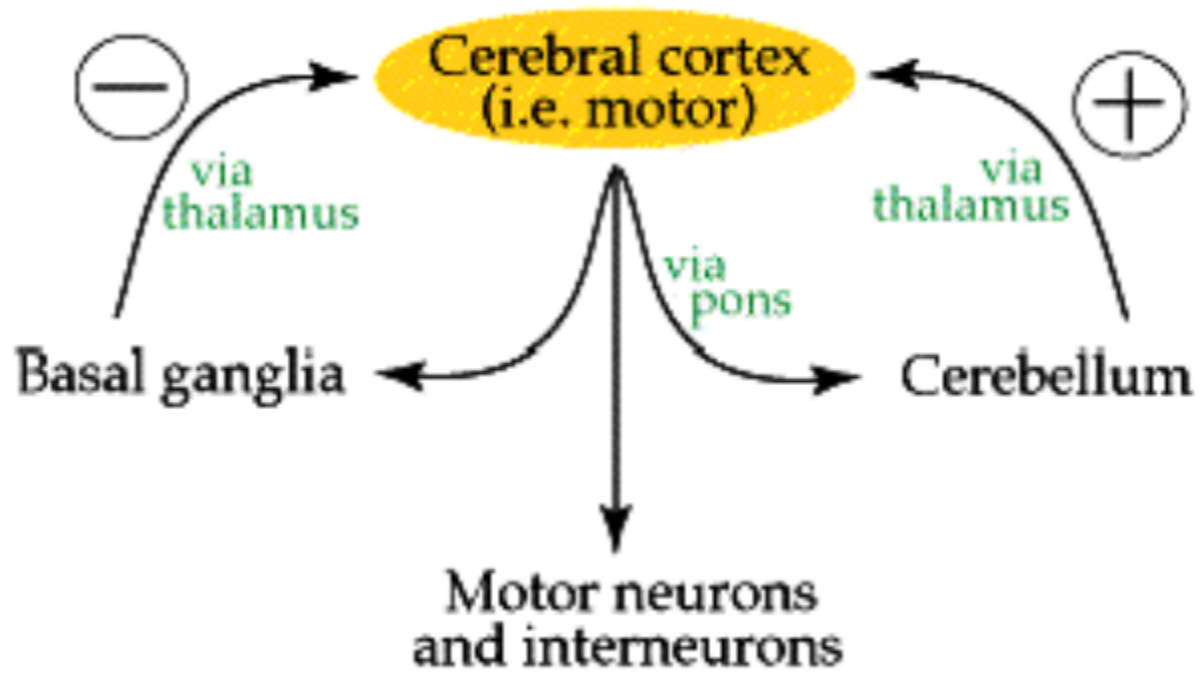


# **PATHWAYS OF THE CEREBELLUM AND BASAL GANGLIA**



# CEREBELLUM

## Functions:

*Maintenance of balance and posture*

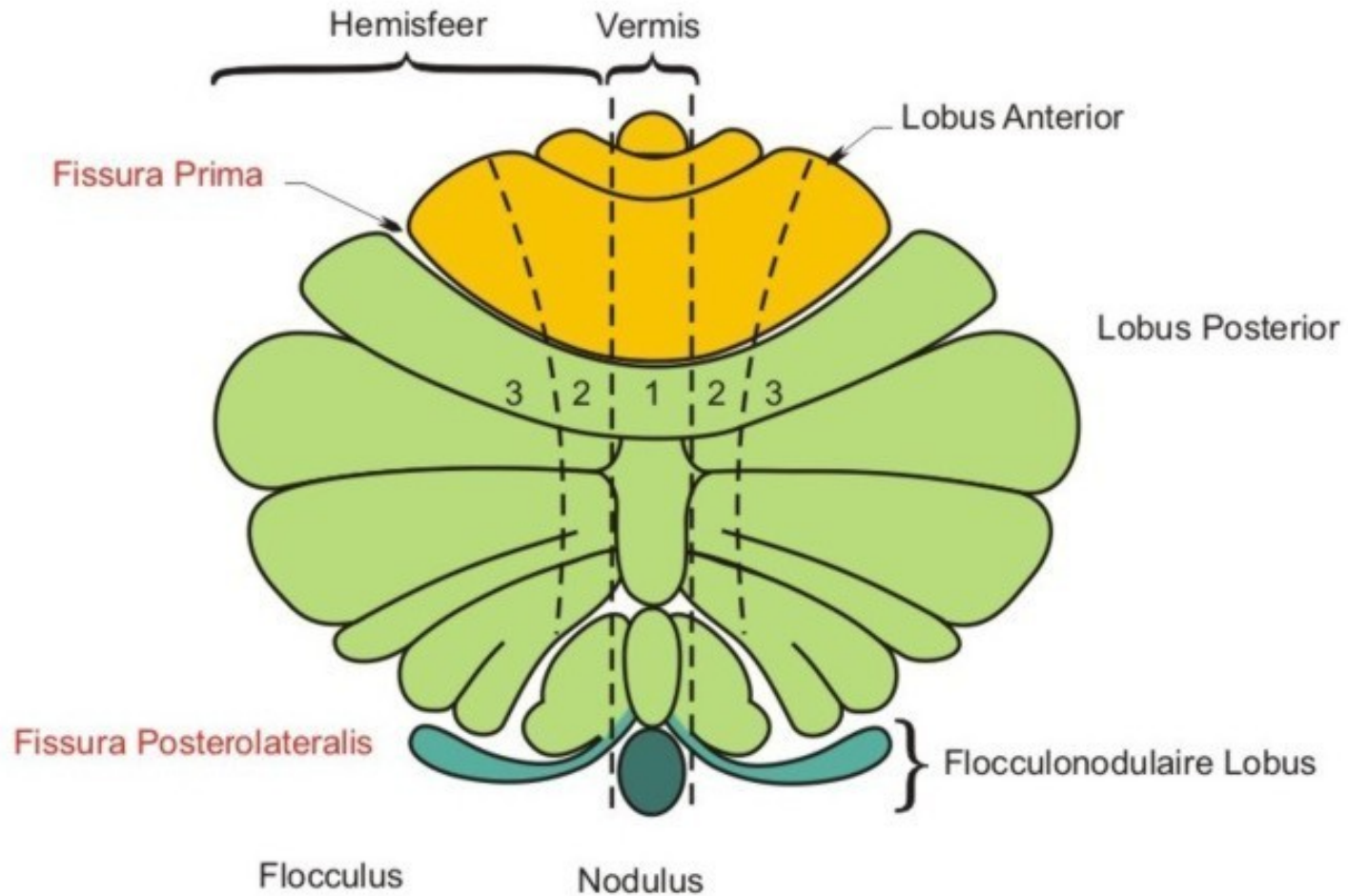
*Coordination of voluntary movements*

*Motor learning*

*Cognitive functions*

# CEREBELLUM

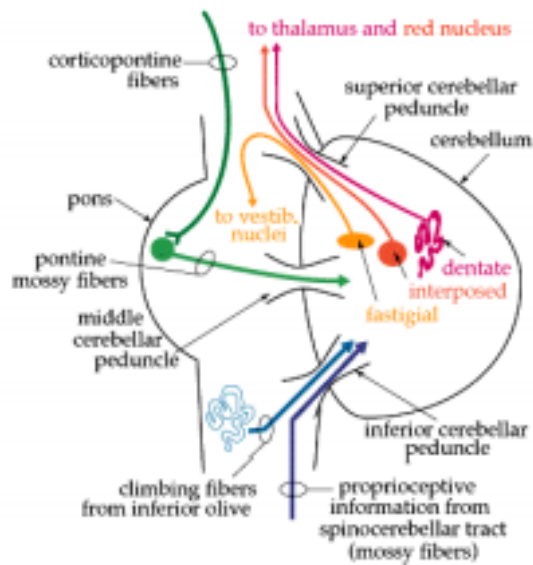
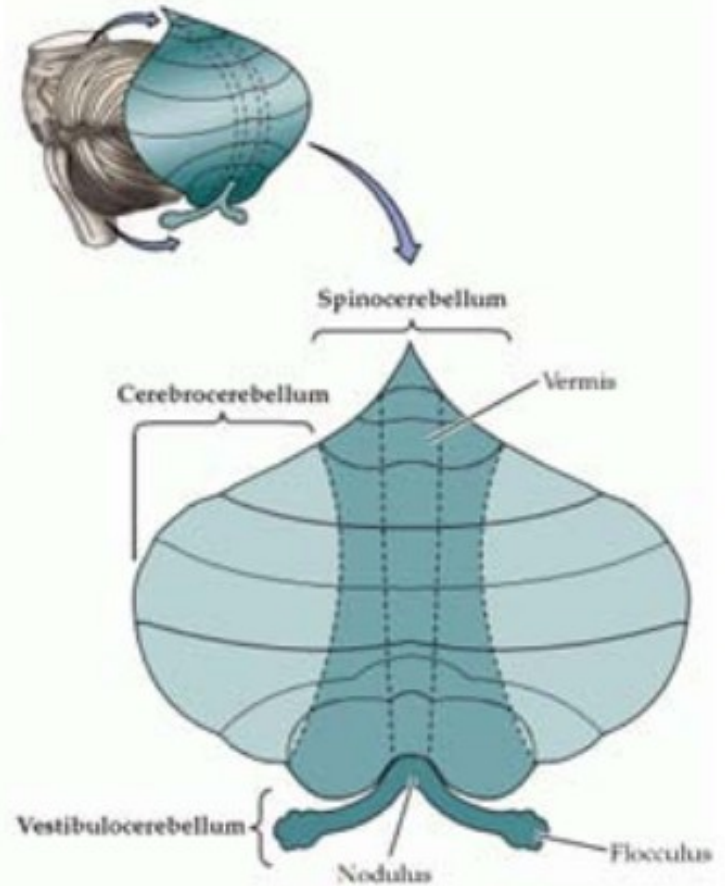
## Anatomical division



# CEREBELLUM

## Developmental division

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



# CEREBELLUM

## Functional division

### VC

- flocculonodular lobe
- vestibular ncll.

### SC - median zone

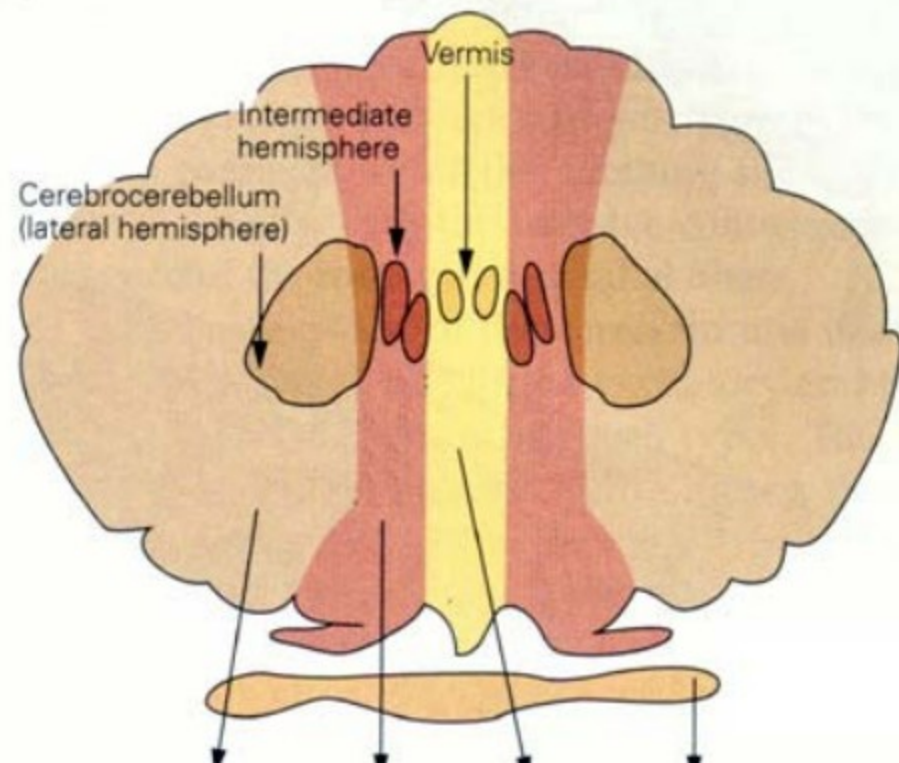
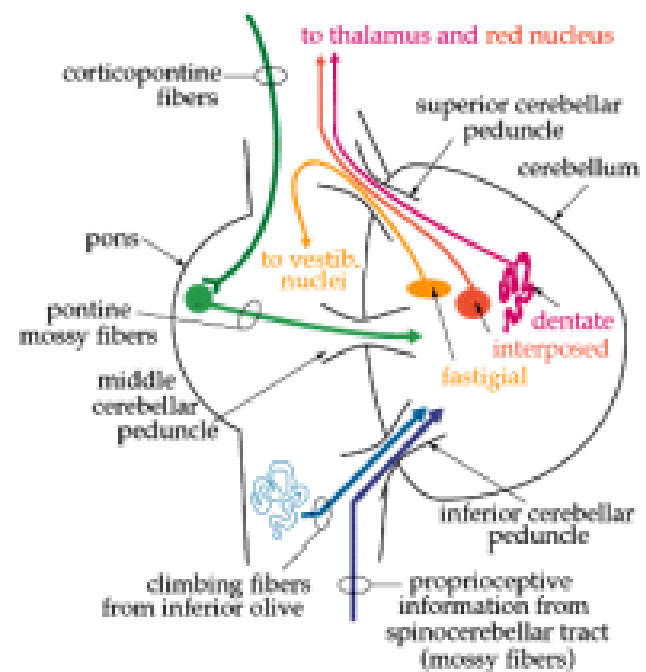
- vermis
- ncl. fastigii

