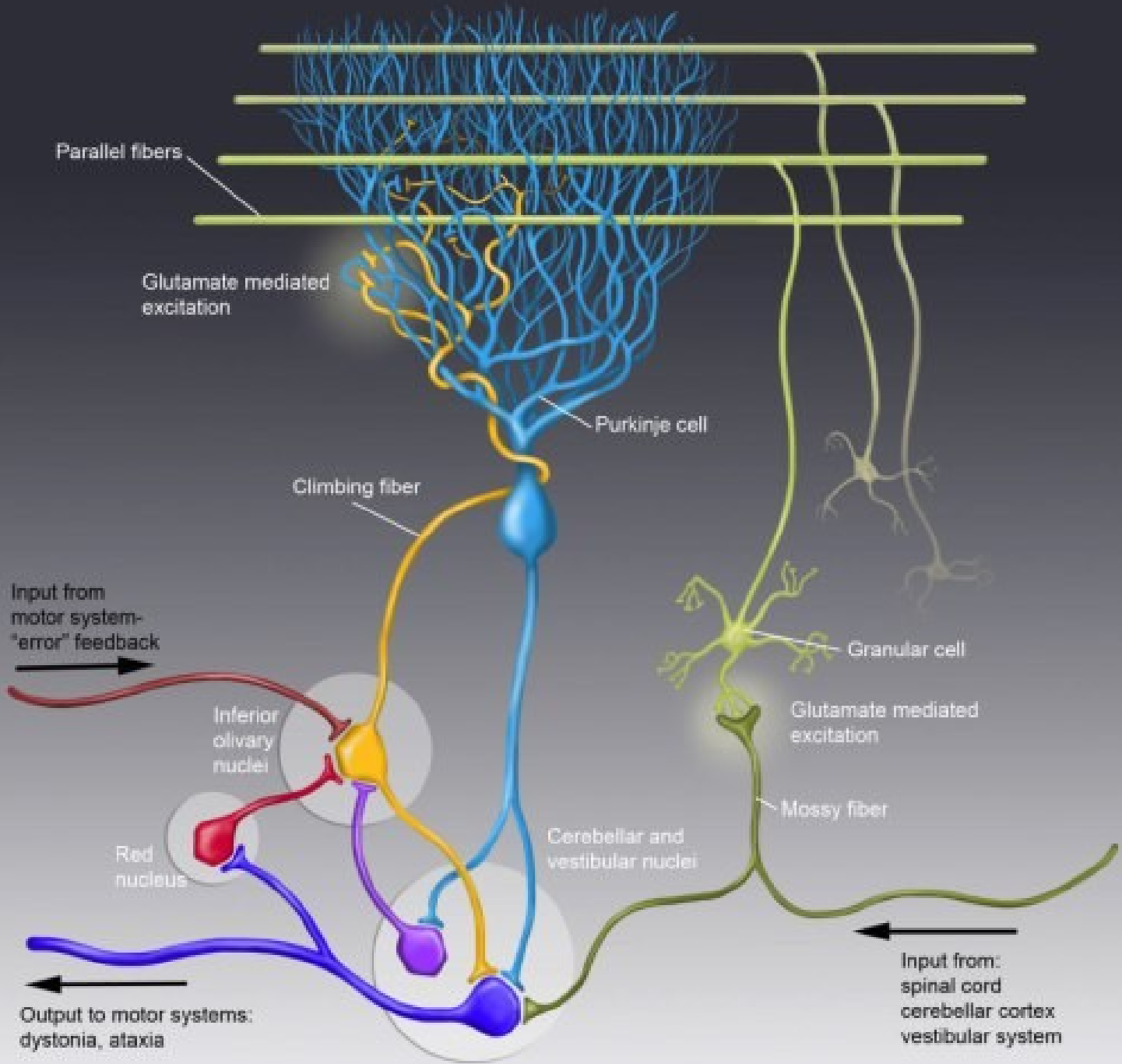


Rubro - olivary tract



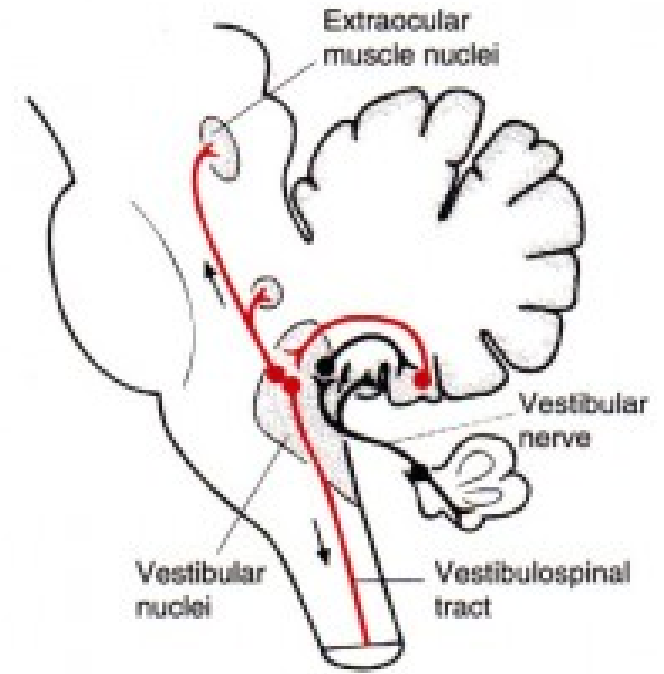
CEREBELLAR CORTEX





Connections of the vestibulocerebellum

Vestibulocerebellum



Flocculonodular lobe
(vestibulocerebellum)

Vestibular ncll.

Pontine ncll.

Vestibulocerebellar tract

Vestibulospinal tracts

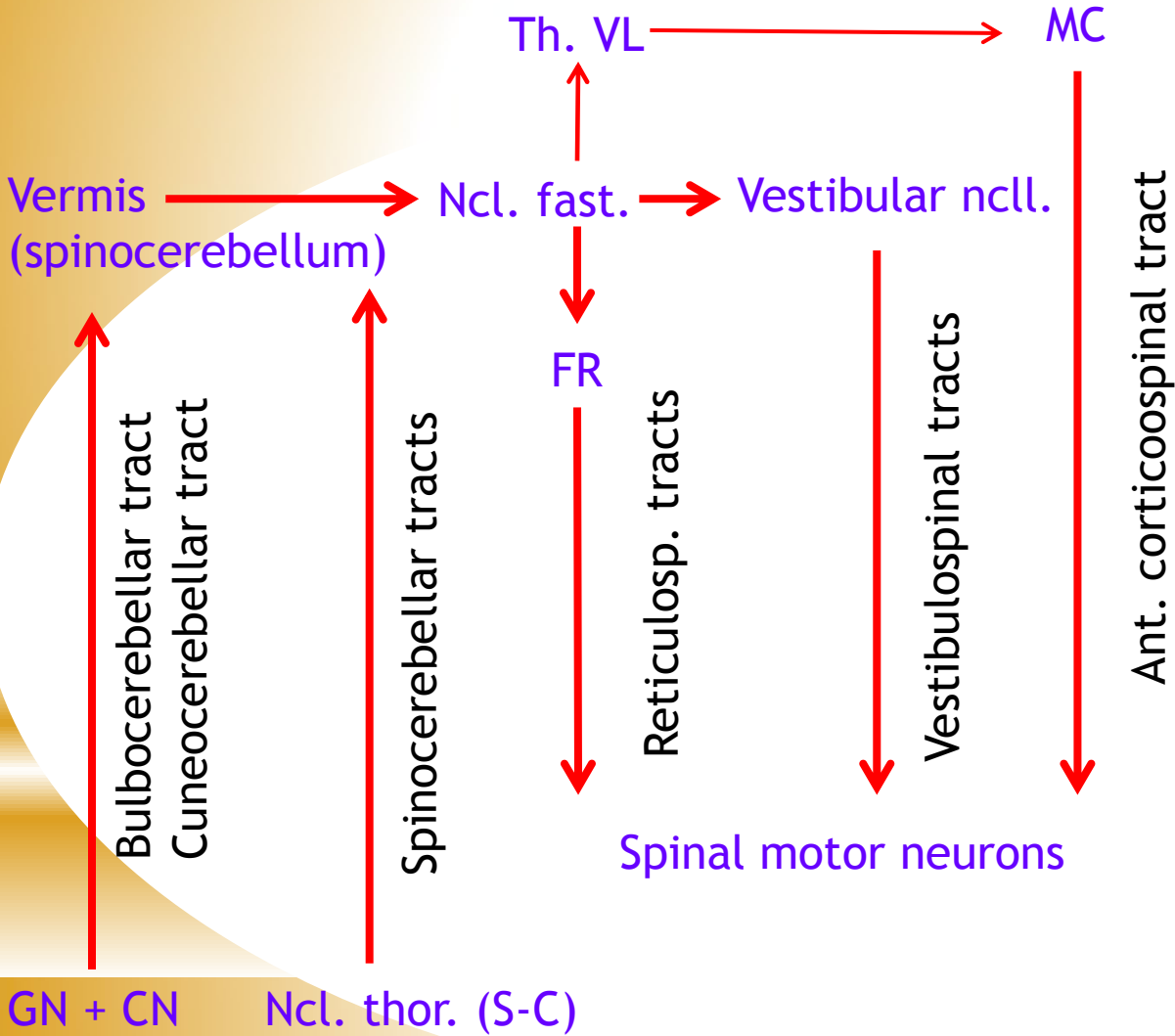
Spinal motor neurons

LGB + Sup.Col.

