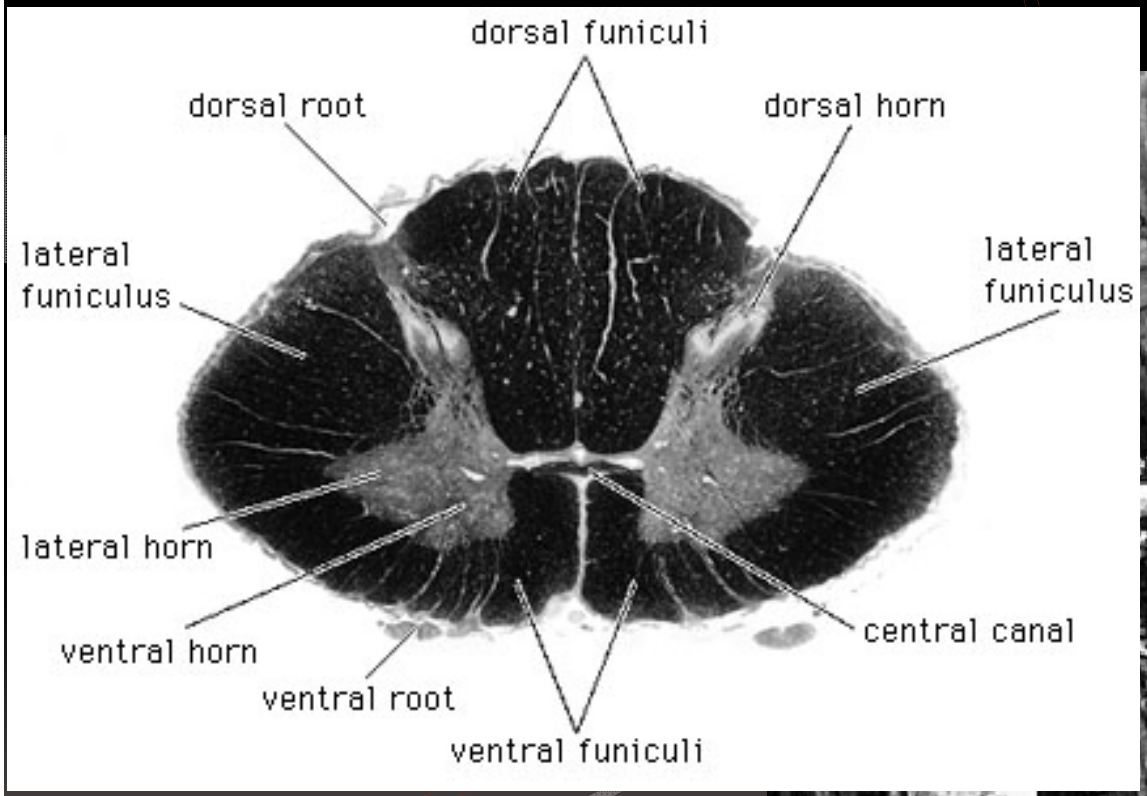
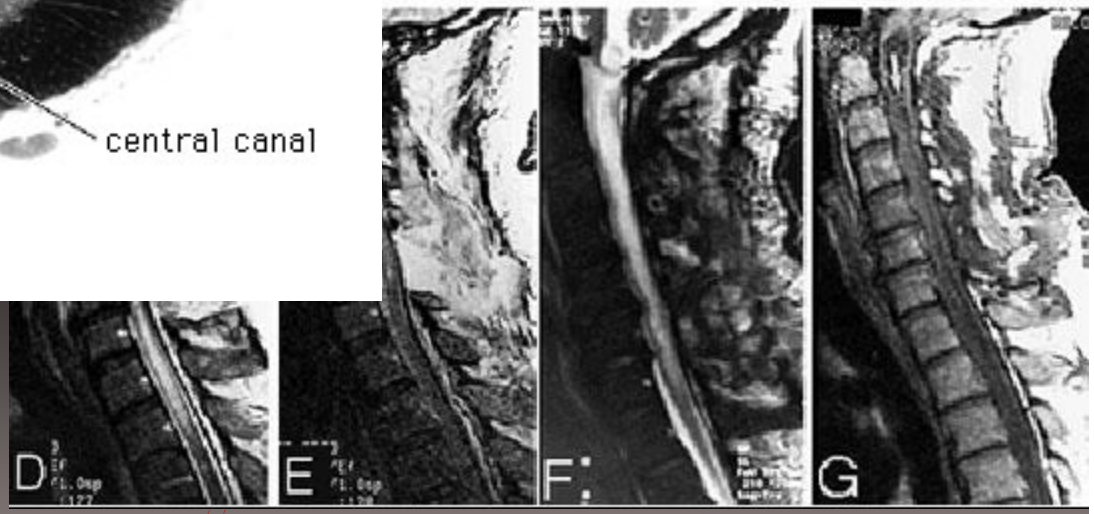
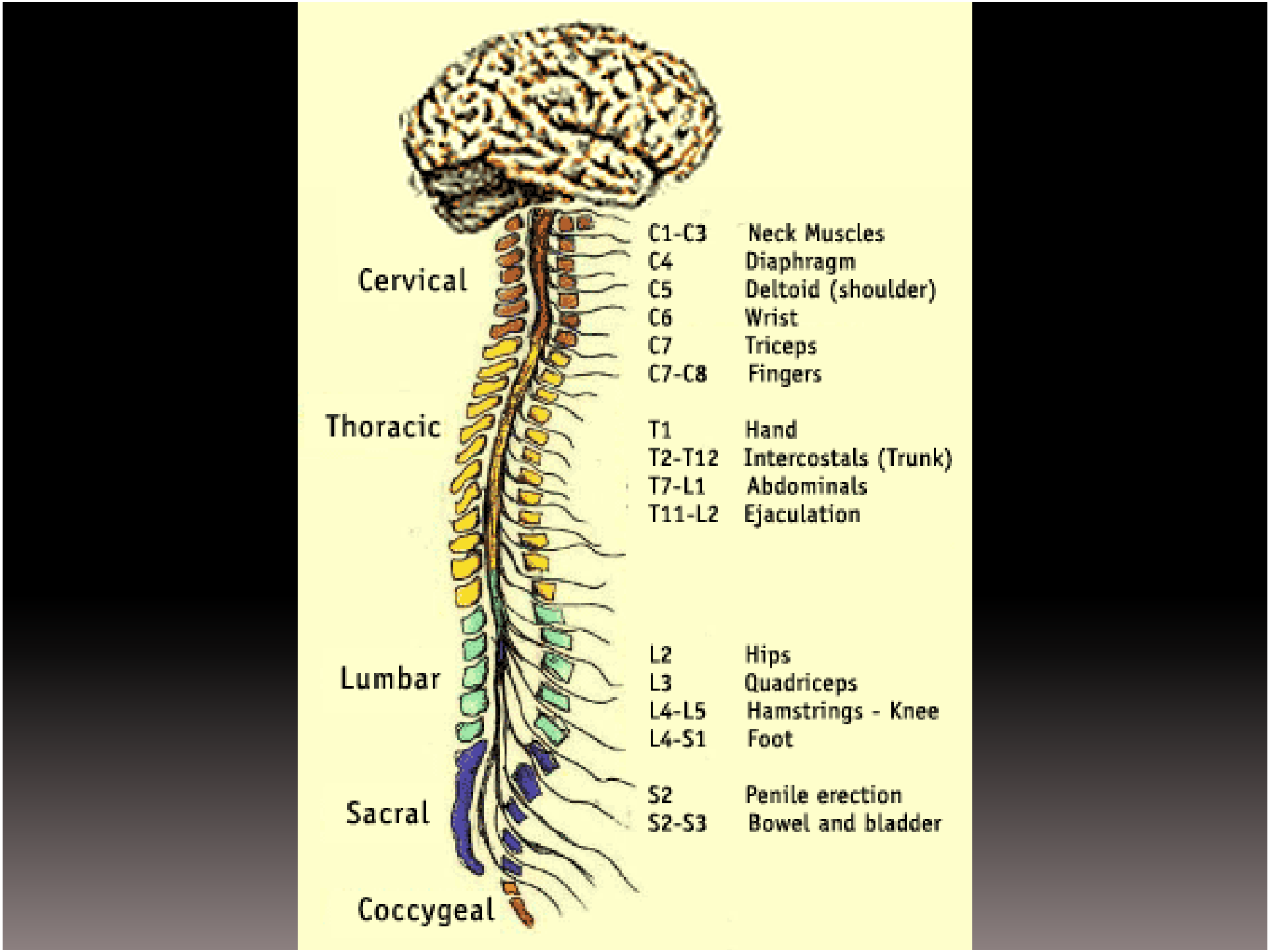
SPINAL CORD ANATOMY AND FUNCTION

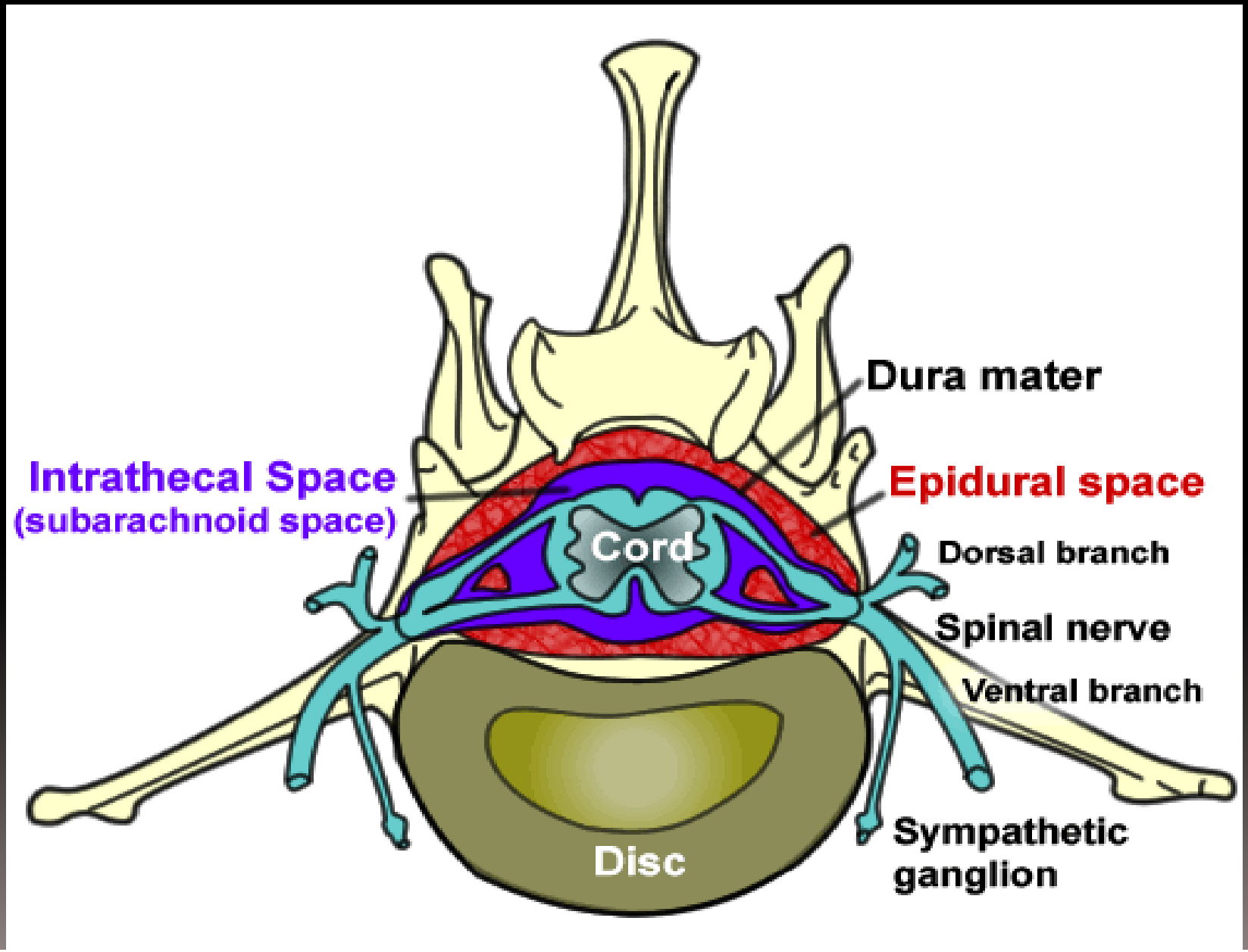
DANIL HAMMOUDI.MD






Cervical
Thoracic
Lumbar
Sacral
Coccygeal
C1-C3 Neck Muscles
C4 Diaphragm
C5 Deltoid (shoulder)
C6 Wrist
C7 Triceps
C7-C8 Fingers
T1 Hand
T2-T12 Intercostals (Trunk)
T7-L1 Abdominals
T11-L2 Ejaculation
L2 Hips
L3 Quadriceps
L4-L5 Hamstrings - Knee
L4-S1 Foot
S2 Penile erection
S2-S3 Bowel and bladder

SPINAL CORD ANATOMY



Lumbar Tap

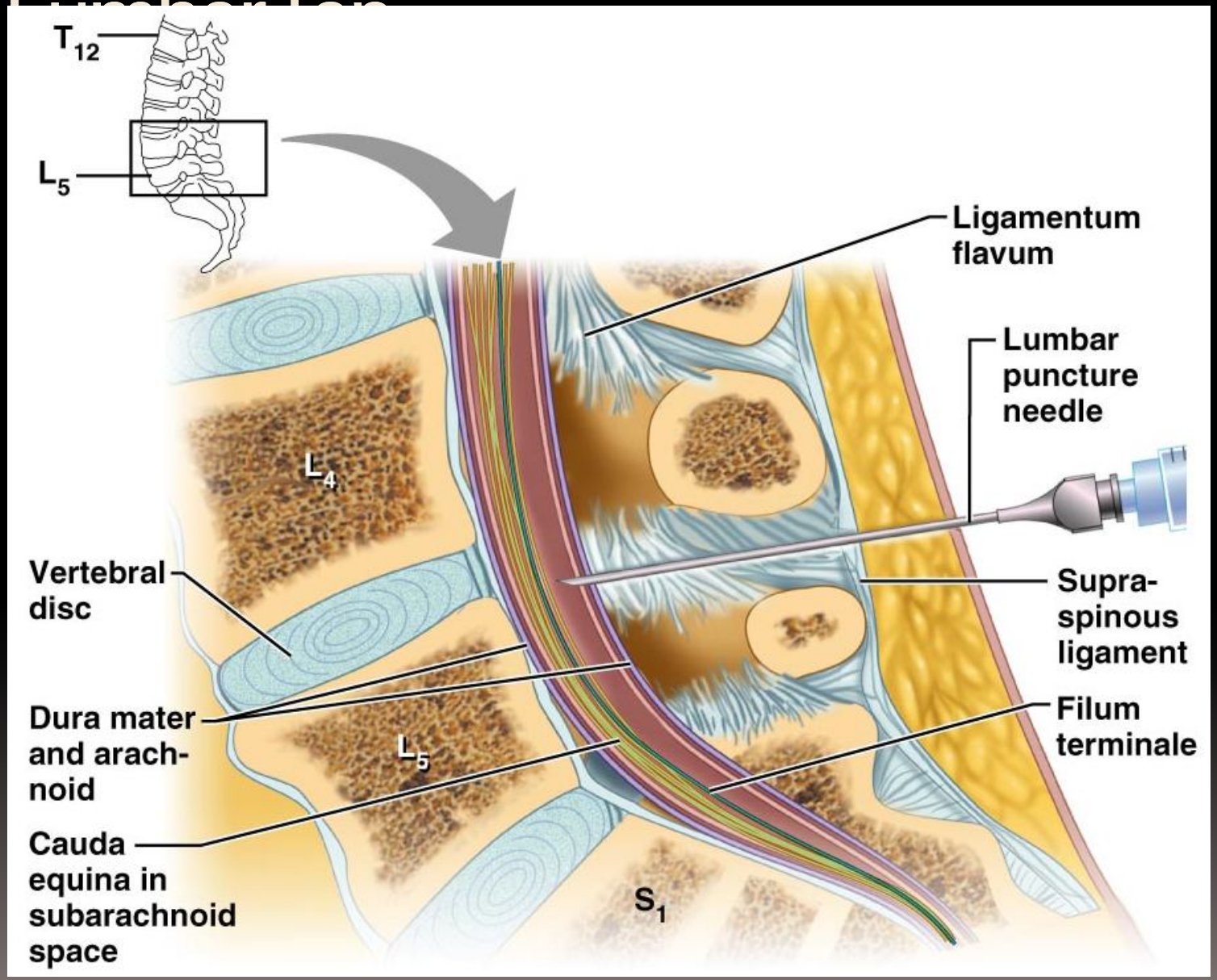


Figure 12.30

Spinal Cord

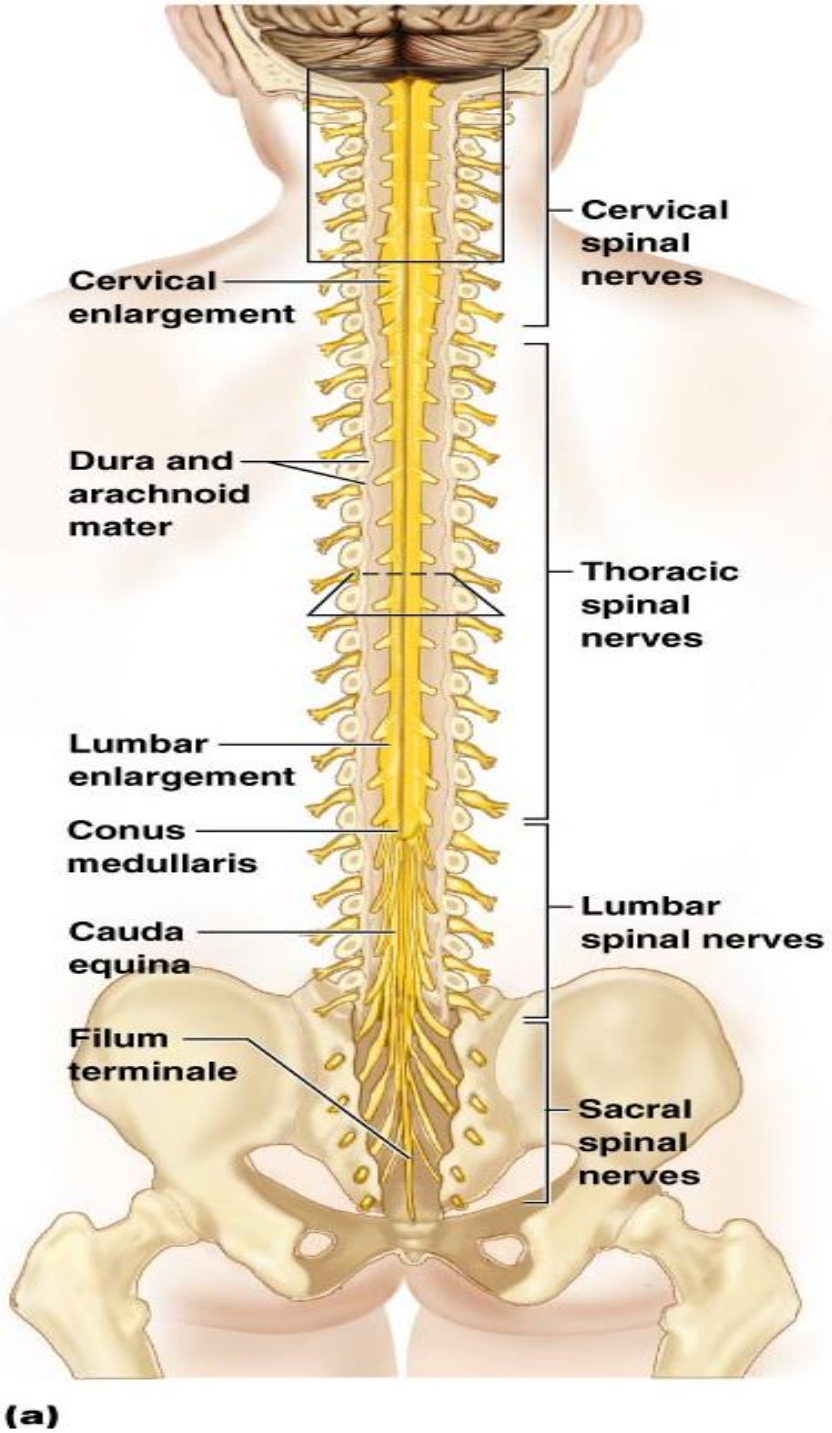


Figure 12.29a

There are 31 spinal cord segments:

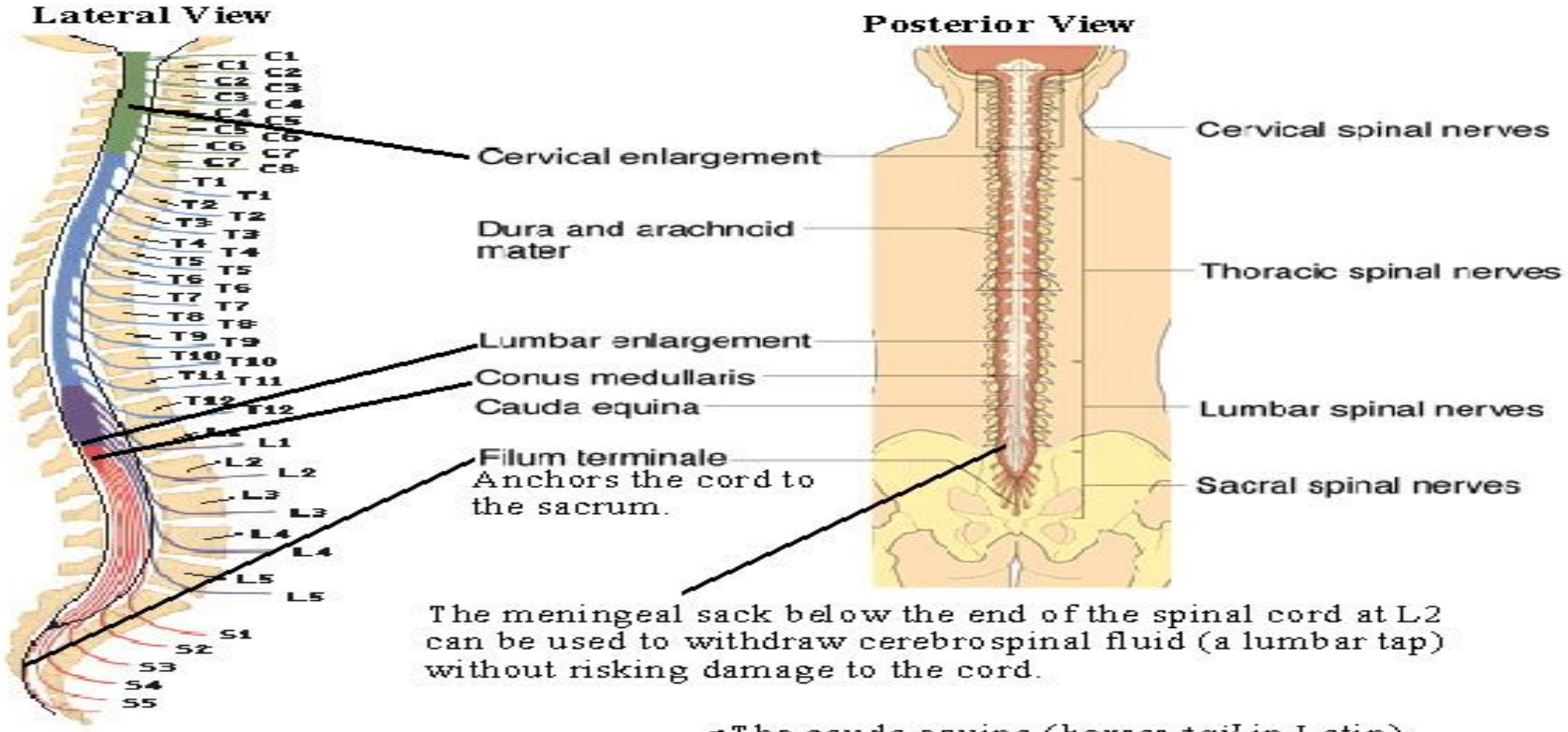
- 8 cervical segments
- 12 thoracic segments
- 5 lumbar segments
- 5 sacral segments
- 1 coccygeal segment

There are two regions where the spinal cord enlarges:

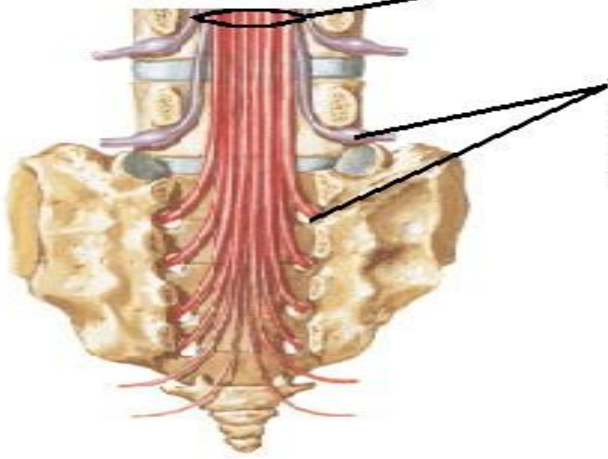
- **Cervical enlargement** - corresponds roughly to the brachial plexus nerves, which innervate the upper limb. It includes spinal cord segments from about C4 to T1. The vertebral levels of the enlargement are roughly the same (C4 to T1).

- **Lumbosacral enlargement** - corresponds to the lumbosacral plexus nerves, which innervate the lower limb. It comprises the spinal cord segments from L2 to S3, and is found about the vertebral levels of T9 to T12.

The Spinal Cord and Spinal Nerves



The meningeal sack below the end of the spinal cord at L2 can be used to withdraw cerebrospinal fluid (a lumbar tap) without risking damage to the cord.



The cauda equina (*horses tail* in Latin)

Nerve roots descend to the appropriate location beneath the vertebra or in the sacrum. The ganglion occurs just outside the vertebral column.

Spinal Cord

- Conus medullaris – terminal portion of the spinal cord
- Filum terminale – fibrous extension of the pia mater; anchors the spinal cord to the coccyx
- Denticulate ligaments – delicate shelves of pia mater; attach the spinal cord to the vertebrae

The **dermatomes** are somatic or musculocutaneous areas served by fibers from specific spinal nerves.

Referred pain is caused when the sensory fibers from an internal organ enter the spinal cord in the same root as fibers from a dermatome. The brain is poor at interpreting visceral pain and instead interprets it as pain from the somatic area of the dermatome.

Cervical Plexus - the **phrenic nerve** travels through the thorax to innervate the diaphragm.

Brachial Plexus -
Axillary nerve - innervates the deltoid muscle and shoulder, along with the posterior aspect of the upper arm.
Musculocutaneous nerve - innervates anterior skin of upper arm and elbow flexors.
Radial nerve - innervates dorsal aspect of the arm and extensors of the elbow, wrist, and fingers, abduction of thumb.
Median nerve - innervates the middle elbow, wrist and finger flexors, adducts the thumb.
Ulnar nerve - innervates the medial aspect wrist and finger flexors.

Lumbar Plexus
genitofemoral - to the **external** genitalia
obturator - to the adductor muscles
femoral - innervates the skin and muscles of upper thigh, including the quadriceps.

Sacral Plexus
gluteal nerves (superior and inferior) - superior innervates the gluteus medius and minimus, inferior innervates the gluteus maximus.
sciatic nerve - the body's largest nerve, consisting of two major branches, the **tibial** and common **peroneal**. Together they innervate most all of leg including the flexors of the knee, part of adductor magnus, muscles for plantar flexion, dorsiflexion, and other movements of the foot and toes.

- **ganglion** - a collection of cell bodies located outside the Central Nervous System. The spinal ganglia or dorsal root ganglia contain the cell bodies of sensory neurons entering the cord at that region.
- **nerve** - a group of fibers (axons) *outside* the CNS. The spinal nerves contain the fibers of the sensory and motor neurons. A nerve does not contain cell bodies. They are located in the ganglion (sensory) or in the gray matter (motor).
- **tract -** a group of fibers *inside* the CNS. The spinal tracts carry information up or down the spinal cord, to or from the brain. Tracts within the brain carry information from one place to another within the brain. Tracts are always part of white matter.
- **gray matter** - an area of unmyelinated neurons where cell bodies and synapses occur. In the spinal cord the synapses between sensory and motor and interneurons occurs in the gray matter. The cell bodies of the interneurons and motor neurons also are found in the gray matter.
- **white matter** - an area of myelinated fiber tracts. Myelination in the CNS differs from that in nerves.