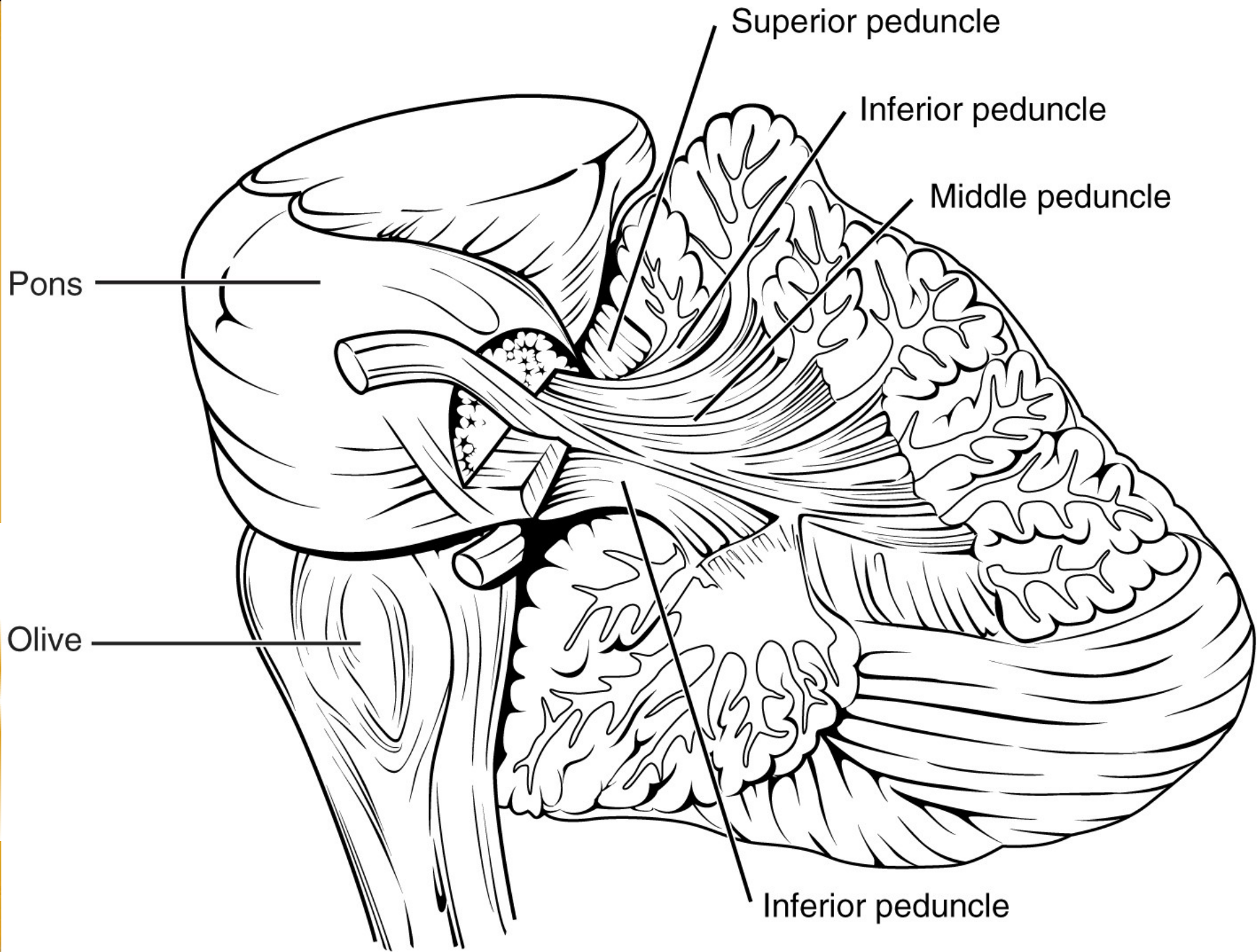
### SC - paramedian zone

- intermediate cortex
- ncll. emboliformis et globosus

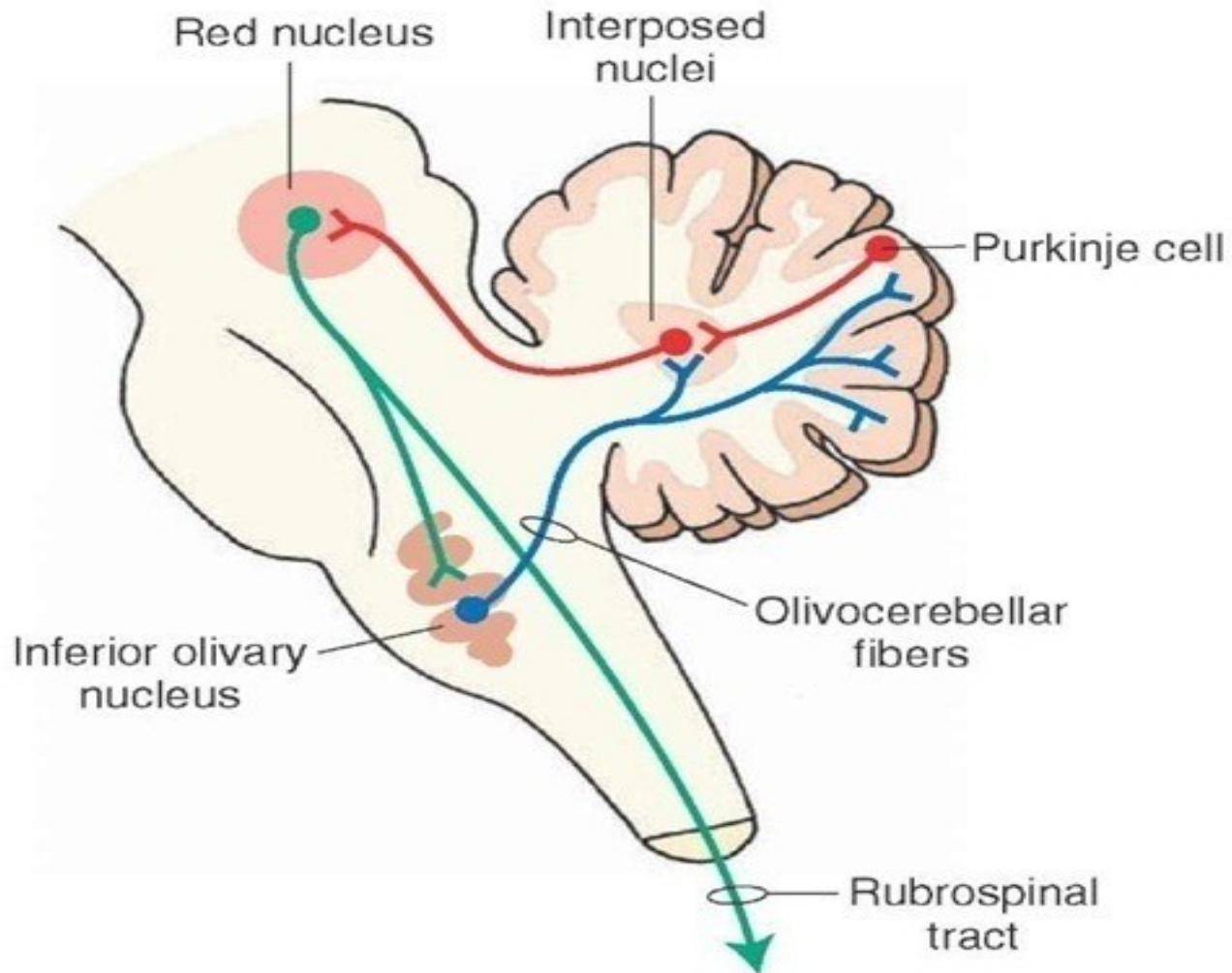
### CC - lateral zone

- cortex cerebellar hemispheres
- ncl. dentatus



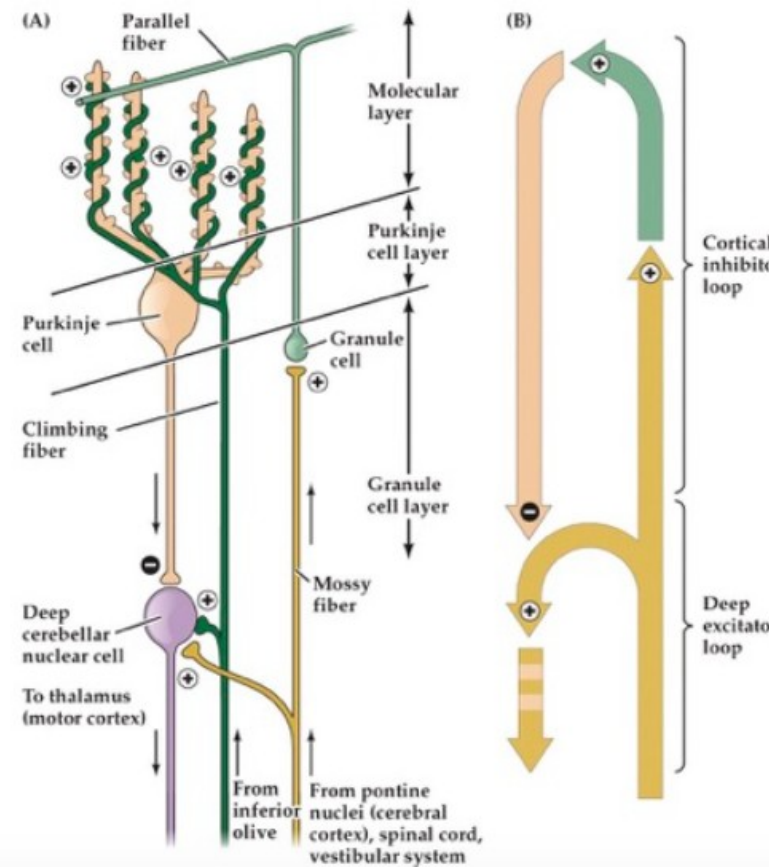
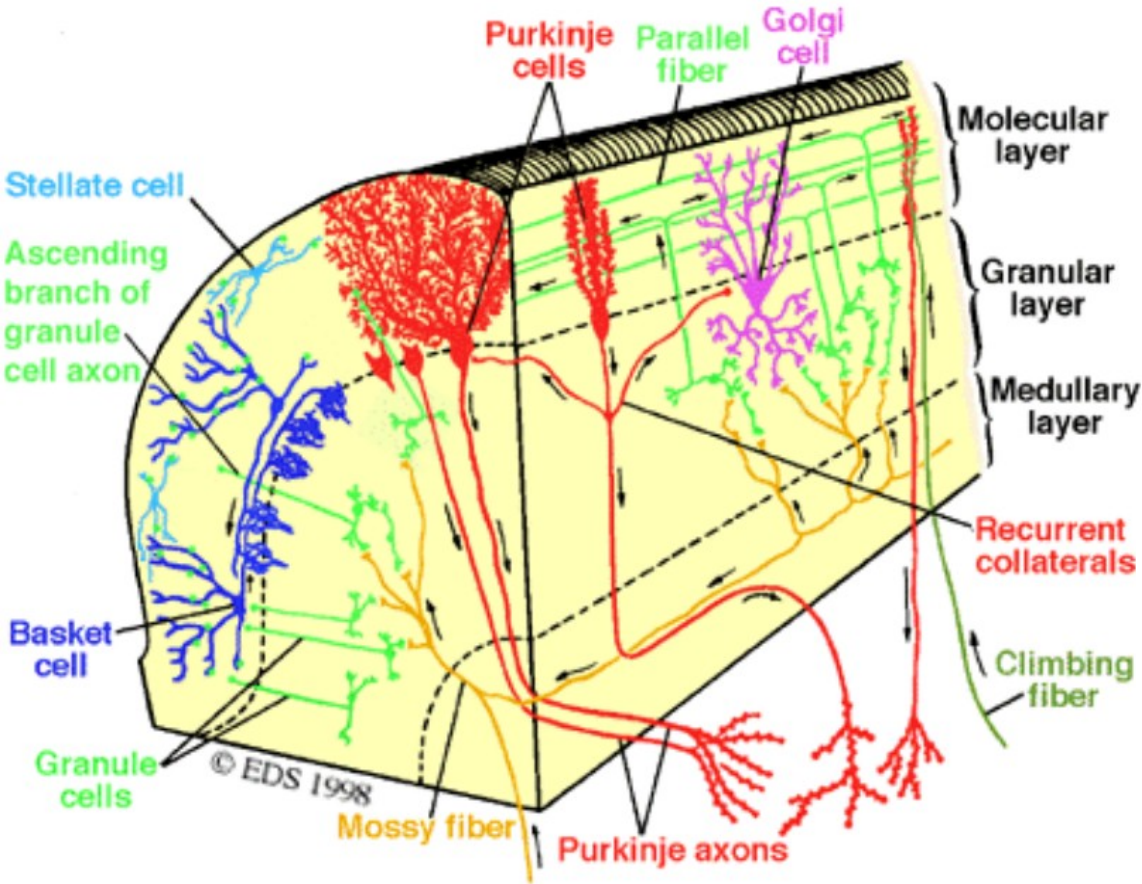


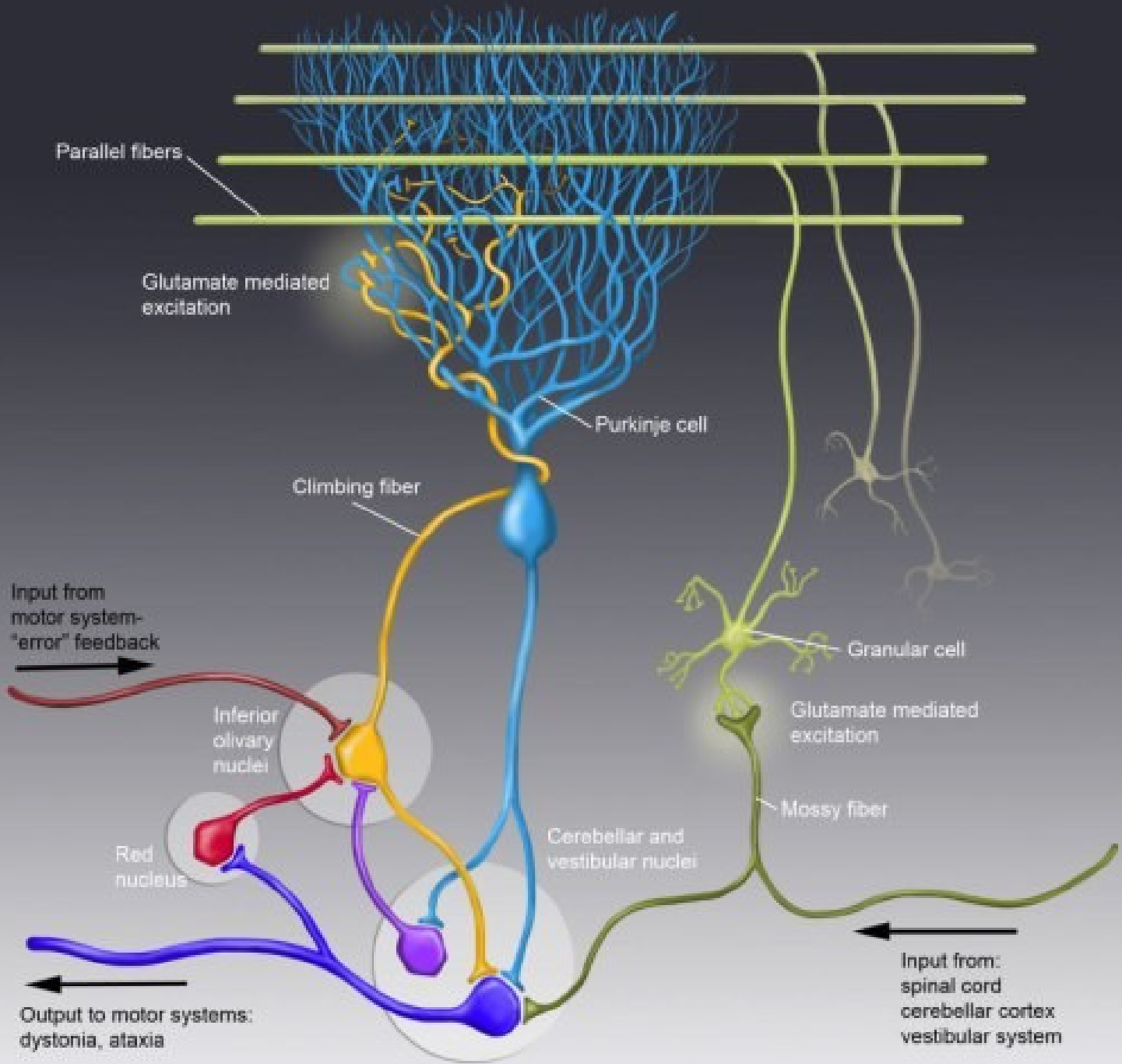
# Rubro - olivary tract





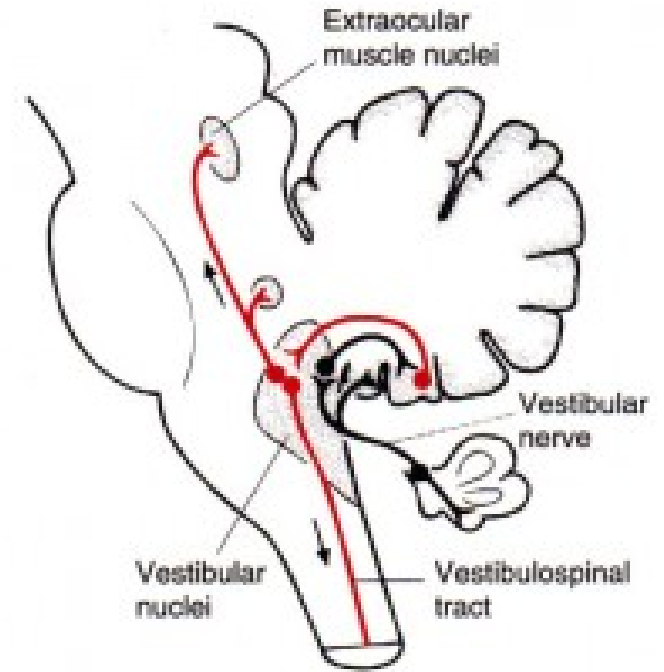
# CEREBELLAR CORTEX





# Connections of the vestibulocerebellum

## Vestibulocerebellum



Flocculonodular lobe  
(vestibulocerebellum)

Vestibular ncll.

Pontine ncll.

