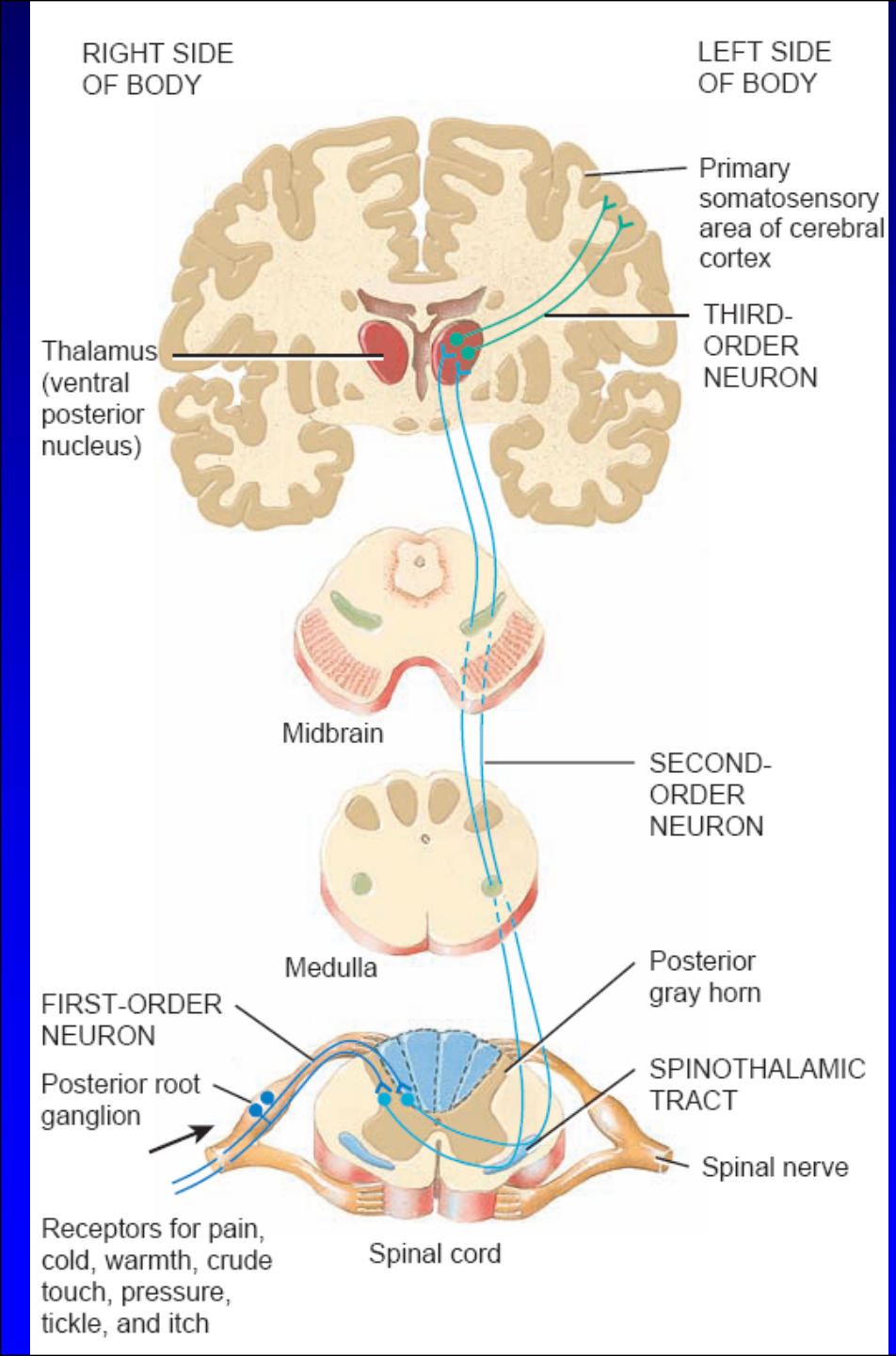
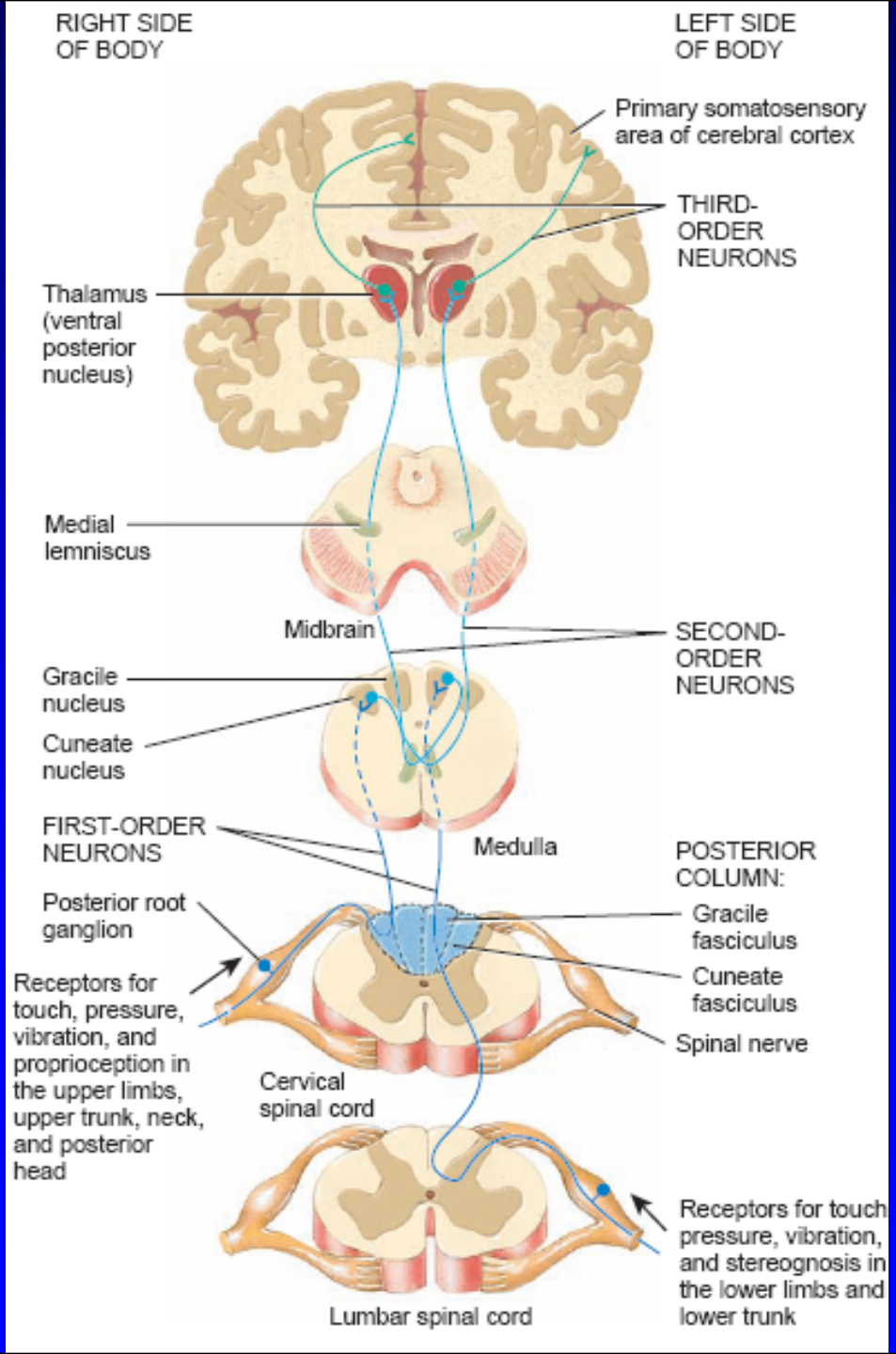
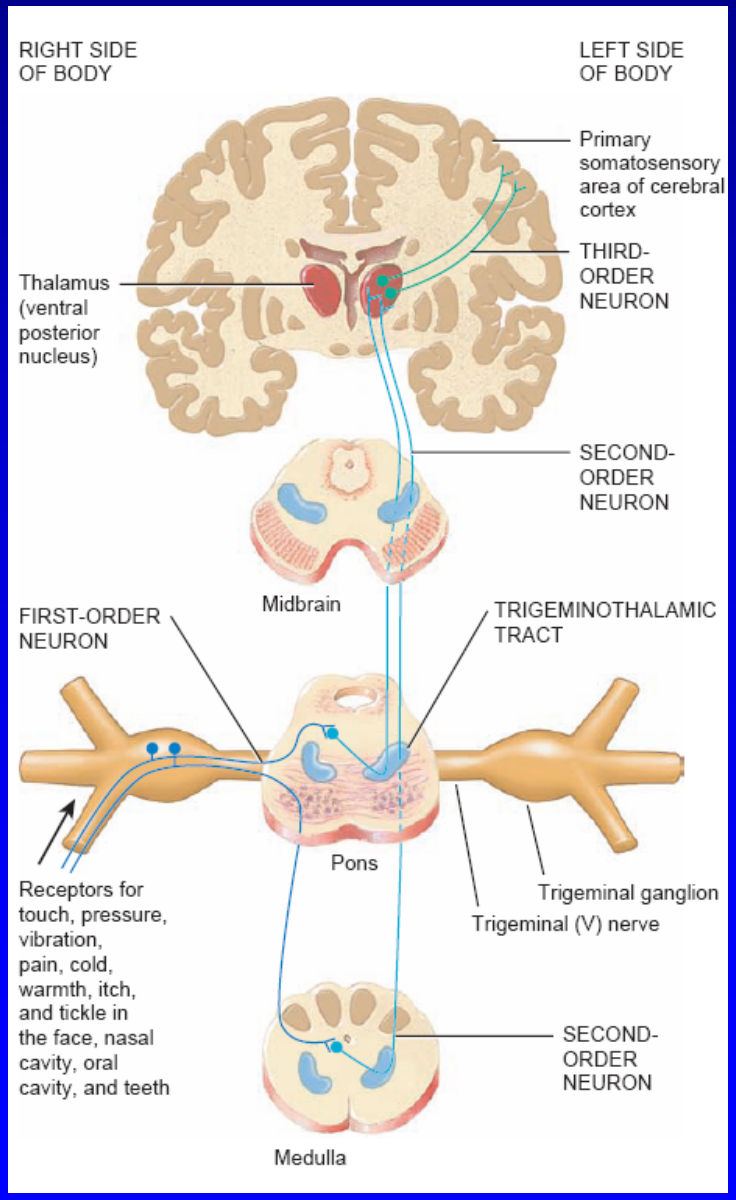
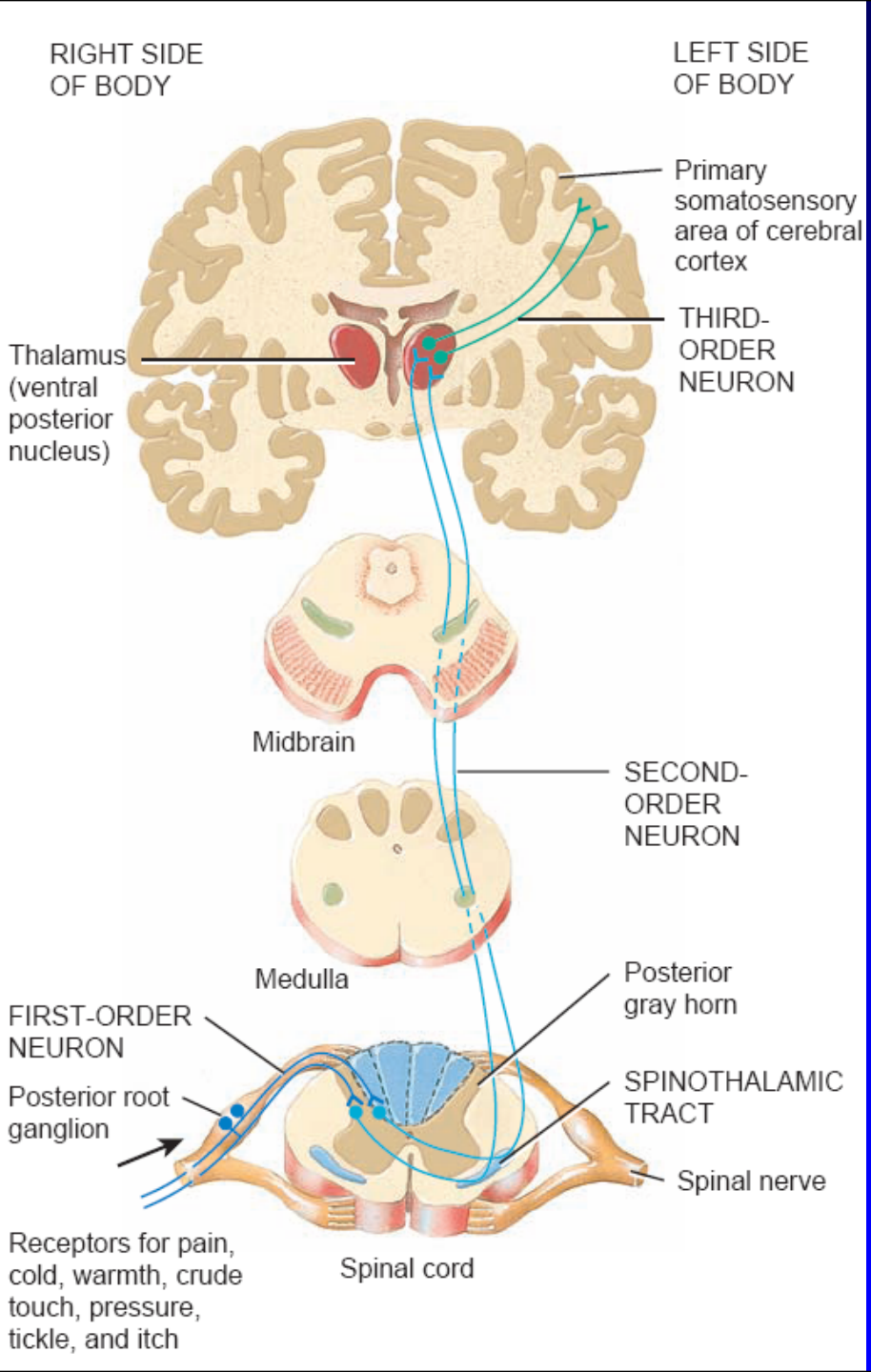

RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Primary somatosensory area of cerebral cortex
THIRD-ORDER NEURON
Thalamus (ventral posterior nucleus)
Midbrain
SECOND-ORDER NEURON
Medulla
Posterior gray horn
FIRST-ORDER NEURON
SPINOTHALAMIC TRACT
Posterior root ganglion
Spinal nerve
Receptors for pain, cold, warmth, crude touch, pressure, tickle, and itch
Spinal cord

