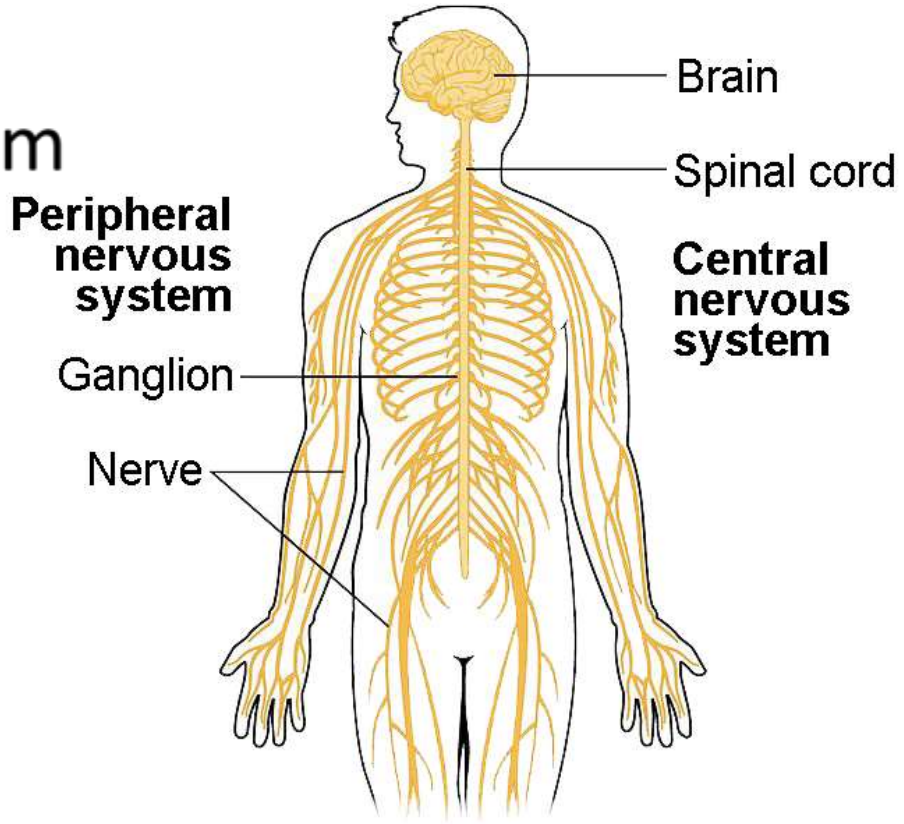
Nervous system

D. Nawras Najah

Nervous system

Divided into two parts :

- Central nervous system
- Peripheral nervous system



Functional divisions of nervous system

1-Somatic NS

- Controls voluntary activities
- Detects changes in external environment

2-Autonomic NS

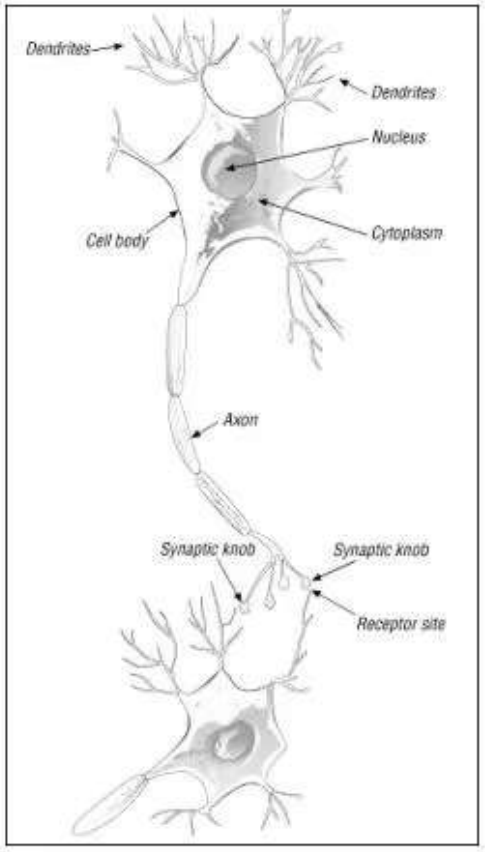
- Controls involuntary activities
- Detects changes in internal body environment

Cellular structure

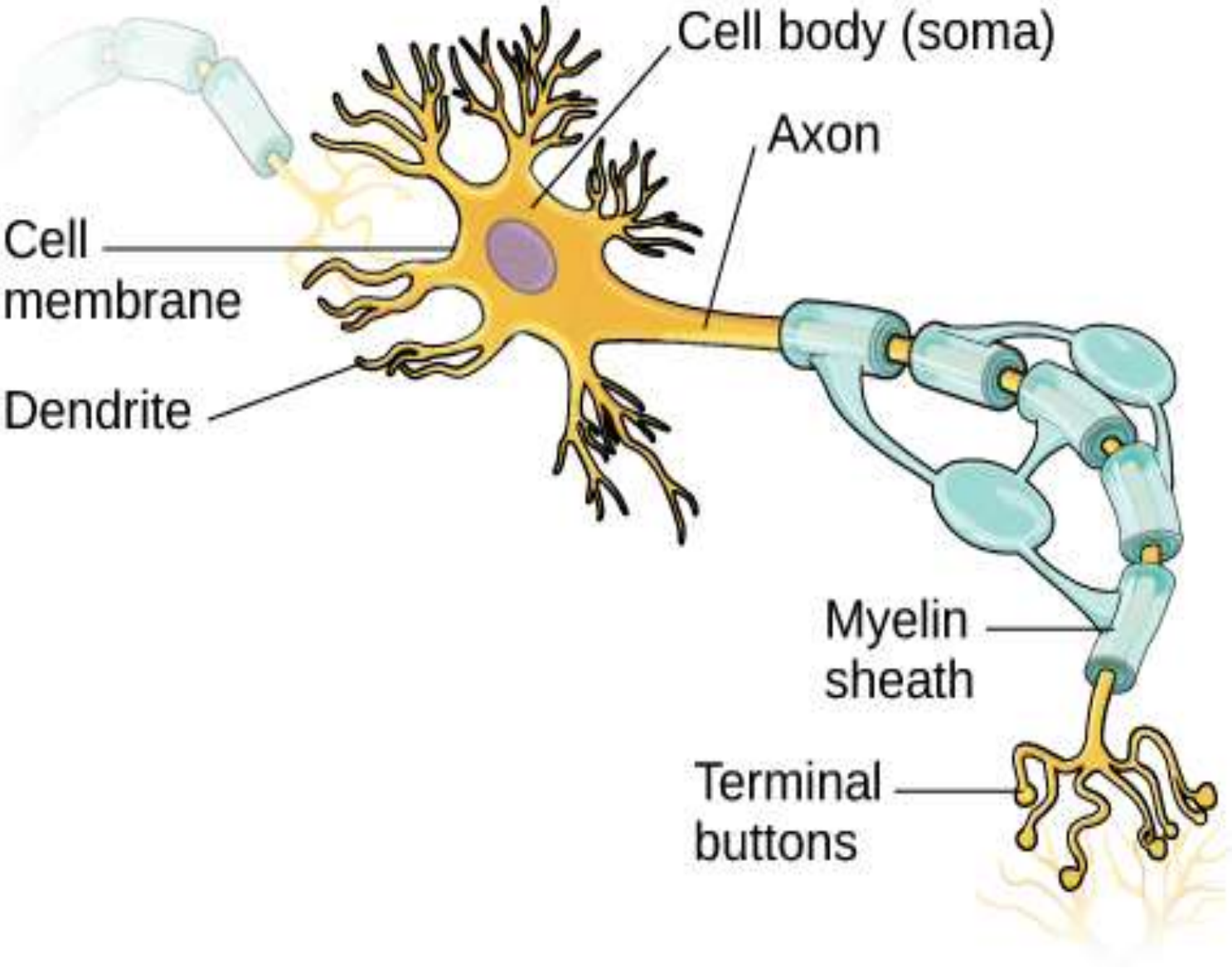
- **Glial cells** : support, insulate, and nourish neurons

- Neuron (Nerve Cell)

  - Cell Body
    - Cytoplasm
    - Nucleus
  - Axon
    - Carry messages away from the cell body to other neurons
  - Dendrites
    - Carry messages to the cell body