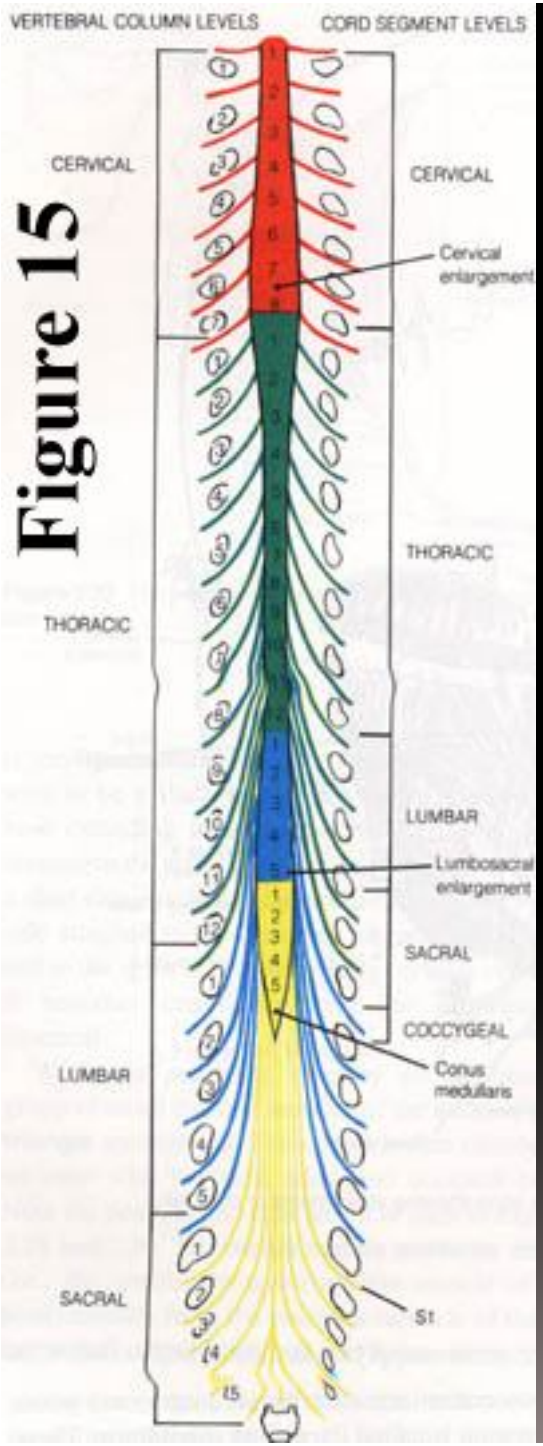
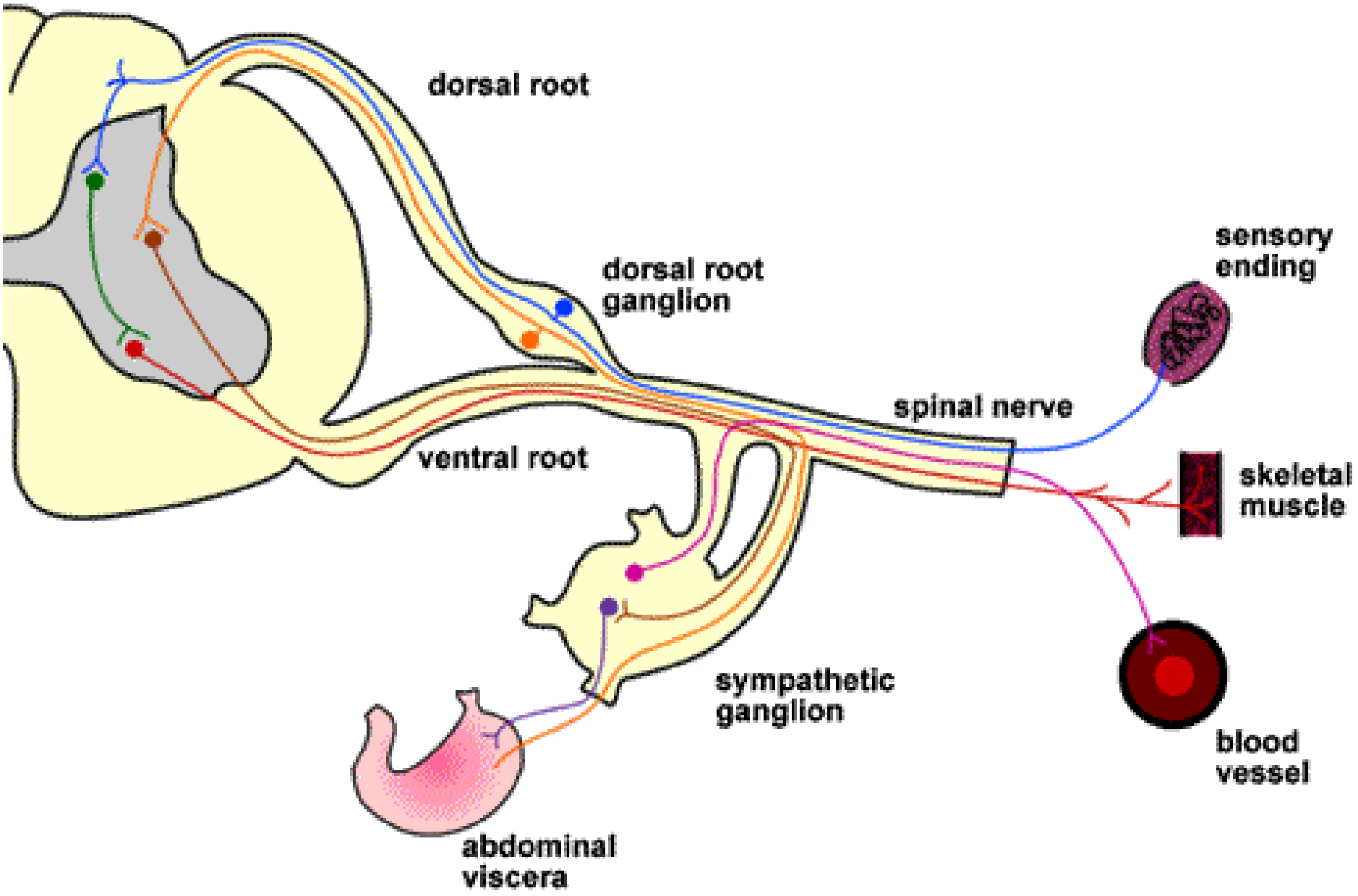
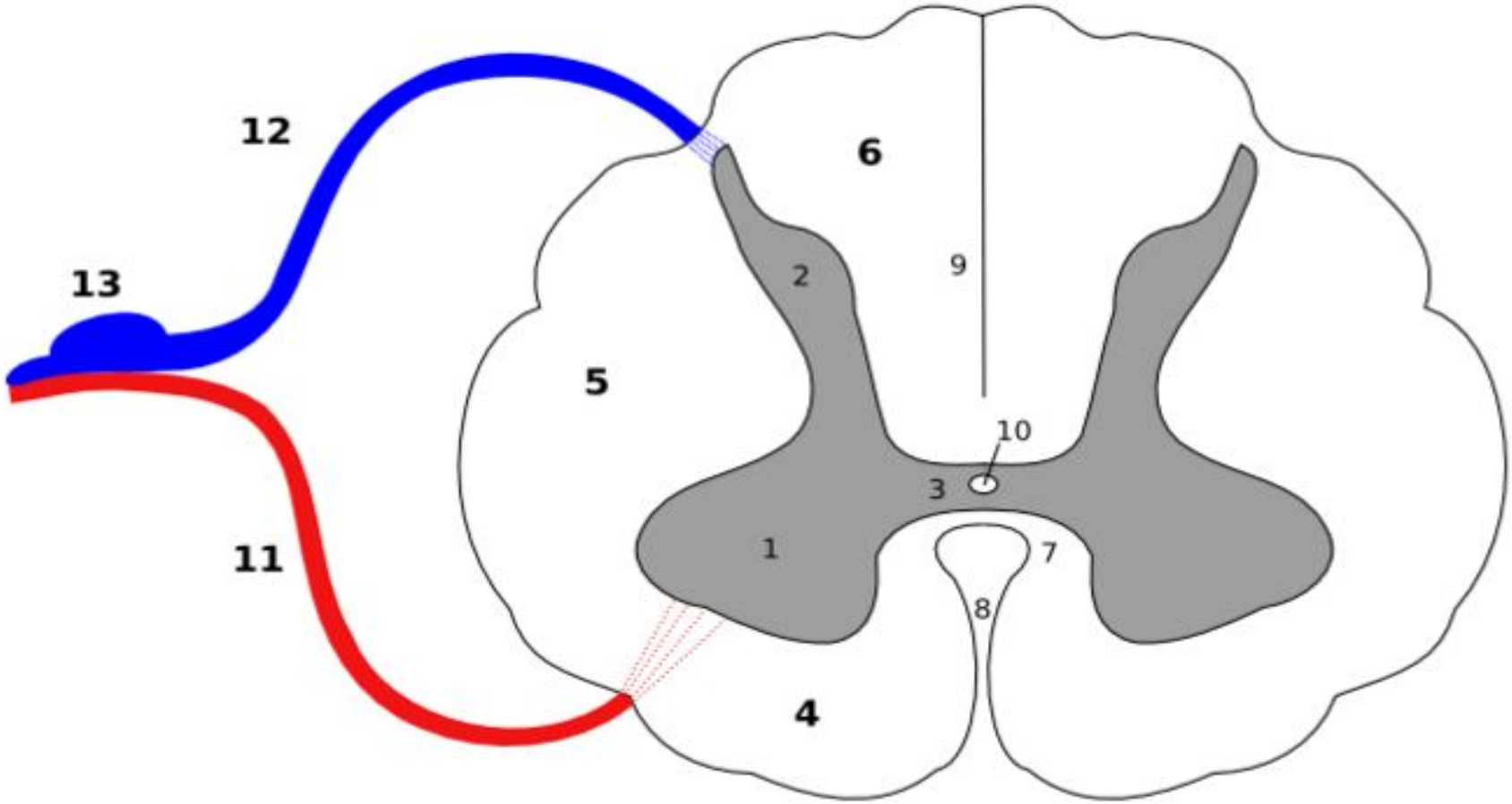


Figure 15

The spinal cord proper begins at the level of the foramen magnum of the skull and ends at the level of the L1ÐL2 intervertebral joint


dorsal root
dorsal root ganglion
sensory ending
spinal nerve
ventral root
skeletal muscle
sympathetic ganglion
blood vessel
abdominal viscera

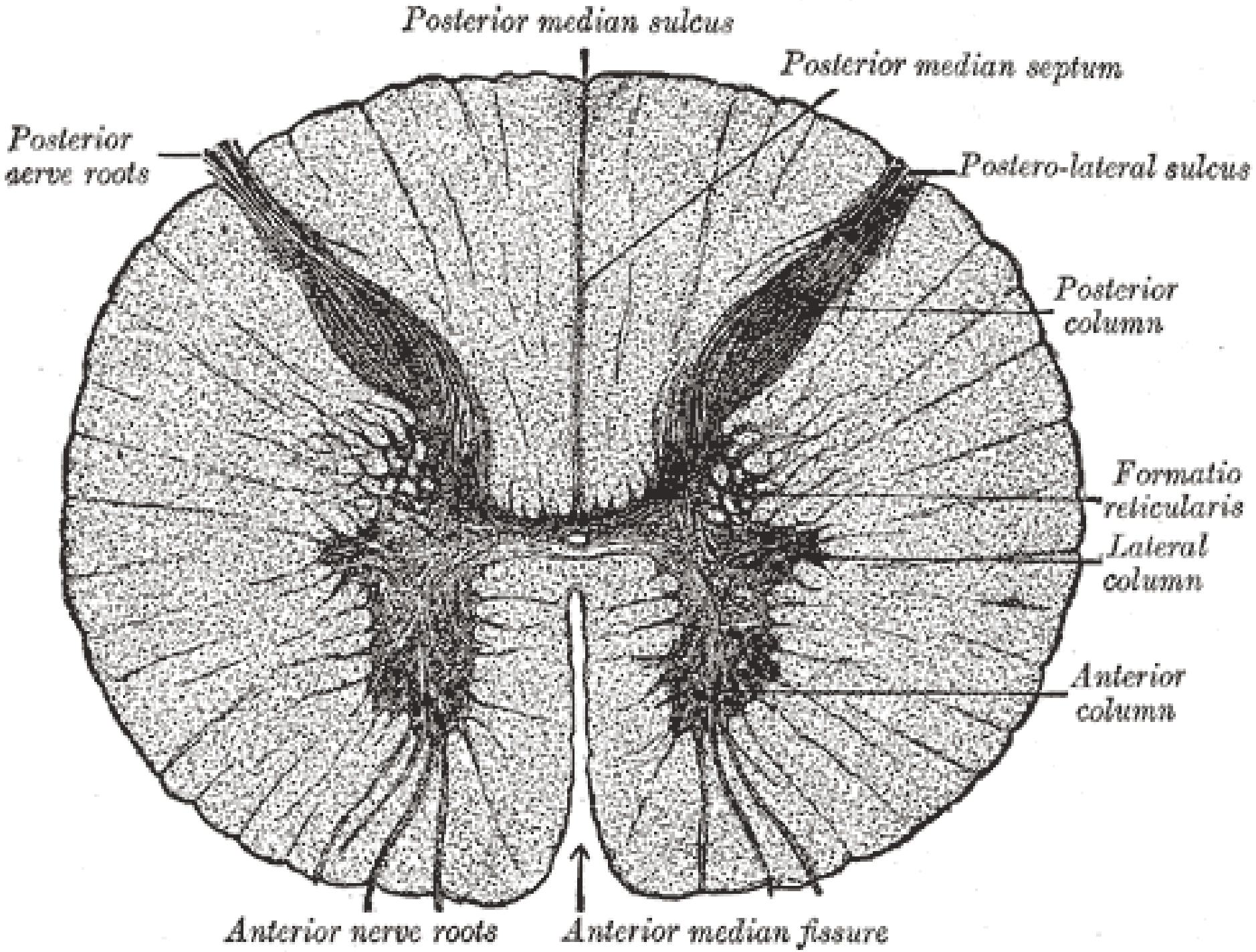


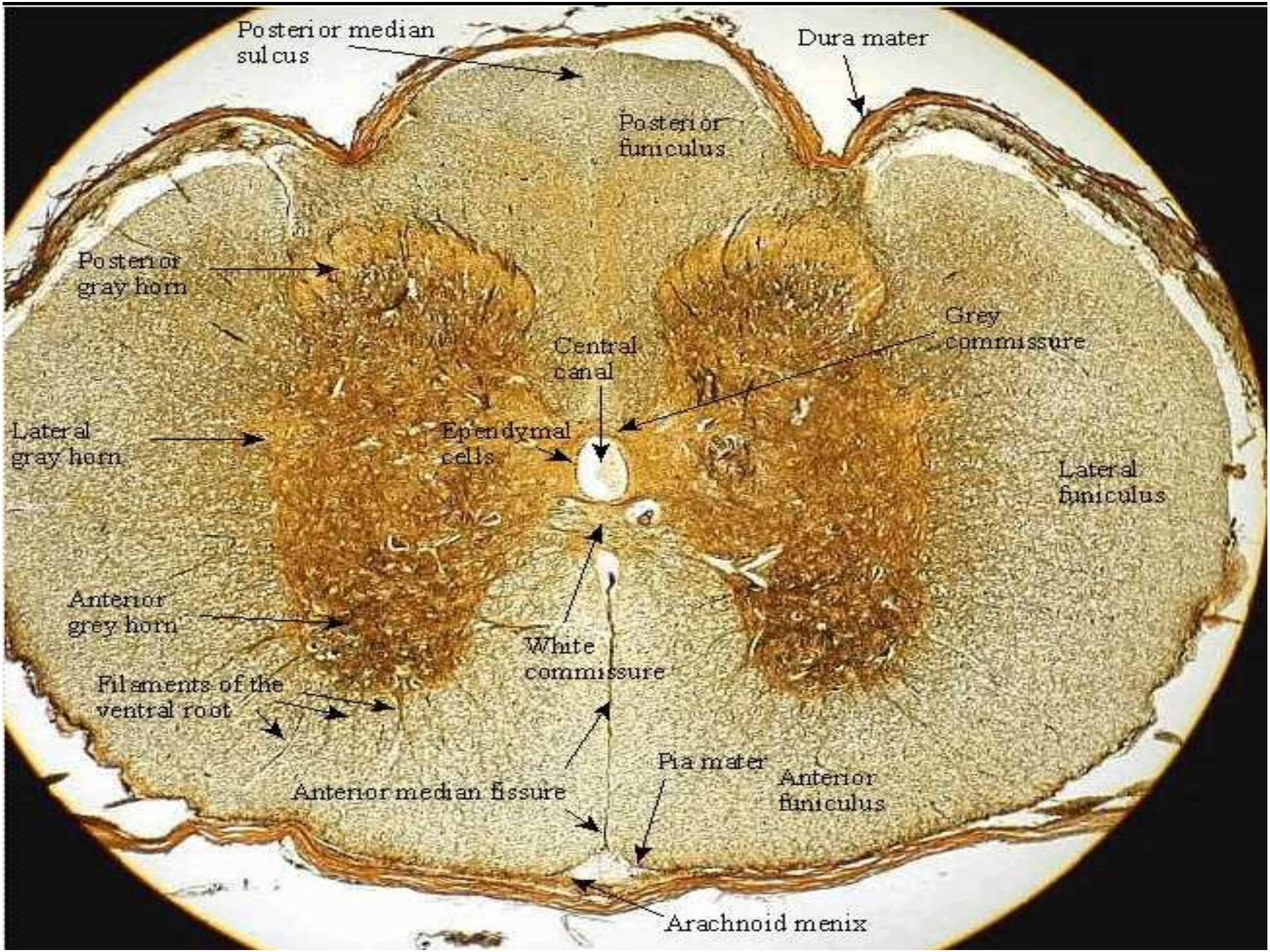
Substantia grisea

1. Cornu anterius
2. Cornu posterius
3. Commisura grisea

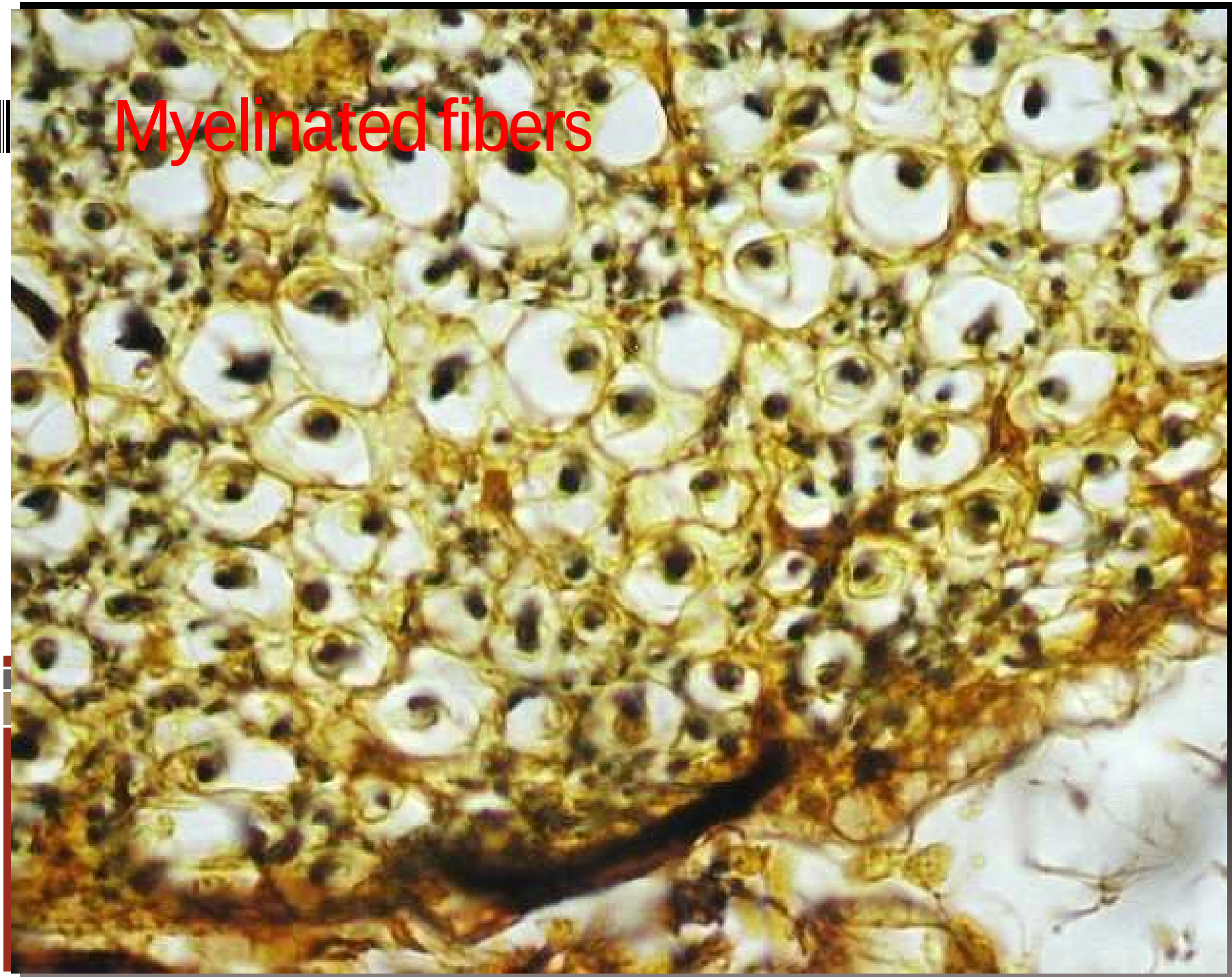
Substantia alba

4. Funiculus anterior
5. Funiculus lateralis
6. Funiculus posterior
7. Commisura alba anterior
8. Fissura mediana anterior
9. Sulcus medianus posterior
10. Canalis centralis
11. Radix anterior
12. Radix posterior
13. Ganglion sensorium nervi spinalis

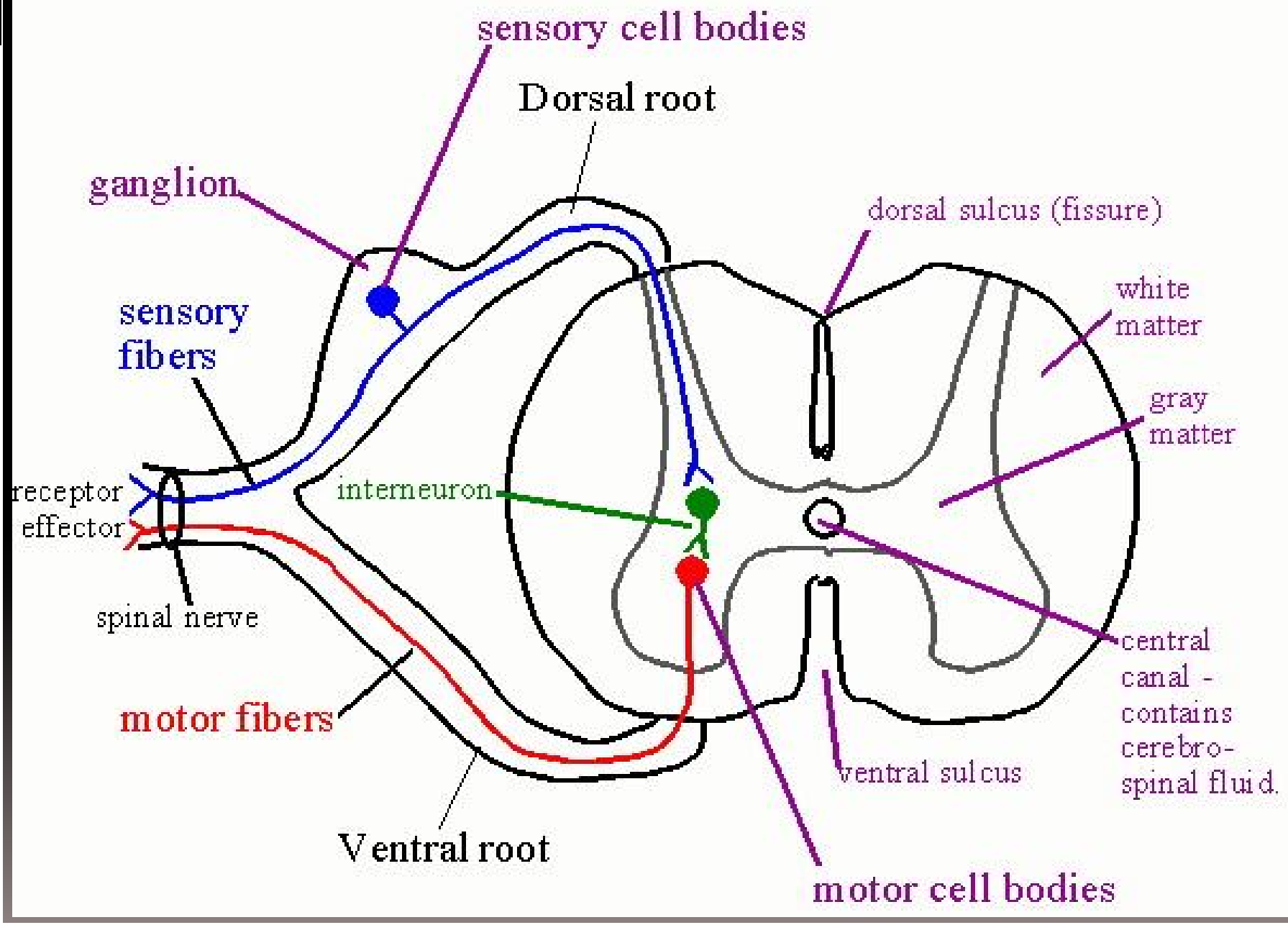

Posterior median sulcus
Posterior median septum
Posterior nerve roots
Postero-lateral sulcus
Posterior column
Formatio reticularis
Lateral column
Anterior column
Anterior nerve roots
Anterior median fissure

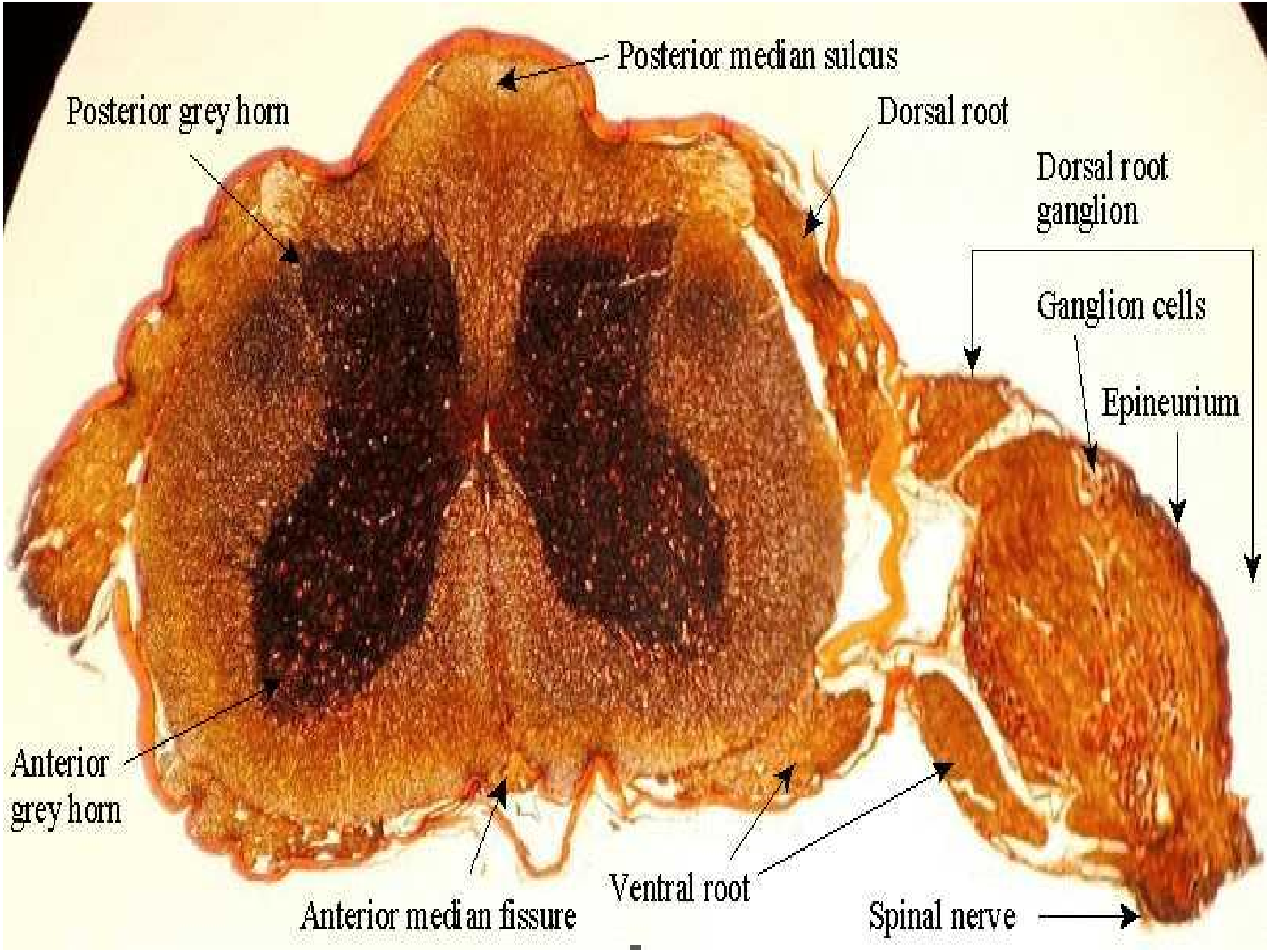

Posterior median sulcus
Dura mater
Posterior funiculus
Posterior gray horn
Grey commissure
Central canal
Lateral gray horn
Ependymal cells
Lateral funiculus
Anterior grey horn
White commissure
Filaments of the ventral root
Pia mater
Anterior funiculus
Anterior median fissure
Arachnoid menix