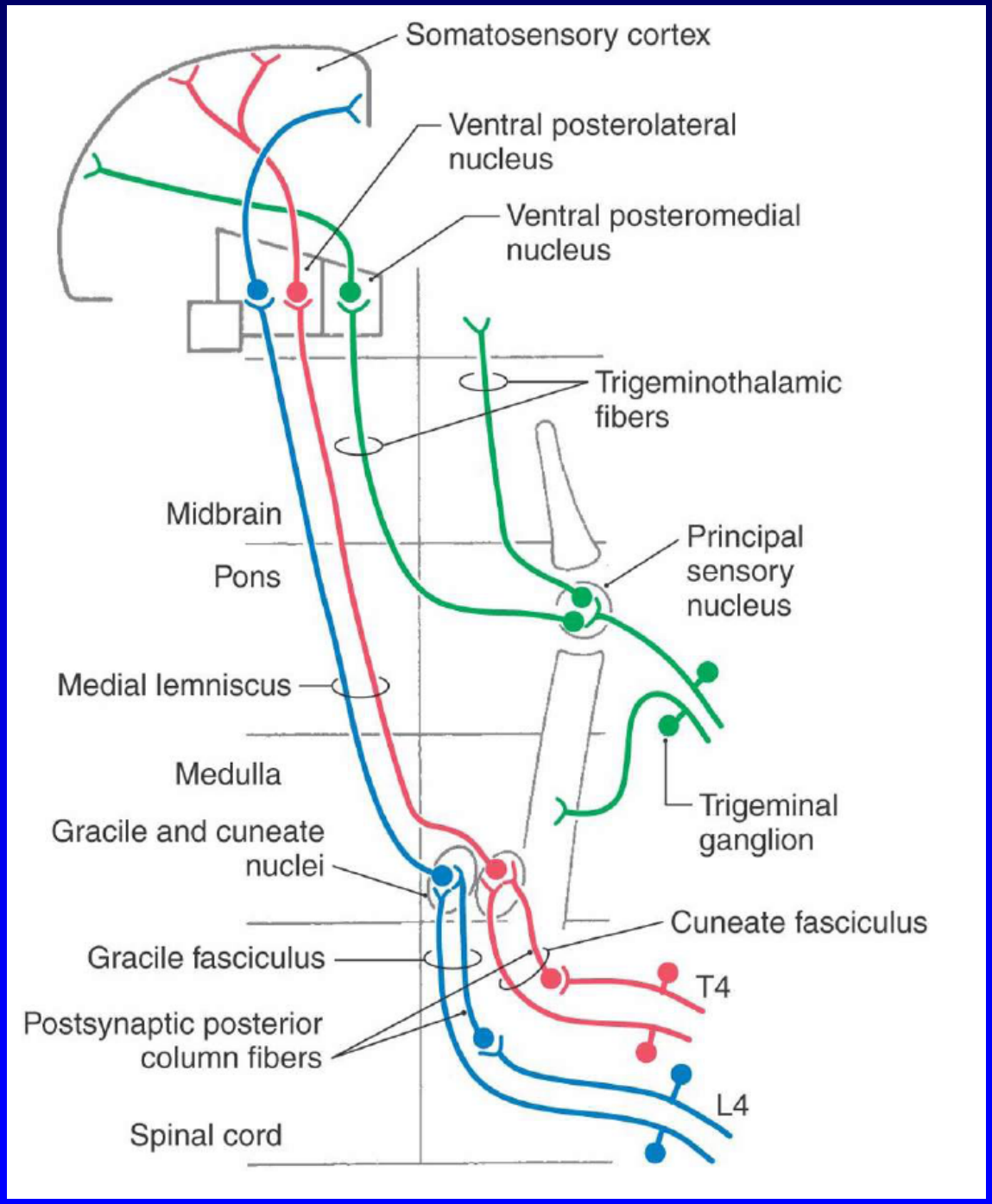

RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Primary somatosensory area of cerebral cortex
THIRD-ORDER NEURONS
Thalamus (ventral posterior nucleus)
Medial lemniscus
Midbrain
SECOND-ORDER NEURONS
Gracile nucleus
Cuneate nucleus
FIRST-ORDER NEURONS
Medulla
POSTERIOR COLUMN:
Posterior root ganglion
Gracile fasciculus
Cuneate fasciculus
Receptors for touch, pressure, vibration, and proprioception in the upper limbs, upper trunk, neck, and posterior head
Spinal nerve
Cervical spinal cord
Receptors for touch pressure, vibration, and stereognosis in the lower limbs and lower trunk
Lumbar spinal cord

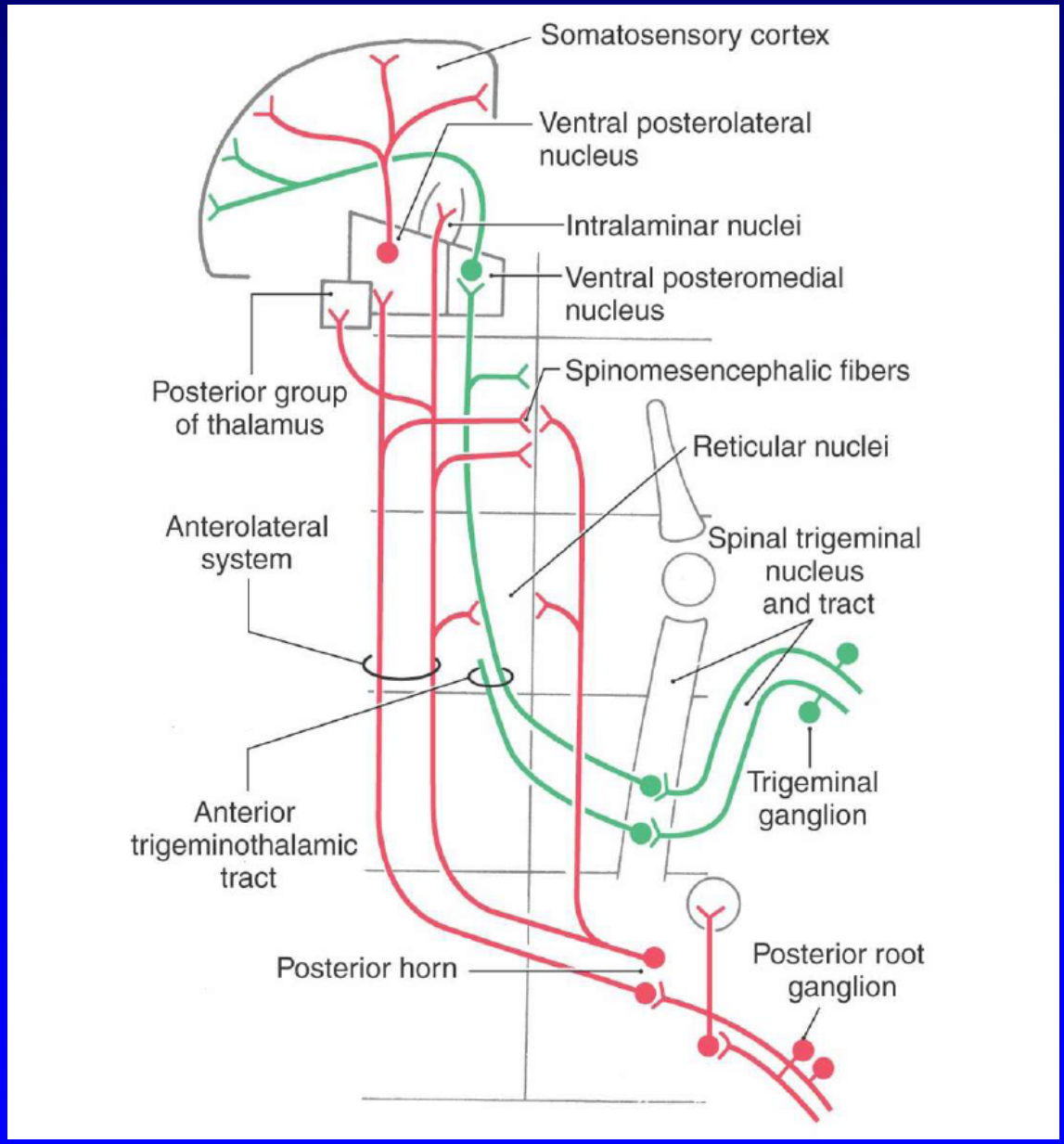
# (Trigeminal system)

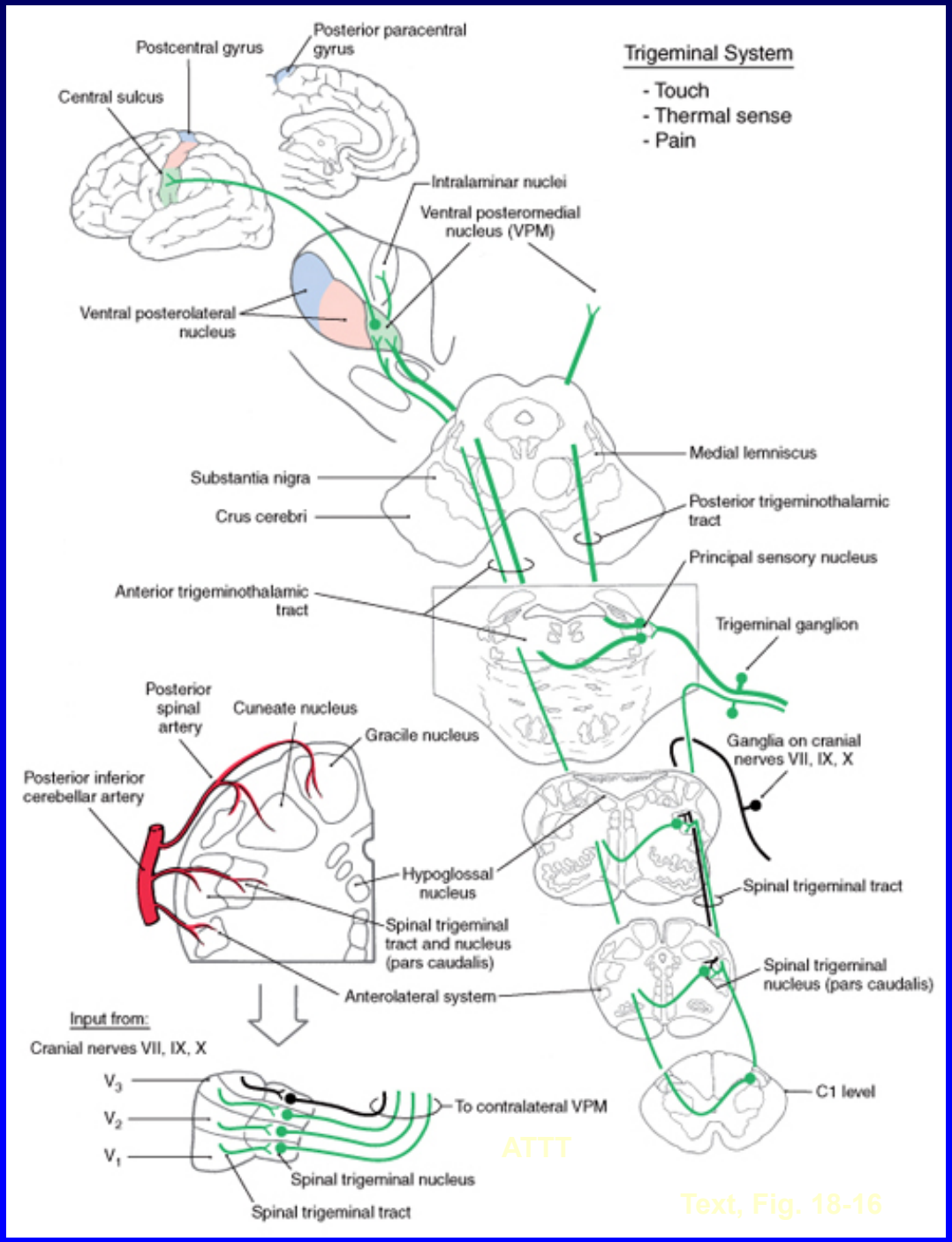
- Carry all the sensation modalities from the face to the brain




RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Primary somatosensory area of cerebral cortex
THIRD-ORDER NEURON
Thalamus (ventral posterior nucleus)
Midbrain
SECOND-ORDER NEURON
Medulla
Posterior gray horn
FIRST-ORDER NEURON
Posterior root ganglion
SPINOTHALAMIC TRACT
Spinal nerve
Receptors for pain, cold, warmth, crude touch, pressure, tickle, and itch
Spinal cord

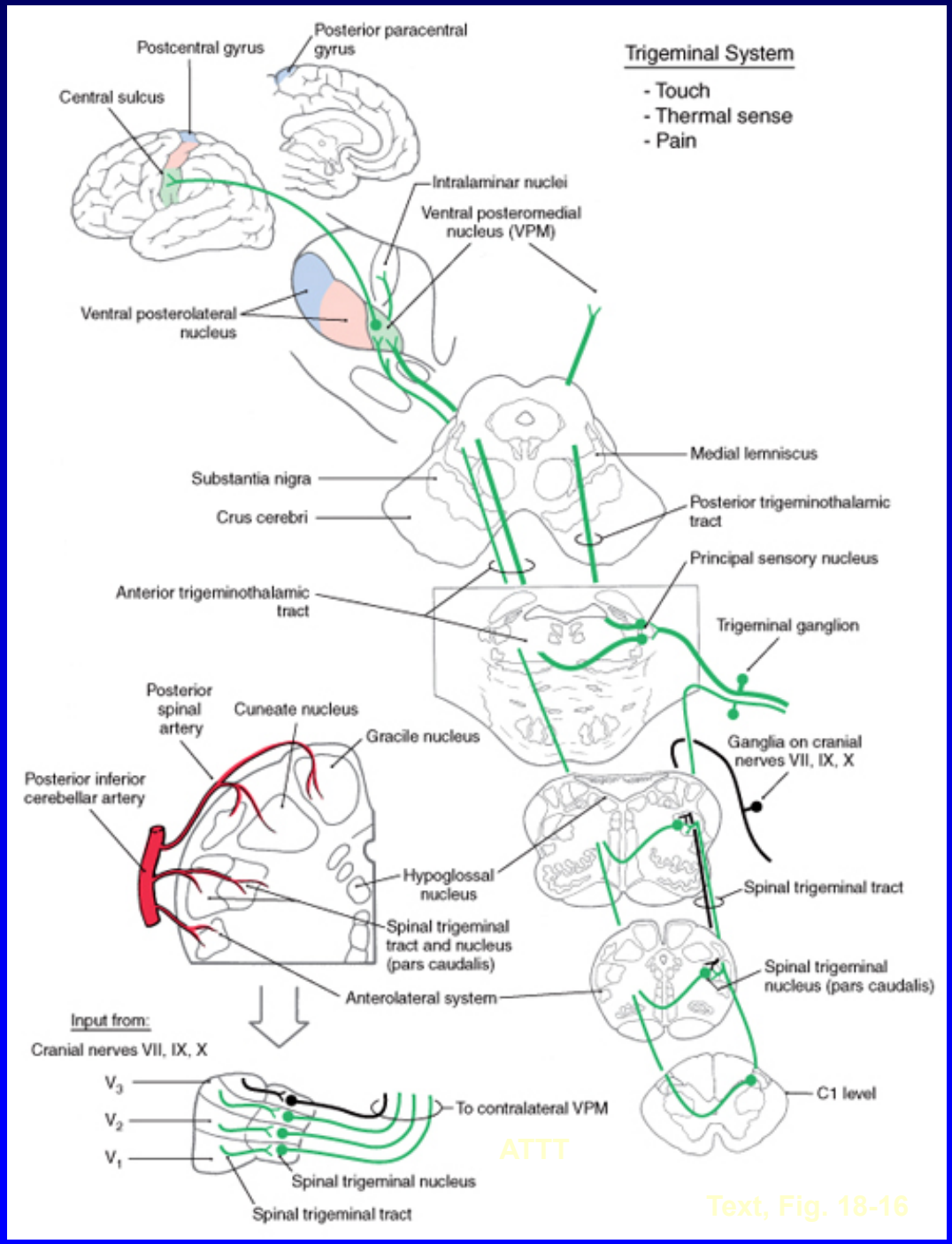

Somatosensory cortex
Ventral posterolateral nucleus
Ventral posteromedial nucleus
Trigeminothalamic fibers
Midbrain
Pons
Principal sensory nucleus
Medial lemniscus
Medulla
Trigeminal ganglion
Gracile and cuneate nuclei
Cuneate fasciculus
Gracile fasciculus
T4
Postsynaptic posterior column fibers
L4
Spinal cord


