Spinal Cord and Peripheral nervous system (PNS)

Anatomy for Nursing students

QUISTION

What is the master gland?

located……..?

Contents

- Spinal cord
- Spinal cord injury: case history

Objectives

- To understand the meaning of:
- PNS
- Spinal nerves and Dermatomes
- Nerve plexuses and important nerves emerge from them
- cranial nerves

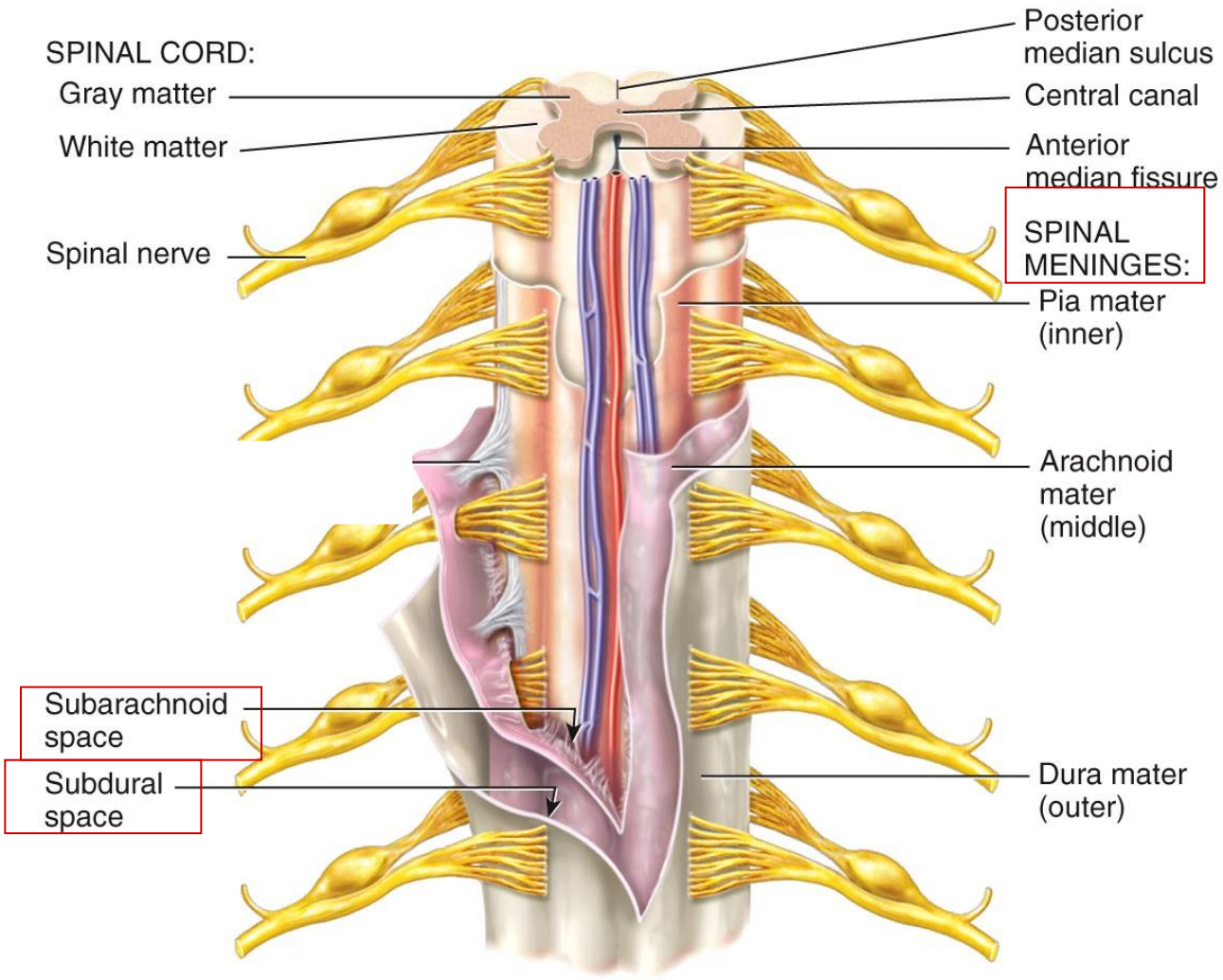
- To distinguish each C.N. on the brain and to know the main function of each nerve

Spinal Cord

Protective Structures

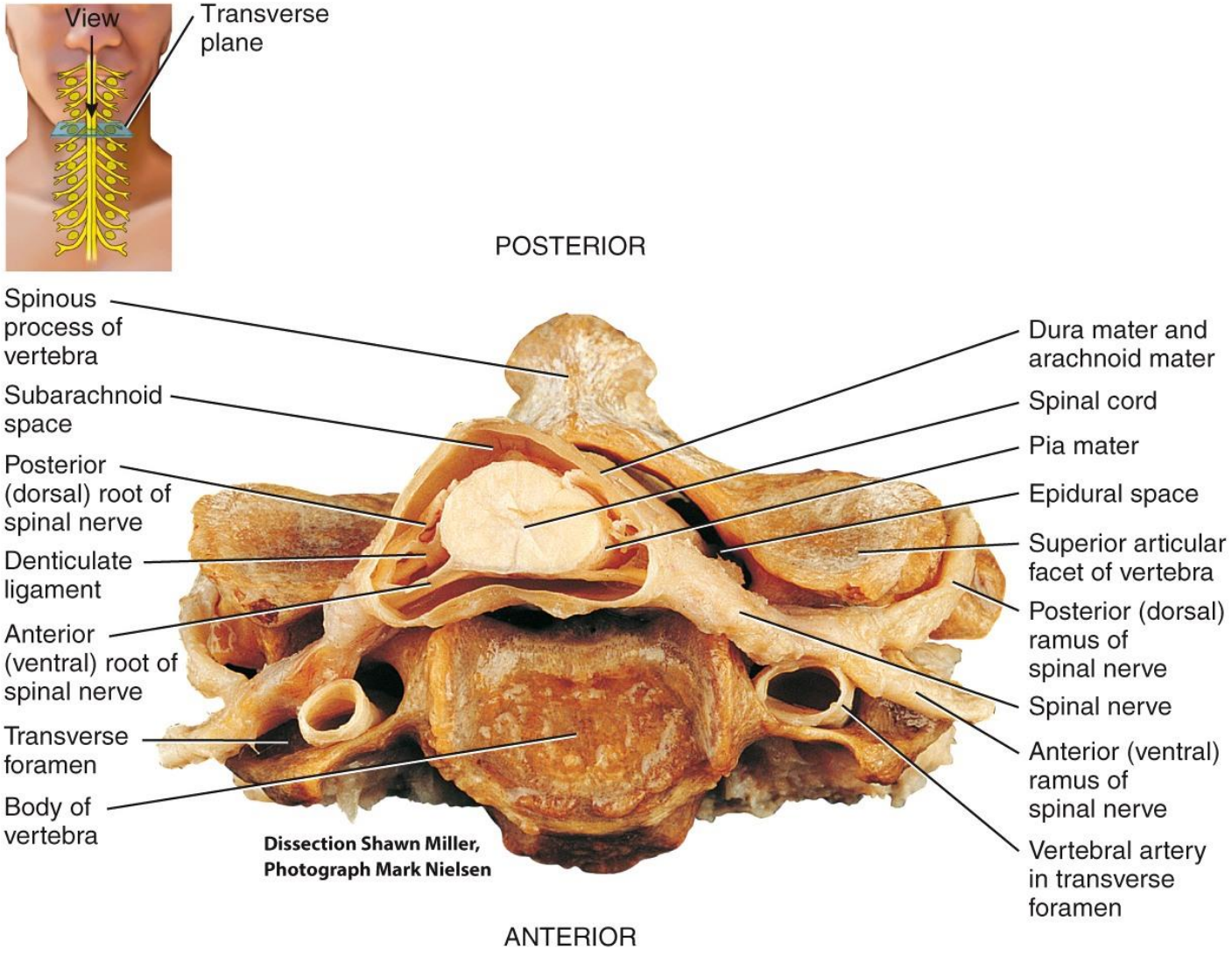
- Vertebral column
- Meninges:
  - Dura mater
  - Arachnoid mater
  - Pia mater

Gross Anatomy of the Spinal Cord



(a) Anterior view and transverse section through spinal cord

Gross Anatomy of the Spinal Cord



(b) Transverse section of the spinal cord within a cervical vertebra

External Anatomy of the Spinal Cord

- The length of the adult spinal cord is 42–45 cm.
- Its maximum diameter is about 1.5 cm in the lower cervical region.
- Cervical enlargement
- Lumbar enlargement
- Conus medullaris
- Filum terminale

Clinical Connection

Epidural anesthesia

Lumbar puncture

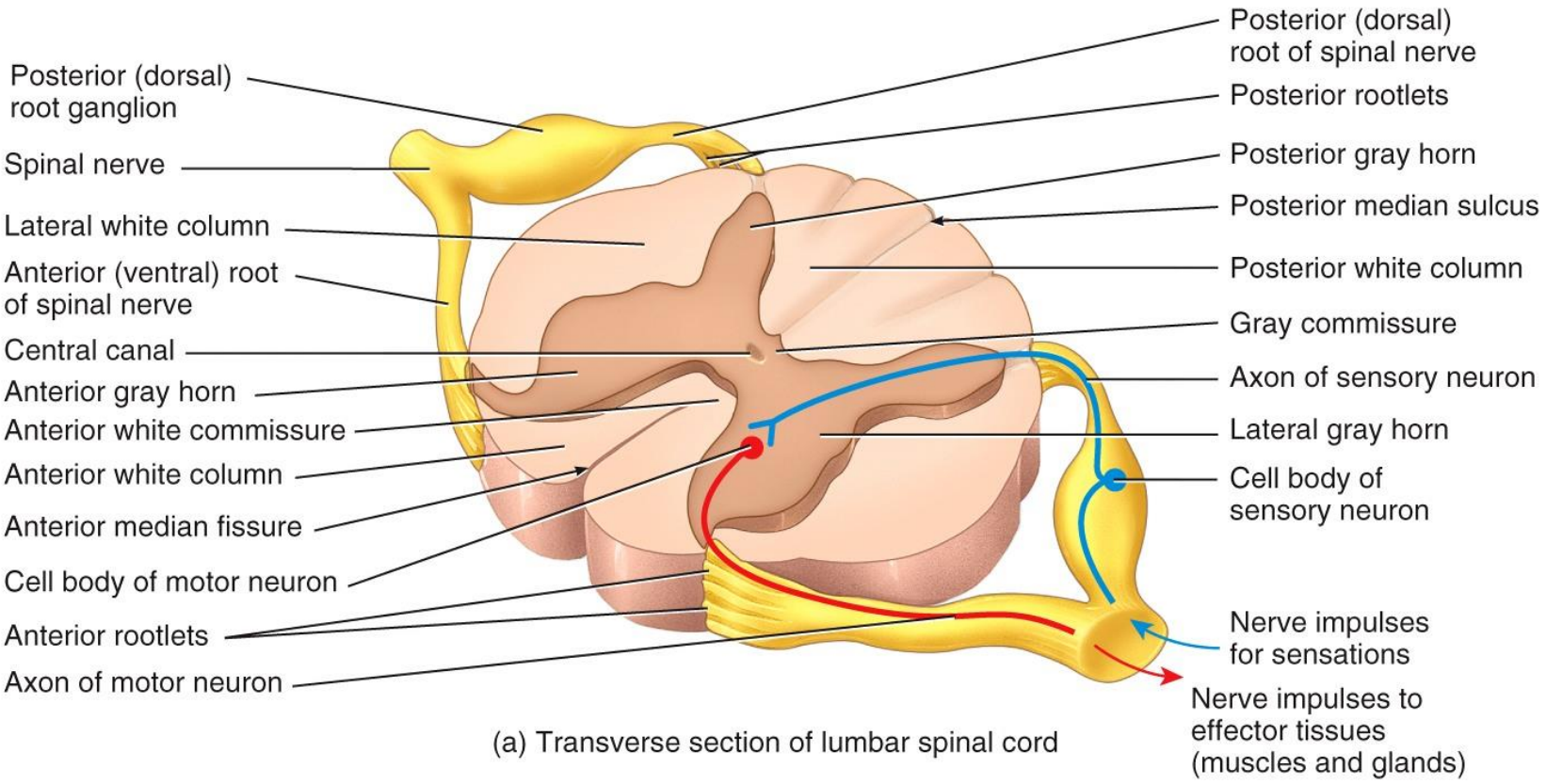
Internal Anatomy of the Spinal Cord

- In a cross section the following parts will can be seen:
- Anterior median fissure
- Posterior median sulcus
- Gray commissure
- Central canal
- Anterior (ventral) white commissure
- Horns
  - Anterior (ventral) gray horns
  - Posterior (dorsal) gray horns
  - Lateral gray horns

Internal Anatomy of the Spinal Cord

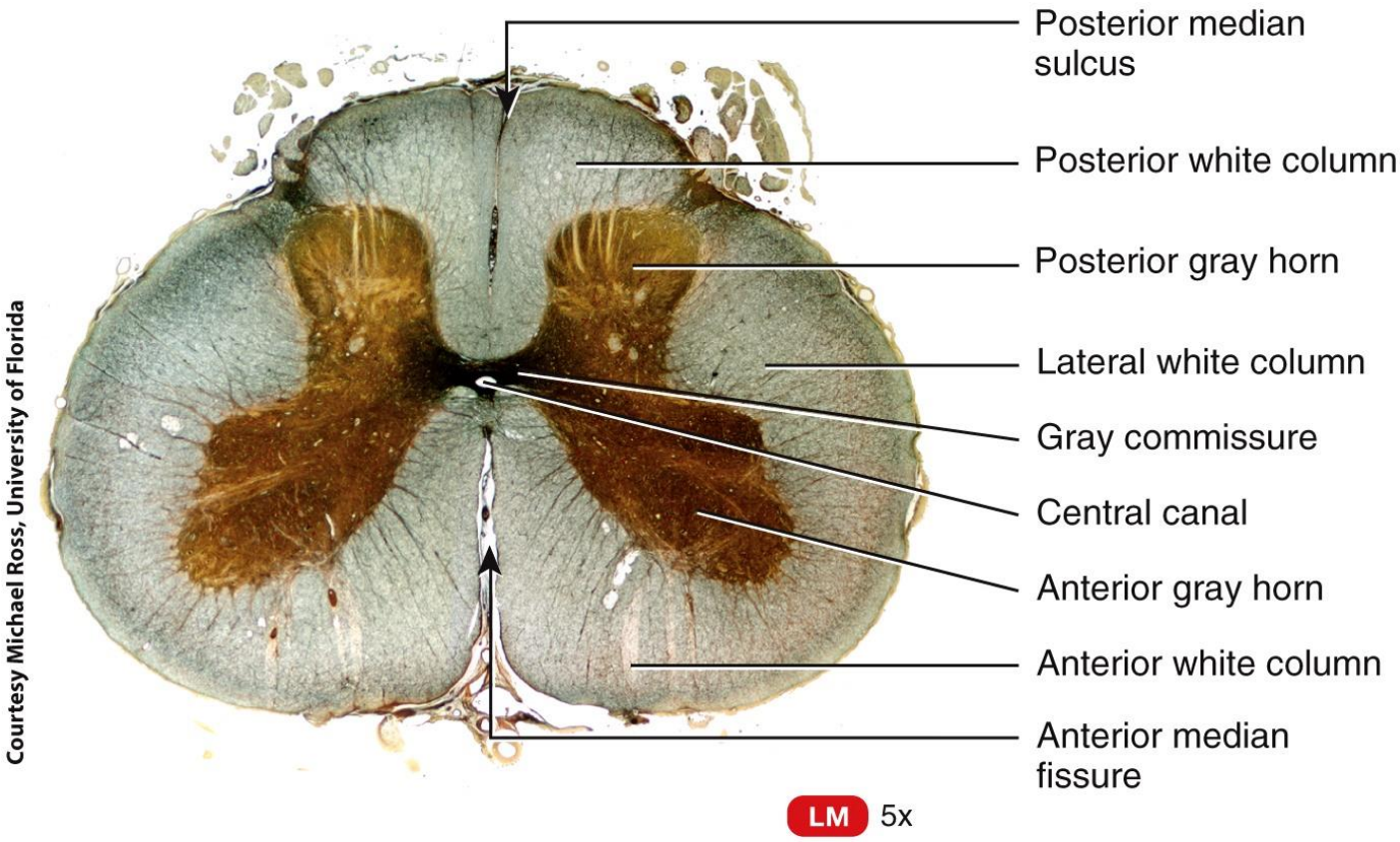
- Columns
  - Anterior (ventral) white columns
  - Posterior (dorsal) white columns
  - Lateral white columns

