

# Nervous system II

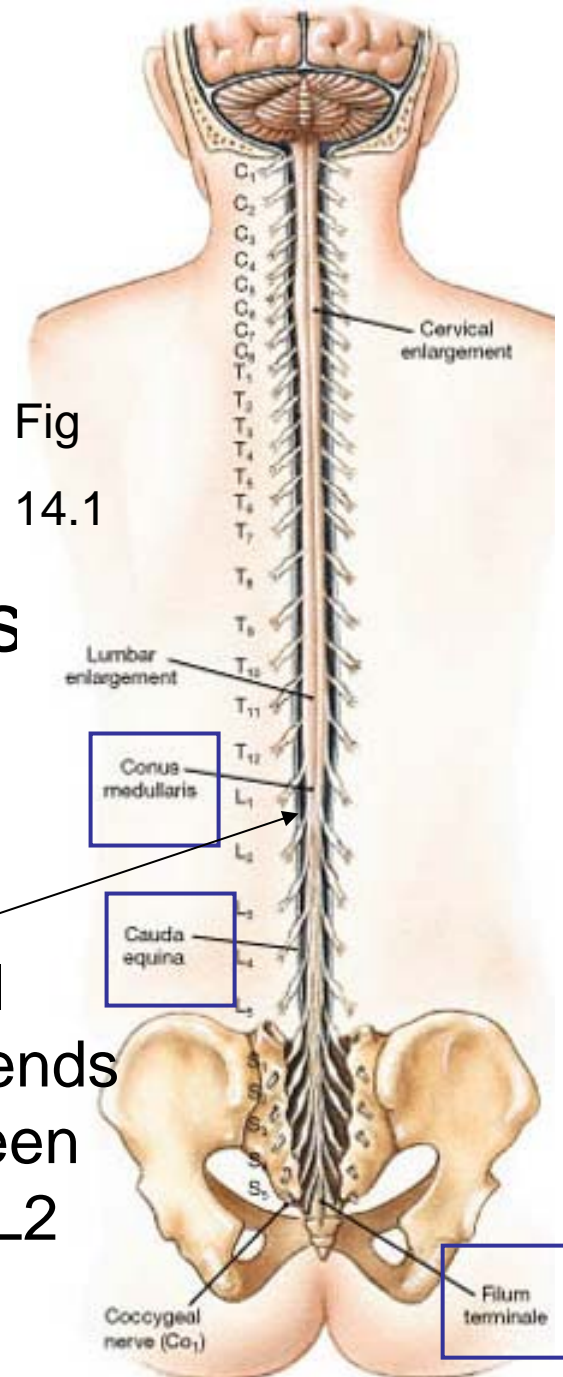


# Spinal cord

- Part of the Central Nervous System
- Sends afferent/efferent signals towards/away from the brain
- Process & integrates info
- Responsible for reflexes

Fig  
14.1

The spinal cord ends between L1 & L2



(a) Spinal cord, posterior view

# Position in body:

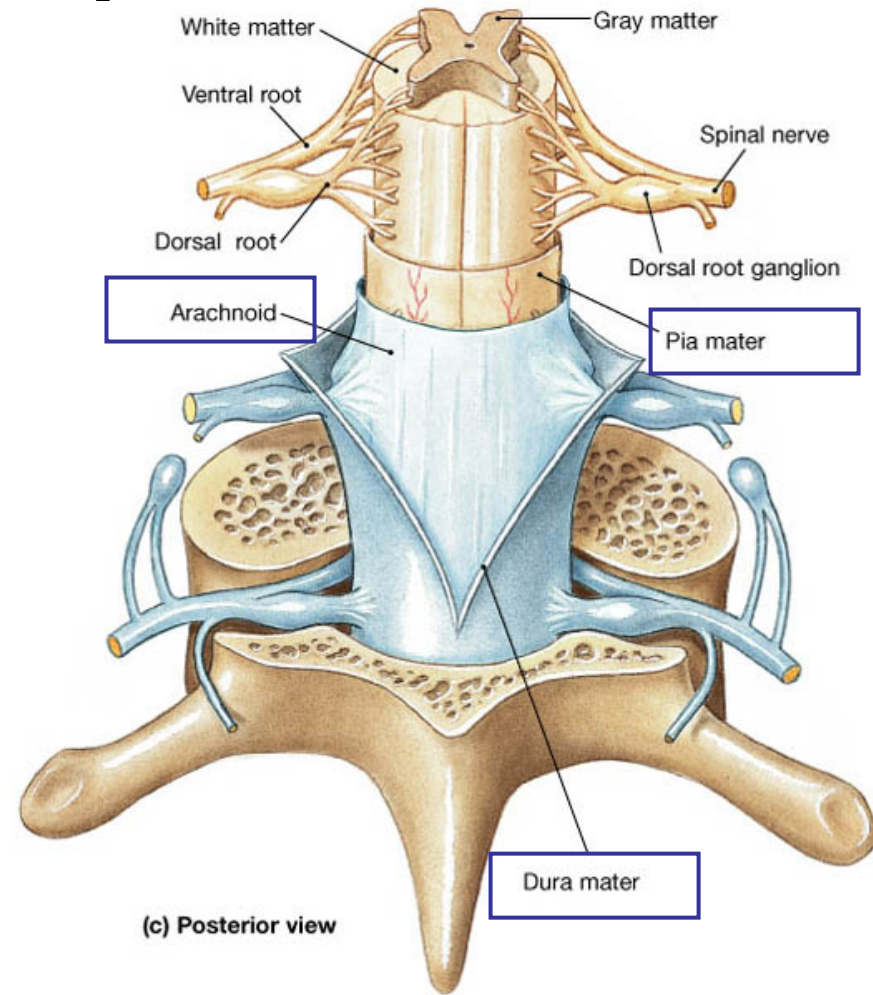
- Foramen Magnum → L1/L2 (conus medullaris)
- Spinal Cord growth stops at about age 4
- Vertebral column ( bones) continues to grow until full height
  
- Tapers to conus medullaris
- Filum terminale originates at tip
  - Strand of fibrous tissue
  - Joins coccygeal ligament

# Protection of spinal cord

- Spinal meninges within spinal cavity
  - meninges (end at S2)-
- Epidural space- filled with connect. tissue, fat. separates dura mater from walls of vertebral canal
- Cerebral Spinal Fluid- cushions cord
- Meninges
  - Superficial
    - Dura mater
    - Arachnoid
    - Pia mater
  - Denticulate ligaments-lateral extensions of the pia mater
  - Deep

- Dura Mater in cranial cavity- anchors spinal cord superiorly
- Filum Terminale (coccygeal lig.)- anchors spinal cord inferiorly

Fig  
14.2



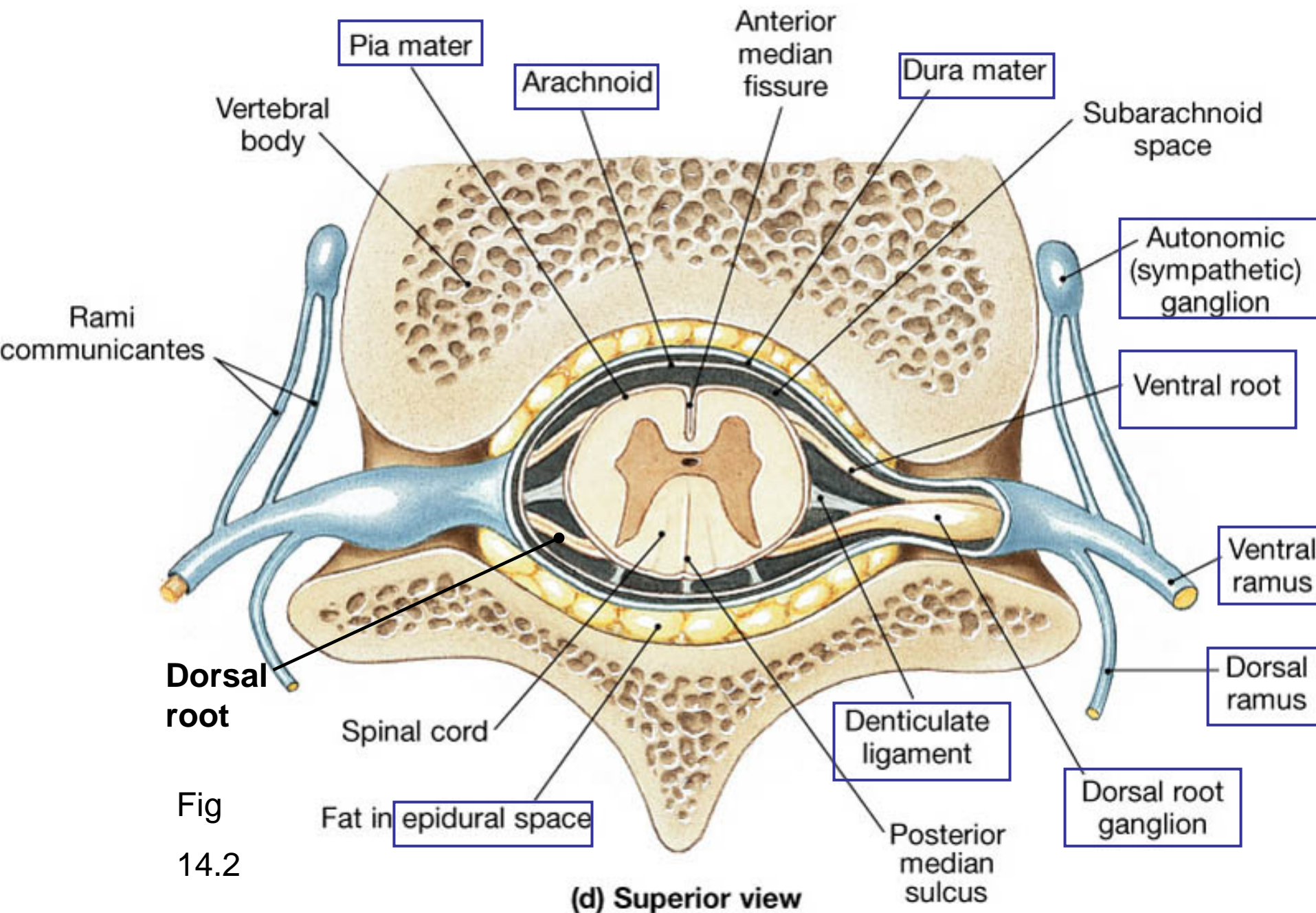


Fig 14.2

(d) Superior view

# Transverse section of spinal cord

- Superficial white matter
- Deep grey matter H/butterfly shape
- **D.A.V.E.**
- Dorsal region of the spinal cord carry afferent signals
- Ventral region of the spinal cord carry efferent signals

# Grey Matter of Spinal Cord

- Mostly cell bodies and interneurons that are unmyelinated
- The “wings” of the grey matter represent the:
  - Dorsal (posterior) horn (somatic/visceral sensory nuclei)
  - Ventral (anterior) horn (somatic-voluntary-motor cell bodies).
  - Lateral horn- visceral motor neurons.