Somatosensory cortex
Ventral posterolateral nucleus
Intralaminar nuclei
Ventral posteromedial nucleus
Posterior group of thalamus
Spinomesencephalic fibers
Reticular nuclei
Anterolateral system
Spinal trigeminal nucleus and tract
Trigeminal ganglion
Anterior trigeminothalamic tract
Posterior horn
Posterior root ganglion



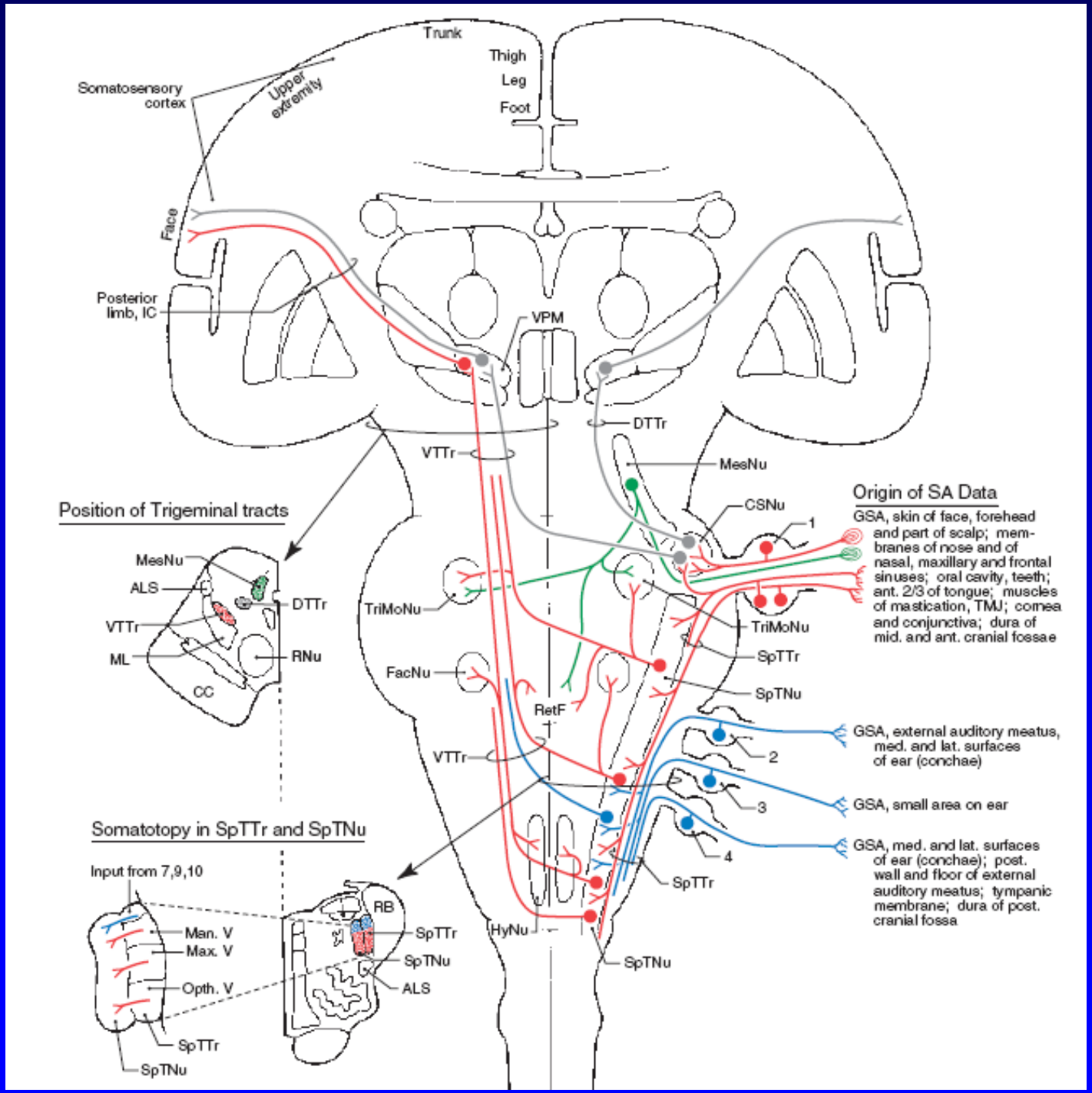

Inputs to the spinal trigeminal nucleus – pain and thermal from the face and oral cavity

Look at the **thin Green** Lines



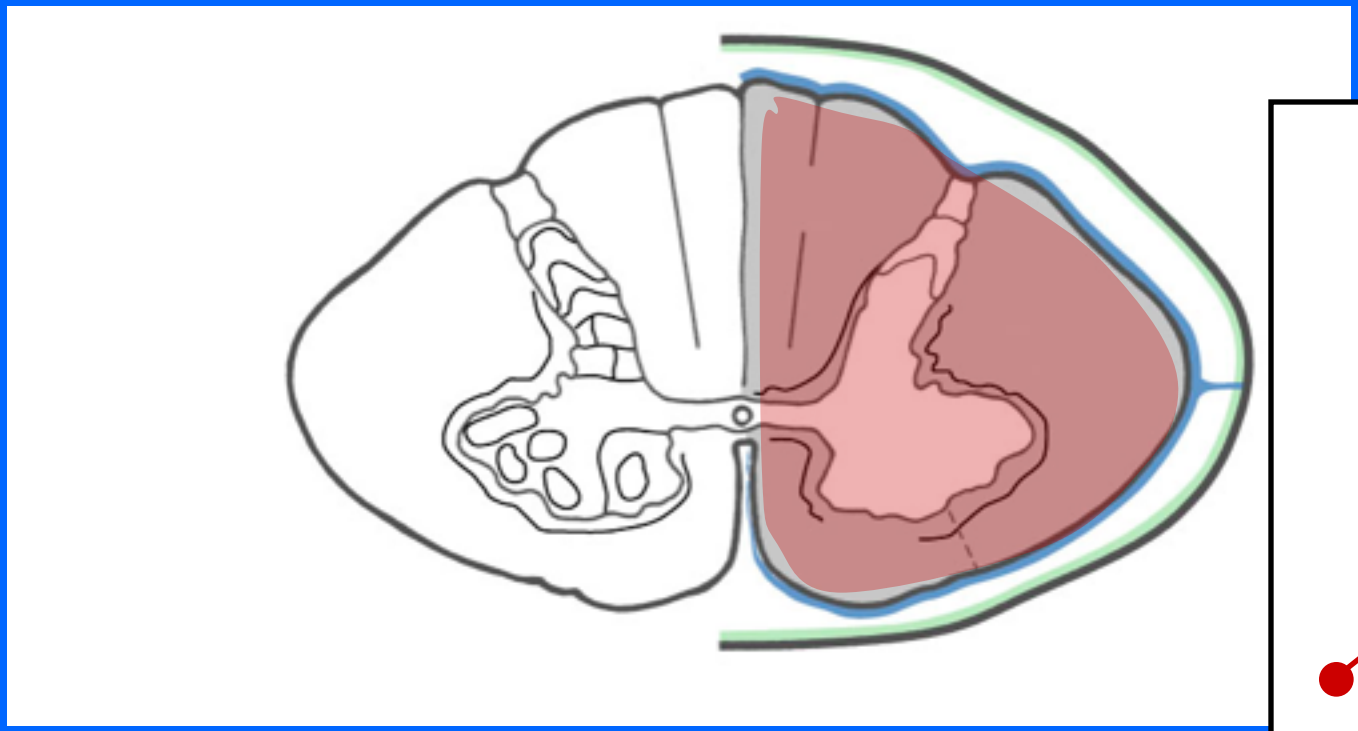

Inputs to the spinal trigeminal nucleus – sensations from from ear and external auditory meatus traveling in CN VII, IX, and X

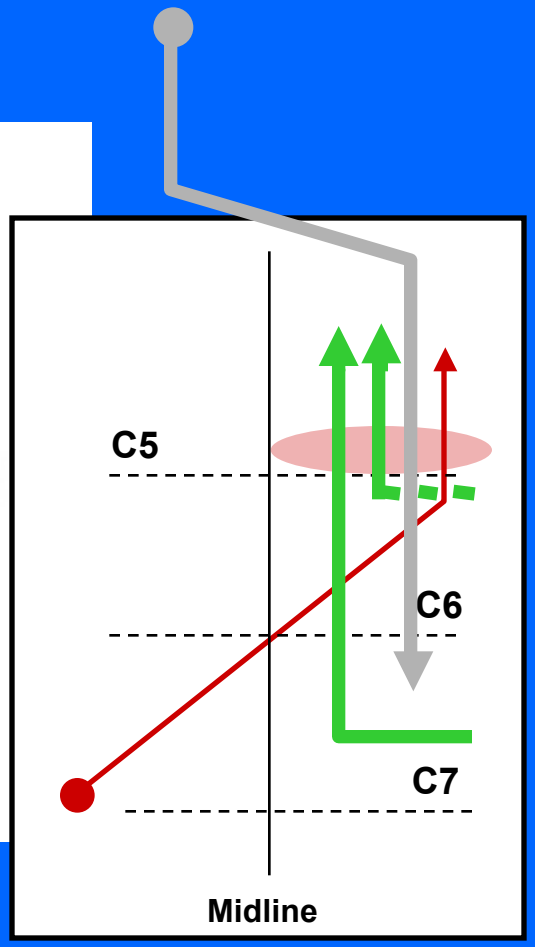
Look at the **thin Black** line

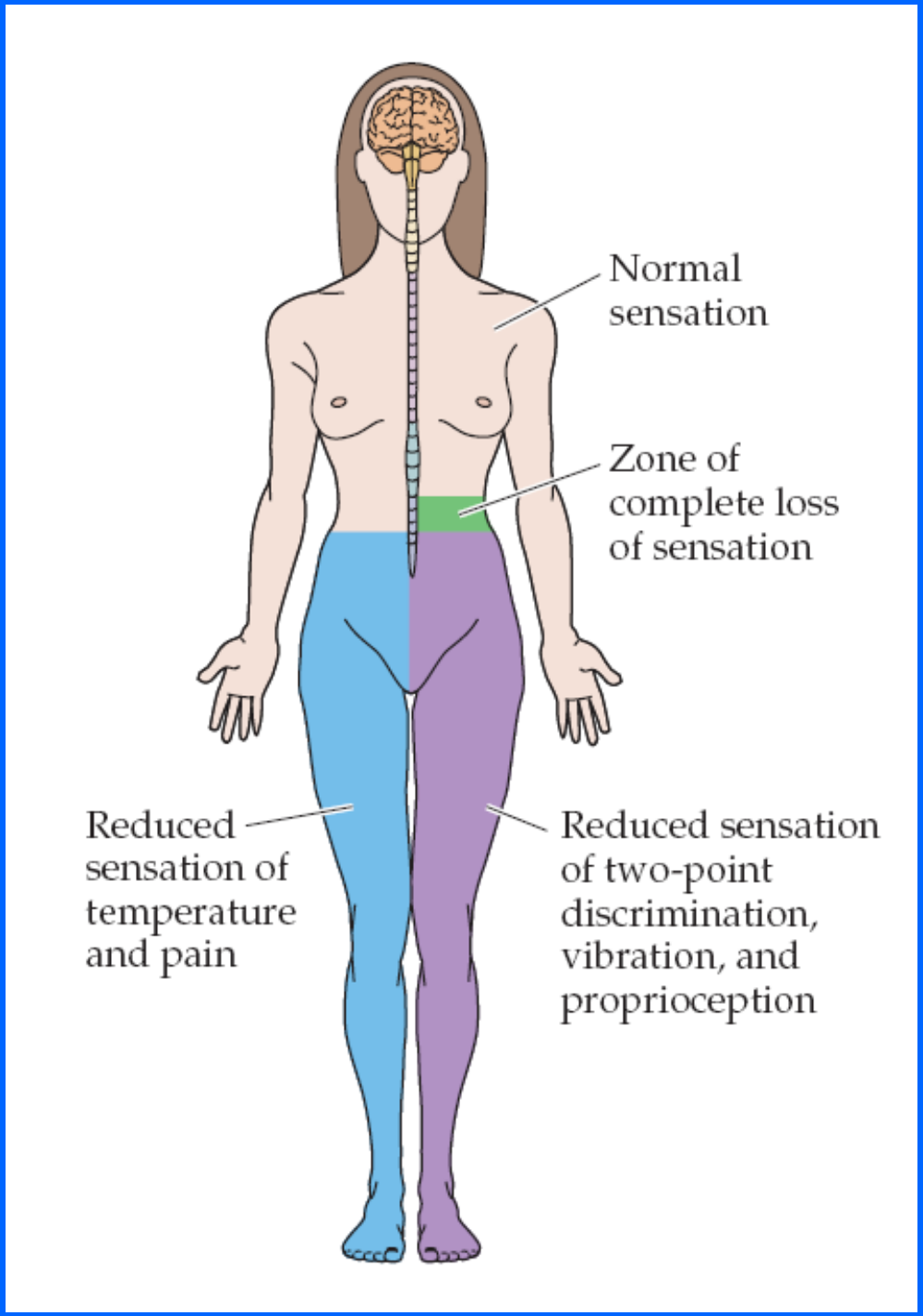

Trunk
Thigh
Leg
Foot
Somatosensory cortex
Upper extremity
Face
Posterior limb, IC
VPM
DTTr
VTTr
MesNu
CSNu
1
TriMoNu
SpTTr
SpTNu
FacNu
RetF
VTTr
2
3
4
GSA, external auditory meatus, med. and lat. surfaces of ear (conchae)
GSA, small area on ear
GSA, med. and lat. surfaces of ear (conchae); post. wall and floor of external auditory meatus; tympanic membrane; dura of post. cranial fossa
SpTTr
HyNu
SpTNu
Origin of SA Data
GSA, skin of face, forehead and part of scalp; membranes of nose and of nasal, maxillary and frontal sinuses; oral cavity, teeth; ant. 2/3 of tongue; muscles of mastication, TMJ; cornea and conjunctiva; dura of mid. and ant. cranial fossae
Position of Trigeminal tracts
MesNu
ALS
DTTr
VTTr
ML
RNu
CC
Somatotopy in SpTTr and SpTNu
Input from 7,9,10
Man. V
Max. V
Opth. V
SpTTr
SpTNu
RB
SpTTr
SpTNu
ALS