Internal Anatomy of the Spinal Cord: The Organization of Gray Matter and White Matter



(a) Transverse section of lumbar spinal cord

Internal Anatomy of the Spinal Cord: The Organization of Gray Matter and White Matter



(b) Transverse section of lumbar spinal cord

Peripheral nervous system (PNS)

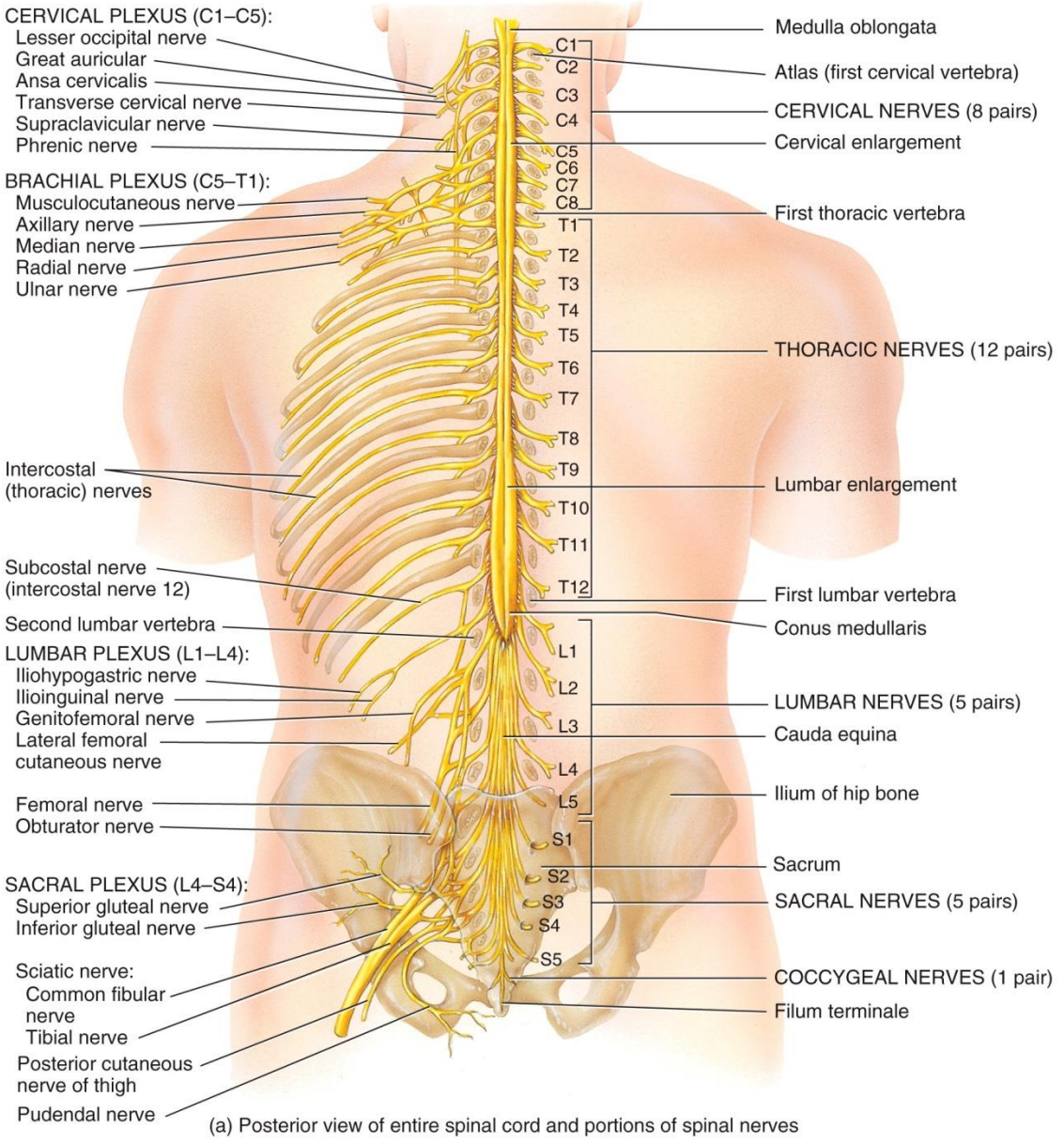
PNS

- PNS Includes:
- Spinal Nerves
  - 31 pairs of nerves that emerge from vertebral foramina
- Cranial Nerves
  - 12 pairs of nerves that pass through cranial foramina
  - numbered from I-XII
- *Nerve: a bundle of 100s to 1000s of axons and the connective tissue that covers them together

Spinal Nerves

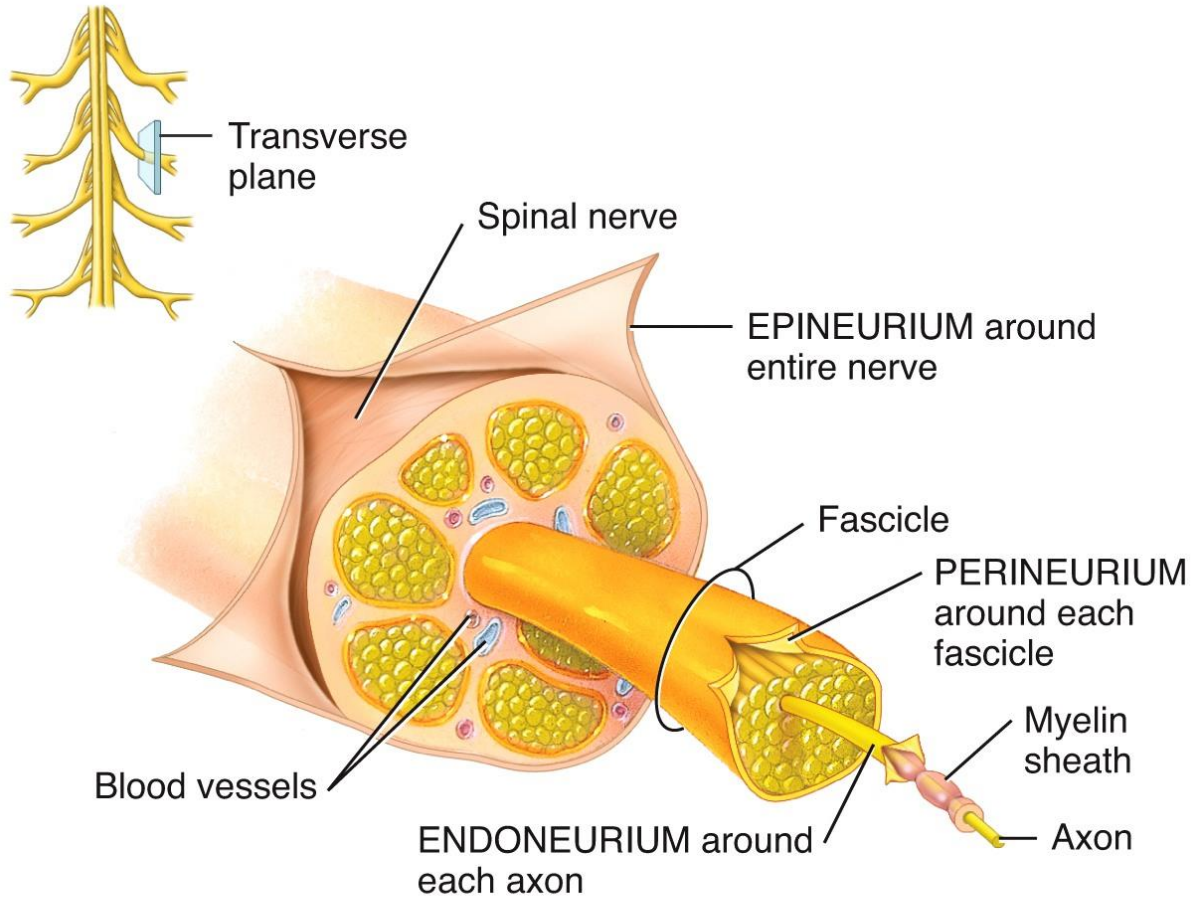
- Spinal nerves and the nerves that branch from them are part of the peripheral nervous system (PNS).
- They connect the CNS to sensory receptors, muscles, and glands in all parts of the body.

External Anatomy of the Spinal Cord and the Spinal Nerves



(a) Posterior view of entire spinal cord and portions of spinal nerves

Organization and Connective Tissue Coverings of a Spinal Nerve



(a) Transverse section showing the coverings of a spinal nerve

Organization of Spinal Nerves

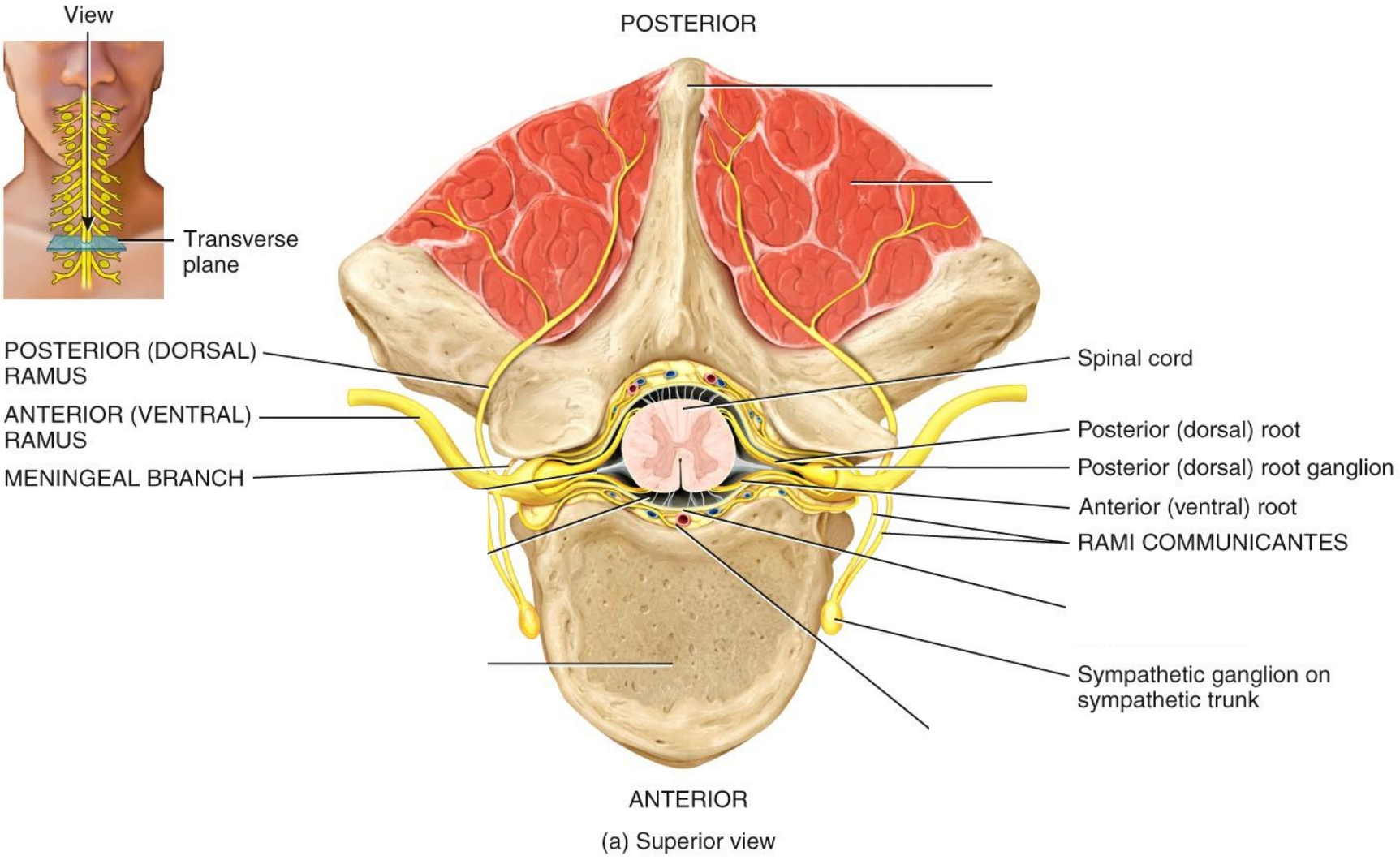
- Rootlets
- Anterior (ventral) roots
- Posterior (dorsal) roots
- Posterior (dorsal) root ganglion
- Spinal nerve trunk

Branches of the Spinal Nerves

- Posterior (dorsal) ramus
- Anterior (ventral) ramus
- Meningeal branch
- Rami communicantes

- Rami (singular = ramus)

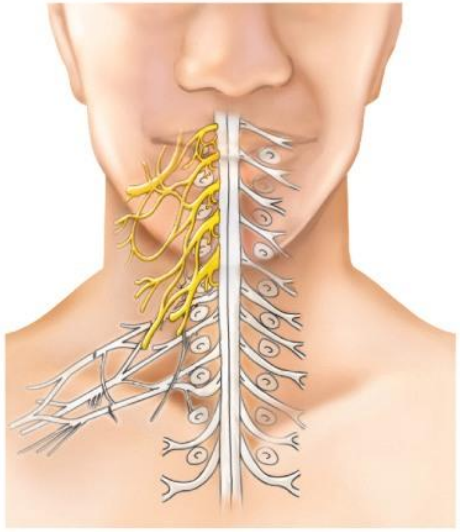
Branches of a Typical Spinal Nerve



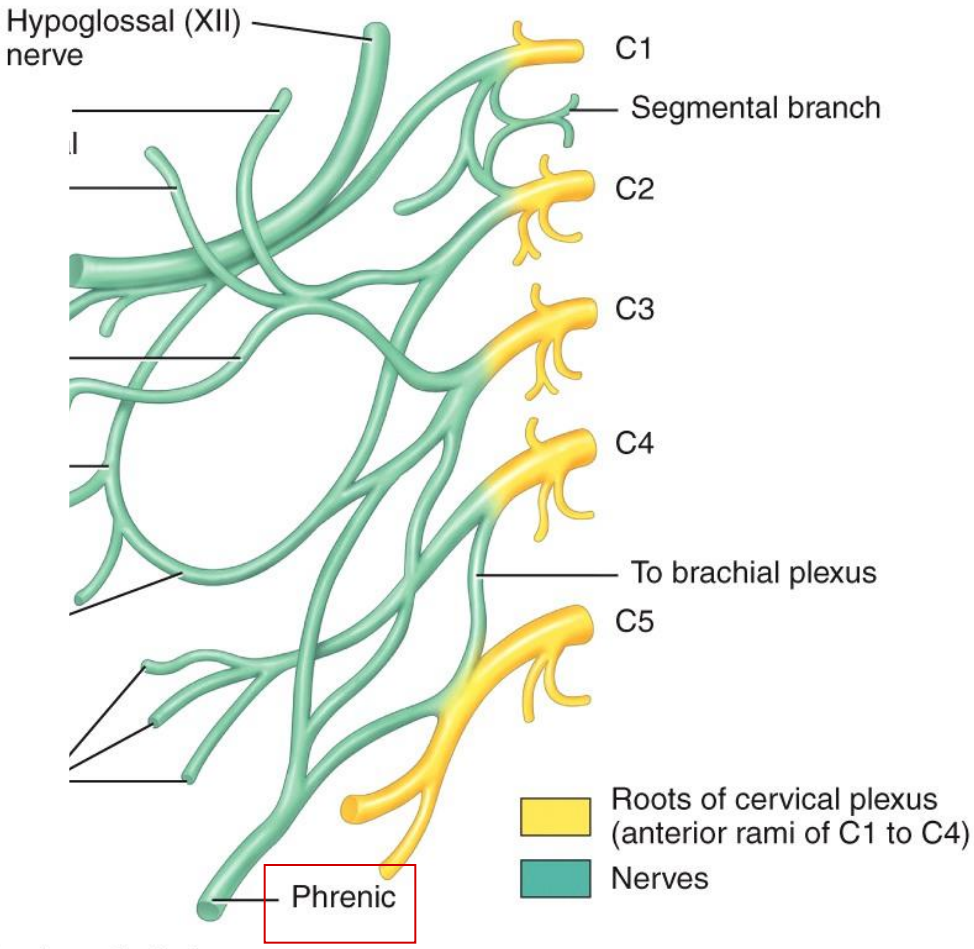
Plexuses

- Axons from the anterior rami of spinal nerves, except for thoracic nerves T2–T12, form networks on both left and right sides of the body. Each network is called a plexus.
- The principal plexuses are the cervical plexus, brachial plexus, lumbar plexus, and sacral plexus.
- A smaller coccygeal plexus is also present.
- Groups of nerves emerge from the plexuses.