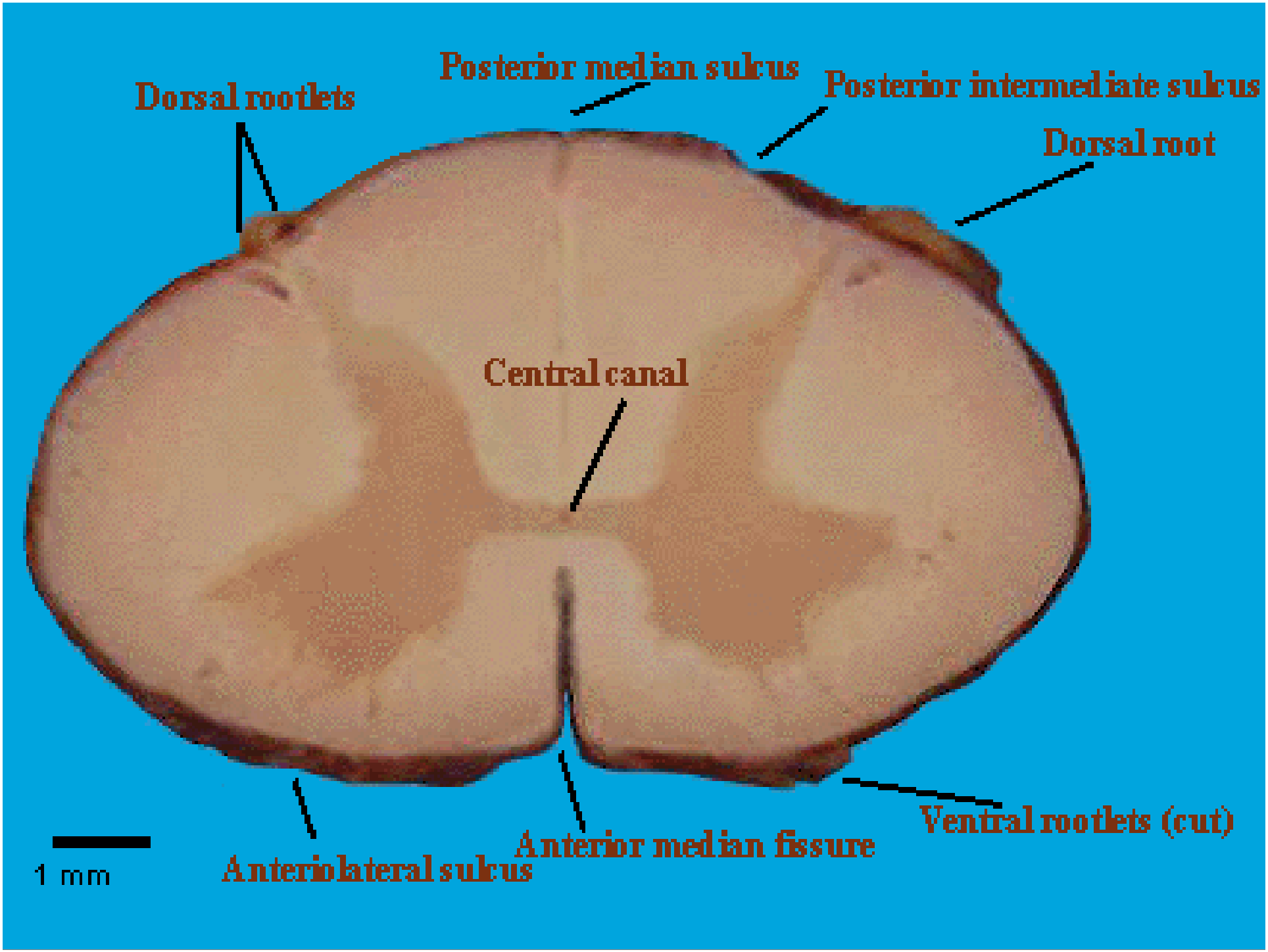
Myelinated fibers

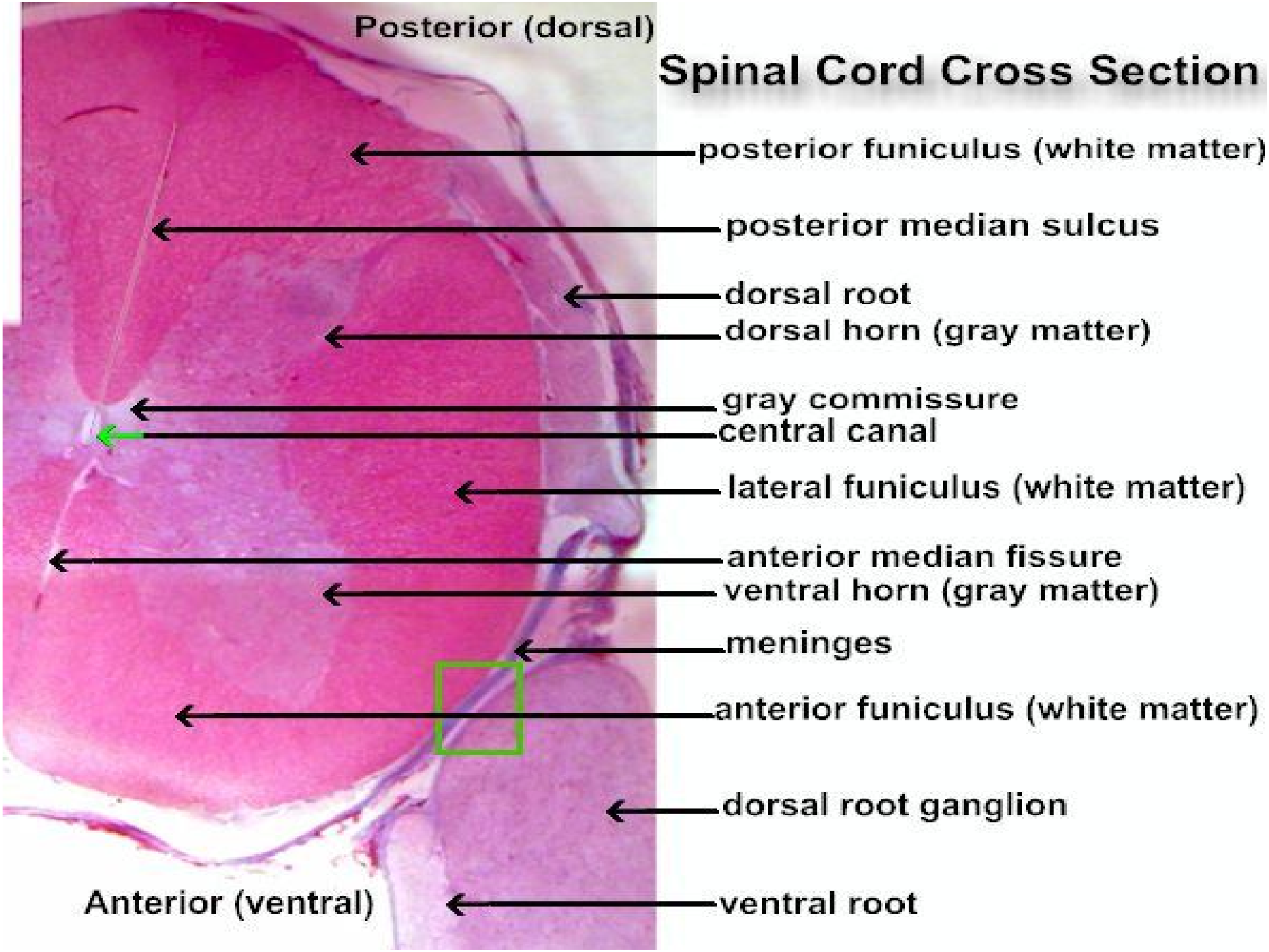


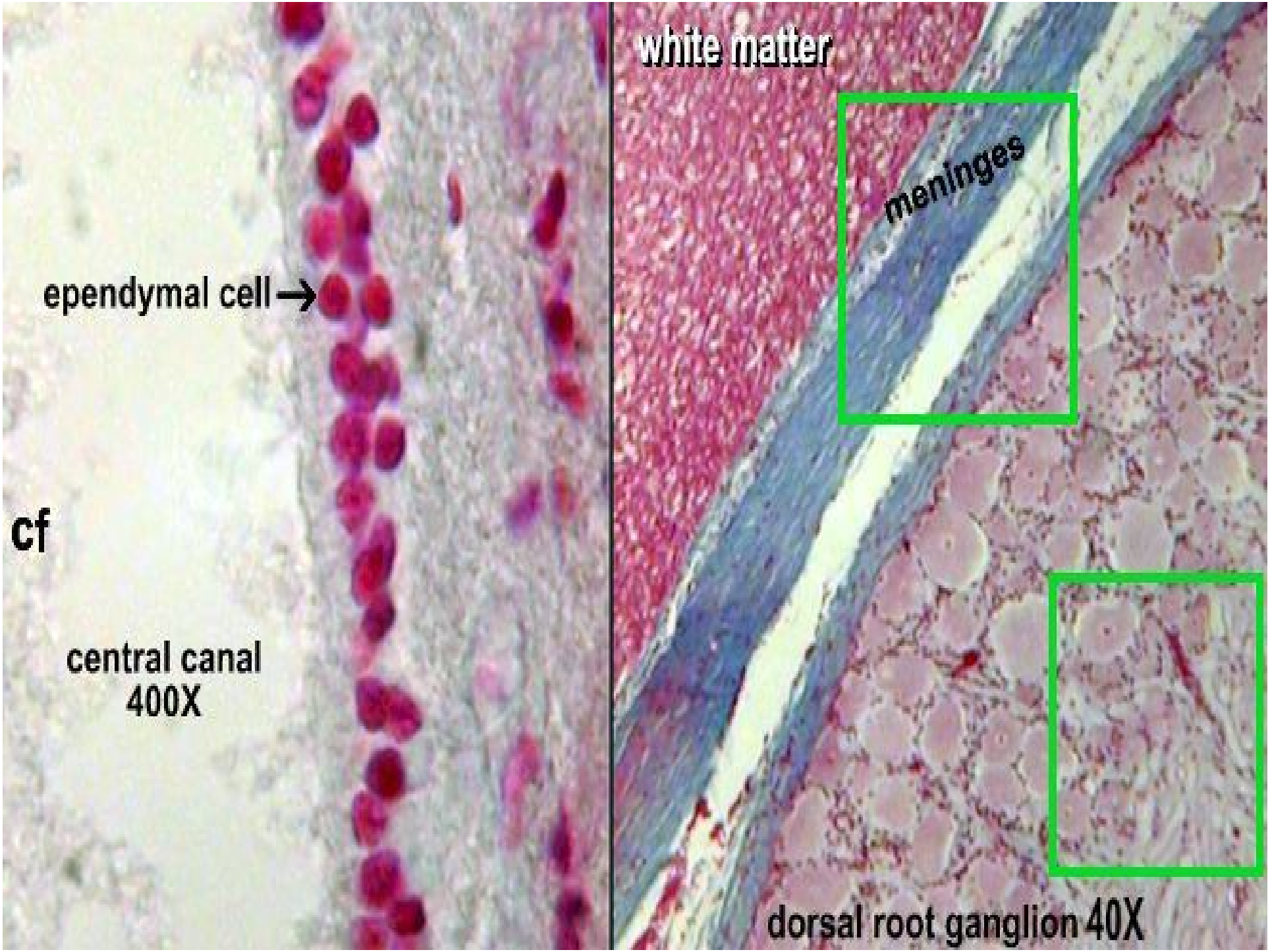
Spinal Cord - Neuron Relationships

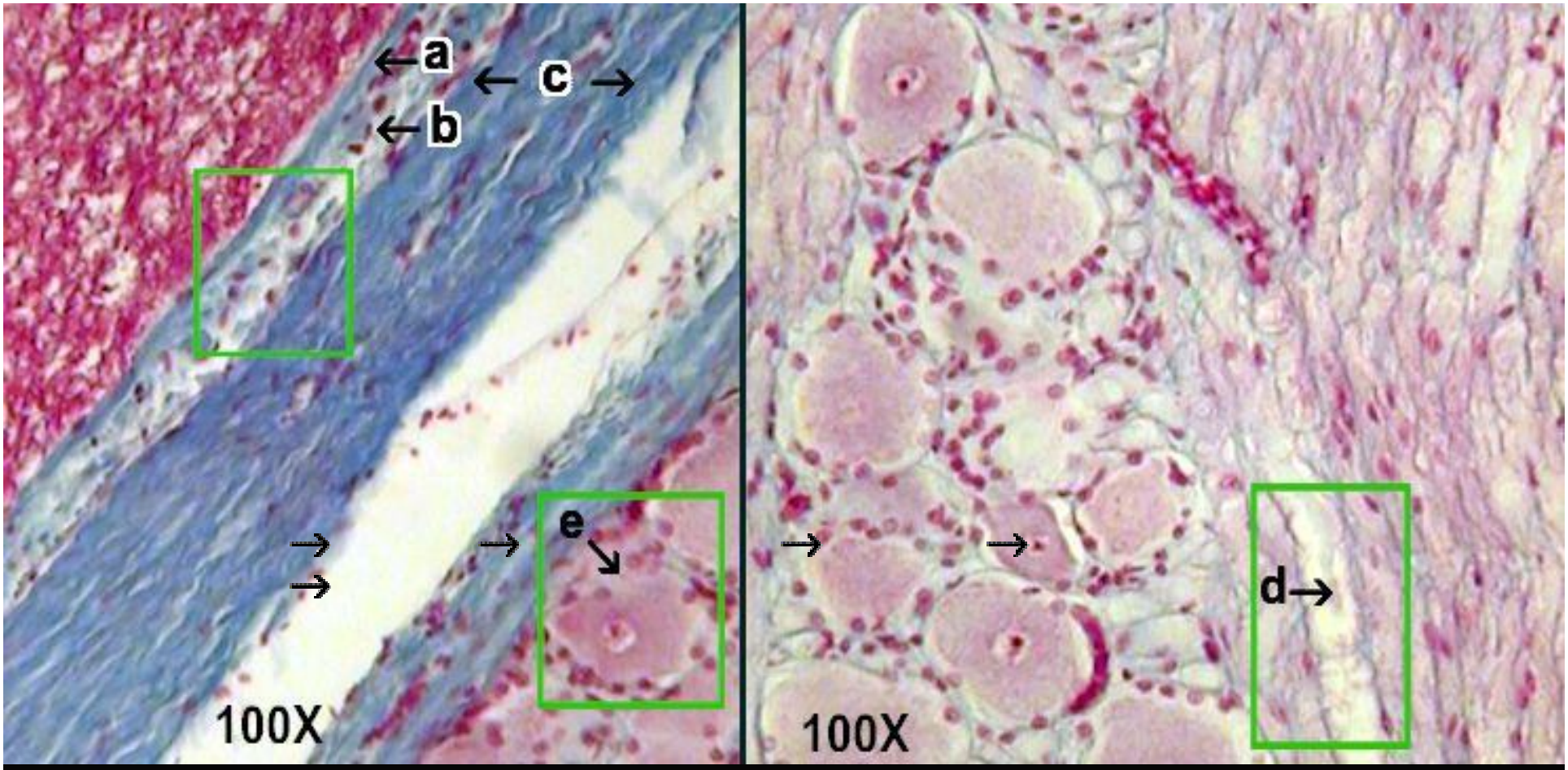



Posterior median sulcus
Posterior grey horn
Dorsal root
Dorsal root ganglion
Ganglion cells
Epineurium
Anterior grey horn
Anterior median fissure
Ventral root
Spinal nerve

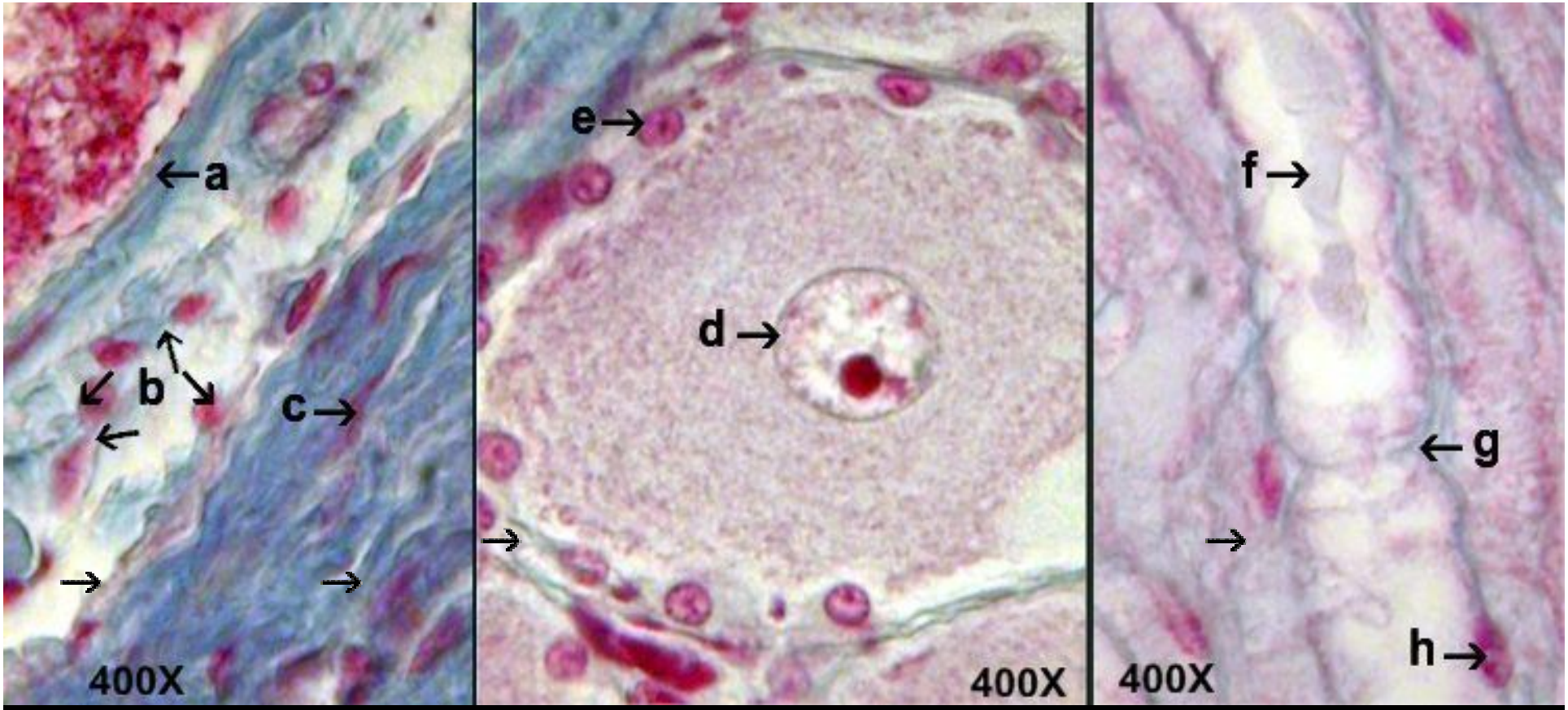

Dorsal rootlets
Posterior median sulcus
Posterior intermediate sulcus
Dorsal root
Central canal
Ventral rootlets (cut)
Anterior median fissure
Anterolateral sulcus
1 mm


Posterior (dorsal)
Spinal Cord Cross Section
posterior funiculus (white matter)
posterior median sulcus
dorsal root
dorsal horn (gray matter)
gray commissure
central canal
lateral funiculus (white matter)
anterior median fissure
ventral horn (gray matter)
meninges
anterior funiculus (white matter)
dorsal root ganglion
Anterior (ventral)
ventral root

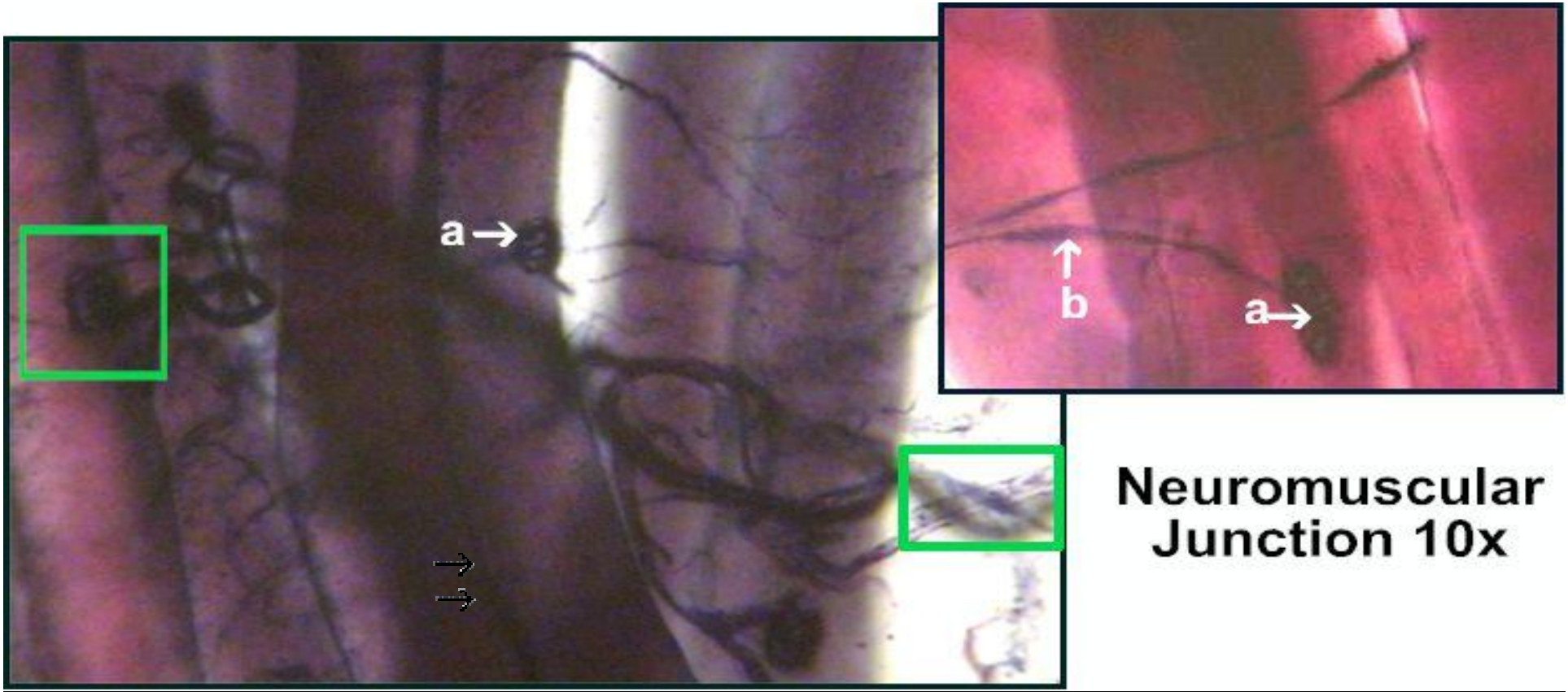

ependymal cell
cf
central canal
400X
white matter
meninges
dorsal root ganglion 40X



a pia mater b subarachnoid space c dura mater d myelinated axon e unipolar neuron of the dorsal root ganglion surrounded by satellite cells (neuroglia).

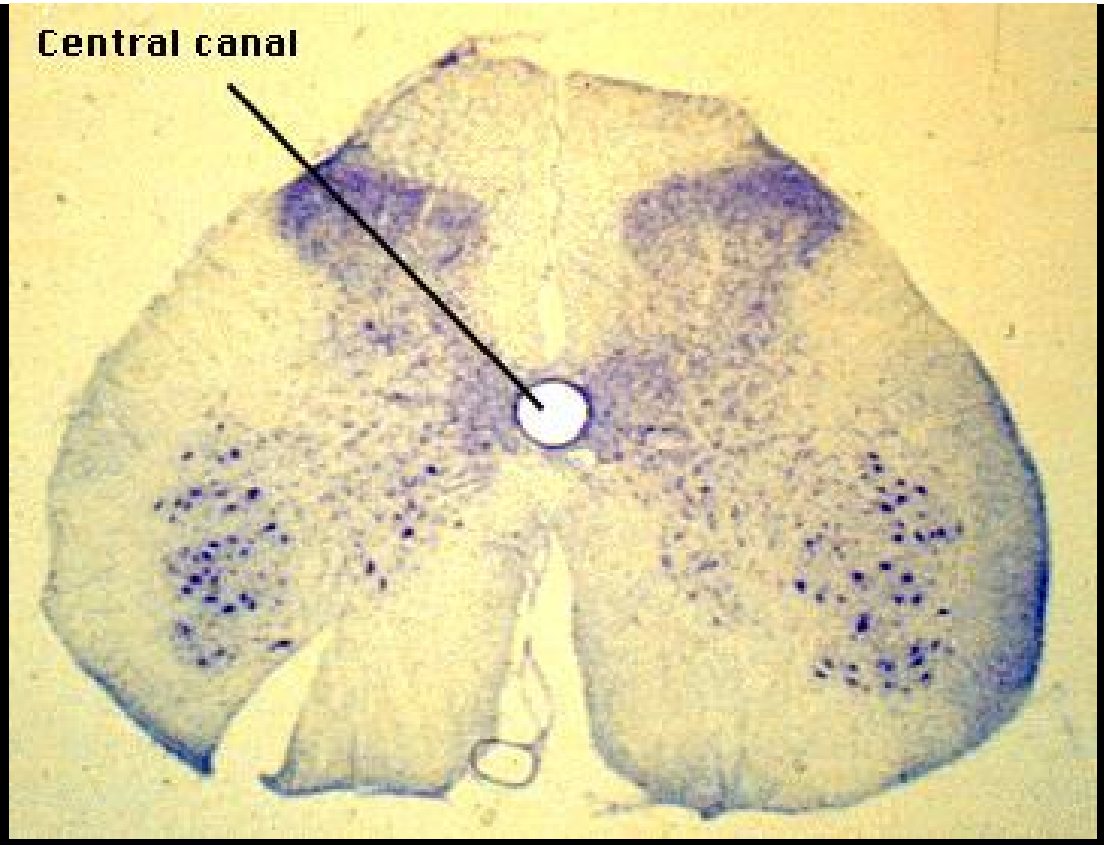


a Pia mater b Subarachnoid space filled with cerebral spinal fluid, wastes and various cells. c Fibrocyte mixed in the blue collagen fibers of the dura mater. d Nucleus & nucleolus of unipolar neuron e Nucleus of one of many tiny satellite cells surrounding the large unipolar neuron. f Myelinated axon g Node of Ranvier h Nucleus of white Schwann cell

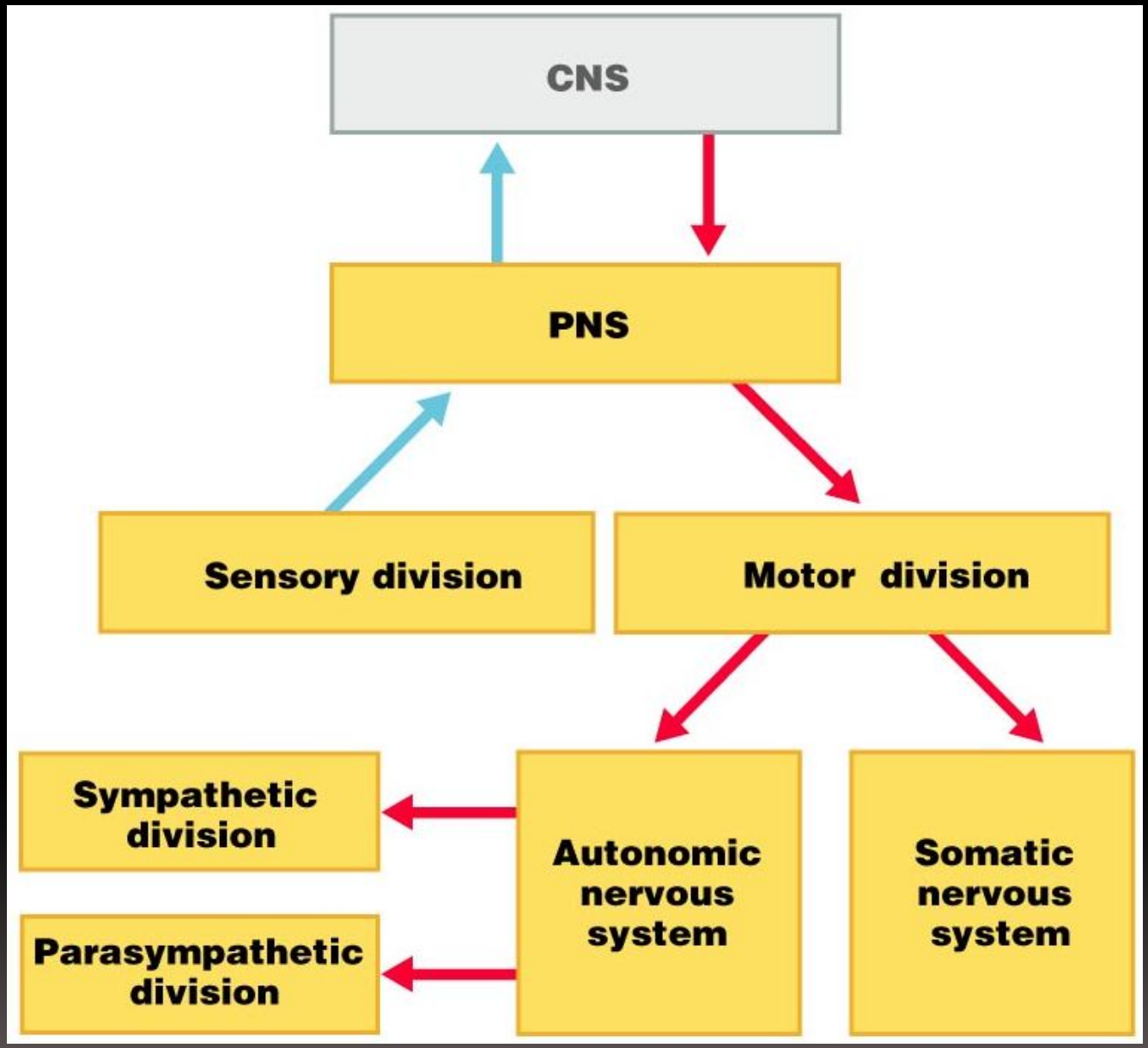


a Synaptic bulbs over the motor end plate - neuromuscular junction

b Neuron axon terminal - black fibers

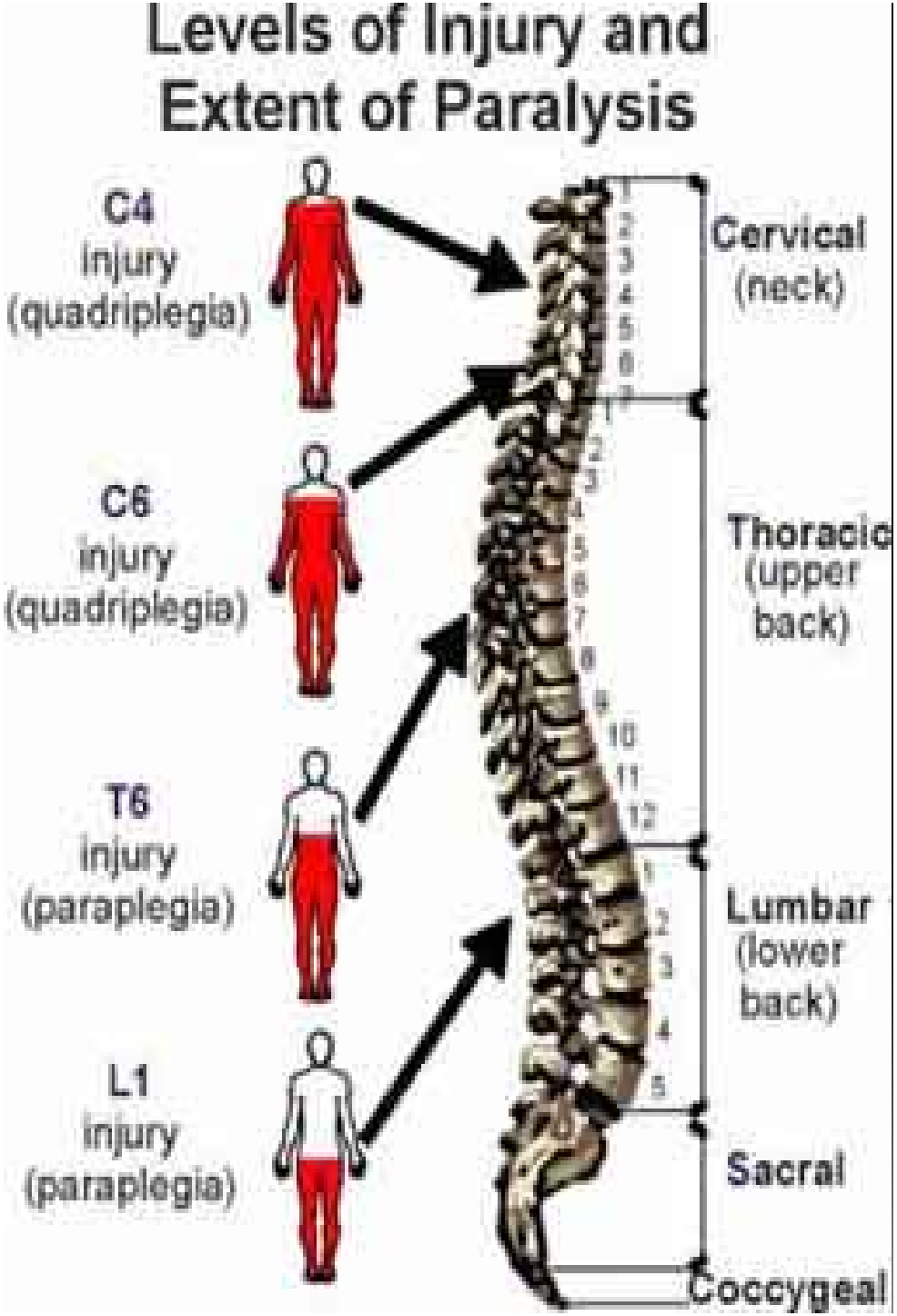


The **central canal** is the cerebrospinal fluid-filled space that runs longitudinally through the length of the entire spinal cord. The central canal is contiguous with the ventricular system of the brain.