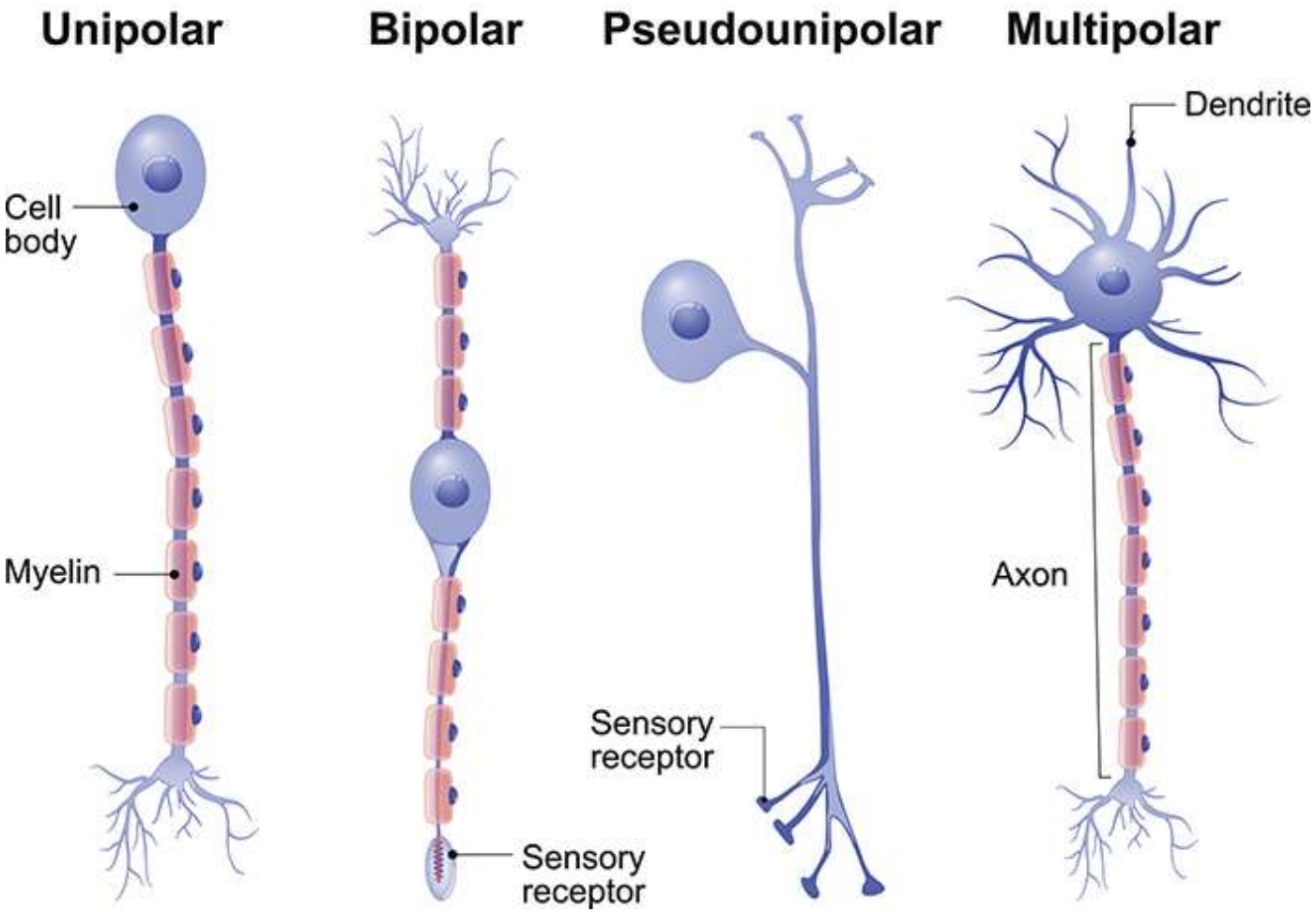


neuron


Cell body (soma)
Axon
Cell membrane
Dendrite
Myelin sheath
Terminal buttons

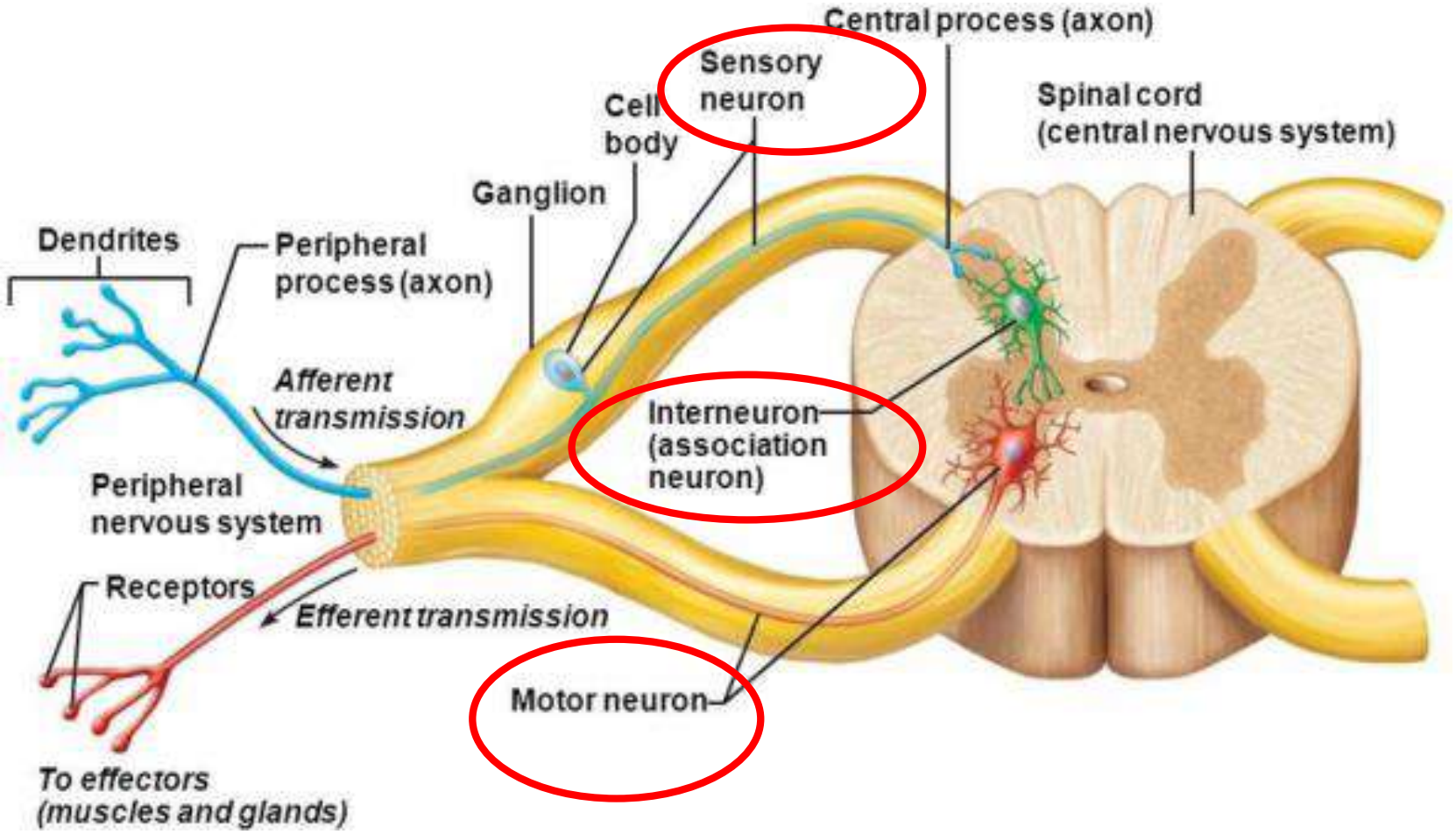
Classification of neuron

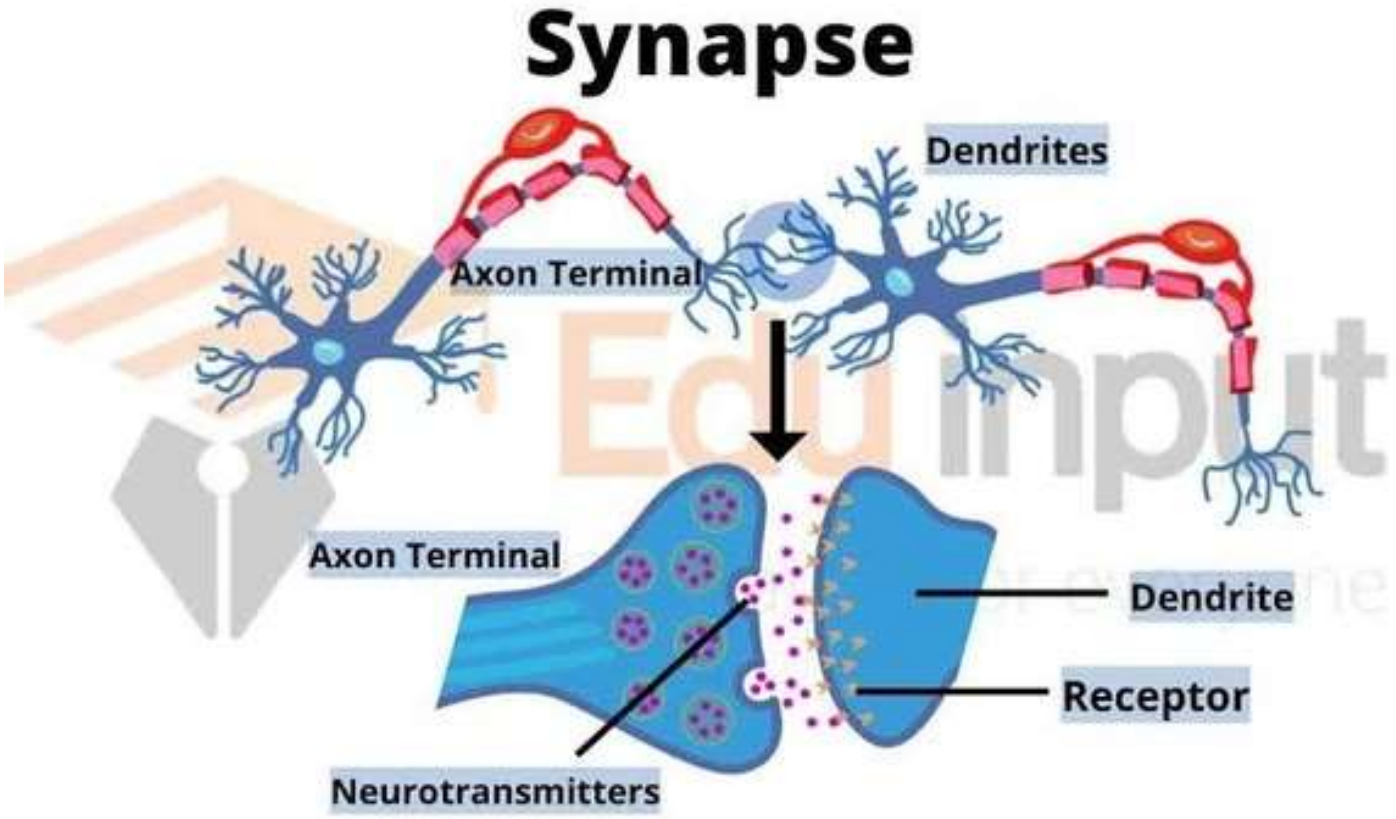
according to no. of process



Classification of neuron

according to function



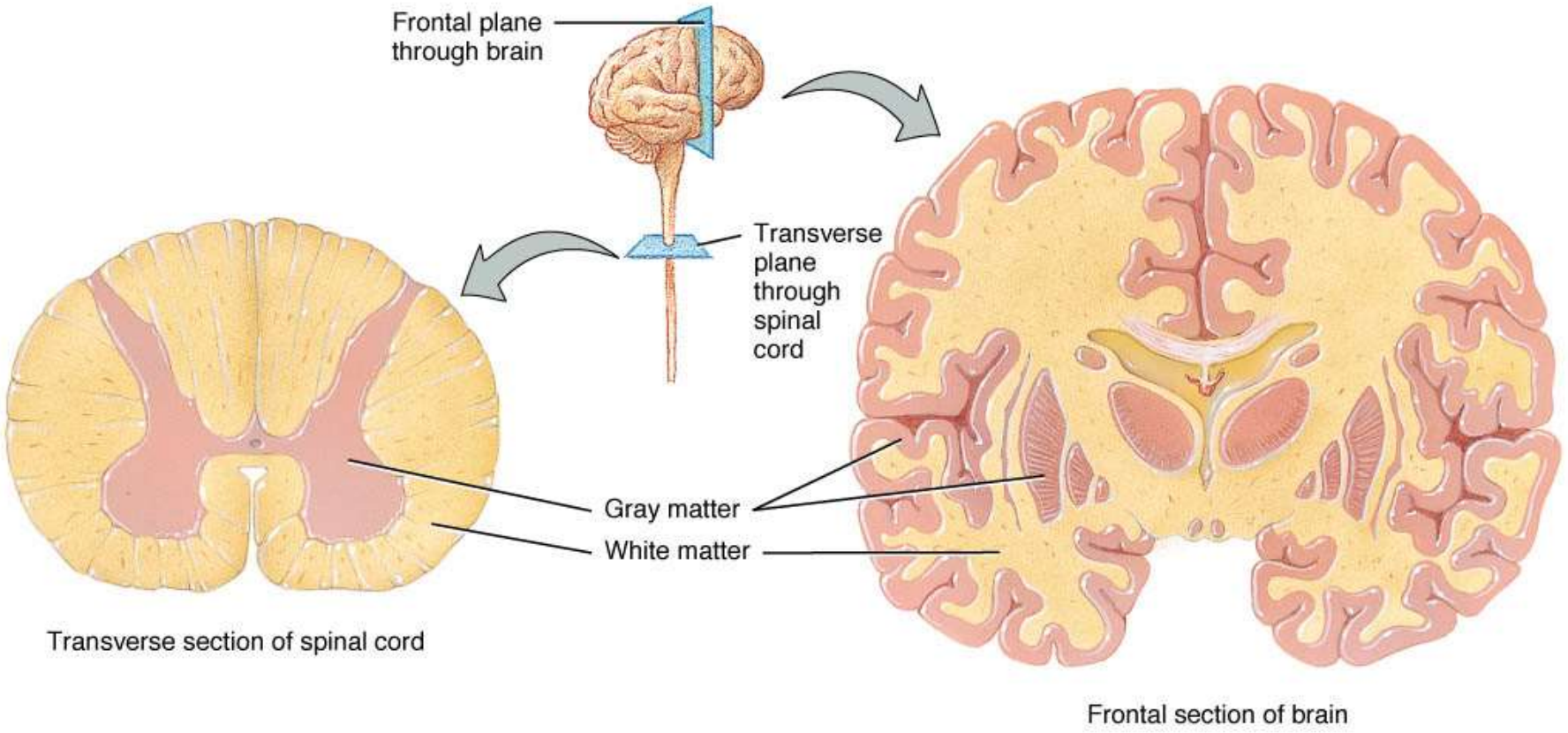


- Site where two neurons come into close proximity leaving a small gap

- The gap is bridged by a neurotransmitter substance

Gray and white matter

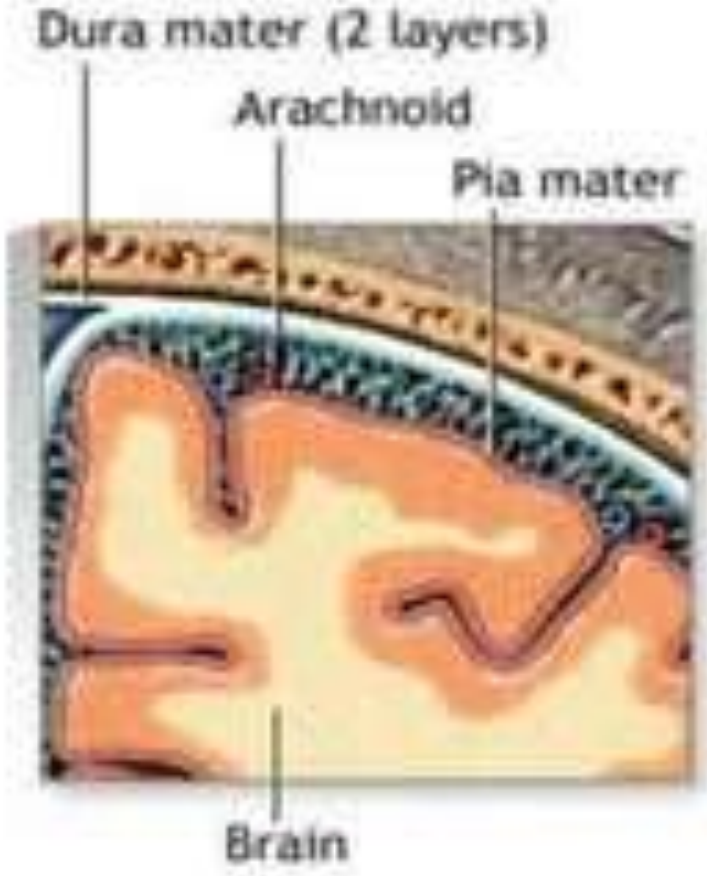
- **Gray matter:** nerve cells embedded in neuroglia
- **White matter:** nerve fibers (axons) embedded in neuroglia