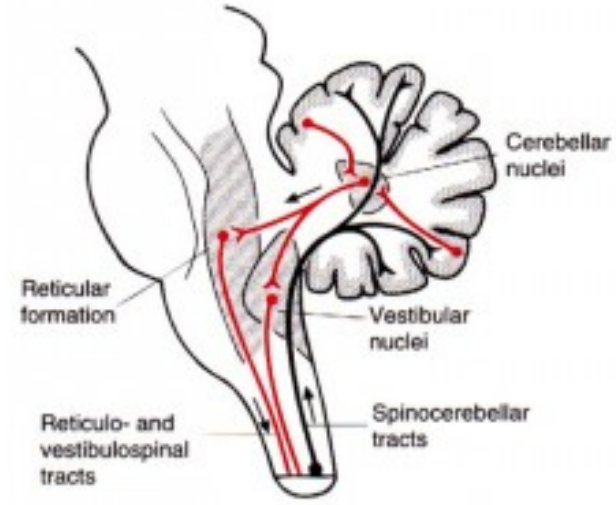
Vestibular system

- vestibular reflexes
- postural maintenance

Connections of the spinocerebellum - median zone

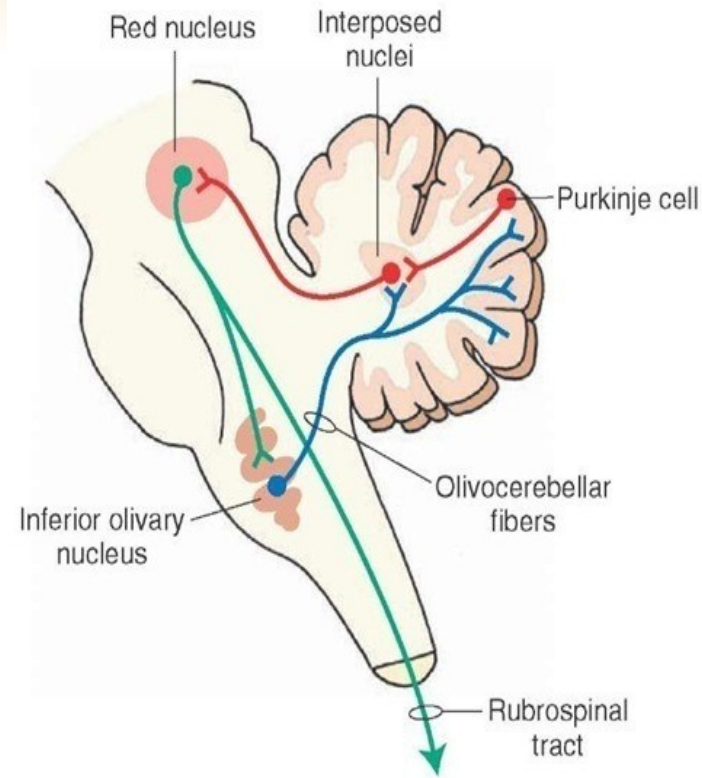
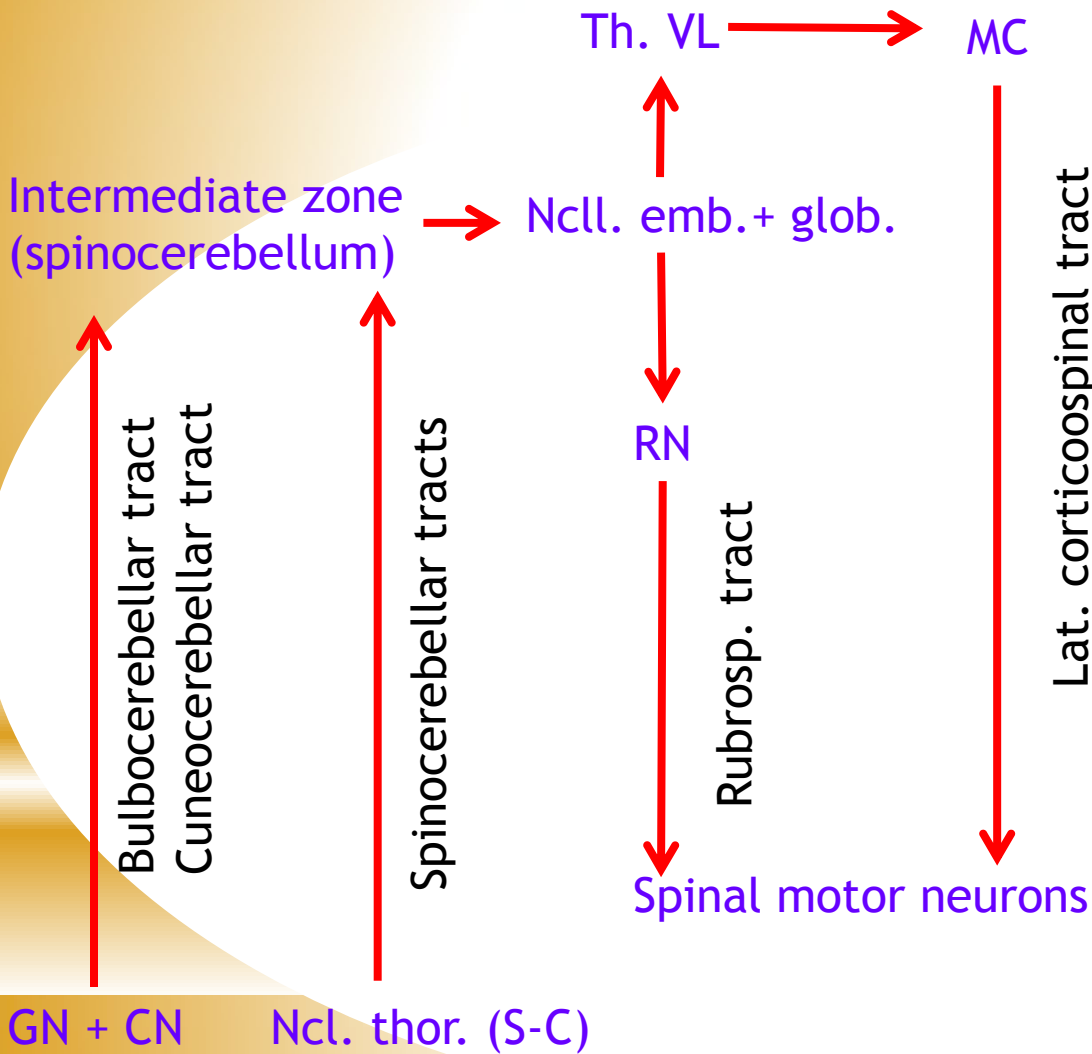


Spinocerebellum



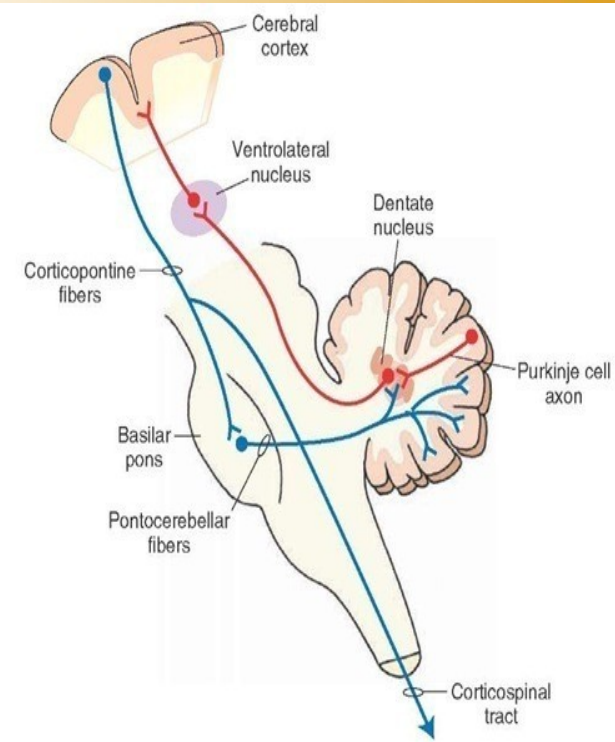
➤ **control of medial descending (motor) system**

Connections of the spinocerebellum - paramedian zone



➤ **control of lateral descending (motor) system**

Connections of the cerebro(ponto)cerebellum - lateral zone



Motor cortex

Corticopontine tract

Pontine ncll.

Pontocerebellar tract

Lateral zone (pontocerebellum)

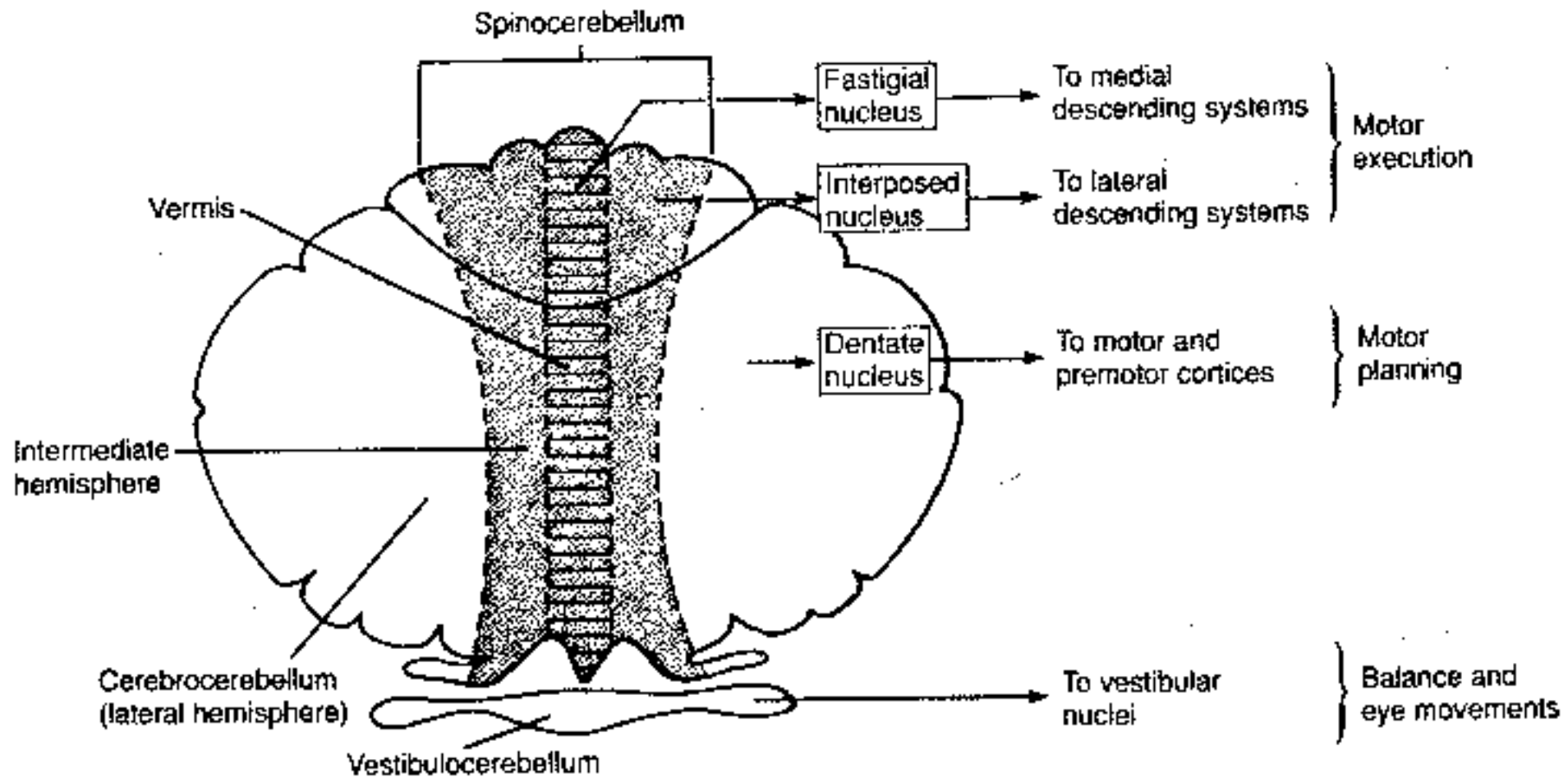
Th. VL

Ncl. dentatus

Lat. corticoospinal tract

Spinal motor neurons

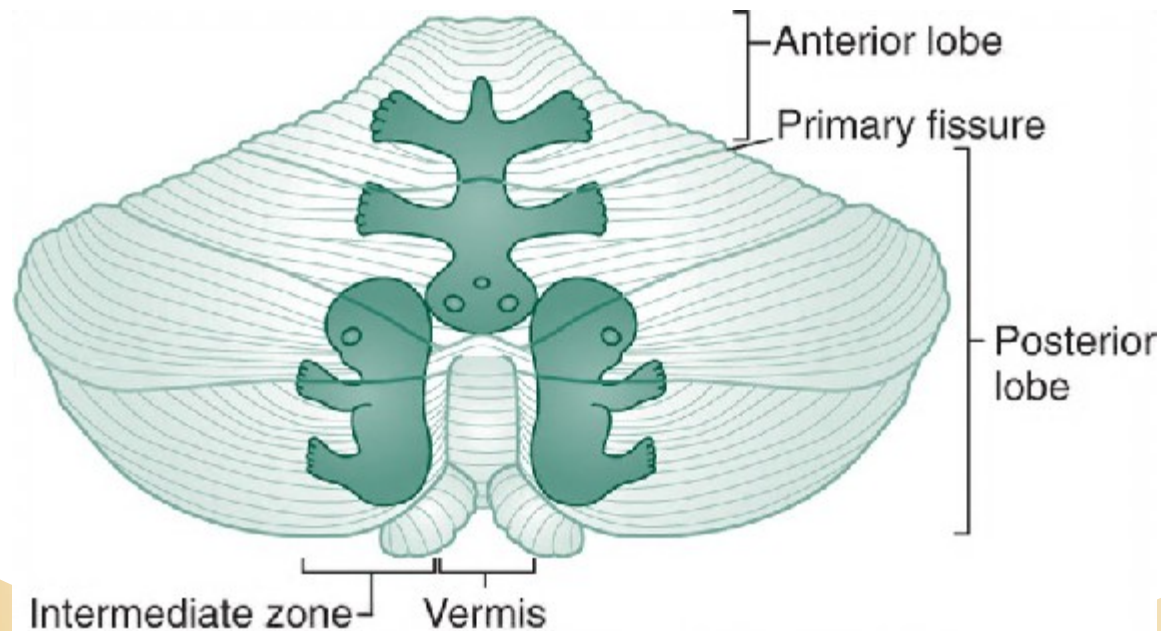
- **planning and timing of movements**
- **cognitive functions**



Somatotopic organization

Projection of both spinocerebellar pathways and motor cortex

- ❑ ipsilateral anterior lobe
- ❑ bilateral paramedian (intermediate) zone



CEREBELLAR DISORDERS

Ataxia - errors in the force, direction, speed and amplitude of movements

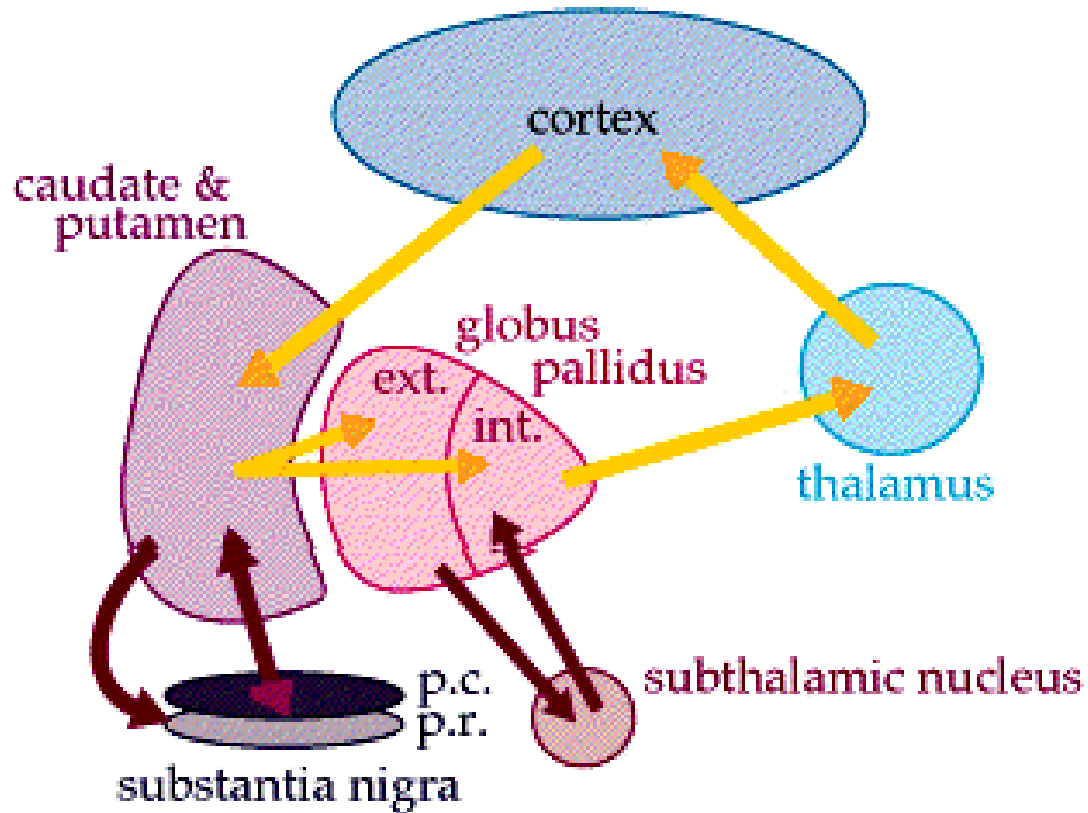
Dysmetria - „overshooting or undershooting“ - the hand may travel past the target