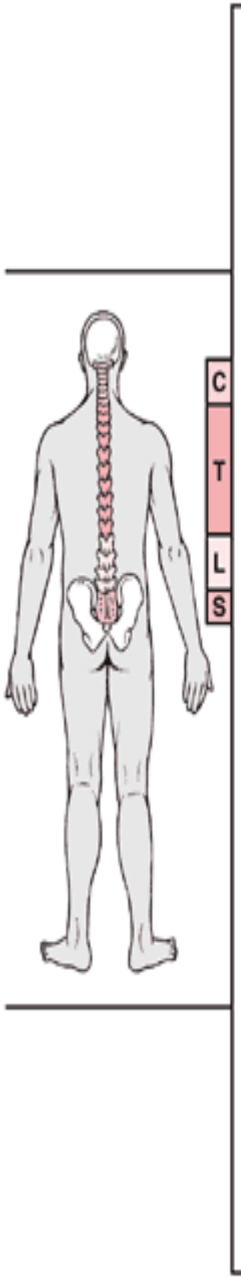


PNS in the Nervous System

Figure 13.1



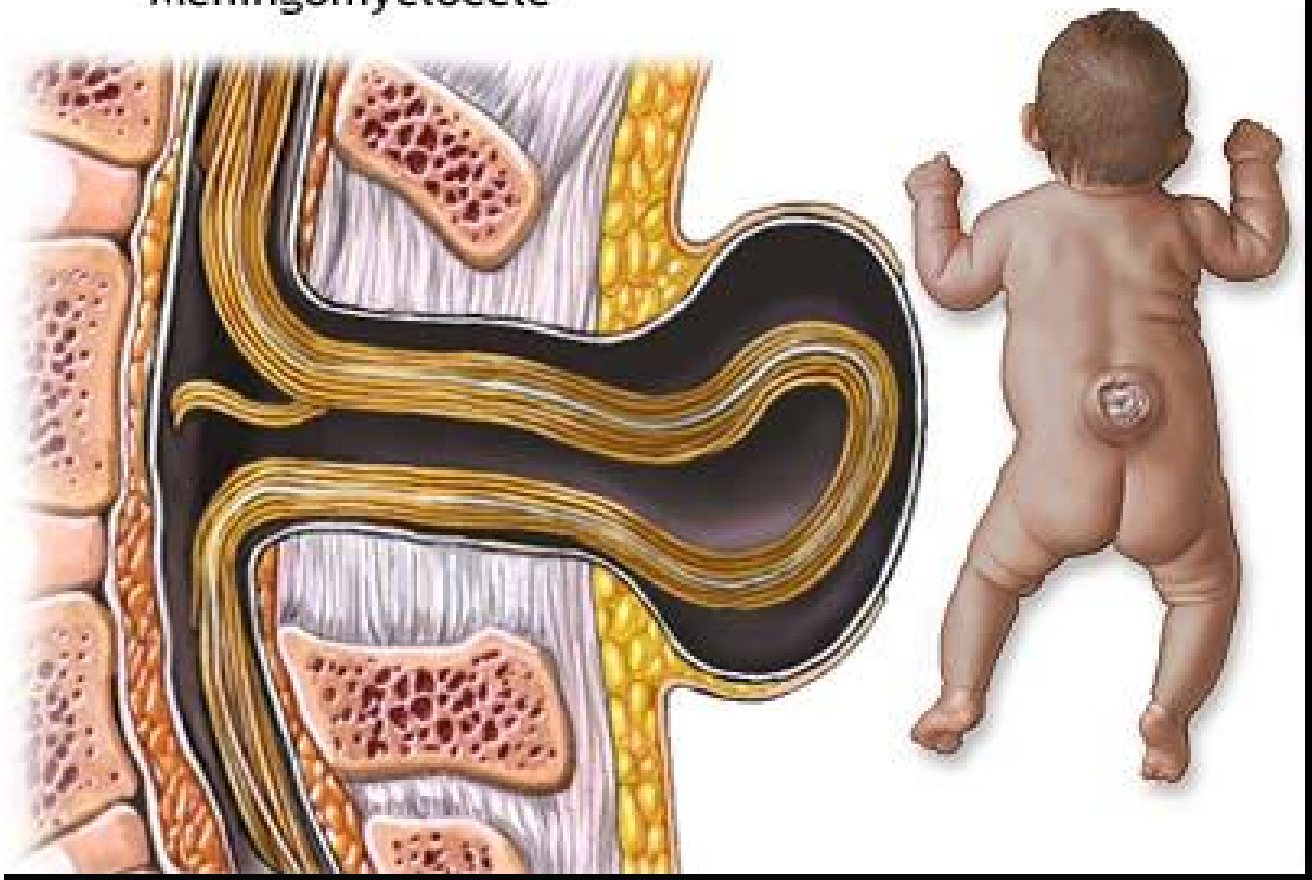
Effects of Spinal Injury



Level of Injury	Effect*
C1 to C5	Paralysis of muscles used for breathing and of all arm and leg muscles; usually fatal.
C5 to C6	Legs paralyzed; slight ability to flex arms
C6 to C7	Paralysis of legs and part of wrists and hands; shoulder movement and elbow bending relatively preserved
C8 to T1	Legs and trunk paralyzed; eyelids droop; loss of sweating on the forehead (Horner's syndrome); arms relatively normal; hands paralyzed
T2 to T4	Legs and trunk paralyzed; loss of feeling below the nipples
T5 to T8	Legs and lower trunk paralyzed; loss of feeling below the rib cage
T9 to T11	Legs paralyzed; loss of feeling below the umbilicus
T12 to L1	Paralysis and loss of feeling below the groin
L2 to L5	Different patterns of leg weakness and numbness
S1 to S2	Different patterns of leg weakness and numbness
S3 to S5	Loss of bladder and bowel control; numbness in the perineum

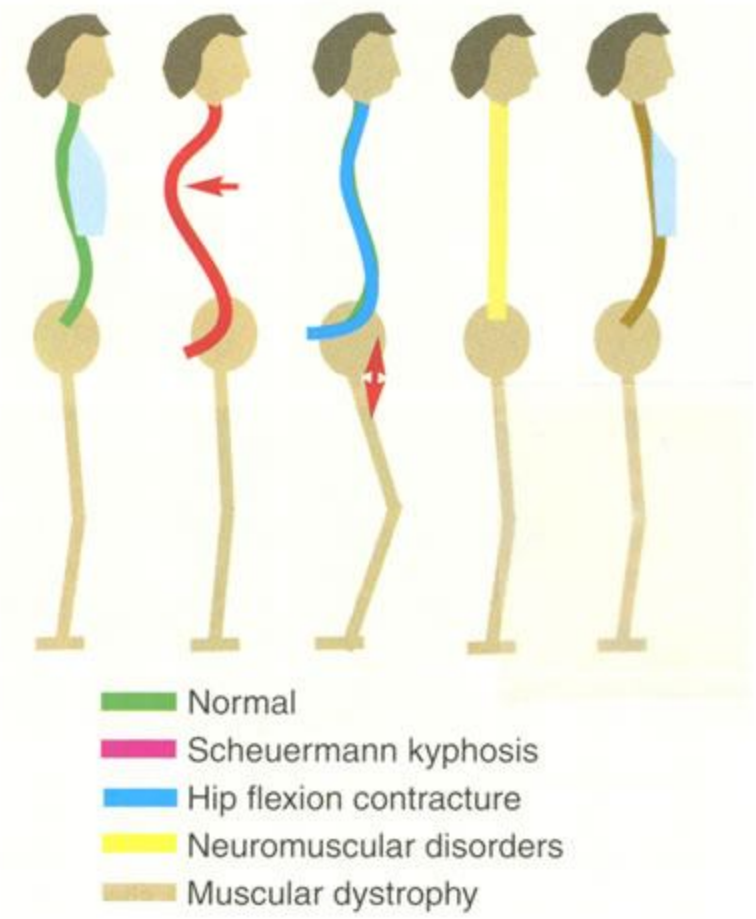
*Loss of bladder and bowel control can occur with severe injury anywhere along the spinal column

Meningomyelocele



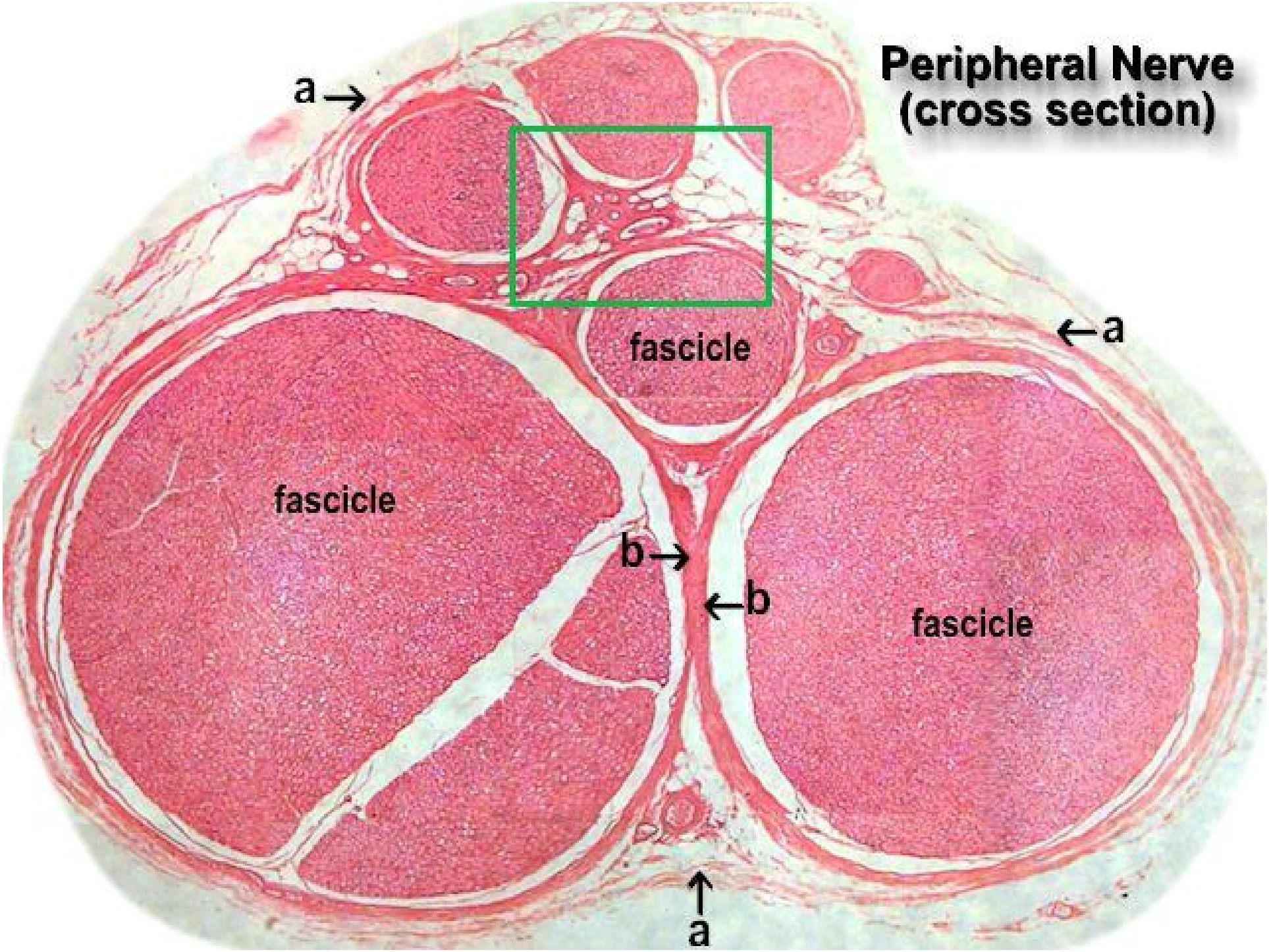
Scheuermann kyphosis

In some rare cases, the bones of the back (vertebrae) do not grow correctly. In Scheuermann kyphosis, the front part of the vertebrae does not grow as well as the back part.



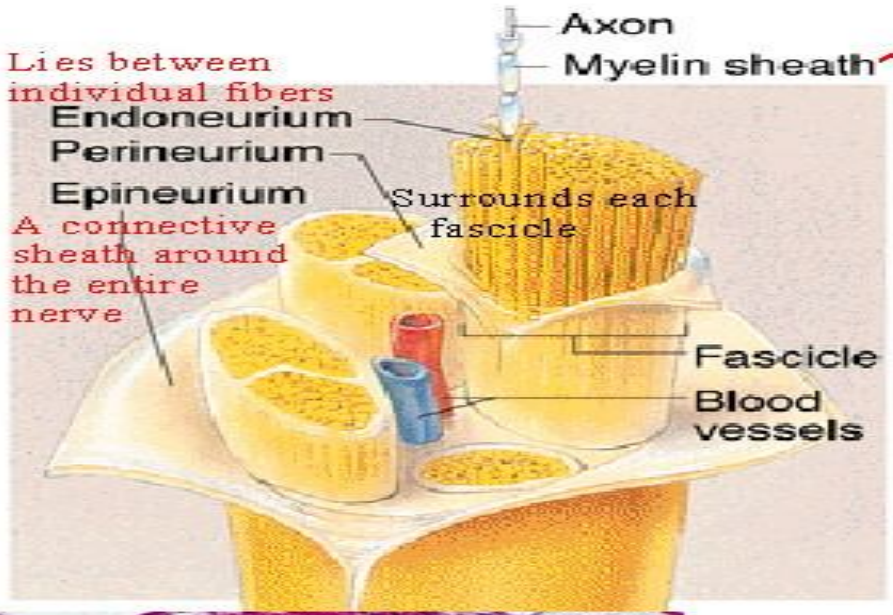
Structure of a Nerve

- Nerve – cordlike organ of the PNS consisting of peripheral axons enclosed by connective tissue
- Connective tissue coverings include:
  - Endoneurium – loose connective tissue that surrounds axons
  - Perineurium – coarse connective tissue that bundles fibers into fascicles
  - Epineurium – tough fibrous sheath around a nerve

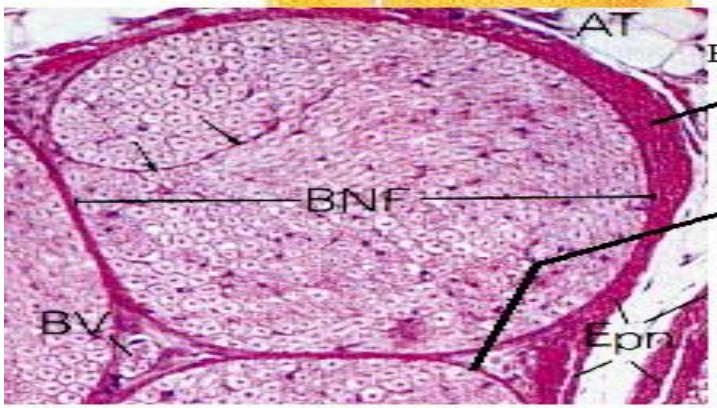

Peripheral Nerve
(cross section)
a
a
a
fascicle
fascicle
fascicle
b
b

Structure of a Nerve

Consists of a continuous series of Schwann cells wrapped around the fiber.



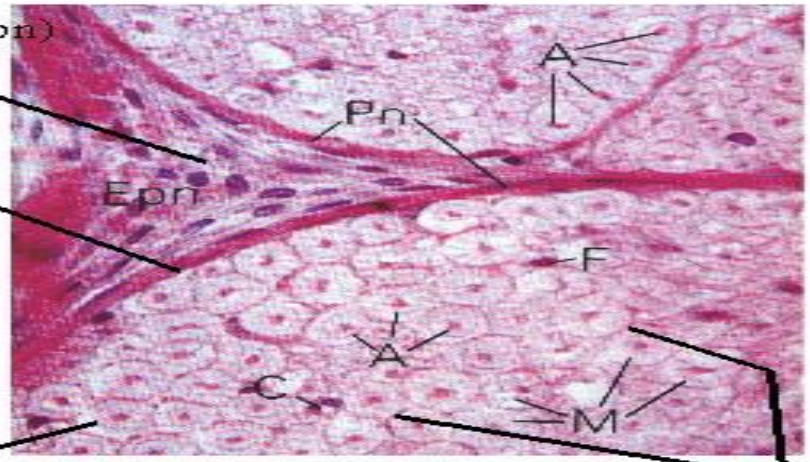
A nerve is a group of axons (nerve fibers) outside the CNS. These fibers are bundled together with connective layers. Many of the fibers are myelinated, which means they have a covering made from successive wrappings of Schwann cells.



BV=blood vessel, BNF=fascicle, A=axons, F=a fibroblast, C=capillary.

Epineurium (Epn)

Perineurium (Pn)



M = the myelin sheath, composed of wrappings of a Schwann cell. The outer membrane or layer of the myelin sheath is called the neurilemma.

Structure of a Nerve

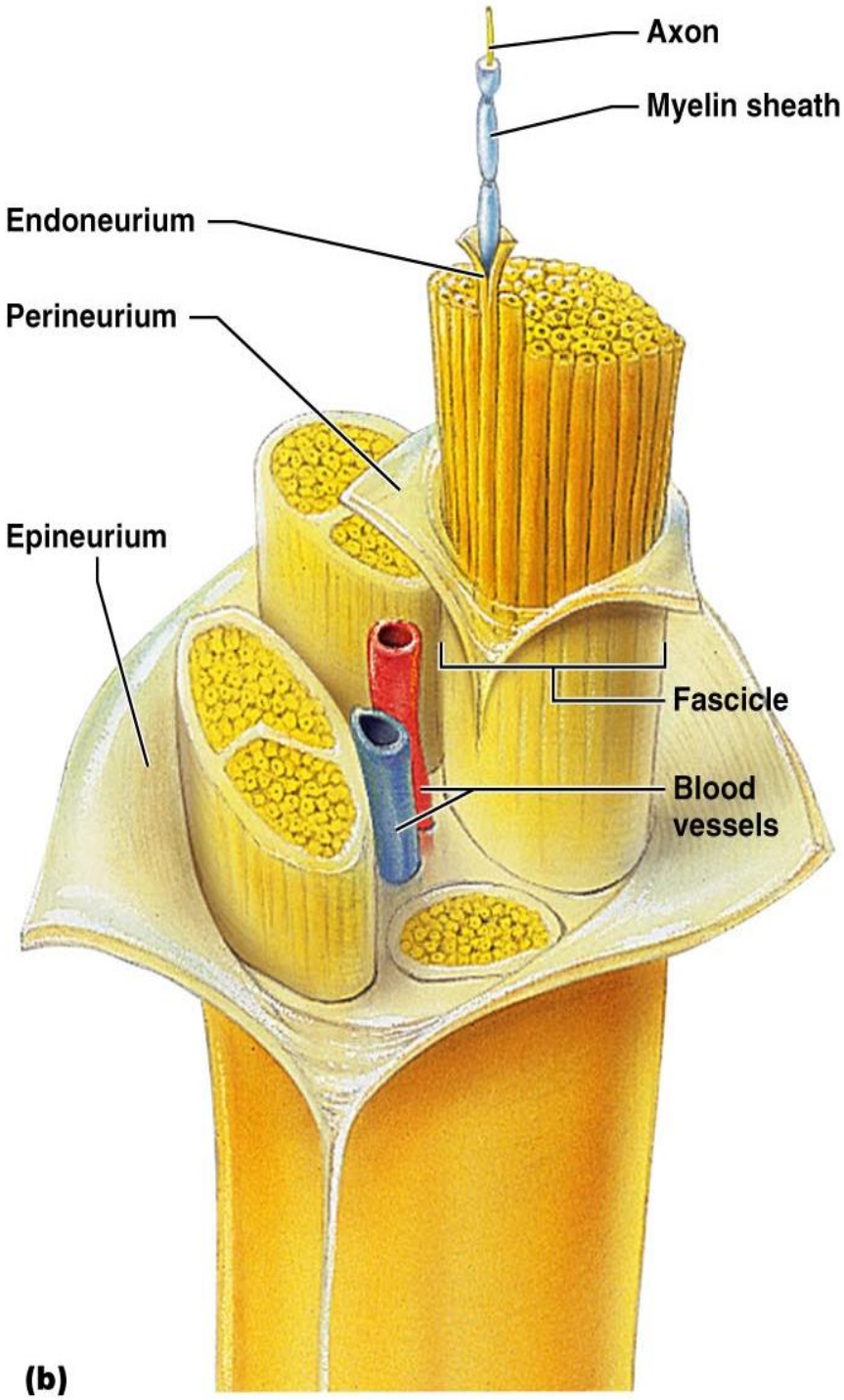


Figure 13.3b

Classification of Nerves

- Sensory and motor divisions
- Sensory (afferent) – carry impulse to the CNS
- Motor (efferent) – carry impulses from CNS
- Mixed – sensory and motor fibers carry impulses to and from CNS; most common type of nerve

Peripheral Nerves

- Mixed nerves – carry somatic and autonomic (visceral) impulses
- The four types of mixed nerves are:
  - Somatic afferent and somatic efferent
  - Visceral afferent and visceral efferent
- Peripheral nerves originate from the brain or spinal column

Regeneration of Nerve Fibers

- Damage to nerve tissue is serious because mature neurons are amitotic
- If the soma of a damaged nerve remains intact, damage can be repaired
- Regeneration involves coordinated activity among:
  - Macrophages – remove debris
  - Schwann cells – form regeneration tube and secrete growth factors
  - Axons – regenerate damaged part