The Meninges

- The Meninges are the membrane covering the brain and spinal cord.
- The Meninges consist of three membranes:

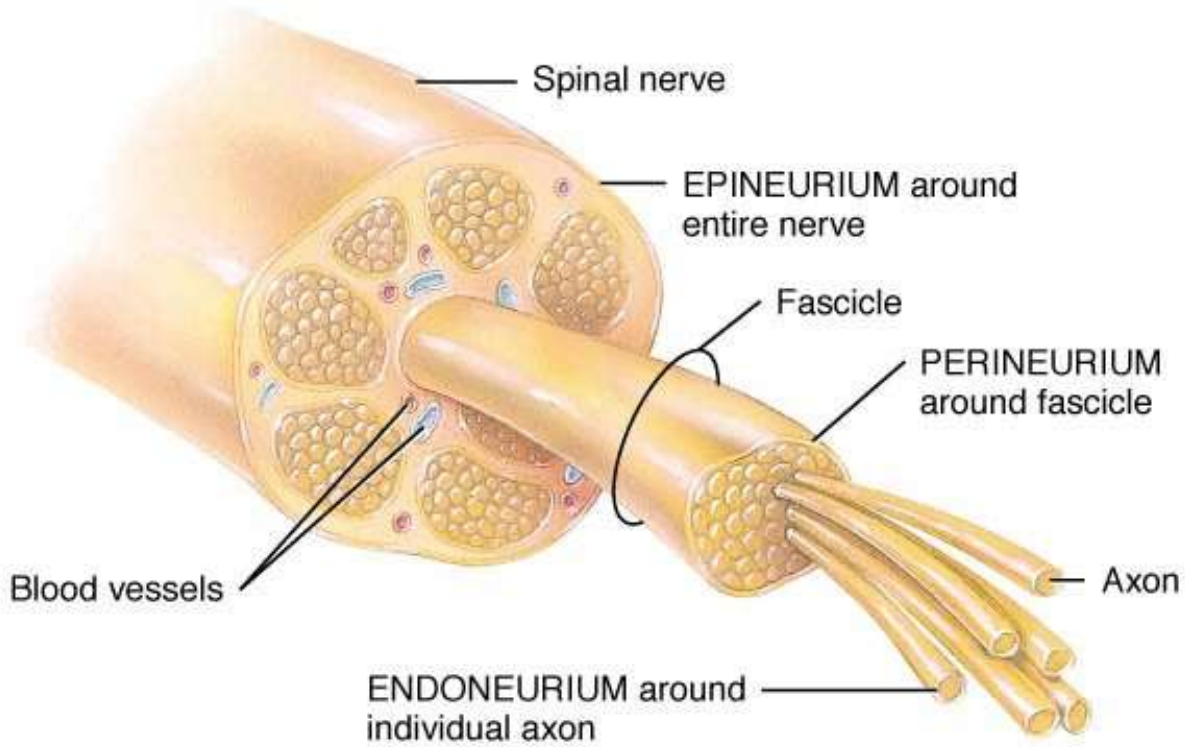
1. The dura mater,
2. The arachnoid mater,
3. The pia mater.



PERIPHERAL NERVES

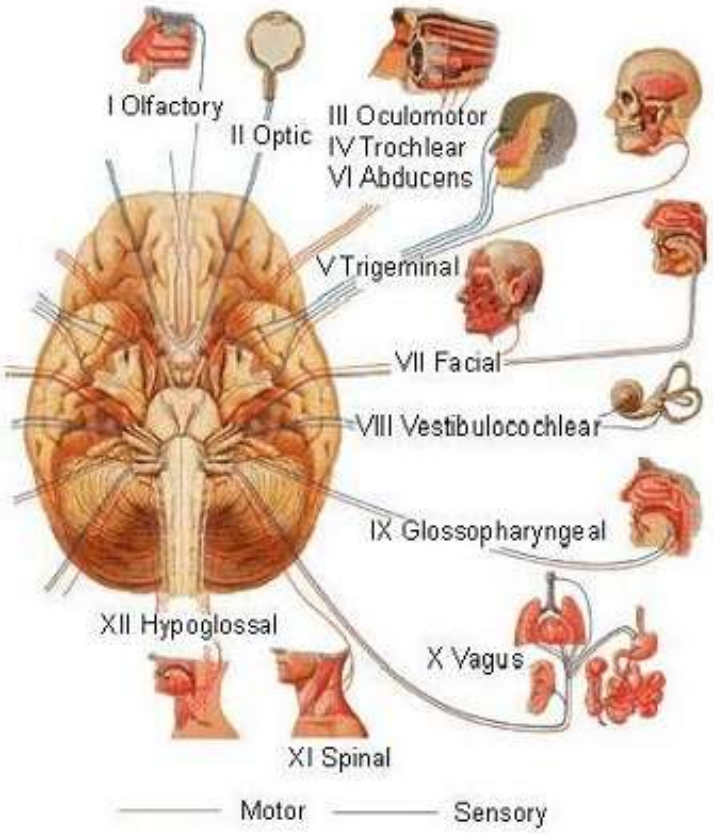
- Made up of bundles of nerve fibers supported by delicate areolar tissue

- Cranial and spinal nerves



Cranial Nerves

- Twelve pairs of nerves associated with the brain
- Most are mixed in function; two pairs are purely sensory
- Each nerve is identified by a number (I through XII) and a name



Spinal Nerves

- There is a pair of spinal nerves at the level of each vertebrae for a total of 31 pairs
- Formed by the combination of the ventral and dorsal roots of the spinal cord
- Named for the region from which they arise

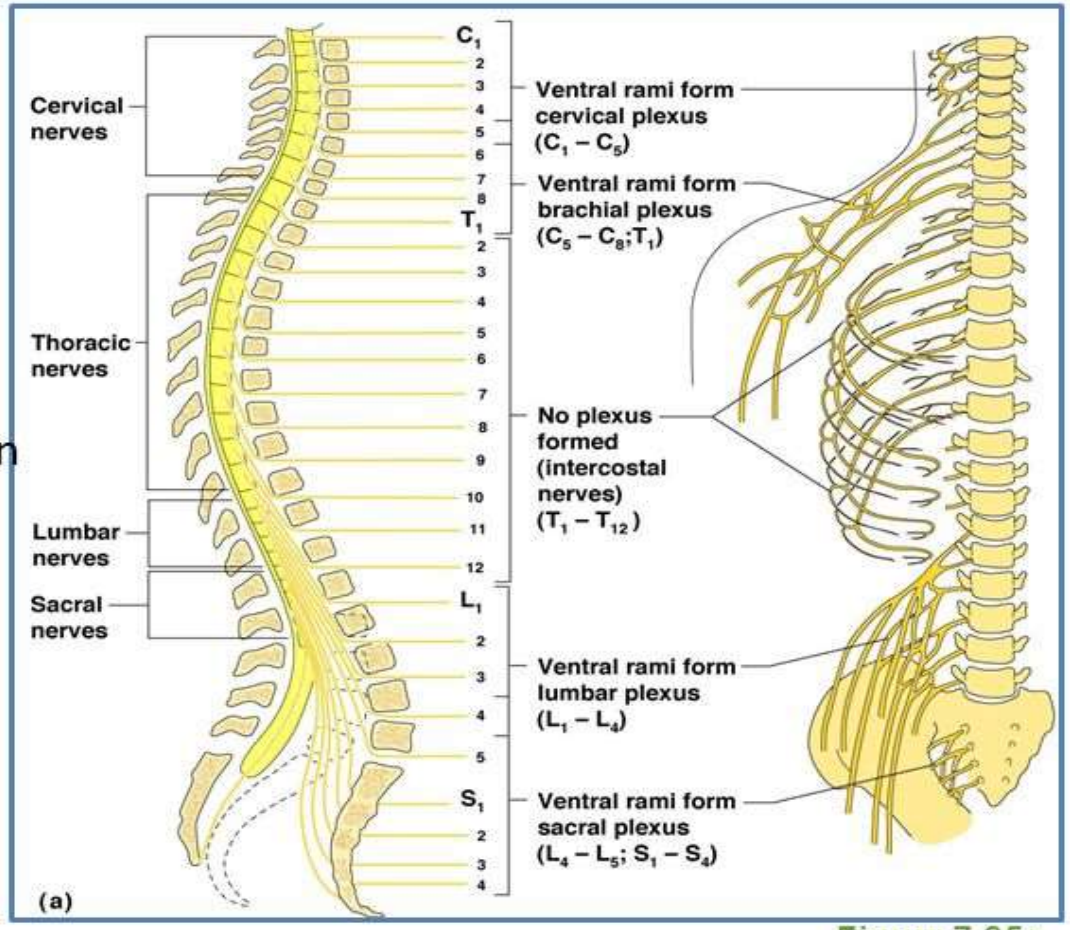
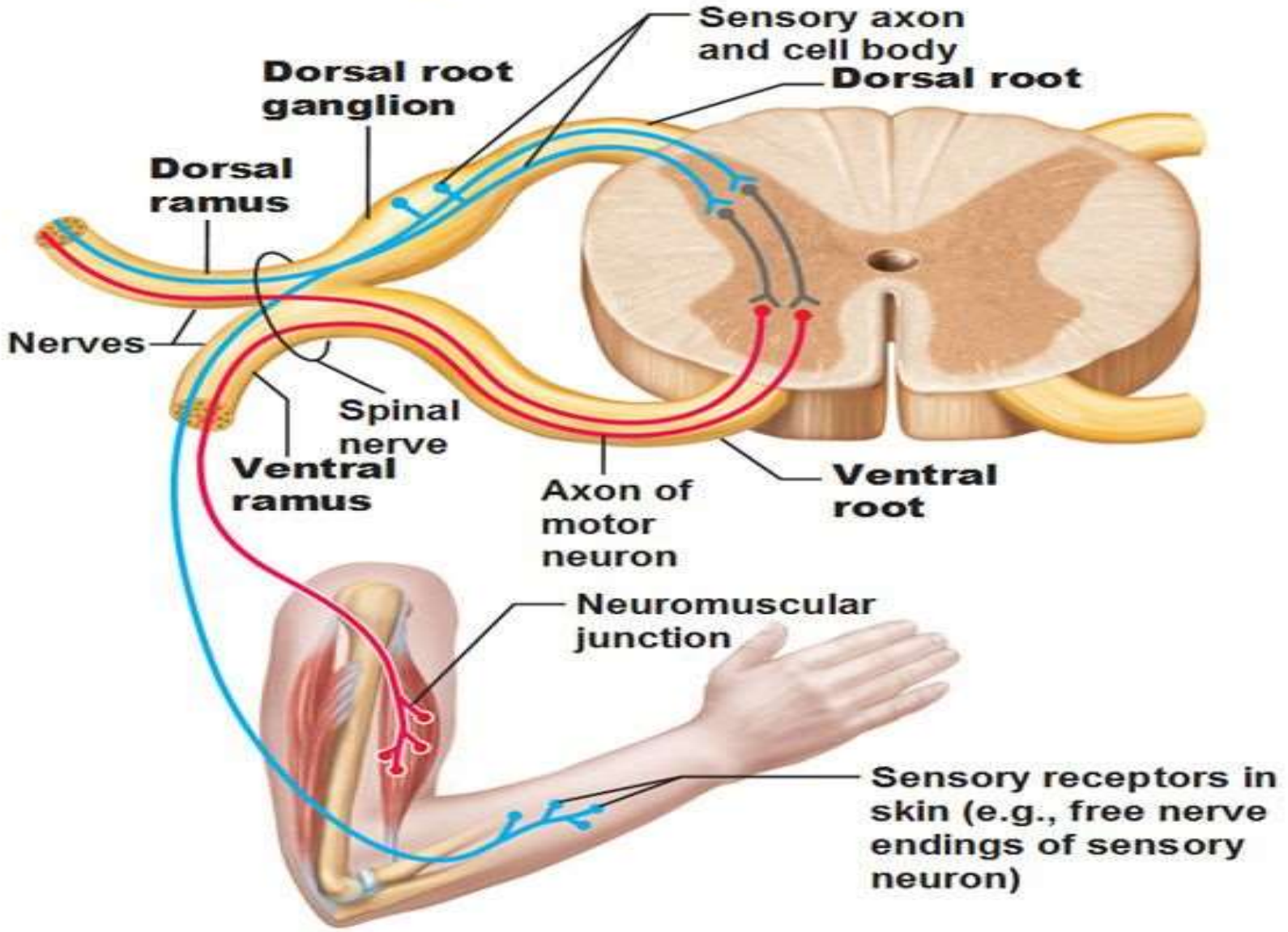