Asynergia - incoordination

Adiadochokinesia - inability to perform rapid alternating movements

Intention tremor - involuntary movement caused by alternating contractions of opposing muscle groups

BASAL GANGLIA



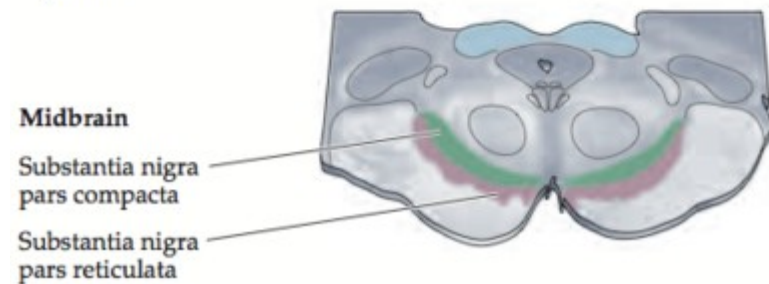
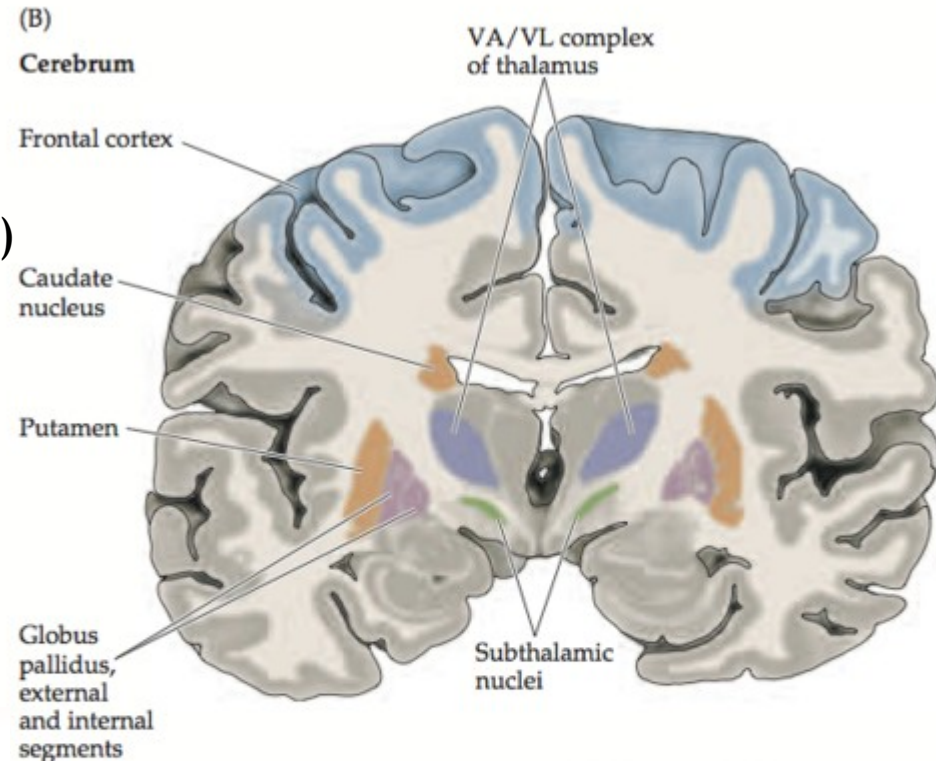
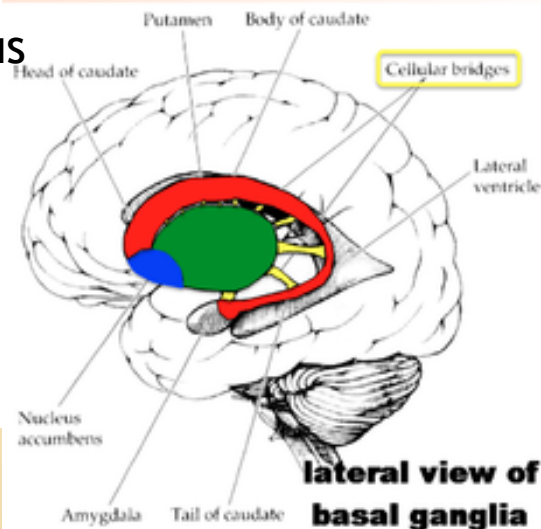
BASAL GANGLIA

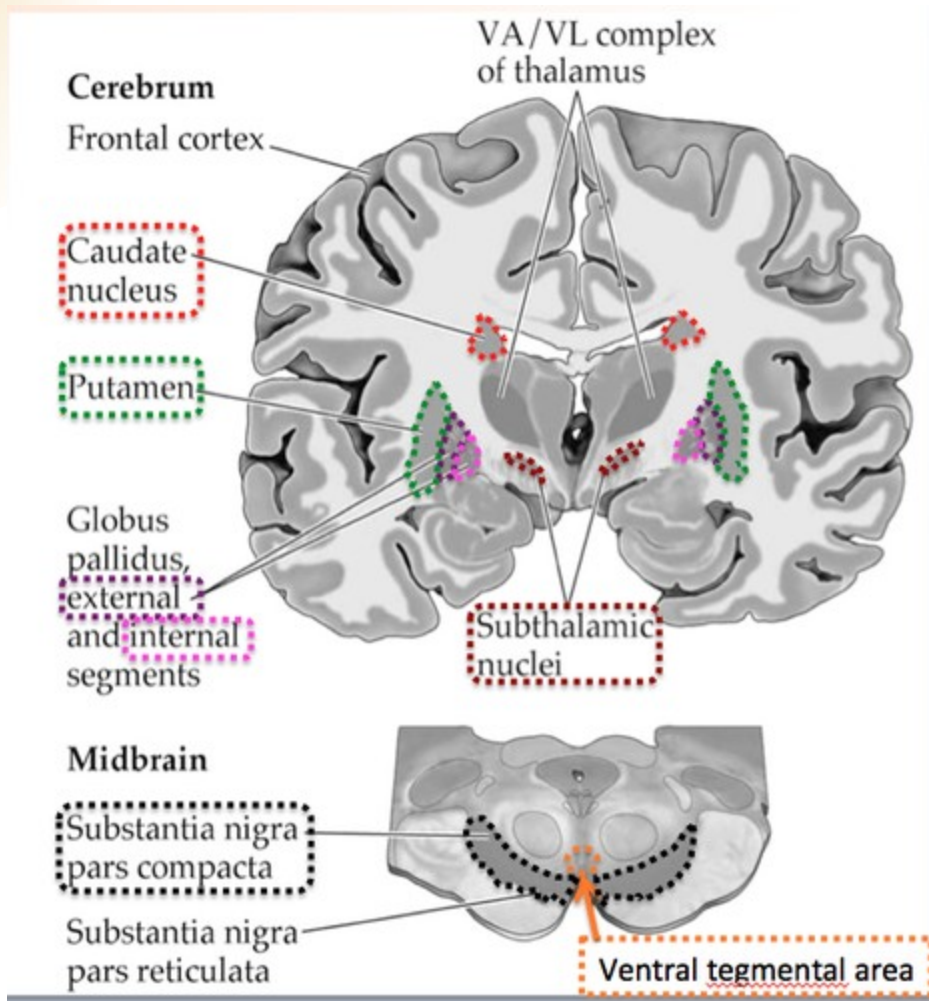
Striatum (neostriatum) - ncl. caudatus (D)
 - putamen (D)
 - ncl. accumbens (V)

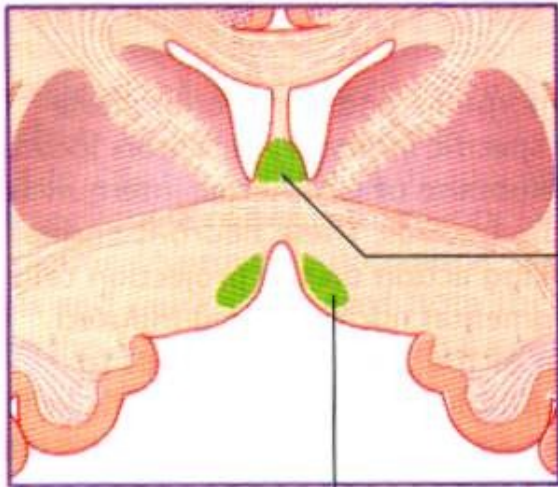
Pallidum (paleostriatum) - globus pallidus
 ↙ ↘
 ext.s. int.s.

Substantia nigra - pars reticularis
 - pars compacta

Ncl. subthalamicus

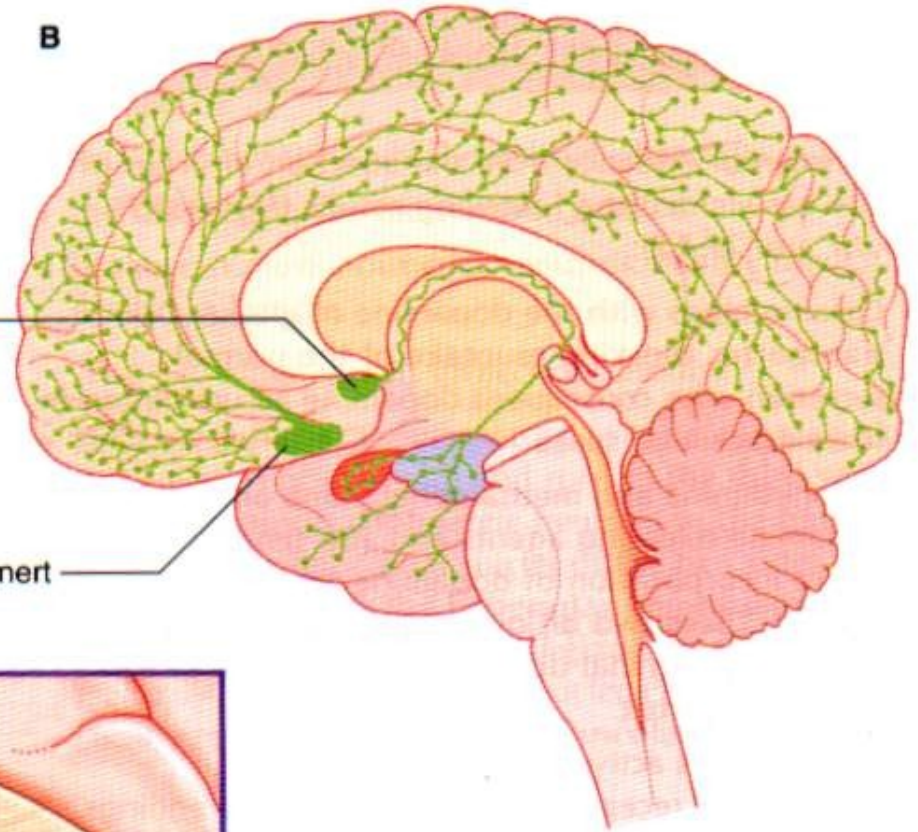
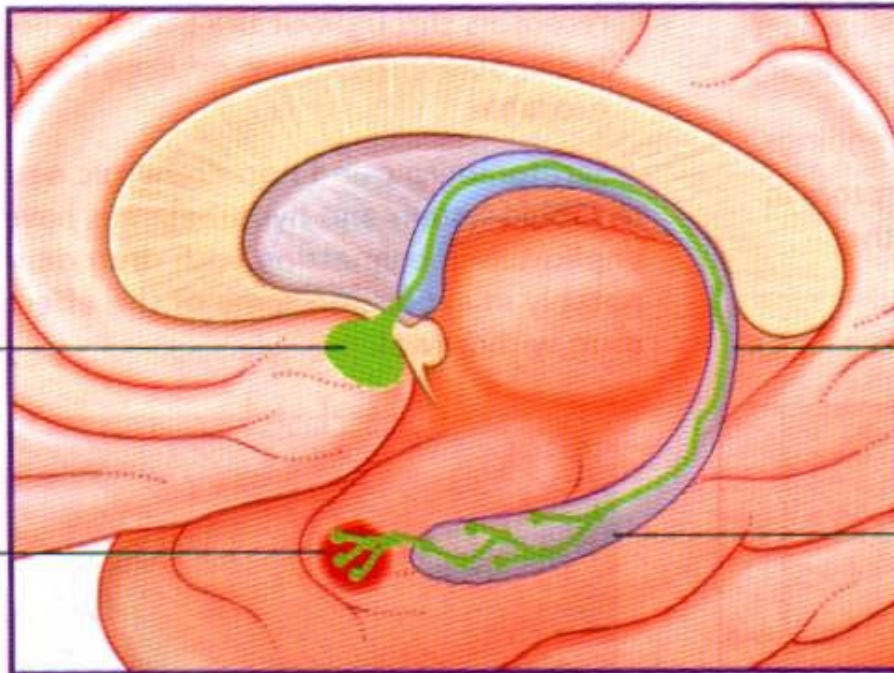