- lateral horns only in thoracic and upper lumbar areas
- Gray commissures
  - Axons of interneurons crossing from right & left sides

# White Matter of Spinal Cord

- arranged in funiculi/columns
  - (lateral / anterior / posterior)
  - Each column contains tracts
  - Axons that share structural or functional similarities

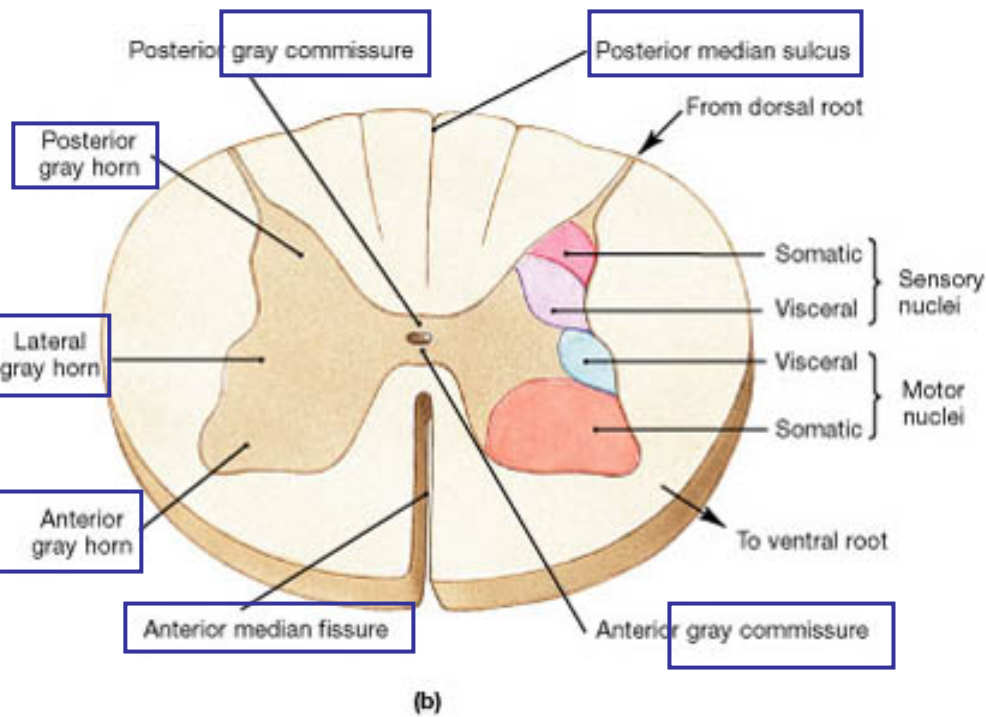
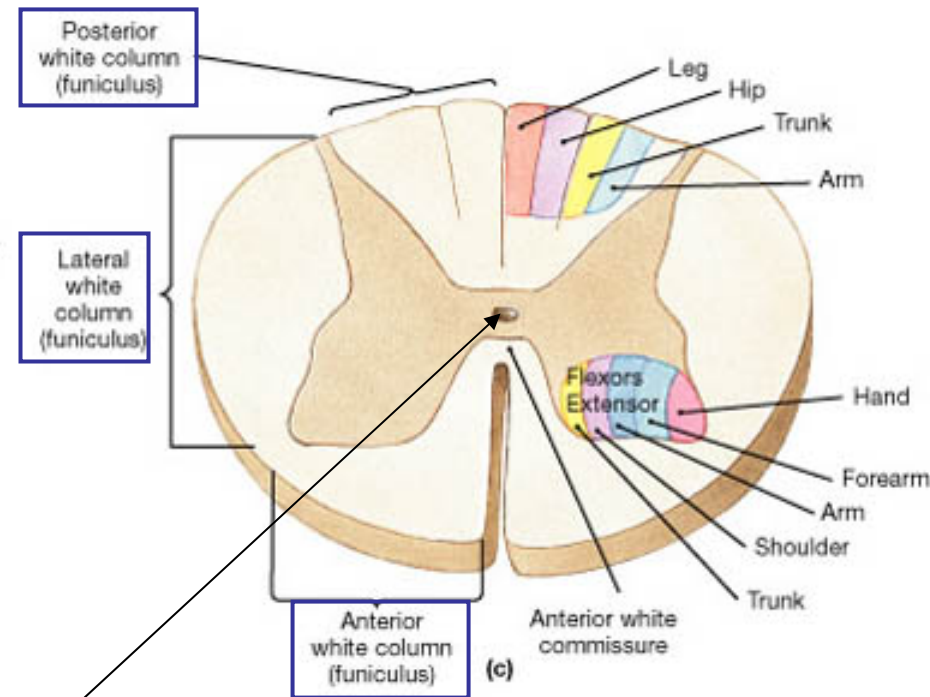


Fig  
14.5



Central canal

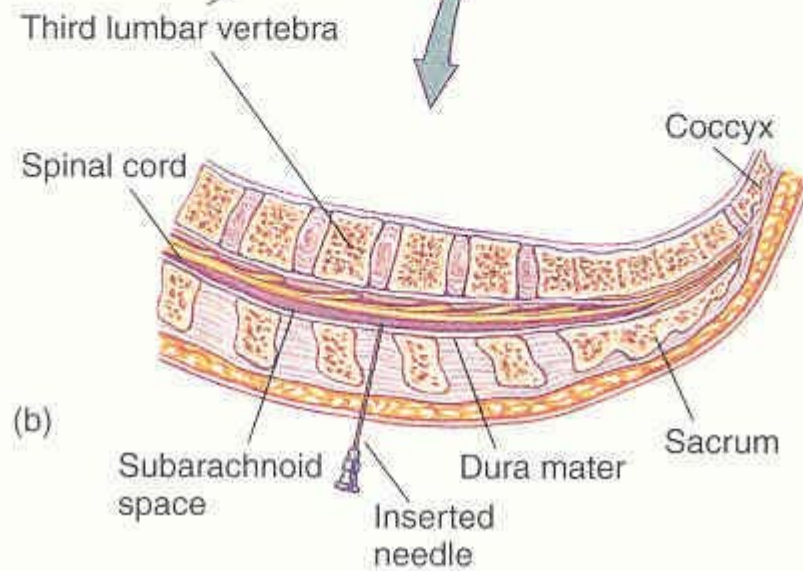
# clinical

- **Lumbar Punctures/Spinal Taps**

- Between L3 & L4
- Small amt of CSF from Sub-Arachnoid space.
- Analysis- For presence of WBC, pathogens, metabolic wastes, etc.

- **Epidural/Spinal Blocks**

- Anesthesia is placed into the epidural space
- In sacral region produces a “causal block” common for childbirth.



# Spinal nerves

- 31 pairs of spinal nerves
- Femoral nerve branches to the saphenous nerve
- Sciatic nerves branches to the tibial & peroneal nerves
- Peroneal nerve = common fibular nerve