# Clinical correlation

# Brown-Séquard syndrome



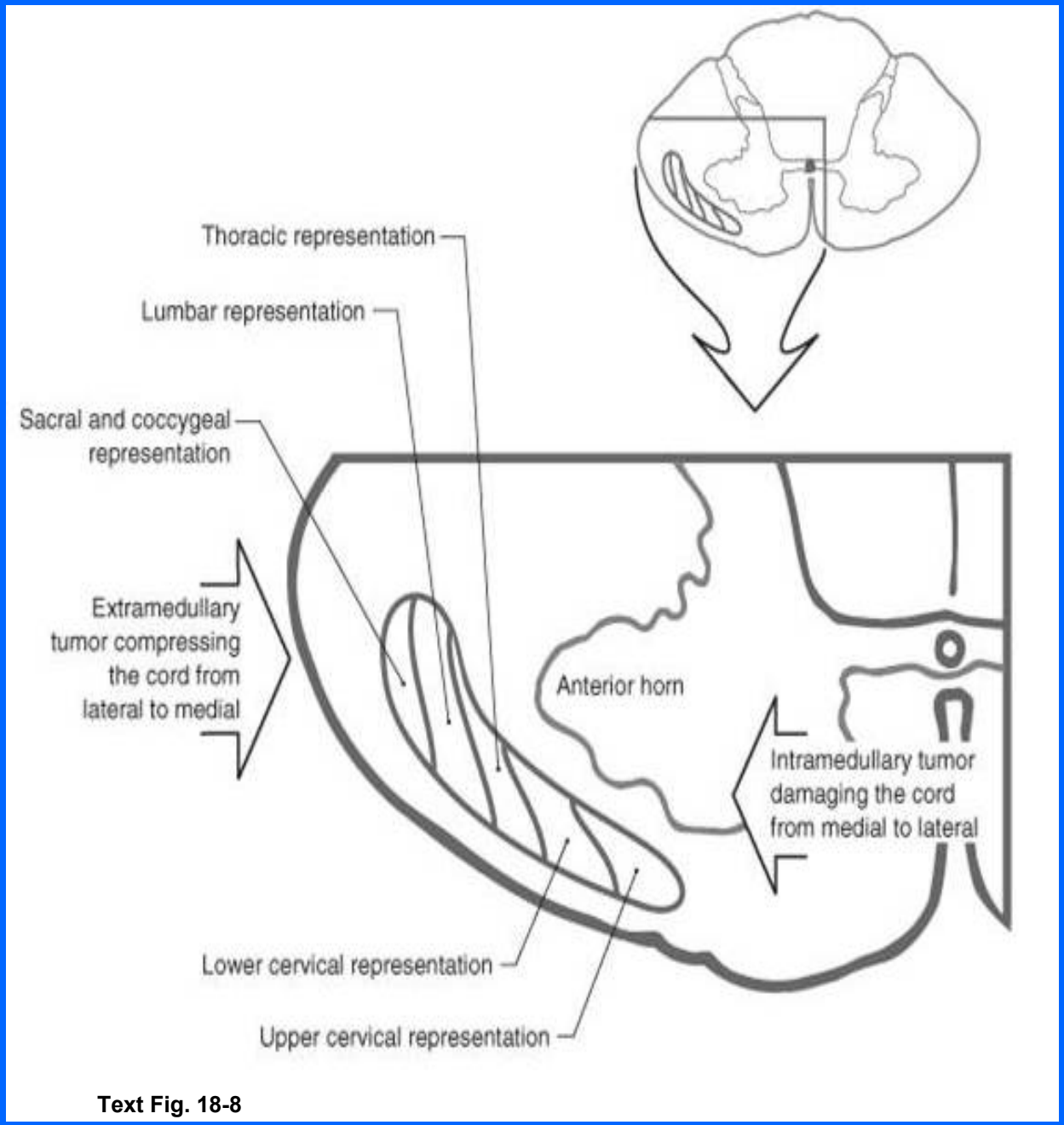



Normal sensation
Zone of complete loss of sensation
Reduced sensation of temperature and pain
Reduced sensation of two-point discrimination, vibration, and proprioception

# **tabes dorsalis** (**progressive locomotor ataxia**).

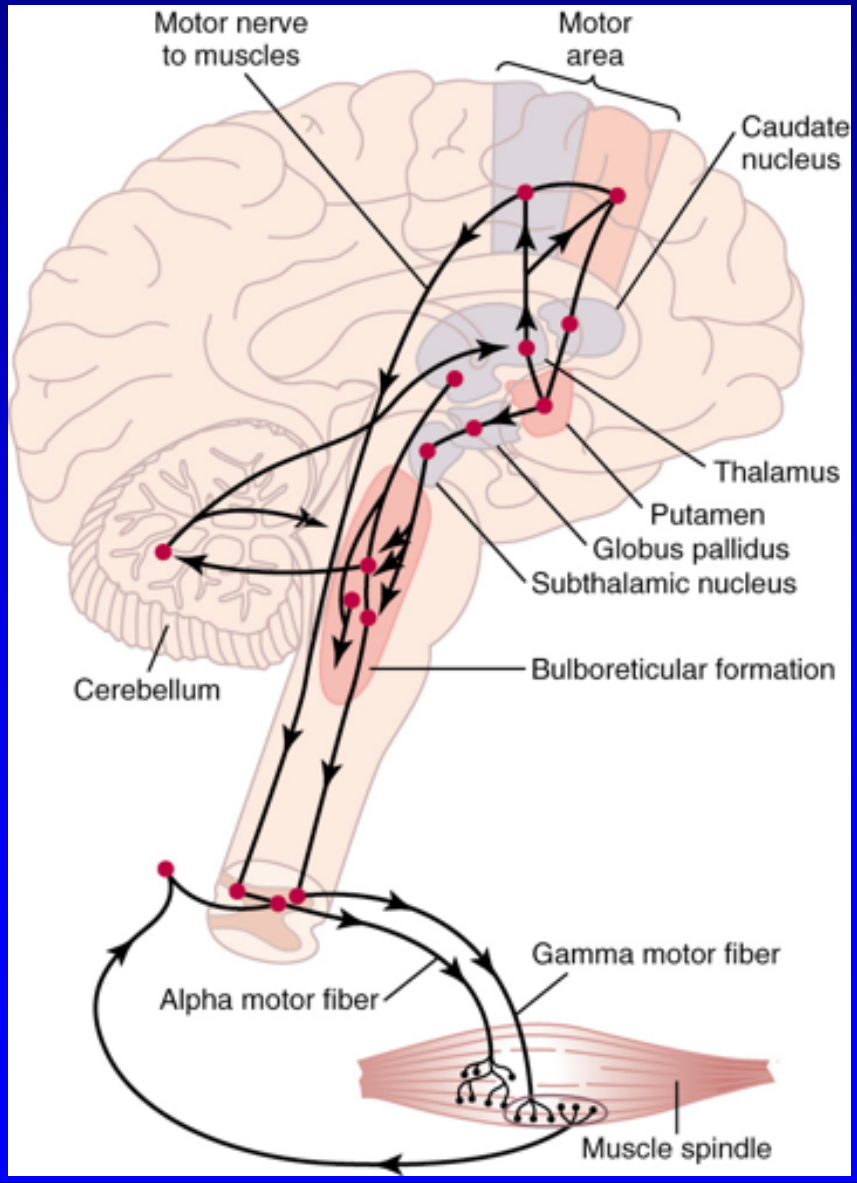
This disease is caused by infectionwith *Treponema pallidum* and is associated with neurosyphilis. The fibers of the posterior columns degenerate, and the patient has ataxia (related to the lack of sensory input, clinically referred to as **sensory ataxia**), loss of muscle stretch (tendon) reflexes, and proprioceptive losses from the extremities. In **sensory ataxia**, the patient may also have a wide-based stance and may place the feet to the floor with force in an effort to create the missing proprioceptive input

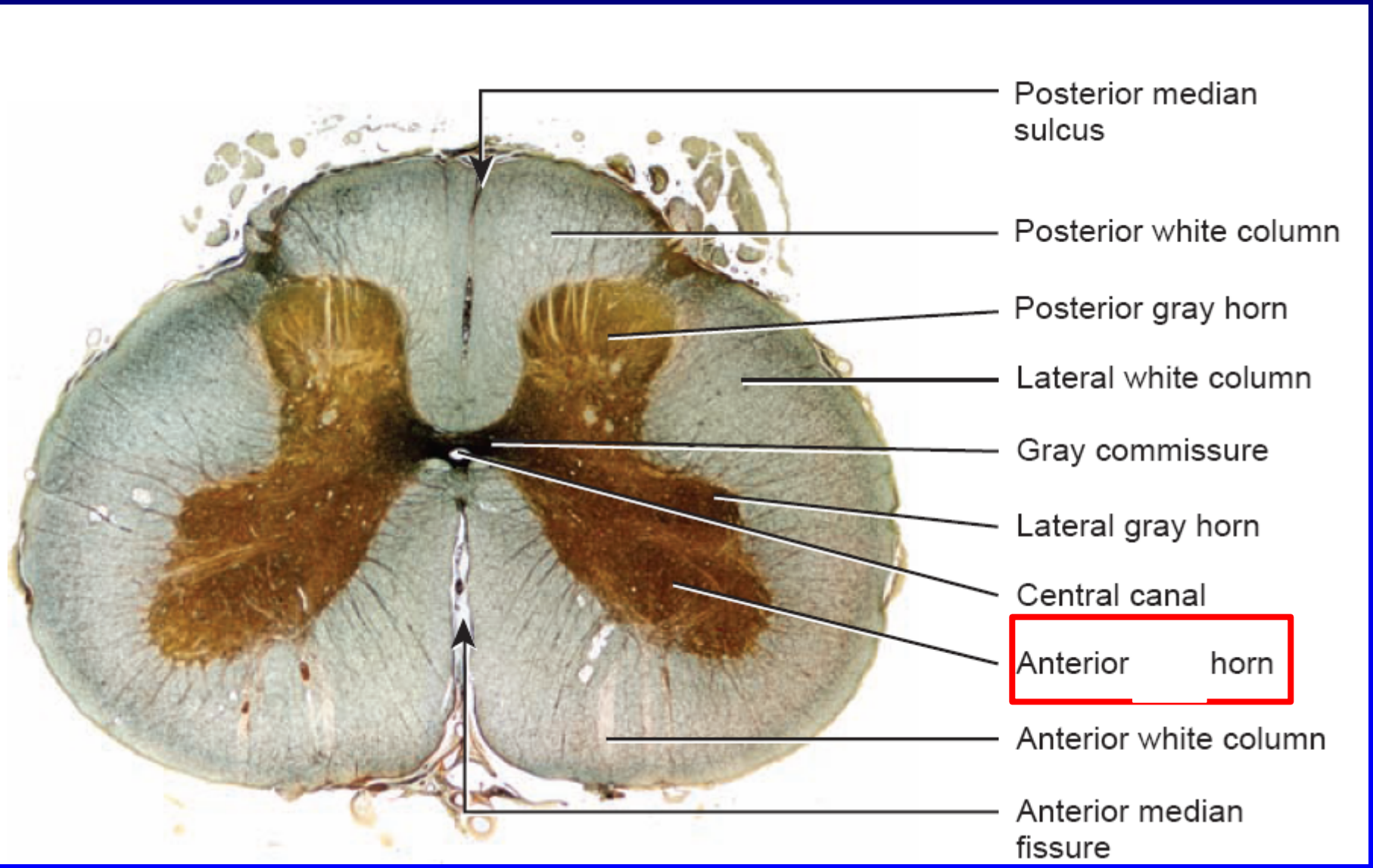
Degeneration of the major spinocerebellar tracts occurs in diseases such as **Friedreich ataxia**. The result is **cerebellar ataxia**—lack of coordination during walking and other movements that occurs because the cerebellum is not receiving the sensory feedback necessary to regulate movement.

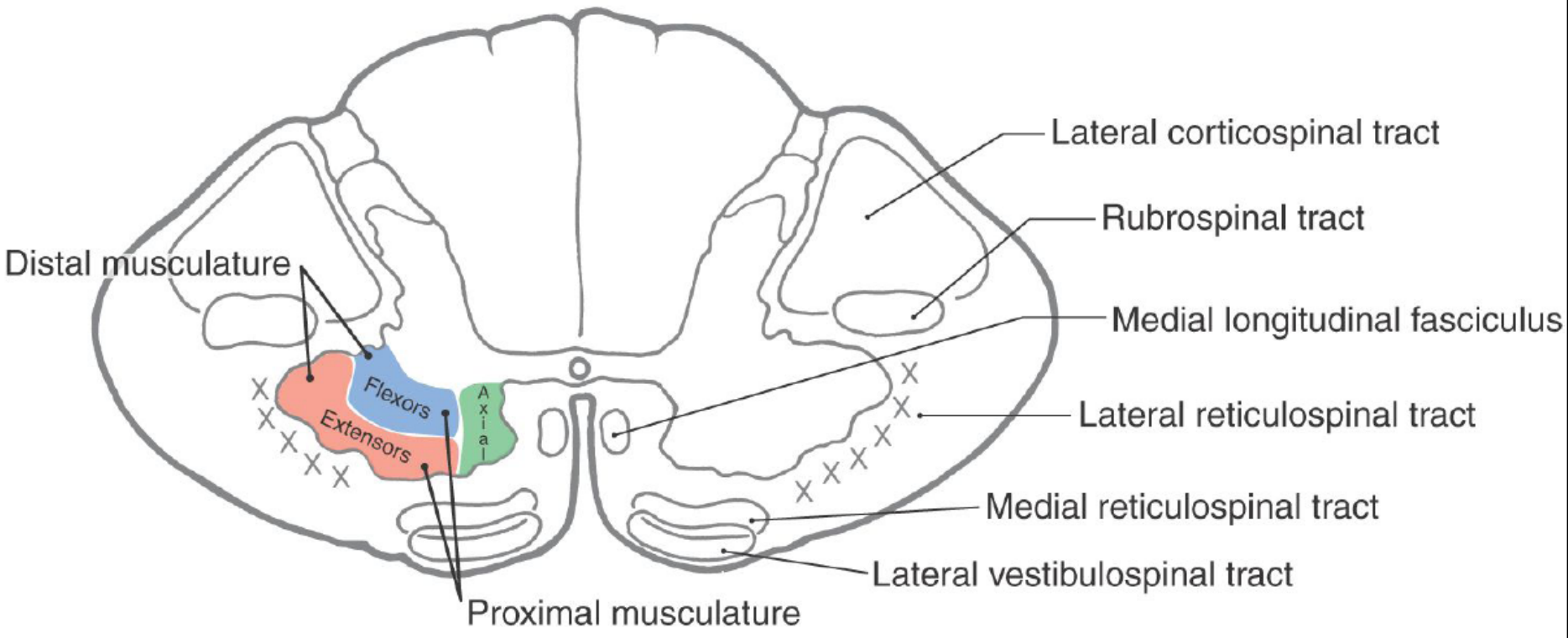

Thoracic representation
Lumbar representation
Sacral and coccygeal representation
Extramedullary tumor compressing the cord from lateral to medial
Anterior horn
Intramedullary tumor damaging the cord from medial to lateral
Lower cervical representation
Upper cervical representation