A

Septal nuclei

Basal nucleus of Meynert

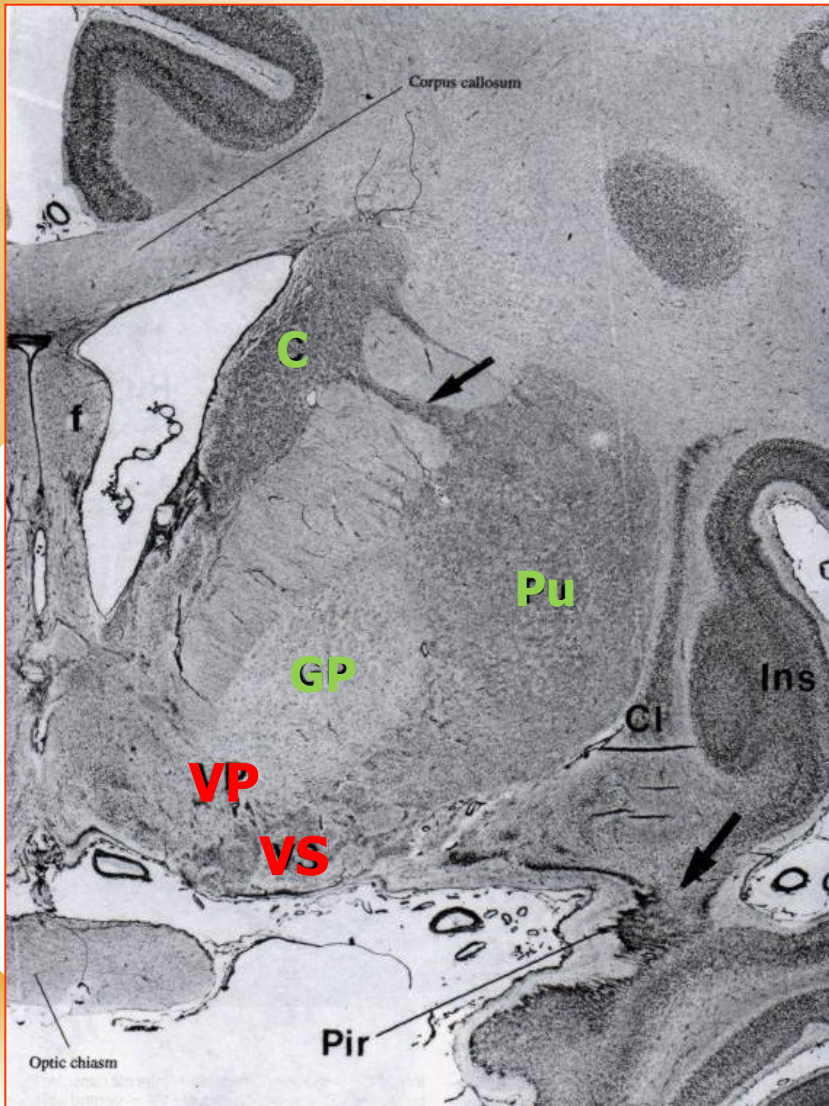
B**C**

Septal nuclei

Amygdala

Fornix

Hippocampus



Ncl caudatus + putamen

= dorsal striatum

Globus pallidus

= dorsal pallidum

Substantia innominata:

VS = ventr. striatum

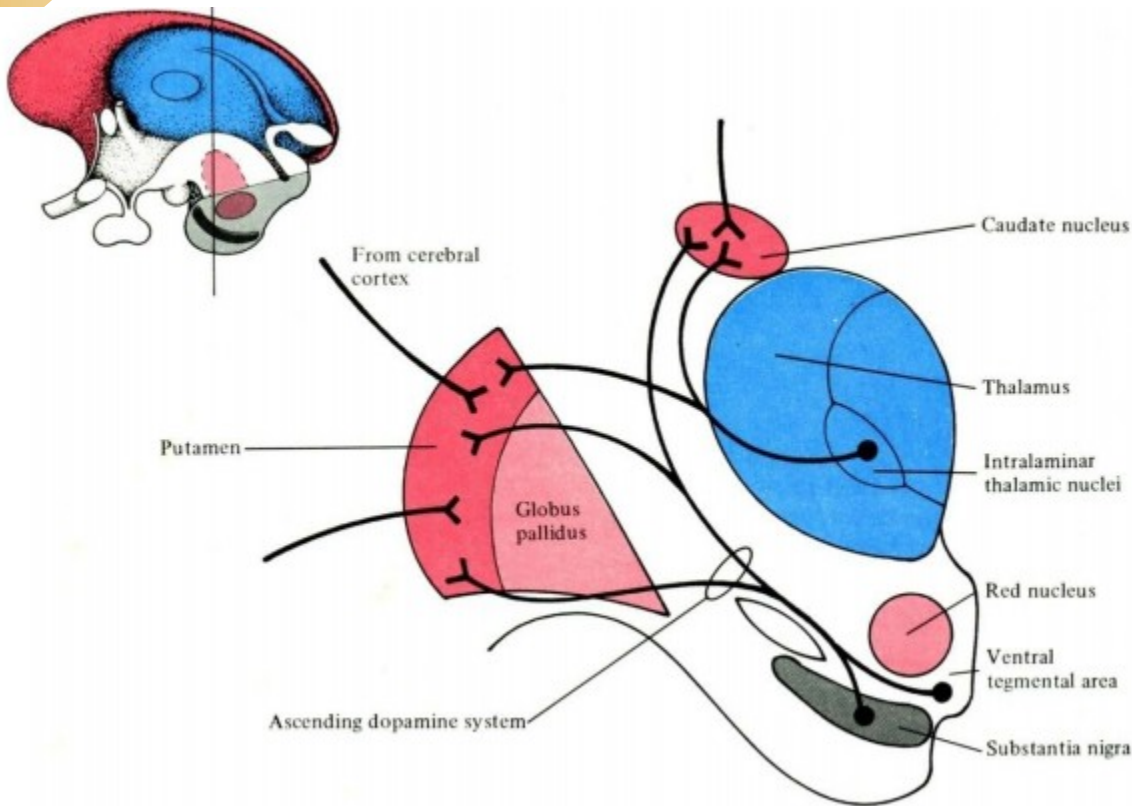
Ncl. accumbens septi

VP = ventral pallidum

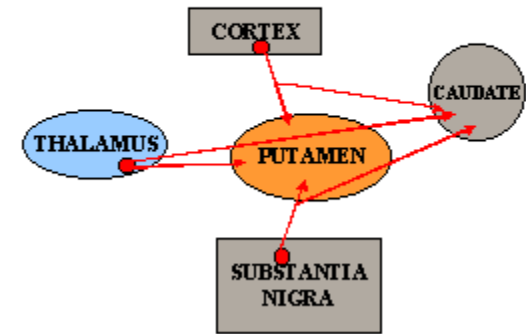
Ncl. basalis Meynerti

Basal ganglia afferents:

- ❑ cortex
- ❑ substantia nigra - pars compacta
- ❑ intralaminar ncl. of thalamus (CM)



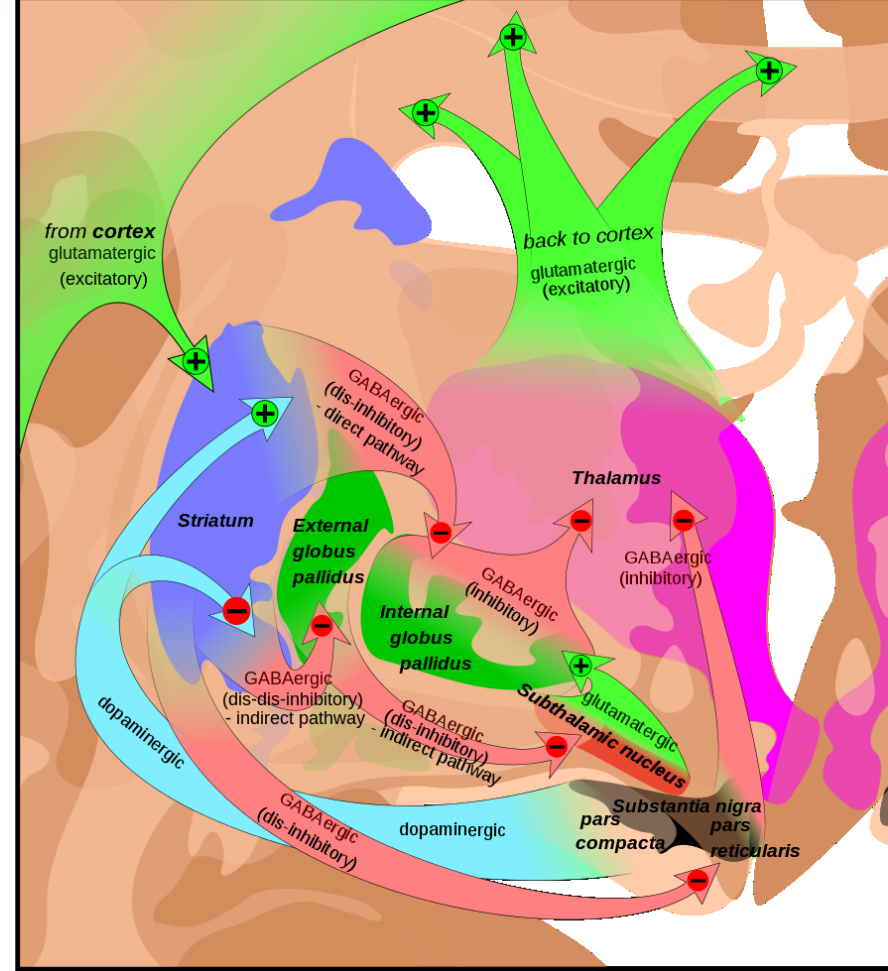
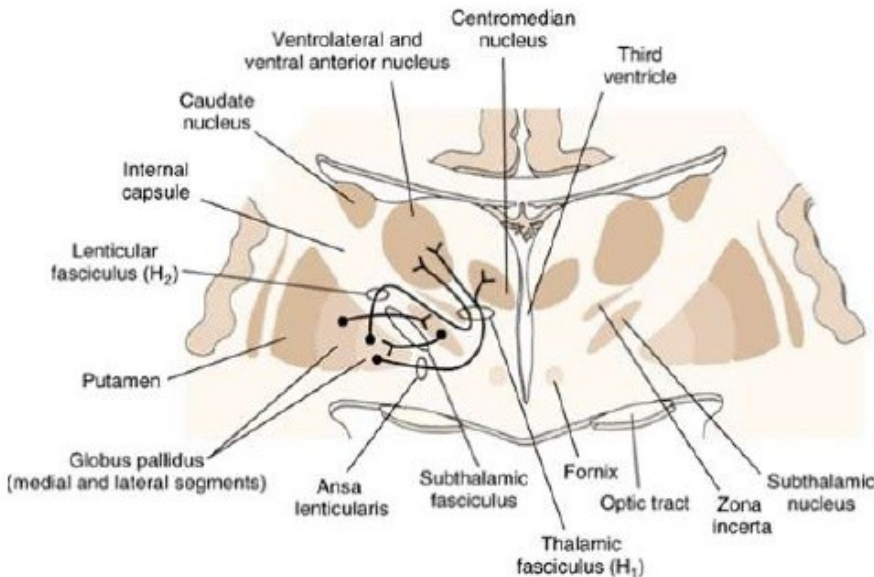
BASAL GANGLIA: AFFERENT CONNECTIONS



Basal ganglia efferents:

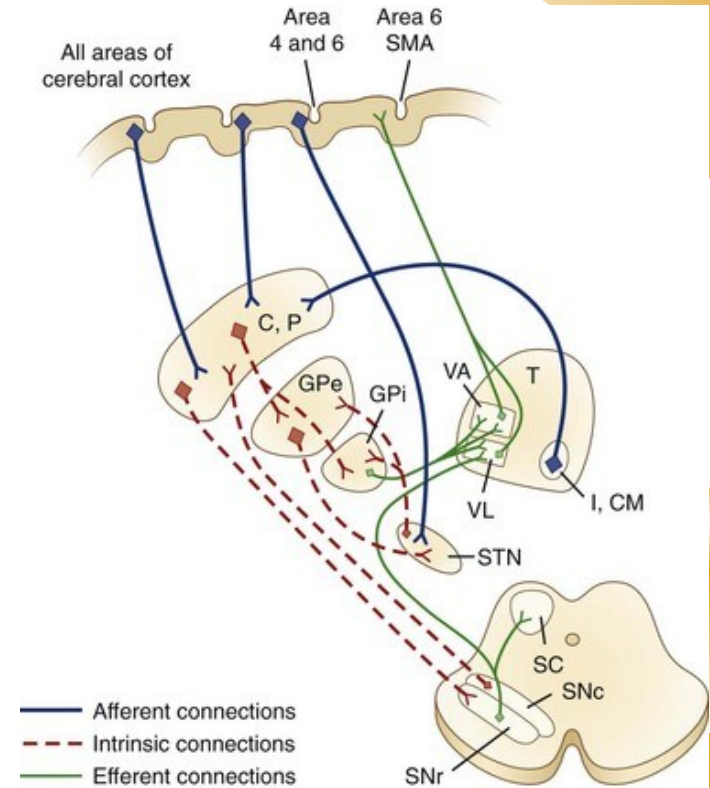
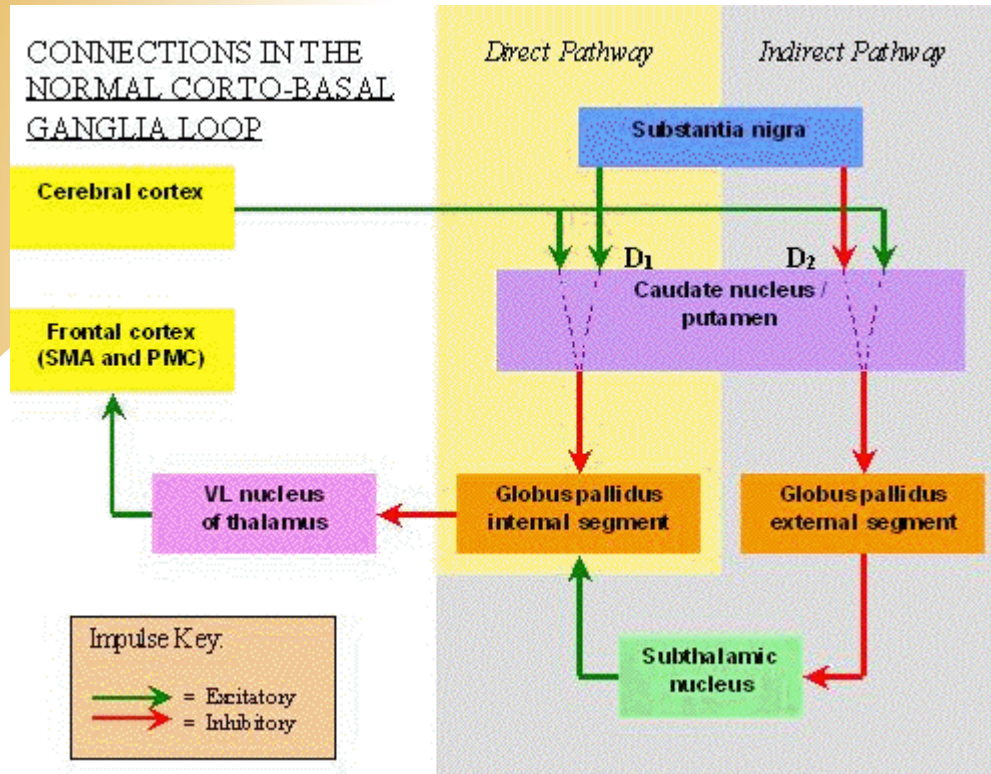
- ❑ GPi
- ❑ SN - pars reticularis
- Th. VA/VL
- Th. CM

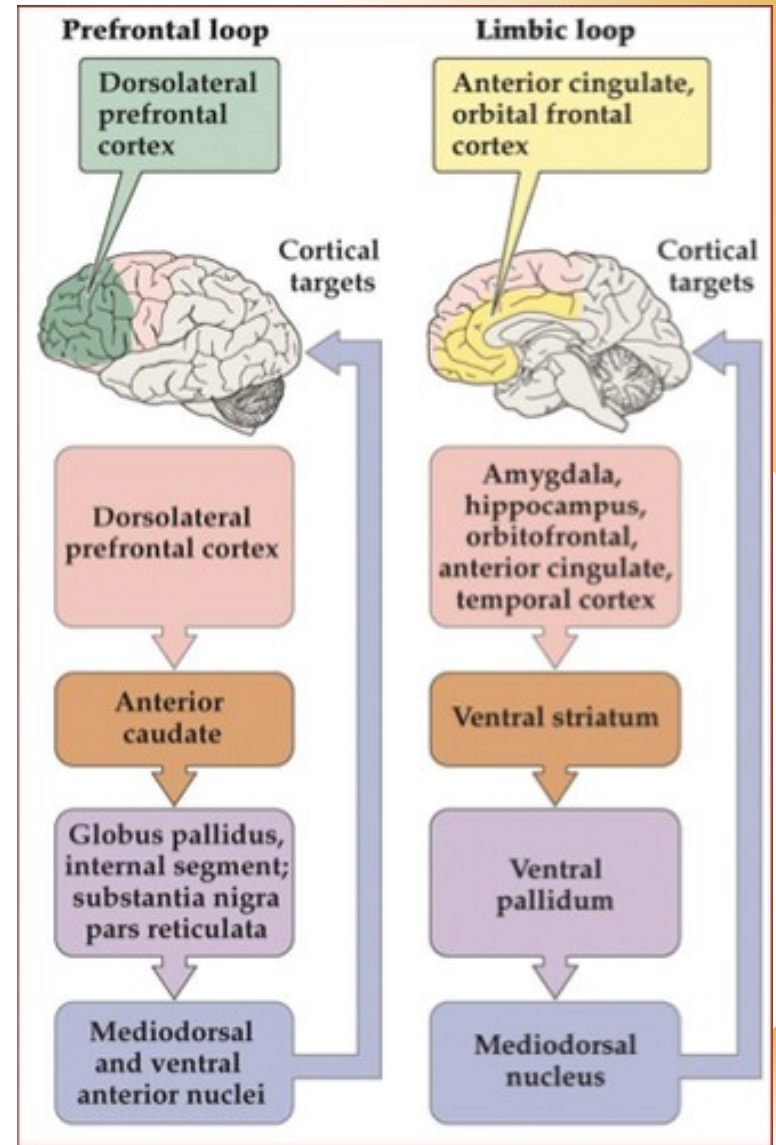
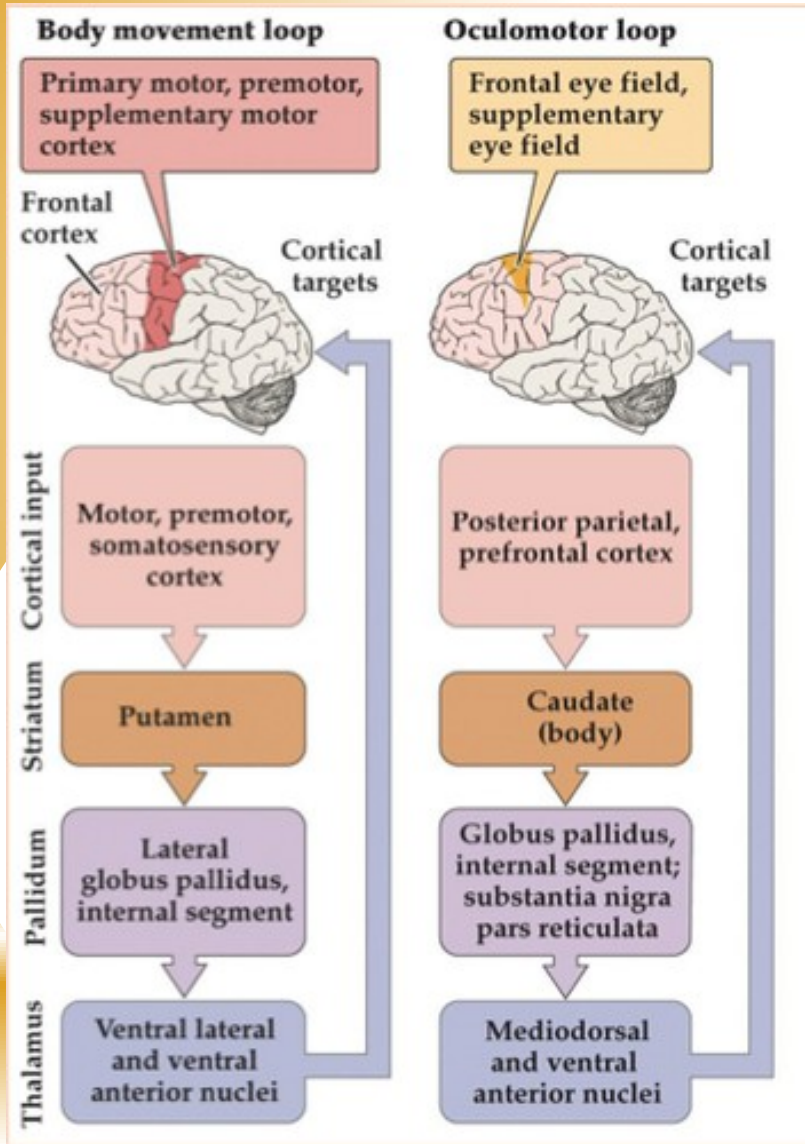
EFFERENT OF BG



(ansa lenticularis + fasciculus lenticularis → fasciculus thalamicus)

Motor loop





SPINAL MOTOR REFLEXES

SPINAL REFLEXES

□ type of afferents

- somatic spinal reflexes
- visceral spinal reflexes

□ type of somatosensor

- proprioceptive reflexes
- exteroceptive reflexes

□ number of involved spinal segments

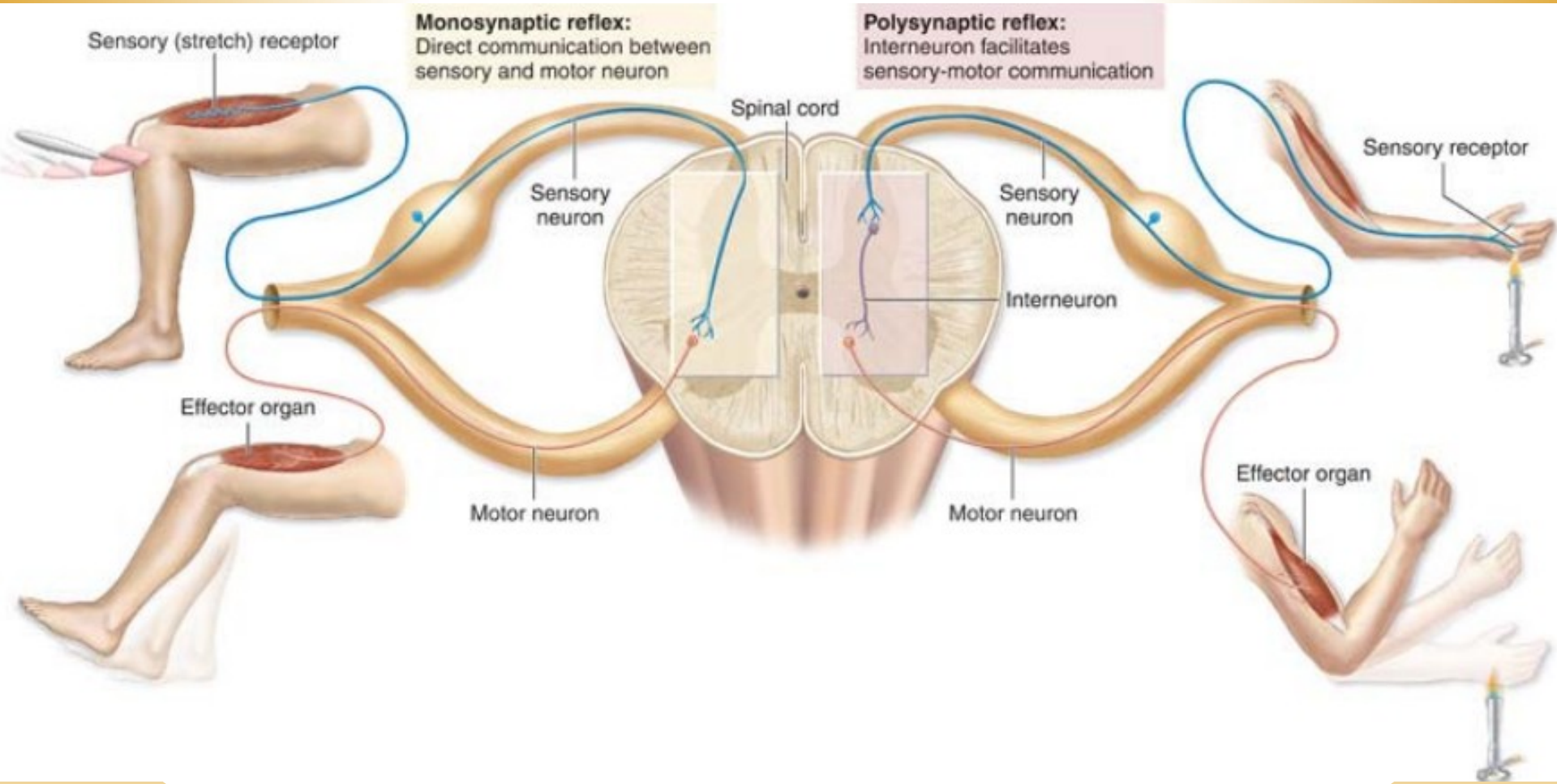
- monosegmental spinal reflexes
- polysegmental spinal reflexes