# Nerve connective tissue layers

Outermost epineurium

Dense network of collagen fibers

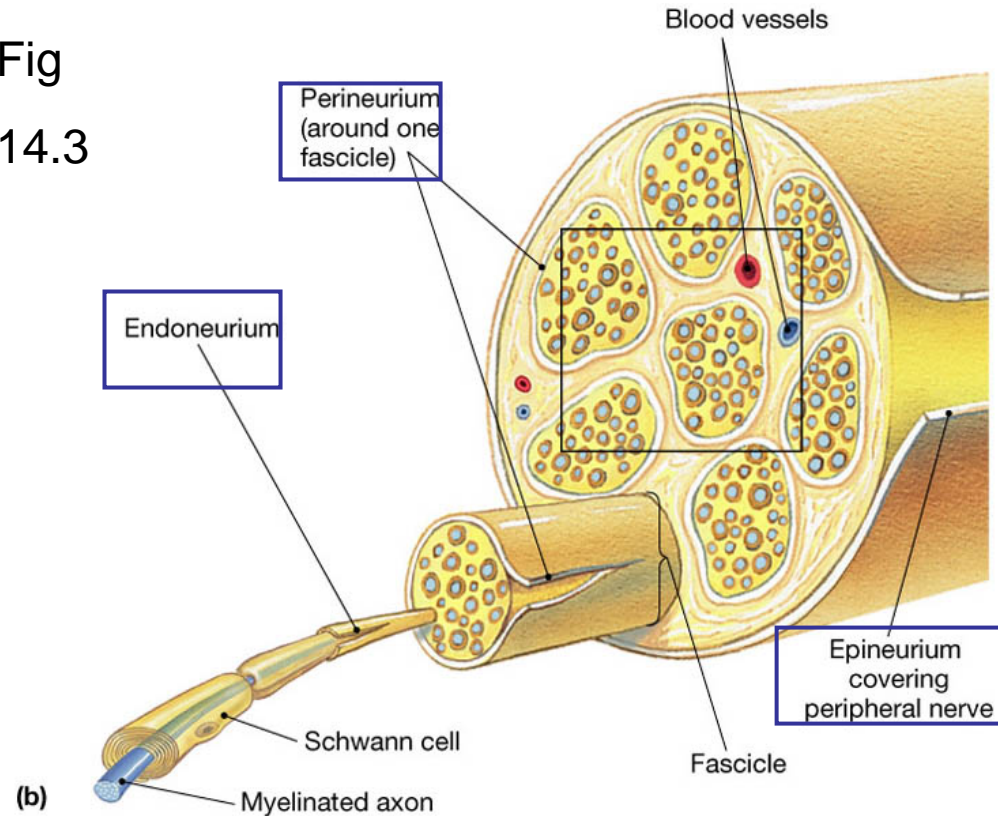
Middle perineurium

Partitions nerve into fascicles

Inner endoneurium

connective tissue around each axon/  
myelin sheath

Fig  
14.3

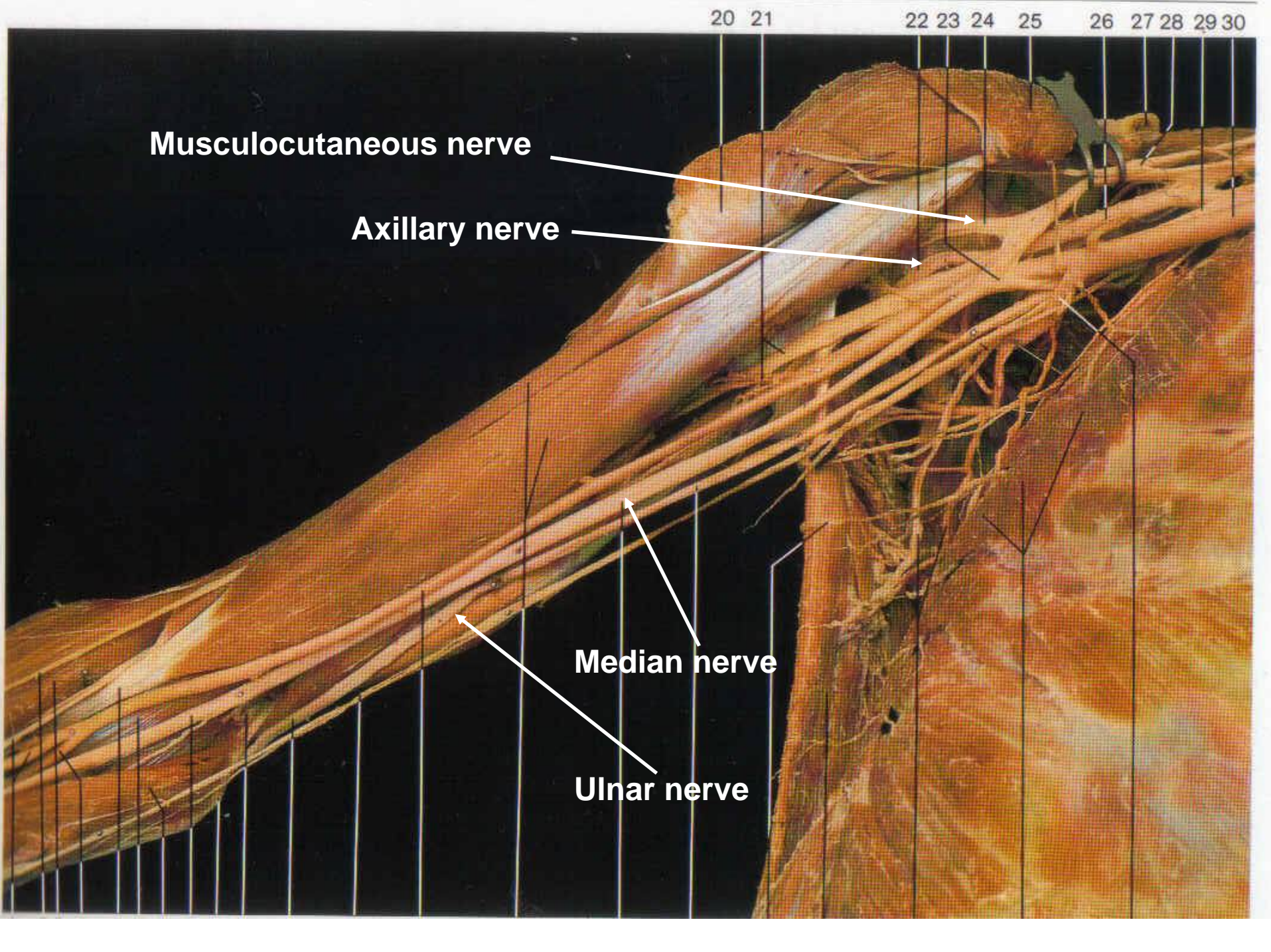


**Musculocutaneous nerve**

**Axillary nerve**

**Median nerve**

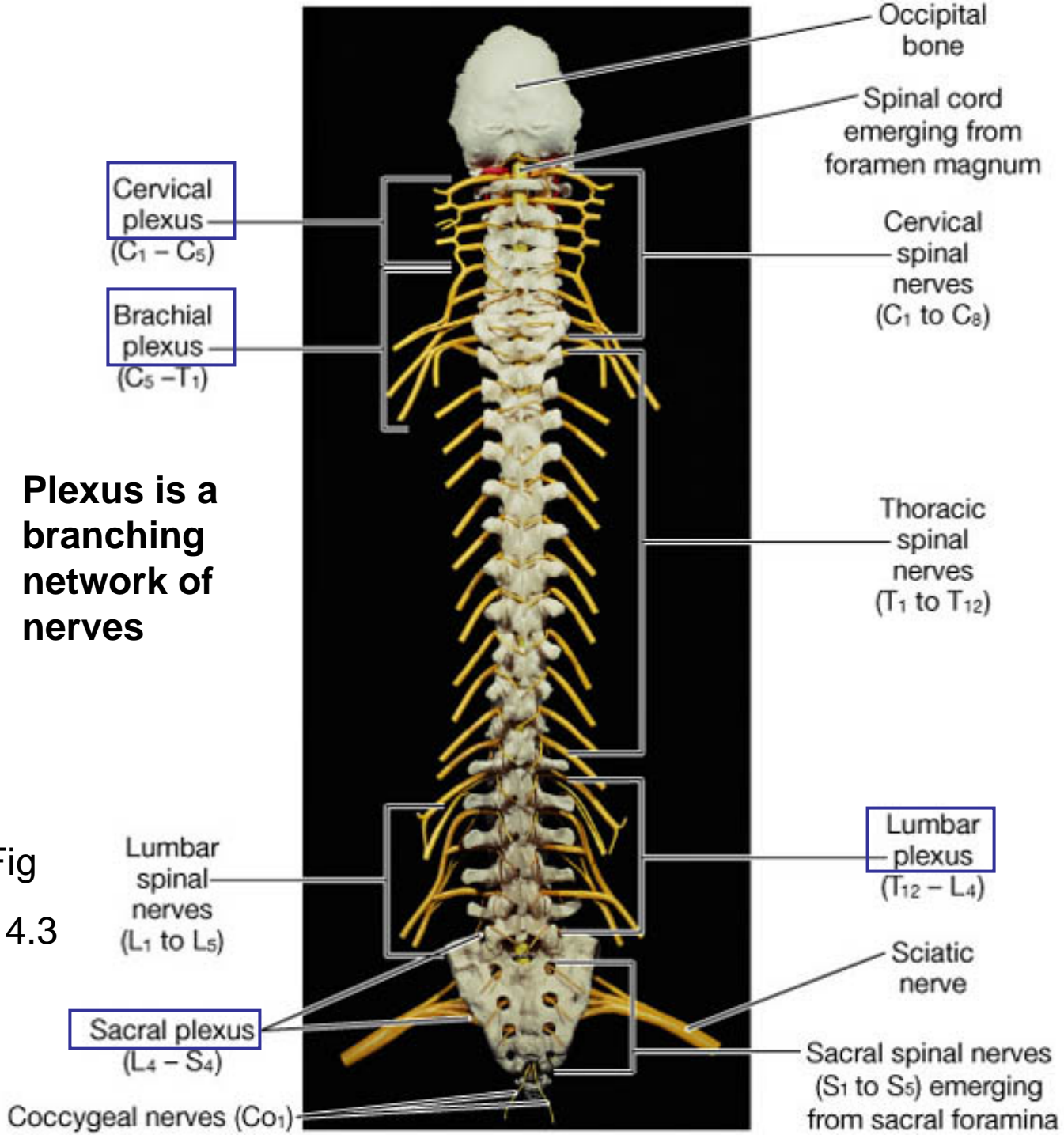
**Ulnar nerve**





**Plexus is a branching network of nerves**

Fig 14.3



# Reflex arc-immediate motor to stimulus

- Five components:
- Sensory receptor
- Sensory neuron
- Interneuron
- Motor neuron
- Effector organ (muscle/gland)

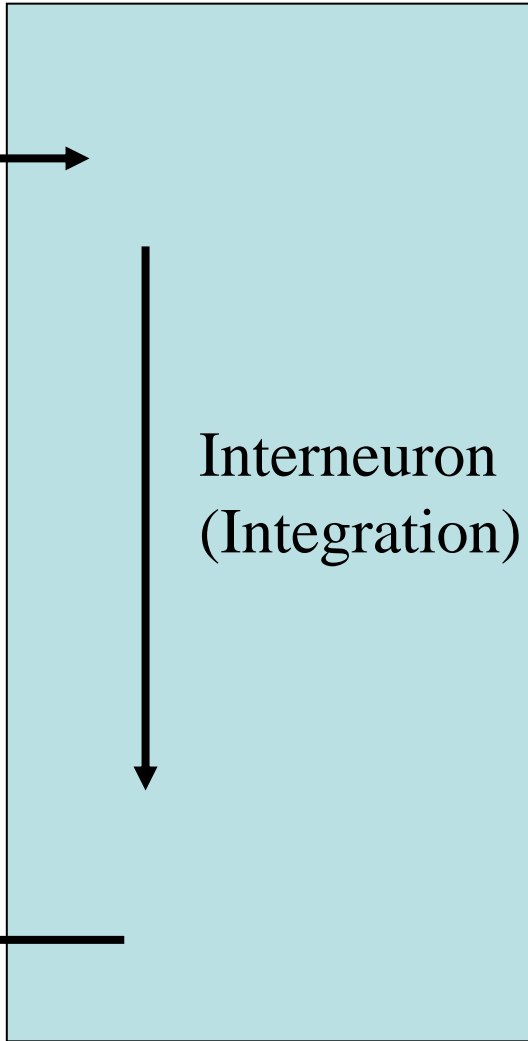
PNS

CNS



Receptors

Sensory Pathway



Interneuron  
(Integration)