Cervical Plexus in Anterior View

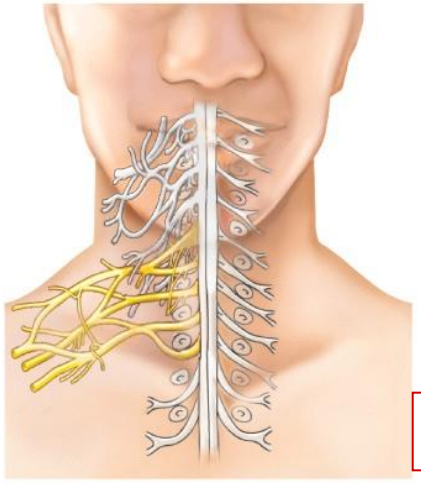


Cervical plexus projected to surface

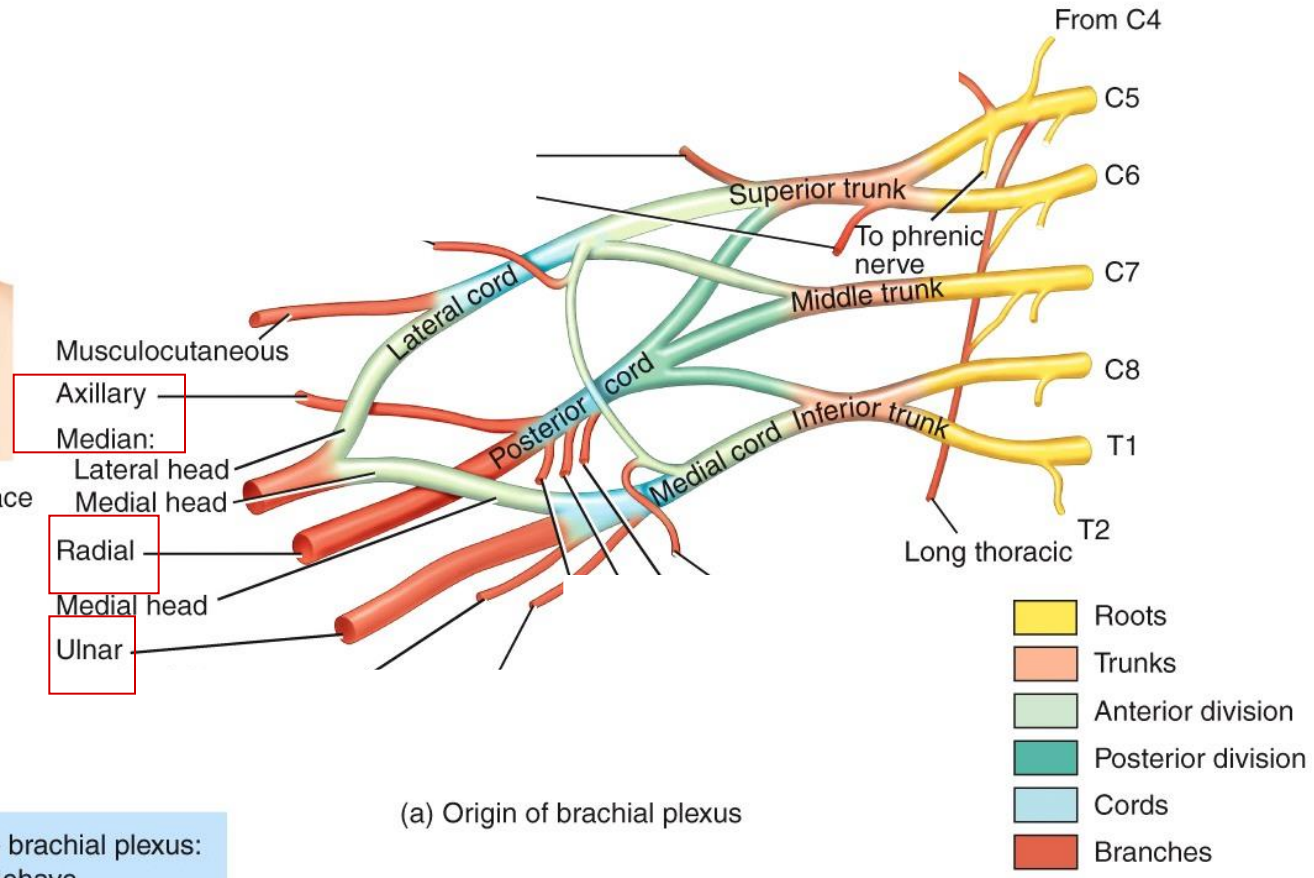


(a) Origin of cervical plexus

Brachial Plexus in Anterior View



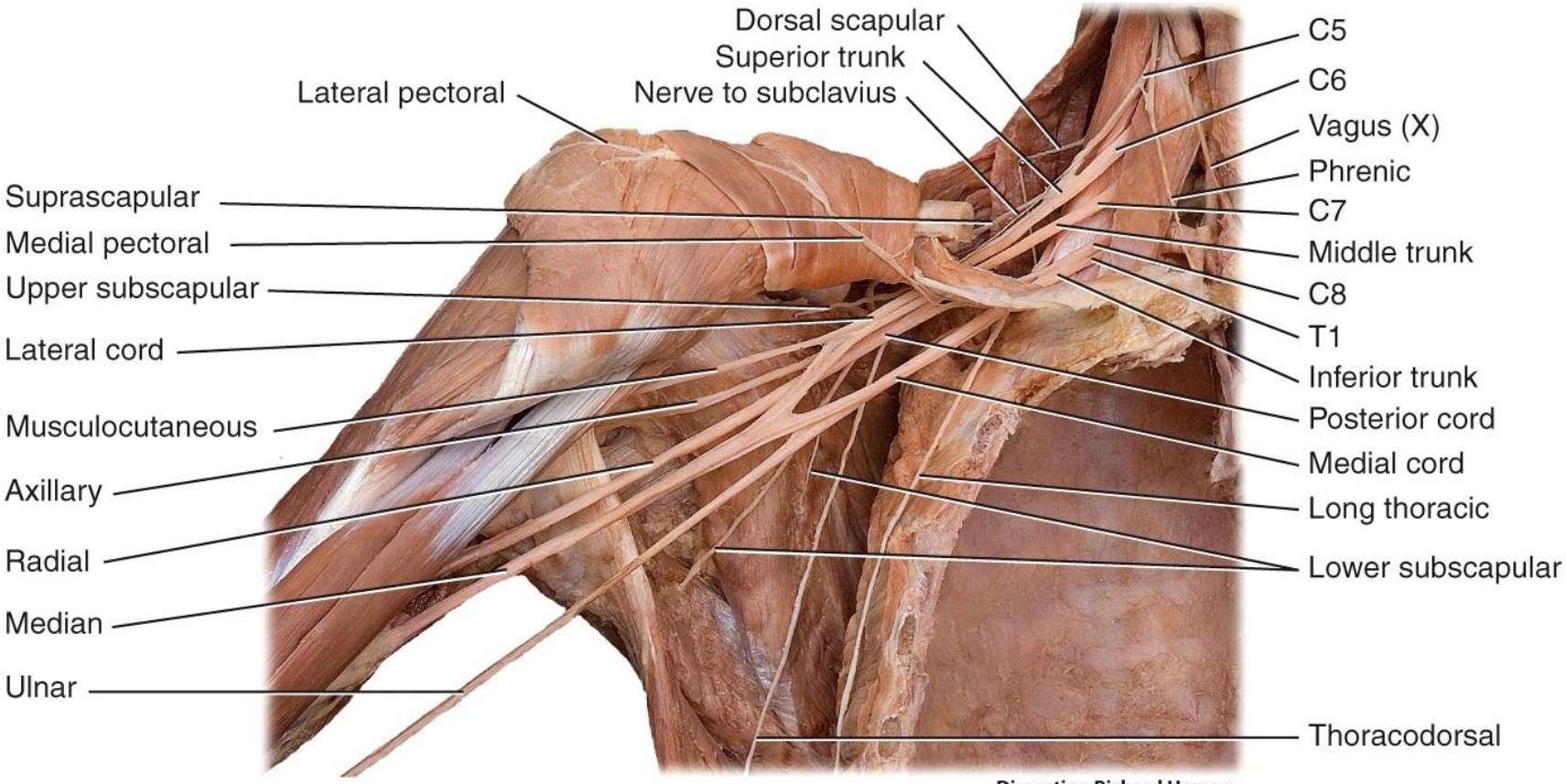
Brachial plexus projected to surface



(a) Origin of brachial plexus

MNEMONIC for subunits of the brachial plexus:
Risk **T**akers **D**on't **C**autiously **B**ehave.
Roots, **T**runks, **D**ivisions, **C**ords, **B**ranches

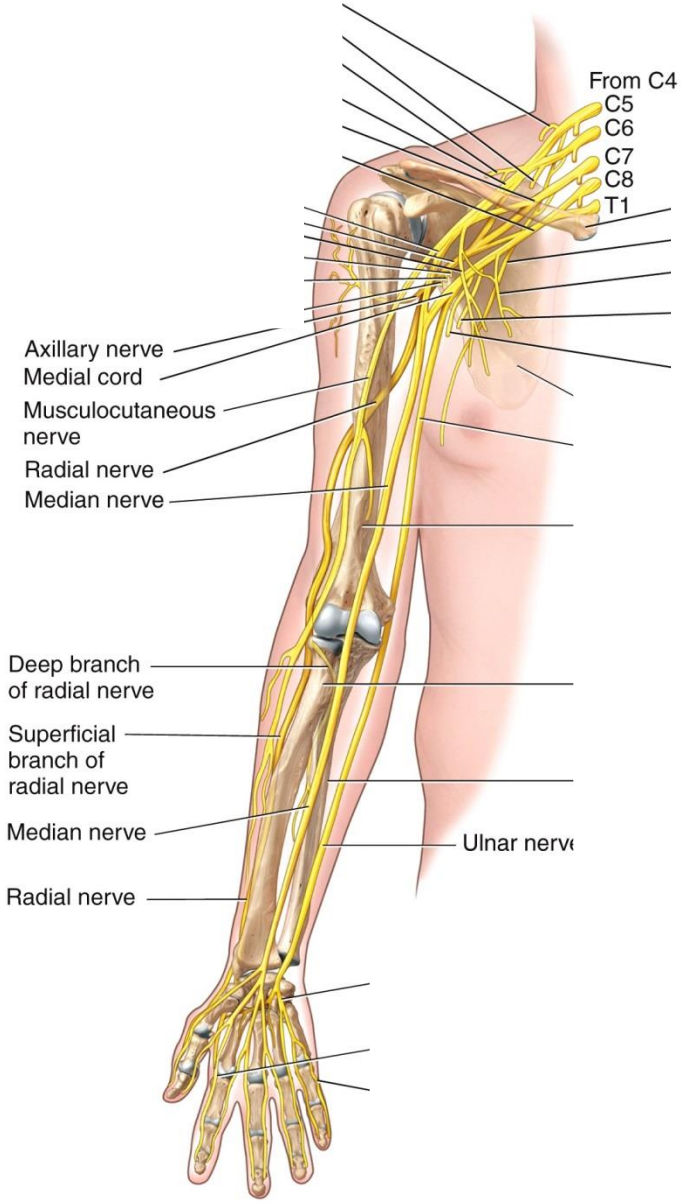
Brachial Plexus in Anterior View



(b) Anterior view of brachial plexus

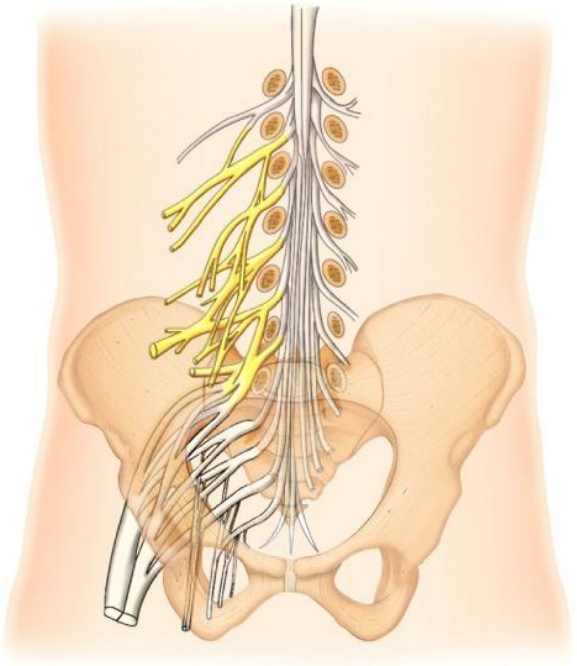
Dissection Richard Homer; Photograph Mark Nielsen