□ number of synapses

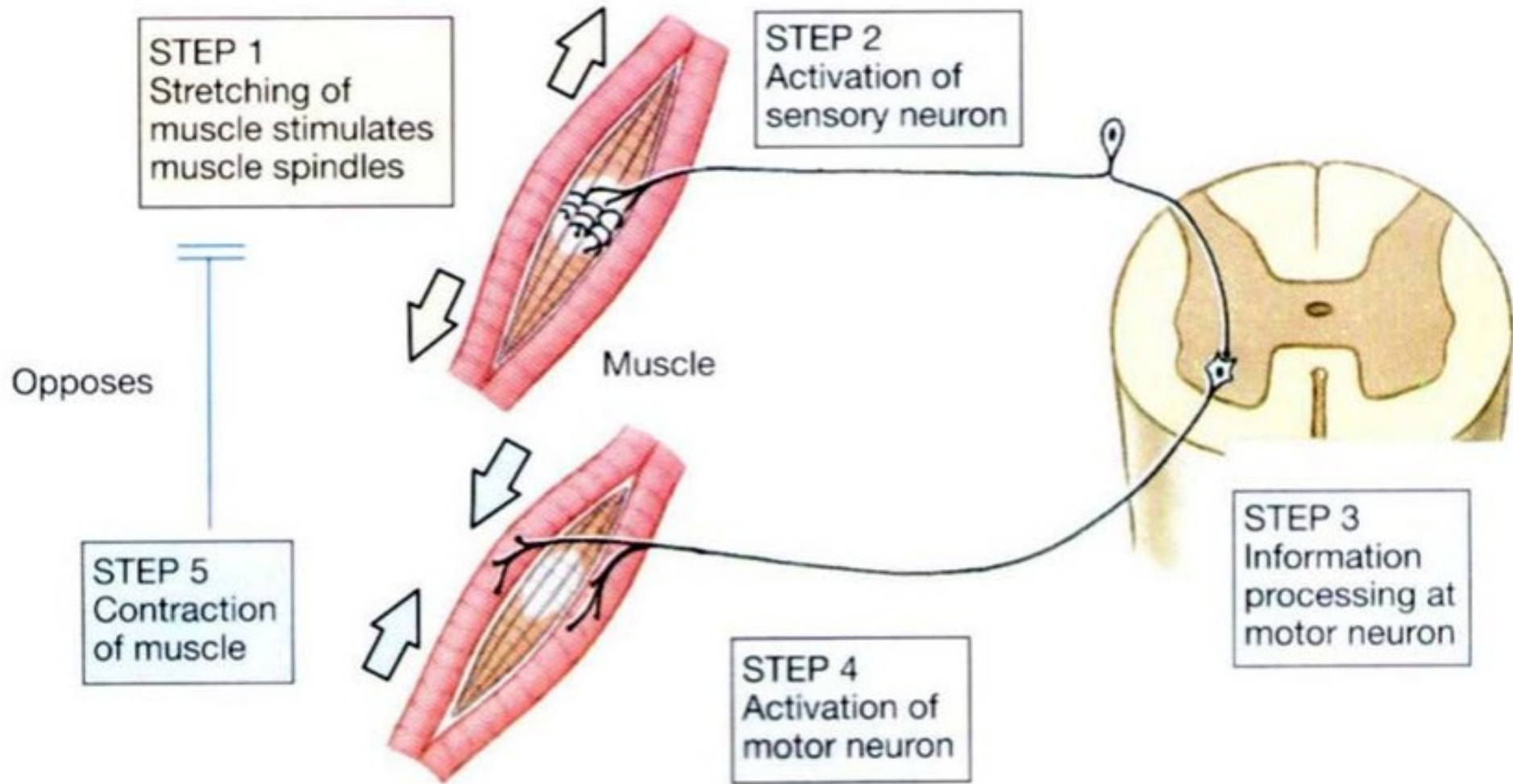
- monosynaptic reflexes
- disynaptic reflexes
- polysynaptic reflexes