Figure 7.25a

Spinal Nerves

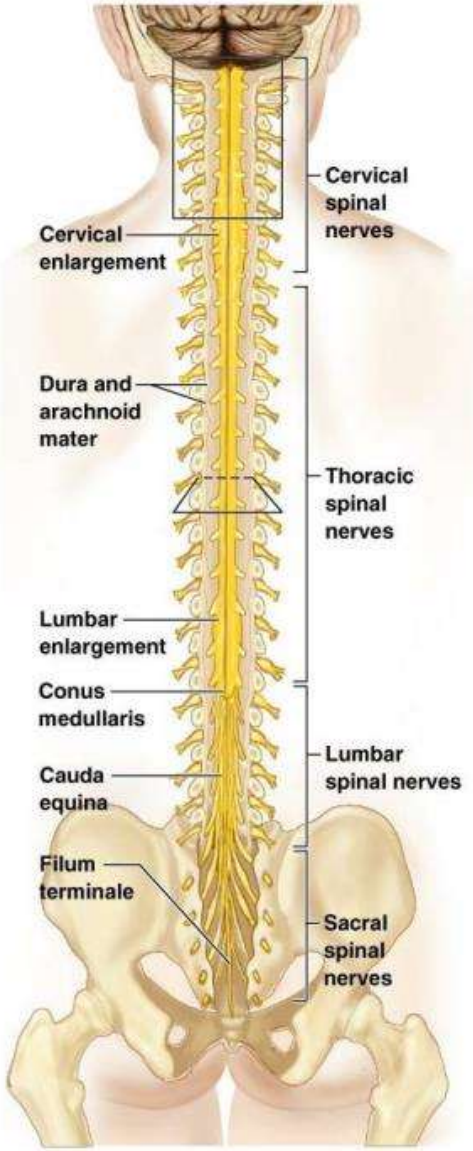


Distal end of the spinal cord

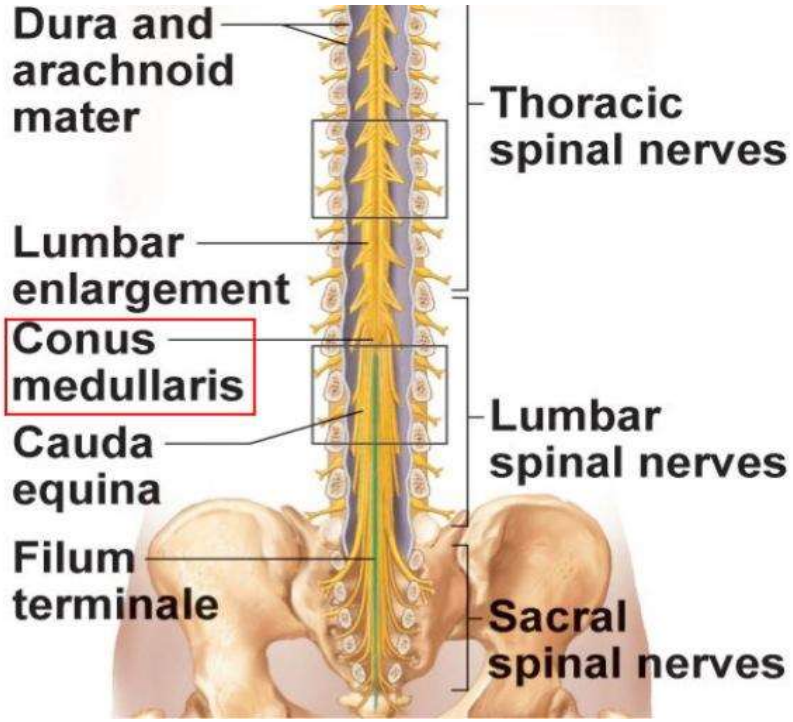
- **Conus medullaris**:
  - thin, conical end of the spinal cord
  - the spinal cord ends at vertebral levels L1-L2
- **Cauda equina (horse tail)**:

  - is the collection of lumbar and sacral spinal nerve roots that pass caudally to exit at their respective intervertebral foramen.

- **Filum terminale**:
  - thin thread of fibrous tissue at end of conus medullaris
  - attaches to coccygeal ligament

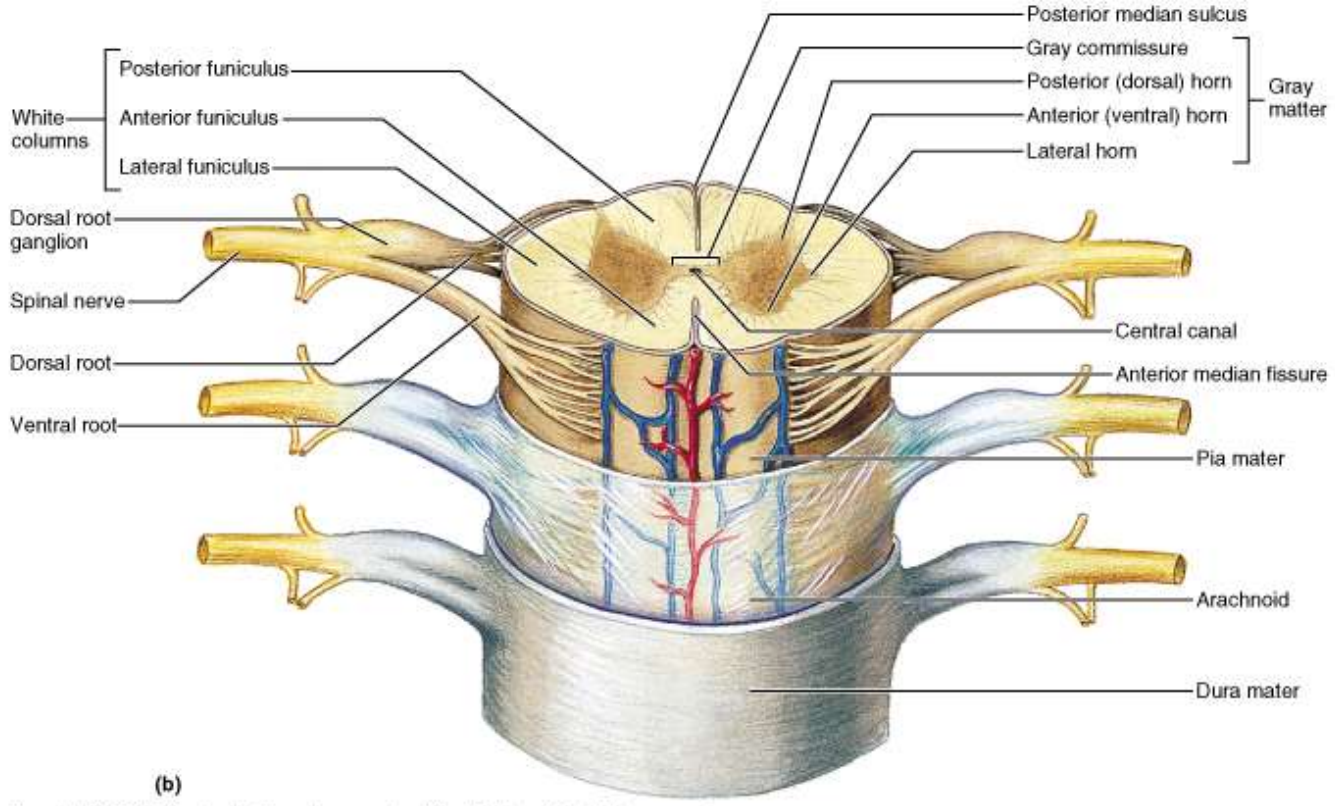


(a)


Dura and arachnoid mater
Lumbar enlargement
Conus medullaris
Cauda equina
Filum terminale
Thoracic spinal nerves
Lumbar spinal nerves
Sacral spinal nerves

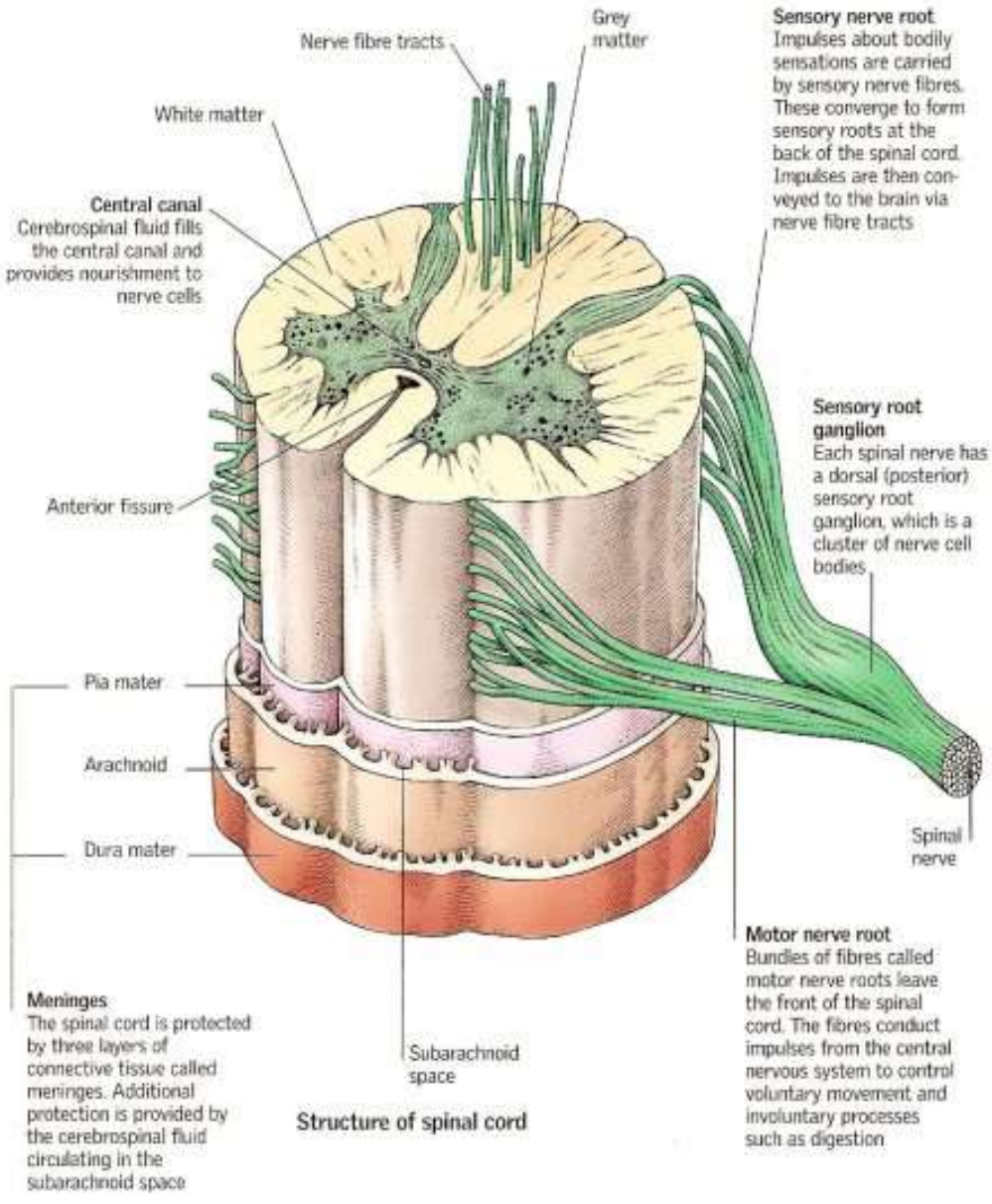
Spinal cord cross section

- Anterior median fissure
- Posterior median sulcus
- Posterolateral sulcus
- Anterior spinal artery
- Posterior spinal arteries