Motor Pathway



Effector  
Tissue

**Step 1:**  
Arrival of stimulus and activation of receptor



**Step 2:**  
Activation of a sensory neuron

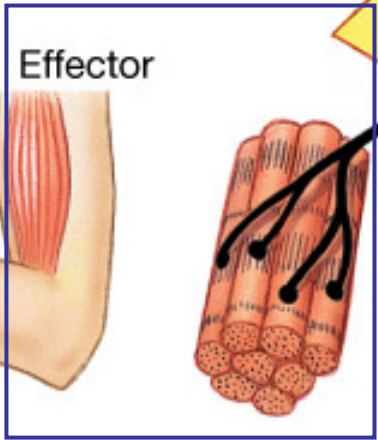
Receptor

REFLEX ARC

Dorsal root

Sensation relayed to the brain by collateral

**Step 5:**  
Response by effector

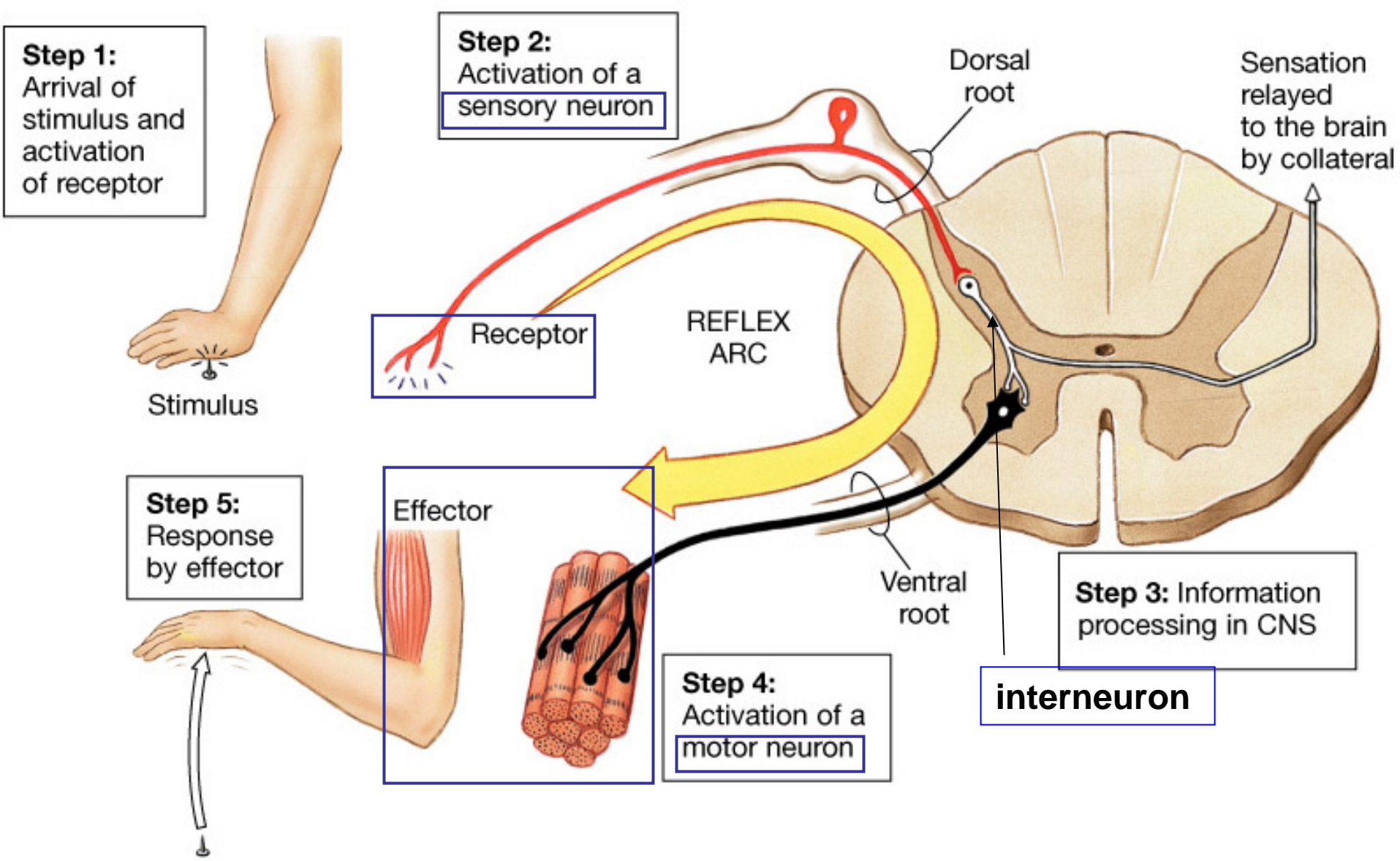


**Step 4:**  
Activation of a motor neuron

Ventral root

**Step 3:** Information processing in CNS

interneuron



# Nervous system

CNS

PNS

Afferent, sensory  
Signal travels from PNS to CNS

Efferent, motor  
Signal travels from CNS to PNS

Afferent, sensory  
Signal travels from PNS to CNS

Efferent, motor  
Signal travels from CNS to PNS

Somatic sensory  
Receives signals from receptors in muscles, skin, joints

Visceral sensory  
Receives signals from receptors in smooth muscle digestive organs

Somatic motor  
Voluntary control  
Conscious control  
Sends signals to skeletal muscles

Visceral motor  
Autonomic nervous system  
involuntary control  
Unconscious control  
Sends signals to smooth, cardiac muscle, glands

S.A.M.E.

Sensory/afferent-sends signal towards the brain

Motor/efferent-sends signal away from the brain

# Visceral motor

- Autonomic nervous system
- Two divisions: opposing effects
- Parasympathetic
- Sympathetic

# Sympathetic (thoracolumbar) division

- Effects of sympathetic innervation:
- Increased alertness
- Feeling of energy & euphoria
- Increased blood pressure, heart rate, & ventilation rate
- The 4 F's: sudden intense physical activity
- Flight, Fighting, Feeding (hunting), Mating (orgasm)

# Adrenal gland

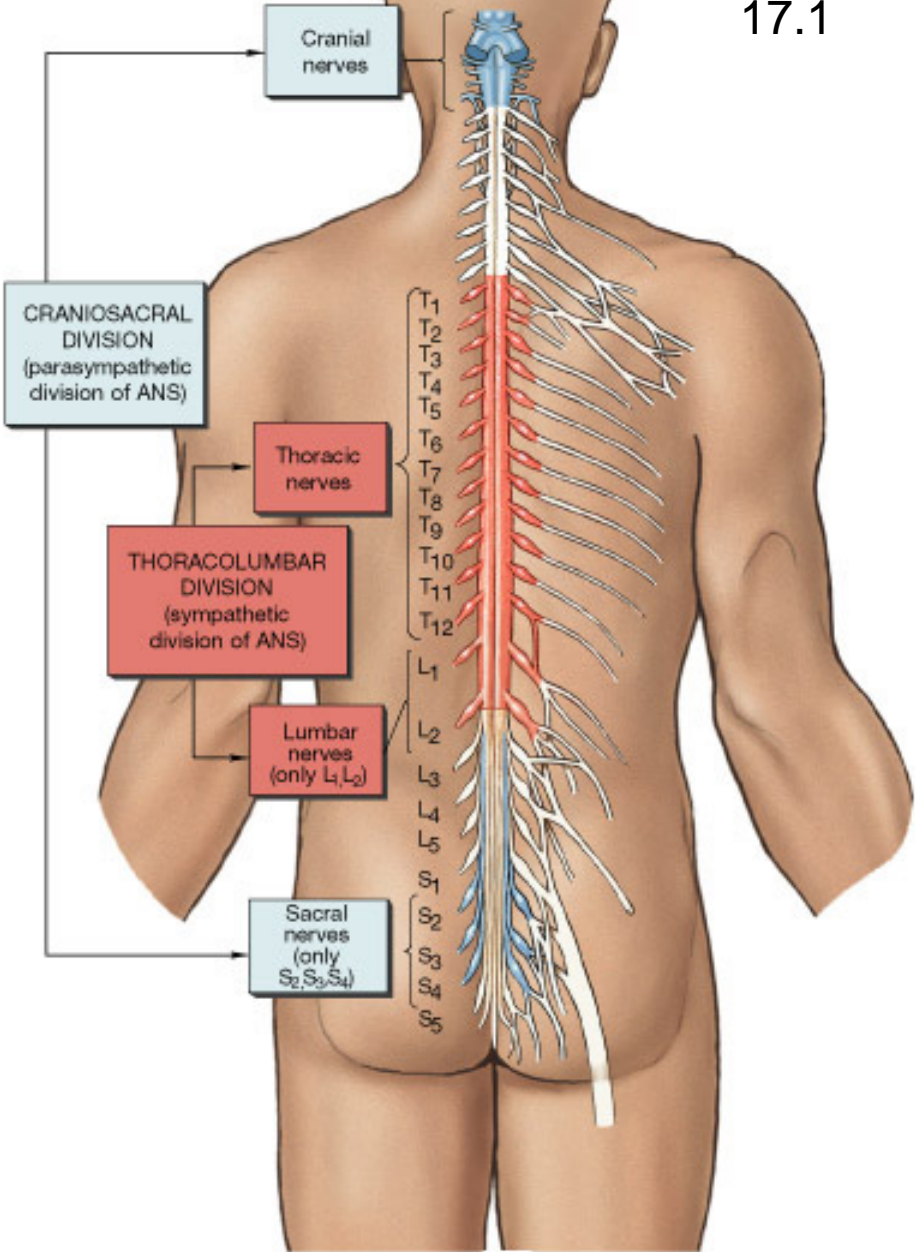
- Sympathetic neuron:
- Bypasses S. Chain Gang.
- Controls release of hormones from adrenal medulla
  