Myotatic reflex

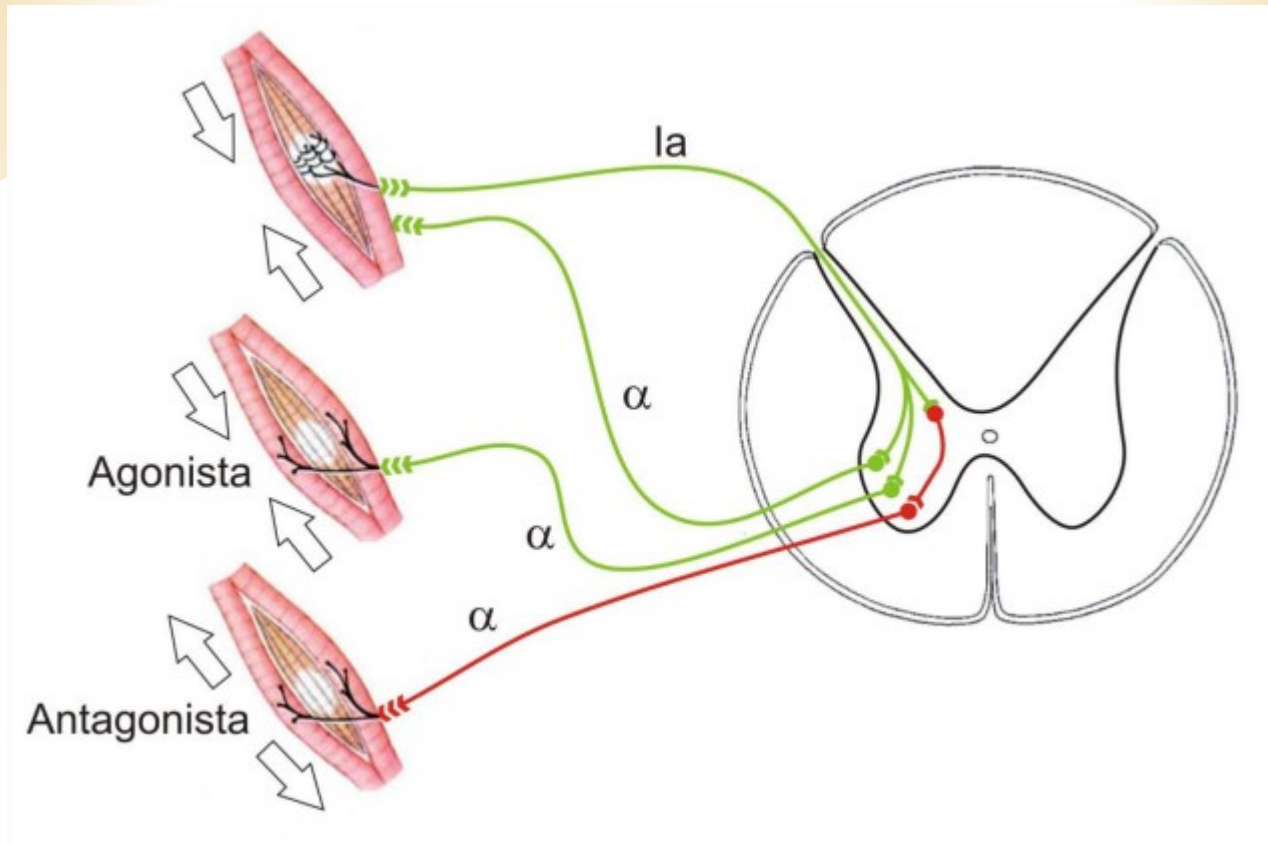
Withdrawal reflex



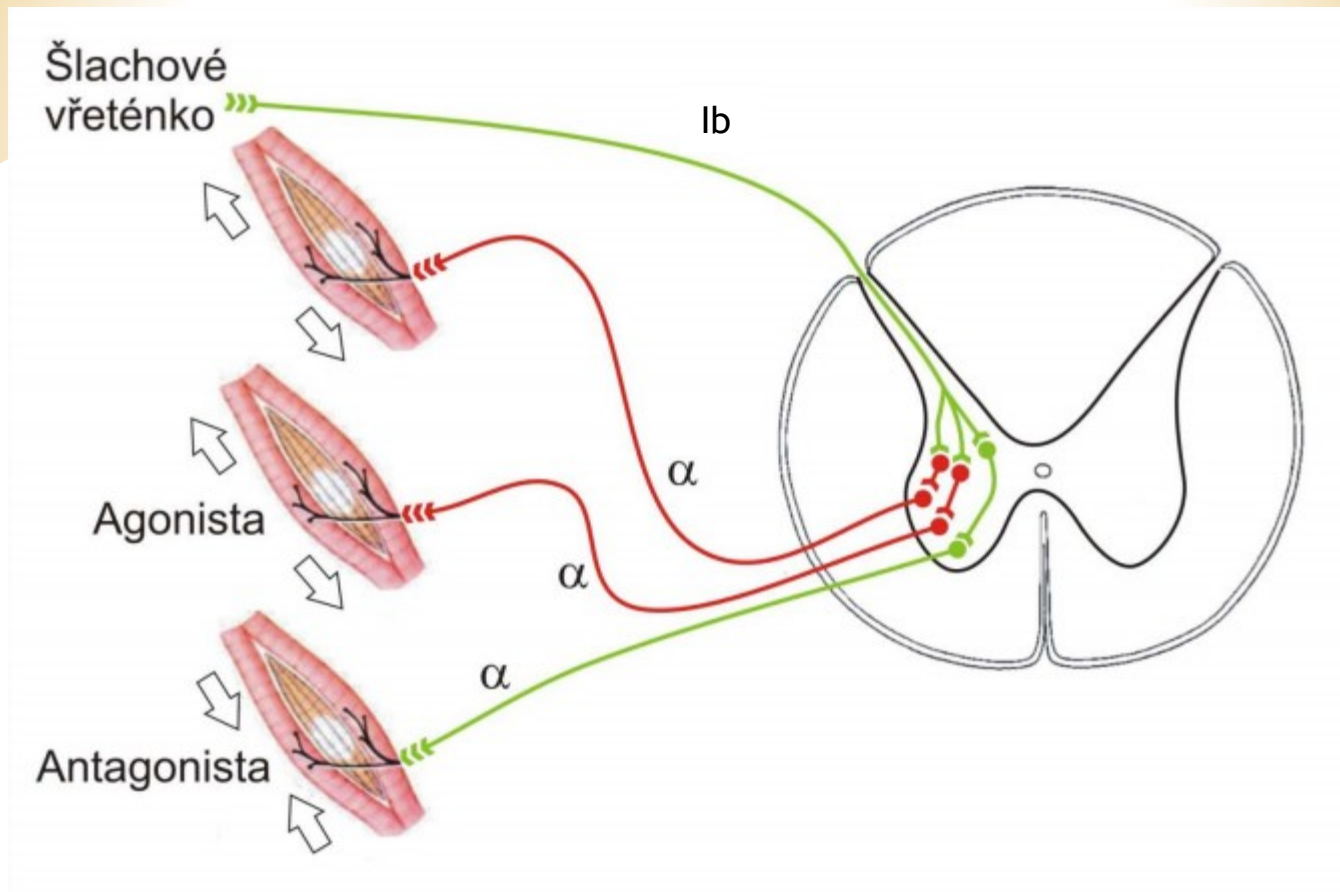
Myotatic (stretch) reflex



Myotatic (stretch) reflex

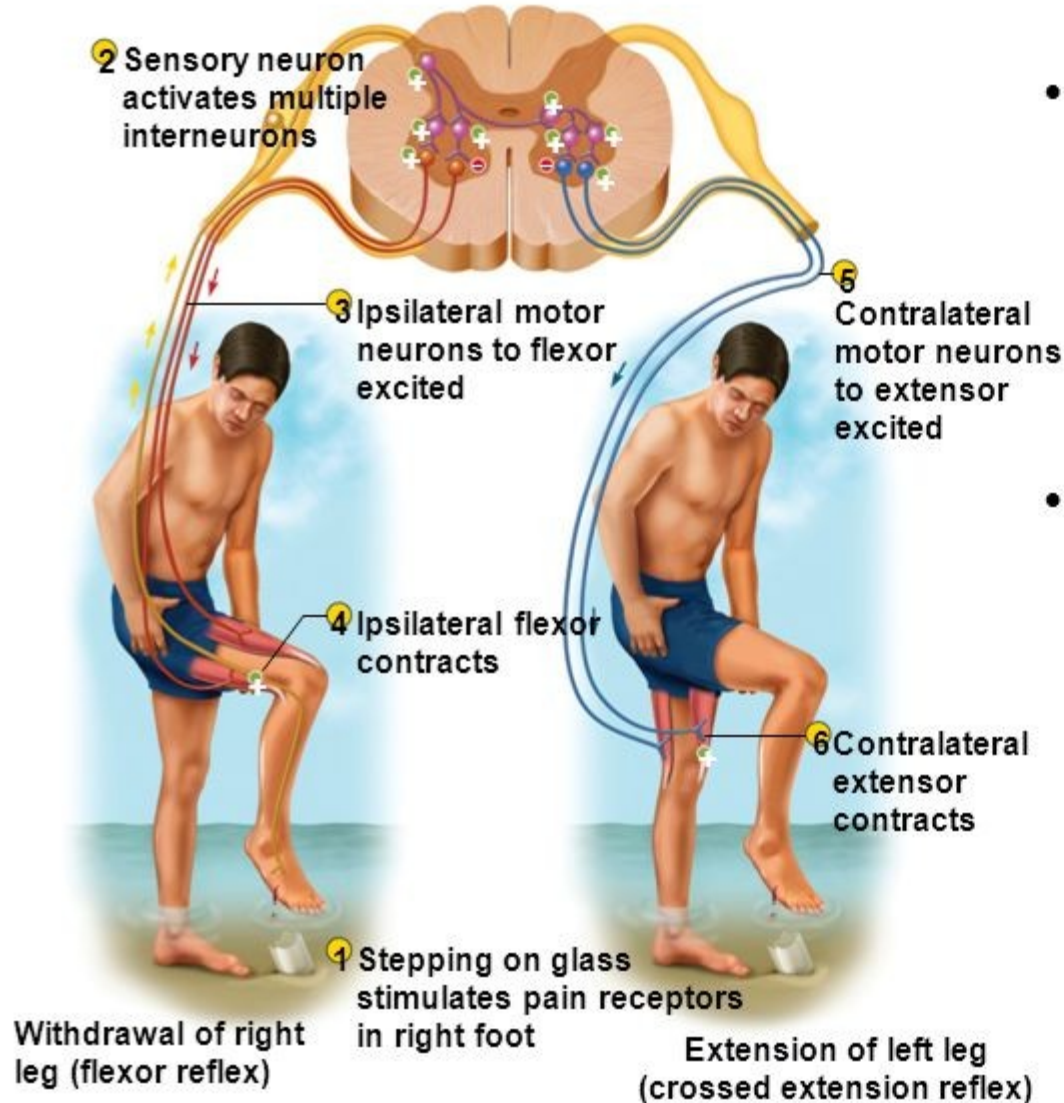


Reflex loop of Golgi tendon organ (inverse myotatic reflex)



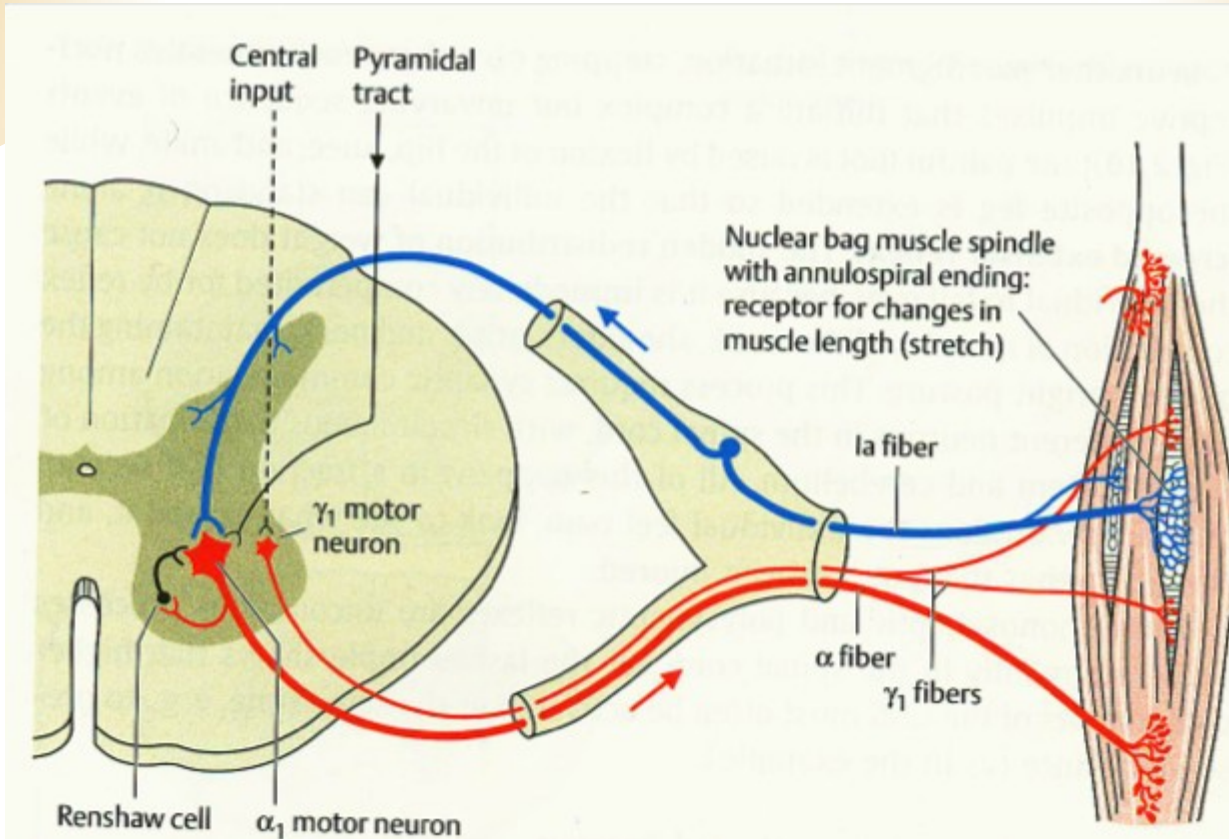
The Flexor (Withdrawal) Reflexes

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

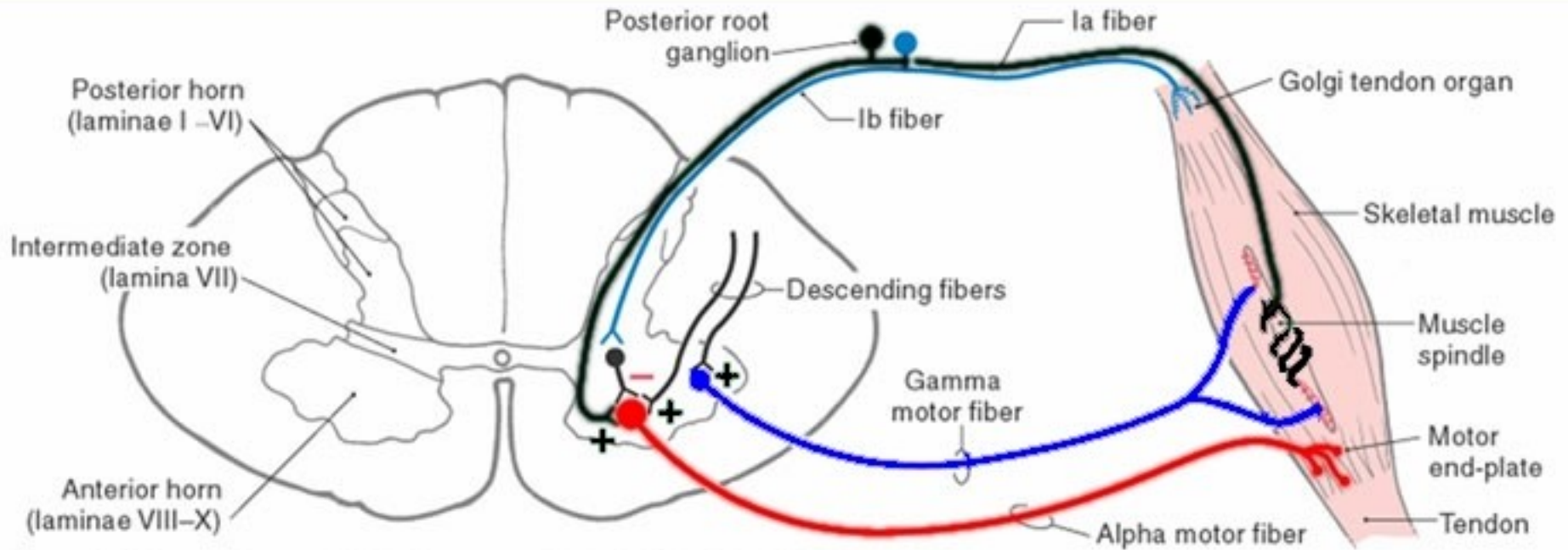


- **flexor reflex** – the quick contraction of flexor muscles resulting in the withdrawal of a limb from an injurious stimulus
- requires contraction of the flexors and relaxation of the extensors

Renshaw cells



Gamma loop



Churchill Livingstone items and derived items copyright © 2002 by Churchill Livingstone

EYE MOVEMENTS



EYE MOVEMENTS

- ❑ Fovea centralis - area of most acute vision
- ❑ Coordination of 12 extraocular muscles
- ❑ **Eye movements**
 - conjugated - both eyes in same direction
 - vergent - during motion of object to and from us
 - convergent
 - divergent

DISJUNCTIVE (VERGENCE)