Vestibulocerebellar tract

Vestibulospinal tracts

Spinal motor neurons

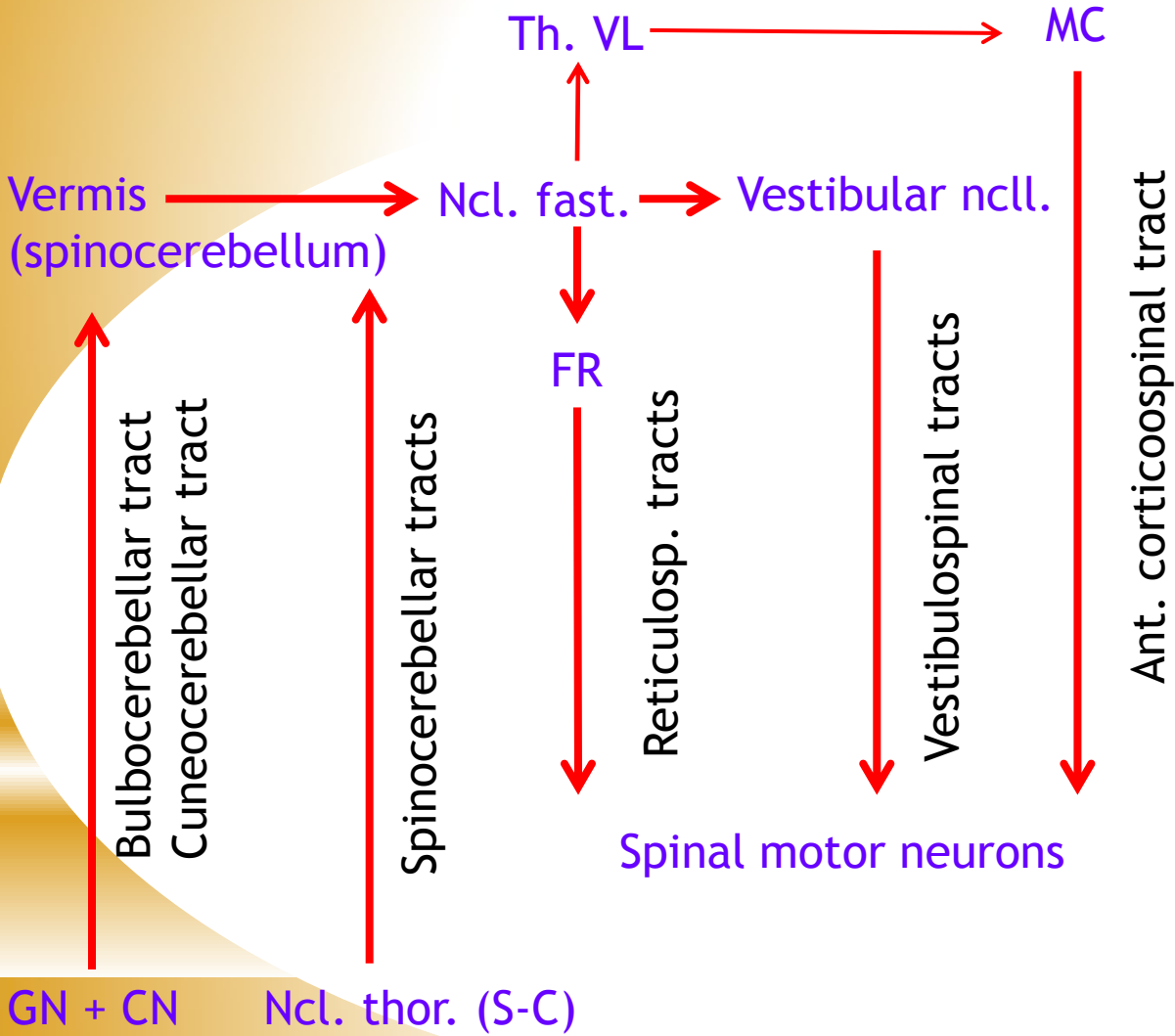
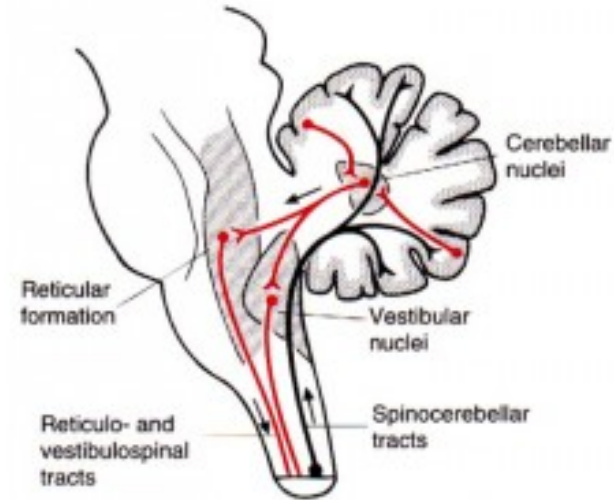
LGB + Sup.Col.

Vestibular apparatus

- vestibular reflexes
- postural maintenance

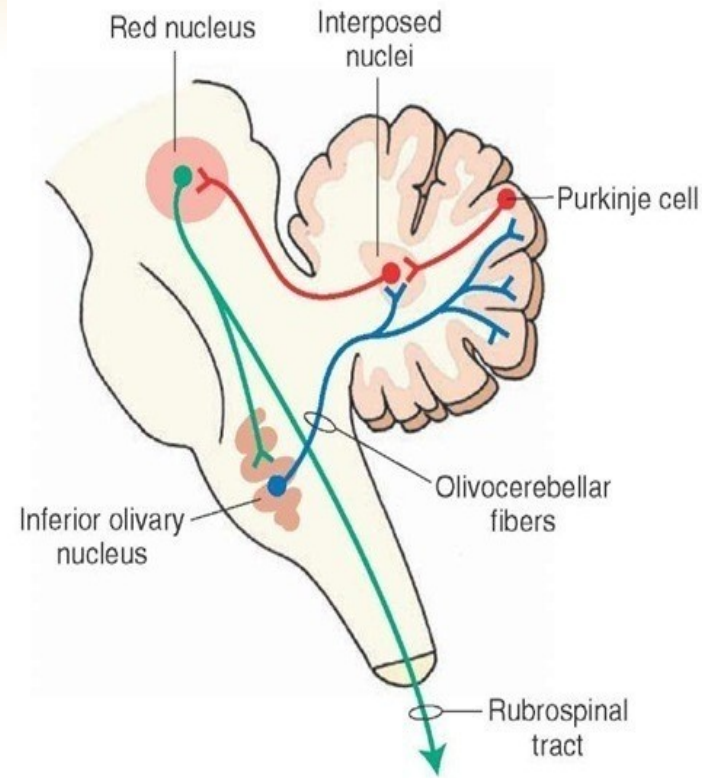
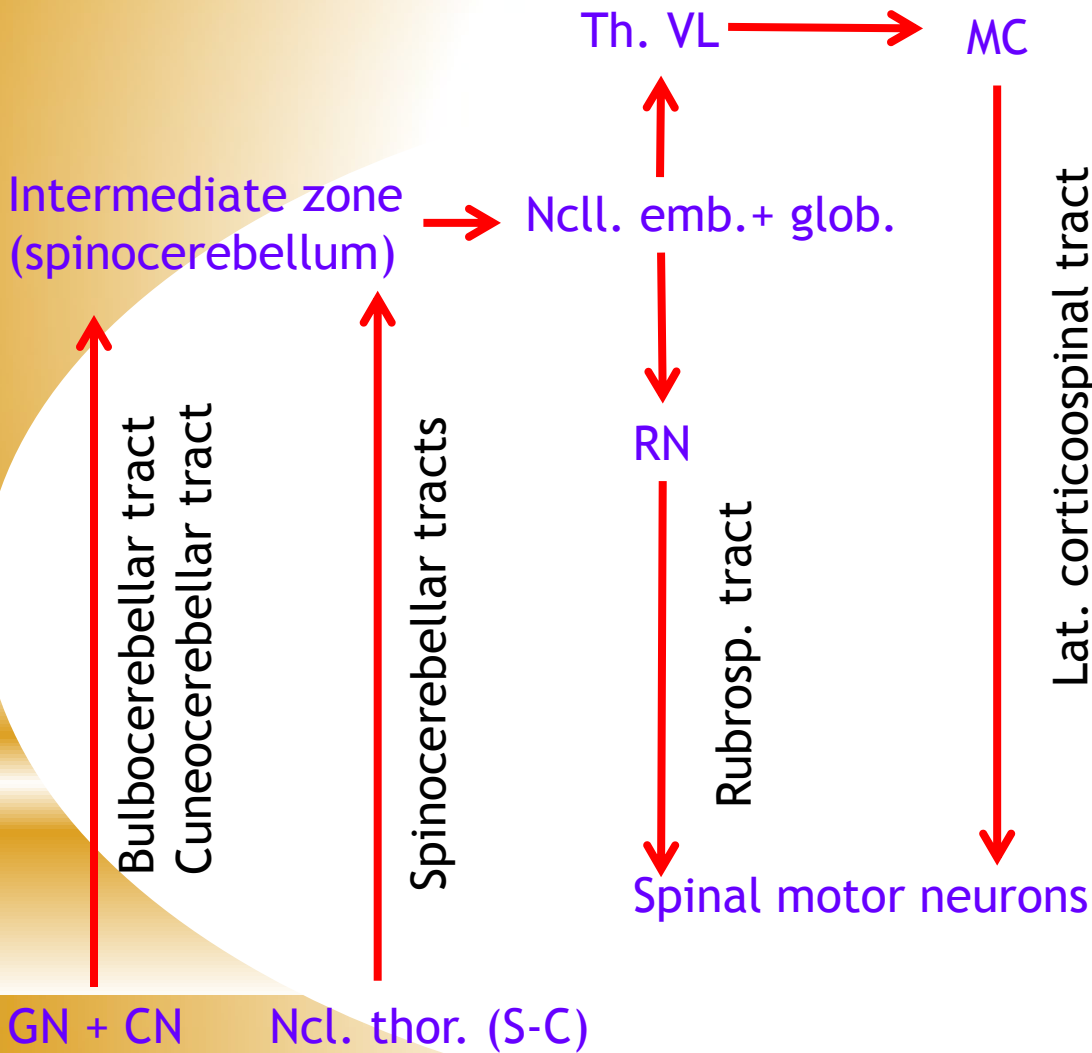
# Connections of the spinocerebellum - median zone

## Spinocerebellum



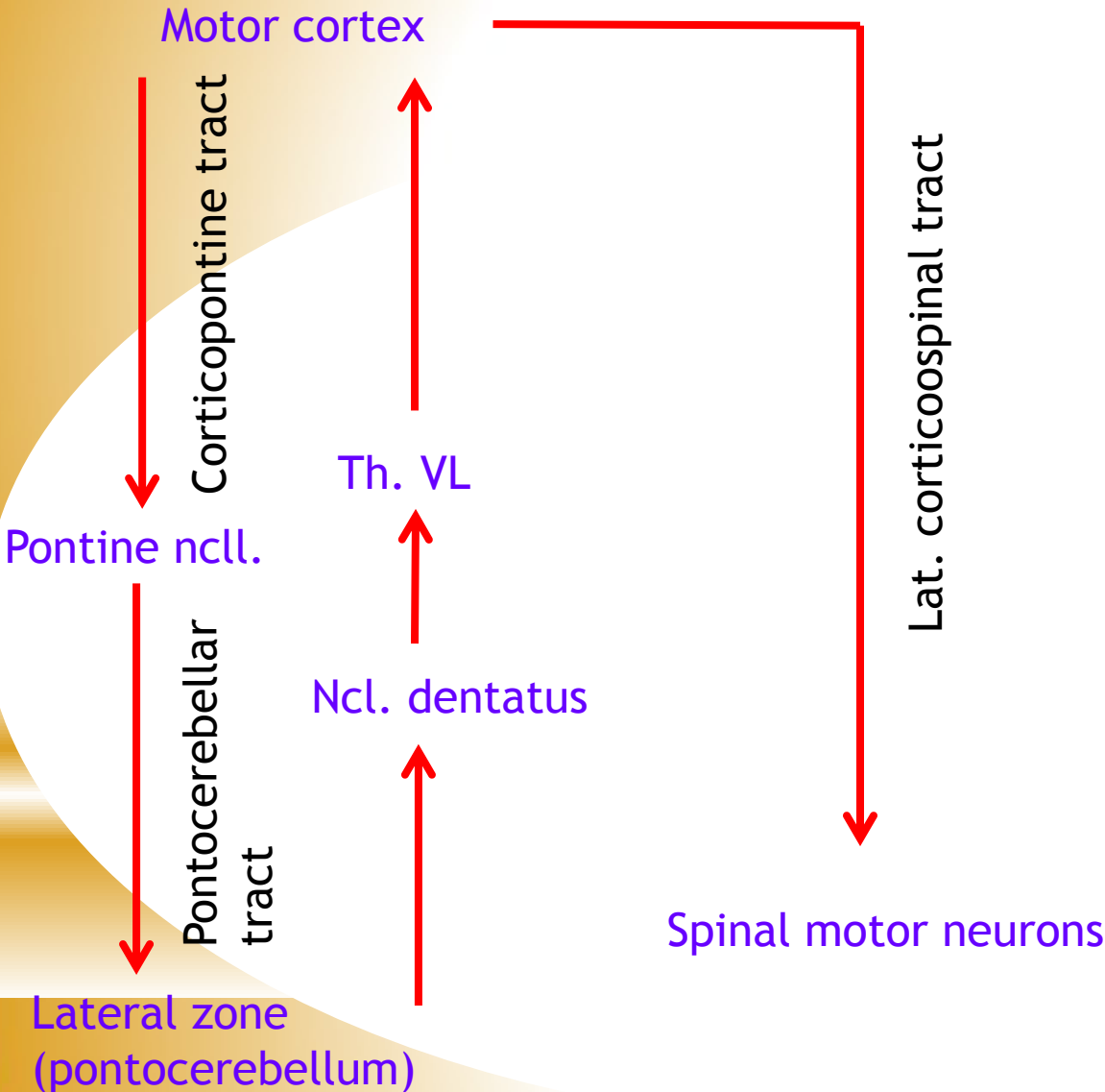
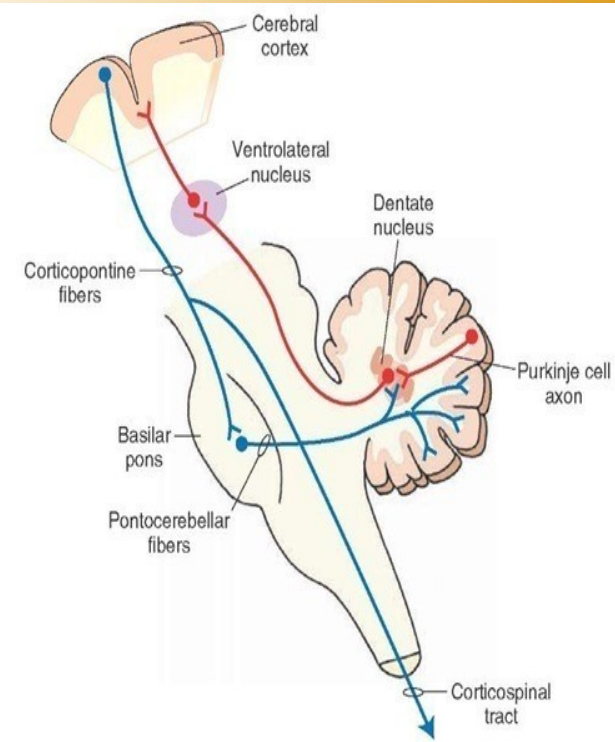
➤ control of medial descending (motor) system