Regeneration of Nerve Fibers

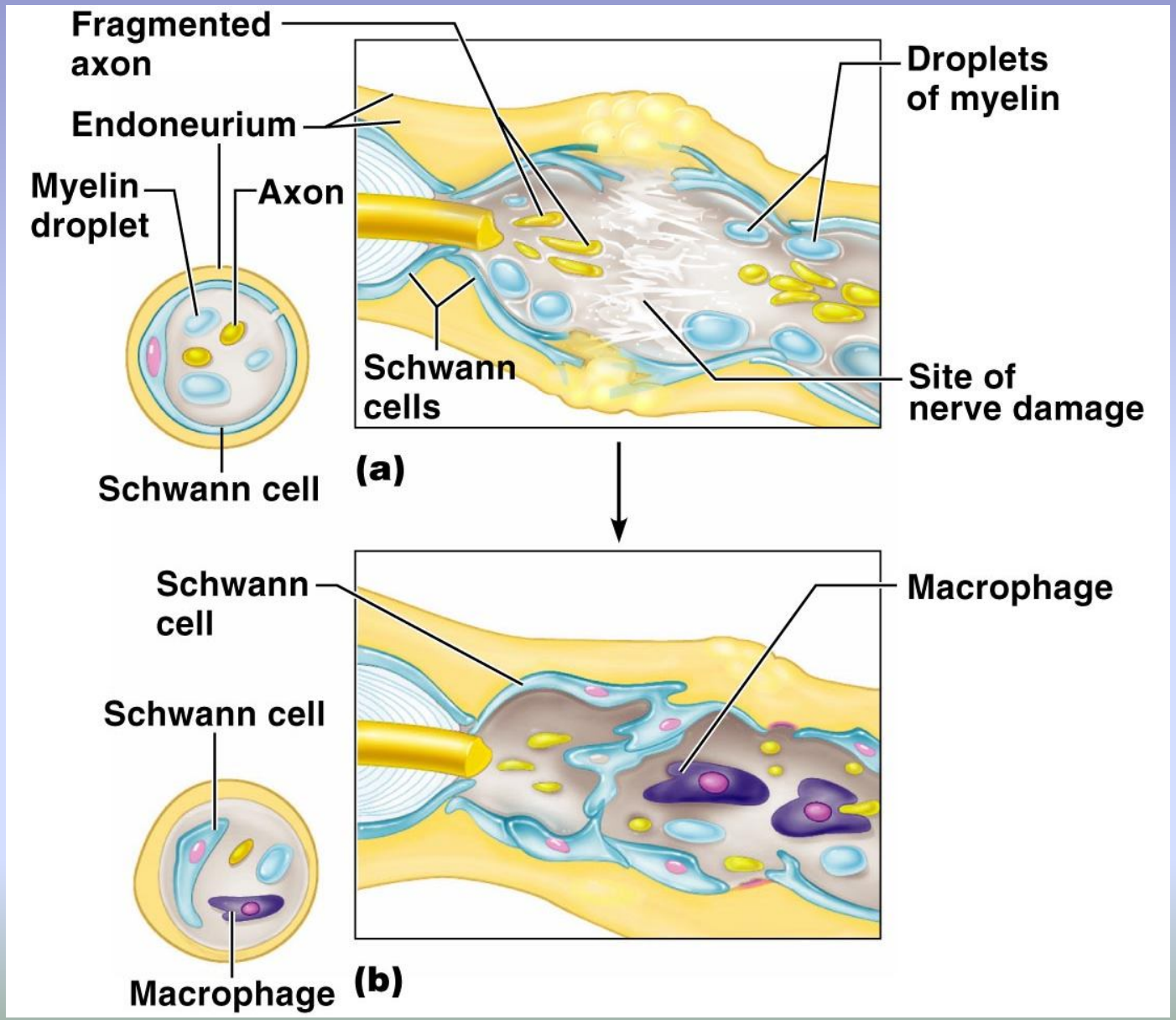


Figure 13.4

Regeneration of Nerve Fibers

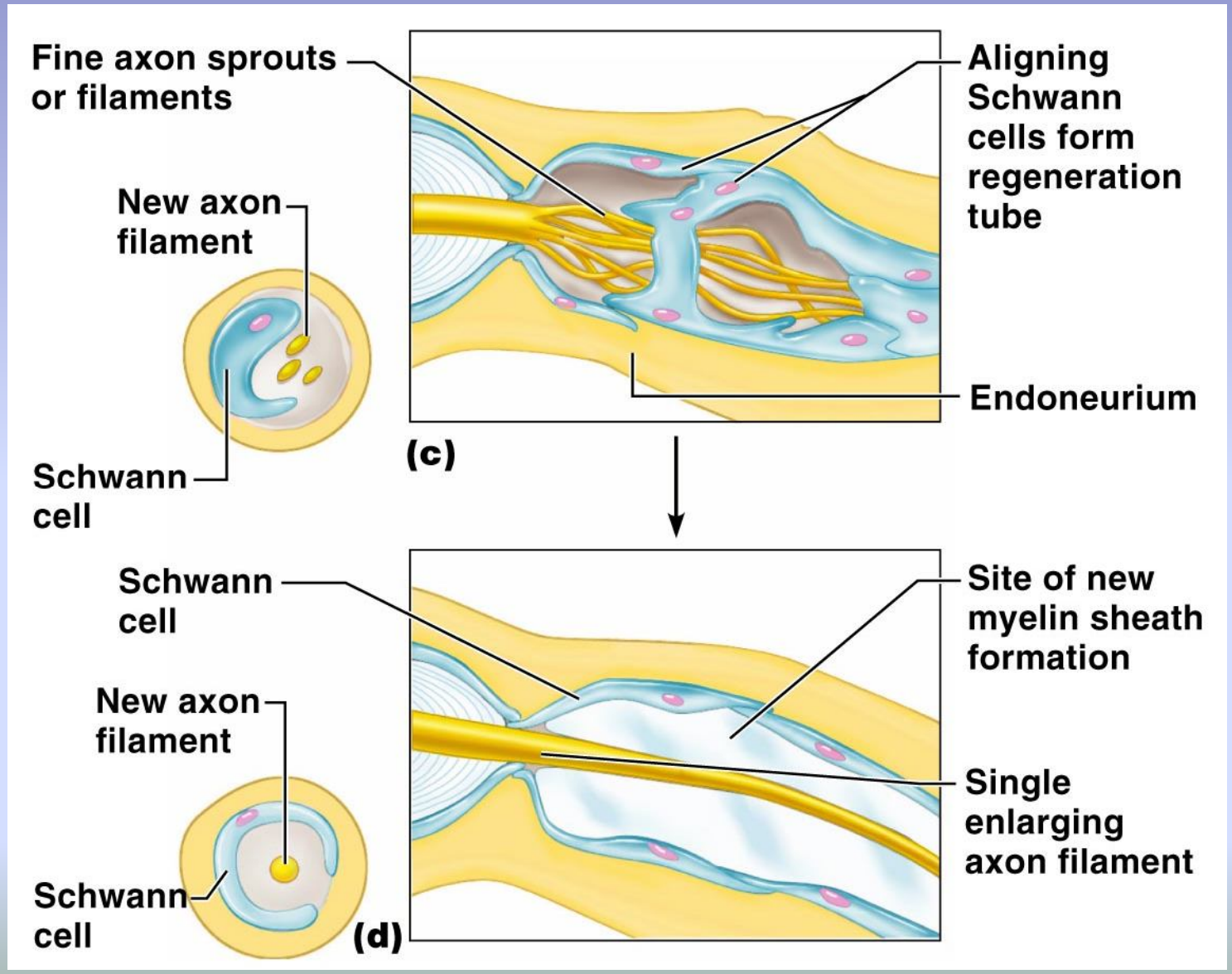


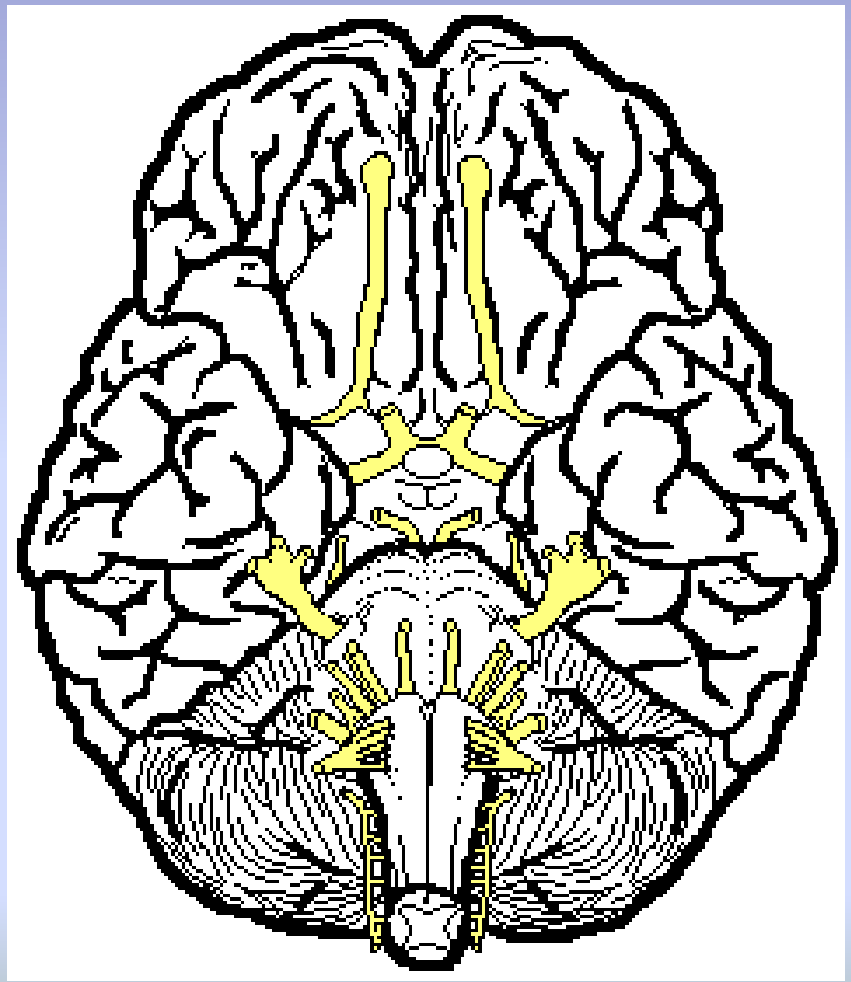
Figure 13.4

Cranial Nerves

- Twelve pairs of cranial nerves arise from the brain
- They have sensory, motor, or both sensory and motor functions
- Each nerve is identified by a number (I through XII) and a name
- Four cranial nerves carry parasympathetic fibers that serve muscles and glands

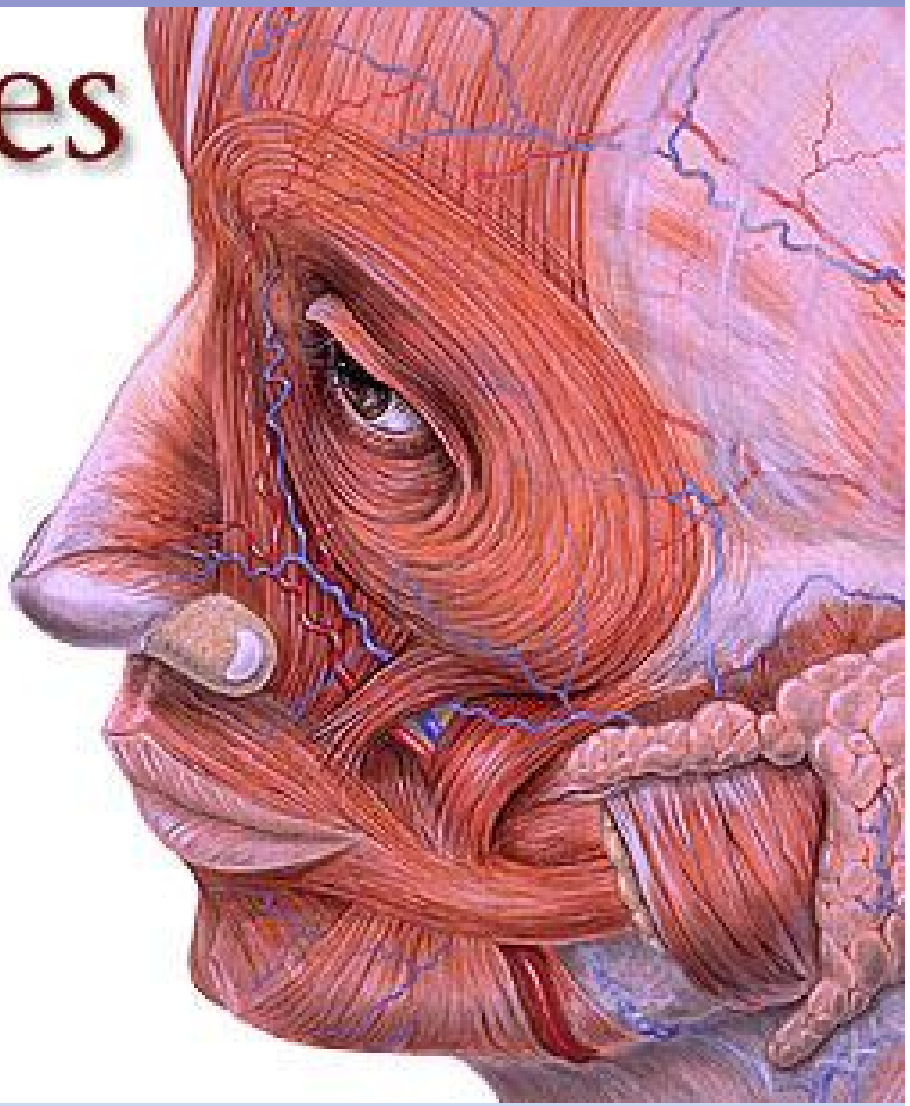
Peripheral Nervous System

- 31 spinal nerves
  - We've already discussed their structure
- 12 cranial nerves
  - How do they differ from spinal nerves?
  - We need to learn their:
    - Names
    - Locations
    - Functions



Cranial Nerves

I	Olfactory
II	Optic
III	Oculomotor
IV	Trochlear
V	Trigeminal
VI	Abducens
VII	Facial
VIII	Vestibulocochlear
IX	Glossopharyngeal
X	Vagus
XI	Accessory
XII	Hypoglossal



Cranial Nerves

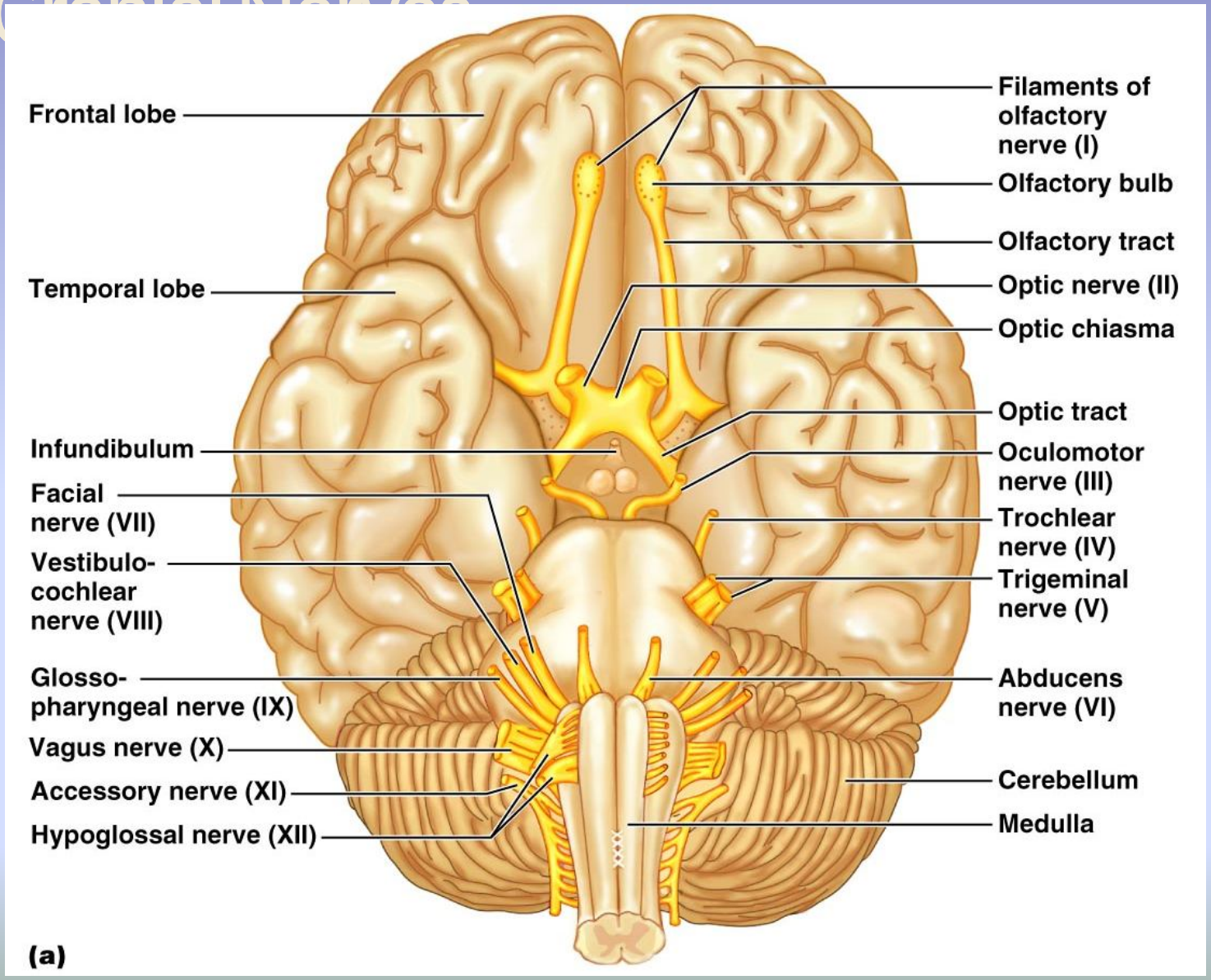


Figure 13.5a

Summary of Function of Cranial Nerves

Cranial nerves I – VI	Sensory function	Motor function	PS* fibers
I Olfactory	Yes (smell)	No	No
II Optic	Yes (vision)	No	No
III Oculomotor	No	Yes	Yes
IV Trochlear	No	Yes	No
V Trigeminal	Yes (general sensation)	Yes	No
VI Abducens	No	Yes	No

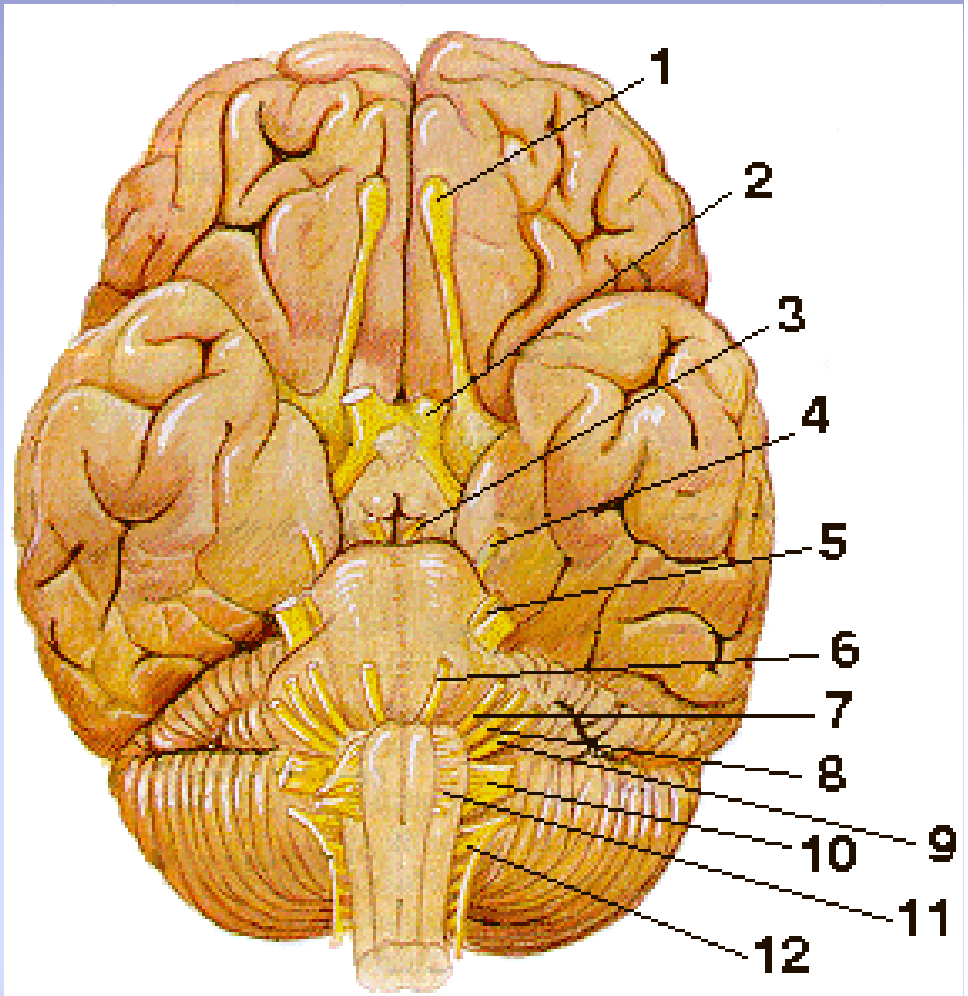
Cranial nerves VII – XII	Sensory function	Motor function	PS* fibers
VII Facial	Yes (taste)	Yes	Yes
VIII Vestibulocochlear	Yes (hearing and balance)	Some	No
IX Glossopharyngeal	Yes (taste)	Yes	Yes
X Vagus	Yes (taste)	Yes	Yes
XI Accessory	No	Yes	No
XII Hypoglossal	No	Yes	No

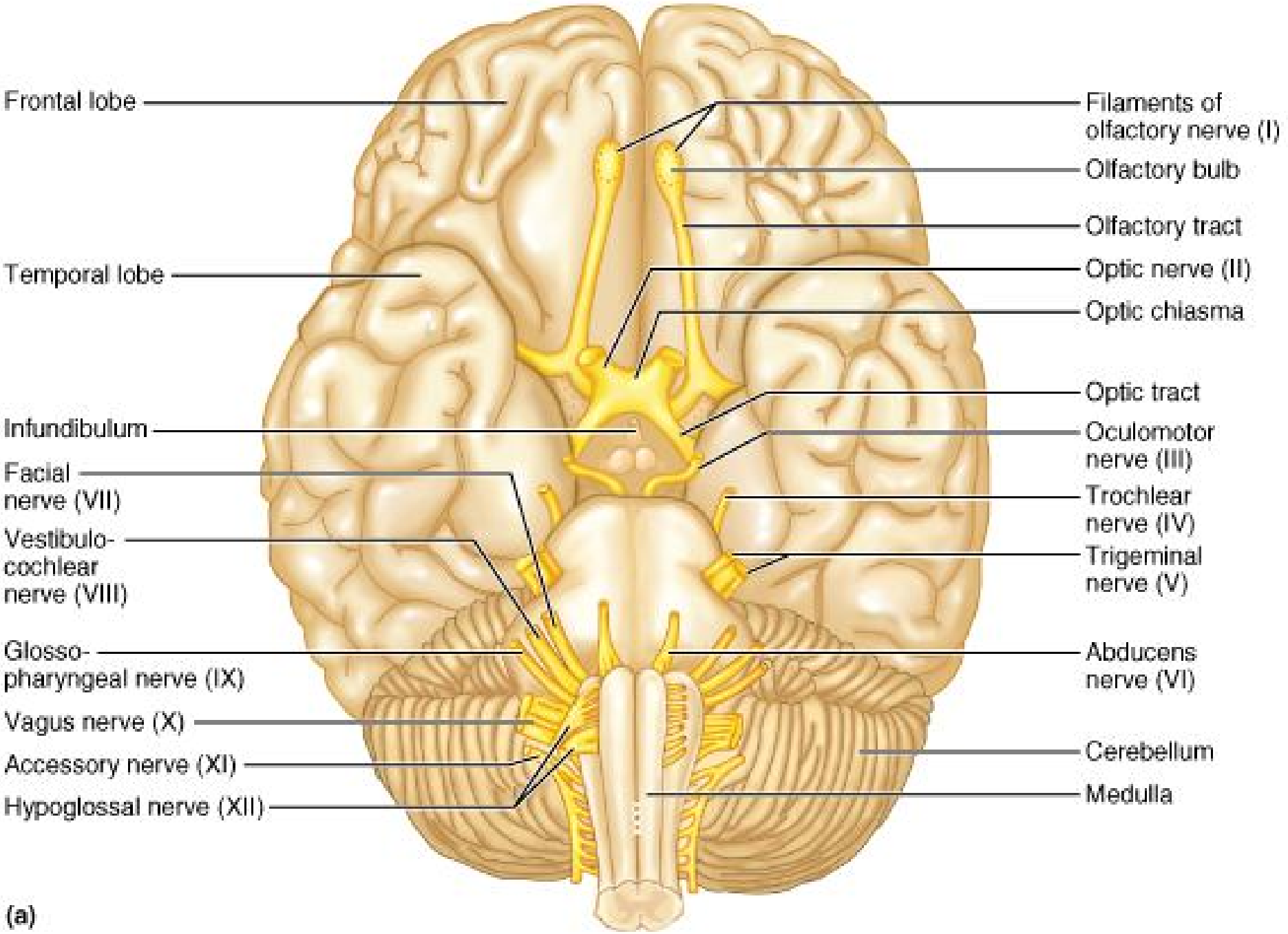
(b) *PS = parasympathetic

Figure 13.5b

12 Cranial Nerves

- How do you remember which nerve is which number?
  - Here is a G-rated mnemonic devices:
    - Old Opie occasionally tries trigonometry and feels very gloomy, vague, and hypoactive.
  - There are also several R-rated ones
- Some cranial nerves are sensory, some motor, and some are both (mixed)?
  - Some say marry money but my brother says big butts matter more.




Frontal lobe
Temporal lobe
Infundibulum
Facial nerve (VII)
Vestibulo-cochlear nerve (VIII)
Glosso-pharyngeal nerve (IX)
Vagus nerve (X)
Accessory nerve (XI)
Hypoglossal nerve (XII)
Filaments of olfactory nerve (I)
Olfactory bulb
Olfactory tract
Optic nerve (II)
Optic chiasma
Optic tract
Oculomotor nerve (III)
Trochlear nerve (IV)
Trigeminal nerve (V)
Abducens nerve (VI)
Cerebellum
Medulla
(a)

Cranial Nerve I: Olfactory

- Arises from the olfactory epithelium
- Passes through the cribriform plate of the ethmoid bone
- Fibers run through the olfactory bulb and terminate in the primary olfactory cortex
- Functions solely by carrying afferent impulses for the sense of smell

Cranial Nerve I: Olfactory

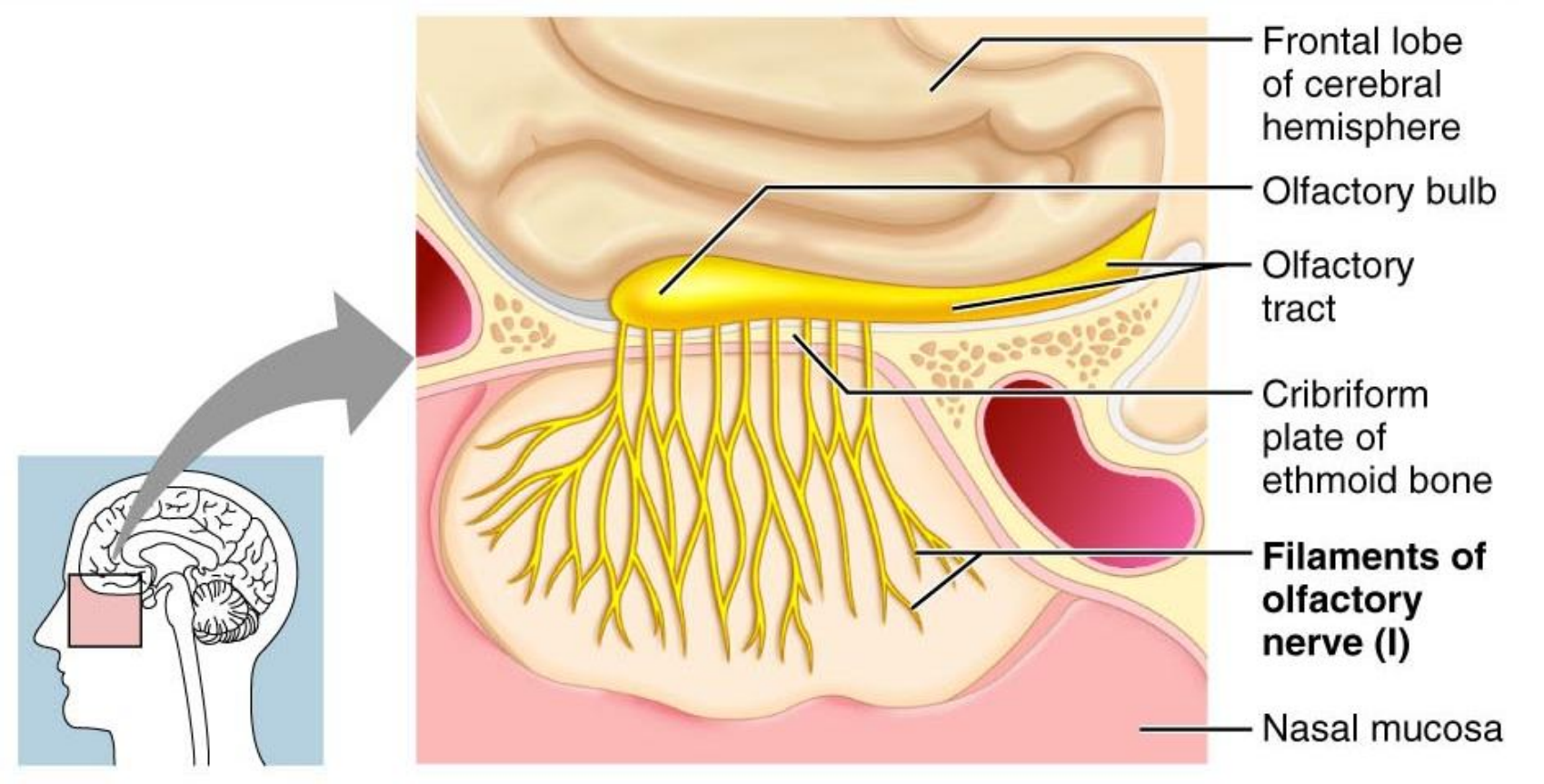
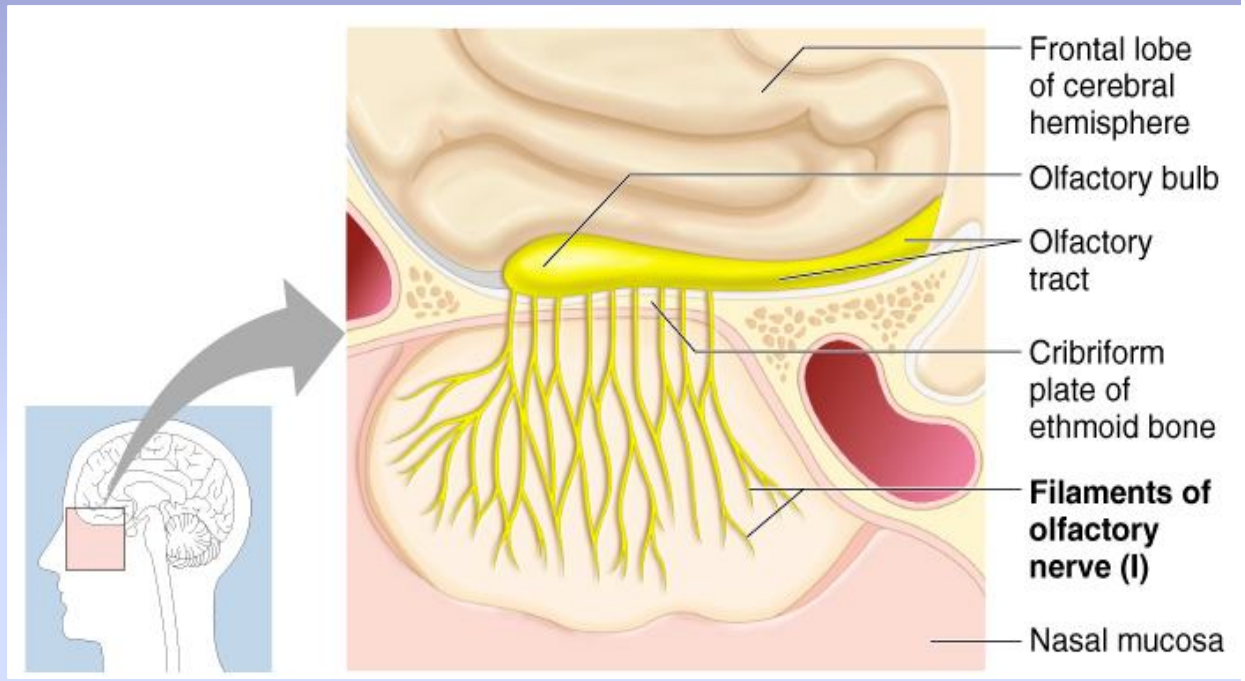
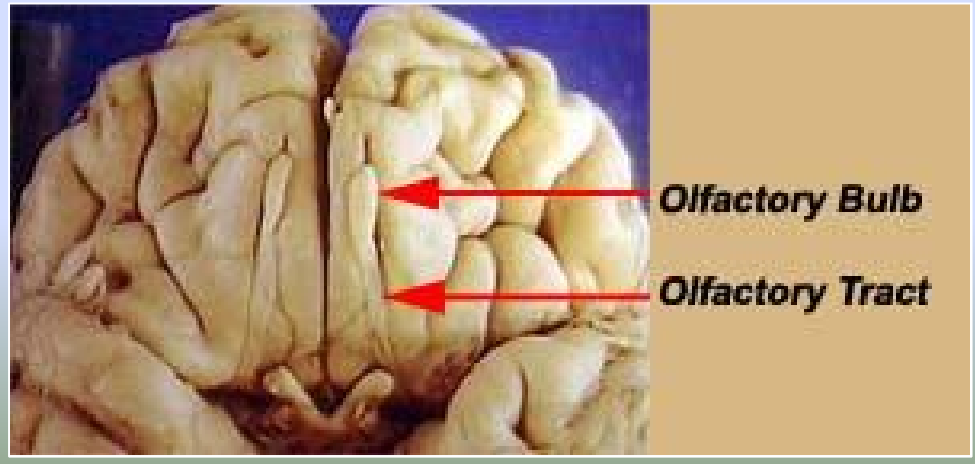


Figure I from Table 13.2

CN1 Olfactory nerves

- How many noses do you have?
- Sensory, motor, or mixed?
- Run from the nasal mucosa to the olfactory bulb.
- Extend thru the cribriform plate.
- Lesion to these nerves or cribriform plate fracture may yield anosmia – loss of smell.