Brachial Plexus in Anterior View

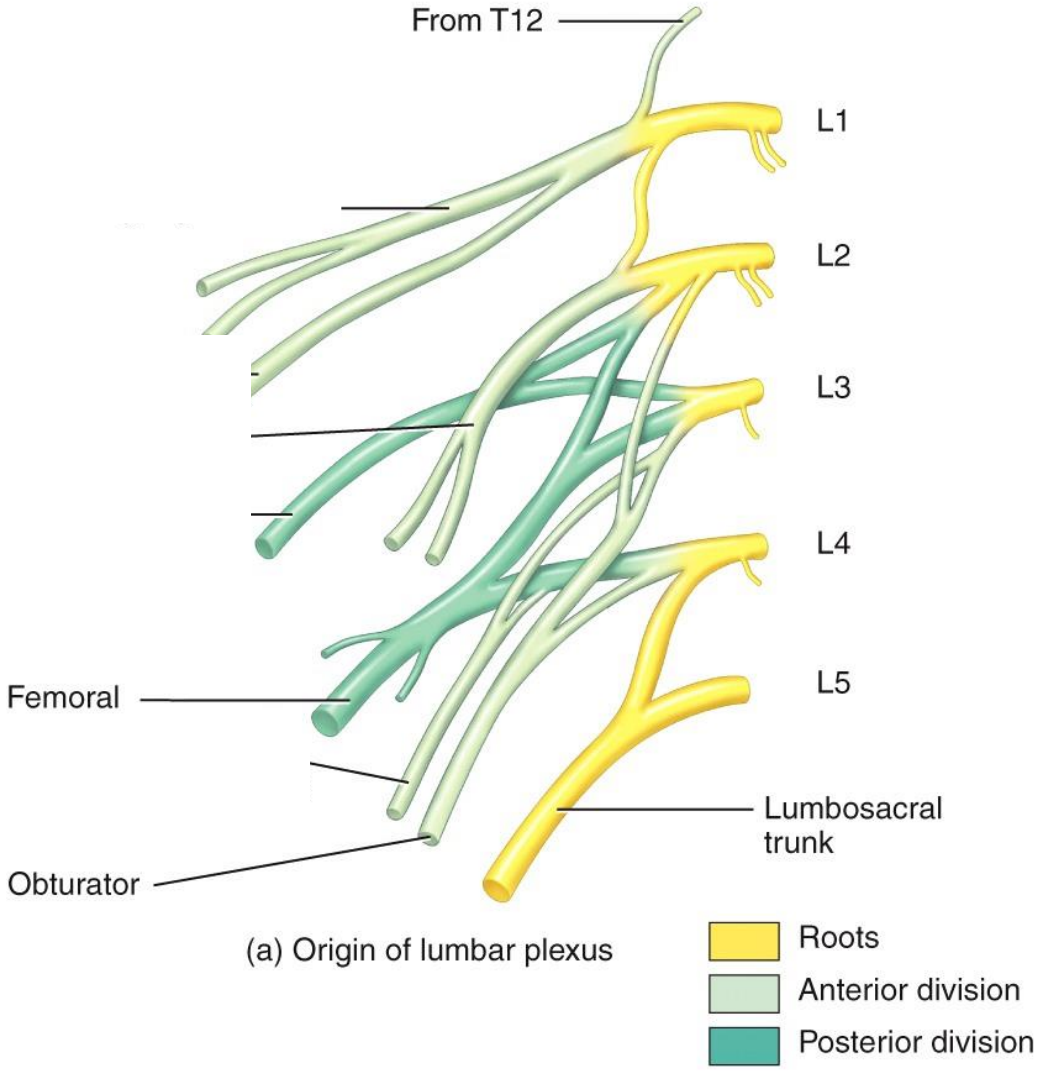


(c) Distribution of nerves from brachial plexus

Lumbar Plexus in Anterior View

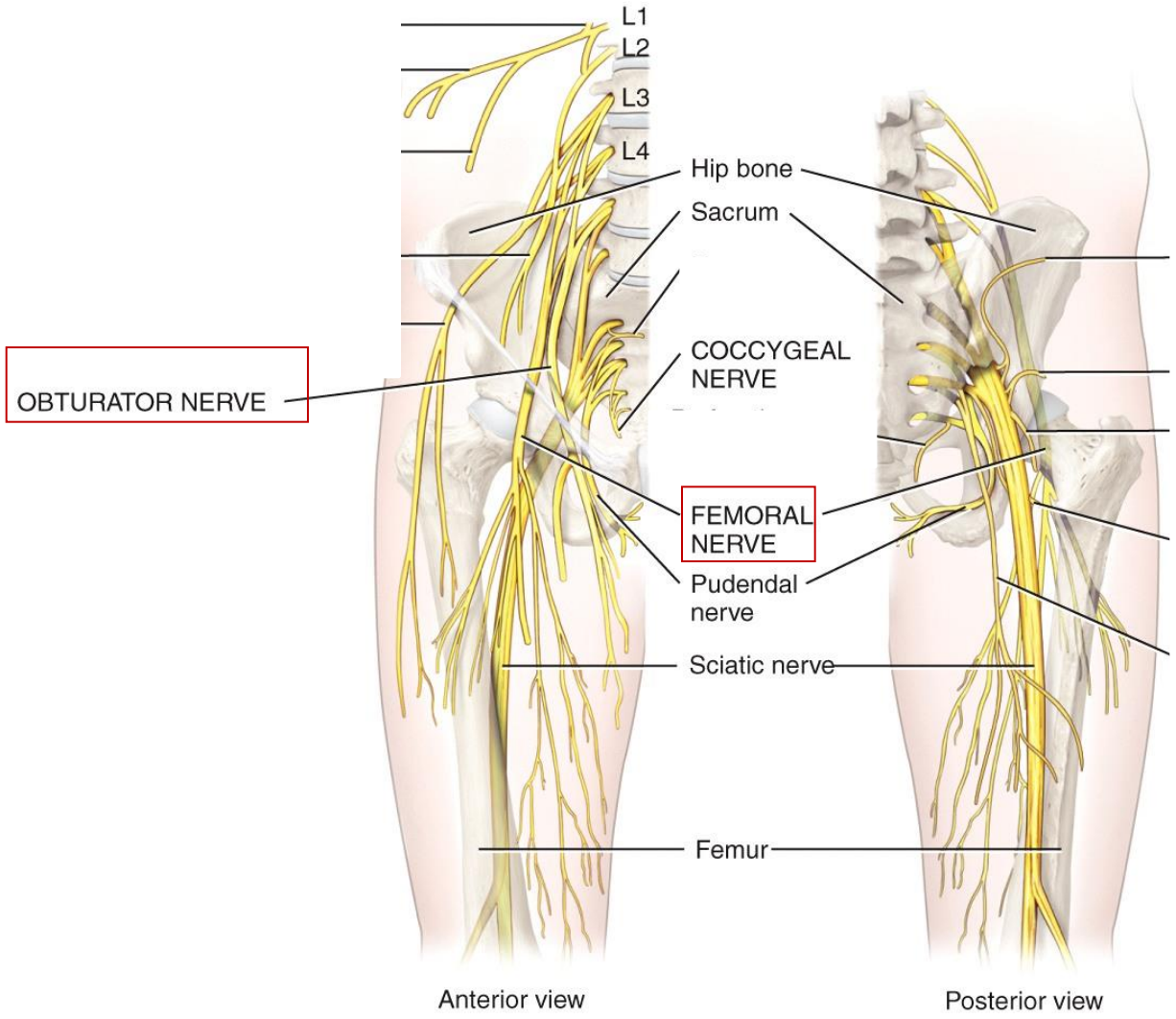


Lumbar plexus projected to surface



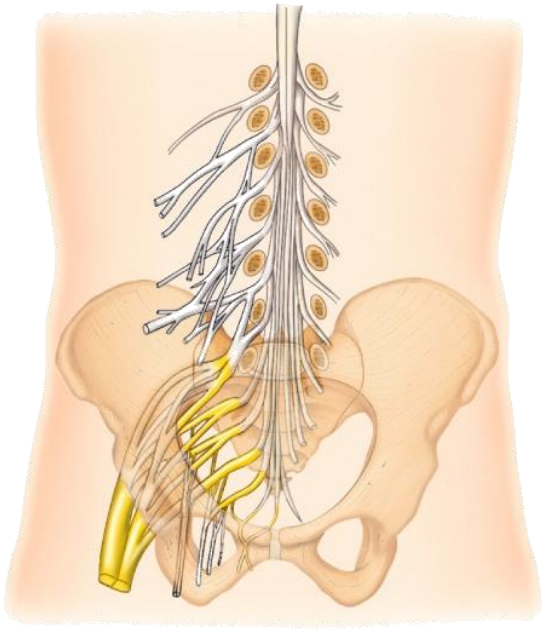
(a) Origin of lumbar plexus

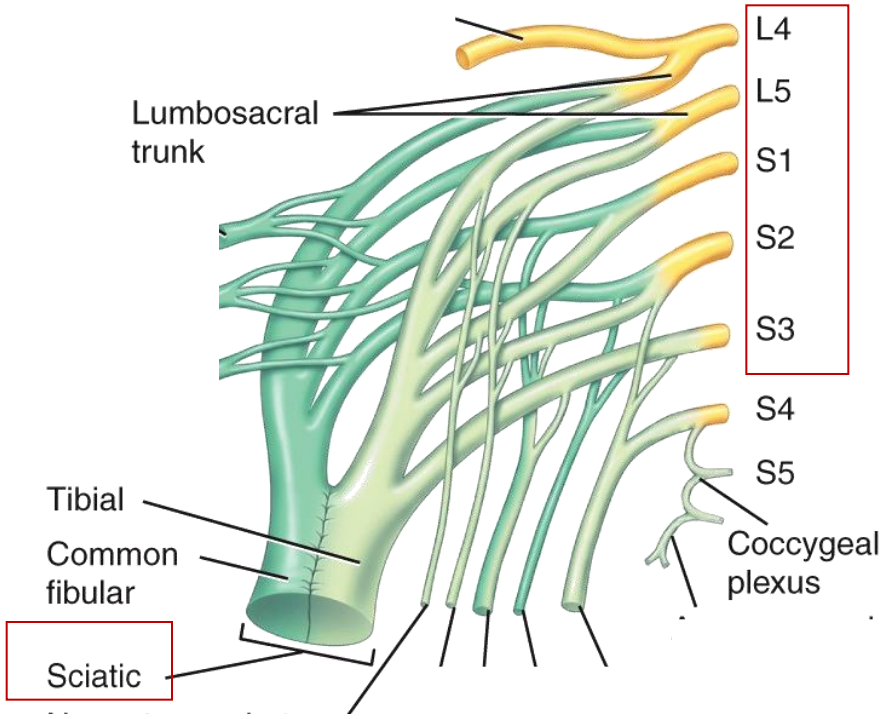
Lumbar Plexus in Anterior View



(b) Distribution of nerves from lumbar plexus

Sacral and Coccygeal Plexuses in Anterior View

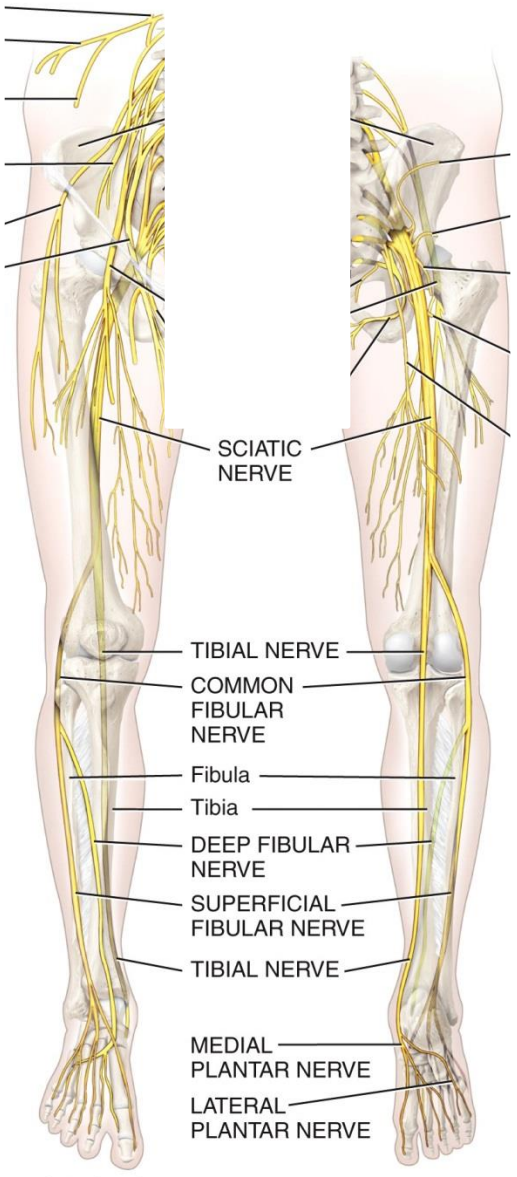




Sacral and coccygeal plexuses projected to surface

(a) Origin of sacral and coccygeal plexuses

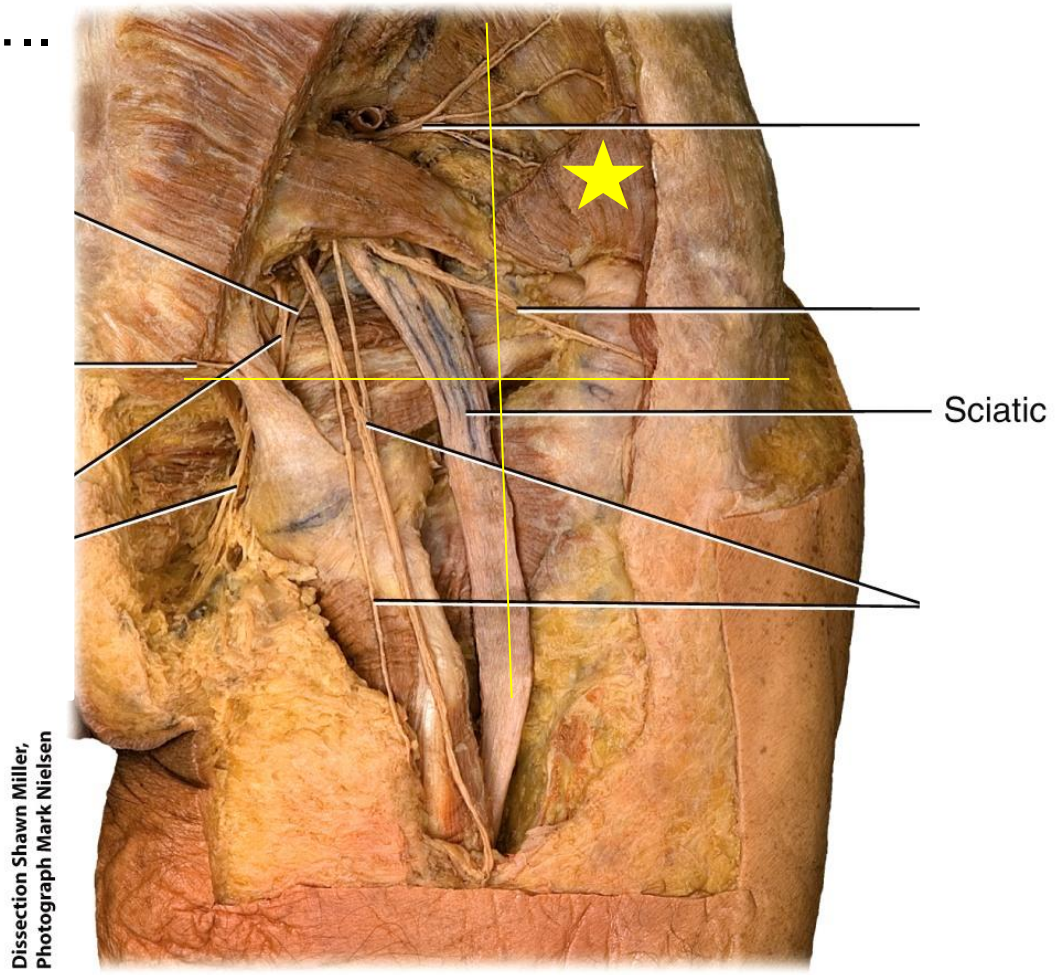
Sacral Plexuses: Sciatic nerve



(b) Distribution of nerves from the sacral and coccygeal plexuses

Sciatic Nerve

To avoid sciatic nerve injury the site of i.m injection should be…..
In the …..

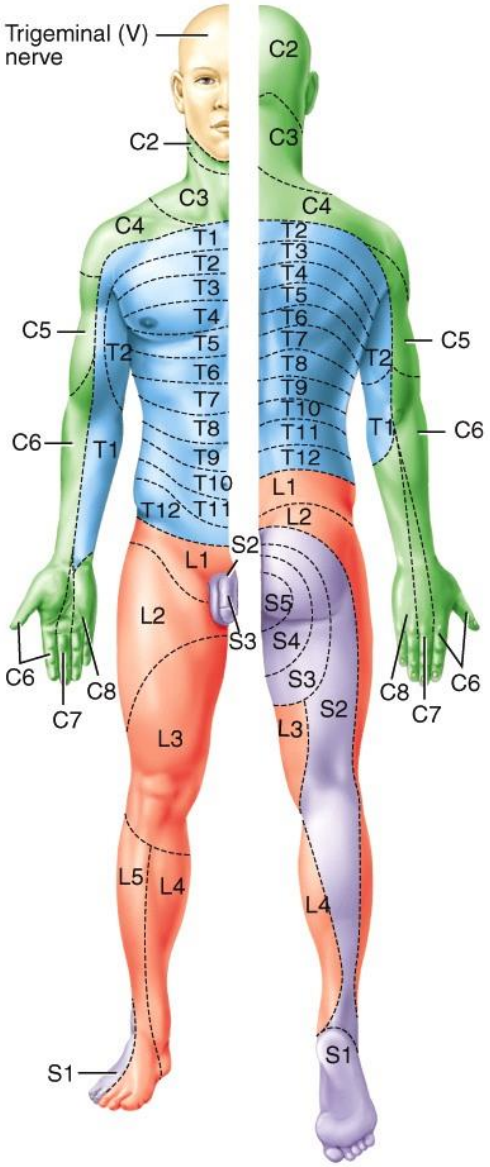


(c) Posterior view of sacral plexus in right gluteal region

Dermatomes versus Cutaneous Fields

- Each spinal nerve contains sensory neurons that serve a specific, predictable segment of the body.
- Dermatomes are the areas of the skin that provides sensory input to the CNS via one pair of spinal nerves.
- Knowing which spinal cord segments supply each dermatome makes it possible to locate damaged regions of the spinal cord.
- The nerve supply in adjacent dermatomes overlaps somewhat.