# Connections of the spinocerebellum - paramedian zone

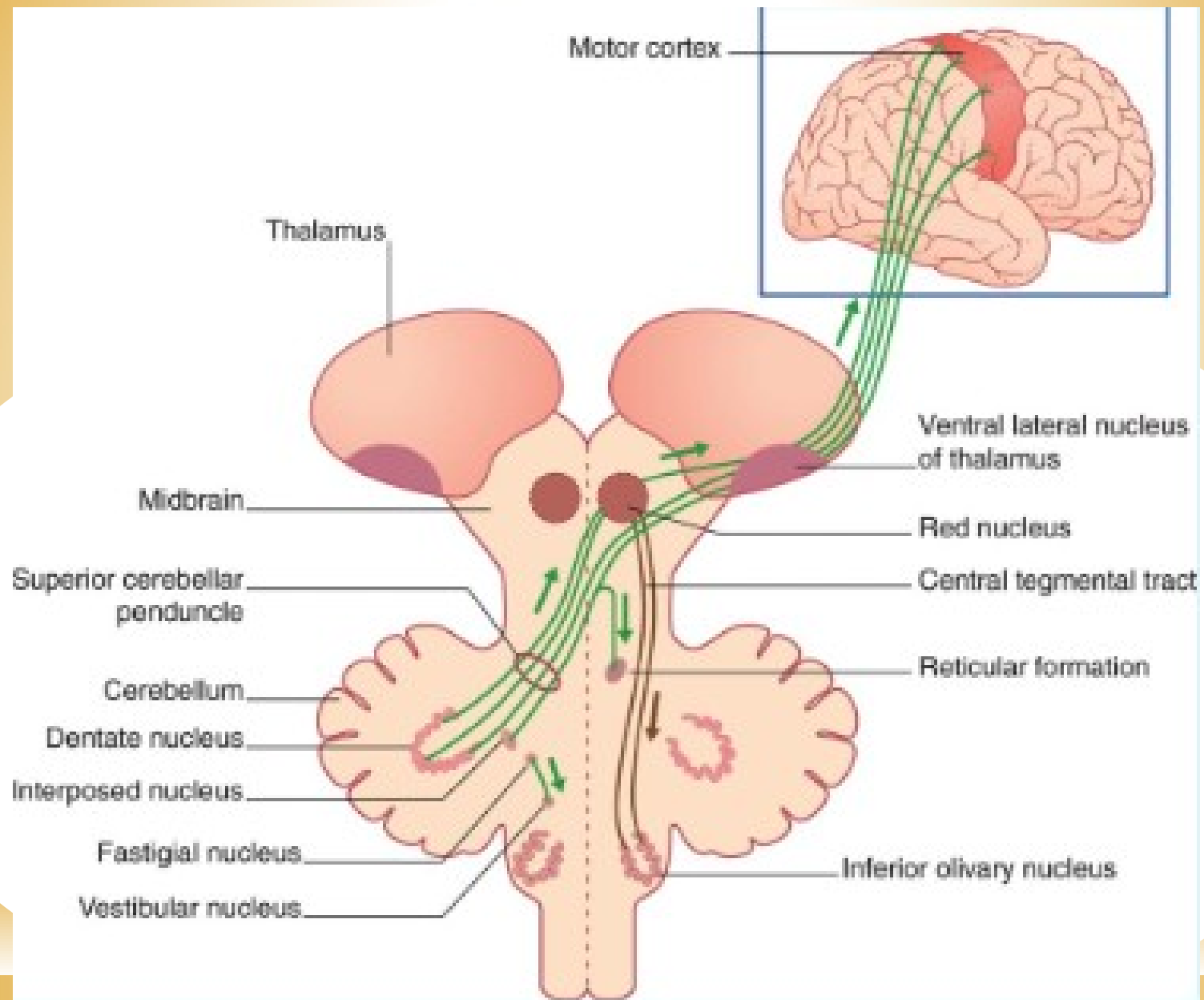


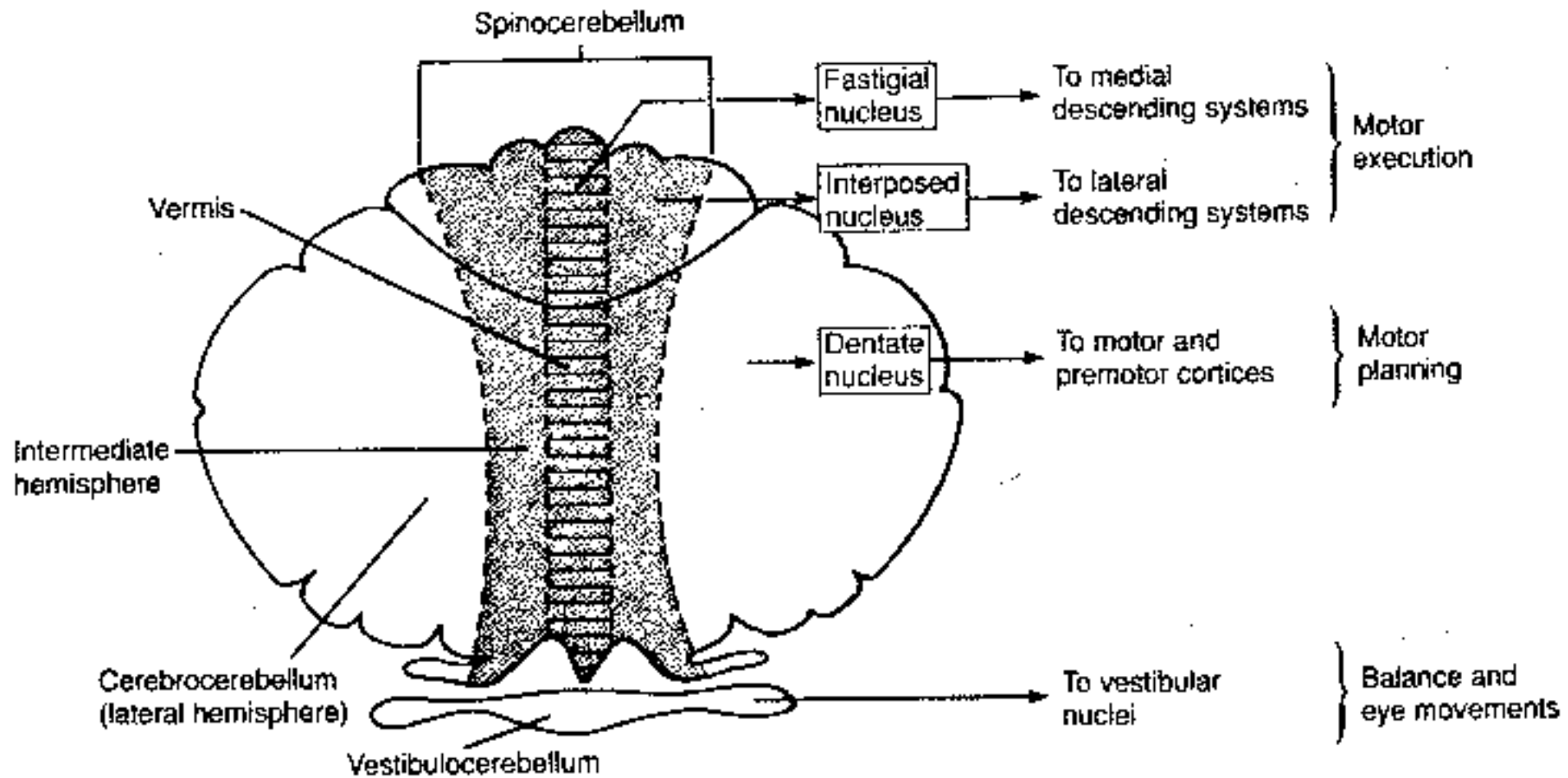
➤ **control of lateral descending (motor) system**

# Connections of the cerebro(ponto)cerebellum - lateral zone



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



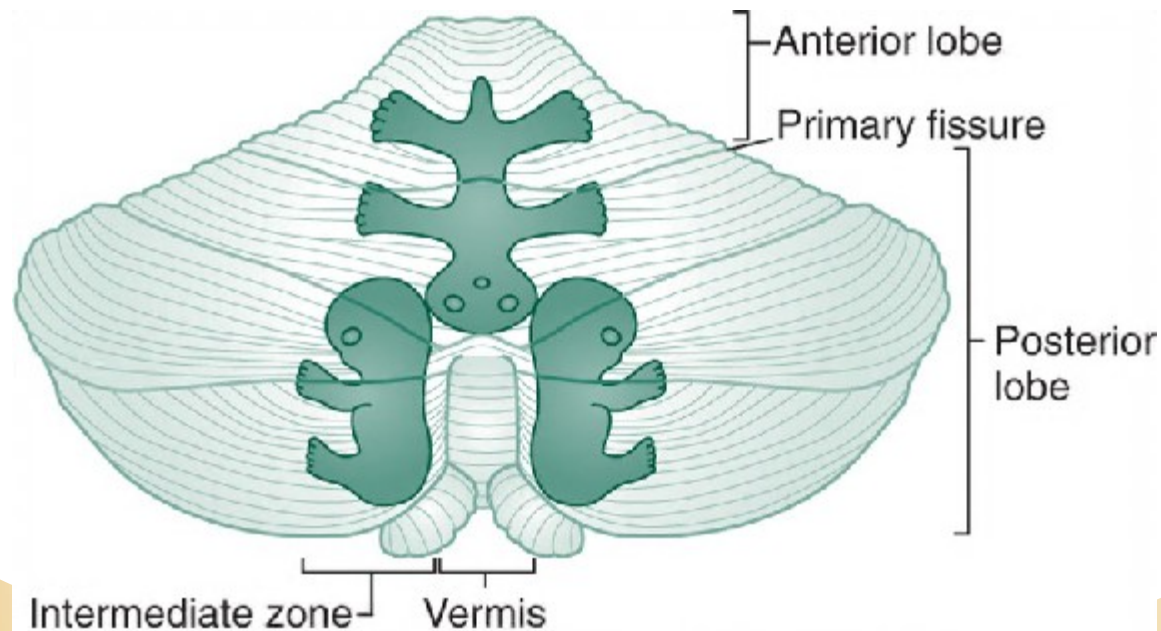




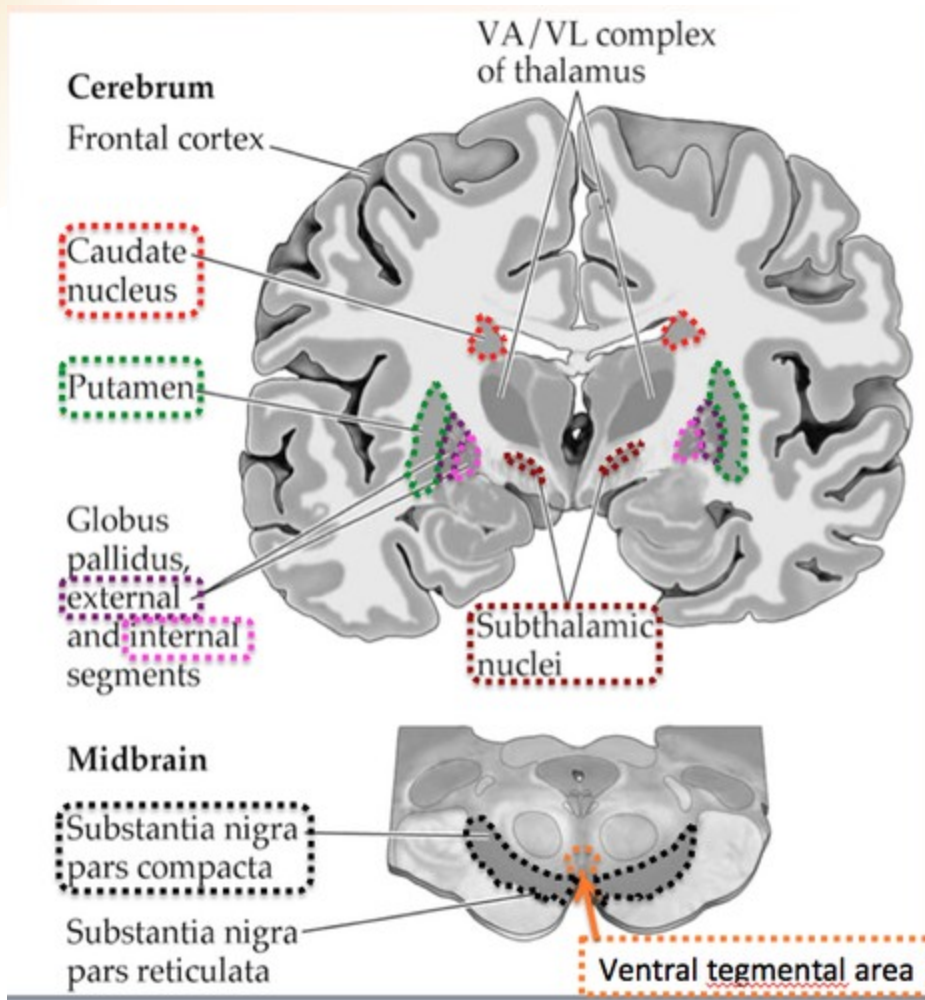
# Somatotopic organization

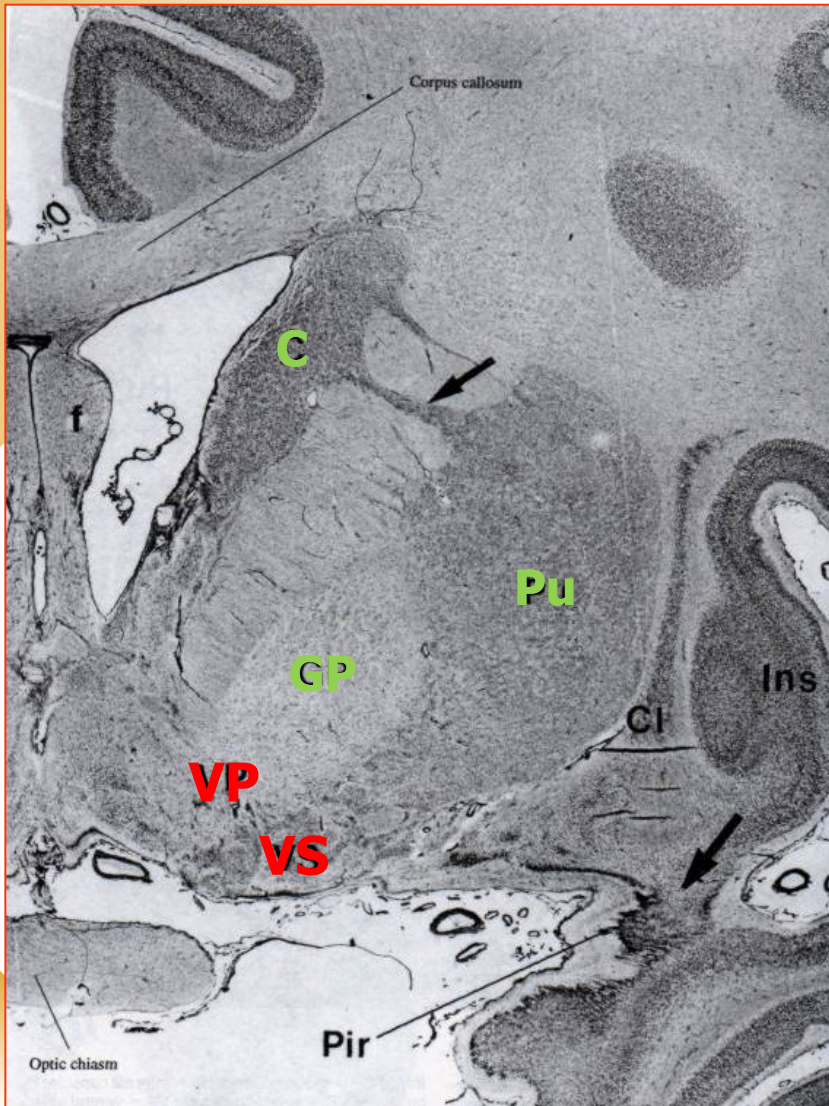
Projection of both spinocerebellar pathways and motor cortex

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









Ncl caudatus + putamen

= dorsal striatum

Globus pallidus

= dorsal pallidum

Substantia innominata:

**VS** = ventr. striatum

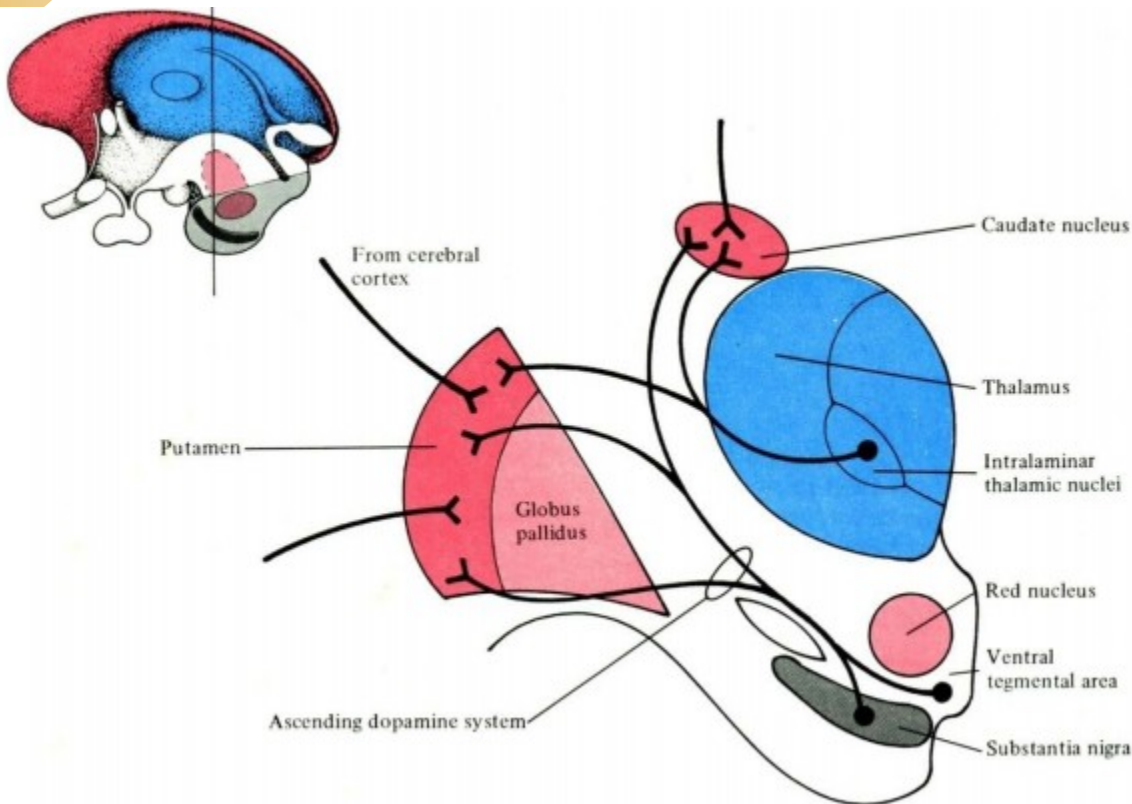
Ncl. accumbens septi

**VP** = ventral pallidum

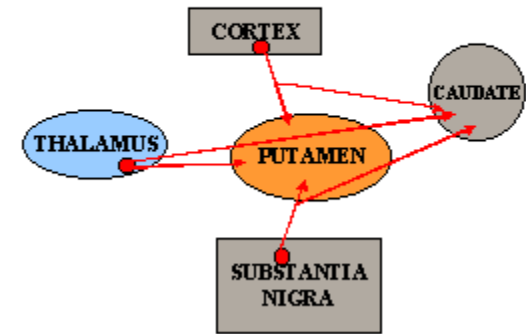
Ncl. basalis Meynerti

# Basal ganglia afferents:

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



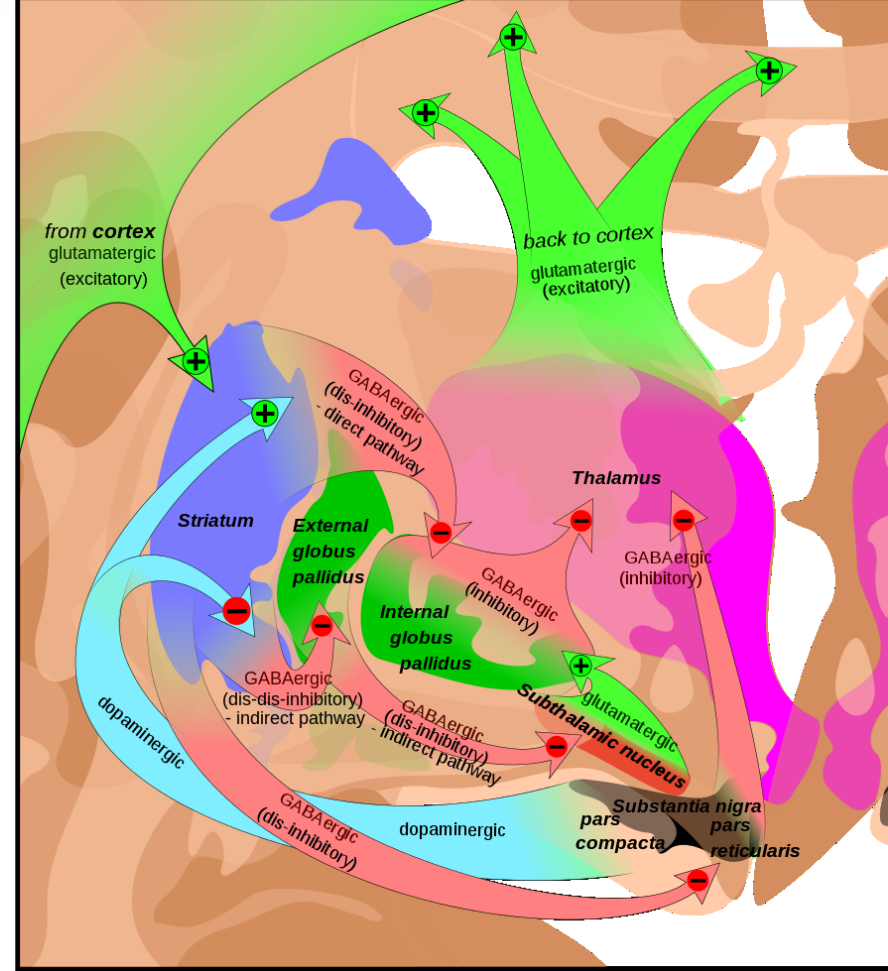
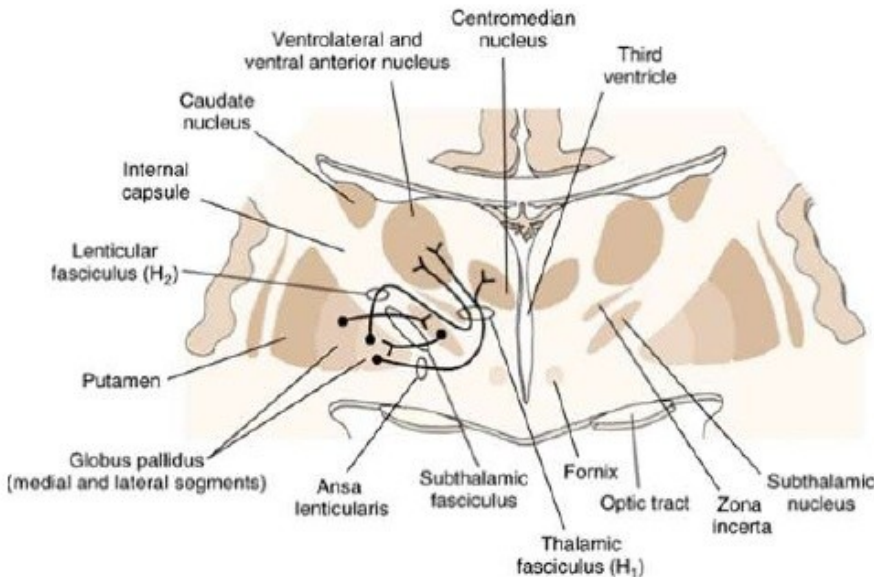
## BASAL GANGLIA: AFFERENT CONNECTIONS



# Basal ganglia efferents:

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

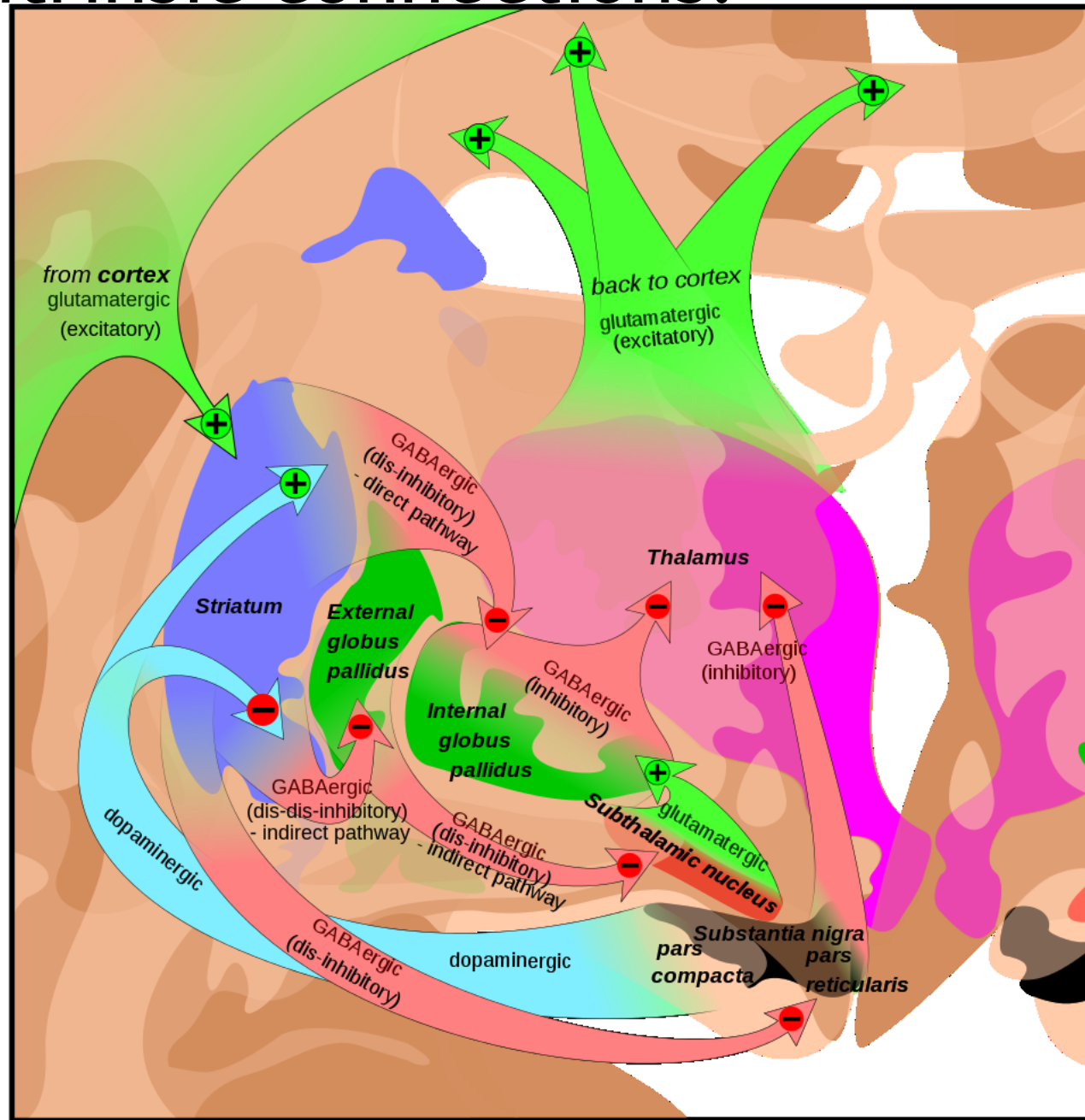
## EFFERENT OF BG



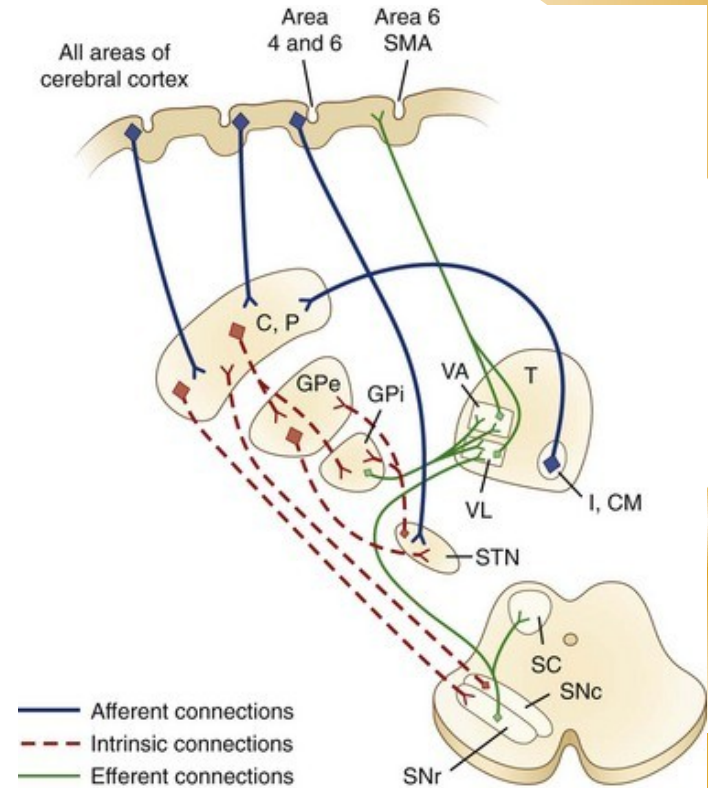
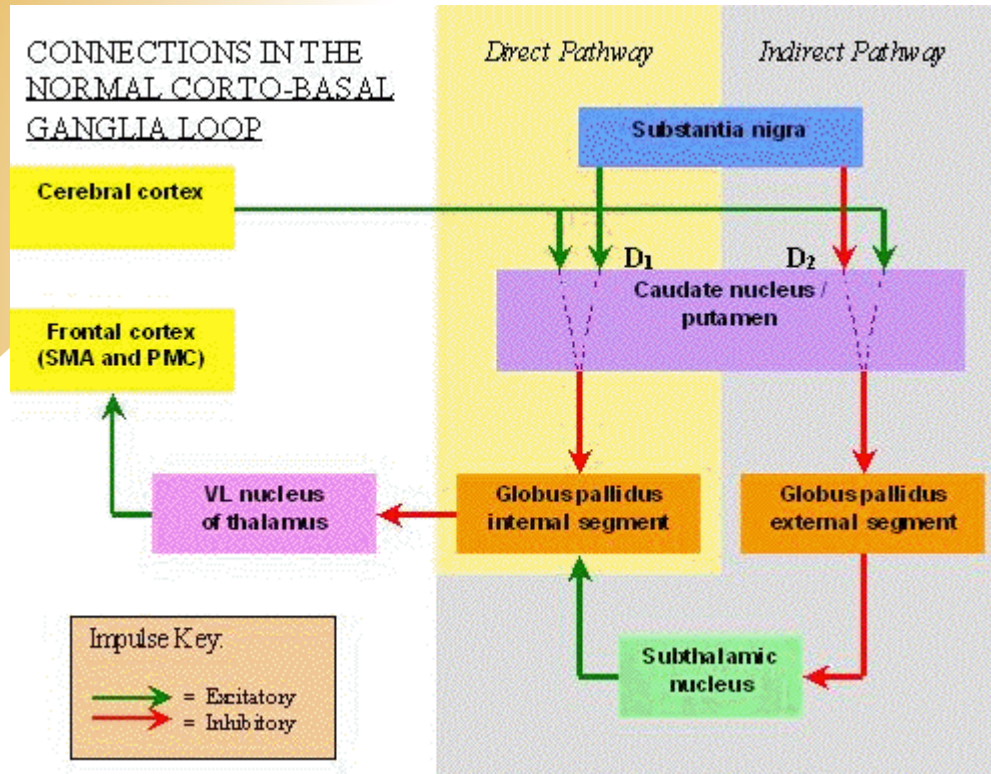
(ansa lenticularis + fasciculus lenticularis → fasciculus thalamicus)

# Basal ganglia intrinsic connections:

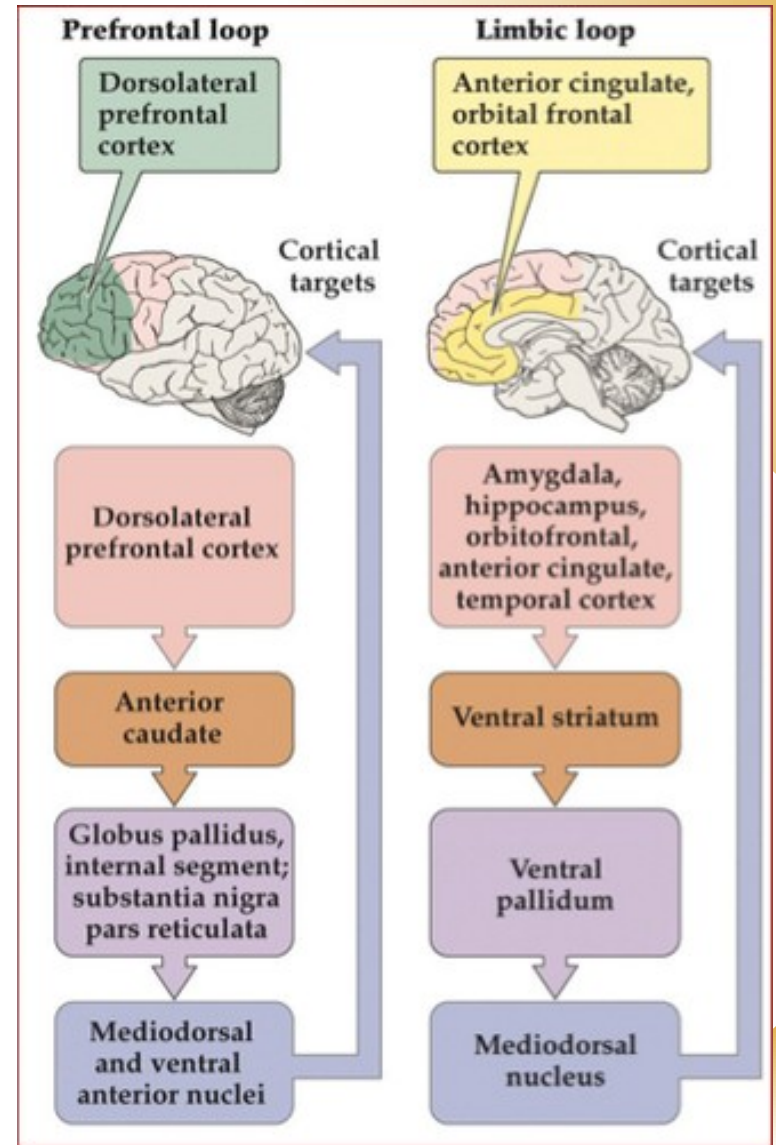
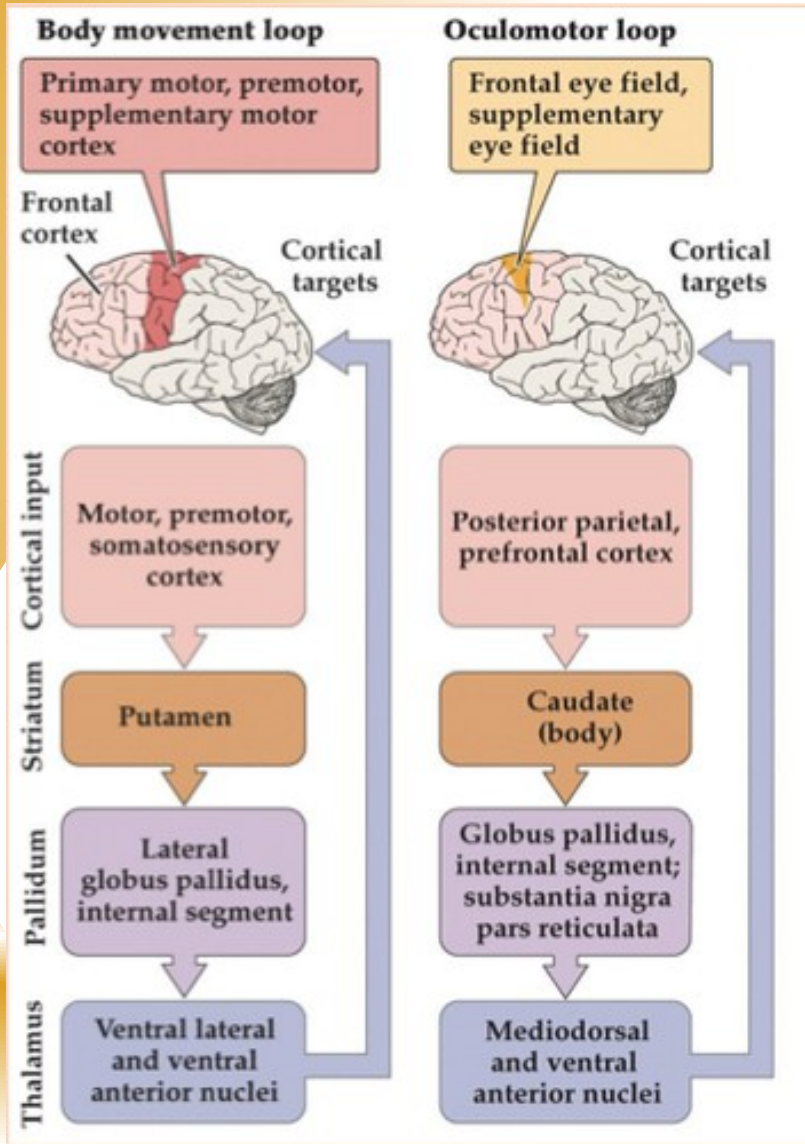
- Striatopallidal p.
- Striatonigral p.
- GPe → STN
- STN → GP, SNr.
- Nigrostriatal p.