- White matter
✓ Anterior column
✓ Posterior column
✓ Lateral column
✓ White commisure

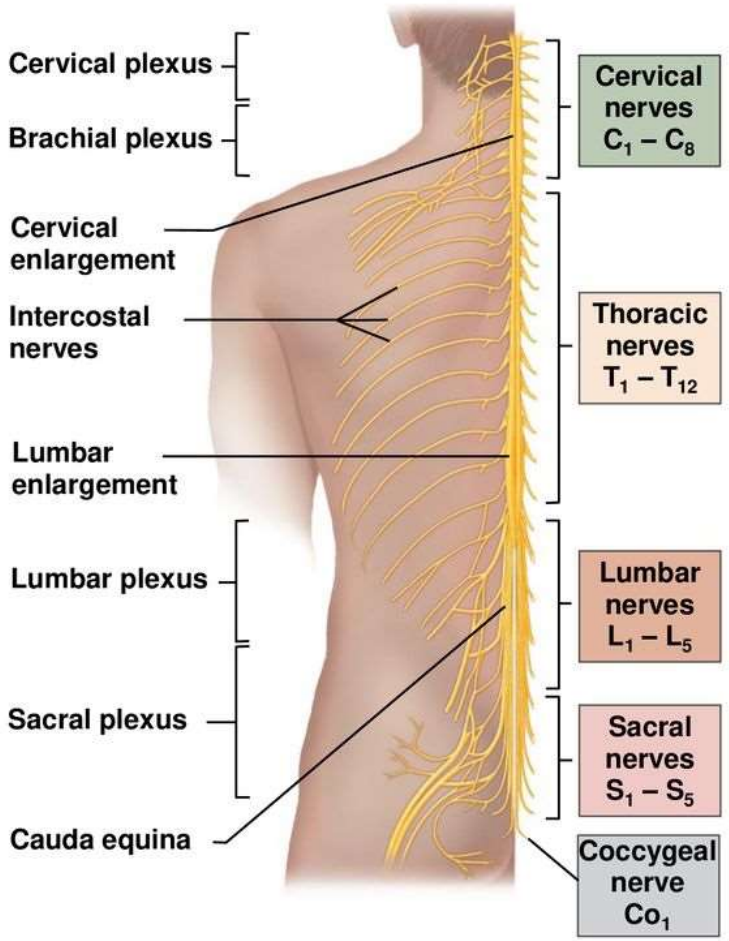
- Grey matter
✓ Anterior horn
✓ Posterior horn
✓ Lateral horn
✓ Grey commisure
✓ Central canal



Nerve plexuses

- At the root of the upper and lower limbs
- By the joining of the anterior rami

Figure 13.7 Spinal nerves.



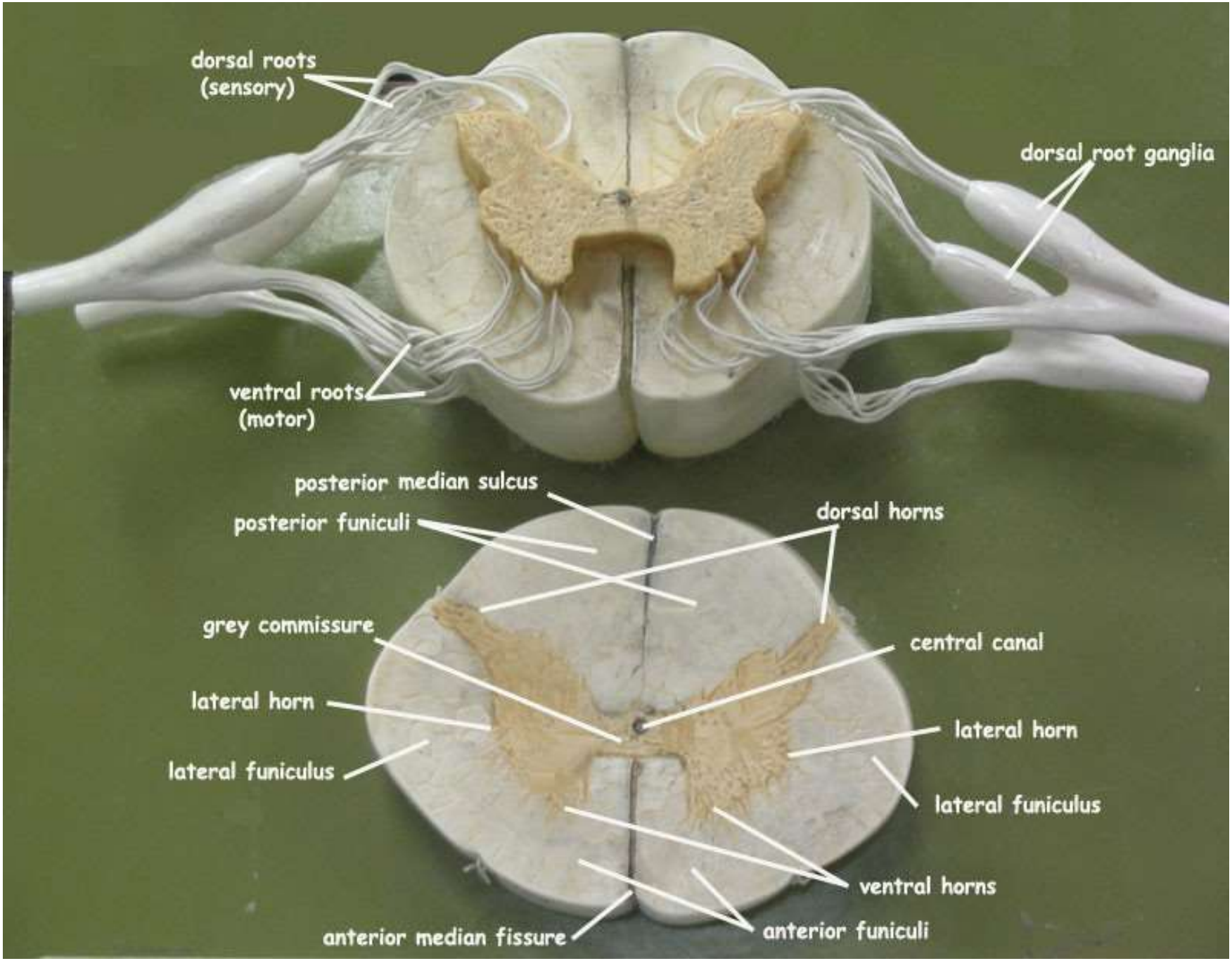
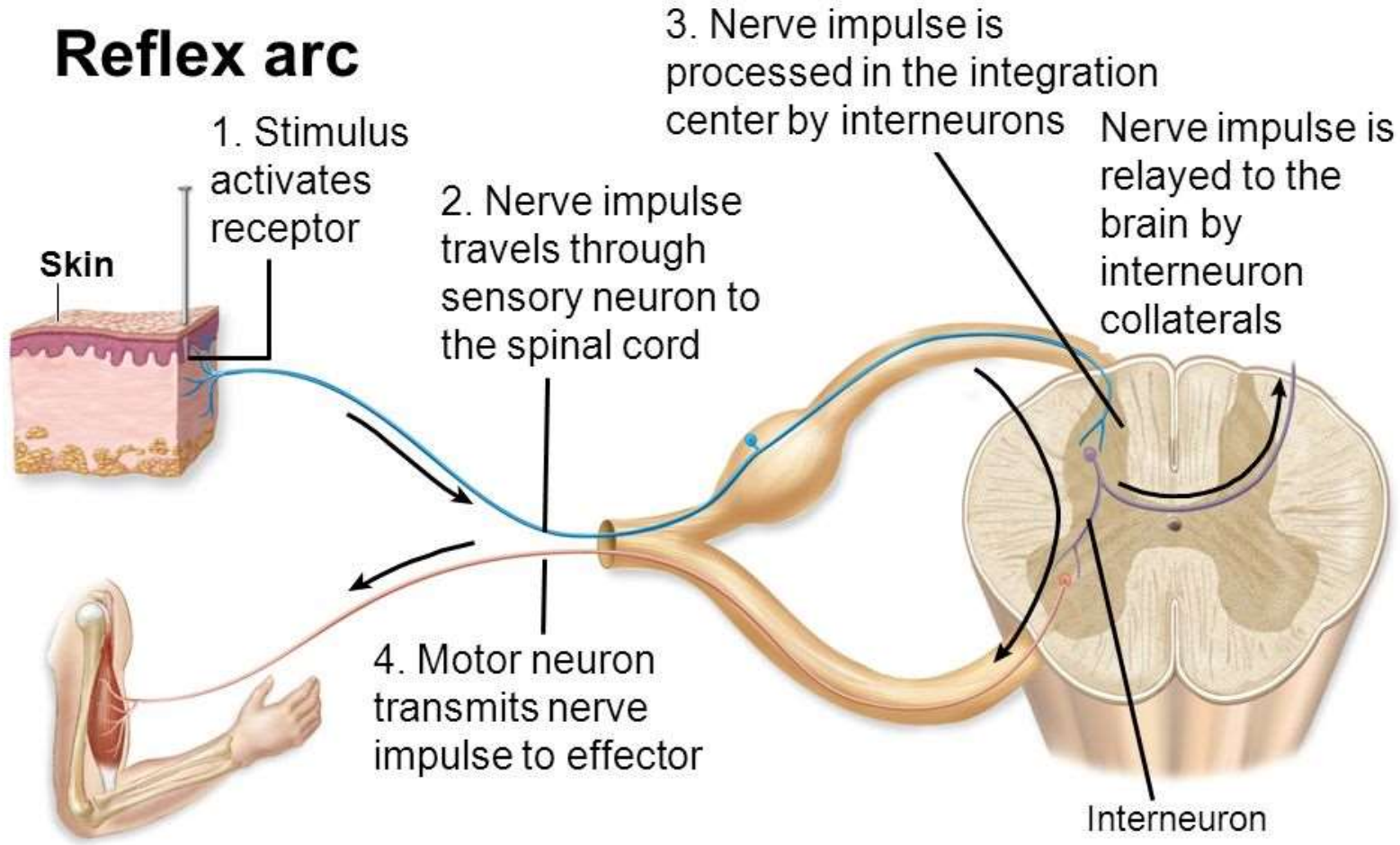
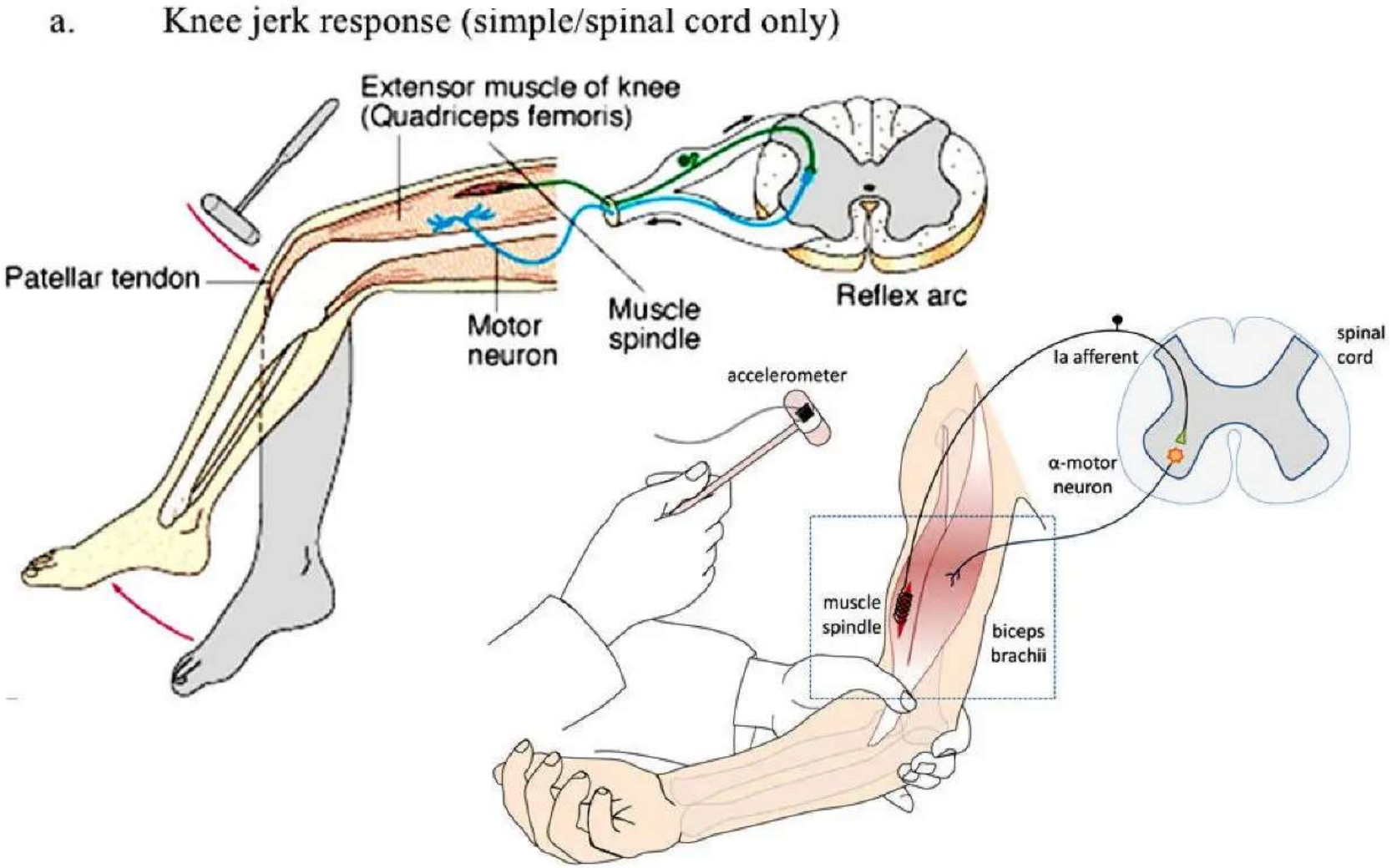