Distribution of Dermatomes and Cutaneous Fields



(a) Distribution of dermatomes

Clinical Connection

- Shingles:

Shingles is caused by the varicella-zoster virus — the same virus that causes chickenpox

Reflexes and Reflex Arcs

- Reflexes:
  - Spinal reflex
  - Cranial reflex
  - Somatic reflex
  - Autonomic (visceral) reflex

Reflex and Reflex Arc

- Components of a reflex arc
  - Sensory receptor
  - Sensory neuron
  - Integrating center
  - Motor neuron
  - Effector

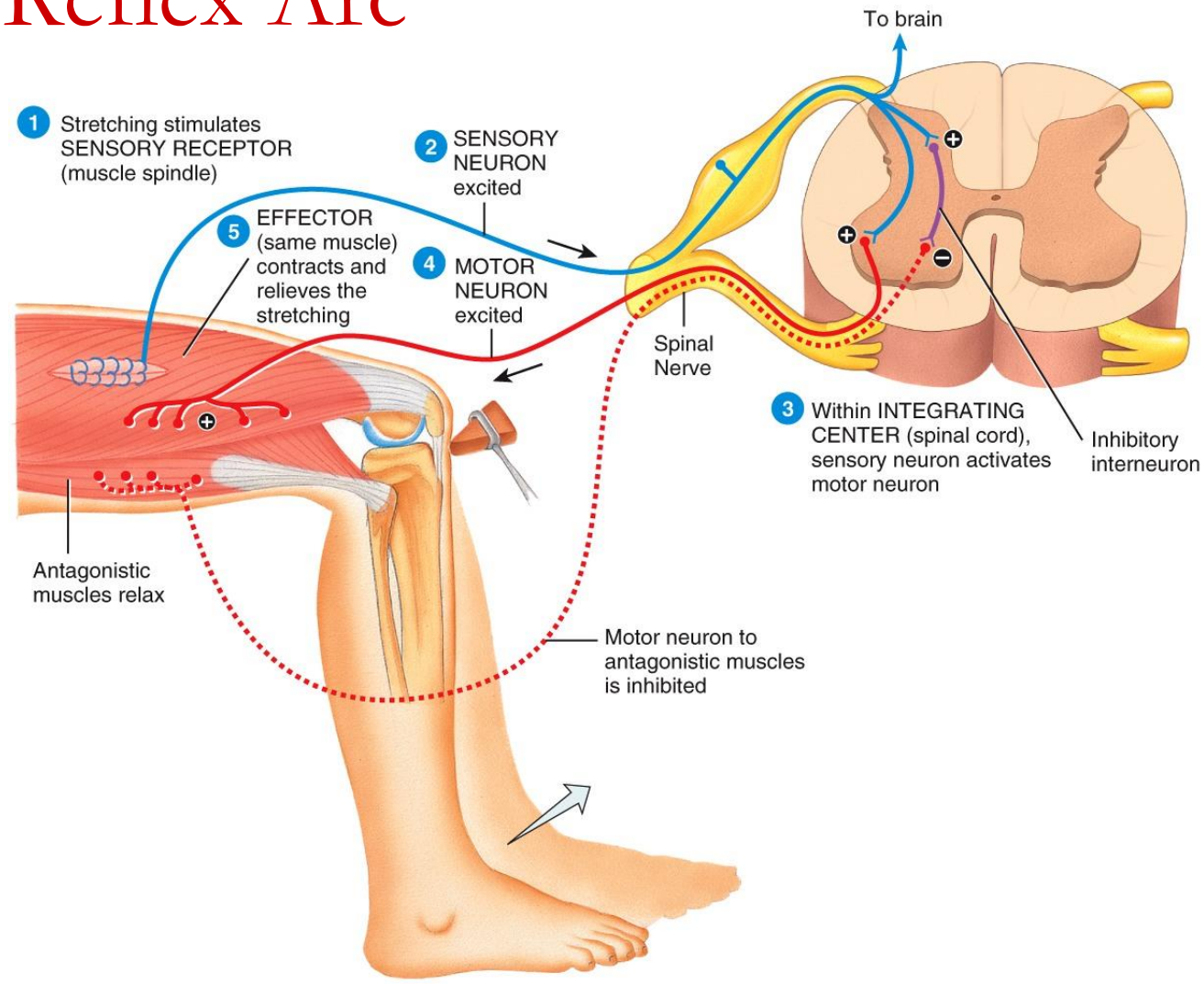
Reflexes

Interactions Animation

- Spinal Somatic Reflexes

You must be connected to the internet to run this animation.

Patellar Reflex Showing Components of a Reflex Arc



CRANIAL NERVES

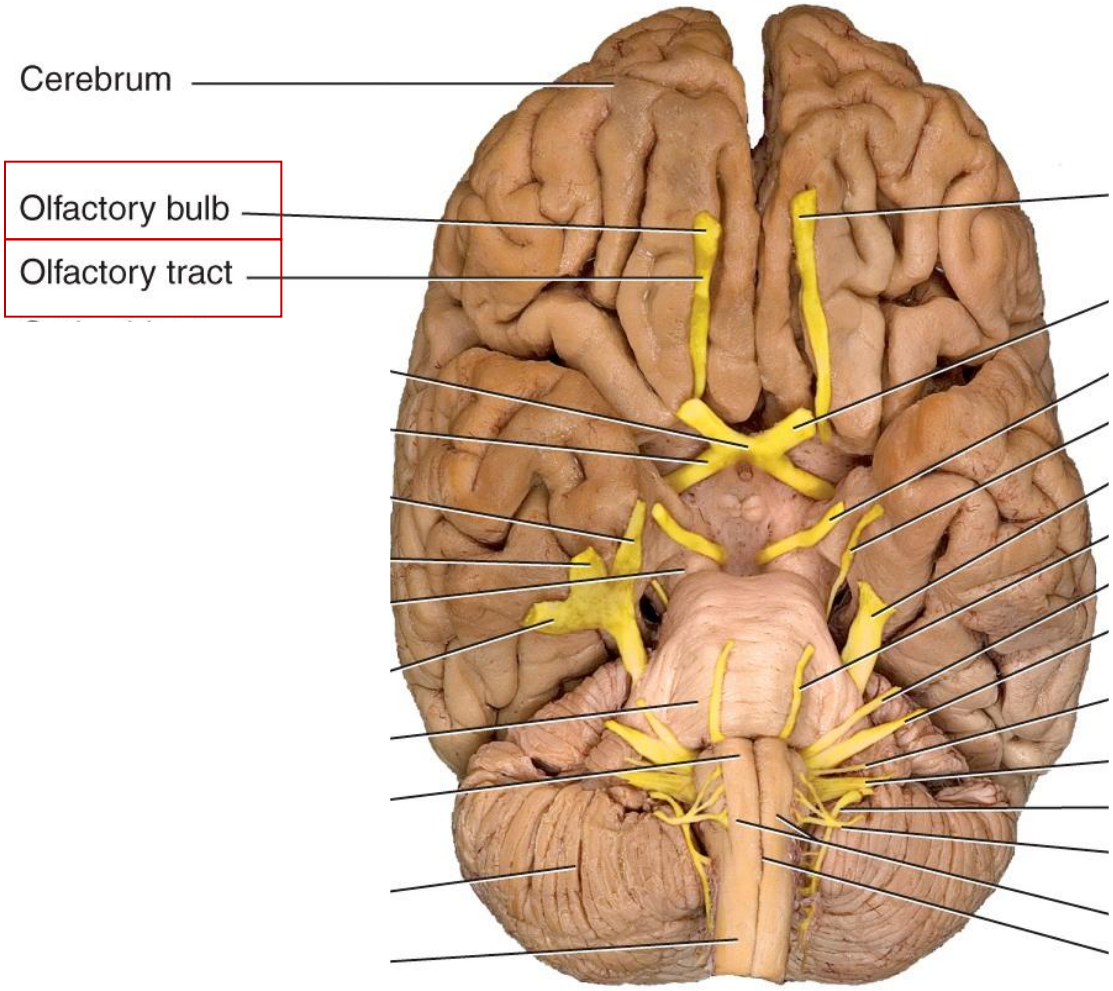
Cranial Nerves

- Cranial Nerves
- 12 pairs of nerves that pass through cranial foramina (hence the name)
- They are part of PNS
- Numbered in order as they arise from Ant. to Post. aspect of the brain
- I is more ant. than II > III …etc

Cranial Nerve I

- Olfactory (I) nerve
  - Olfactory bulbs
  - Olfactory tracts

Cranial Nerves I and II



Dissection Shawn Miller, Photograph Mark Nielsen

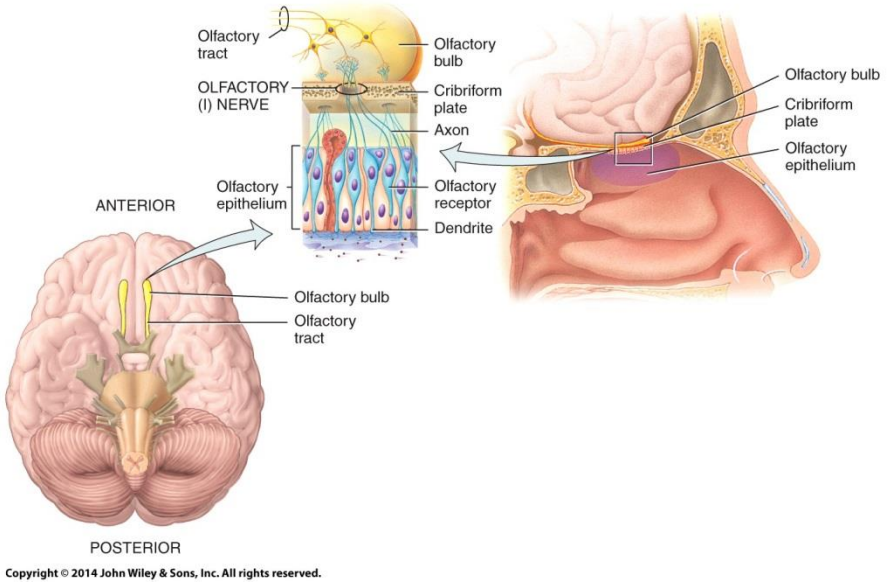
(a) Inferior aspect of brain

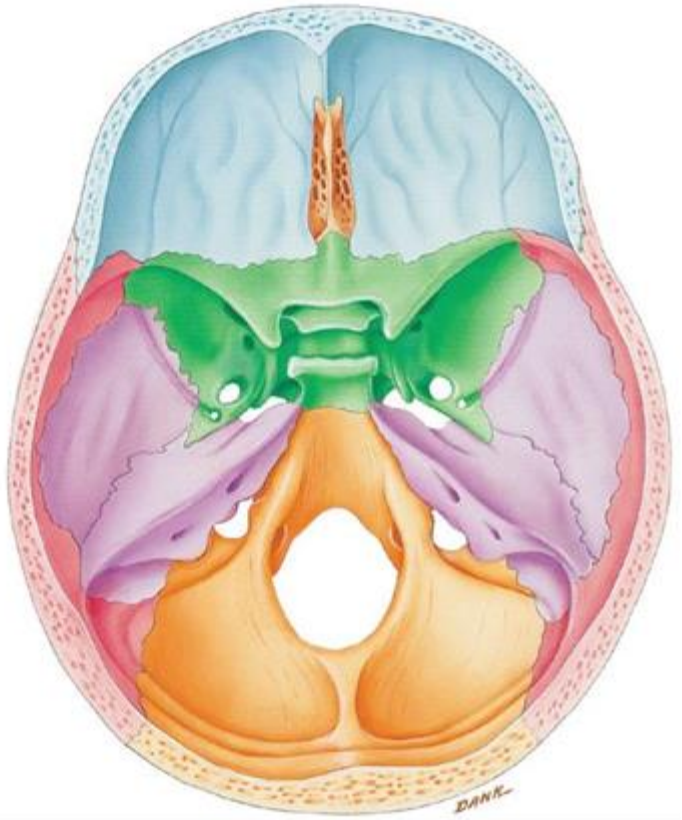
Olfactory (I) Nerve

- Entirely sensory
- Conduct the sense of smell

Olfactory axons extend through cribriform plate of ethmoid & gather in olfactory bulbs where they synapse

Axons of second neurons pass through olfactory tracts to temporal lobe





Location of Cranial Nerves I and II

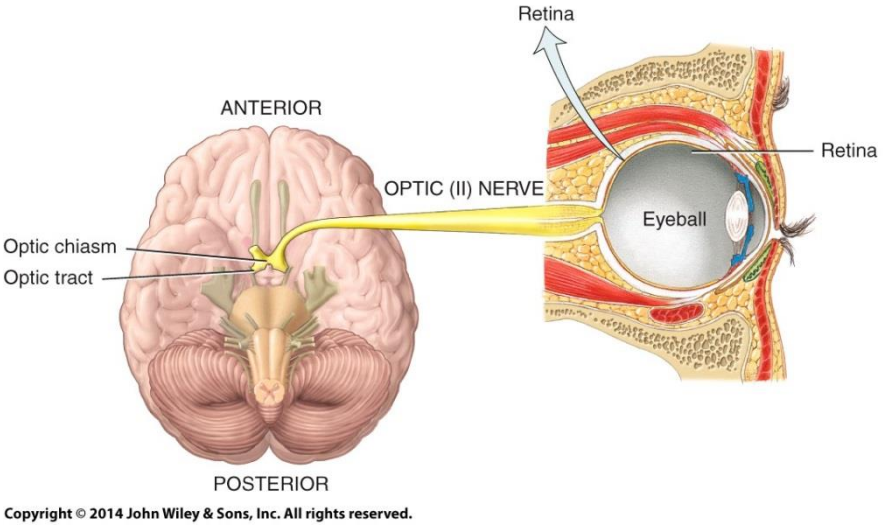
- Optic (II) nerve
  - Optic chiasm
  - Optic tracts

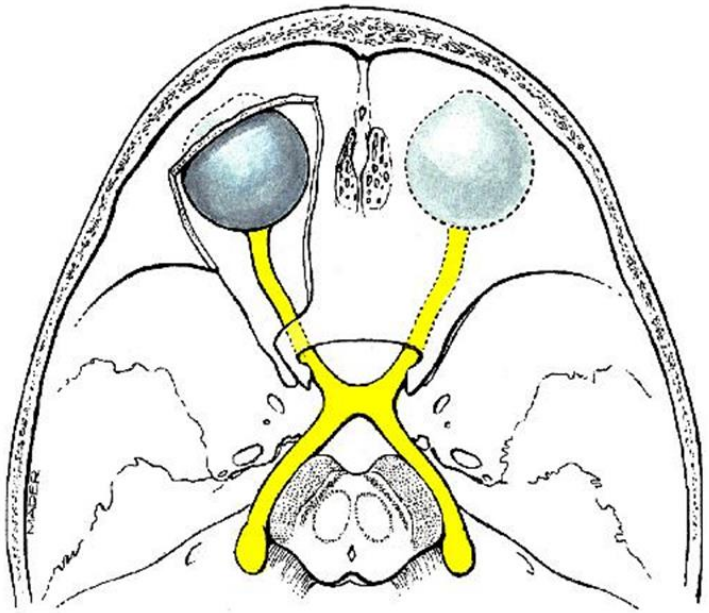
Optic (II) Nerve

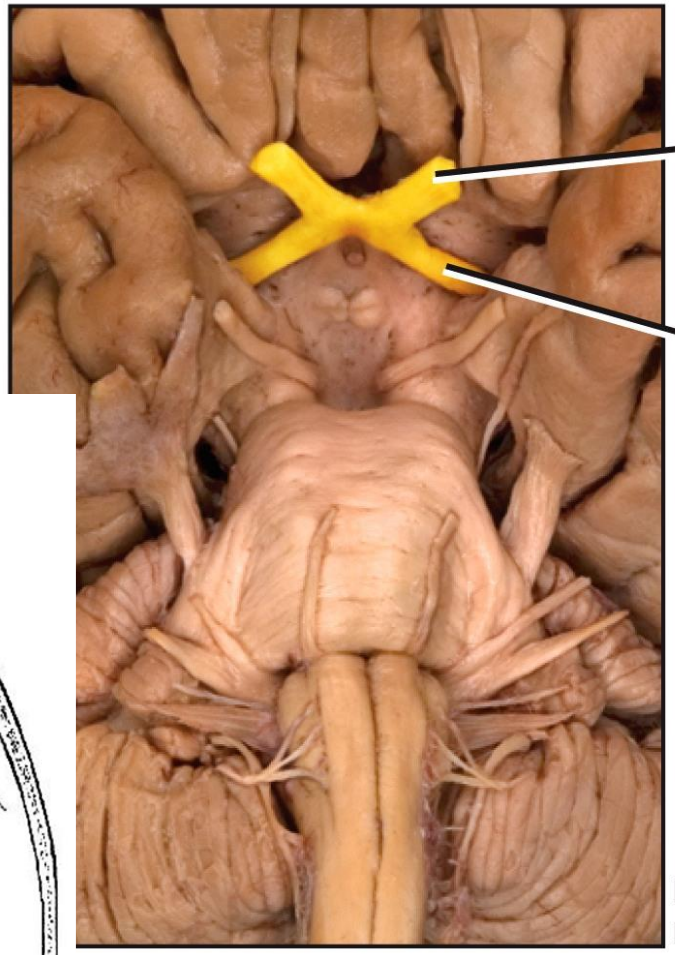
- Special sensory
- Conduct the sense of vision