# 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

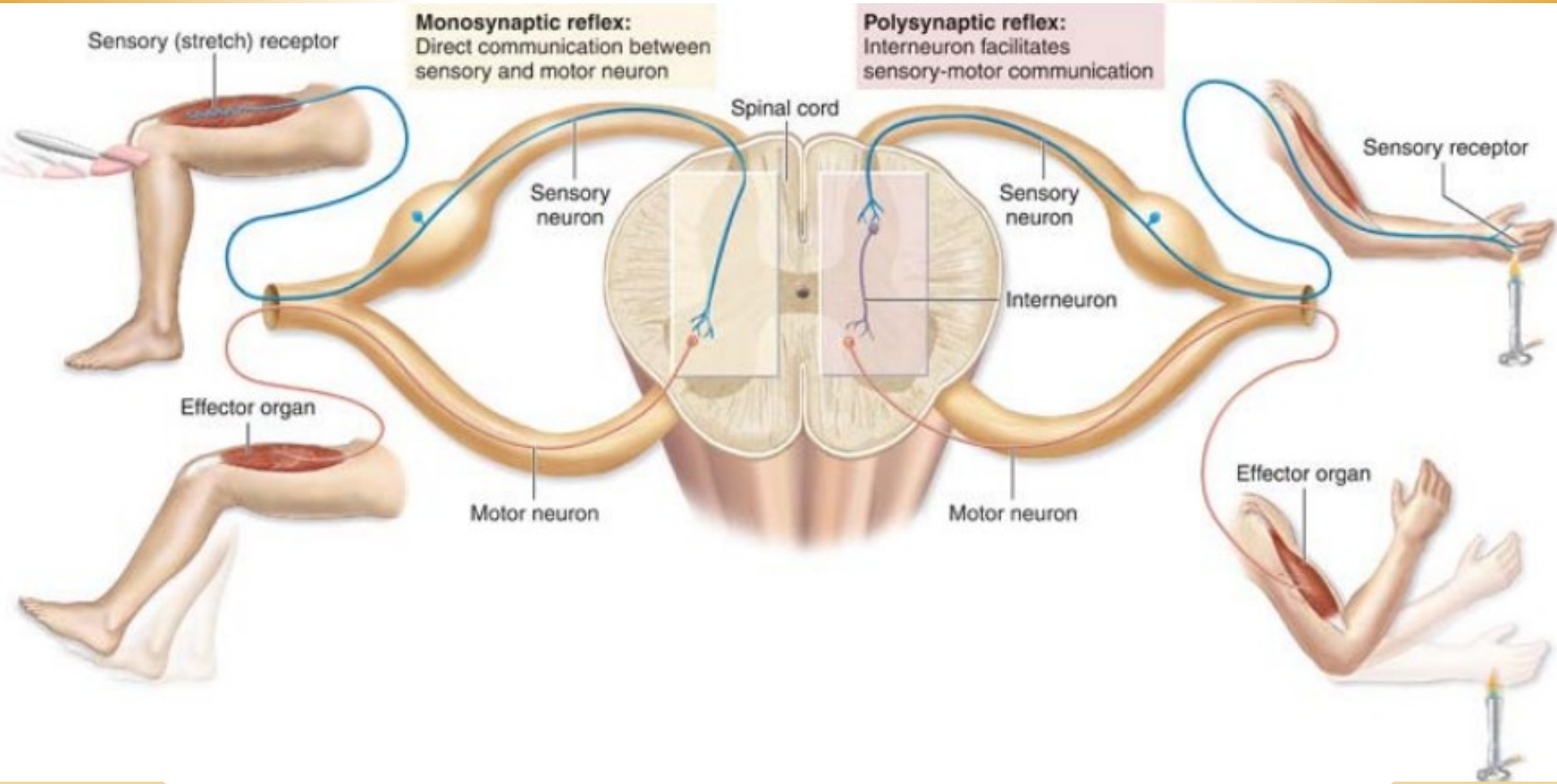
- monosegmental spinal reflexes
- polysegmental spinal reflexes

## □ number of synapses

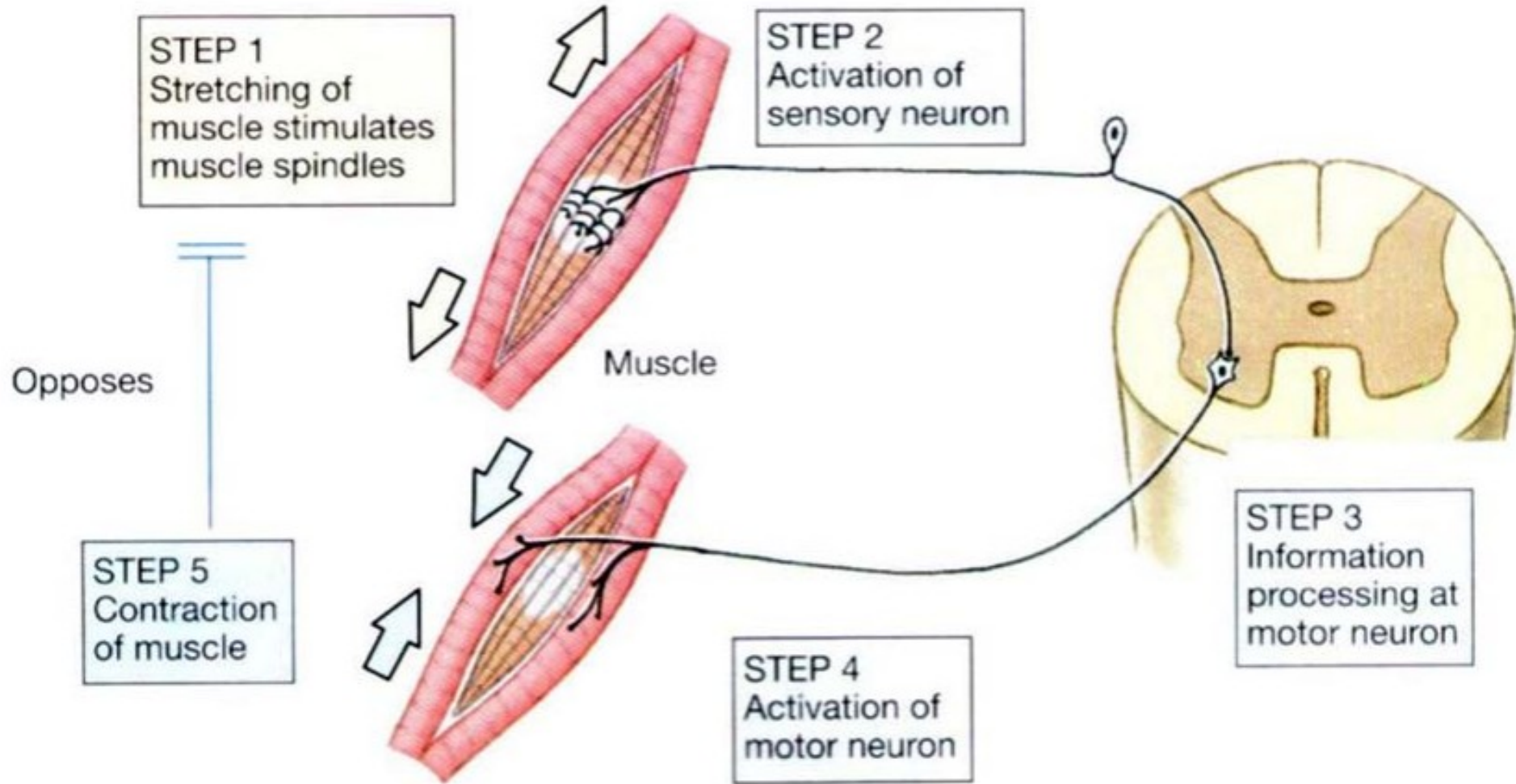
- monosynaptic reflexes
- disynaptic reflexes
- polysynaptic reflexes

# Myotatic reflex

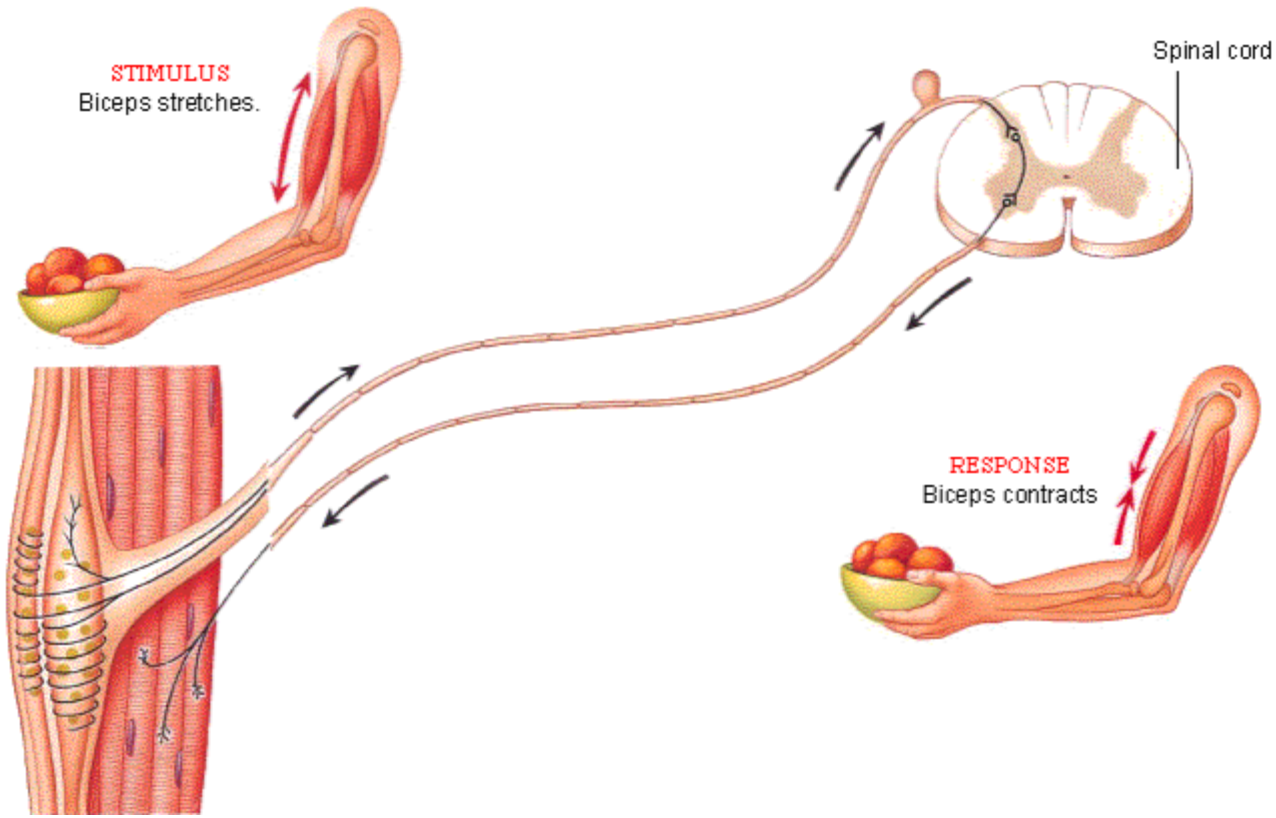
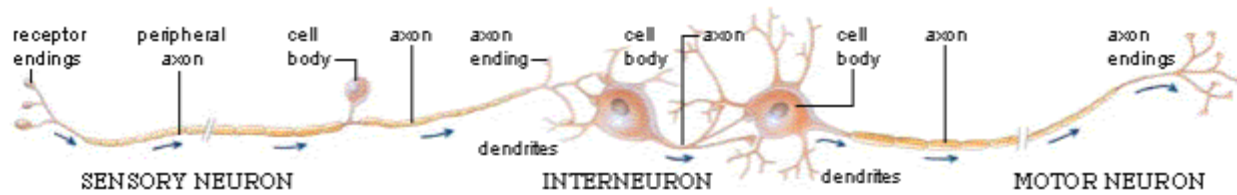
# Withdrawal reflex