**Text Fig. 18-8**

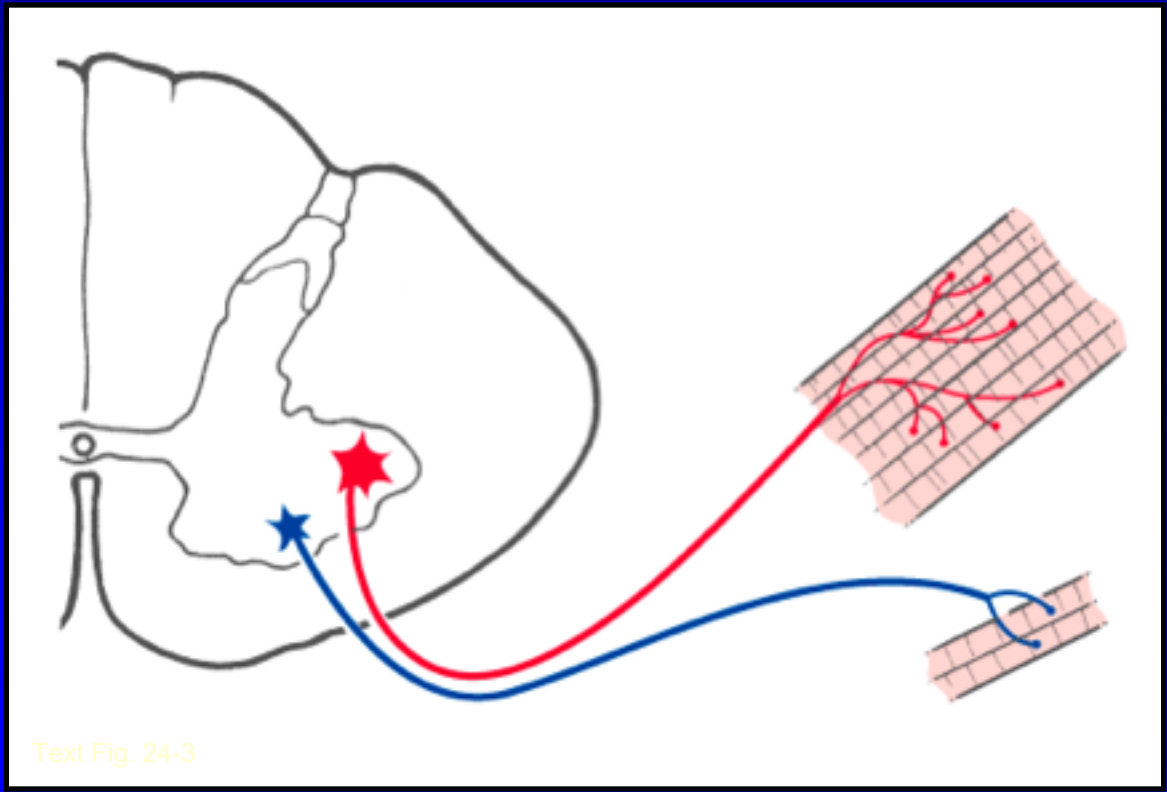
# Motor system



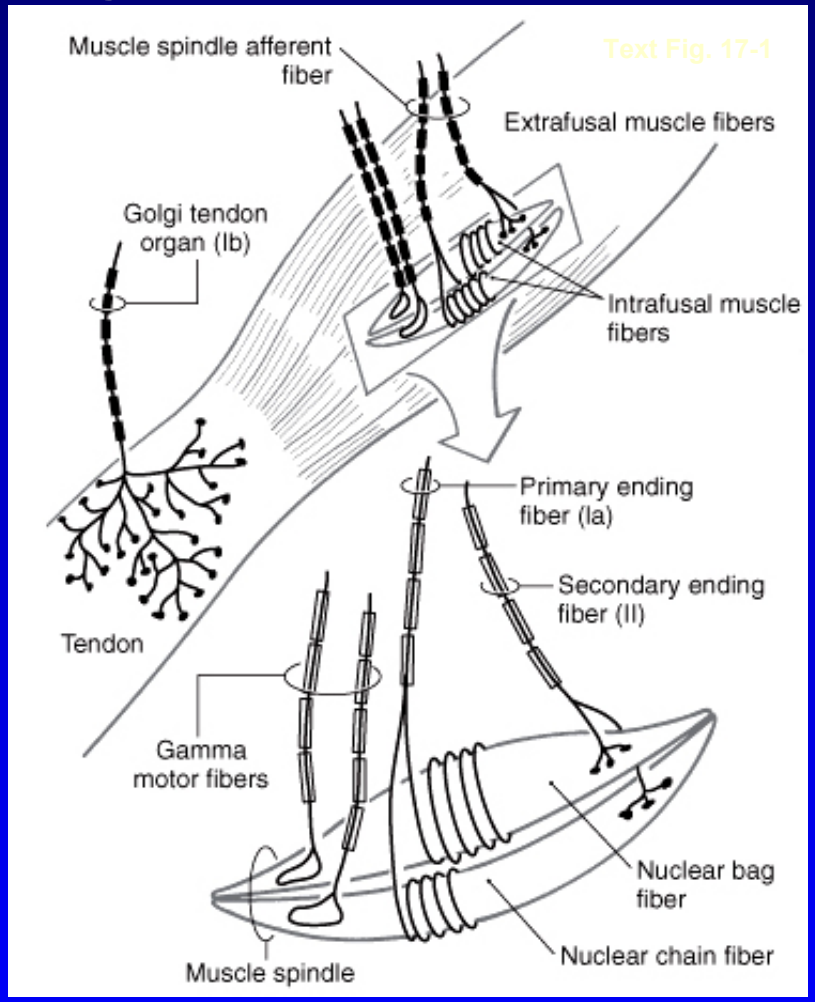

Posterior median sulcus
Posterior white column
Posterior gray horn
Lateral white column
Gray commissure
Lateral gray horn
Central canal
Anterior horn
Anterior white column
Anterior median fissure


Lateral corticospinal tract
Rubrospinal tract
Distal musculature
Medial longitudinal fasciculus
Flexors
Axial
Extensors
Lateral reticulospinal tract
Medial reticulospinal tract
Lateral vestibulospinal tract
Proximal musculature

# Motor Units – Large Versus Small

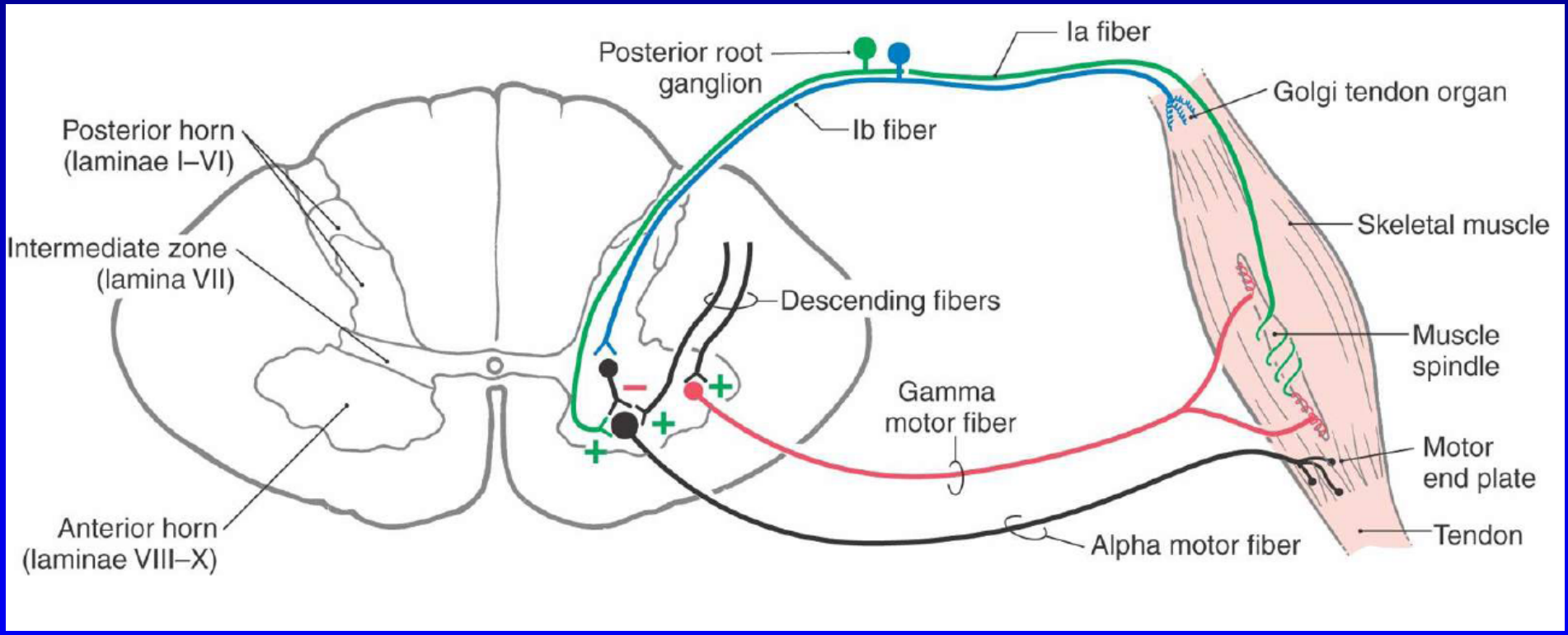


# Major receptors involved in spinal cord reflexes: muscle spindle and golgi tendon organ

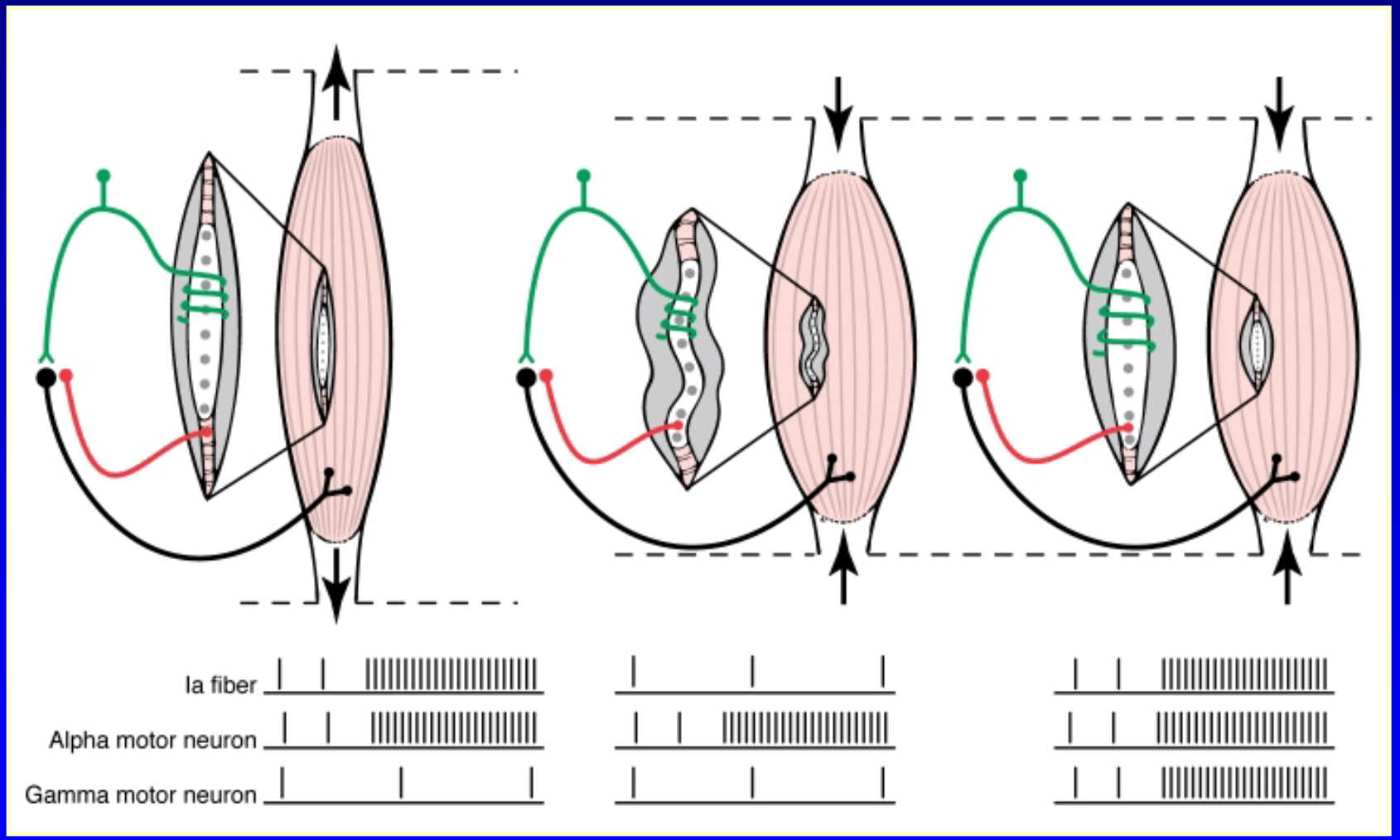


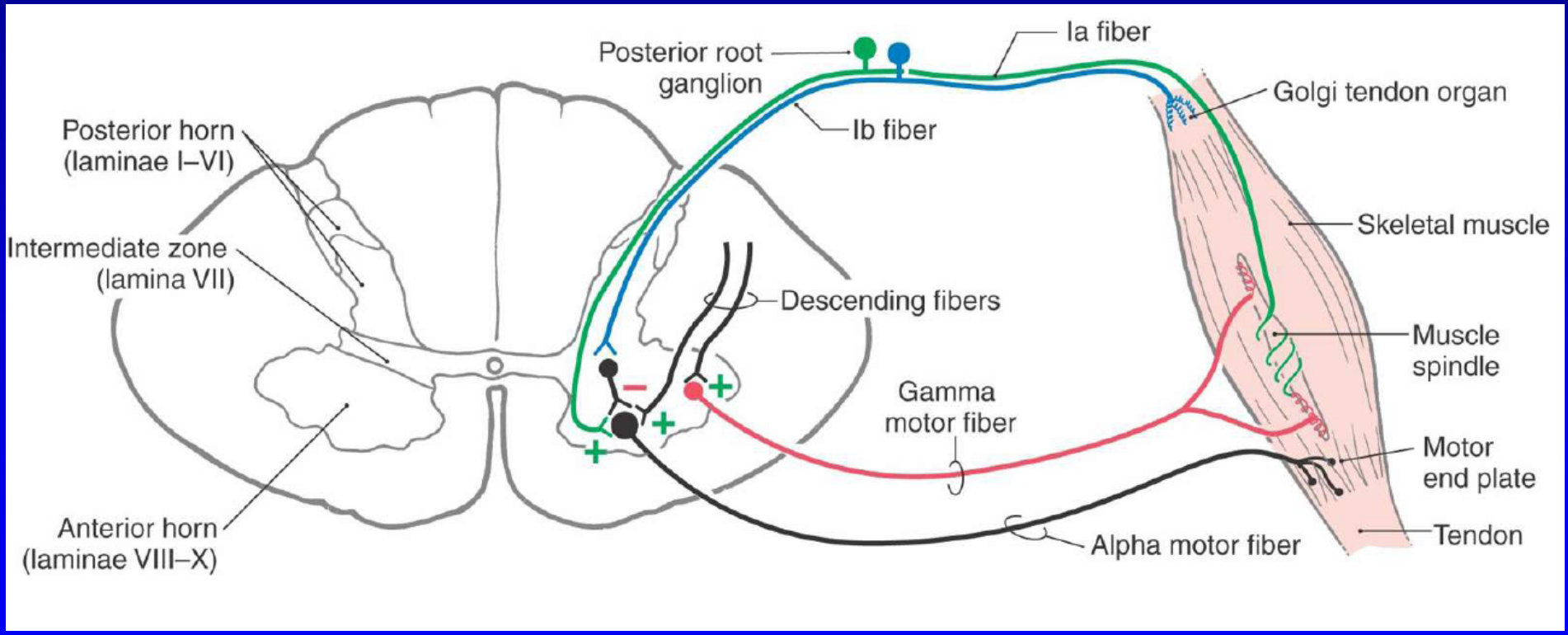

**Muscle spindle sense change and rate of change in muscle length**

**Golgi tendon organ sense the force of muscle contraction (tension)**


Posterior root ganglion
Ia fiber
Golgi tendon organ
Posterior horn (laminae I–VI)
Ib fiber
Skeletal muscle
Intermediate zone (lamina VII)
Descending fibers
Muscle spindle
Gamma motor fiber
Motor end plate
Anterior horn (laminae VIII–X)
Alpha motor fiber
Tendon