Axons extend from sensory receptors in the retina to form the optic nerve, then pass through optic foramen

Optic nerves from both sides crossover posterior to the orbit to form optic chiasma

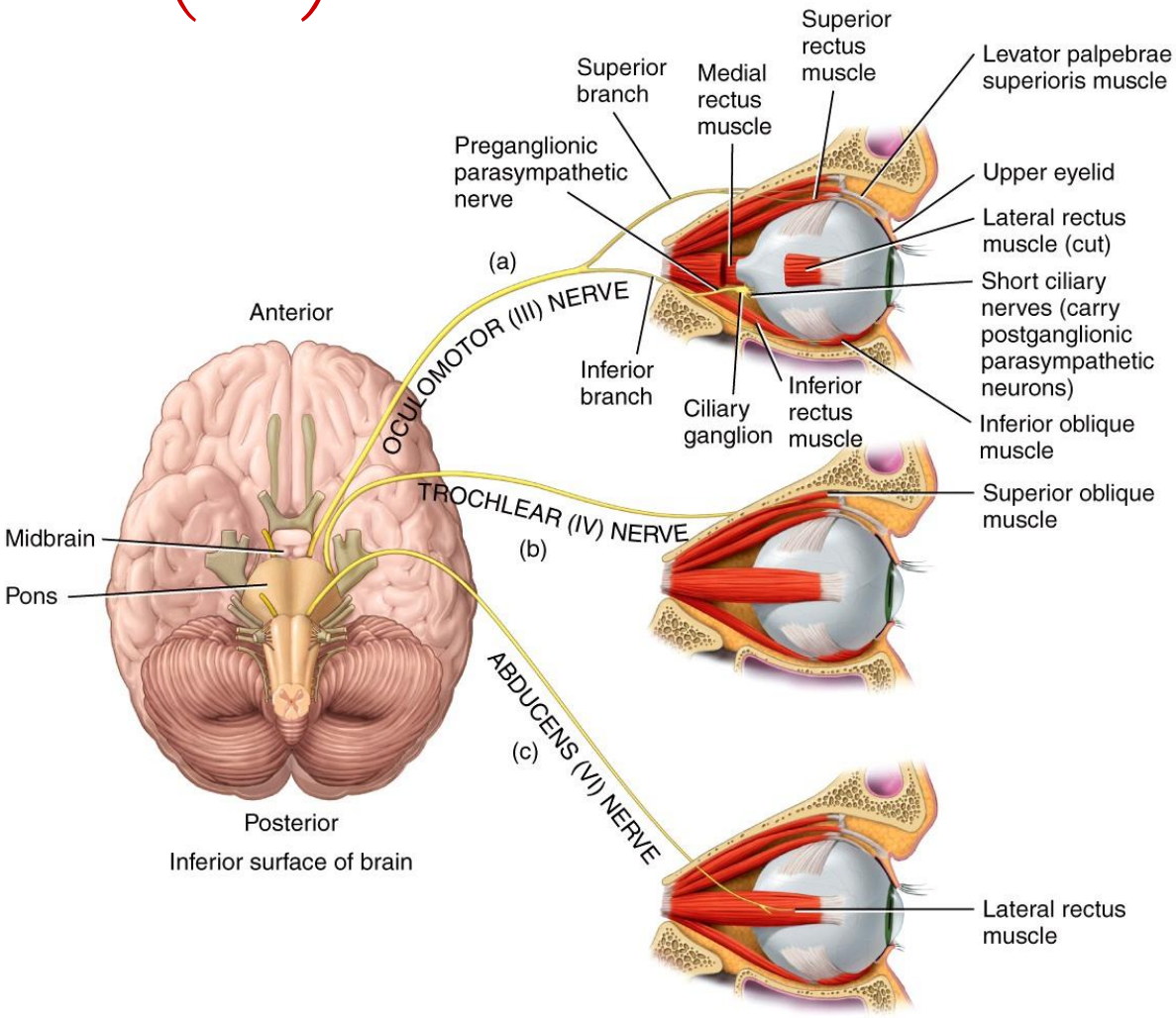






Dissection Shawn Miller, Photograph Mark Nielsen

Oculomotor (III), Trochlear (IV), and Abducens (VI) Nerves



Oculomotor (III)

Mixed

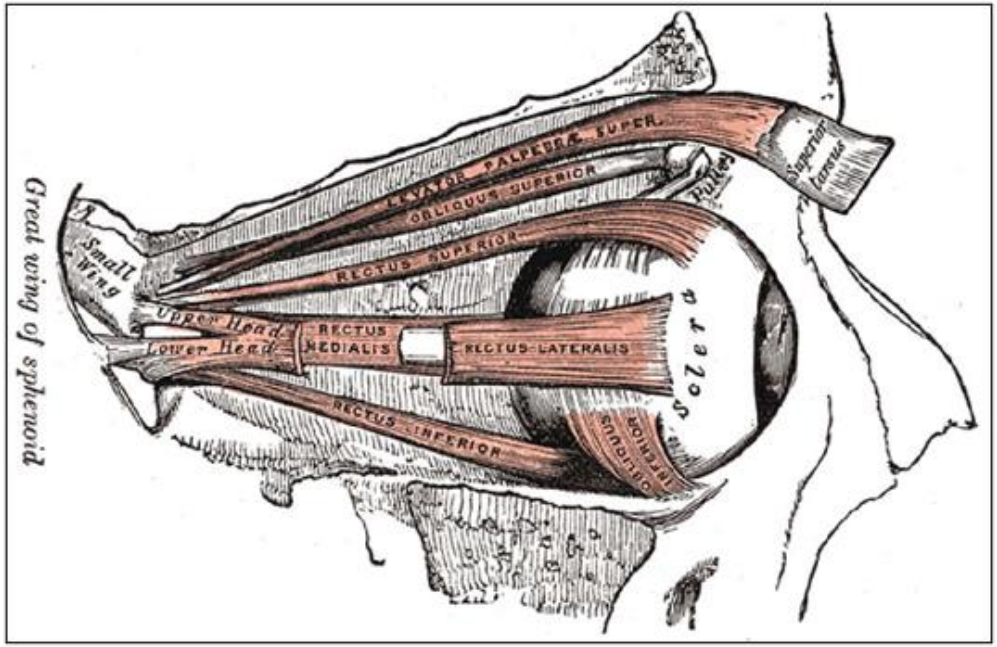
Divides into sup. & inf. branches before it pass through superior orbital fissure to the orbit

Supply extrinsic muscles of the eye except: Superior oblique (SO) & lateral rectus (LR)

Muscles of The Orbit

7 muscles:

- Levator palpebrae superioris
- 4 recti muscles
- Sup. & Inf. obliques



Trochlear (IV)

Motor

The smallest C.N.

Pass through superior orbital fissure to supply:
Superior Oblique muscle
(SO4)

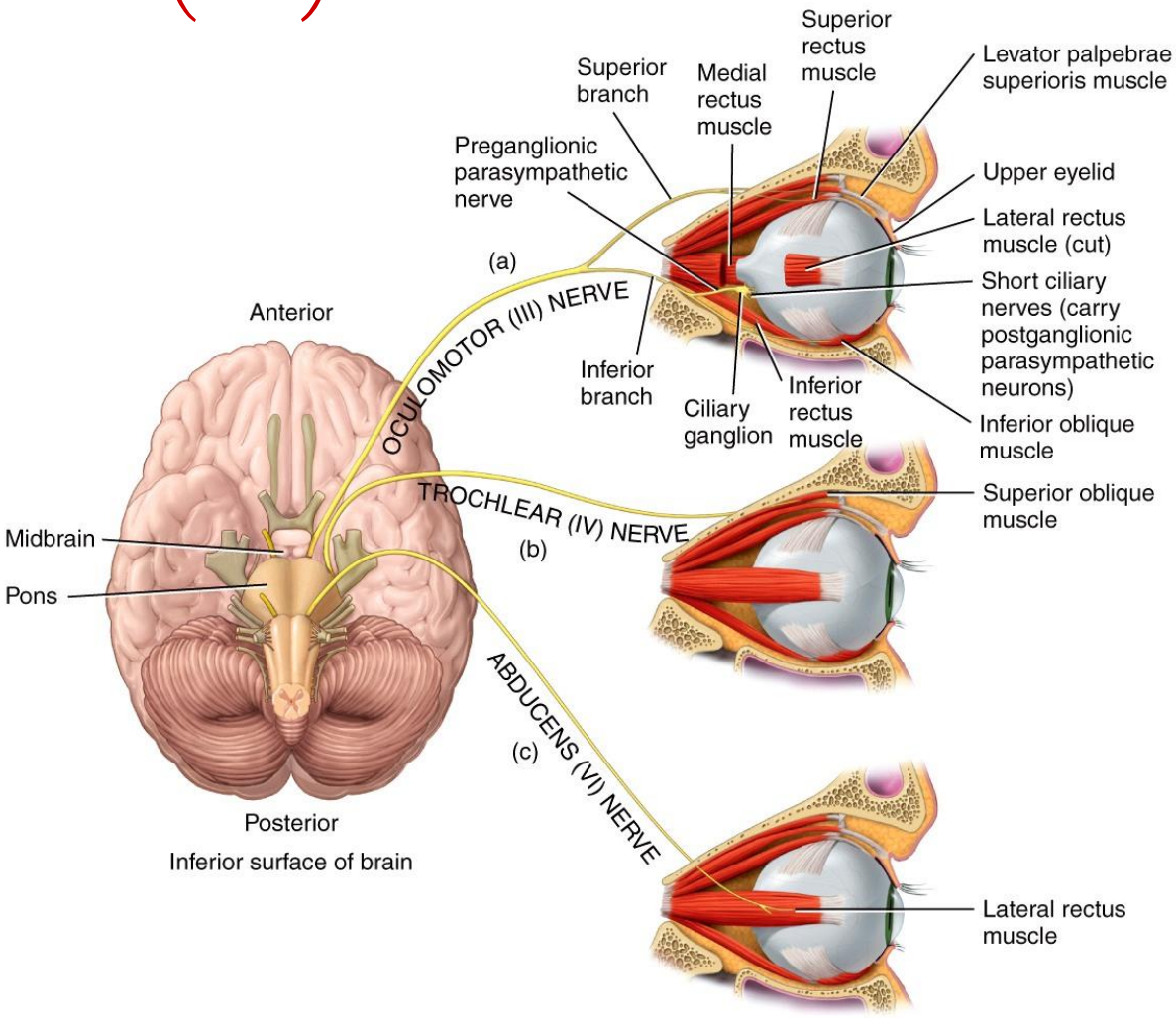
Abducens (VI)

Motor

Pass through superior orbital fissure
supply: Lateral Rectus muscle (LR6)

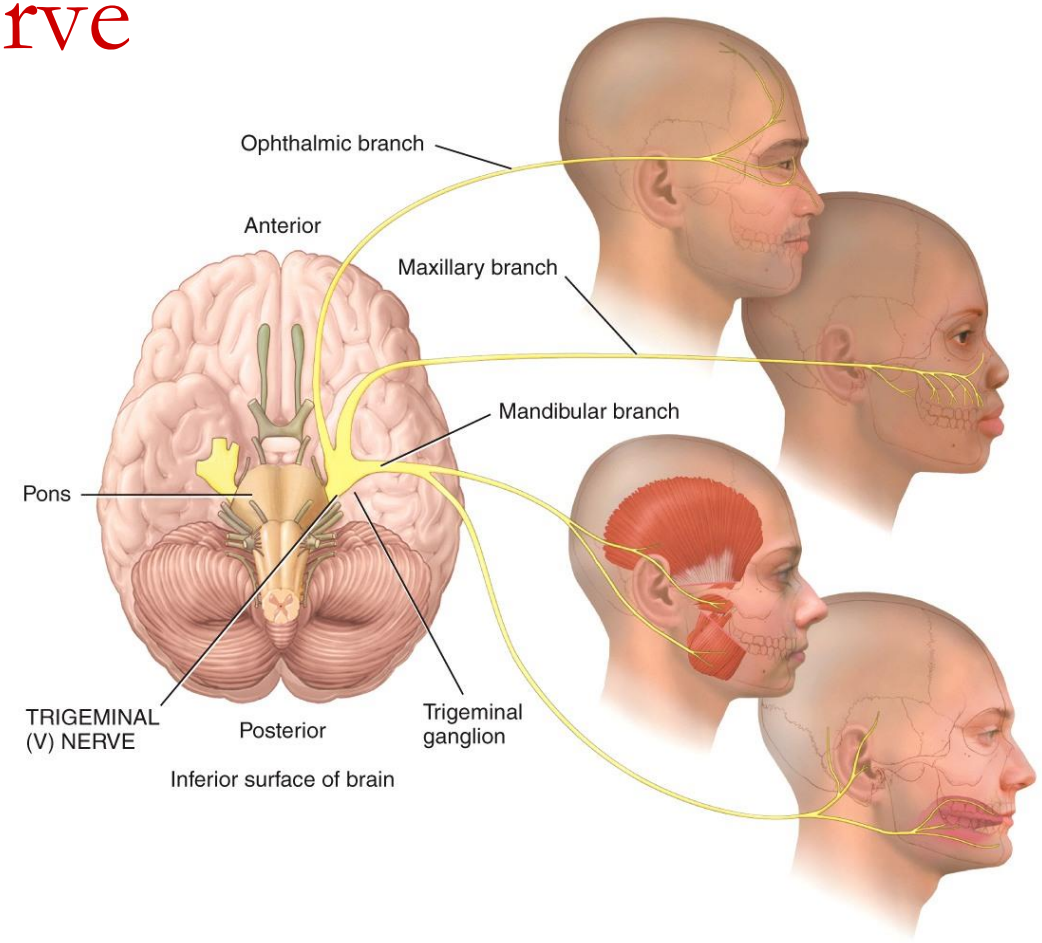
Abduction of the eye

Oculomotor (III), Trochlear (IV), and Abducens (VI) Nerves



Trigeminal (V) Nerve

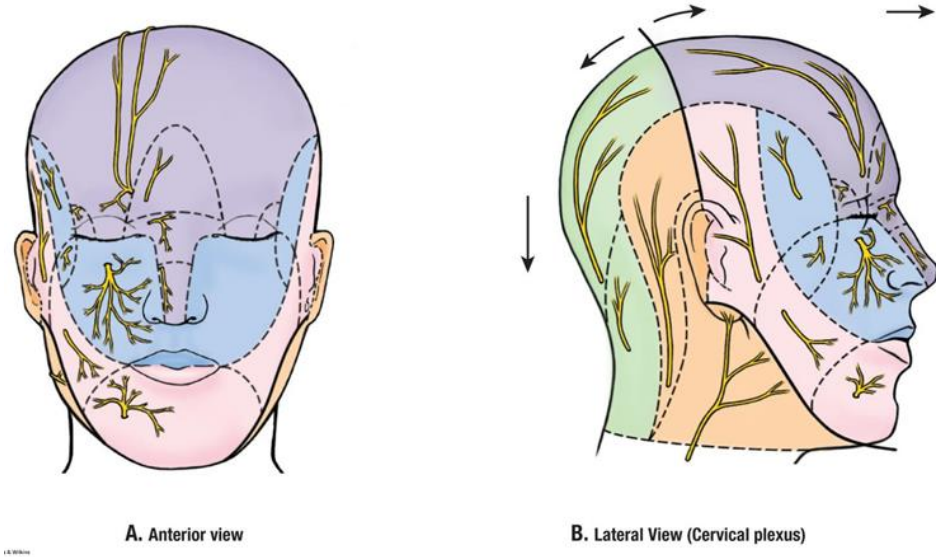
- Mixed nerve:
  - Sensory: face & teeth
  - Motor: muscles of mastication
- The largest of C.N.
- 3 divisions:
  - Ophthalmic
  - maxillary
  - mandibular