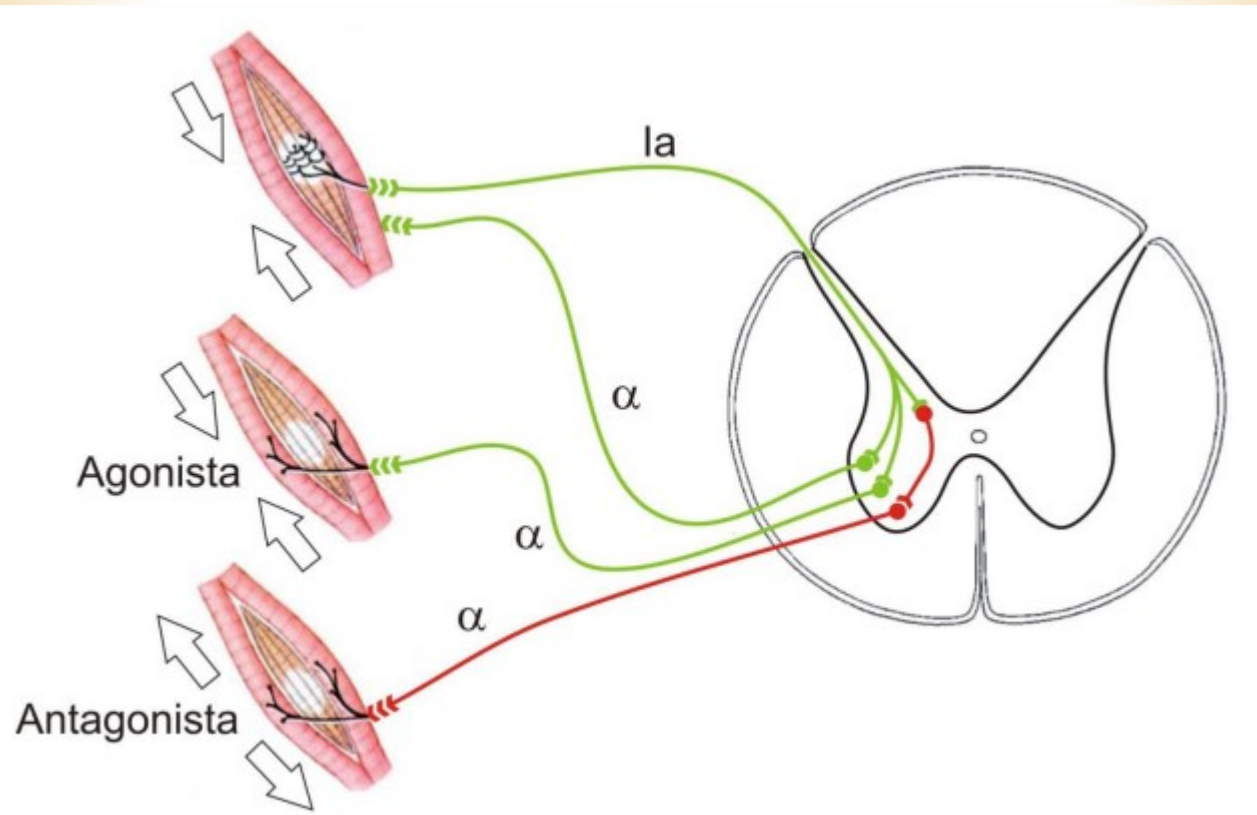
# Myotatic (stretch) reflex



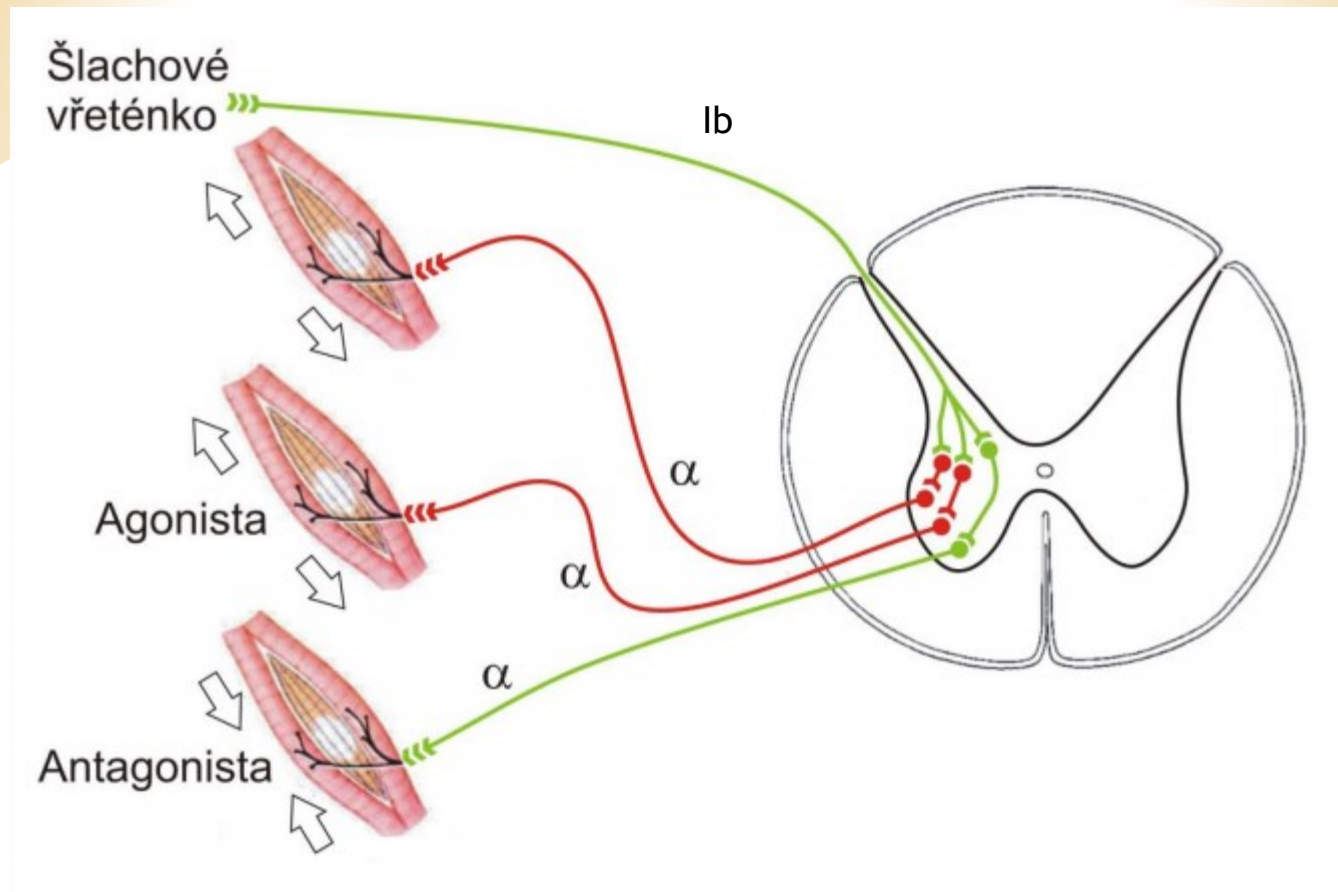
# Myotatic (stretch) reflex



# Myotatic (stretch) reflex

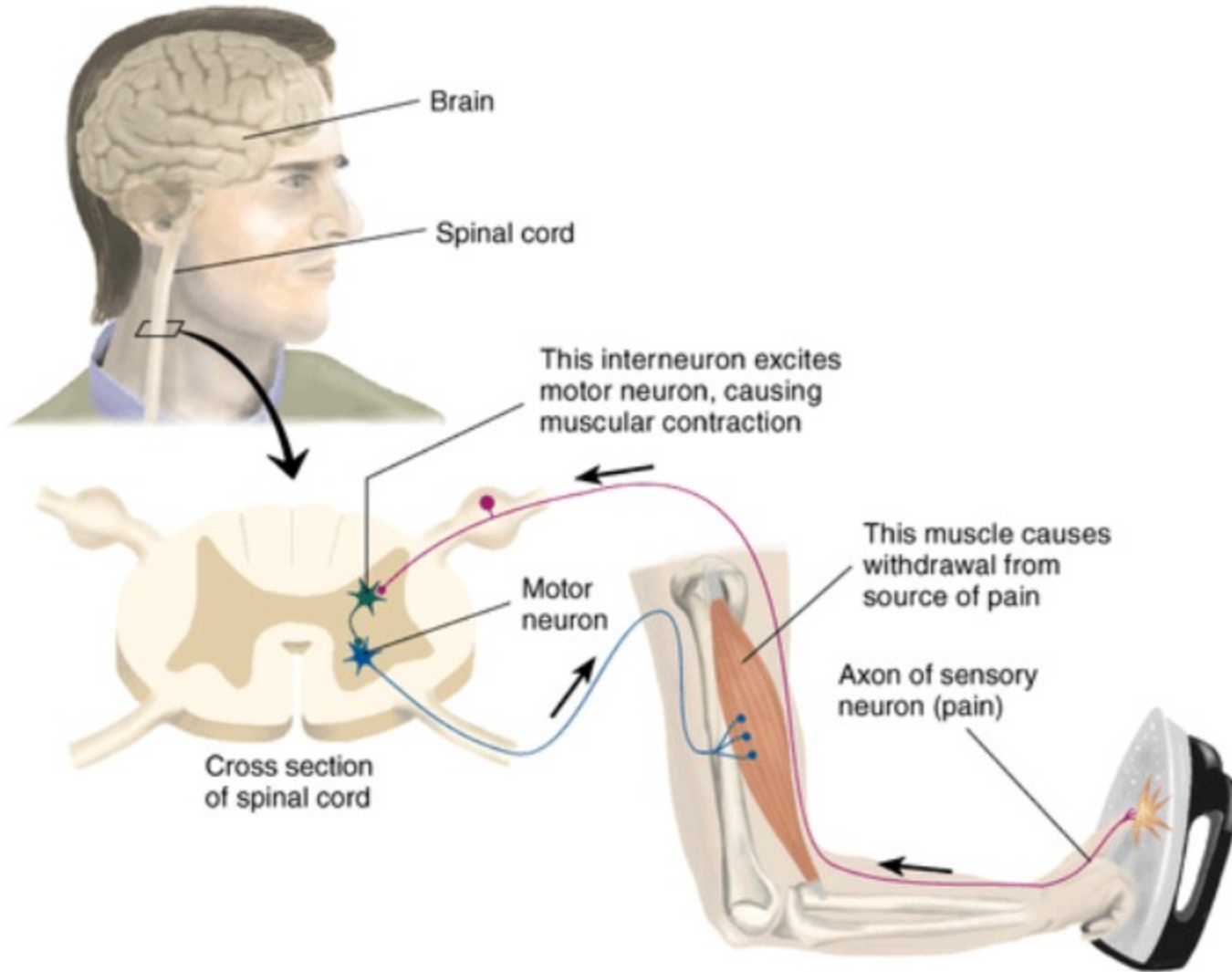


# Reflex loop of Golgi tendon organ (inverse myotatic reflex)



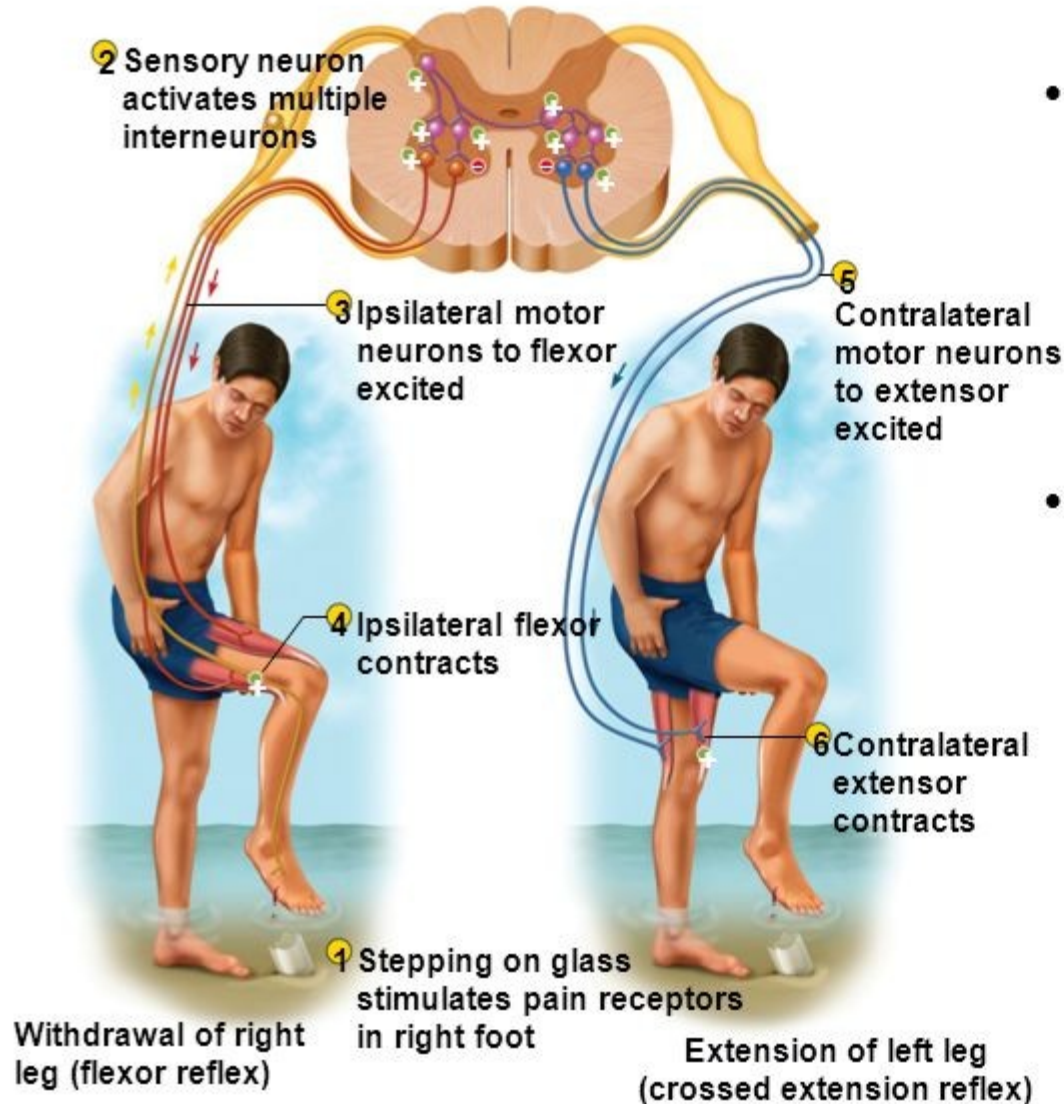


# Flexor (withdrawal) reflex



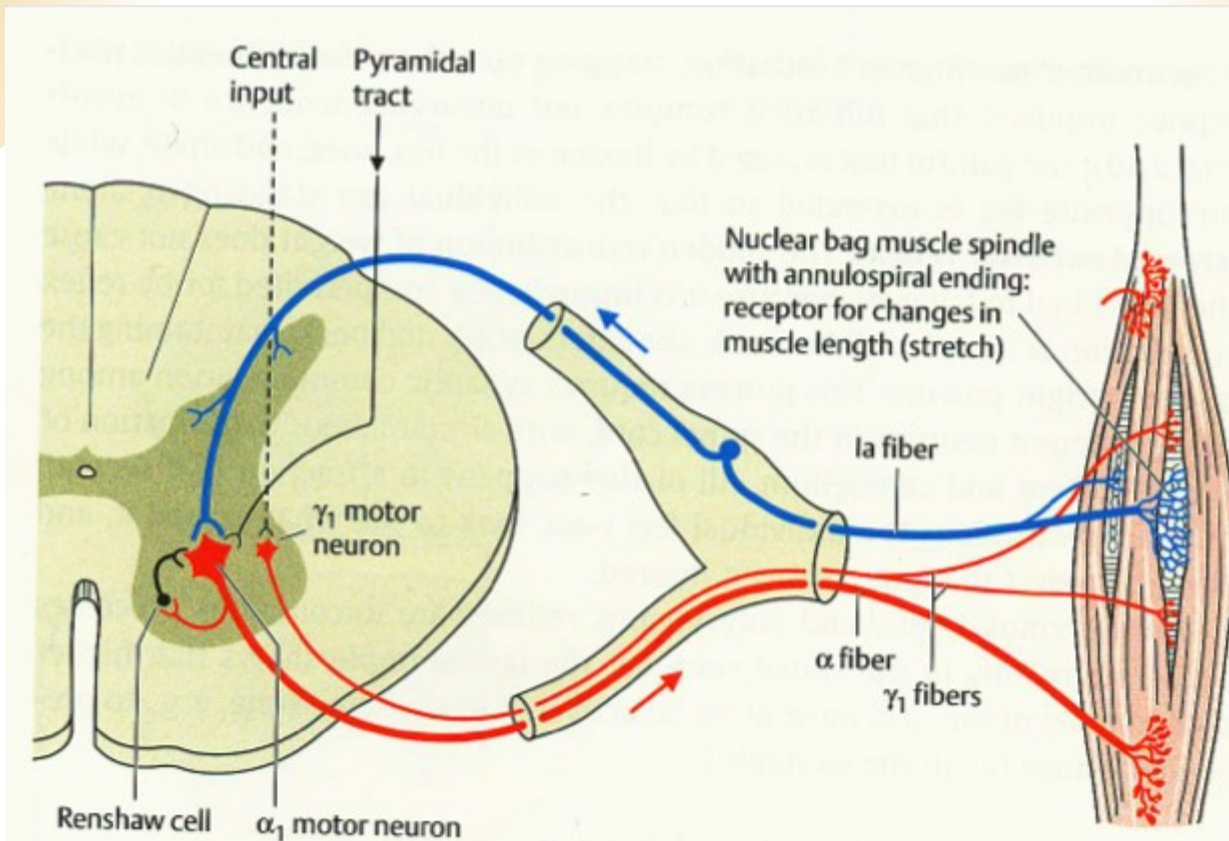
# The Flexor (Withdrawal) Reflexes

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

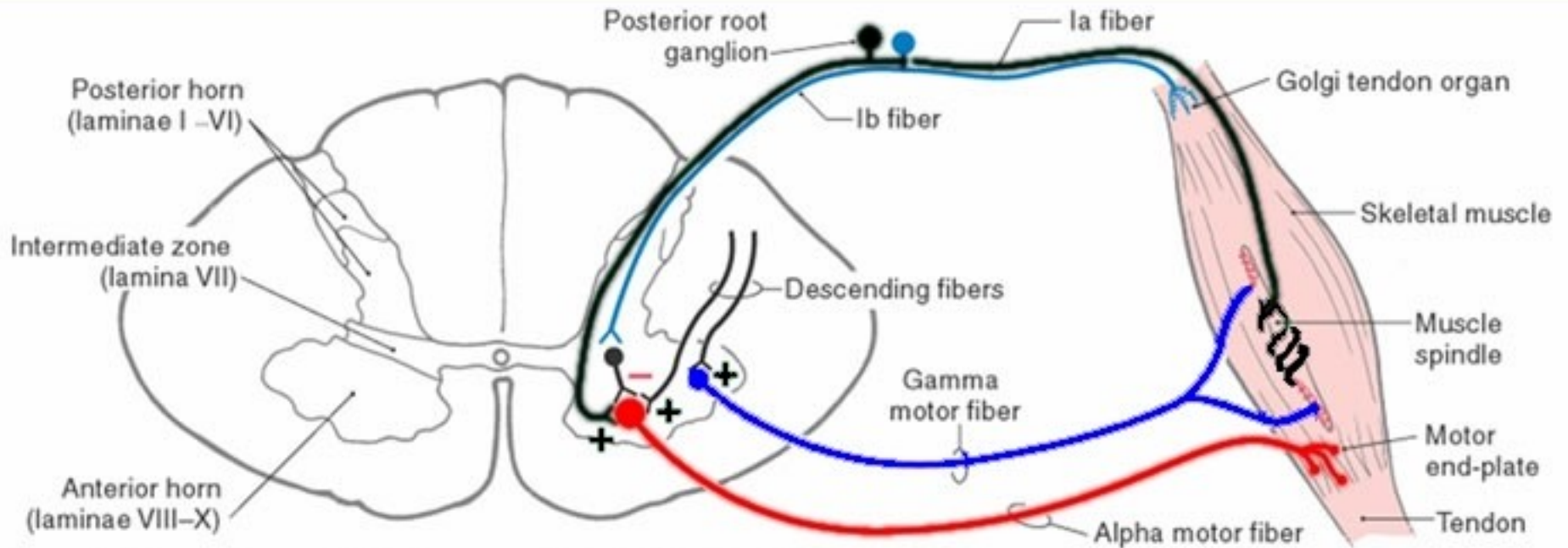


- **flexor reflex** – the quick contraction of flexor muscles resulting in the withdrawal of a limb from an injurious stimulus
- requires contraction of the flexors and relaxation of the extensors