- Hormones cause longer lasting sympathetic effect on body



# Parasympathetic (craniosacral) division

- Effects of parasympathetic innervation:
- Stimulation of digestive glands
- Increased activity in digestive tract
- Stimulation of urination & defecation
- Sexual arousal

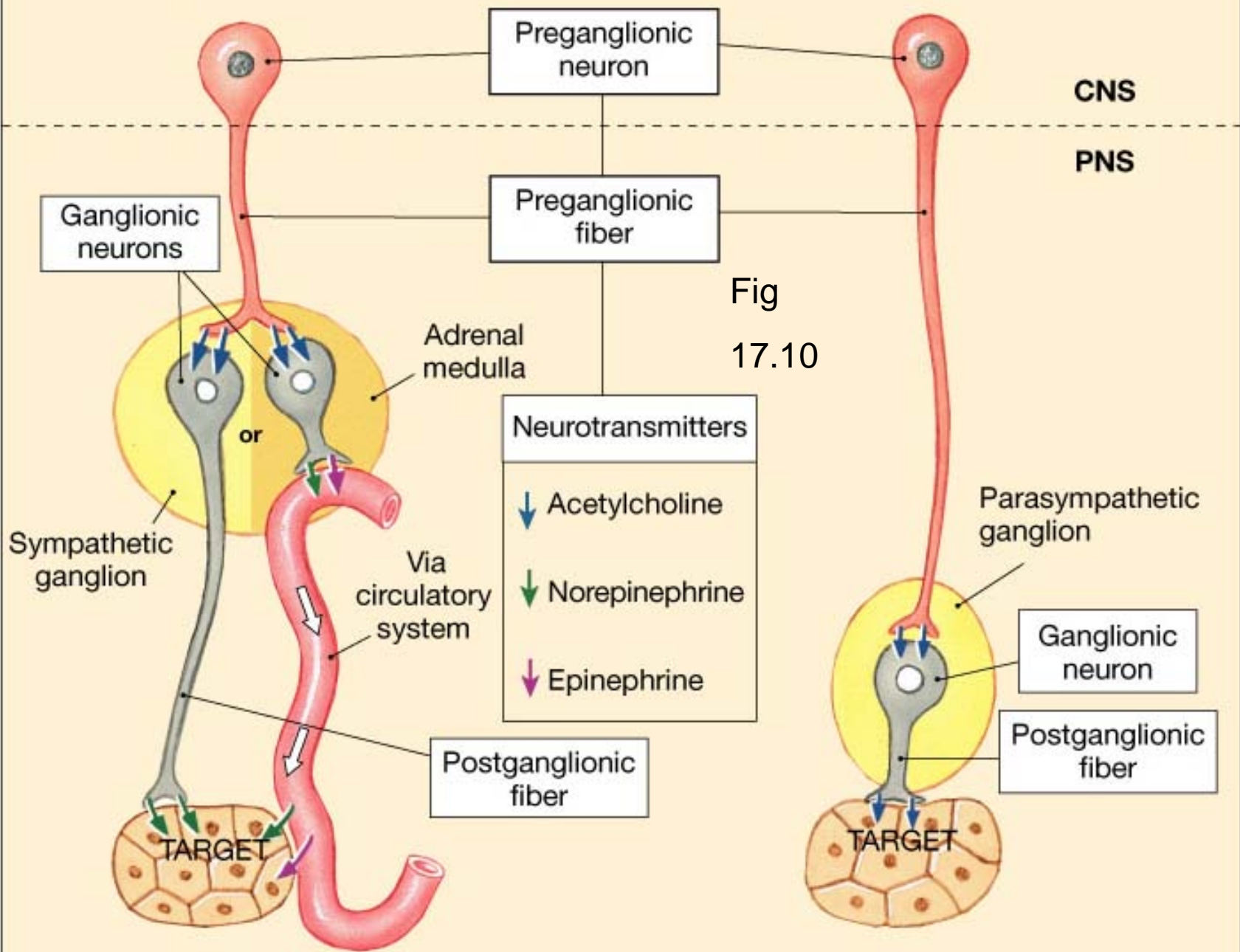
Fig  
17.1



(b)