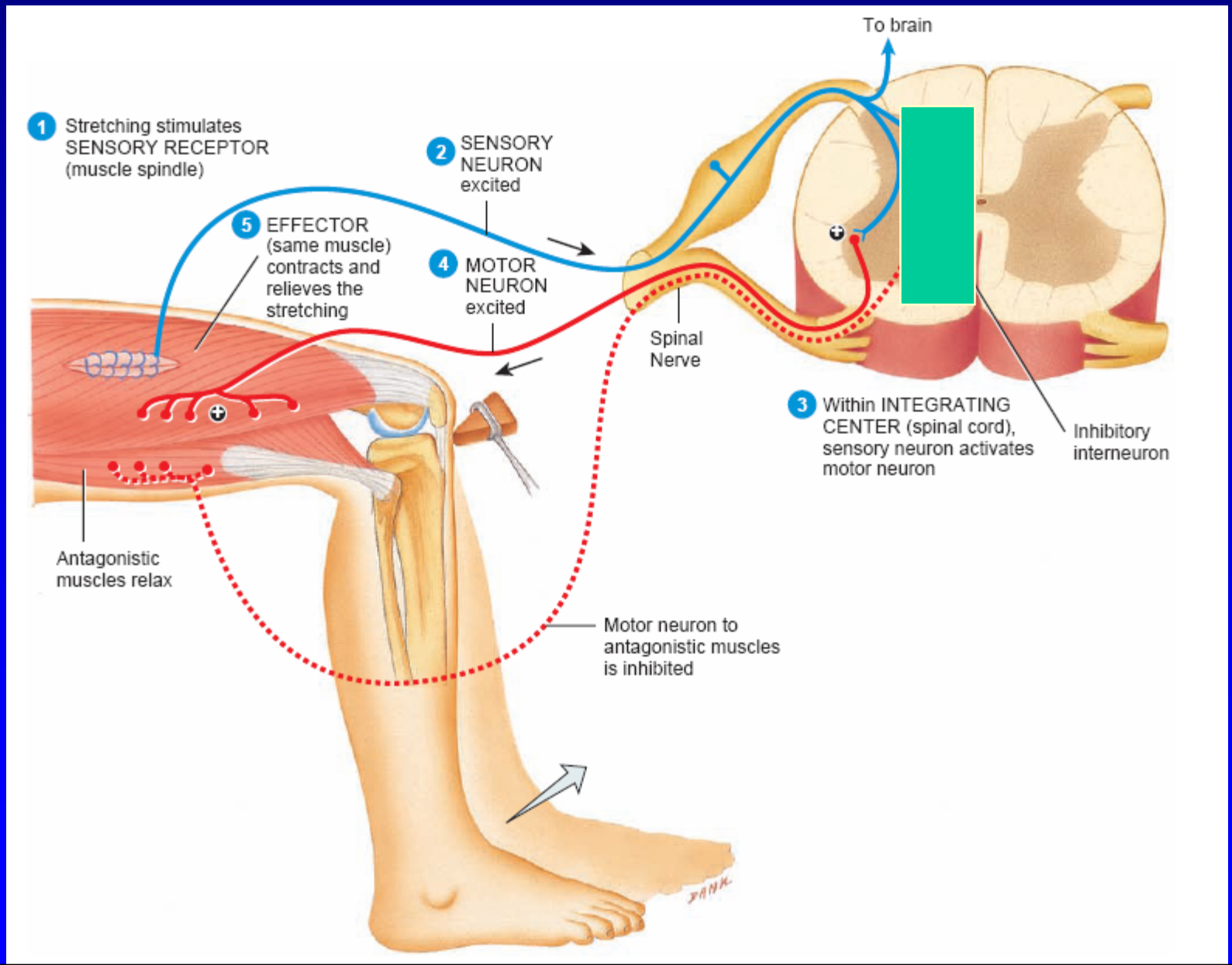
# The Muscle Spindle When Activated



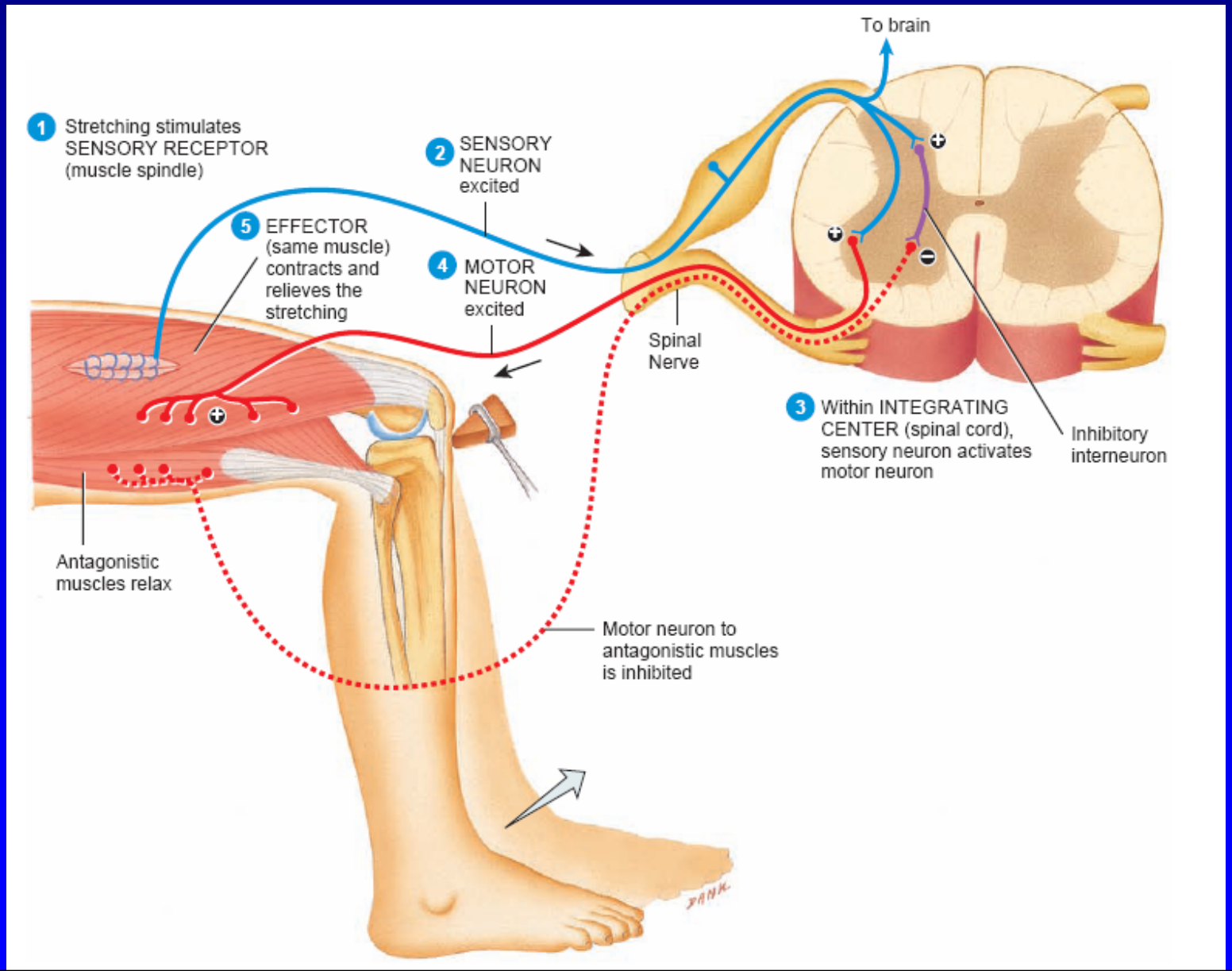

Posterior root ganglion
Ia fiber
Golgi tendon organ
Posterior horn (laminae I–VI)
Ib fiber
Skeletal muscle
Intermediate zone (lamina VII)
Descending fibers
Muscle spindle
Gamma motor fiber
Motor end plate
Anterior horn (laminae VIII–X)
Alpha motor fiber
Tendon

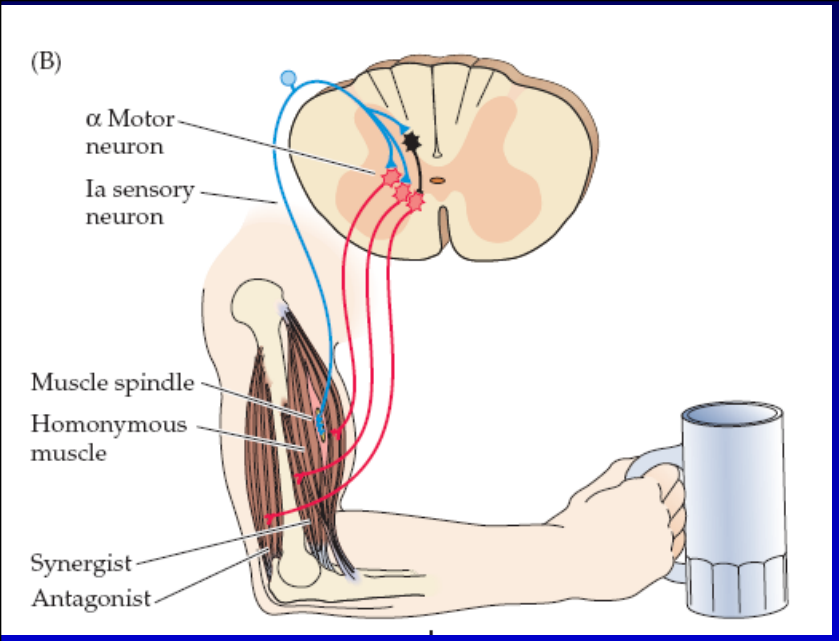
# Spinal cord Reflexes

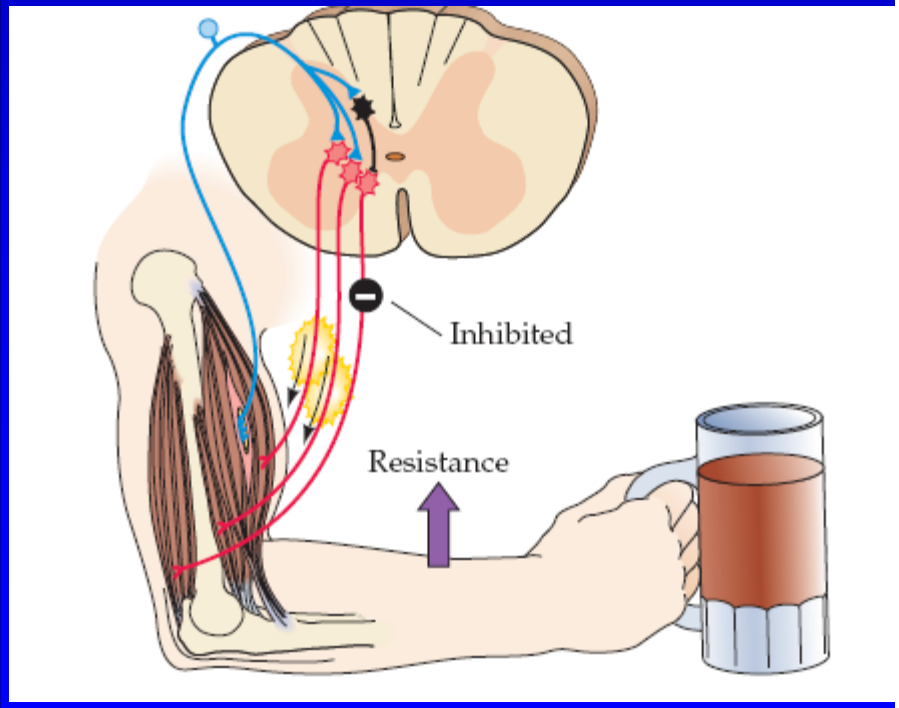
# Muscle stretch reflex

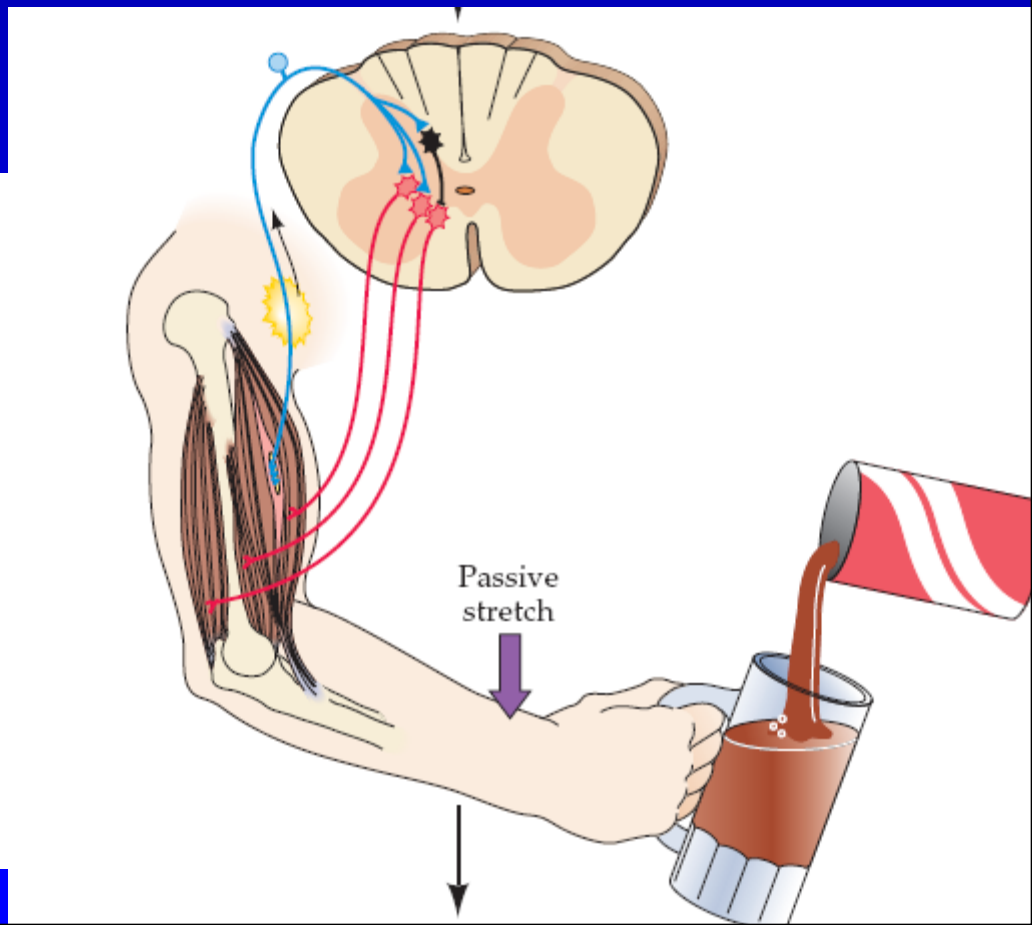


# Muscle stretch reflex / Reciprocal inhibition

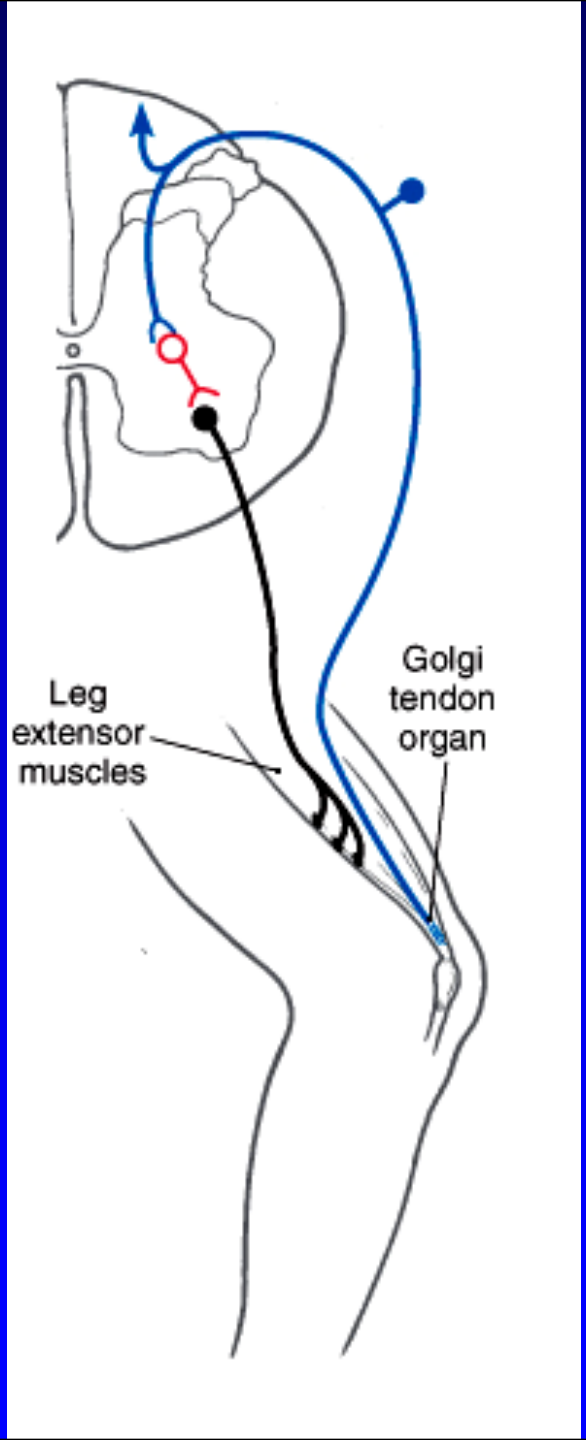



(B)
α Motor neuron
Ia sensory neuron
Muscle spindle
Homonymous muscle
Synergist
Antagonist