dorsal roots
(sensory)
dorsal root ganglia
ventral roots
(motor)
posterior median sulcus
posterior funiculi
dorsal horns
grey commissure
central canal
lateral horn
lateral horn
lateral funiculus
lateral funiculus
ventral horns
anterior median fissure
anterior funiculi

Fig. 16.12


Reflex arc
1. Stimulus activates receptor
Skin
2. Nerve impulse travels through sensory neuron to the spinal cord
3. Nerve impulse is processed in the integration center by interneurons
Nerve impulse is relayed to the brain by interneuron collaterals
4. Motor neuron transmits nerve impulse to effector
Interneuron

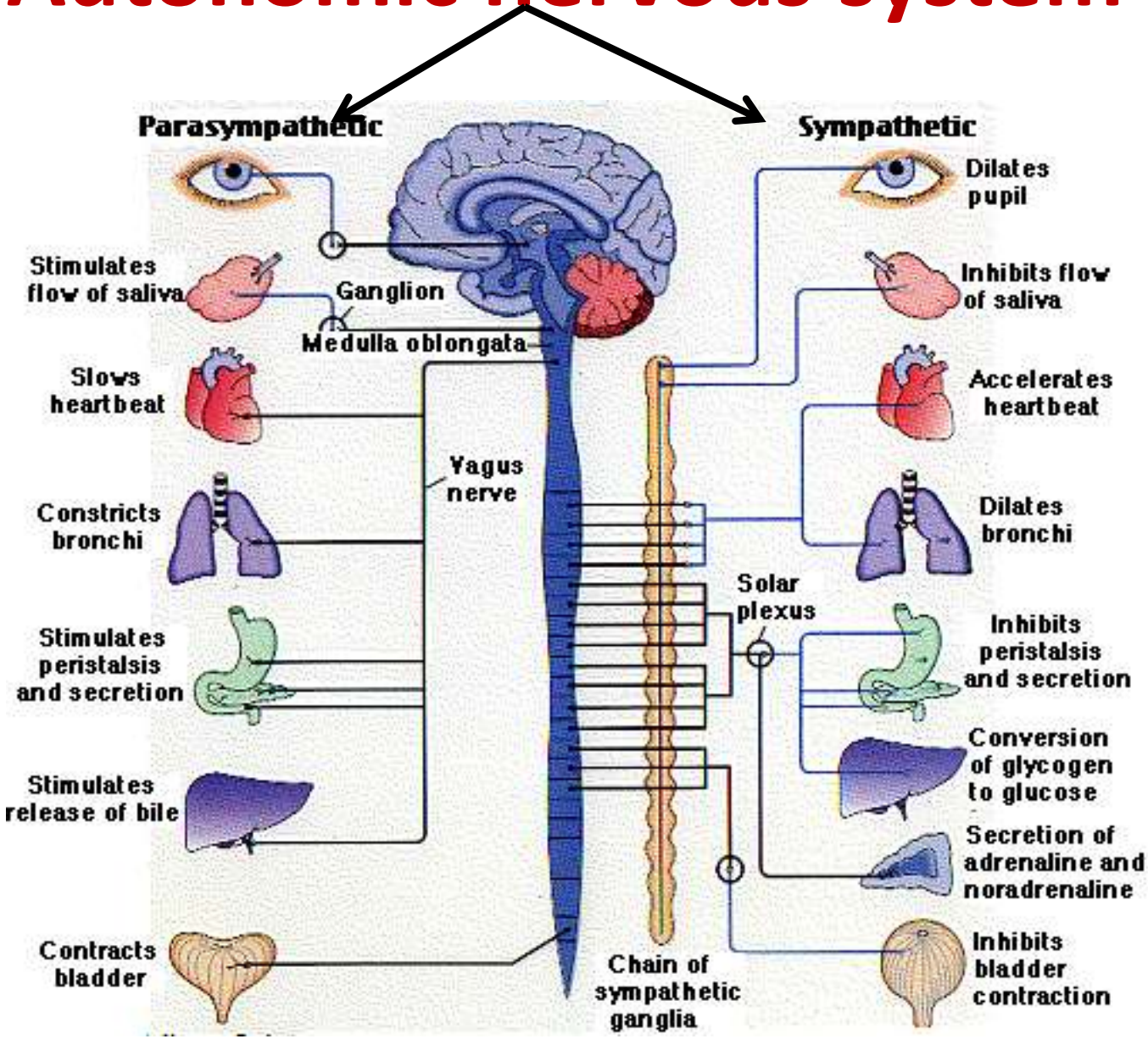
Example of Somatic reflex



Segmental innervation of muscle

- Many muscles of limbs are innervated by two, three, or four spinal nerves
- Biceps brachii tendon reflex: C5 and 6
- Patellar tendon reflex (knee jerk): L2, 3, and 4
- Achilles tendon reflex (ankle jerk): S1 and 2

Autonomic nervous system



Functions of sympathetic N.S.

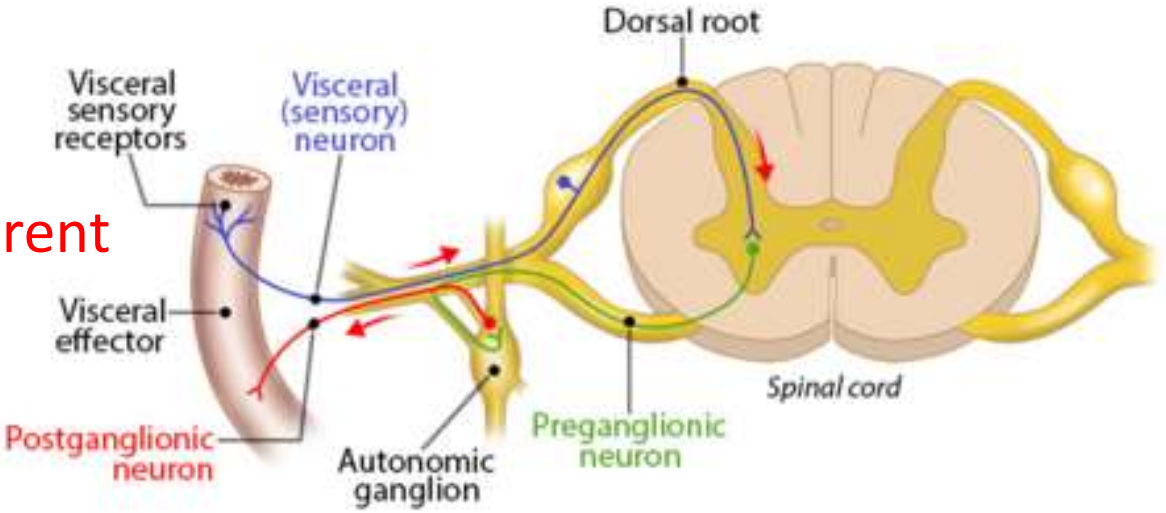
- Heart rate increase
- Vasoconstriction and blood pressure raises
- Inhibits peristalsis of the intestinal tract
- Closes the sphincters
- Prepare the body for emergency ((fight or flight))
- Redistribute the blood to brain, heart, skeletal muscle

Functions of parasympathetic N.S.

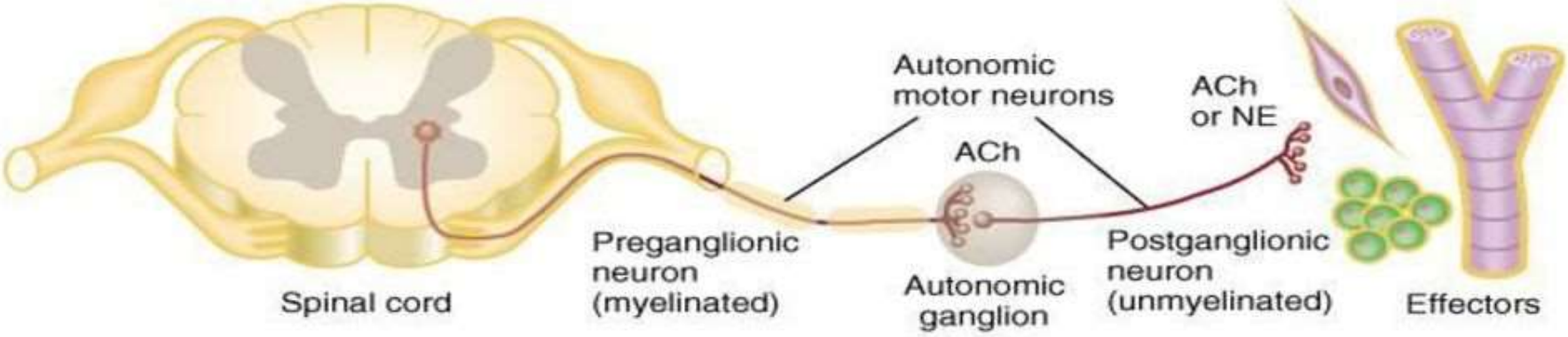
- Slow the heart rate
- Glandular activity
- Increase peristalsis of the intestine
- Open the sphincters
- Conserve and restore energy ((digest and rest

Autonomic nervous system

- Motor/ Visceral efferent nerves to:
  - Smooth muscle in blood vessels and viscera
  - Cardiac muscle
  - Glands
- Sensory/ Visceral Afferent nerves
  - Conduct visceral pain
  - Conduct visceral sensations (e.g., hunger, malaise, nausea, and bladder fullness)
  - Regulate visceral function



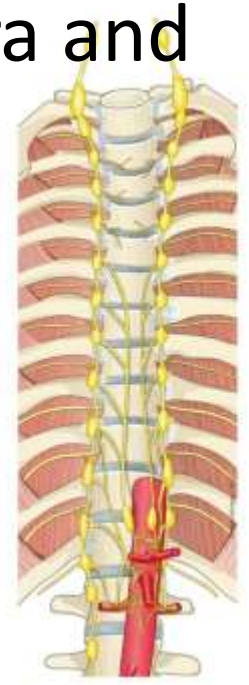
Basic Anatomy of ANS



- **Preganglionic neuron**
  - cell body in brain or spinal cord
  - axon is myelinated type B fiber that extends to autonomic ganglion
- **Postganglionic neuron**
  - cell body lies outside the CNS in an autonomic ganglion
  - axon is unmyelinated type C fiber that terminates in a visceral effector