Cranial Nerve II: Optic

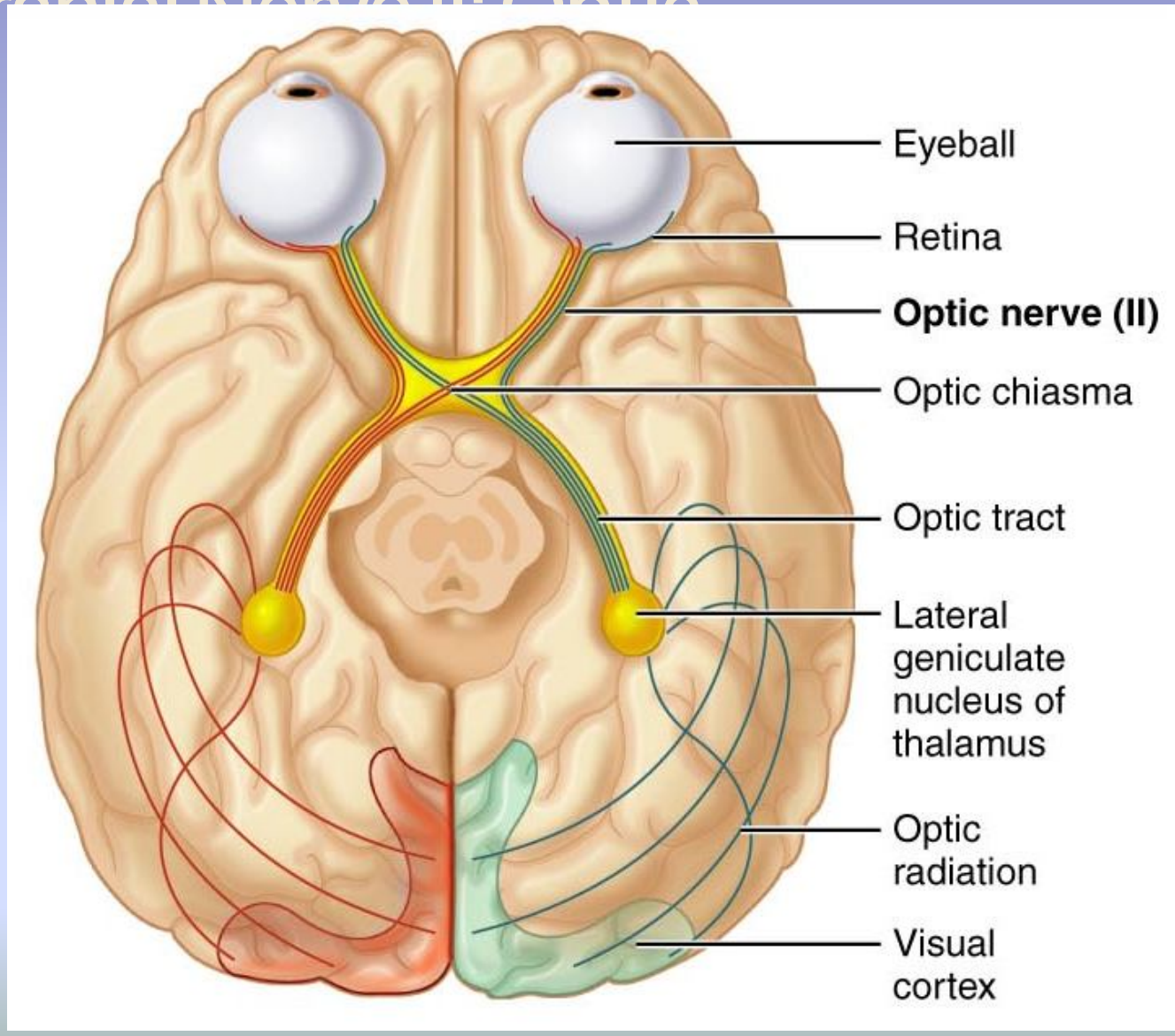
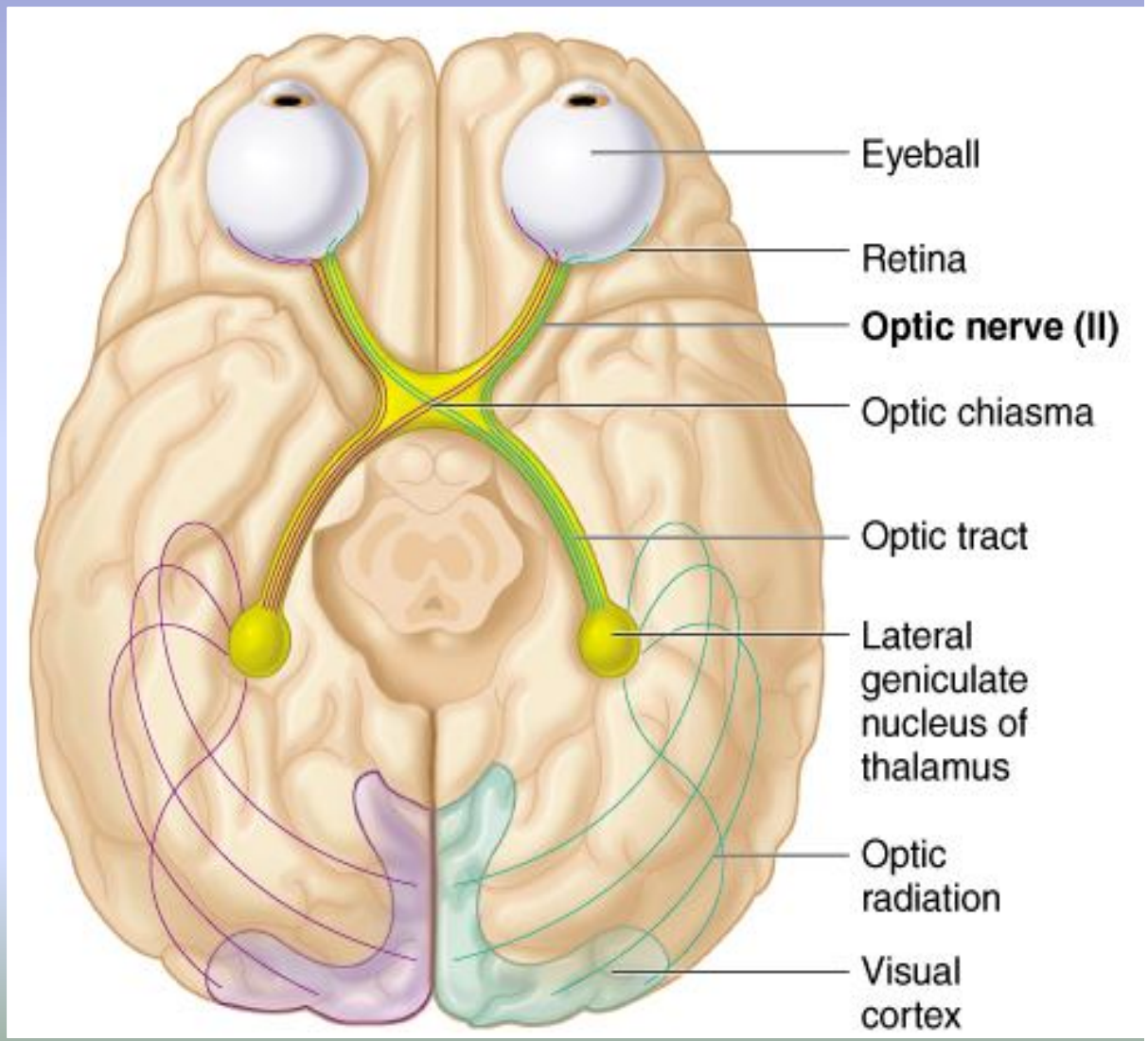
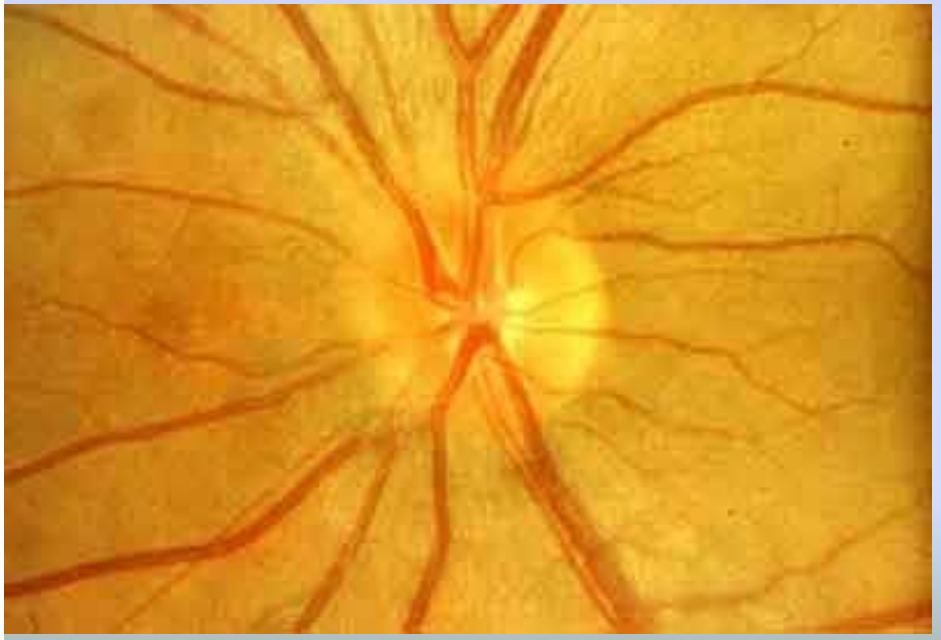


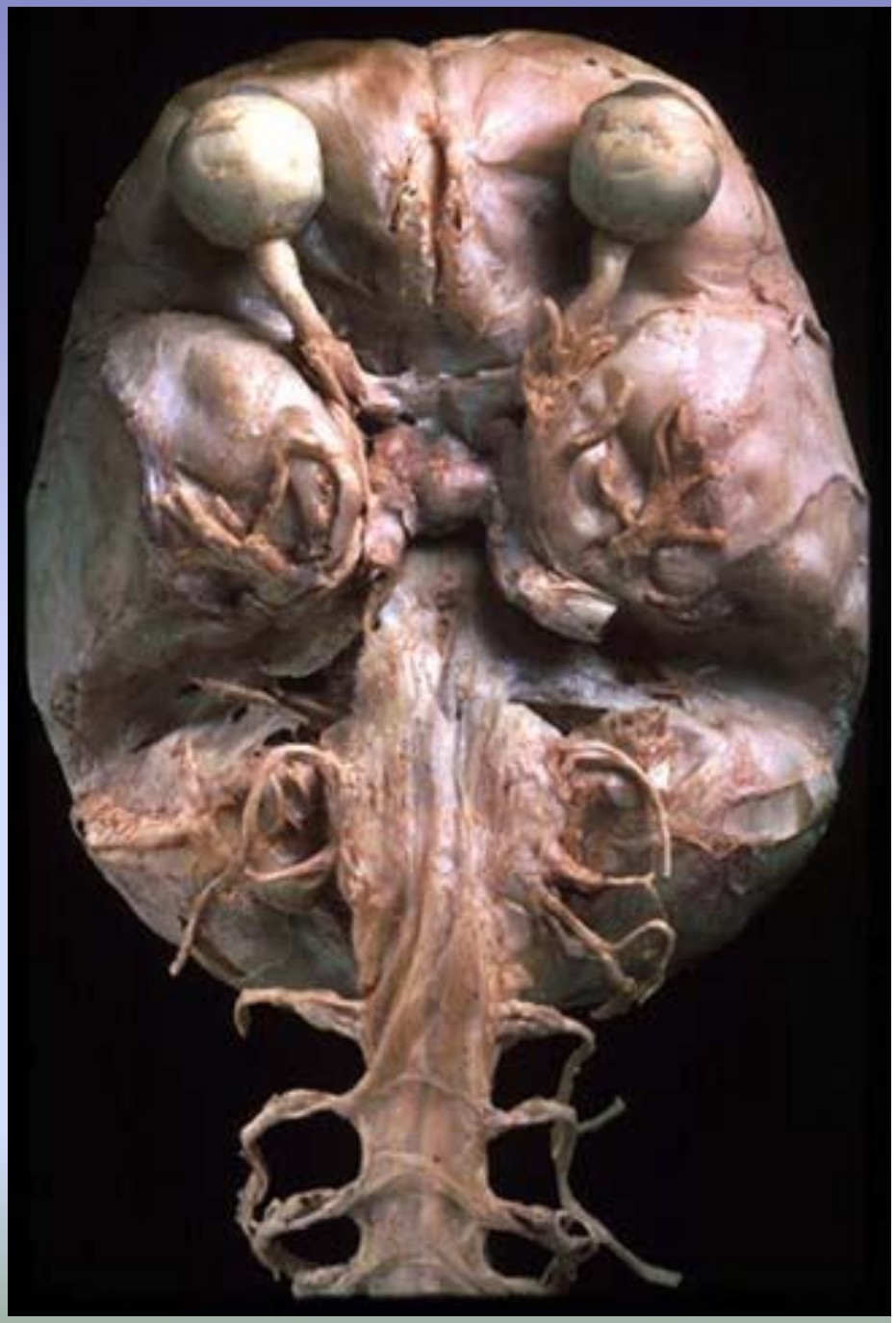
Figure II from Table 13.2

CN2
Optic Nerves

- How many eyes do you have?
- Sensory, motor, or mixed?
- Begin at the retina, run to the optic chiasm, cross over, continue as the optic tract and synapse in the thalamus.
- Optic nerve damage yields blindness in the eye served by the nerve. Optic tract damage yields partial visual loss.
- Visual defects = anopsias



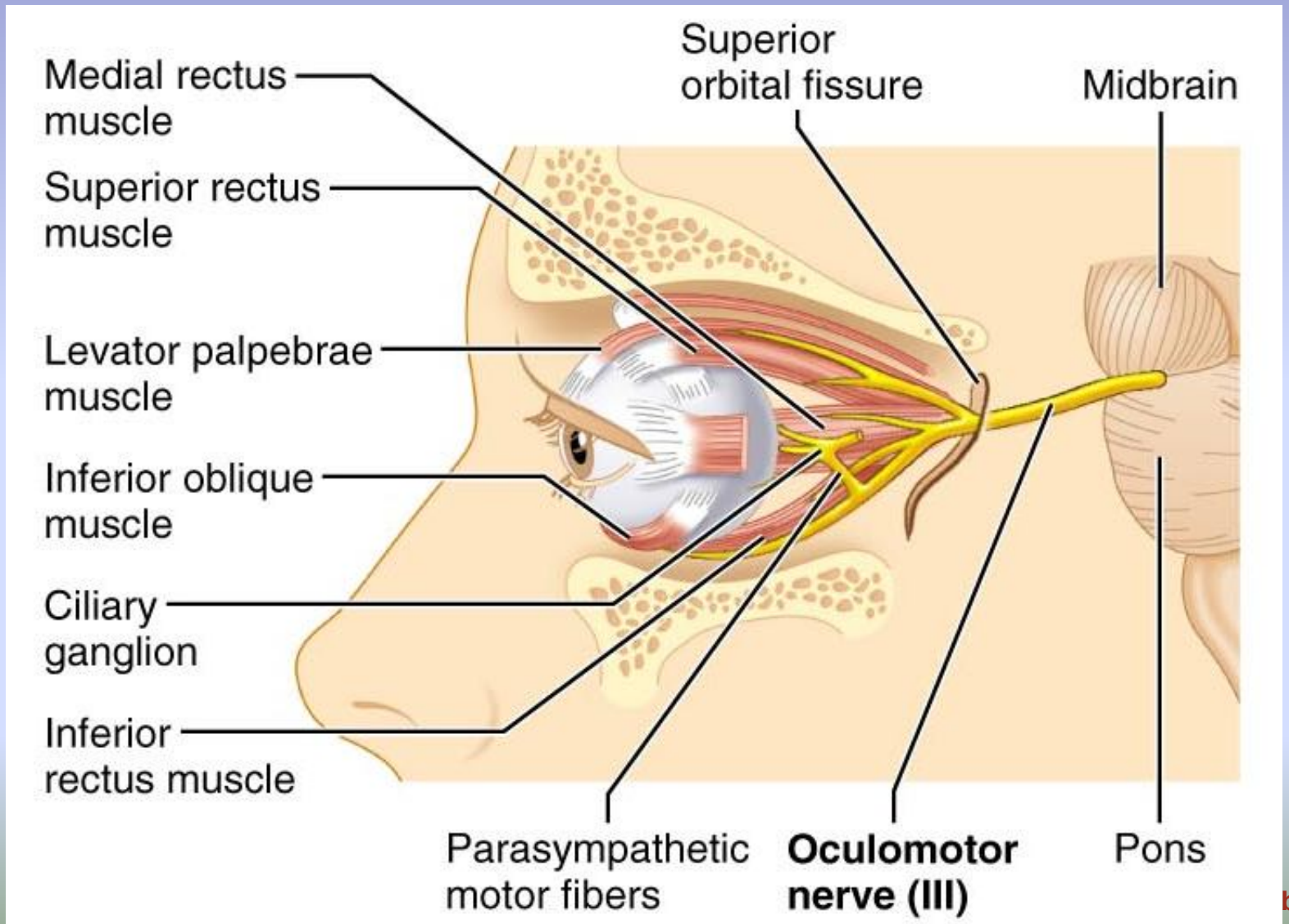




Cranial Nerve III: Oculomotor

- Fibers extend from the ventral midbrain, pass through the superior orbital fissure, and go to the extrinsic eye muscles
- Functions in raising the eyelid, directing the eyeball, constricting the iris, and controlling lens shape
- Parasympathetic cell bodies are in the ciliary ganglia

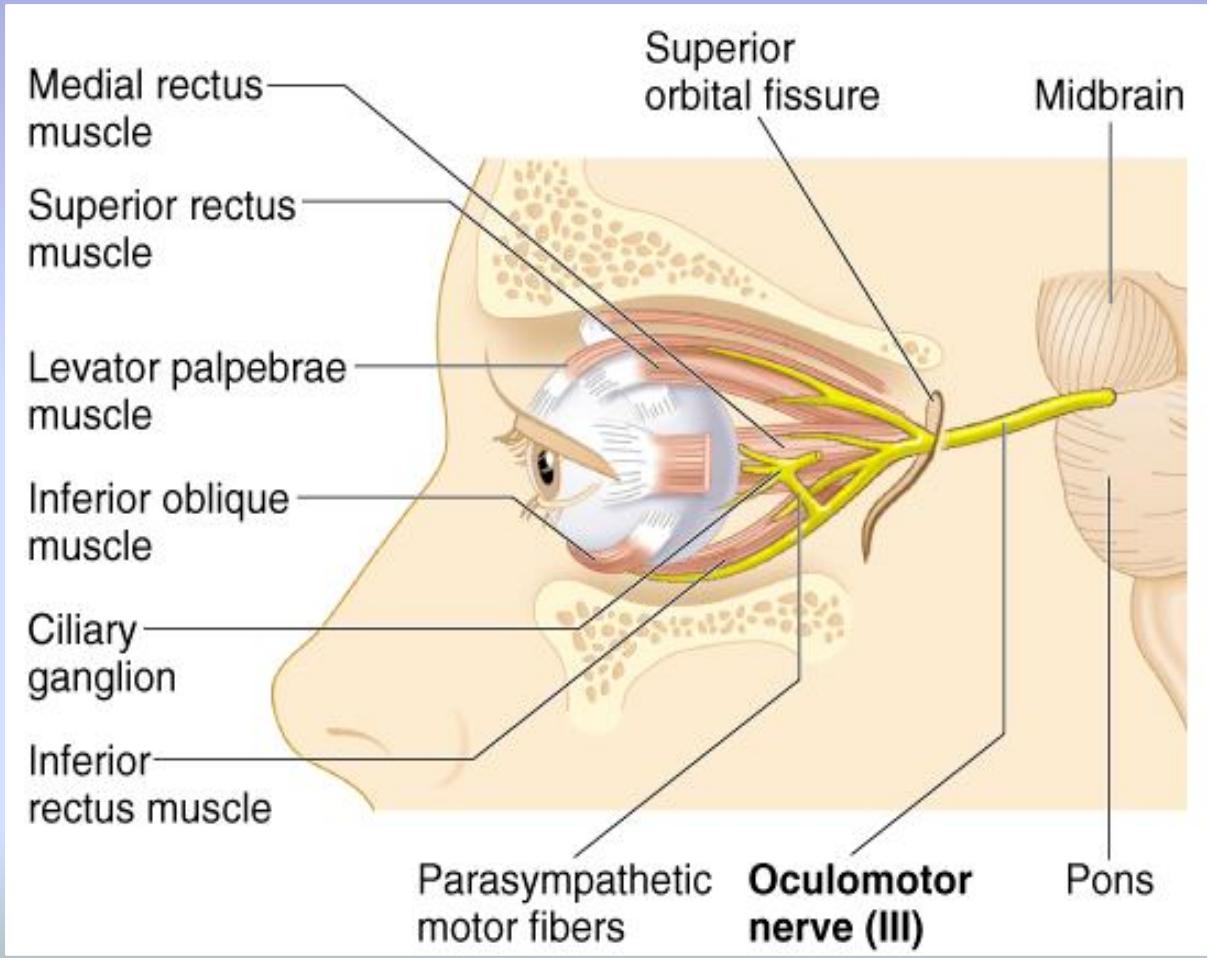
Cranial Nerve III: Oculomotor



ble 13.2

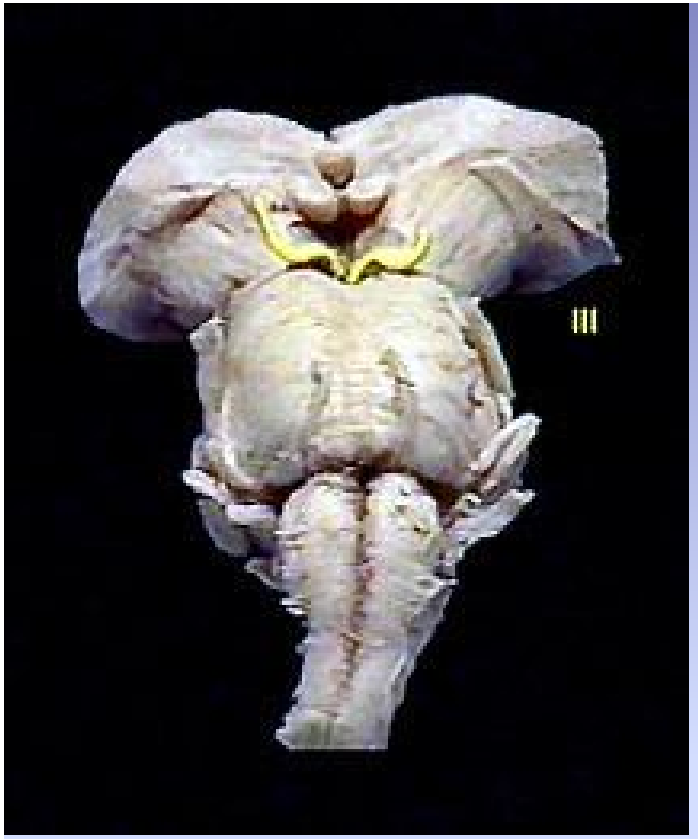
CN3
Oculomotor Nerves

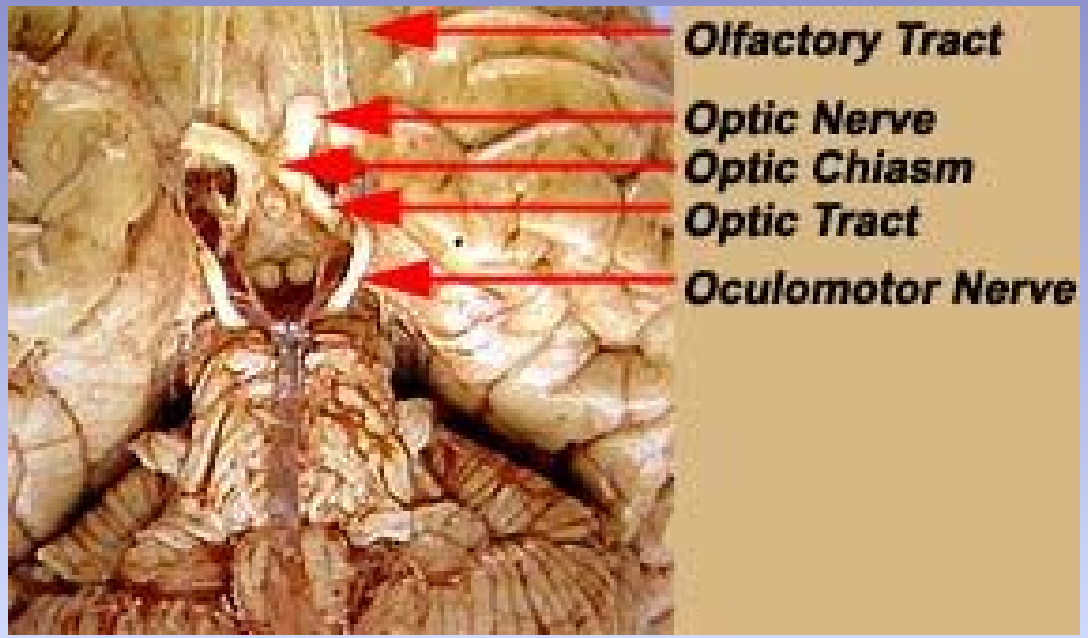
- "Eye mover"
- Sensory, motor, or mixed?
- Originate at the ventral midbrain.
- Synapse on:
  - Extraocular muscles
    - Inferior oblique; Inferior, medial, and superior rectus
  - Iris constrictor muscle
  - Ciliary muscle
- Disorders can result in eye paralysis, diplopia or ptosis.