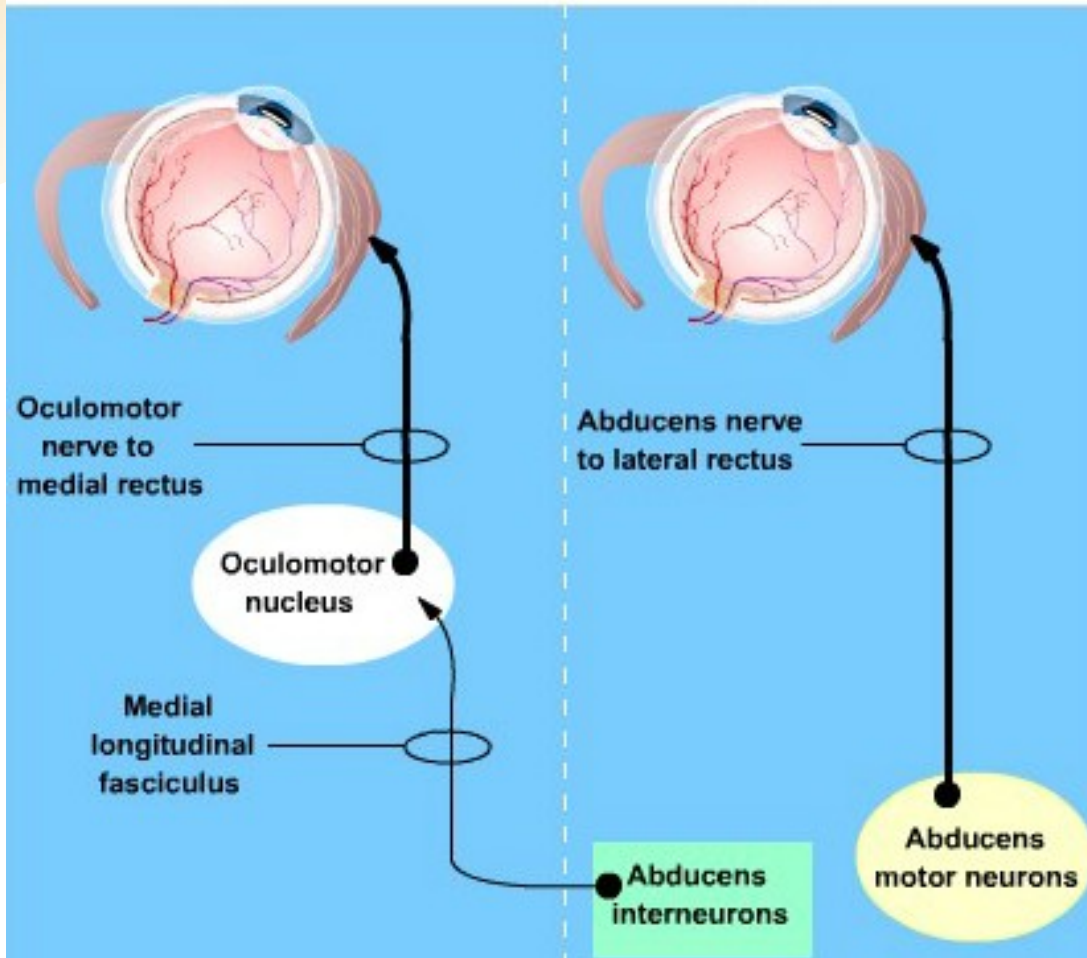


CONJUGATE



LEFT

RIGHT

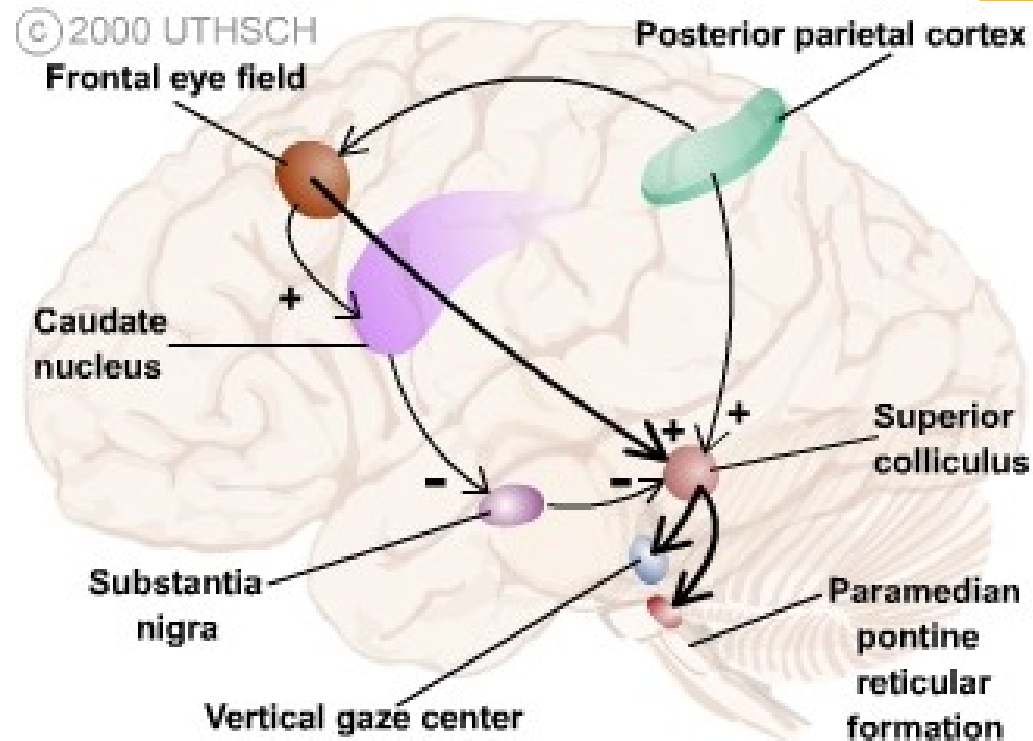
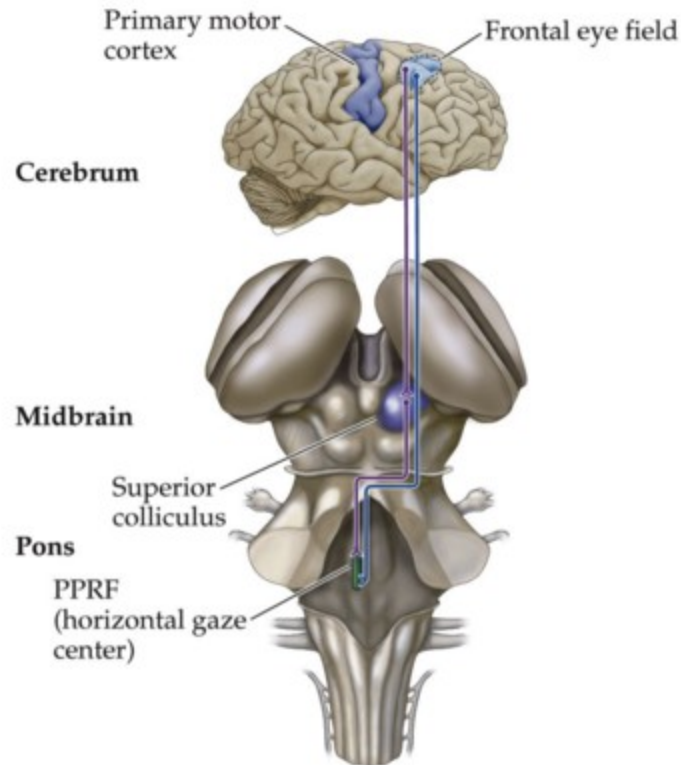


Four basic types of eye movements

- ❑ Saccades
- ❑ Smooth pursuit movements
- ❑ Vergence movements
- ❑ Vestibulo-ocular movements

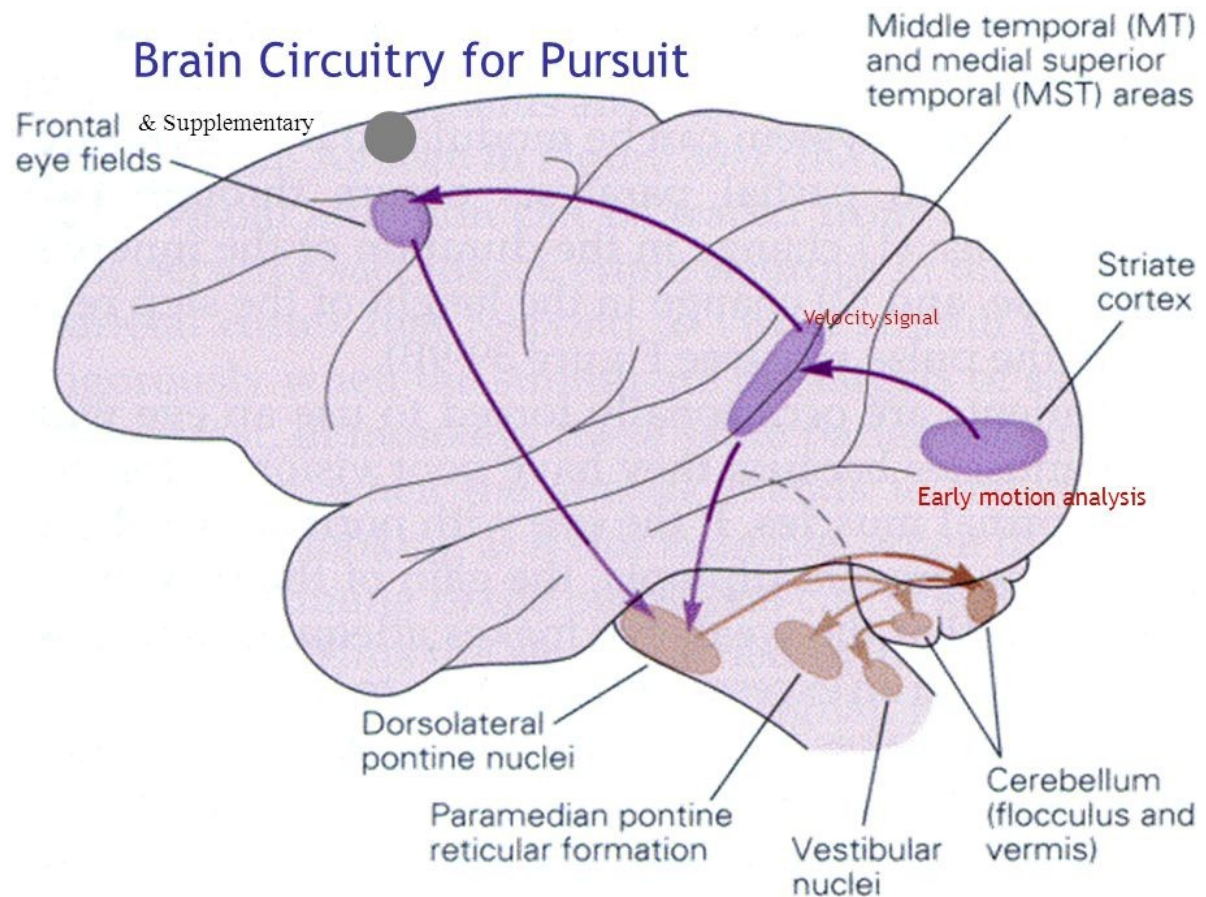
Saccadic eye movements

- horizontal gaze center - PPRF
- vertical gaze center - RF of the midbrain
- superior colliculi - information from FEF, retina, auditory, and tactile i.



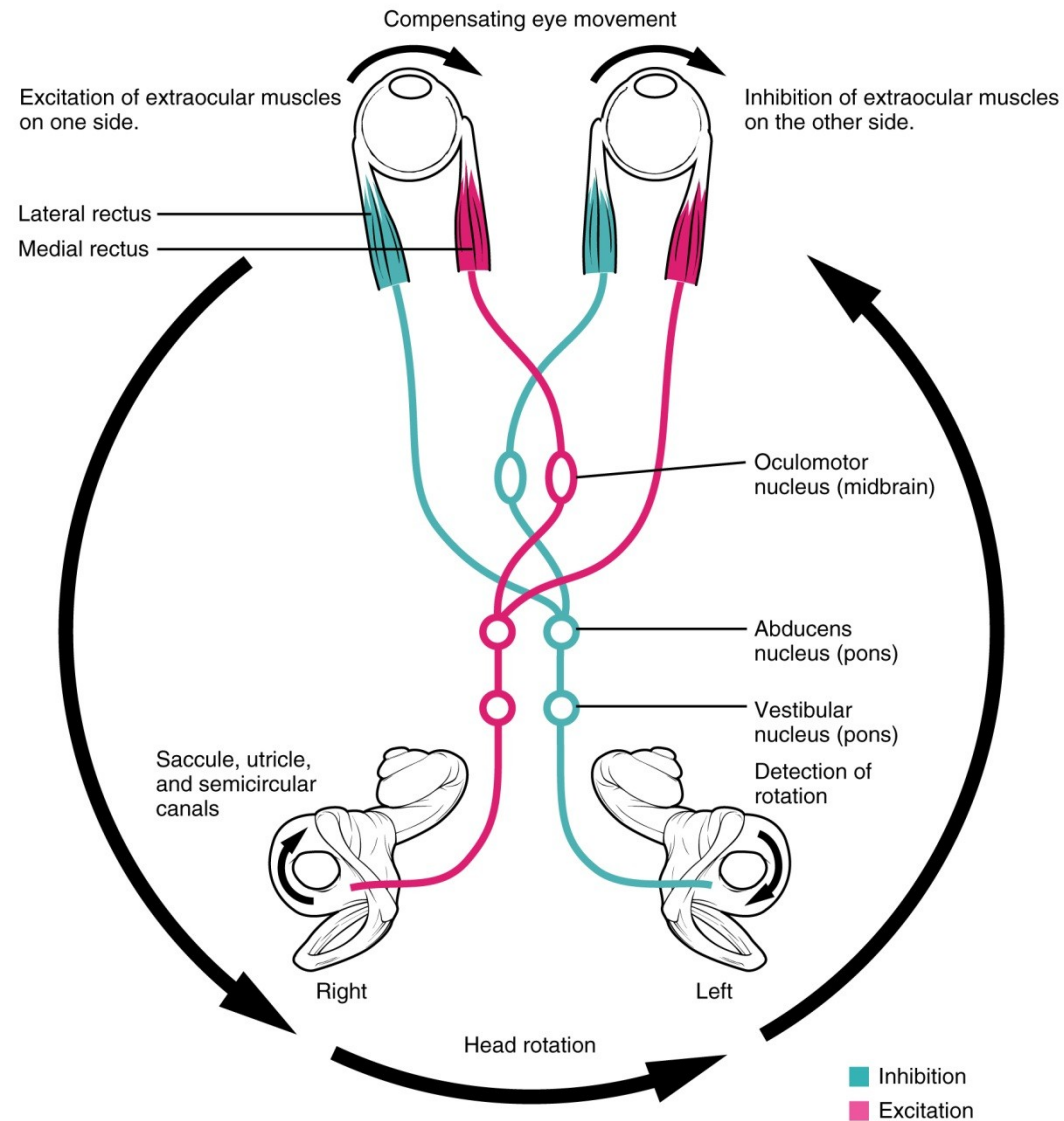
Smooth pursuit movements

- ❑ elicited by a moving visual target that the eyes follow voluntarily or under direction
- ❑ the moving visual target is required to initiate this eye movement

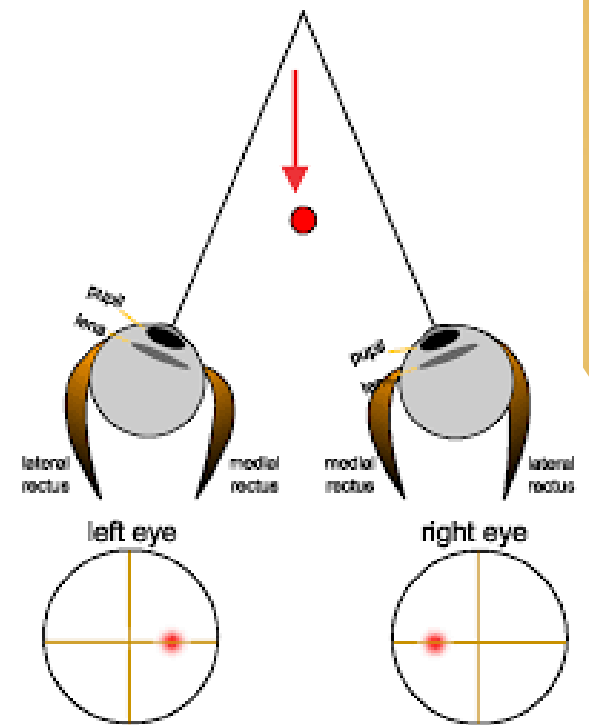


Vestibulo-ocular movements

- stabilize the eyes relative to the external world, thus compensating for head movements



Vergence movements



**Near reflex triad: convergence
accommodation of the lens
pupillary constriction**

Illustrations were copied from:

**Neuroscience Online, the Open-Access Neuroscience
Electronic Textbook**

Department of Neurobiology and Anatomy
University of Texas Medical School at Houston