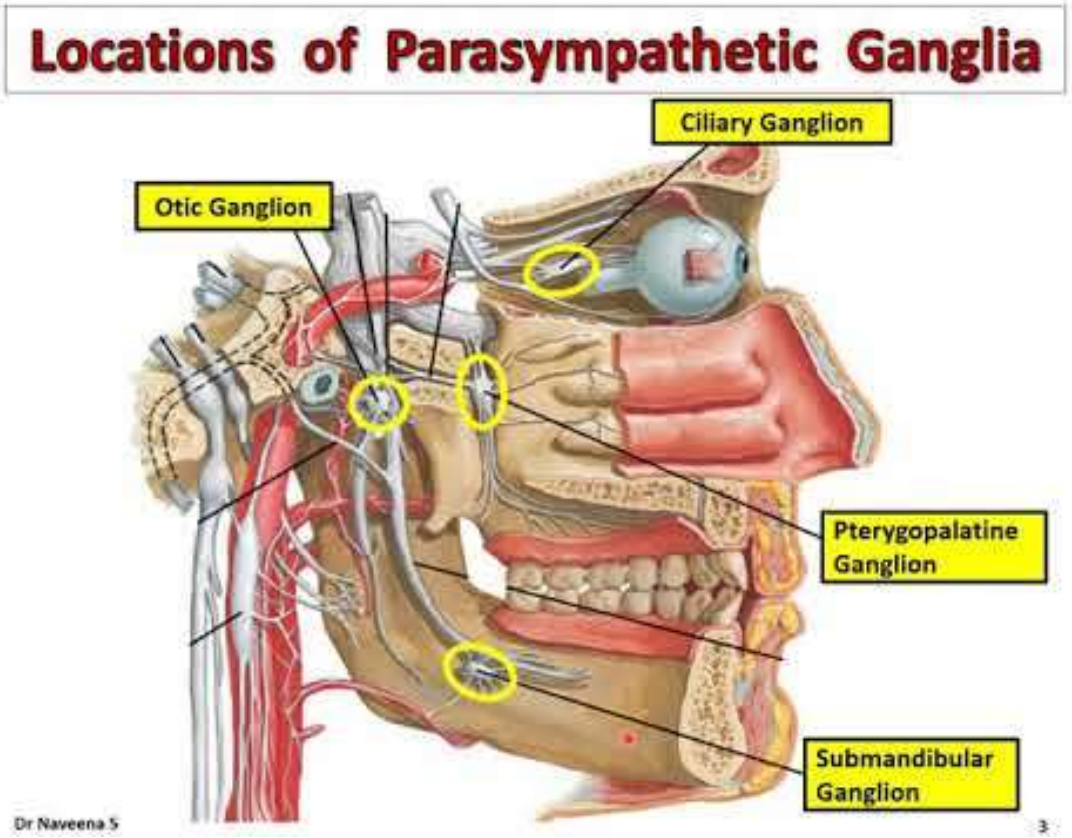
Sympathetic ganglia

- Sympathetic trunk (paravertebral ganglia) end below as the ganglion impar
- Prevertebral ganglia (around the abdominal aorta)
- Suprarenal gland
- Their fibers distributed to internal viscera and body wall



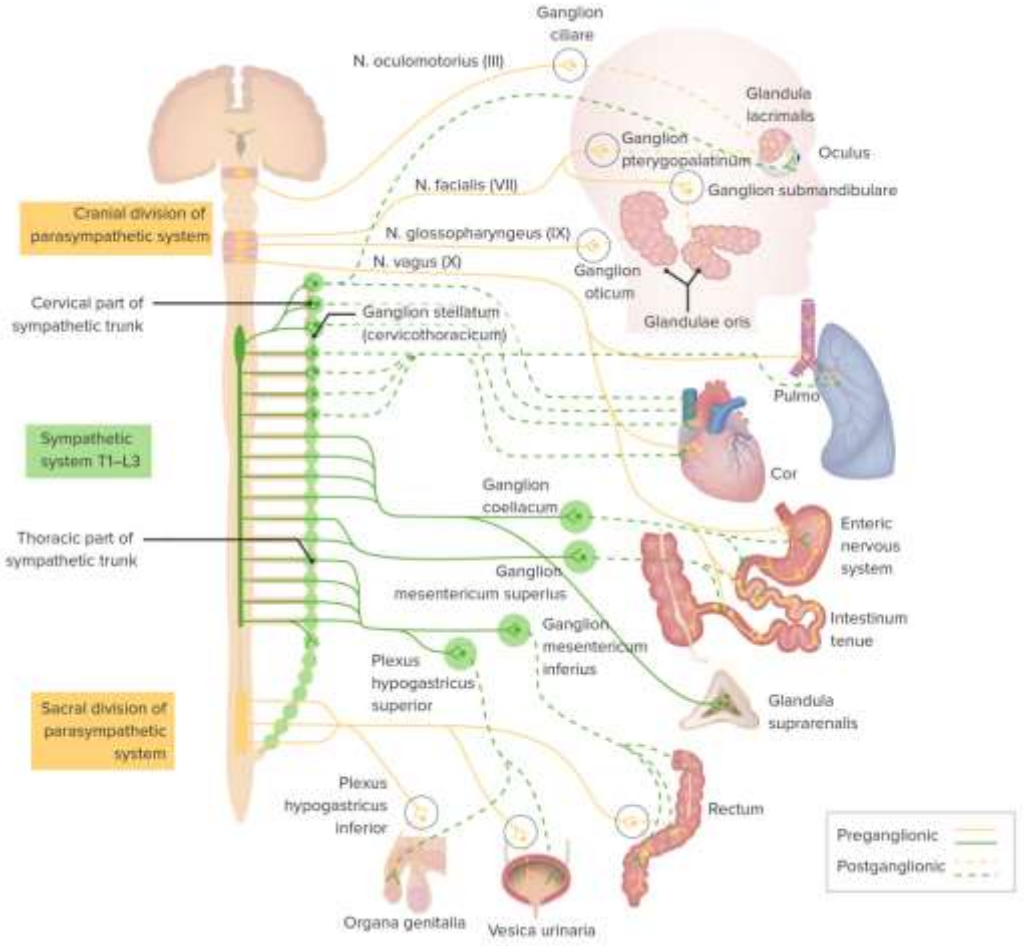
Parasympathetic ganglia

- Cranial ganglia
- Ganglia near viscera
- Their fibers distributed to internal viscera only



Preganglionic neurons of Sympathetic System

- Gray matter of spinal cord
- T1 – L2 spinal cord segments
- Lateral horn

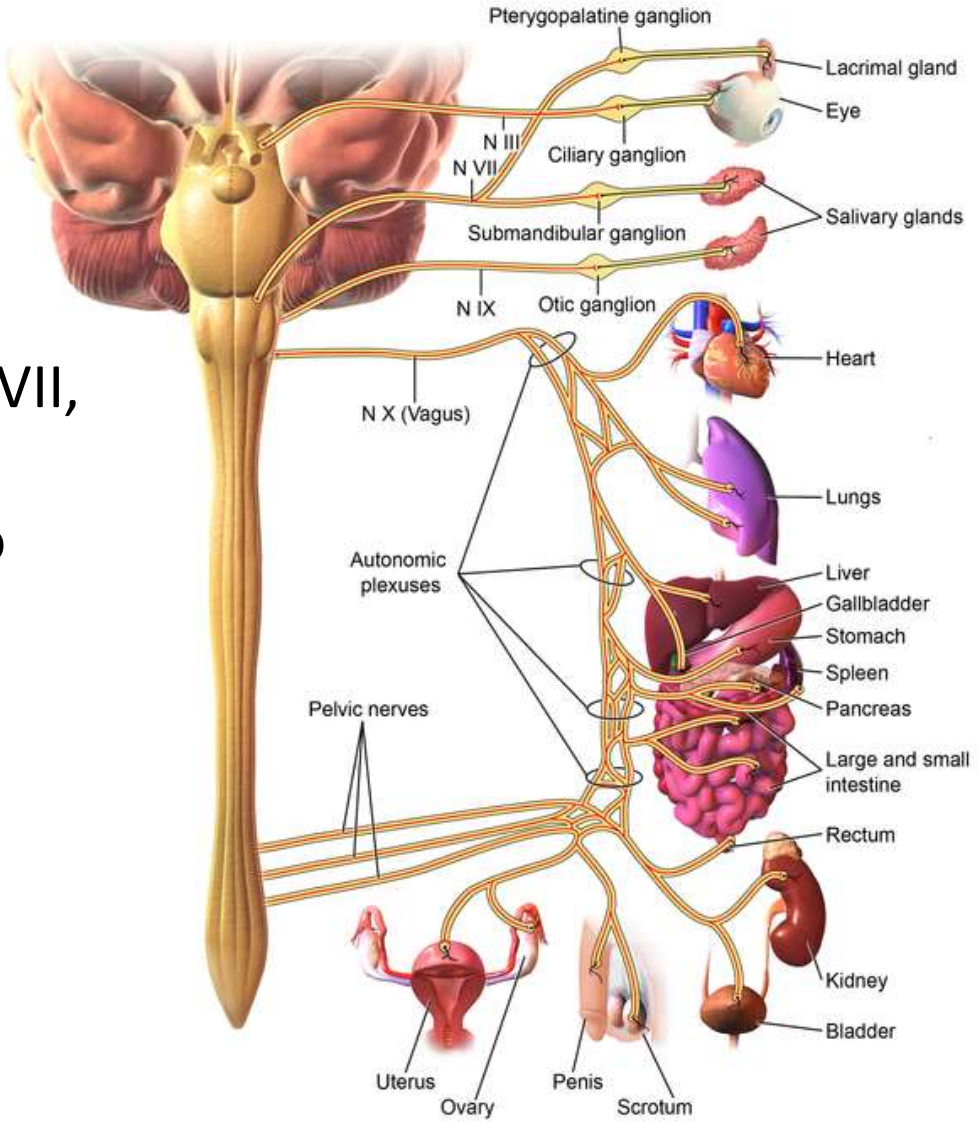


Preganglionic neurons of Parasympathetic System

Gray matter of :

1.Brain: cranial nerve nuclei III, VII, IX, and X

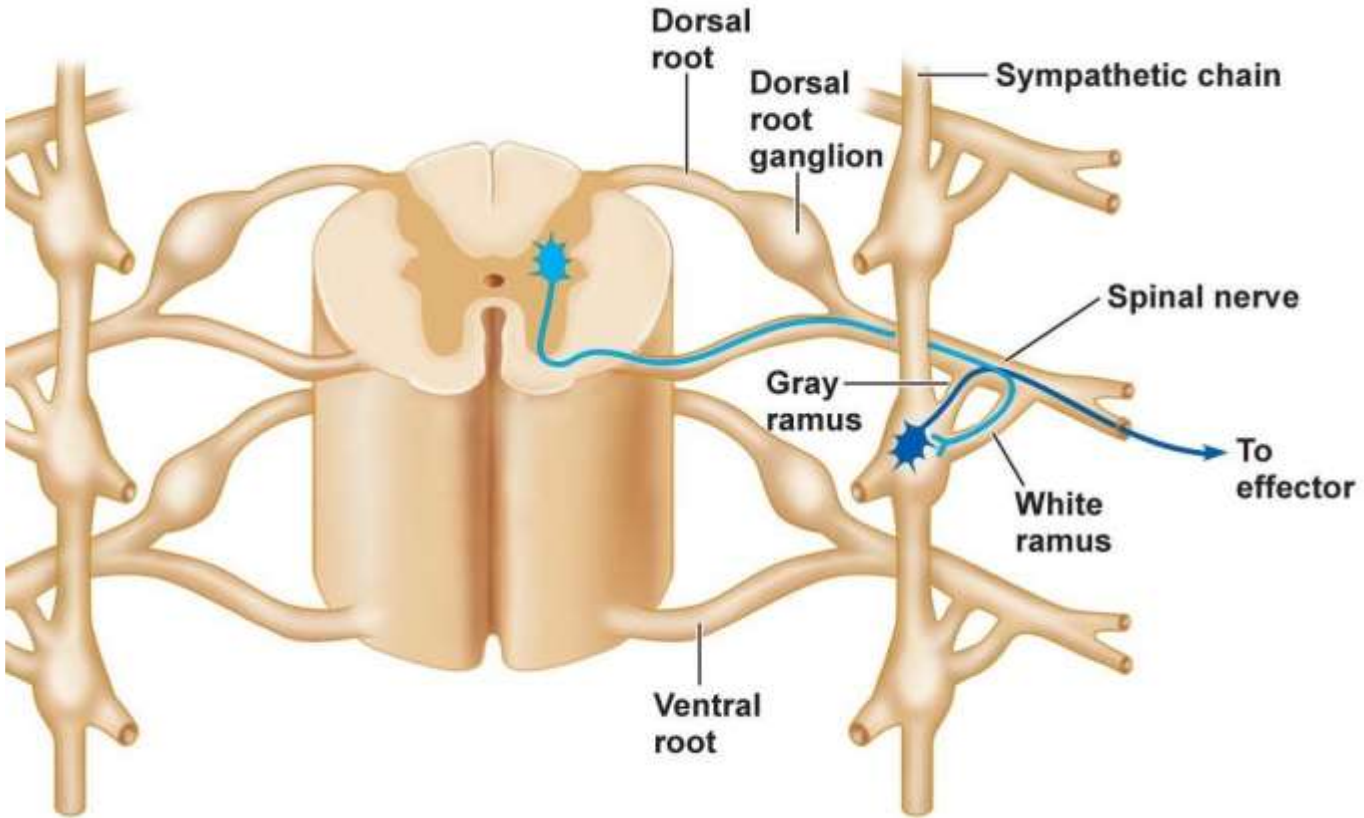
2.S2-4 spinal cord segments (no lateral horn)