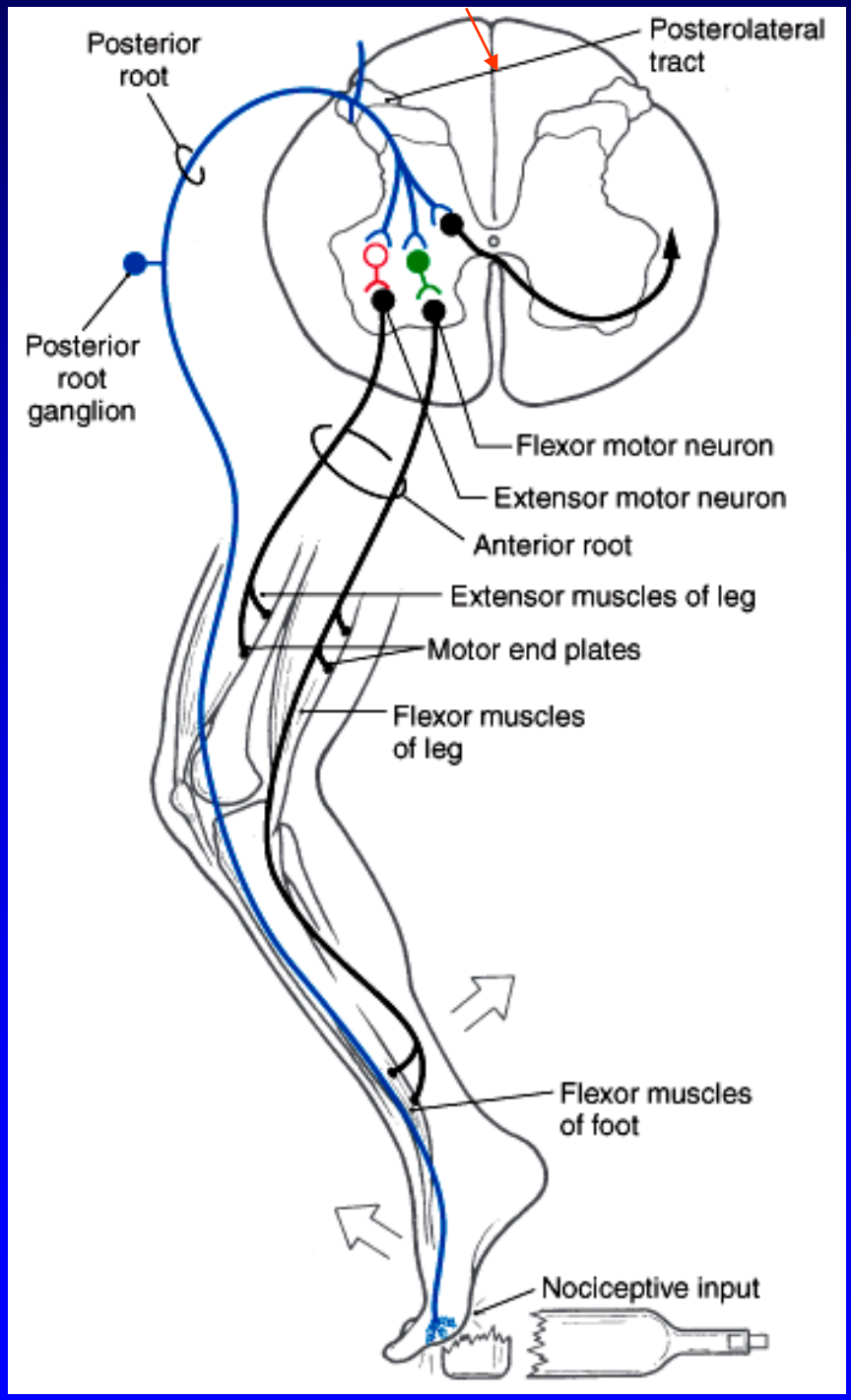

Inhibited
Resistance


Passive stretch

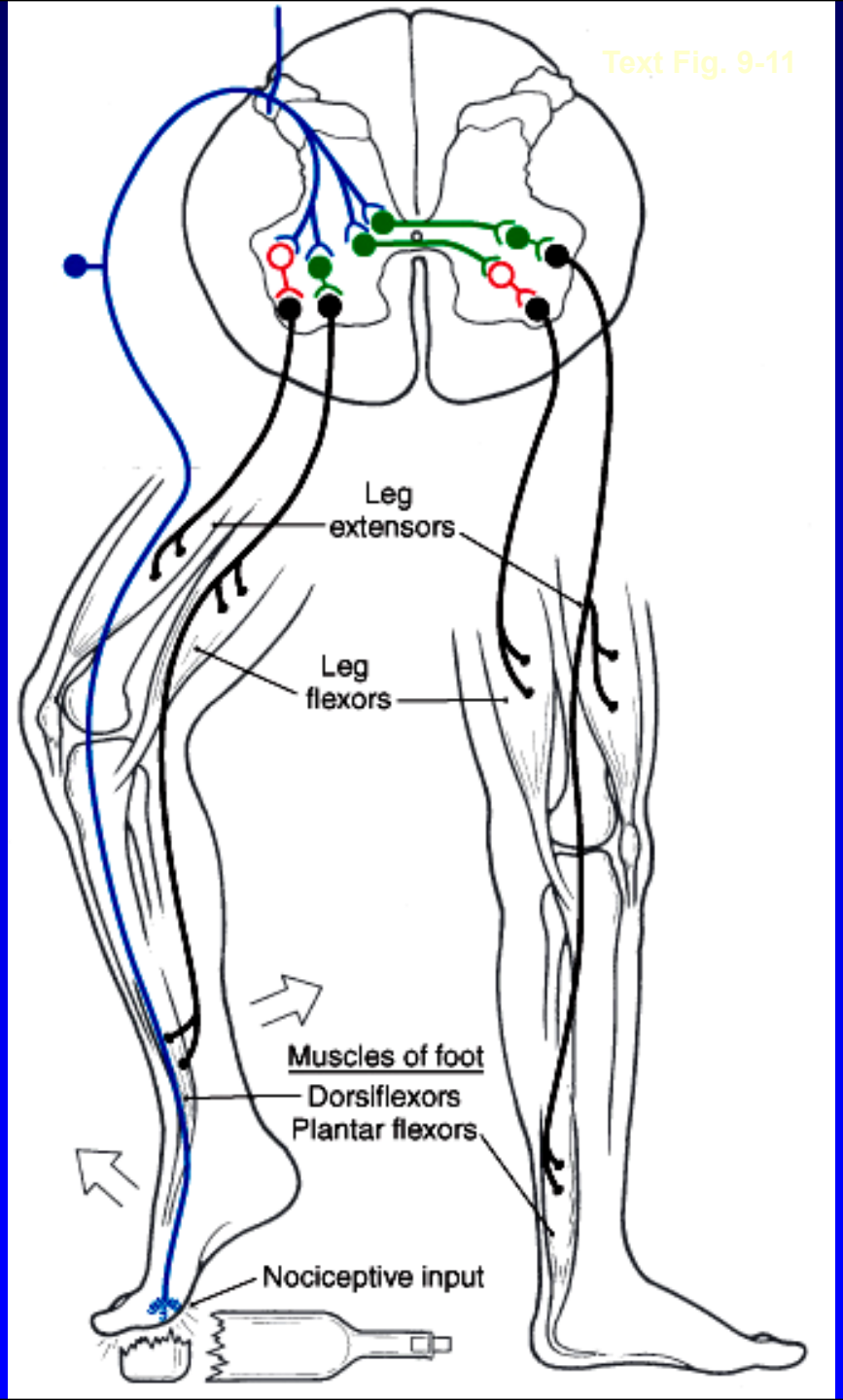
# Tendon reflex (autogenic inhibition)



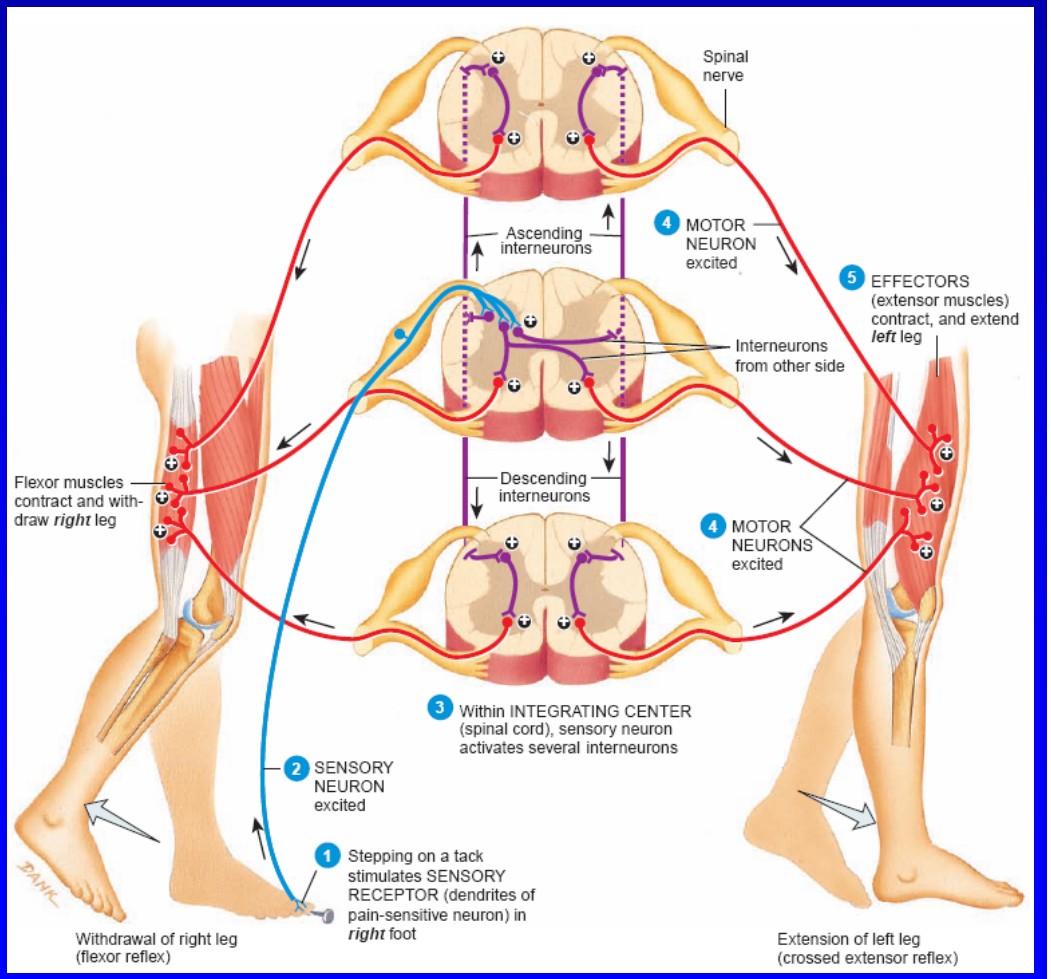
# Flexor (withdrawal ) reflex (nociceptive reflex)