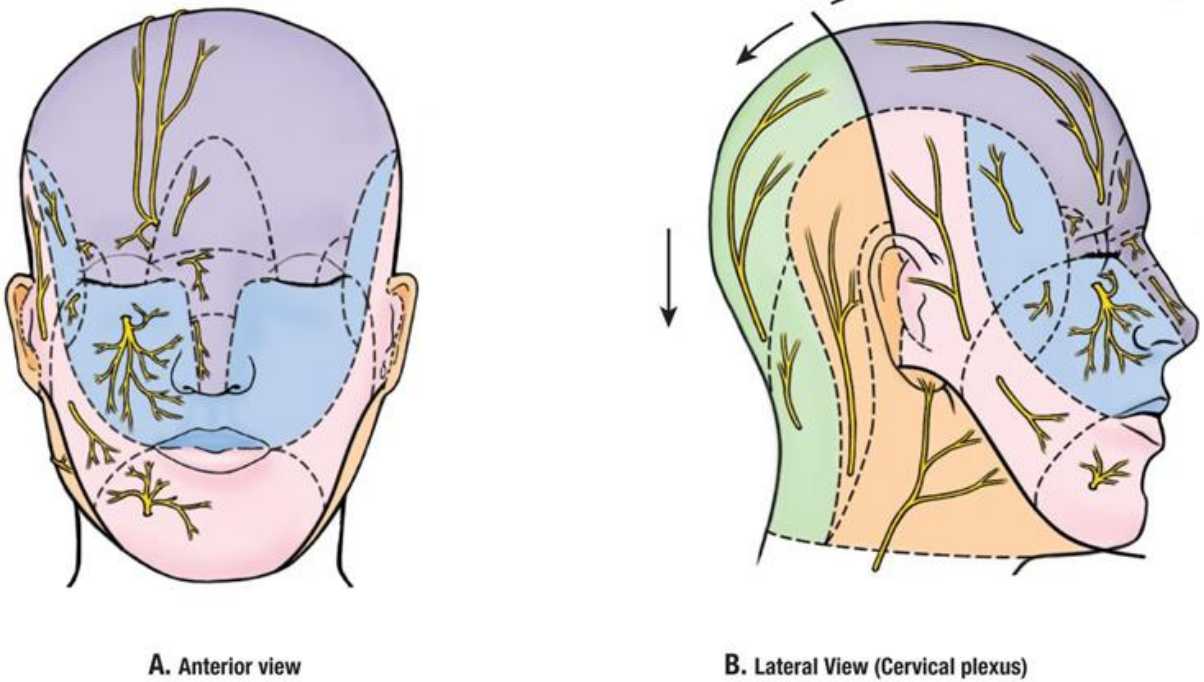
Trigeminal (V) Nerve

- ❑ Ophthalmic Nerve (V1)
- Entirely sensory branch:
- Forehead, ant. ½ scalp, upper eyelid, & bridge of the nose

- Pass to orbit through: superior orbital fissure



Maxillary Nerve (V2) OF Trigeminal



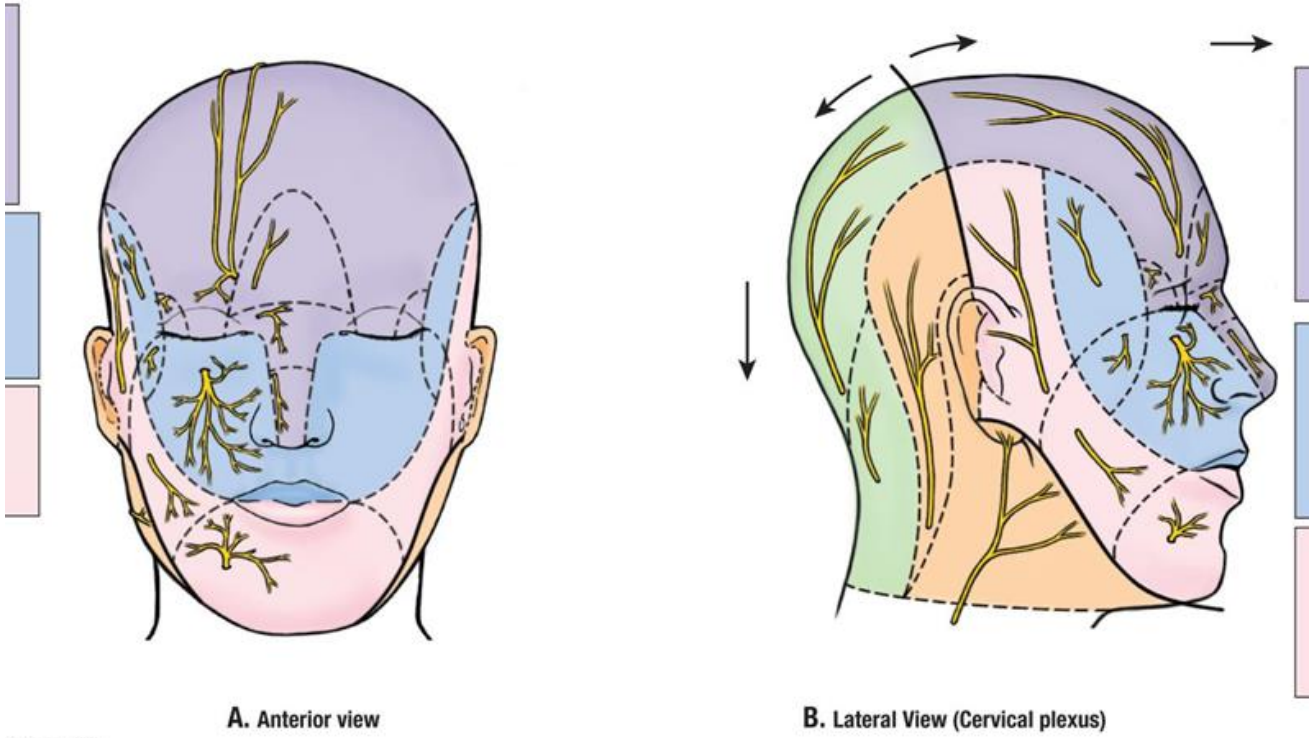
A. Anterior view

B. Lateral View (Cervical plexus)

- Sensory branch:
- skin over maxilla, upper teeth, & palate

- Pass through foramen rotundum

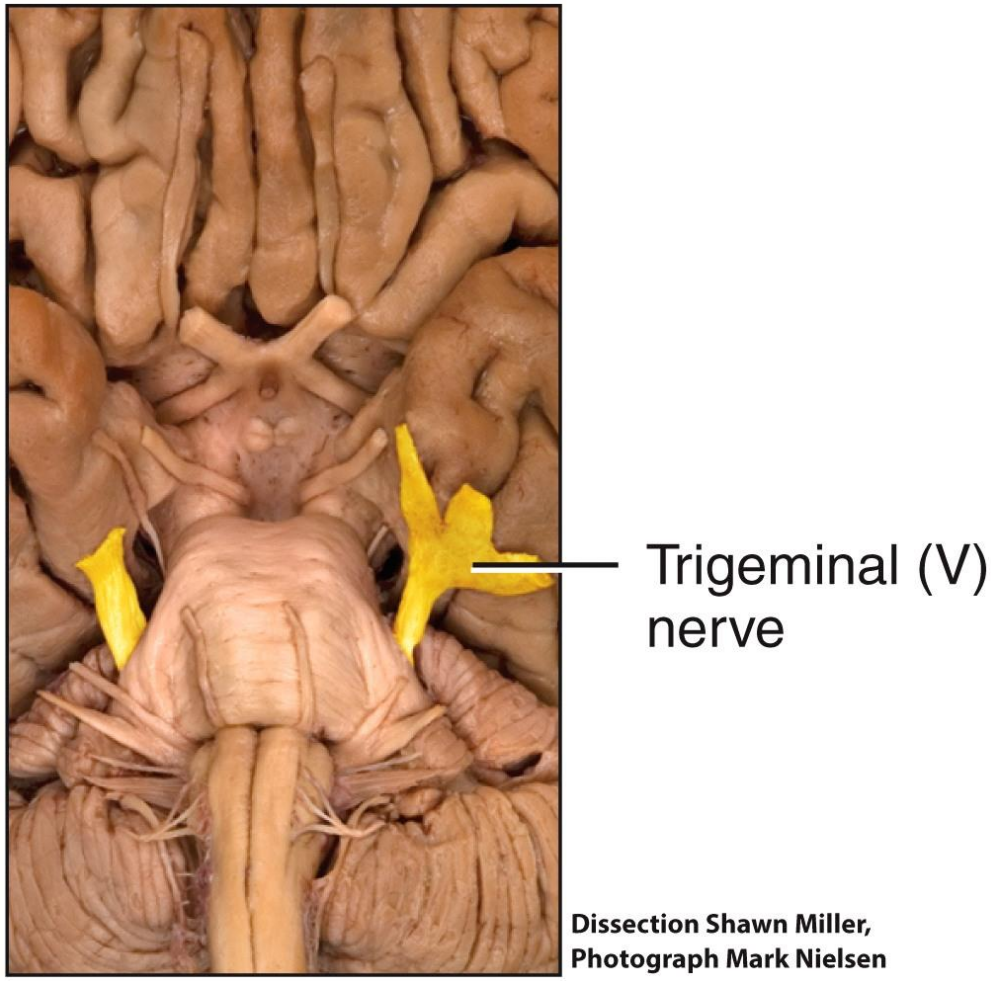
Mandibular Nerve (V3) OF Trigeminal



- Mixed branch:
- Sensory: skin over the mandible & cheeks ant . & sup. to the auricle (temporal)
- Tongue ant. 2/3 &
- Motor: muscles of mastication
- Pass through foramen ovale as a main trunk

Clinical Connection

- Trigeminal neuralgia

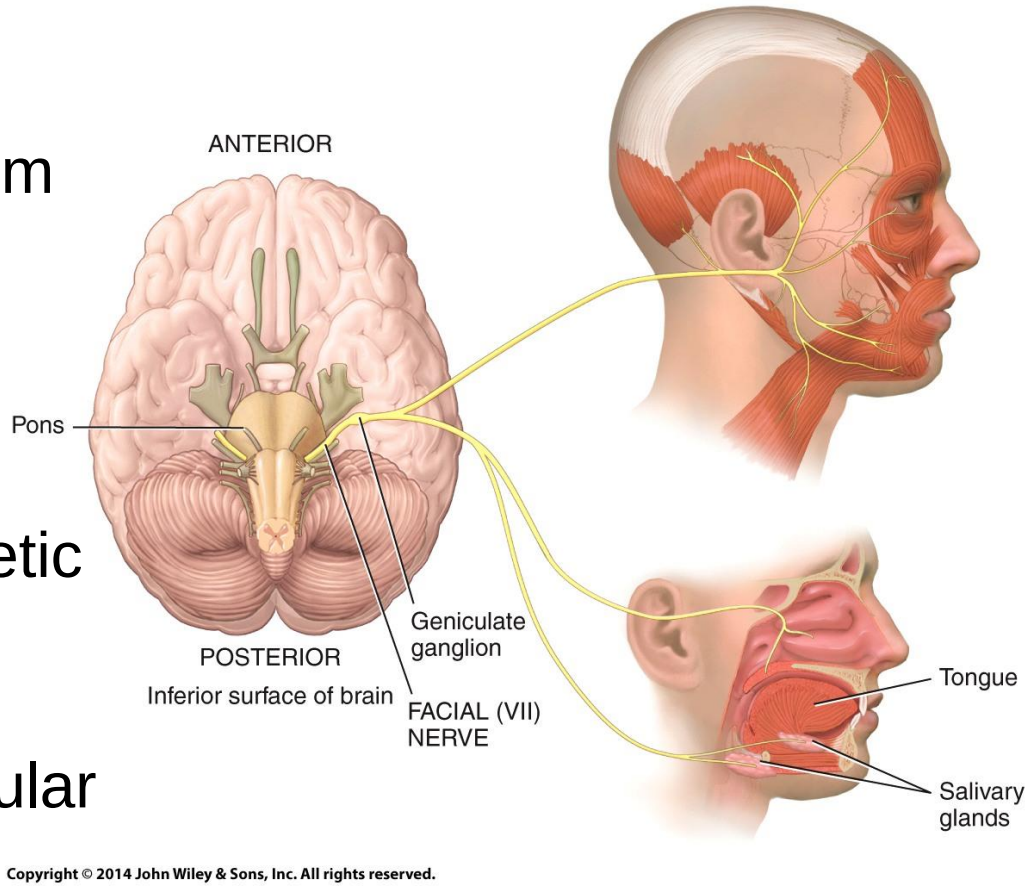


Dissection Shawn Miller, Photograph Mark Nielsen

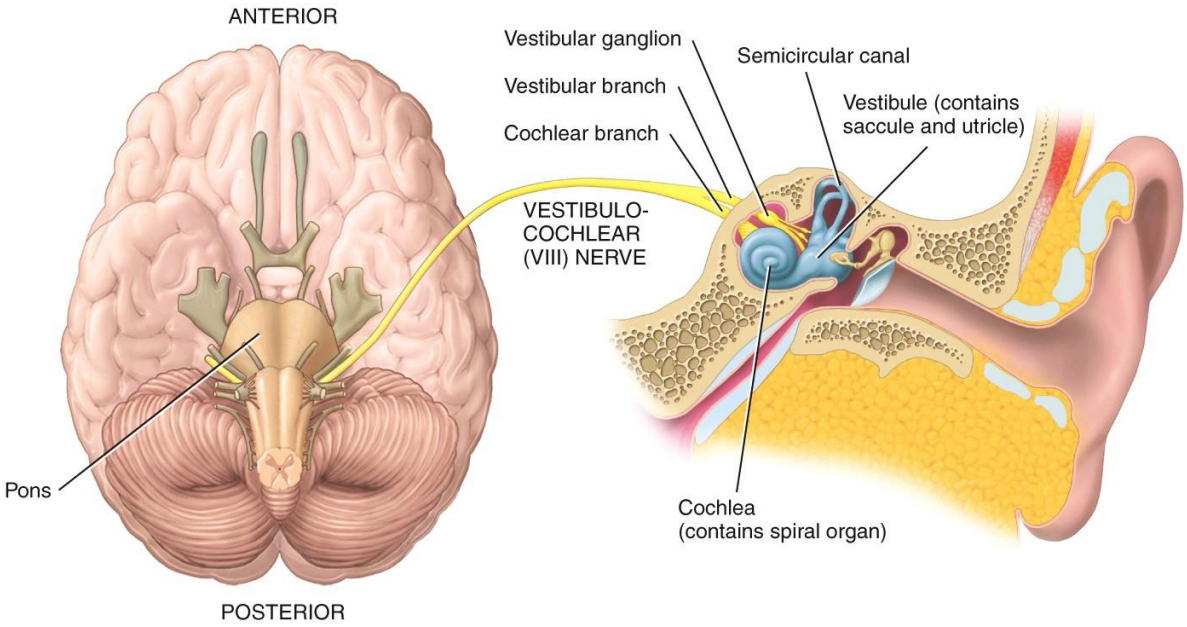
Facial (VII) Nerve

Mixed Somatic:
-special sensory: taste from ant. 2/3 of tongue
-motor: muscles of facial expression& stapedius