Parasympathetic Innervation

Sympathetic efferent fibers

anterior nerve roots >> white rami communicantes >> paravertebral ganglia (sympathetic trunk)



Destination

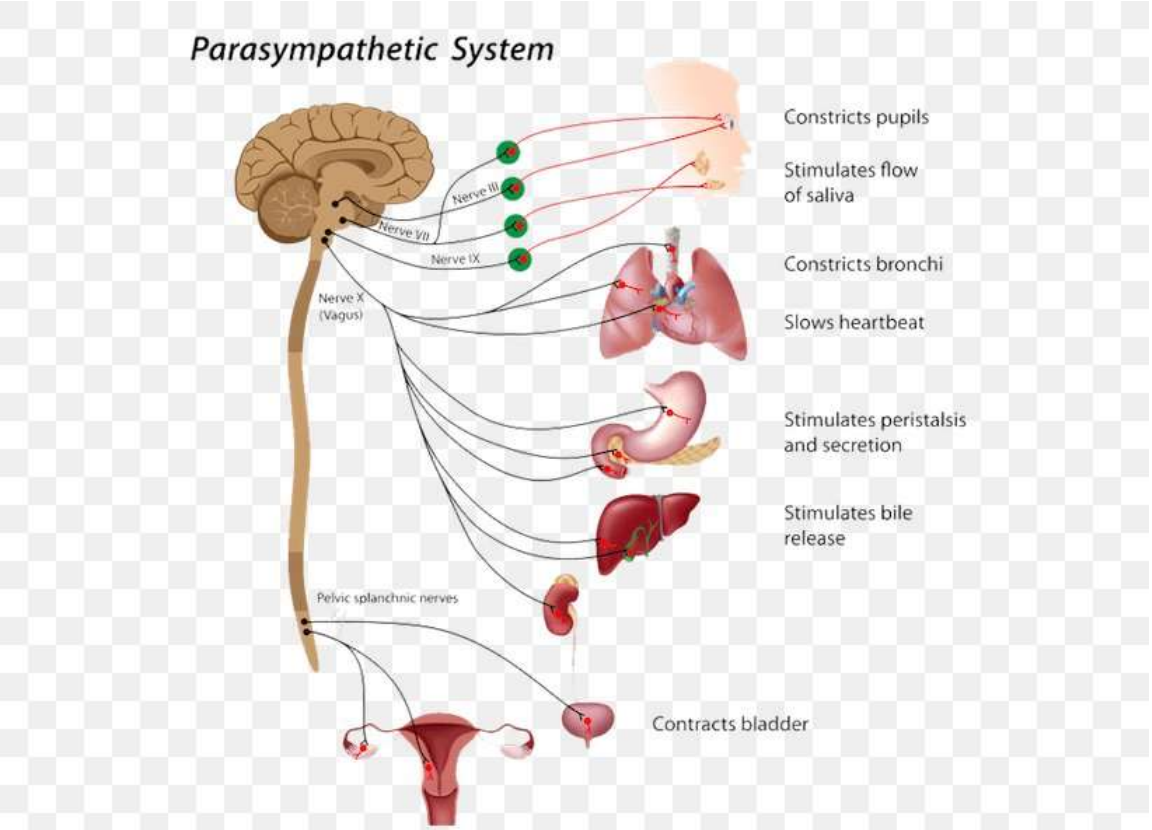
- Synapse within the ganglia of the same level, pass through gray rami communicantes to spinal nerve
- Synapse within ganglia of higher level (cervical), pass through gray rami communicantes to spinal nerves
- Synapse within ganglia of lower level (lumbosacral), pass through gray rami communican
- Do not synapse within the ganglia, pass through gray rami communicantes to form 3 splanchnic nerves, synapse within prevetebral ganglia

Parasympathetic efferent

Craniosacral outflow

1.Cranial nerves (1973) >>> cranial parasympathetic ganglia or target organs

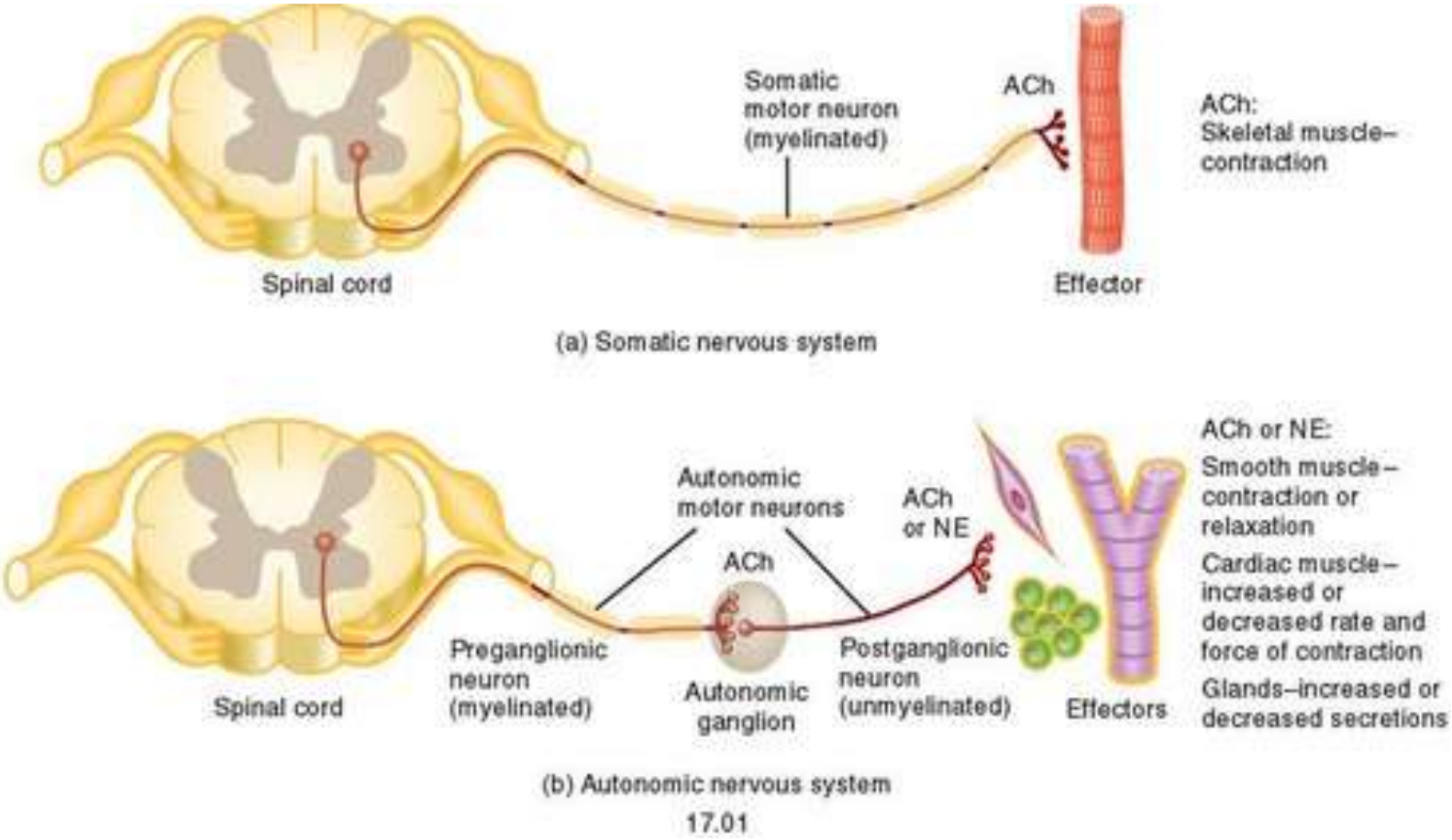
2.Sacral spinal nerves (S2-4) >>> pelvic splanchnic nerves >>>>> hypogastric plexuses or walls of target organs



- Autonomic afferent fibers
  run in reverse course to efferent fibers

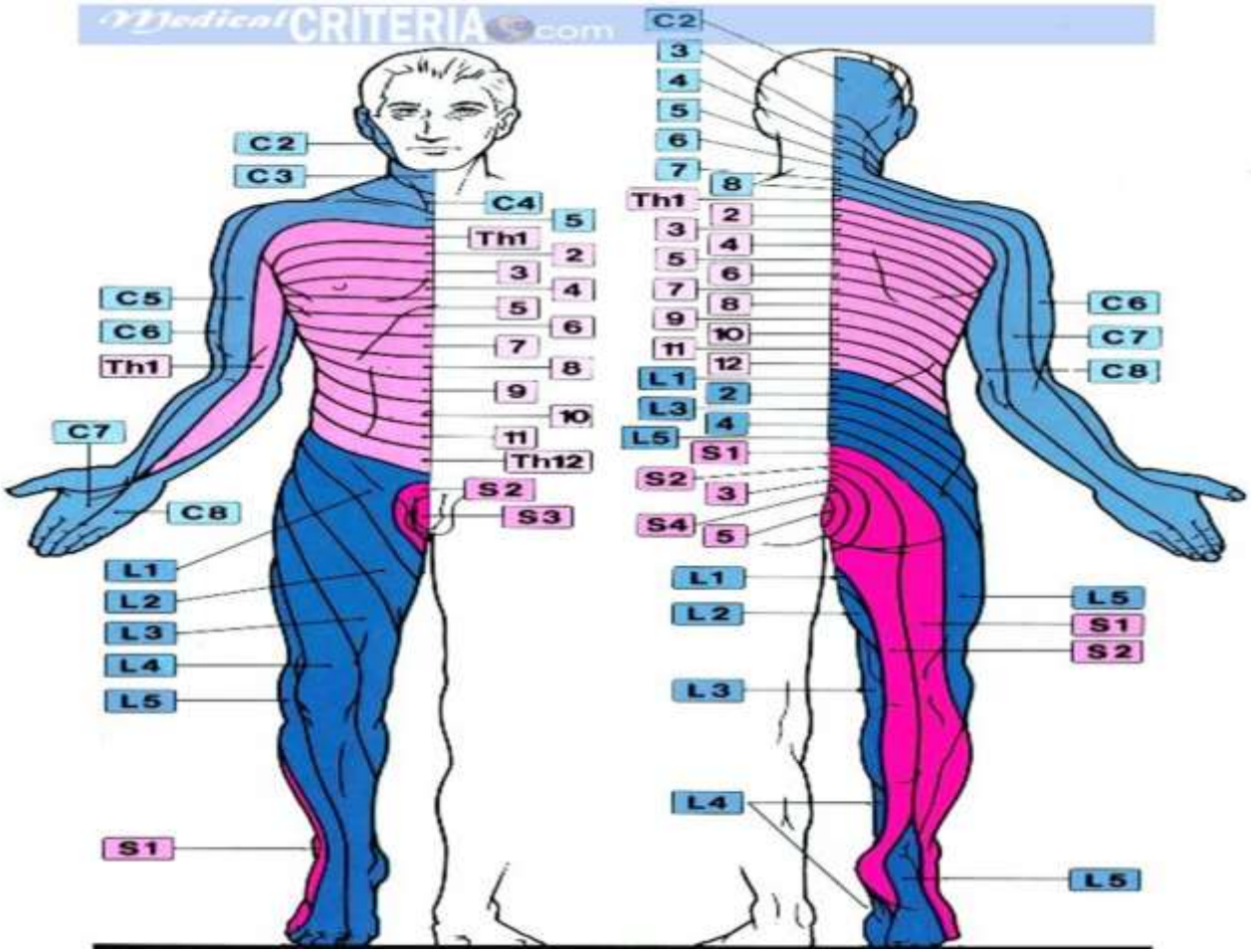
Somatic vs autonomic

- Single neuron pathway to effector organ
- Two neurons pathway to effector organ



Dermatome :

The area of skin supplied by a single spinal nerve (segment of spinal cord)



Q /