# 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 oculomotor muscles
- ❑ **Eye movements**
  - conjugated - both eyes in same direction
  - vergent - during motion of object to and from us
    - convergent
    - divergent

DISJUNCTIVE (VERGENCE)

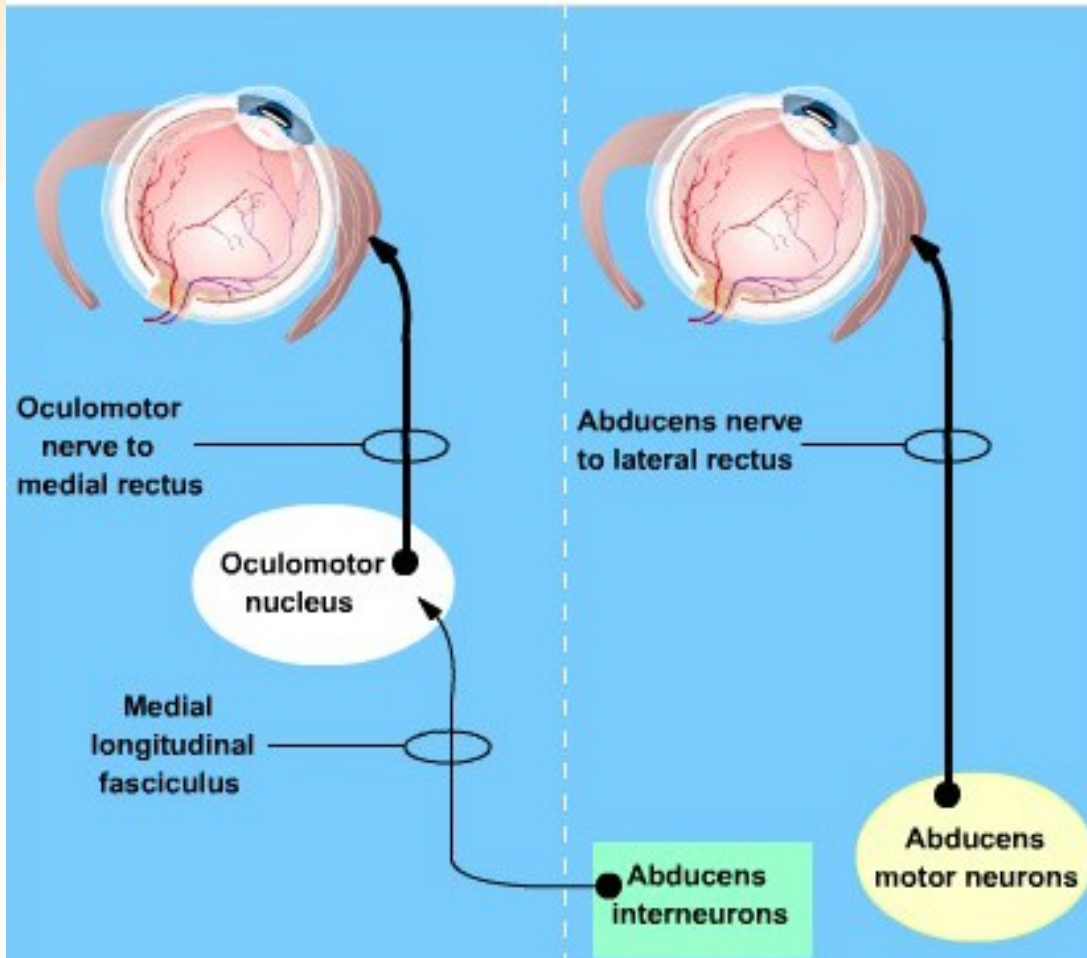


CONJUGATE



**LEFT**

**RIGHT**



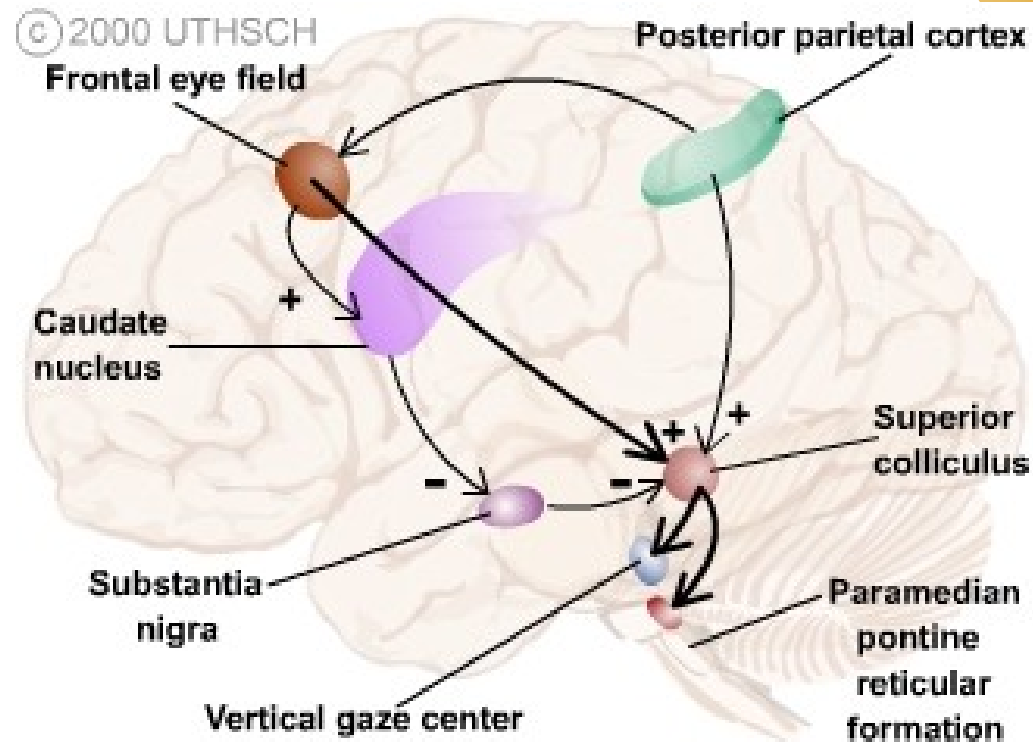
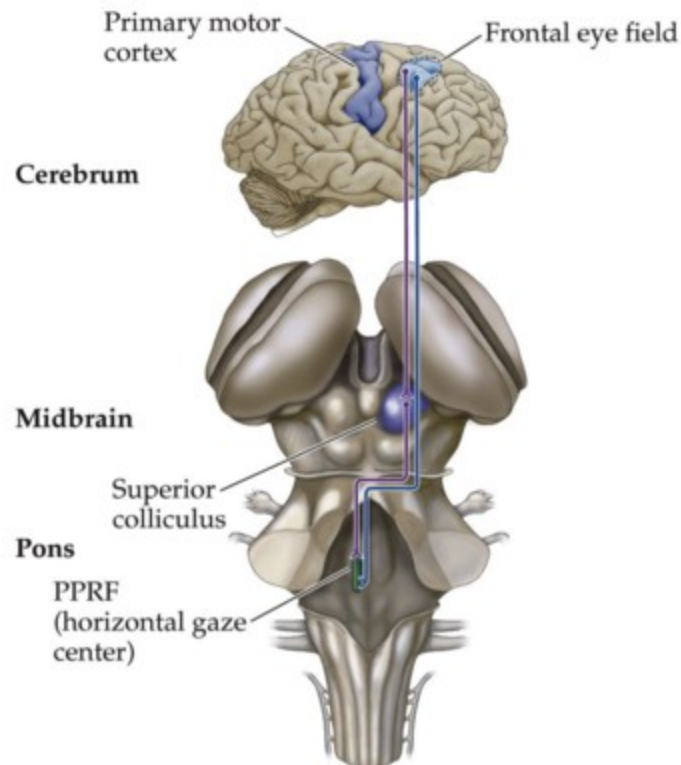
# Four basic types of eye movements

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



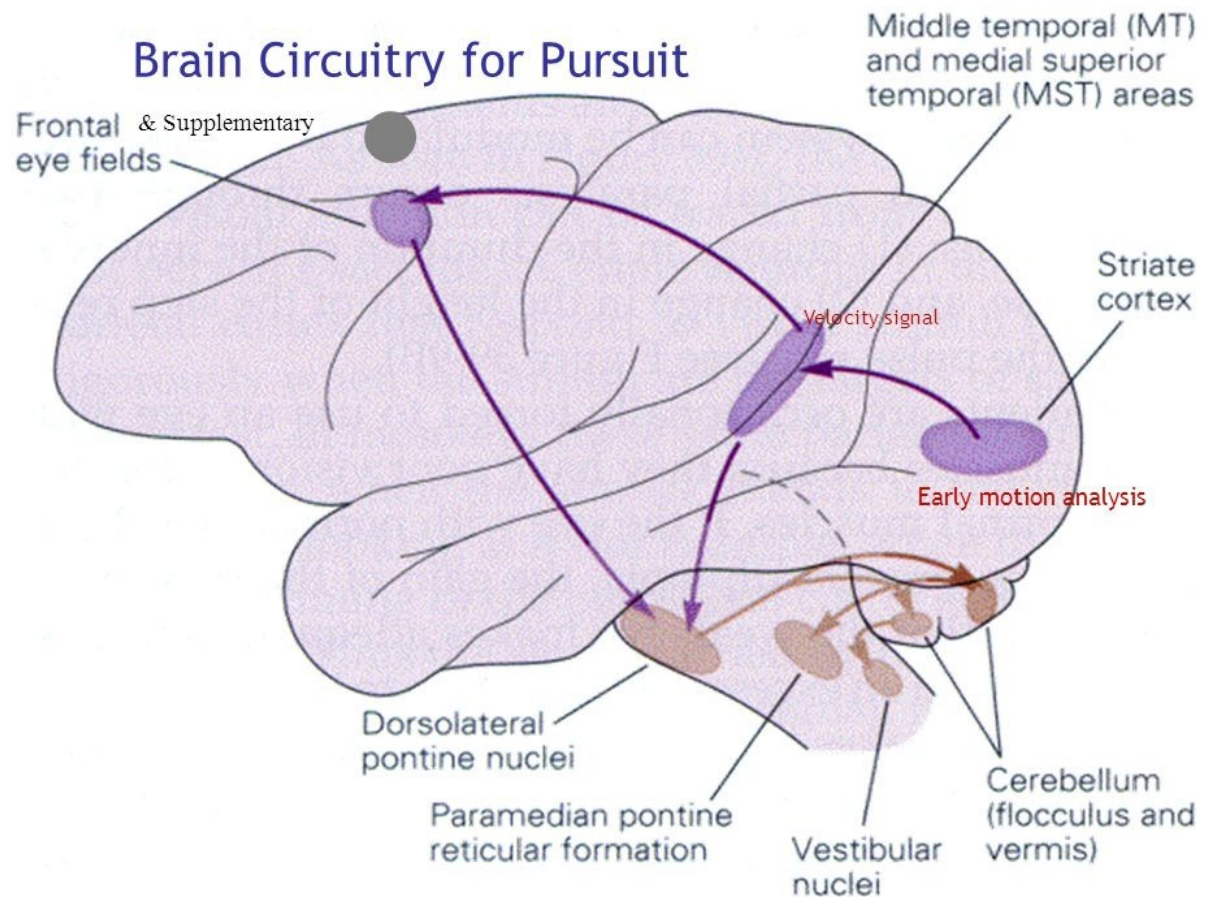
# Saccadic eye movements

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



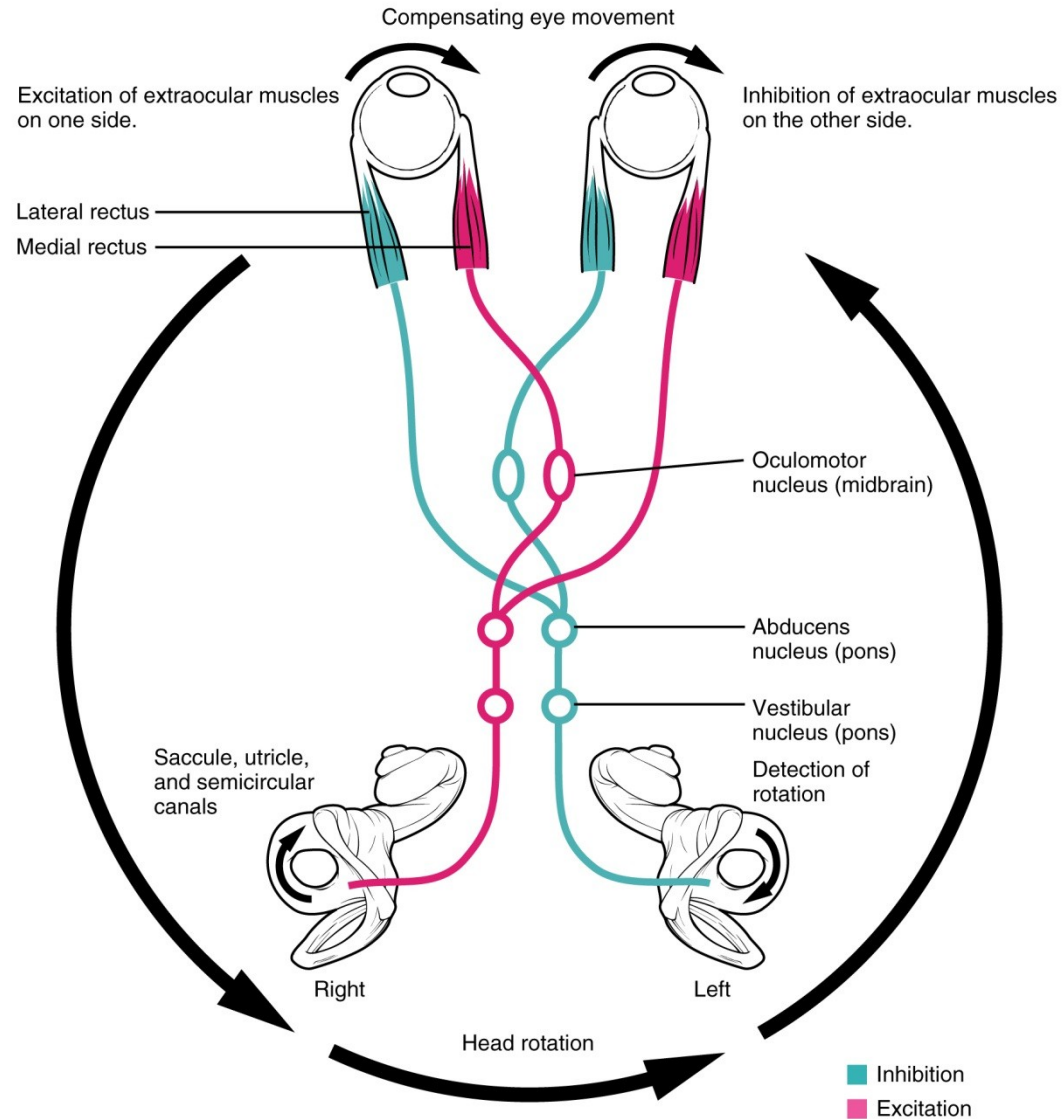
# Smooth pursuit movements

- ❑ 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

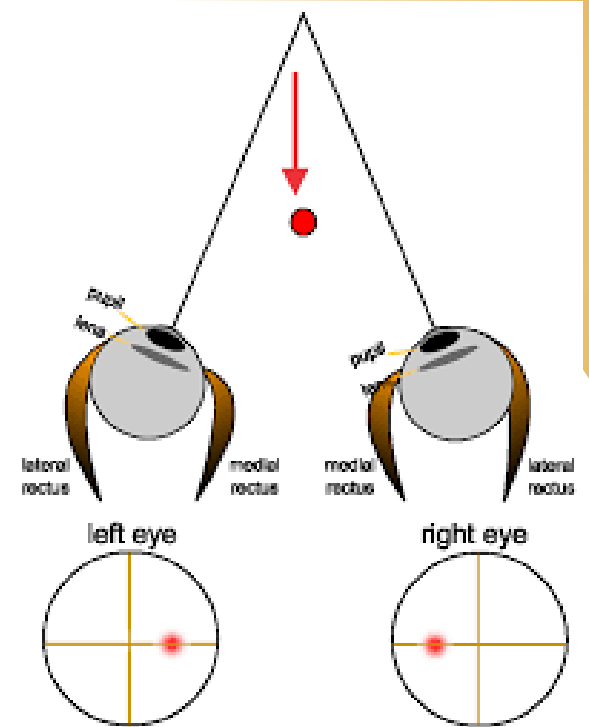


# Vestibulo-ocular movements

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



# Vergence movements



Illustrations were copied from:

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

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