# Sympathetic

# Parasympathetic



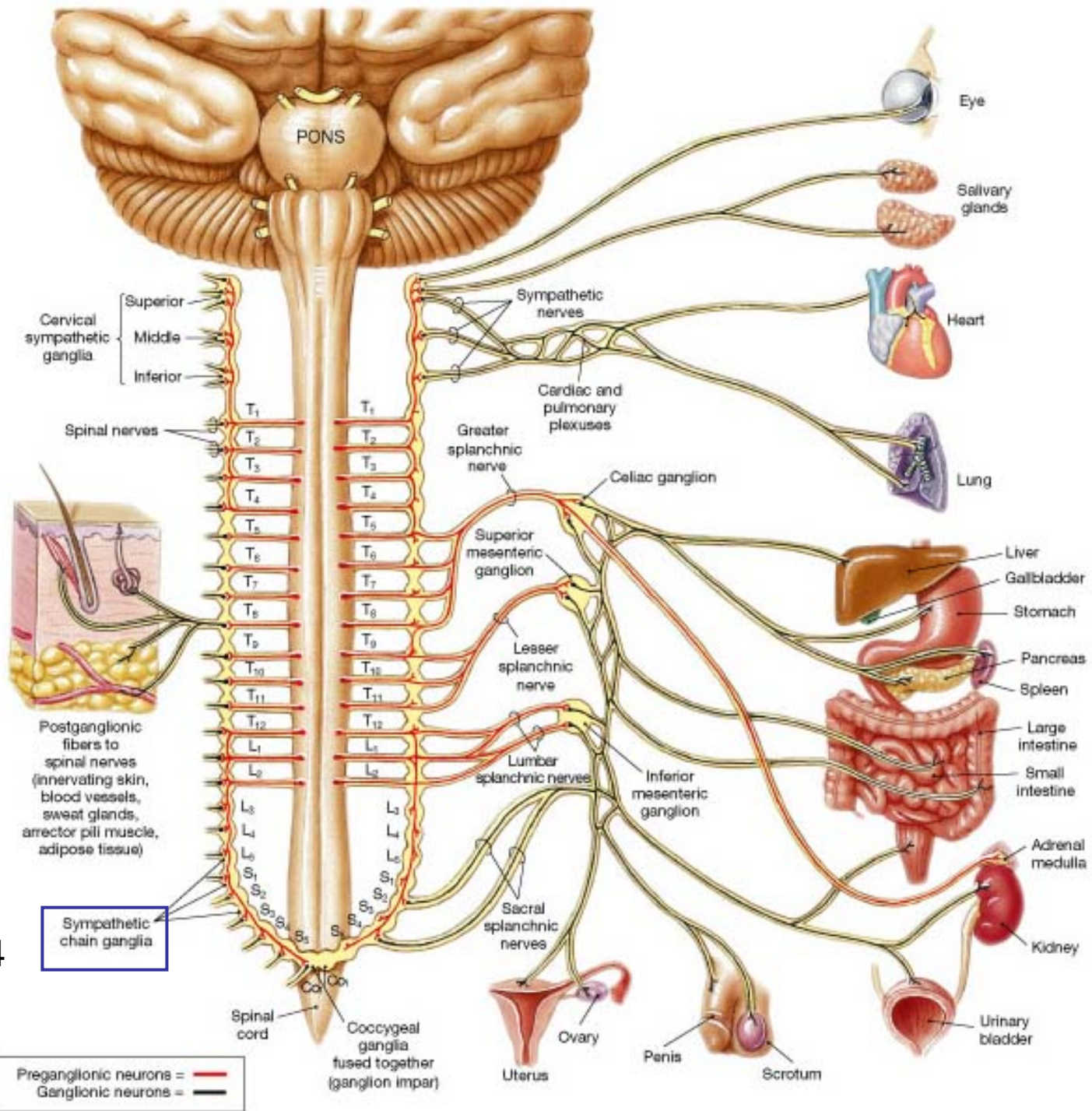


Fig  
17.4

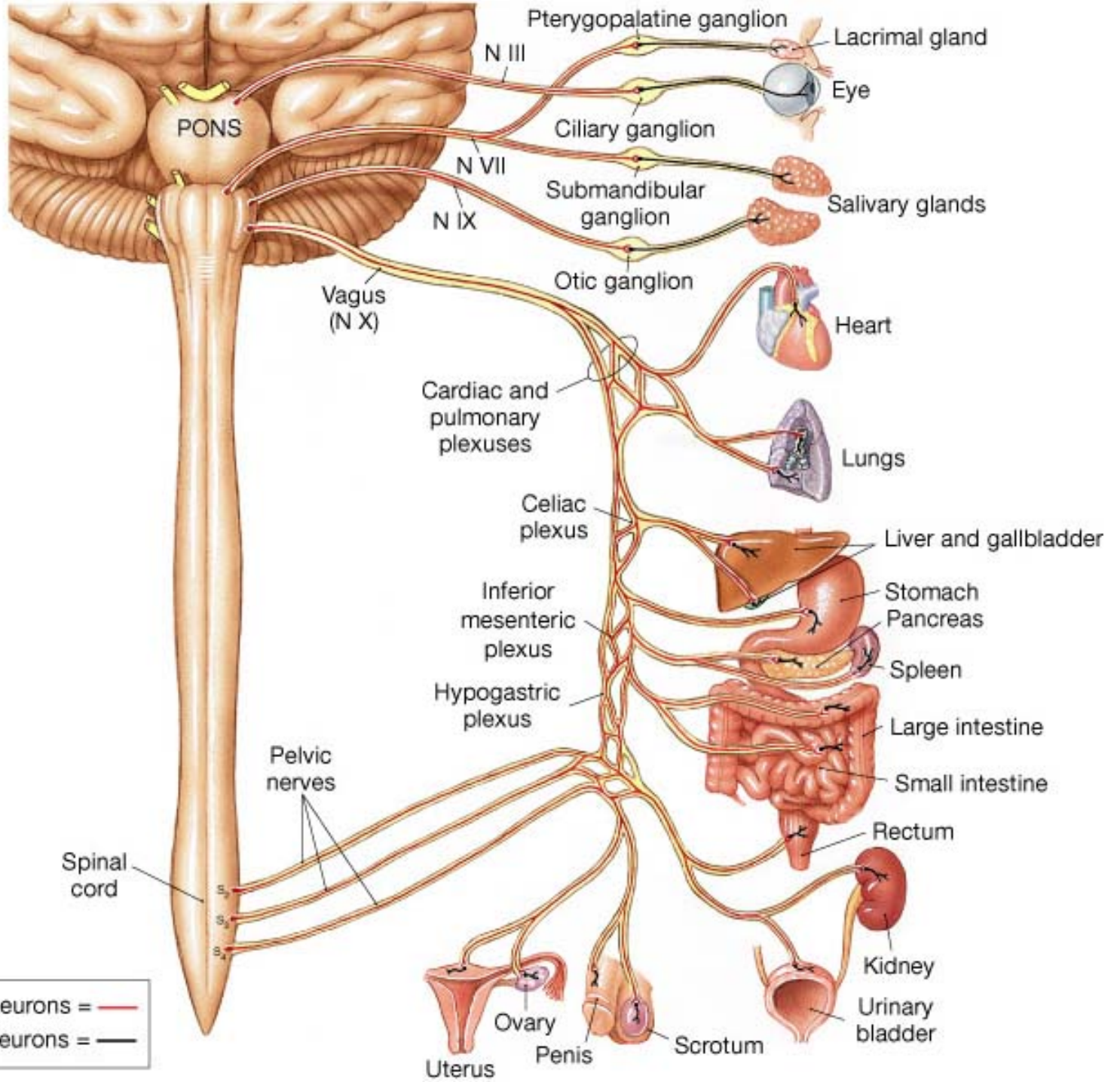


Fig 17.8

Preganglionic neurons = — (red)  
 Ganglionic neurons = — (black)

break

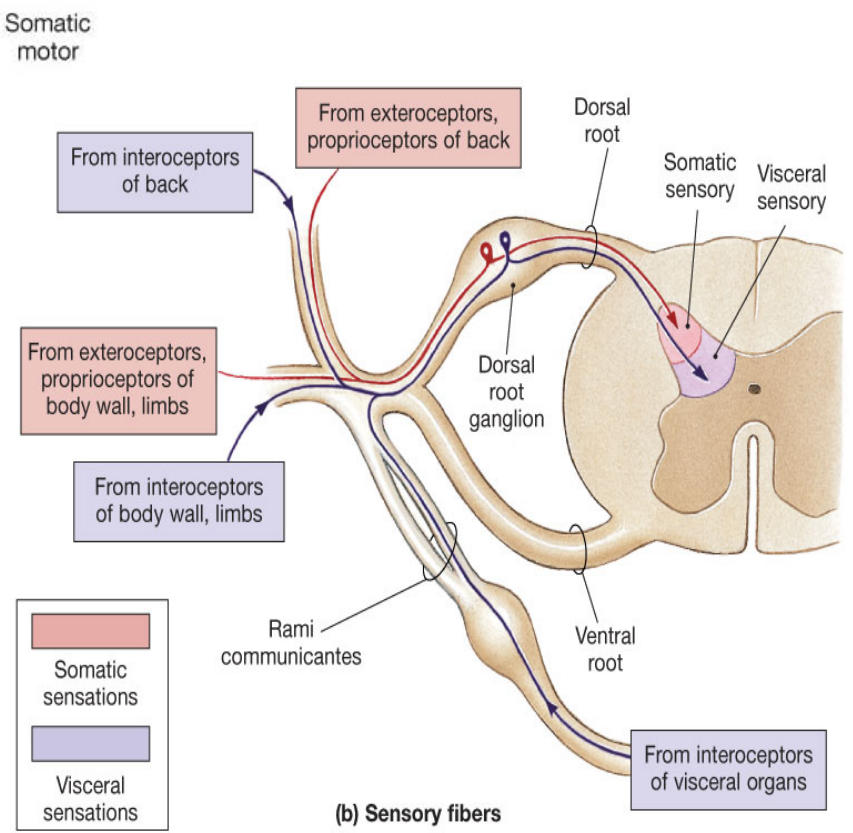
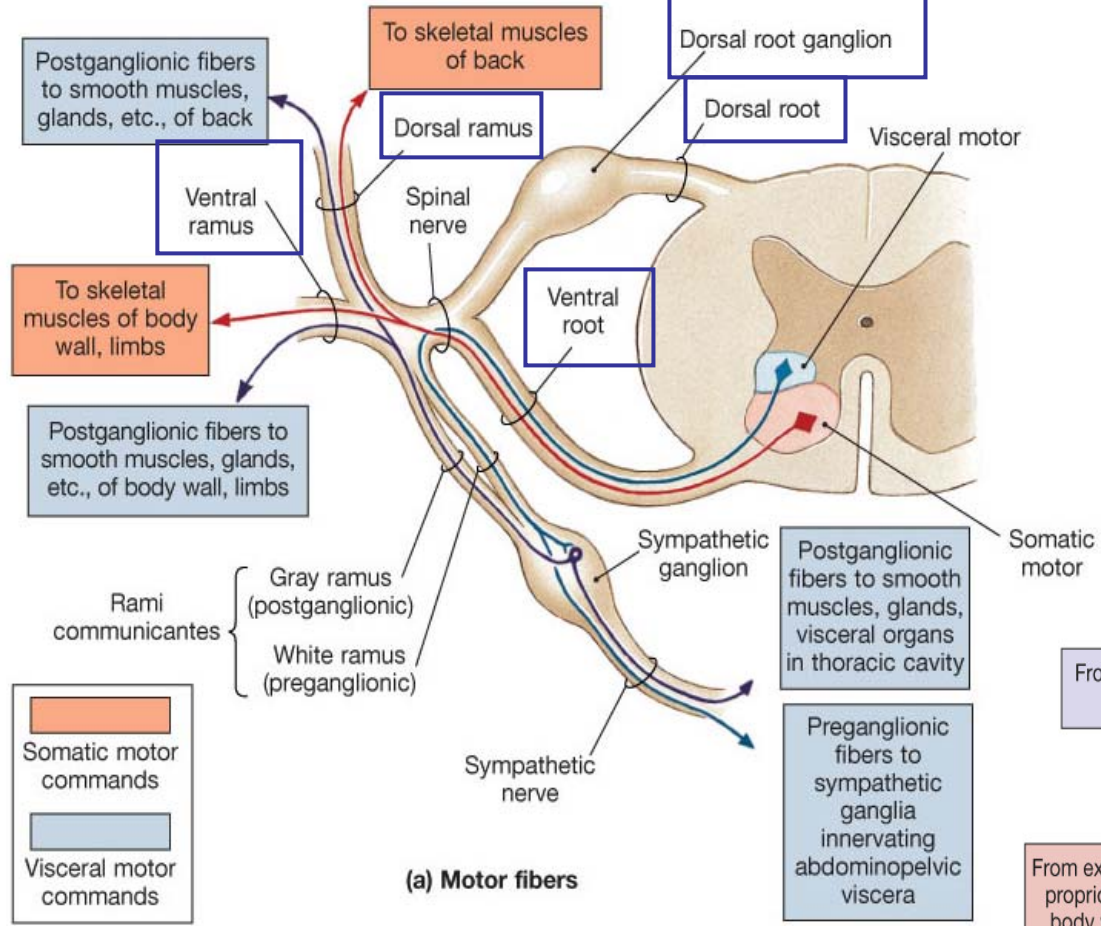
- Motor cortex of cerebrum (frontal lobe)
- Internal capsule
- mesencephalon
- pons
- Medulla oblongata
- Anterior horn
- Ventral root
- Ventral ramus
- Brachial plexus
- Radial nerve
- Wrist extensor muscles

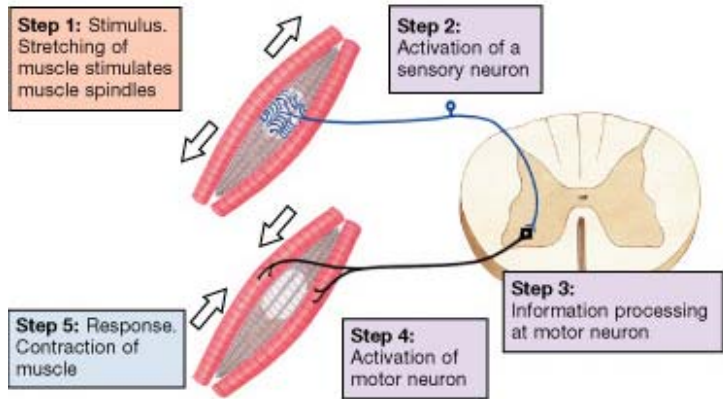
**Extending  
wrist**

- Mechanoreceptors
- thoracic nerves
- dorsal ramus
- dorsal root ganglion
- dorsal root
- dorsal horn
- Thalamus
- internal capsule
- cerebral cortex in parietal lobe