Cranial Nerve IV: Trochlear

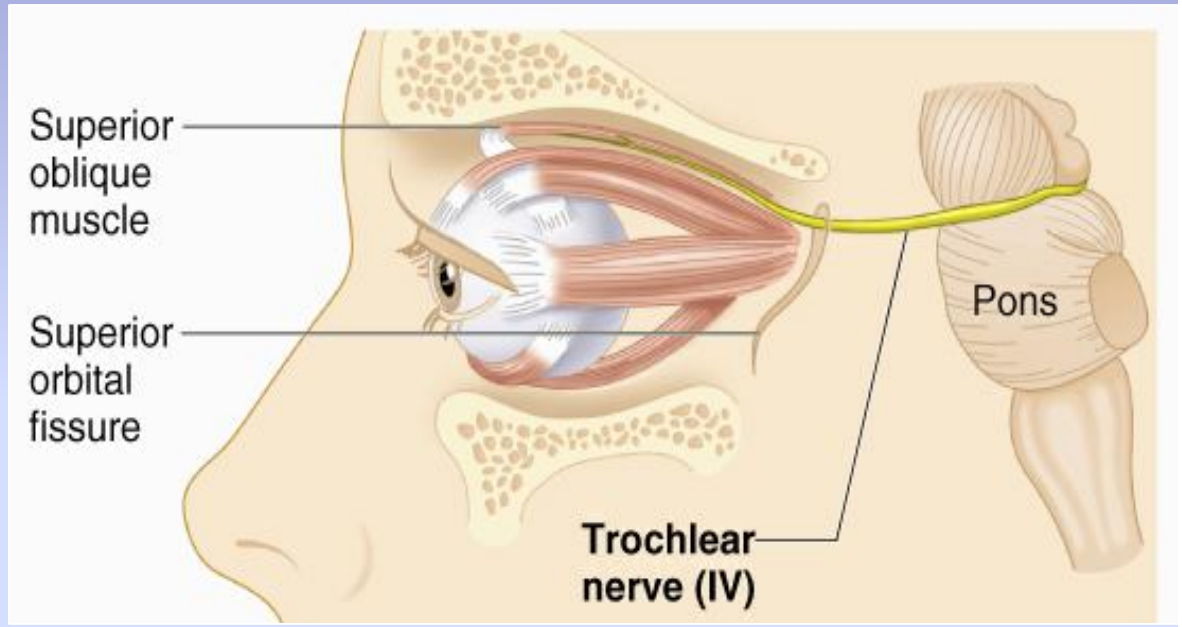
- Fibers emerge from the dorsal midbrain and enter the orbits via the superior orbital fissures; innervate the superior oblique muscle
- Primarily a motor nerve that directs the eyeball

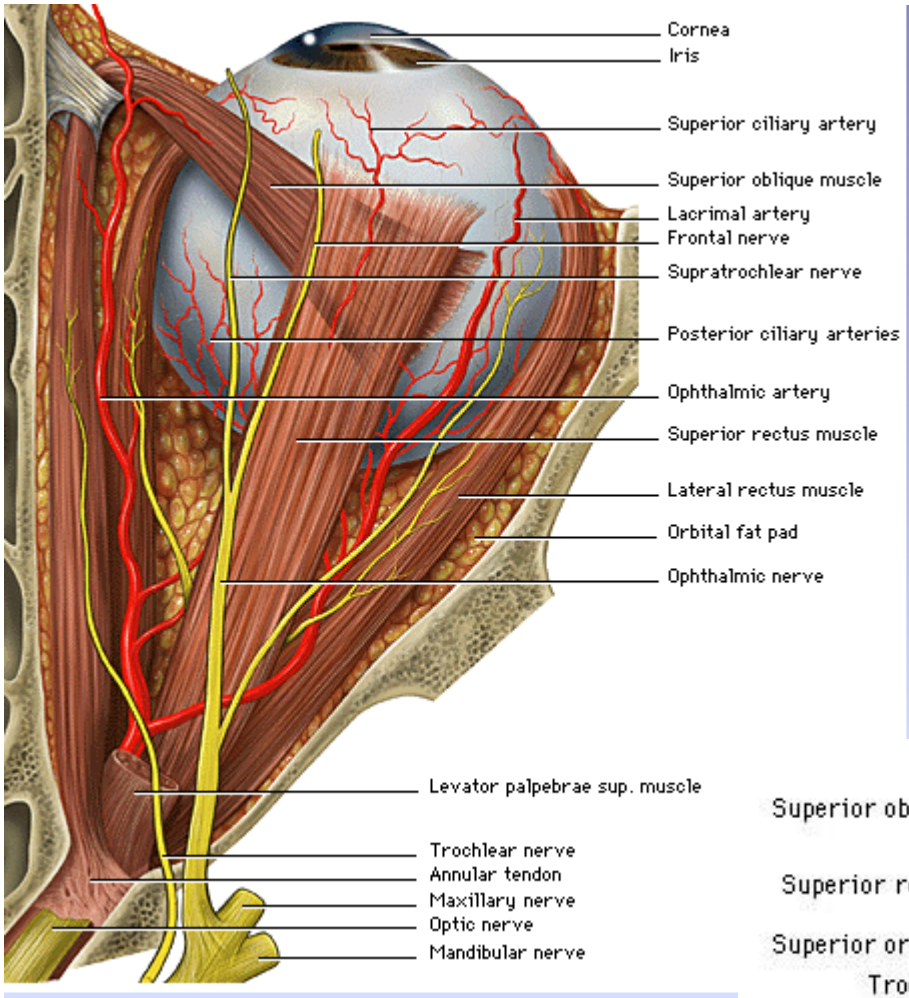

III

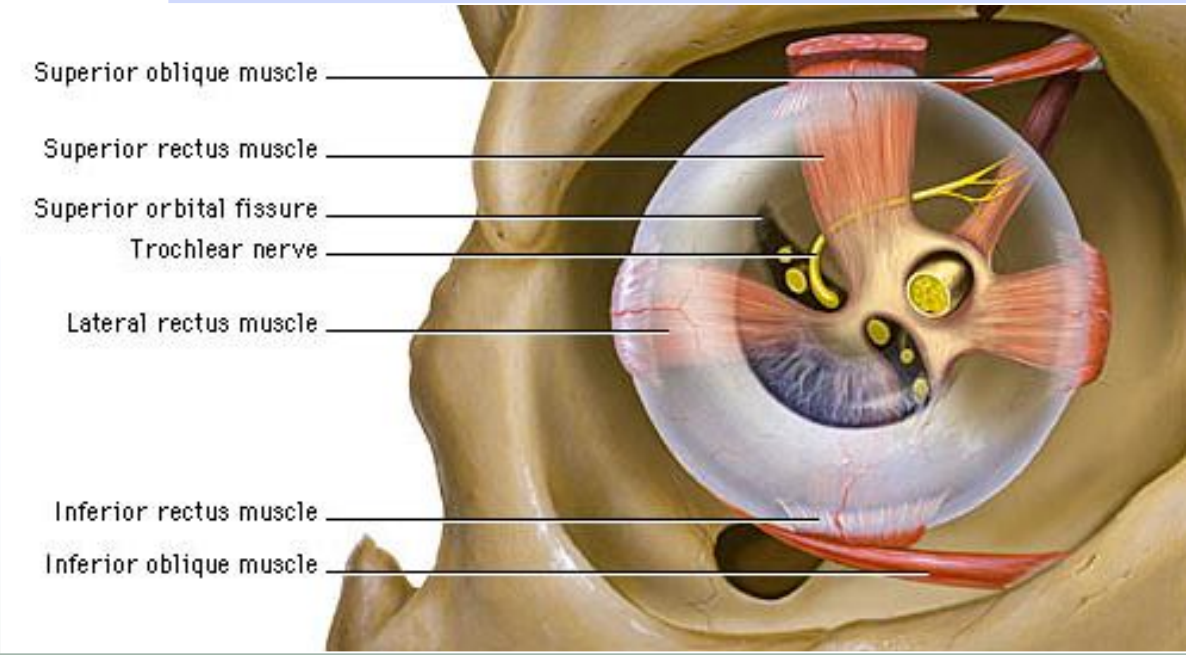

Olfactory Tract
Optic Nerve
Optic Chiasm
Optic Tract
Oculomotor Nerve

CN4
Trochlear Nerves

- Controls the superior oblique muscle which depresses the eye via pulling on the superior oblique tendon which loops over a ligamentous pulley known as the trochlea.
- Originates on the dorsal midbrain and synapses on the superior oblique
- Sensory, motor, or mixed?
- Trauma can result in double vision. Why?




Cornea
Iris
Superior ciliary artery
Superior oblique muscle
Lacrimal artery
Frontal nerve
Supratrochlear nerve
Posterior ciliary arteries
Ophthalmic artery
Superior rectus muscle
Lateral rectus muscle
Orbital fat pad
Ophthalmic nerve
Levator palpebrae sup. muscle
Trochlear nerve
Annular tendon
Maxillary nerve
Optic nerve
Mandibular nerve


Superior oblique muscle
Superior rectus muscle
Superior orbital fissure
Trochlear nerve
Lateral rectus muscle
Inferior rectus muscle
Inferior oblique muscle

Cranial Nerve V: Trigeminal

- Three divisions: ophthalmic (V_1), maxillary (V_2), and mandibular (V_3)
- Fibers run from the face to the pons via the superior orbital fissure (V_1), the foramen rotundum (V_2), and the foramen ovale (V_3)
- Conveys sensory impulses from various areas of the face (V_1) and (V_2), and supplies motor fibers (V_3) for mastication

Cranial Nerve V: Trigeminal

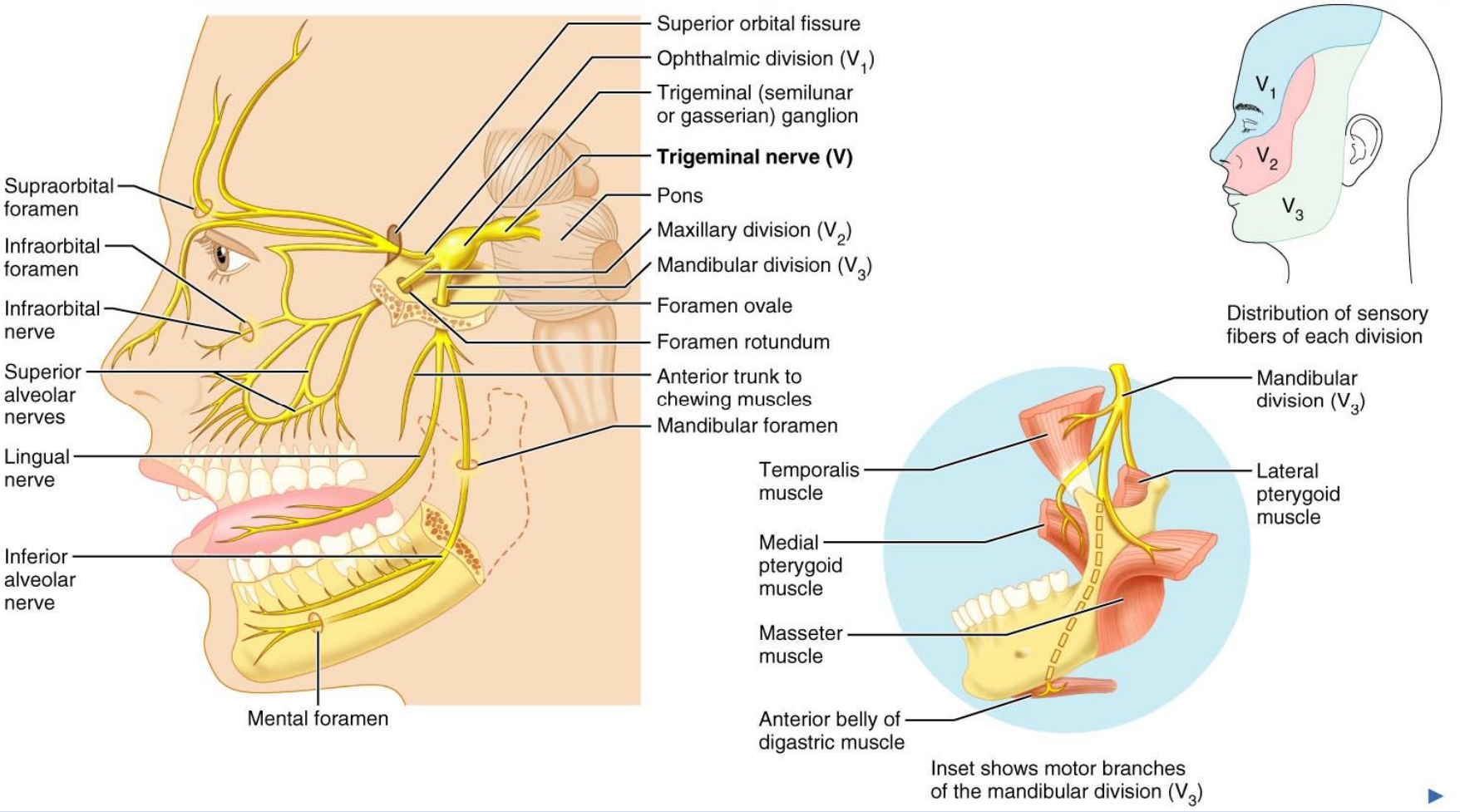
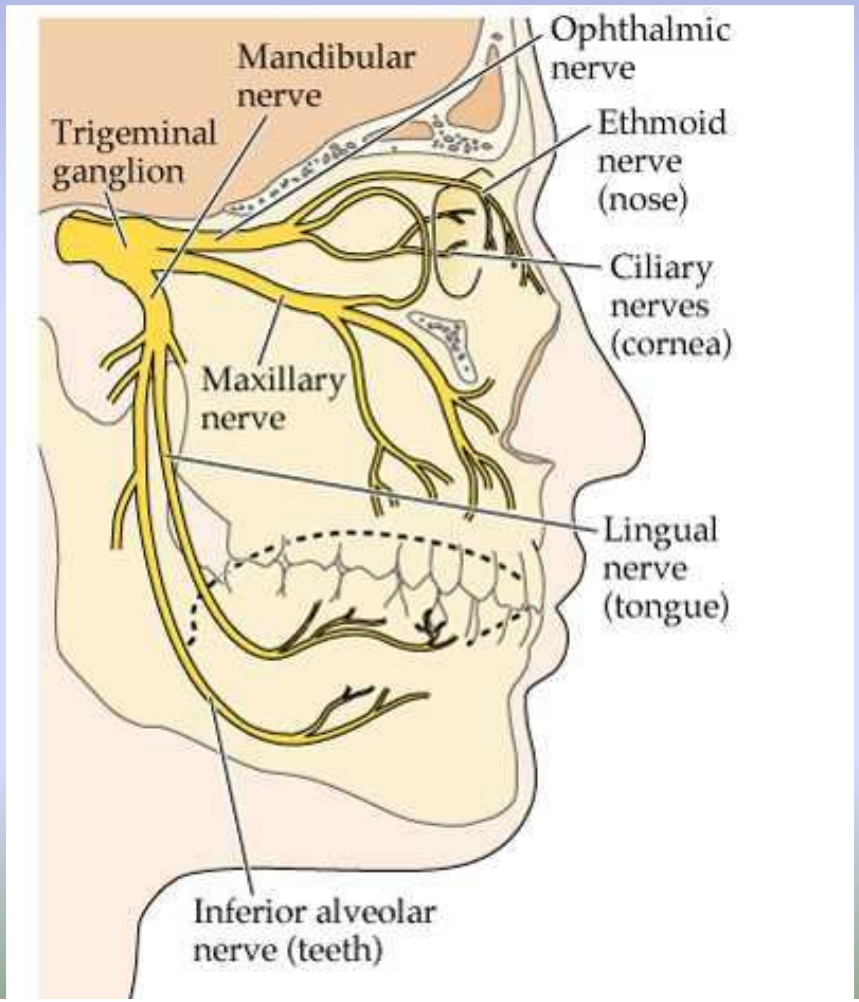
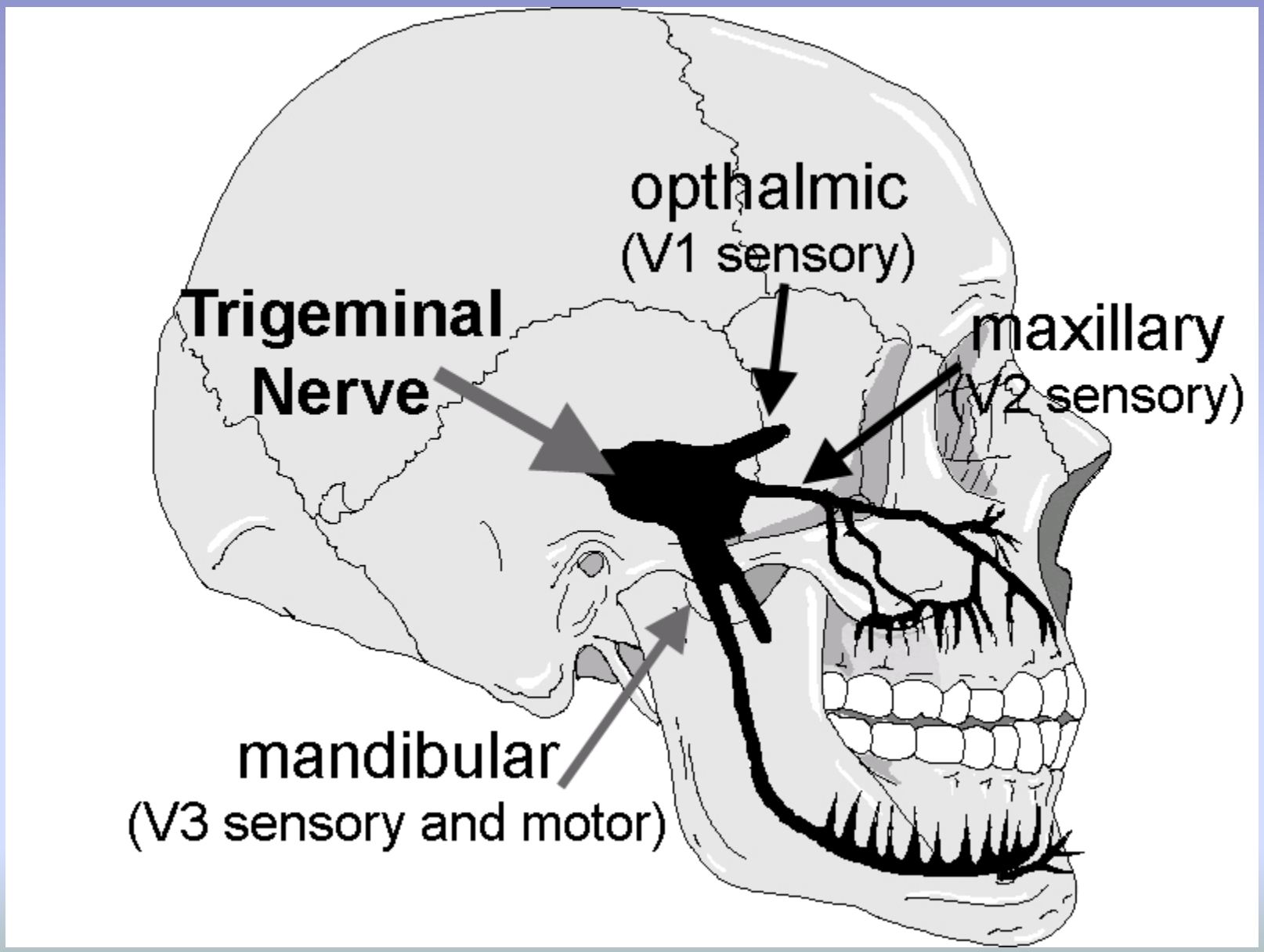


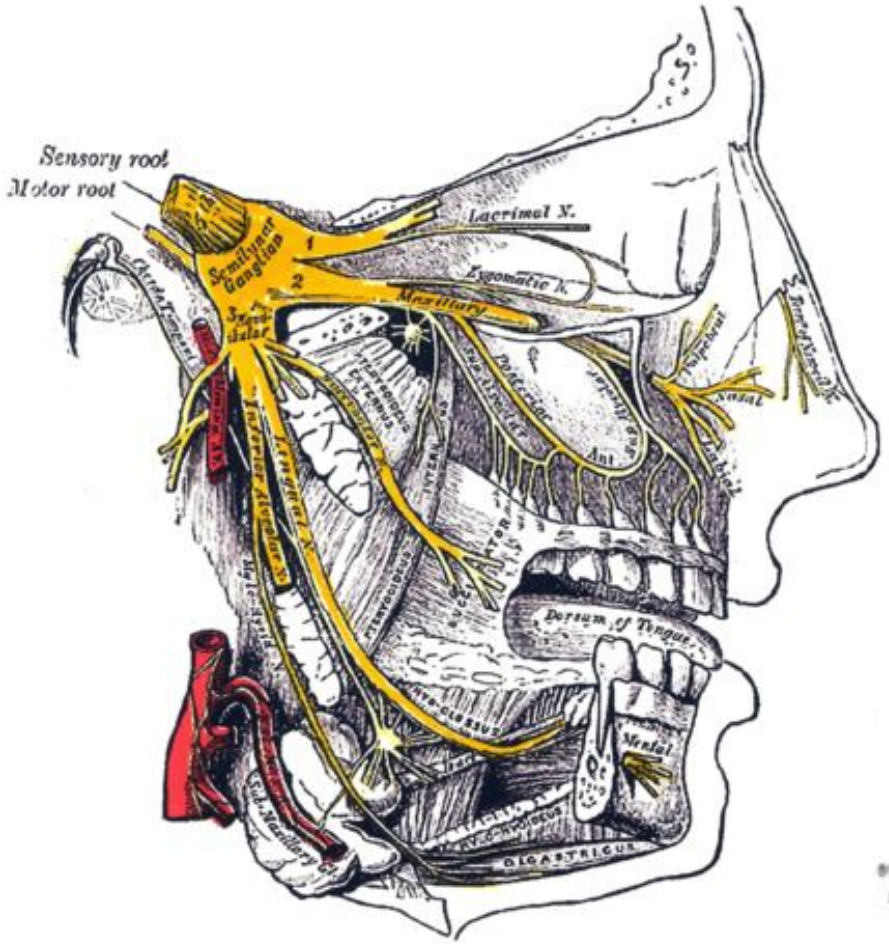
Figure V from Table 13.2

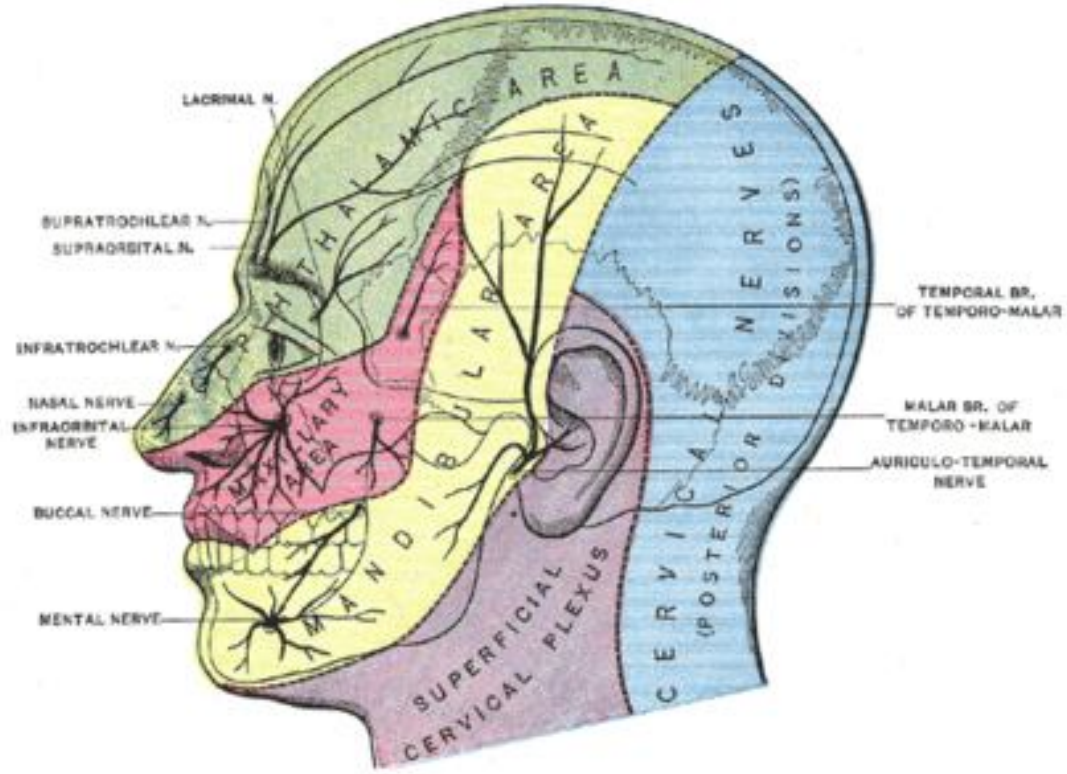
CN5
Trigeminal Nerves

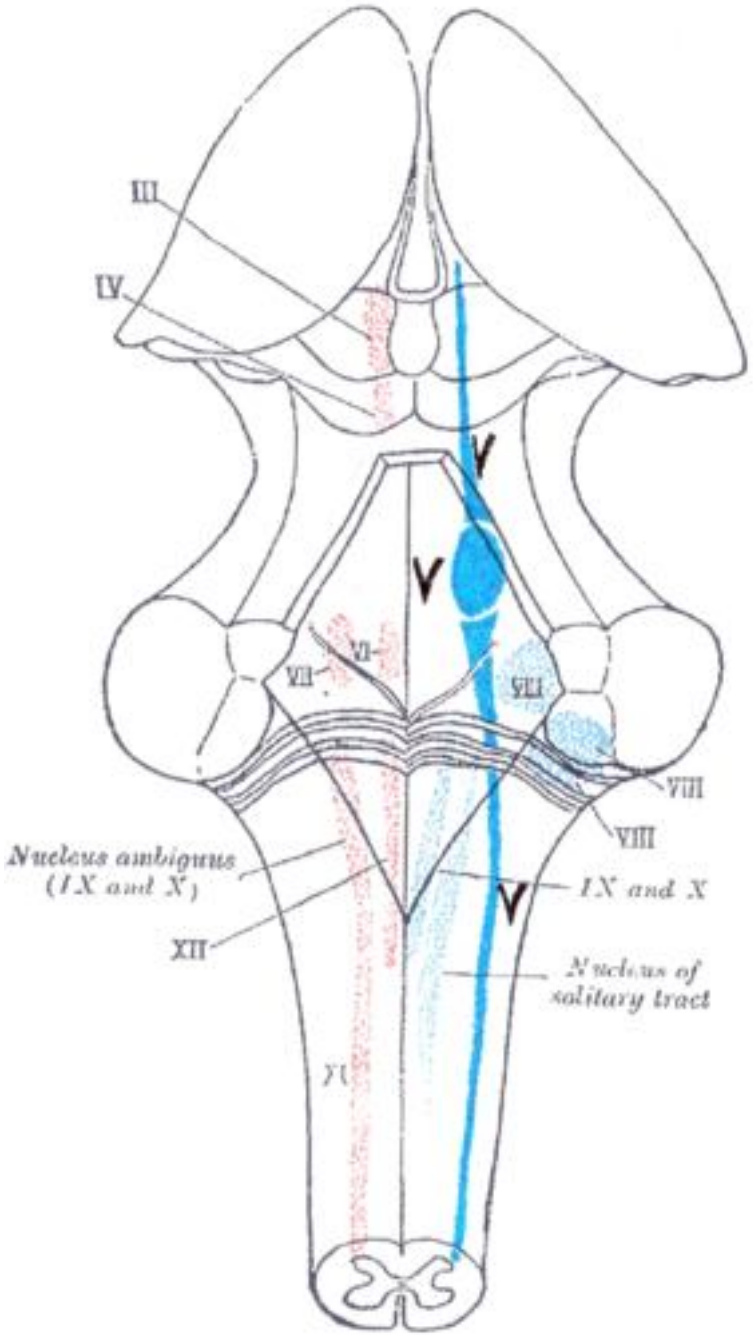
- Sensory, motor, or mixed?
- Biggest cranial nerve
- Originates in the pons and eventually splits into 3 divisions:
  - Ophthalmic (V1), Maxillary (V2), &
    Mandibular (V3).
- Sensory info (touch, temp., and pain) from face.
- Motor info to muscles of mastication
- Damage?




opthalmic
(V1 sensory)
Trigeminal
Nerve
maxillary
(V2 sensory)
mandibular
(V3 sensory and motor)


Sensory root
Motor root
Lacrimal N.
Zygomatic N.
Maxillary
Semilunar Ganglion
Dorsum of Tongue
Mental
Digastricus


LACRIMAL N.
SUPRATROCHLEAR N.
SUPRAORBITAL N.
INFRATROCHLEAR N.
NASAL NERVE
INFRAORBITAL NERVE
BUCCAL NERVE
MENTAL NERVE
OPHTHALMIC AREA
MAXILLARY AREA
MANDIBULAR AREA
SUPERFICIAL CERVICAL PLEXUS
CERVICAL NERVES (POSTERIOR DIVISIONS)
TEMPORAL BR. OF TEMPORO-MALAR
MALAR BR. OF TEMPORO-MALAR
AURICULO-TEMPORAL NERVE



The **spinal trigeminal nucleus** represents **pain/temperature** sensation from the face. Pain/temperature fibers from peripheral nociceptors are carried in cranial nerves V, VII, IX and X. On entering the brainstem, sensory fibers are grouped together and sent to the spinal trigeminal nucleus. This bundle of incoming fibers can be identified in cross sections of the pons and medulla as the **spinal tract of the trigeminal nucleus**, which parallels the spinal trigeminal nucleus itself. The spinal tract of V is analogous to, and continuous with, **Lissauer's tract** in the spinal cord.