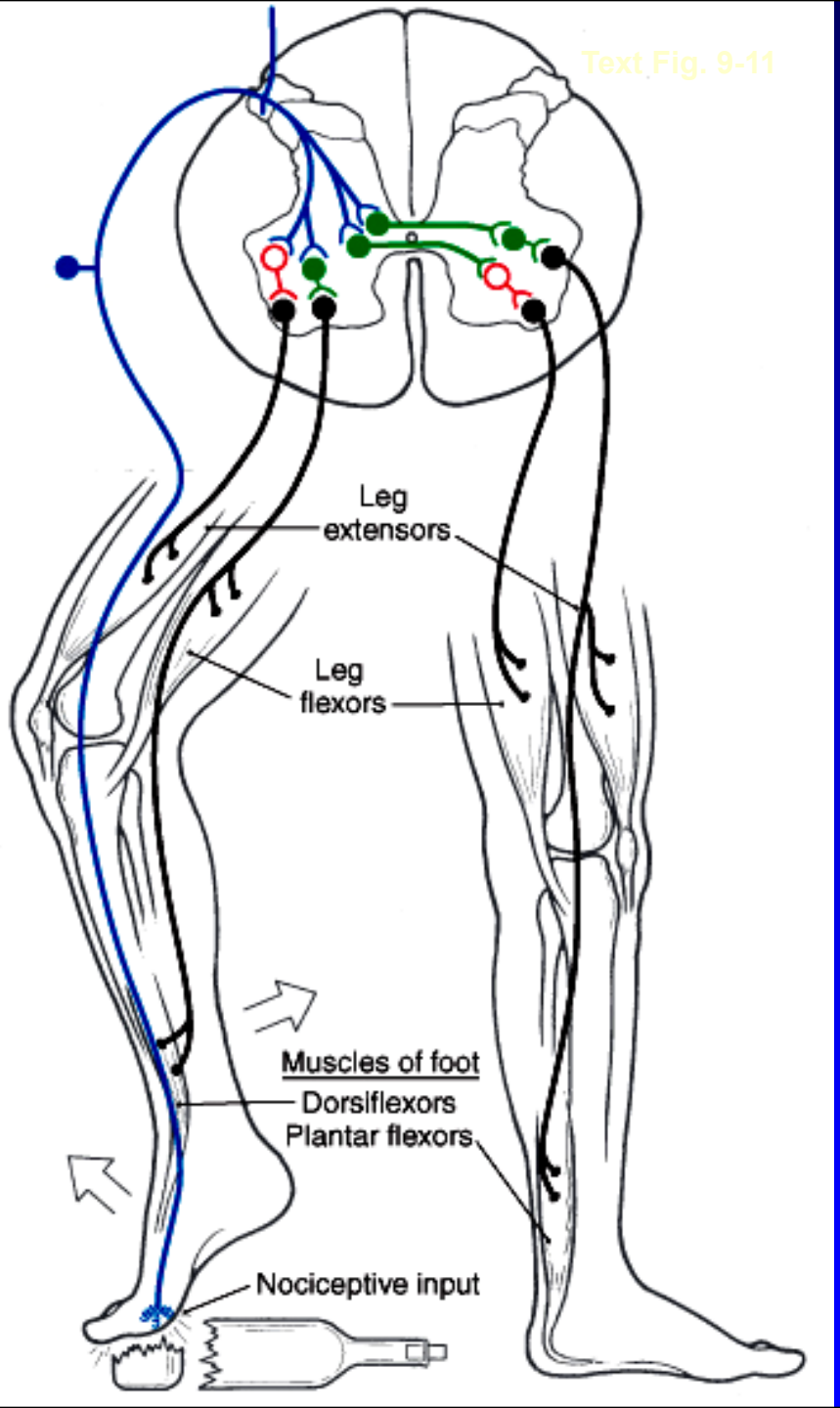


# Crossed Extension Reflex



# Crossed Extension Reflex



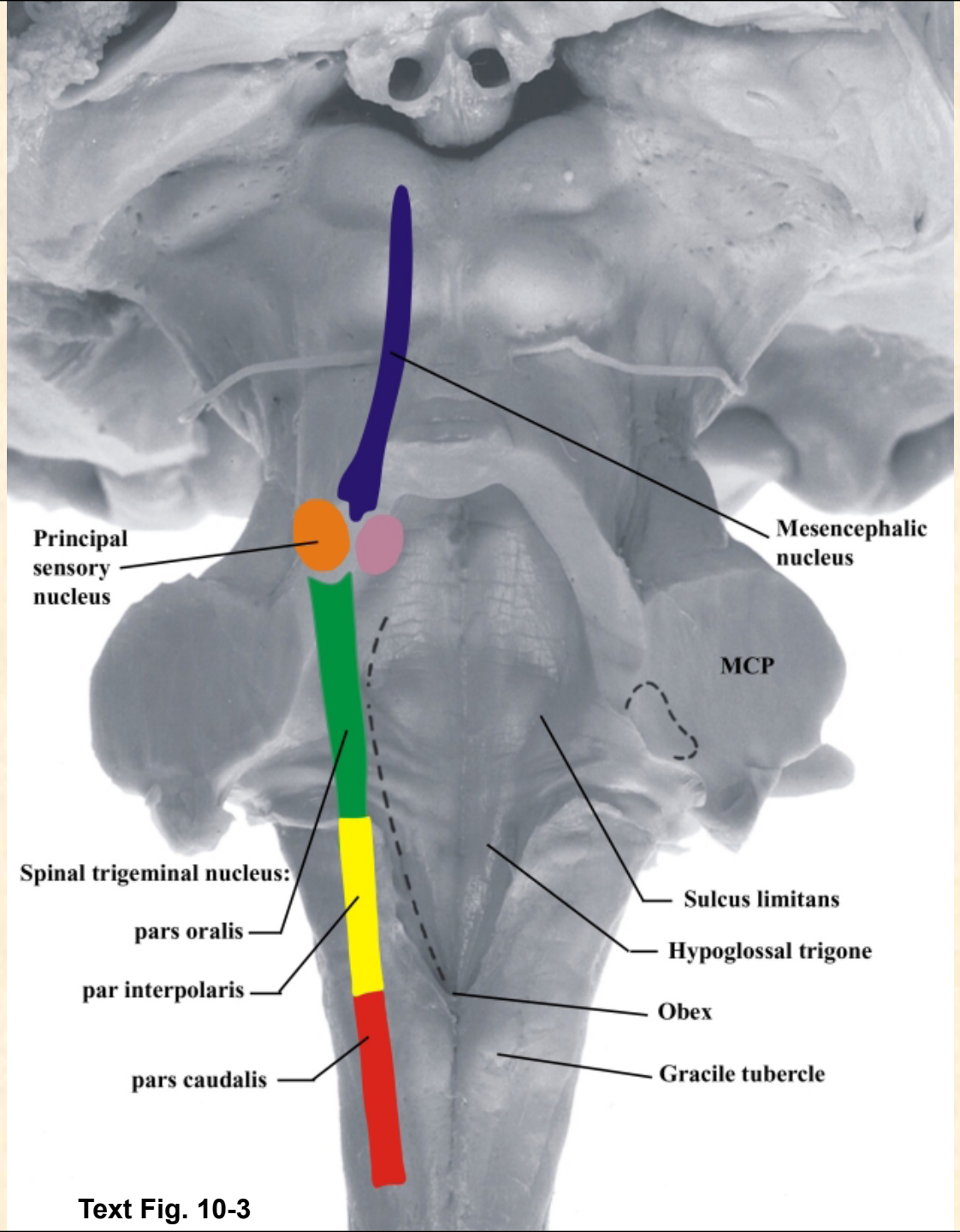



# Anatomical overview of the trigeminal nuclei

***Pars caudalis*** **extends from C2 or C3 rostrally to the level of the obex.**

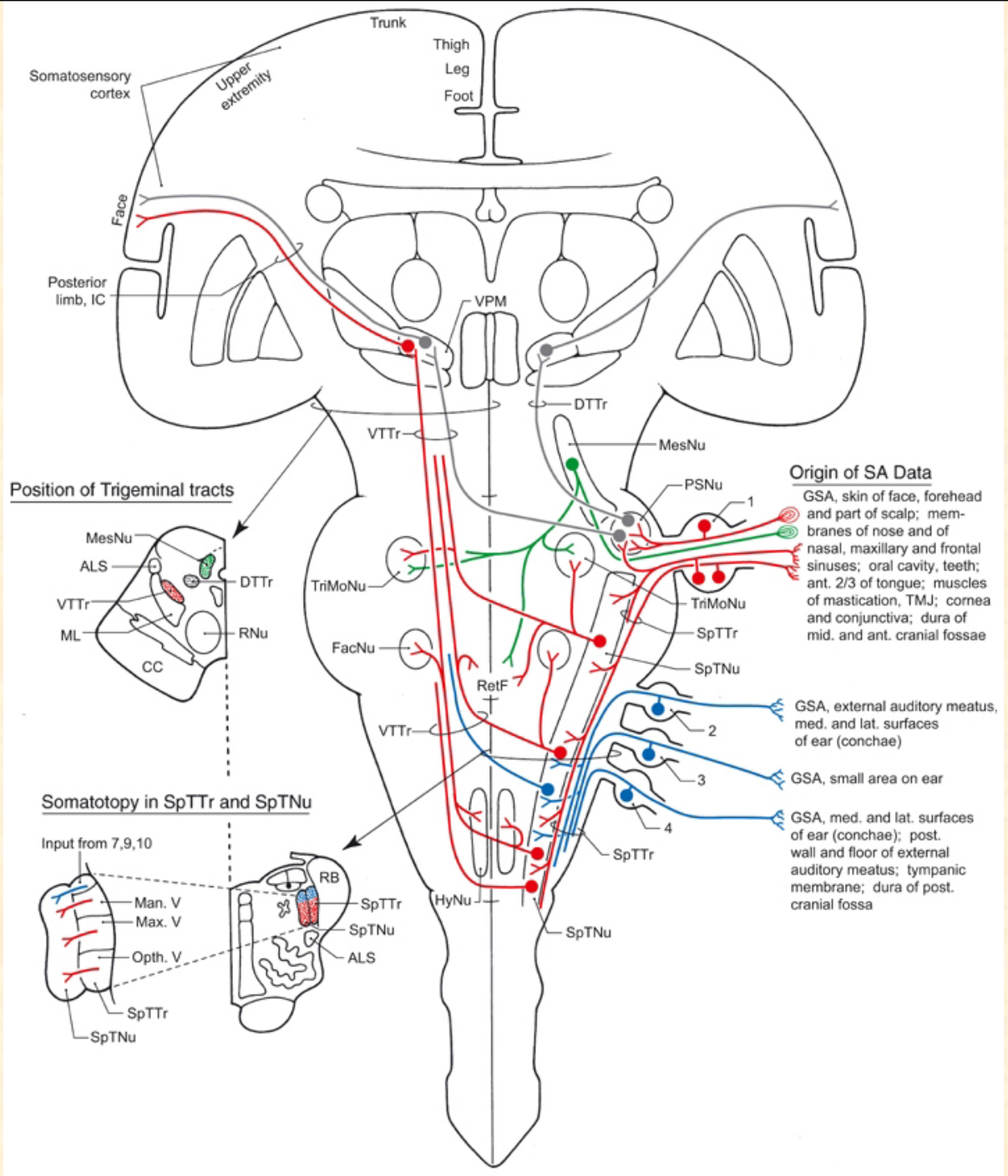
***Pars interpolaris*** **is located between the level of the obex and the rostra] pole of the hypoglossal (XII) nucleus.**

***Pars oralis*** **extends from the level of the rostral pole of the hypoglossal nucleus to the caudal end of the trigeminal motor nucleus**




**Text Fig. 10-3**

# Overview Trigeminal pathway




Atlas, Fig. 8-9

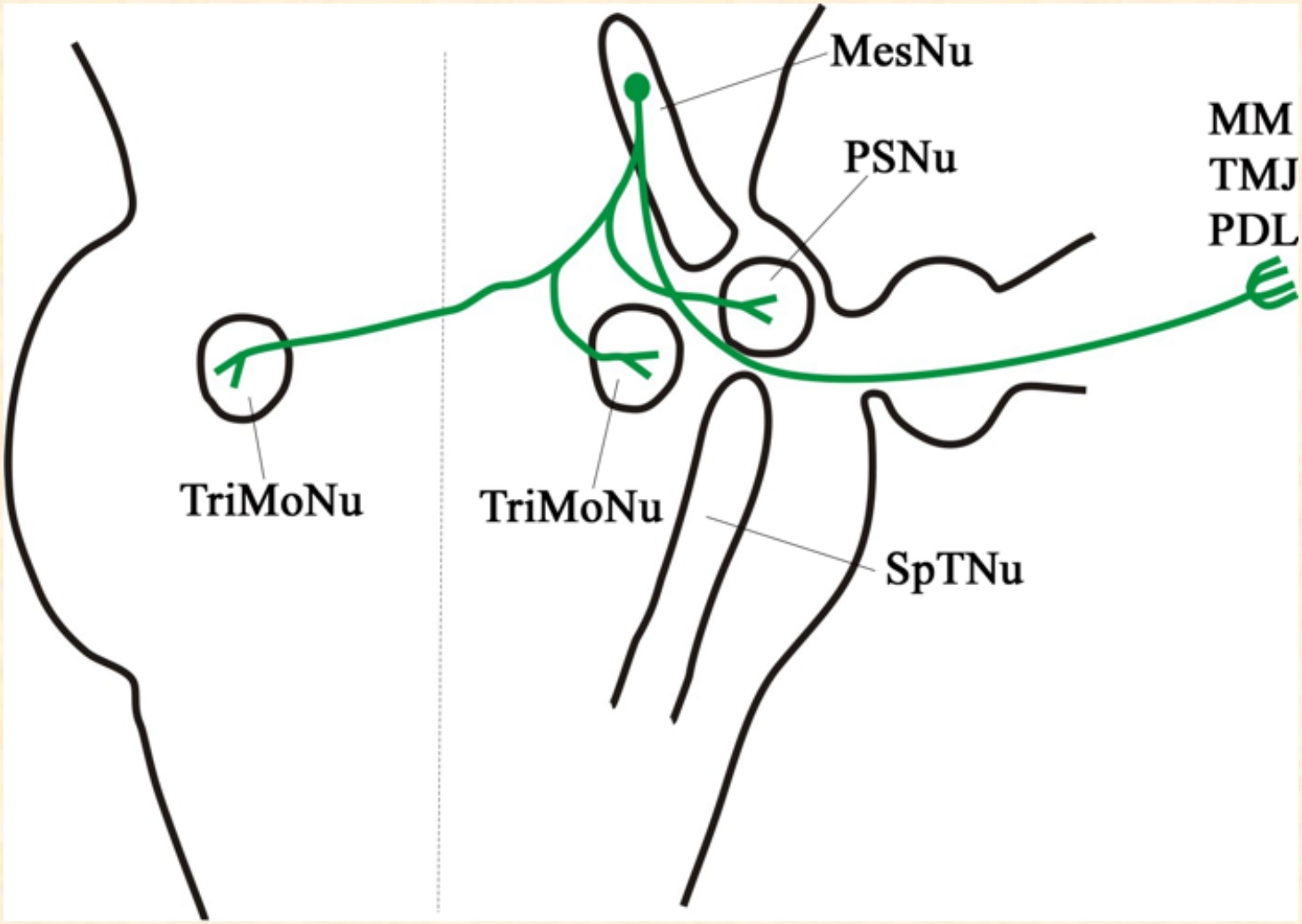
# Trigeminal Mesencephalic nucleus
# Trigeminal Motor nucleus

- Mesencephalic nucleus – provides proprioceptive sensations from the muscles of mastication, TMJ and PDL

- Mes V neurons transmit the proprioceptive signals from periodontal ligaments to 2$^{nd}$ order neurons in the principle sensory nucleus

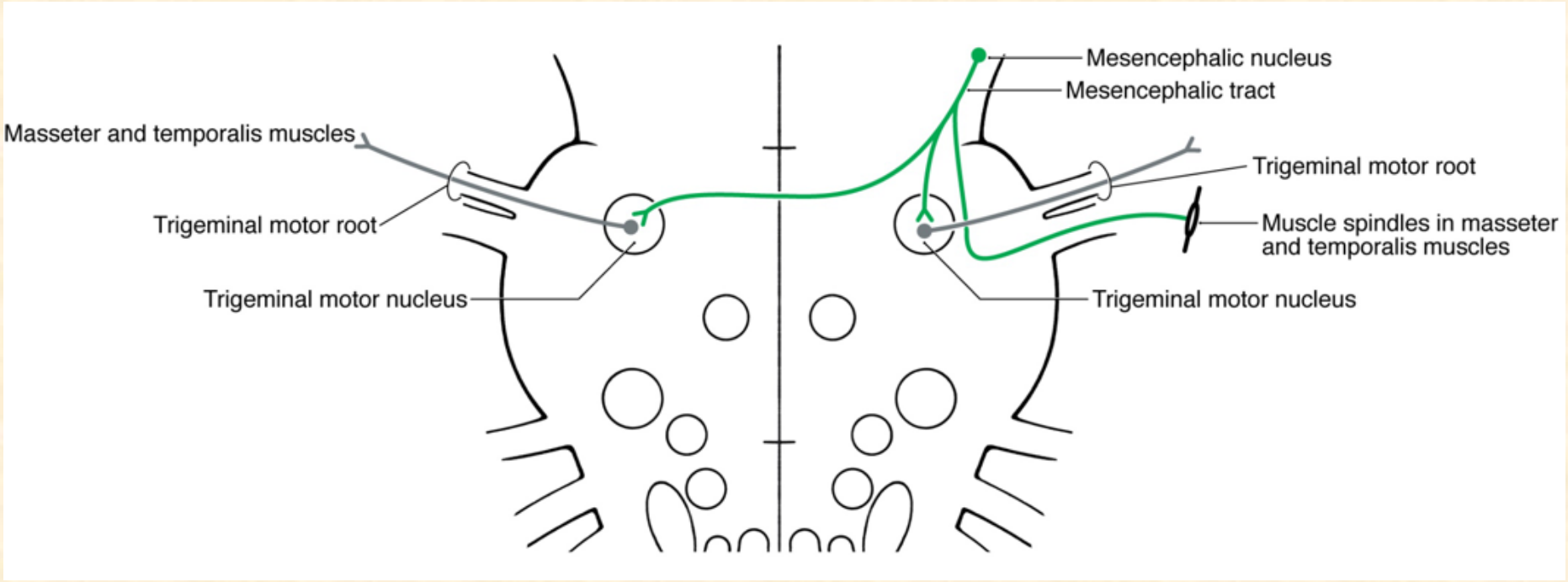
- Trigeminal motor nucleus – motor control for muscles of mastication

# Trigeminal mesencephalic and motor nuclei



# Jaw jerk reflex pathway

Afferent limb involves Mesencephalic neurons
Efferent limb involves motor fibers via V3 to the muscles of mastication



# Corneal blink reflex pathway

Afferent limb – sensory signals via V1
Efferent limb - motor fibers to the orbicularis oculi muscle via CN VII