**Back rub**



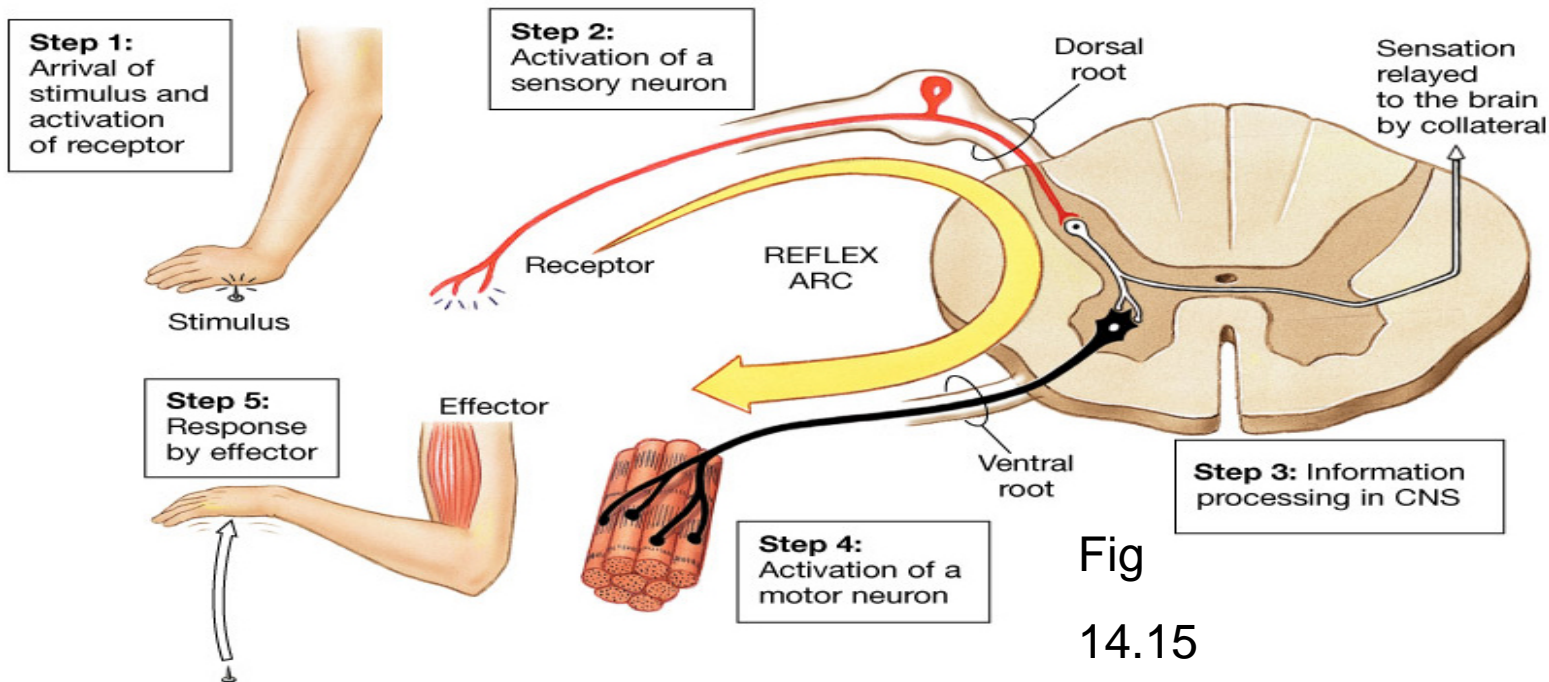
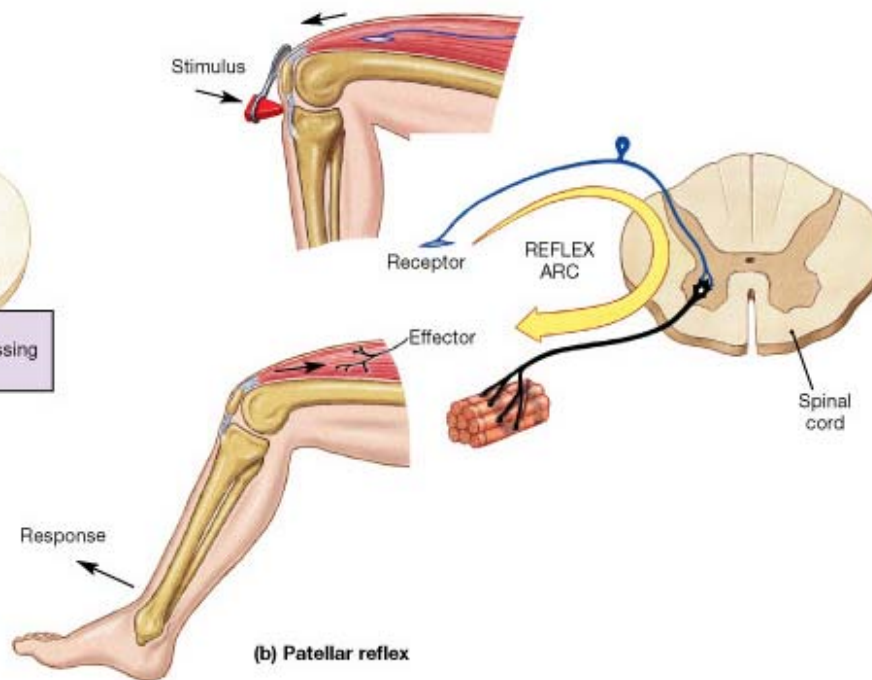