Autonomic: (parasympathetic secretomotor)
- lacrimal gland
- sublingual & submandibular salivary glands



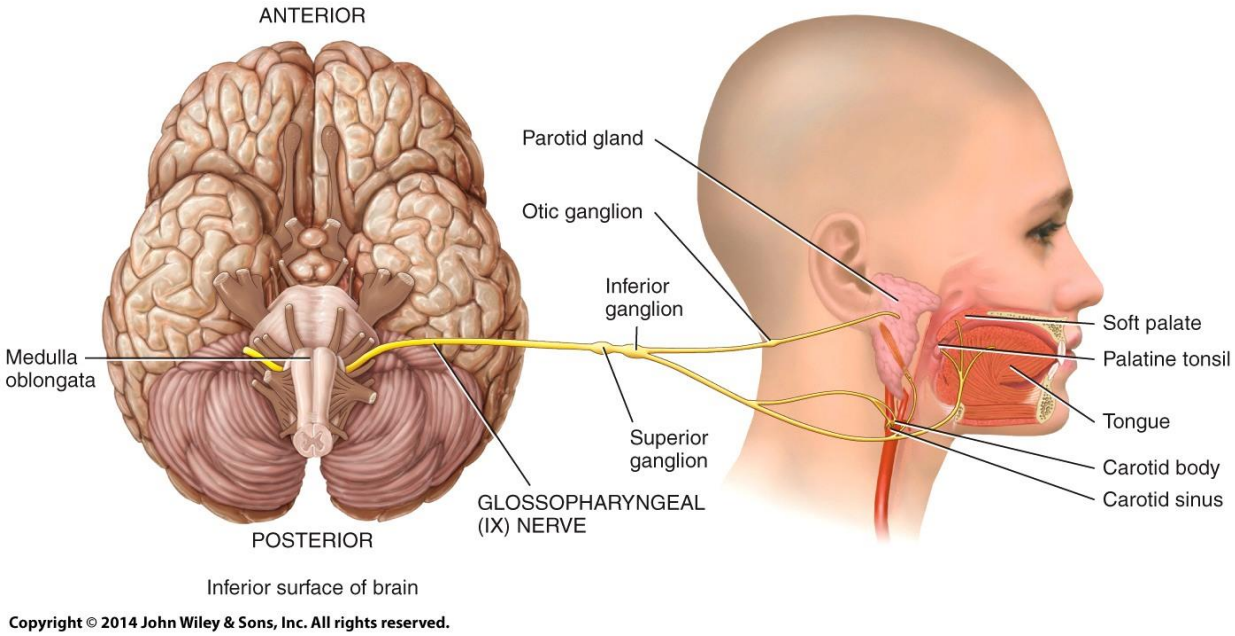
Vestibulocochlear (VIII) Nerve



Mainly sensory
Conduct the sense of hearing (auditory)

Concerned with hearing &

Glossopharyngeal (IX) Nerve



Mixed

Mixed Somatic:

- post. 1/3 of the tongue (general & special taste)
- stylopharyngeus muscle

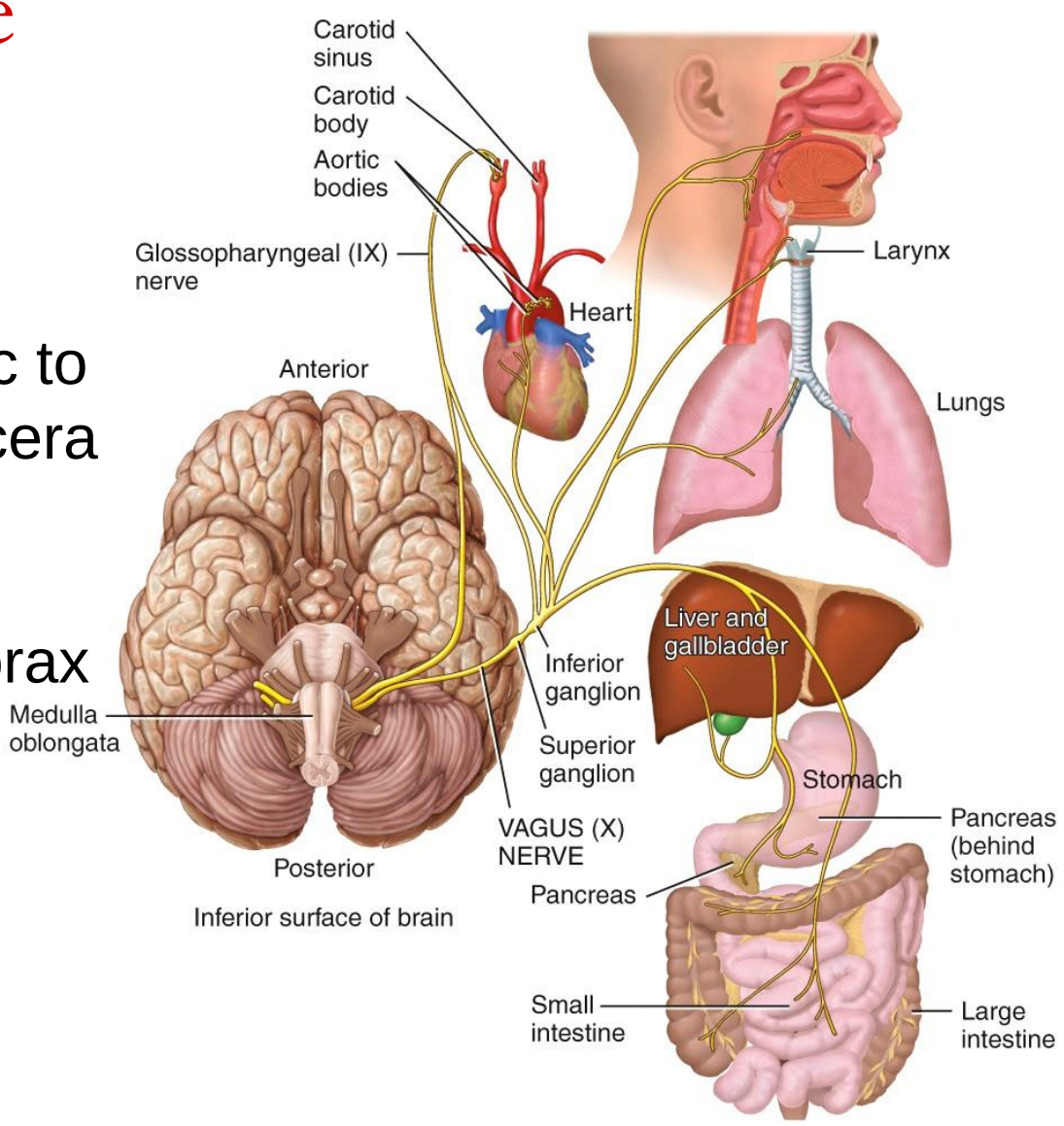
Autonomic:

- secretomotor to parotid gland

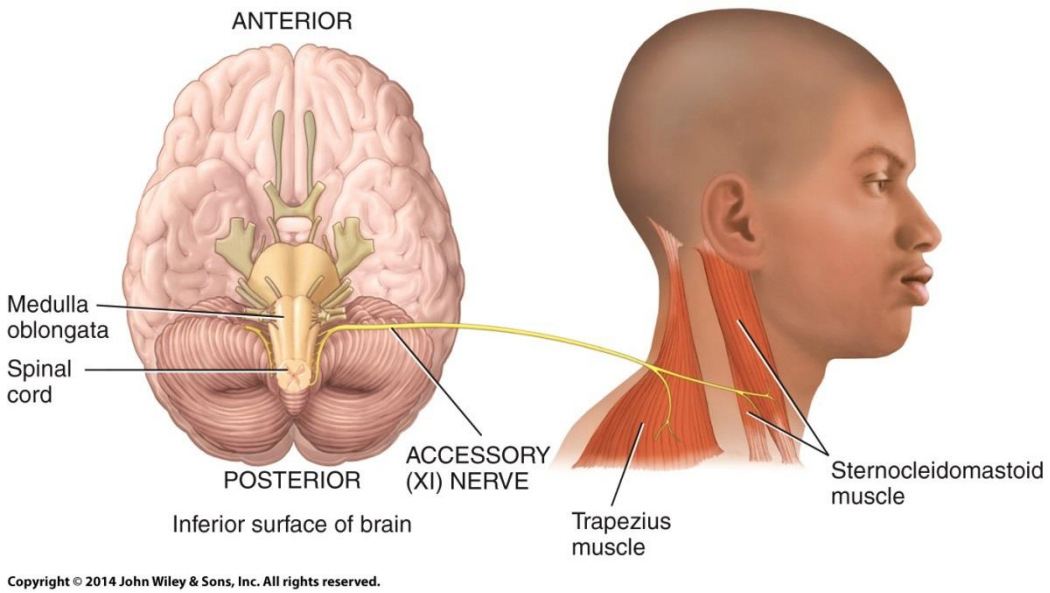
Vagus (X) Nerve

Mixed
Mainly parasympathetic to thorax & abdominal viscera

Extends widely into Thorax & abdomen
(hence the name)



Accessory (XI) Nerve

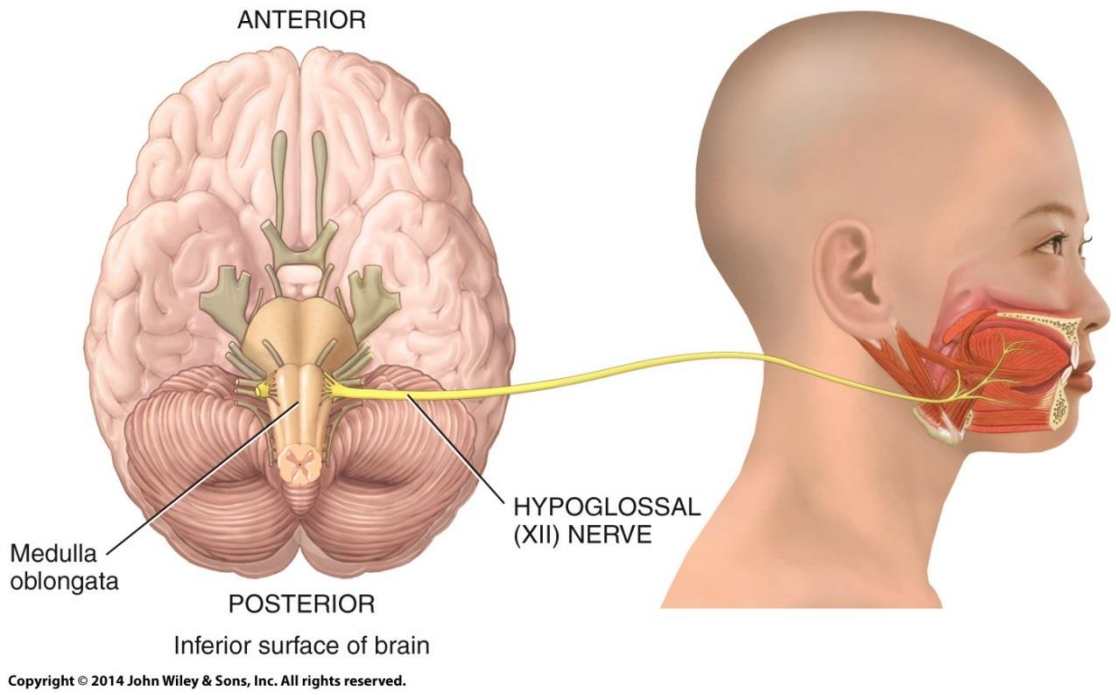


Mainly motor
*Has 2 origins:
- cranial: brain stem - spinal: spinal cord

*- Cranial: muscles of pharynx, larynx & soft palate

- Spinal: sternocleidomastoid m. & Trapezius

Hypoglossal (XII) Nerve



Mainly motor:
Supply tongue muscles

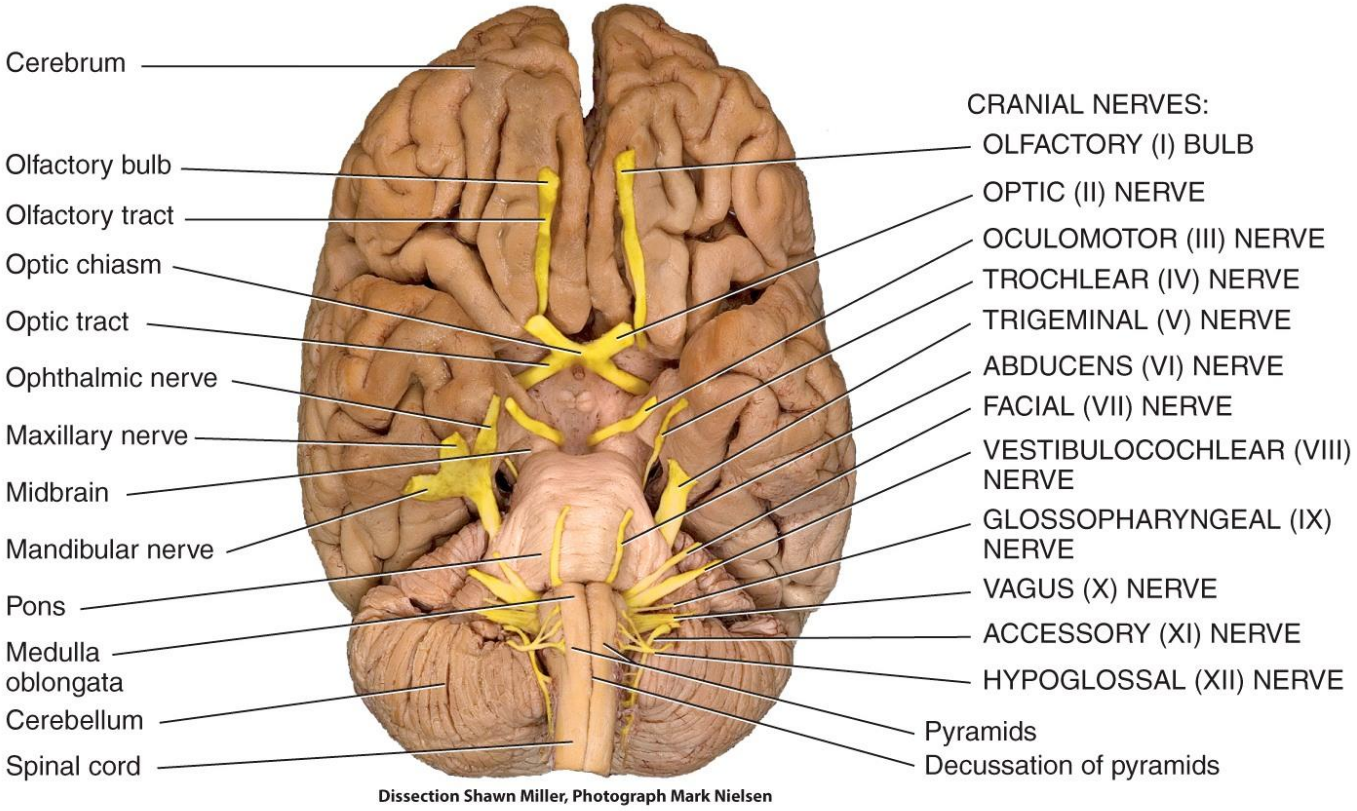
Tongue innervation

Sensory: V, VII, IX
Motor: XII

Cranial Nerves I and II

Cranial nerves with autonomic divisions: 1973

Cranial nerves that move the eye ball SO4+ LR6
3



(a) Inferior aspect of brain