(a) Stretch reflex

Fig

14.18



Fig

14.15

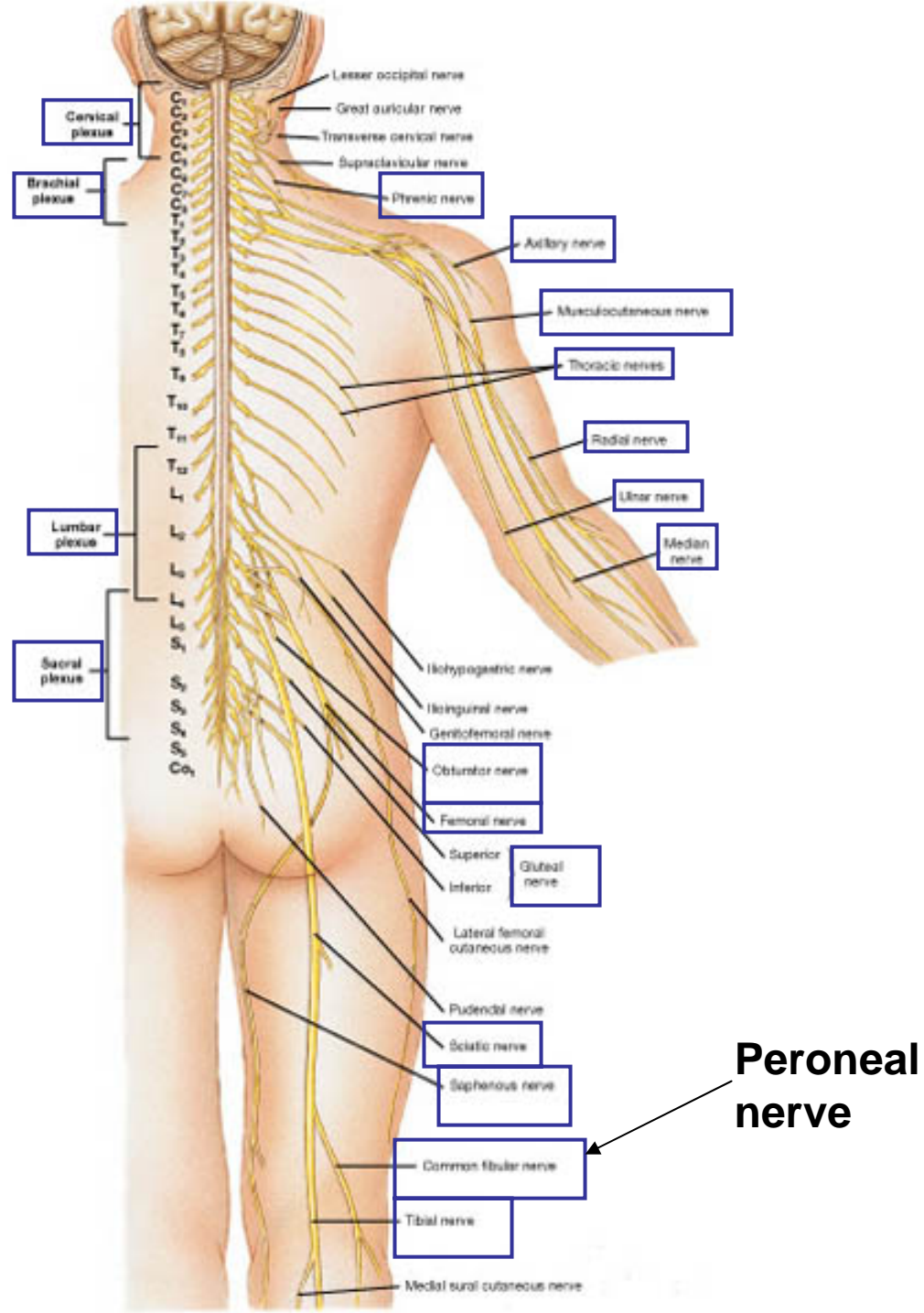


Fig  
14.9

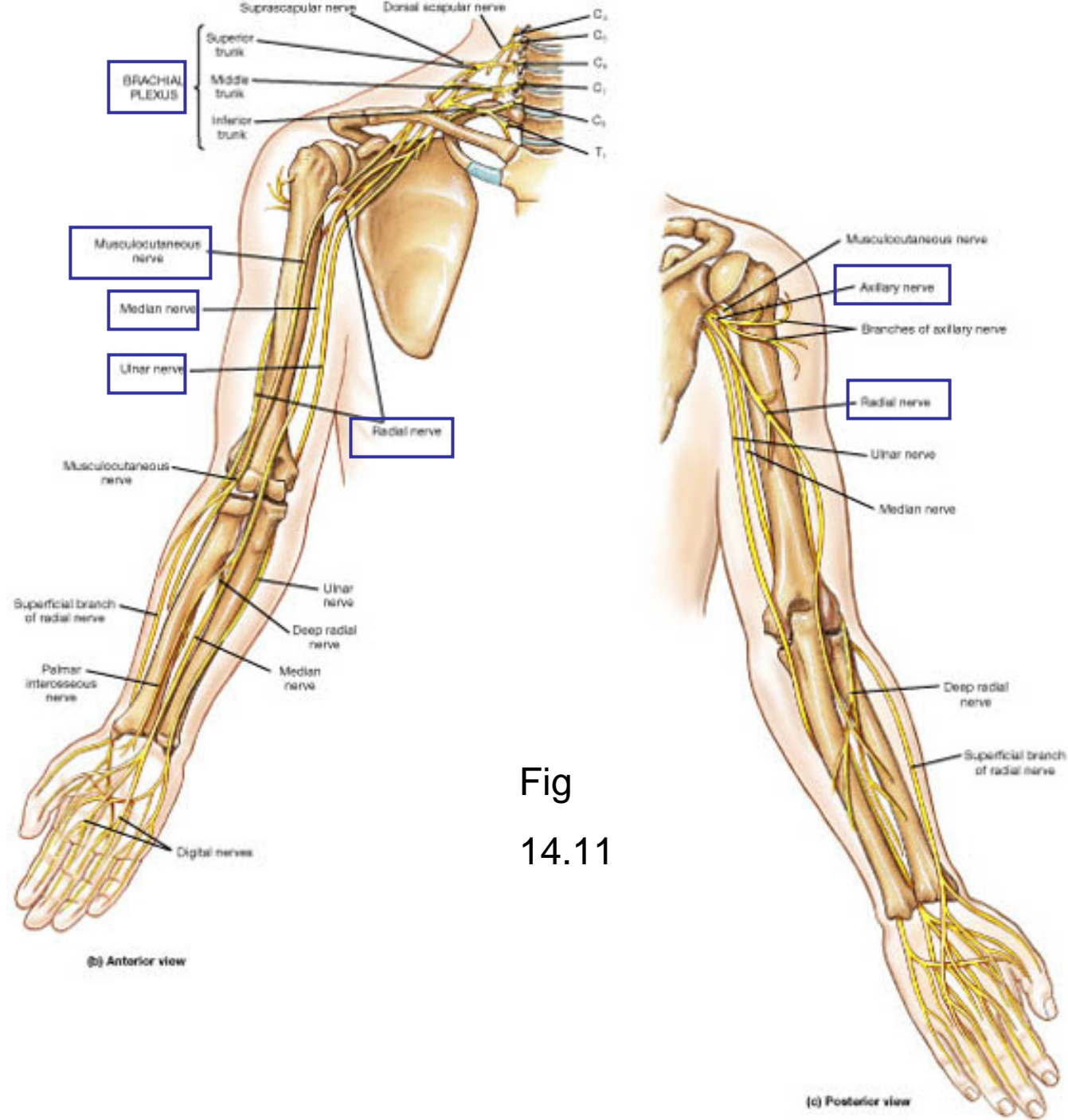


Fig  
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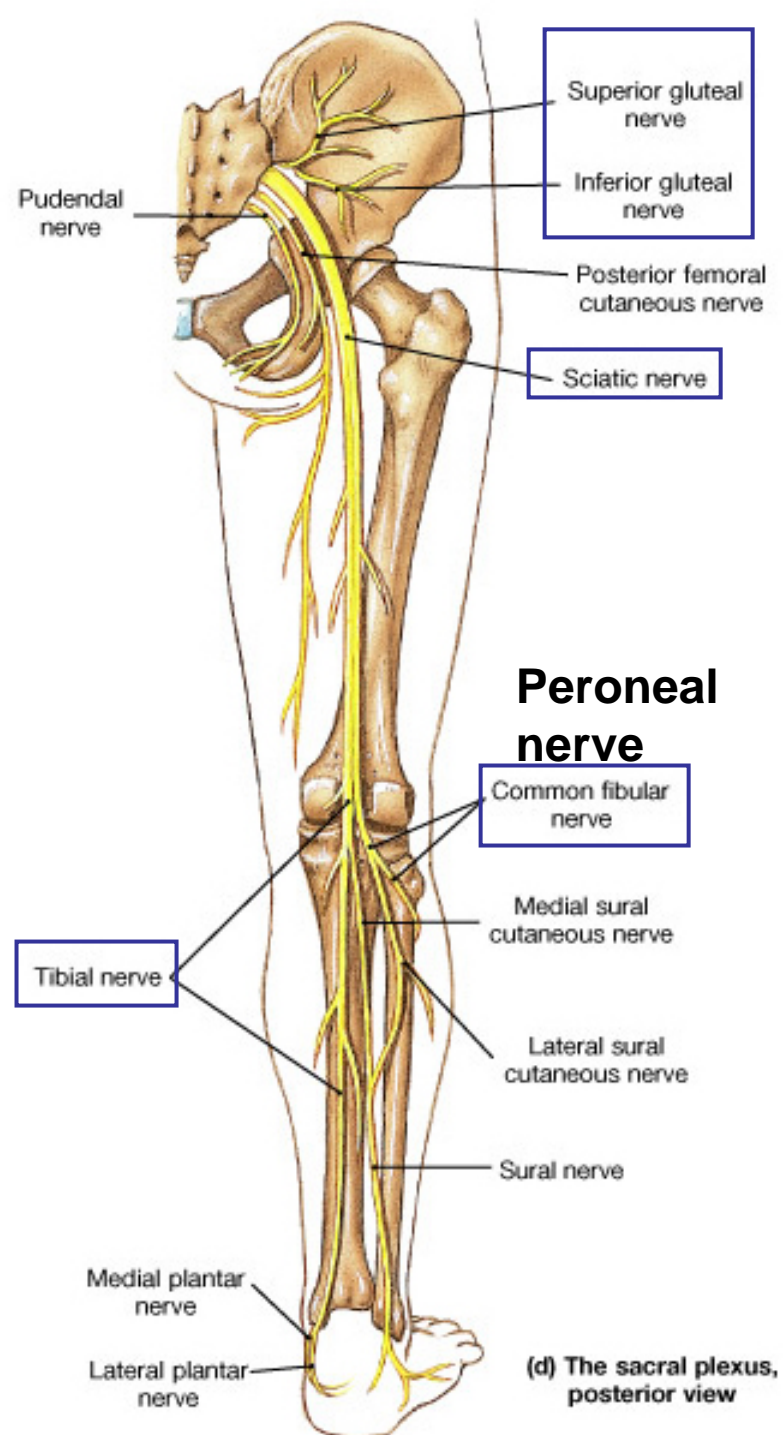
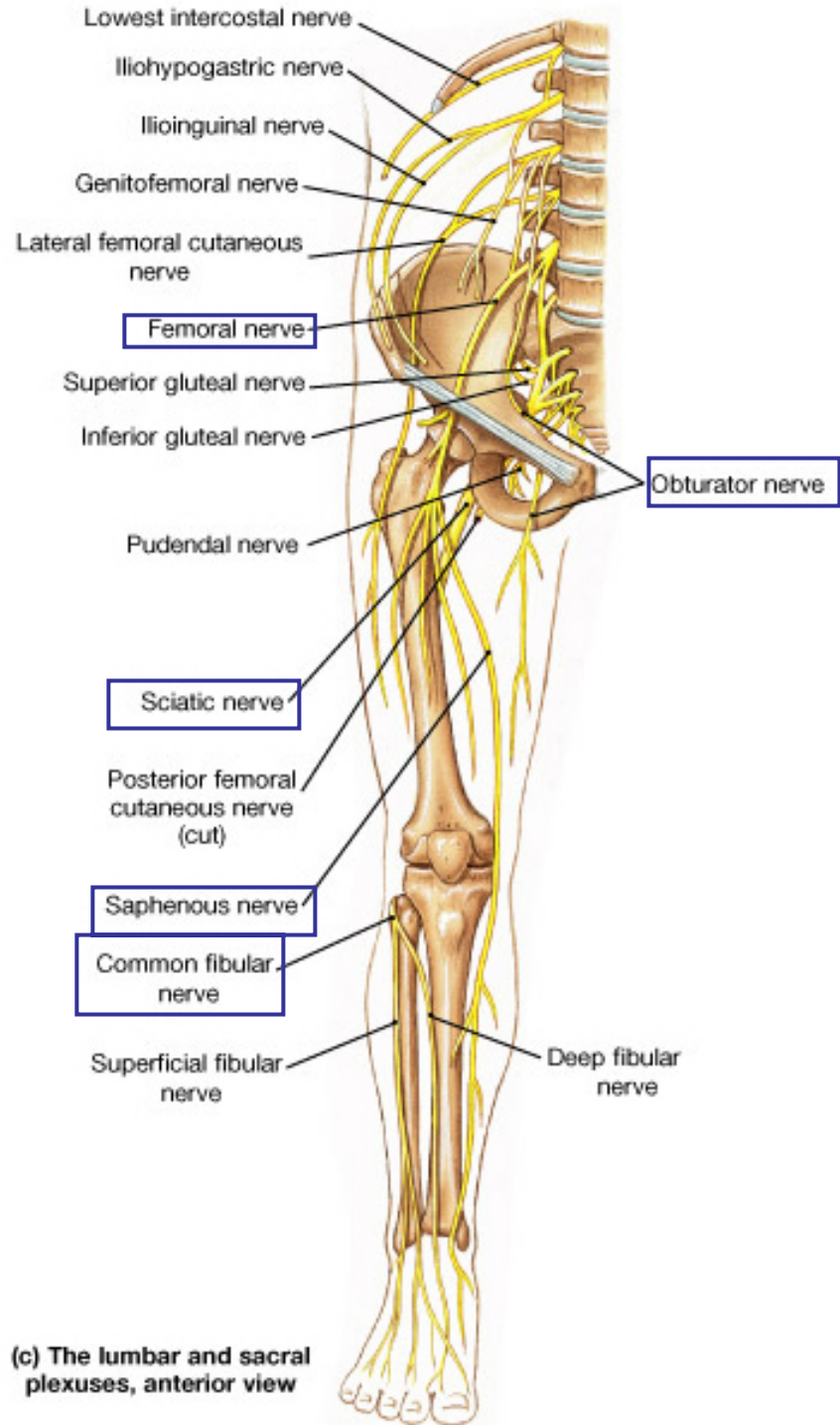


Fig 14.13