Cranial Nerve VI: Abdcuens

- Fibers leave the inferior pons and enter the orbit via the superior orbital fissure
- Primarily a motor nerve innervating the

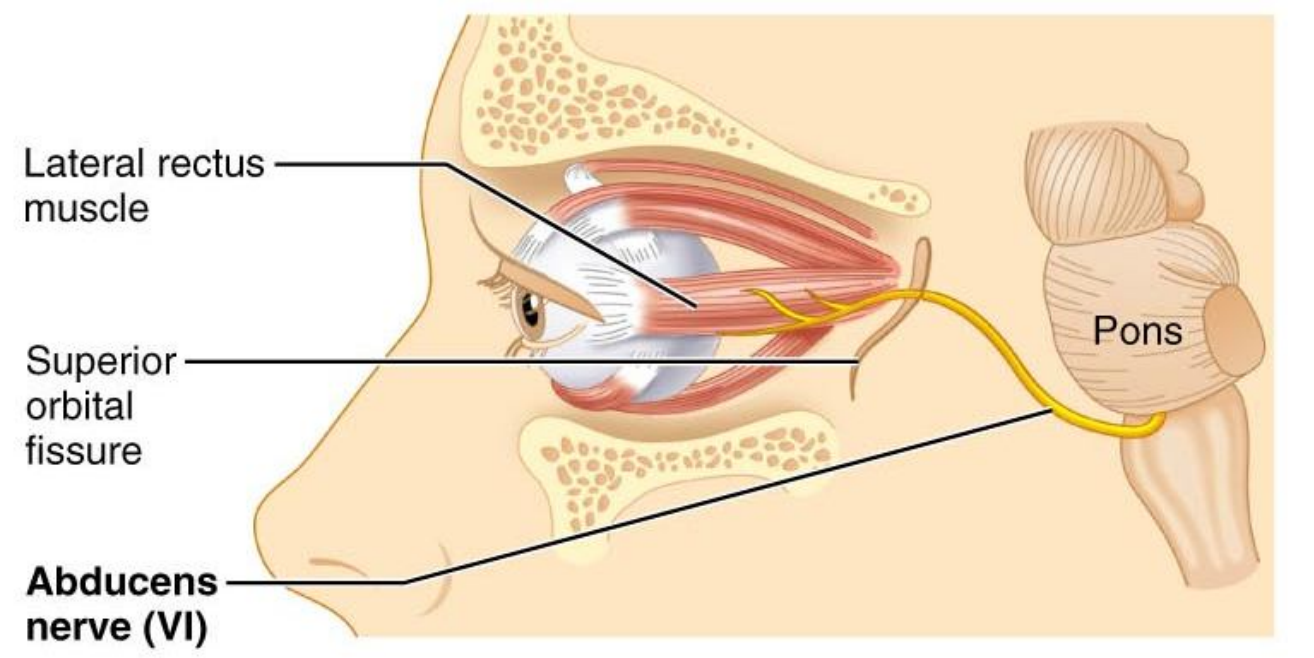
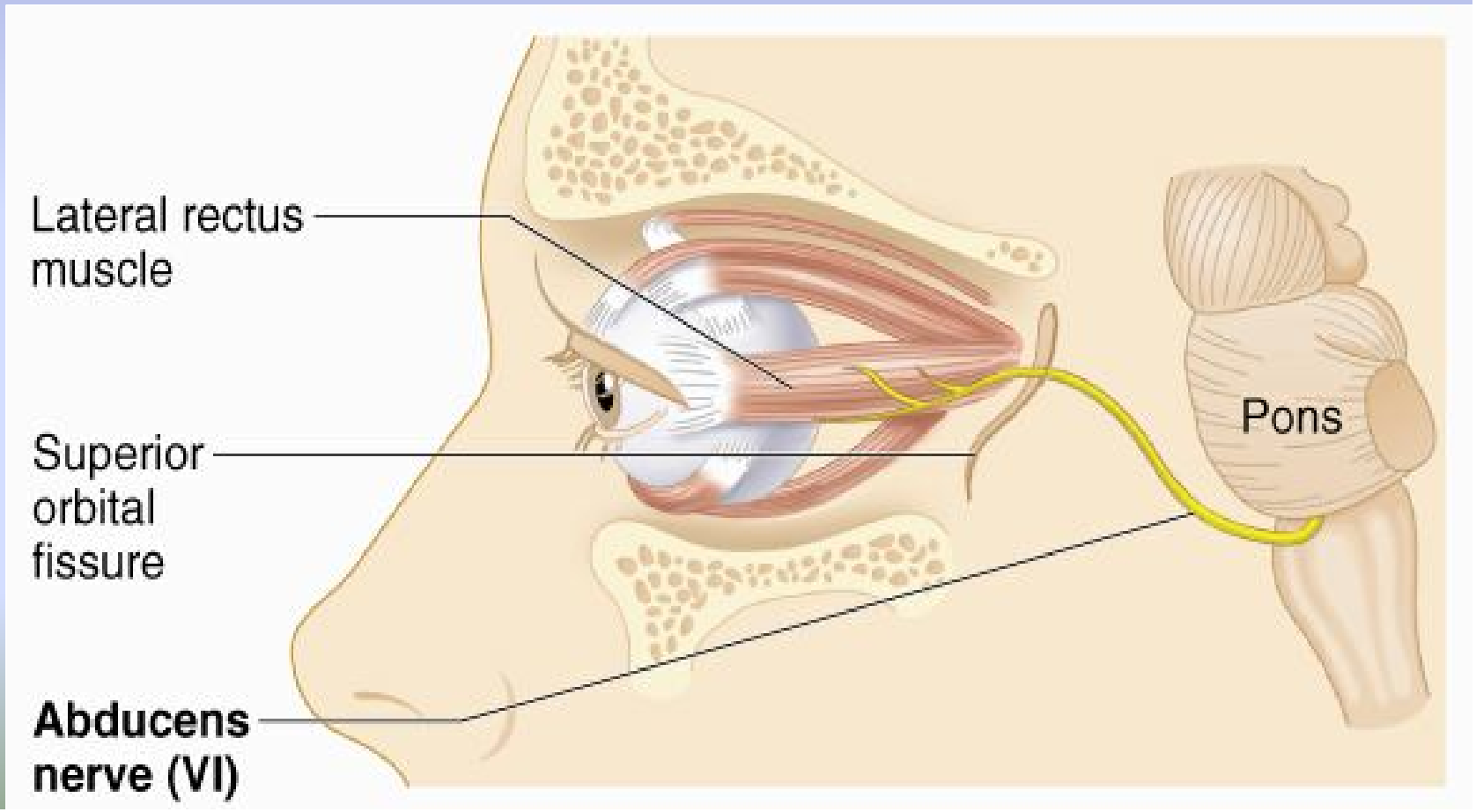
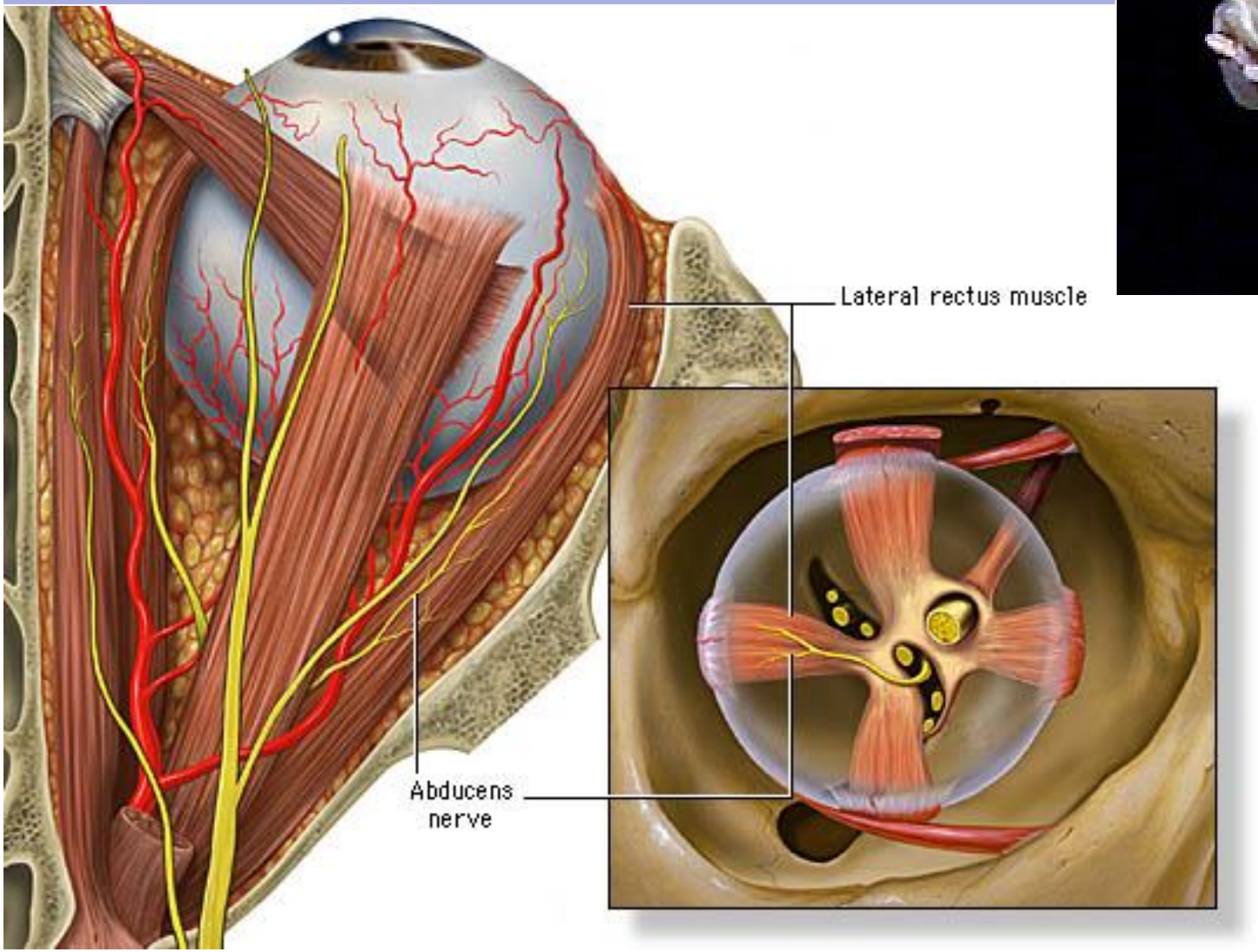


Figure VI from Table 13.2

CN6
Abducens Nerves

- Sensory, motor, or mixed?
- Runs between inferior pons and lateral rectus.



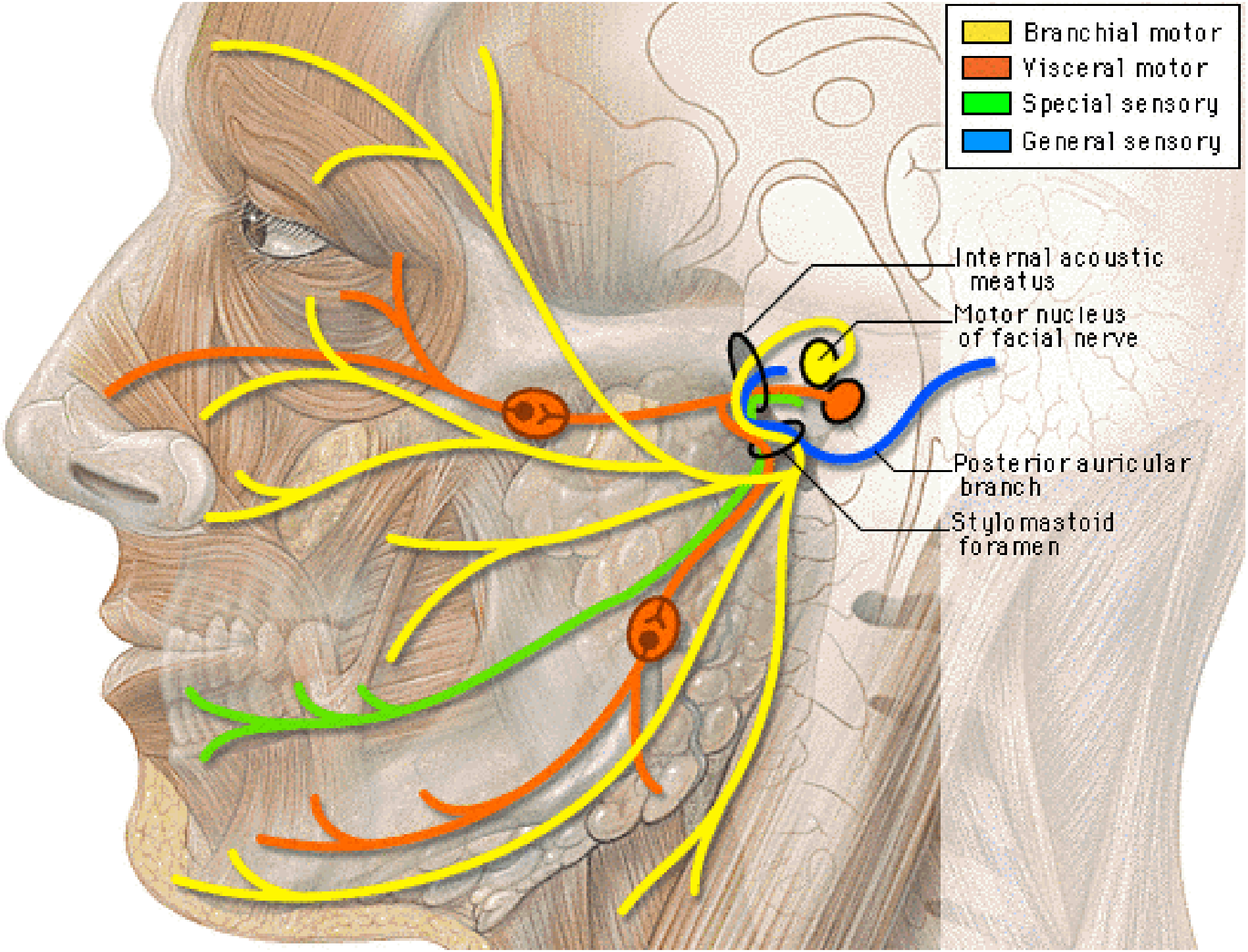

Lateral rectus muscle
Abducens nerve

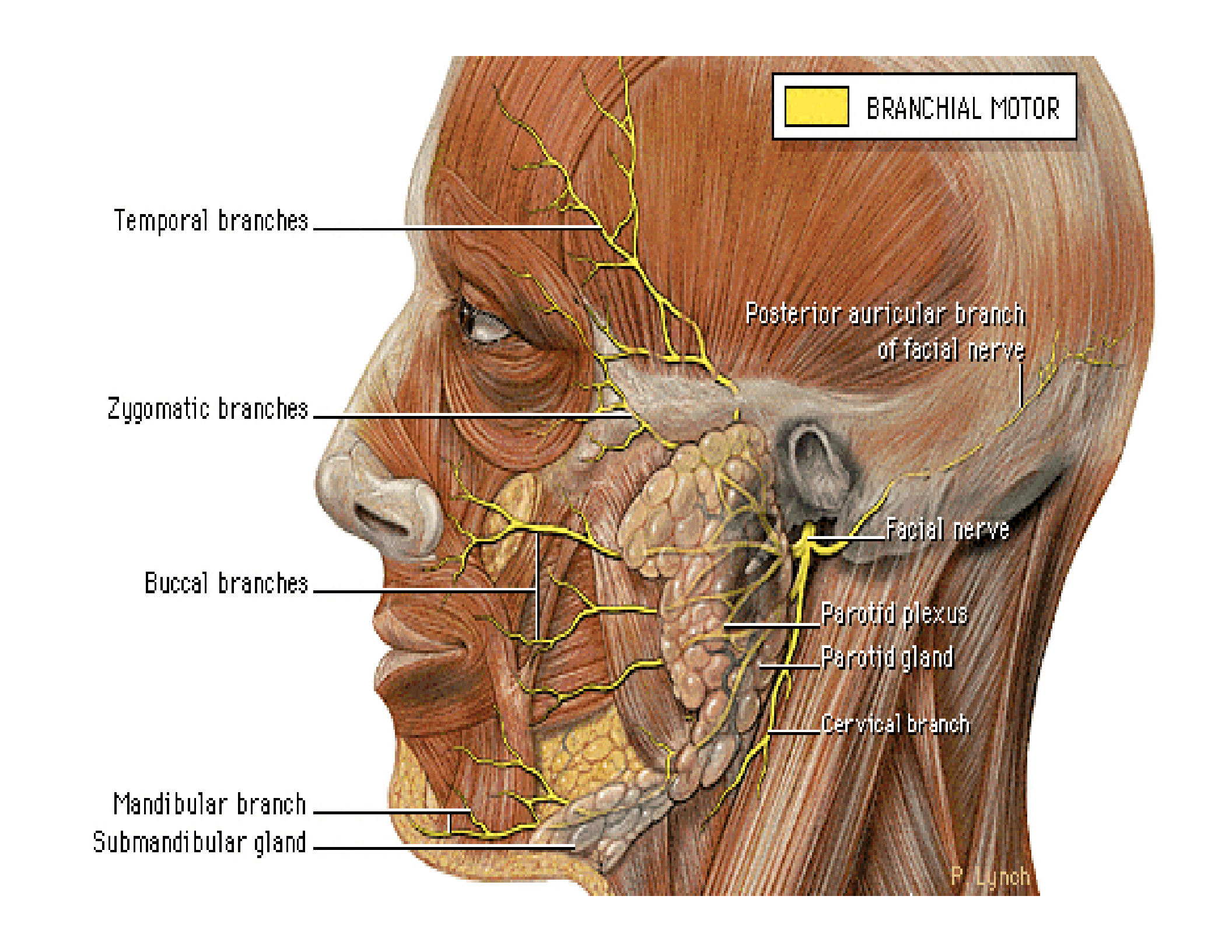

VI

Cranial Nerve VII: Facial

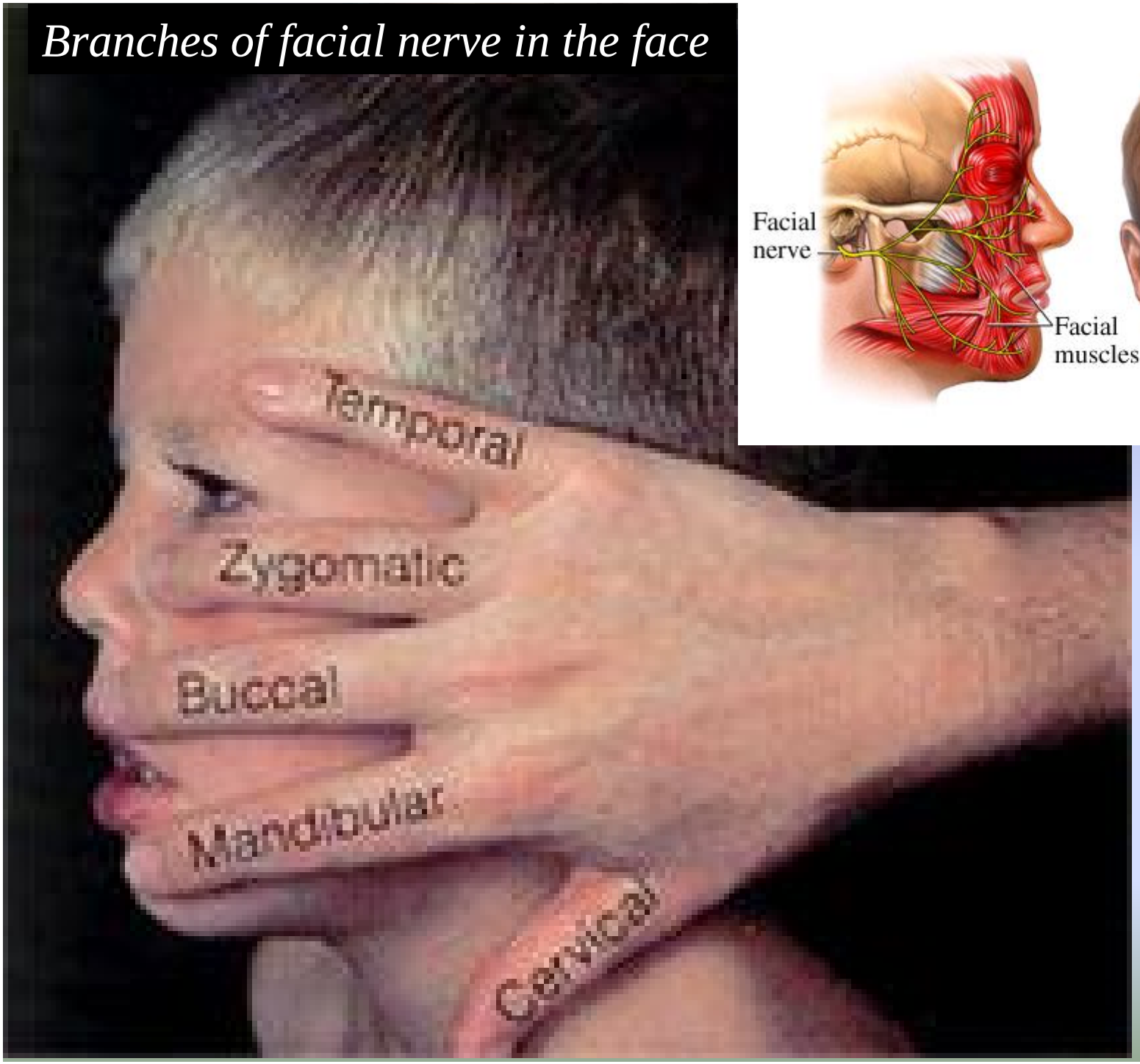
- Fibers leave the pons, travel through the internal acoustic meatus, and emerge through the stylomastoid foramen to the lateral aspect of the face
- Mixed nerve with five major branches
- Motor functions include facial expression, and the transmittal of autonomic impulses to lacrimal and salivary glands
- Sensory function is taste from the anterior two-thirds of the tongue

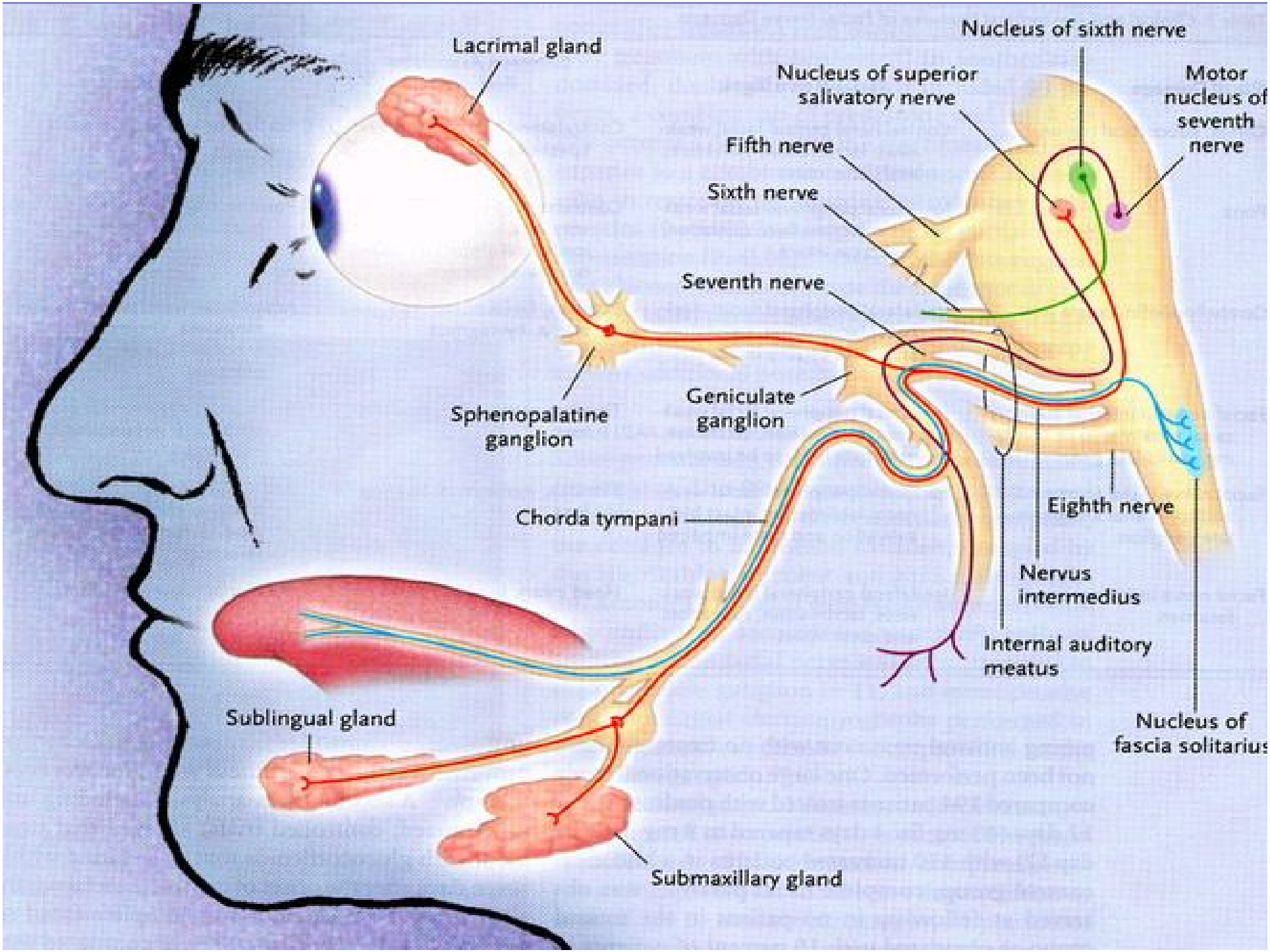
The facial nerve has four components with distinct functions:		
	Branchial motor (special visceral efferent)	Supplies the muscles of facial expression; posterior belly of digastric muscle; stylohyoid, and stapedius.
	Visceral motor (general visceral efferent)	Parasympathetic innervation of the lcrimal, submandibular, and sublingual glands, as well as mucous membranes of nasopharynx, hard and soft palate.
	Special sensory (special afferent)	Taste sensation from the anterior 2/3 of tongue; hard and soft palates.
	General sensory (general somatic afferent)	General sensation from the skin of the concha of the auricle and from a small area behind the ear.


Branchial motor
Visceral motor
Special sensory
General sensory
Internal acoustic meatus
Motor nucleus of facial nerve
Posterior auricular branch
Stylomastoid foramen

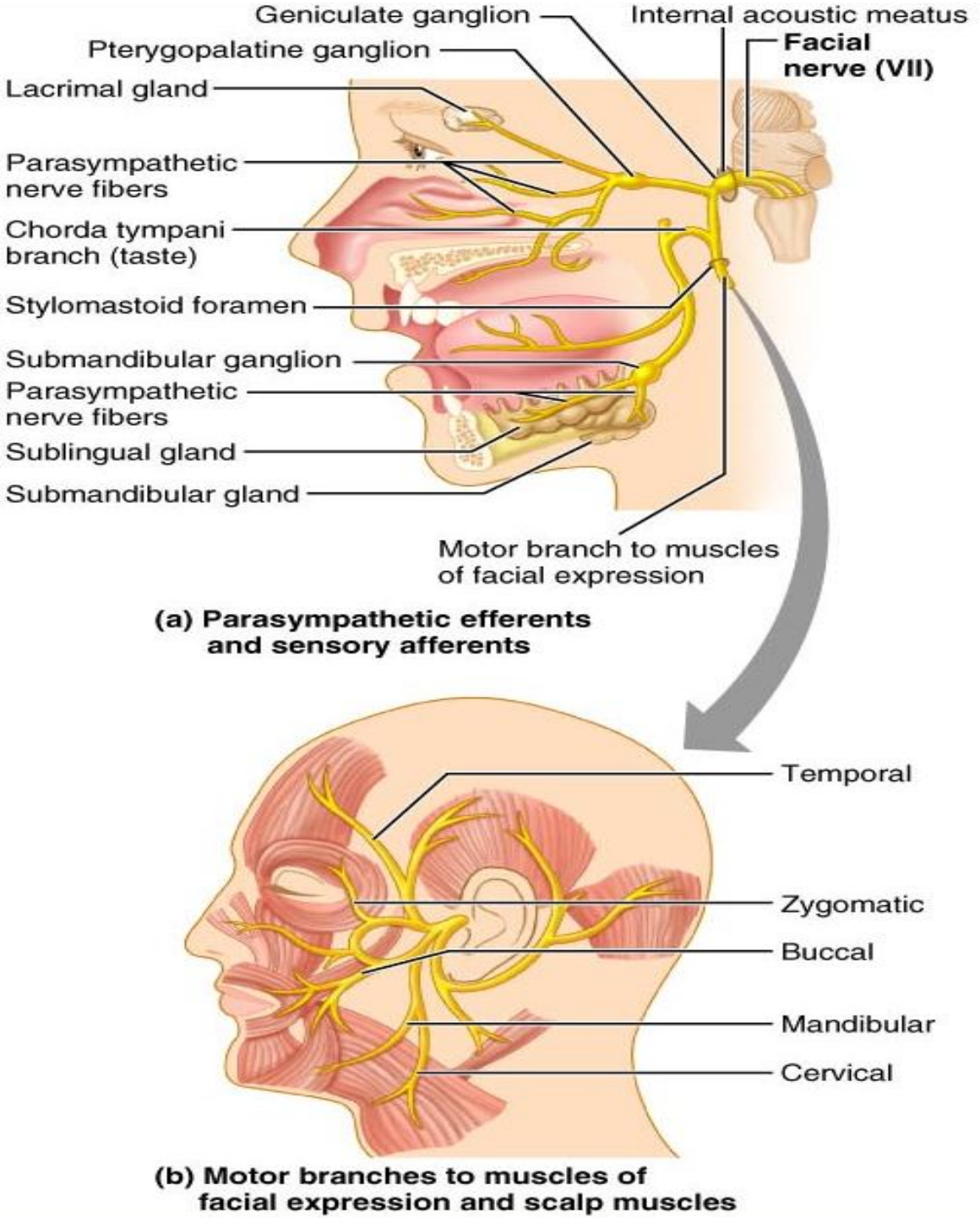

BRANCHIAL MOTOR
Temporal branches
Zygomatic branches
Buccal branches
Mandibular branch
Submandibular gland
Posterior auricular branch of facial nerve
Facial nerve
Parotid plexus
Parotid gland
Cervical branch
P. Lynch

Branches of facial nerve in the face




Lacrimal gland
Nucleus of sixth nerve
Nucleus of superior salivatory nerve
Motor nucleus of seventh nerve
Fifth nerve
Sixth nerve
Seventh nerve
Sphenopalatine ganglion
Geniculate ganglion
Chorda tympani
Eighth nerve
Nervus intermedius
Internal auditory meatus
Nucleus of fascia solitarius
Sublingual gland
Submaxillary gland

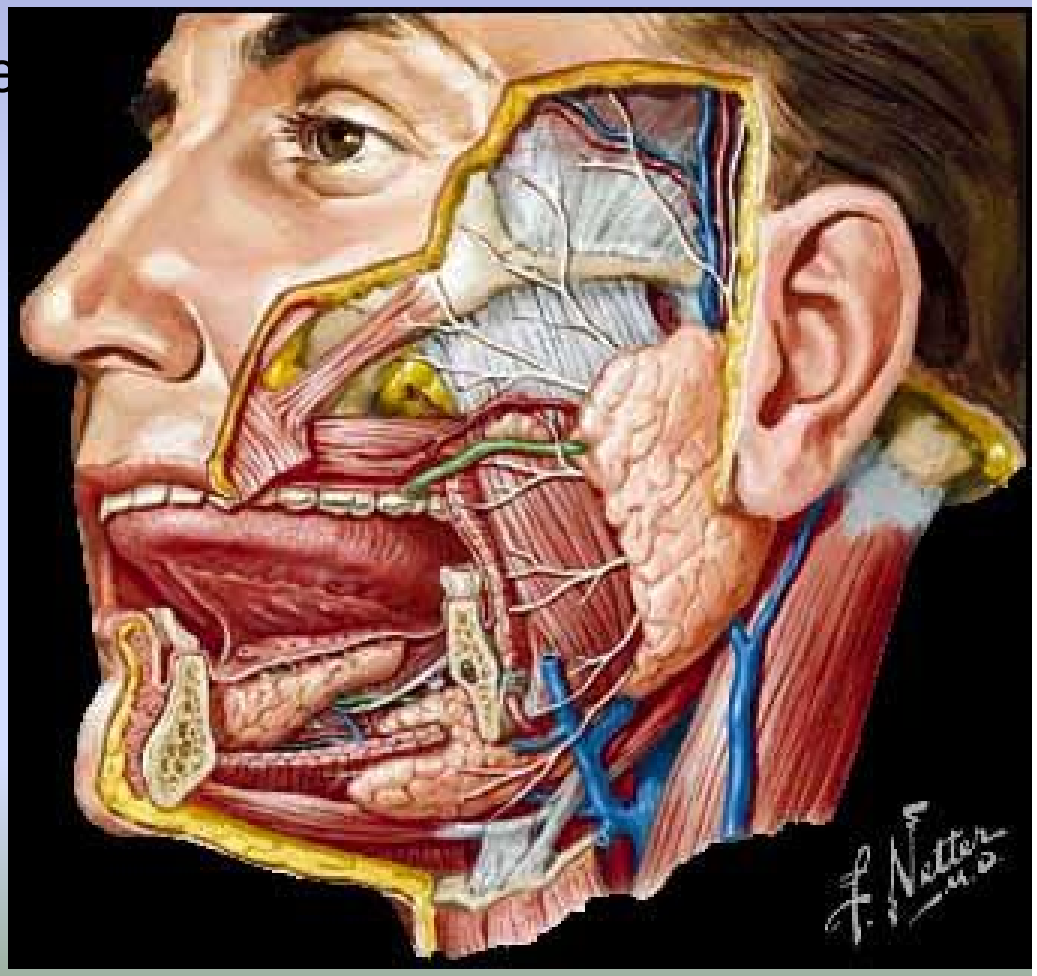
Cranial Nerve VII: Facial

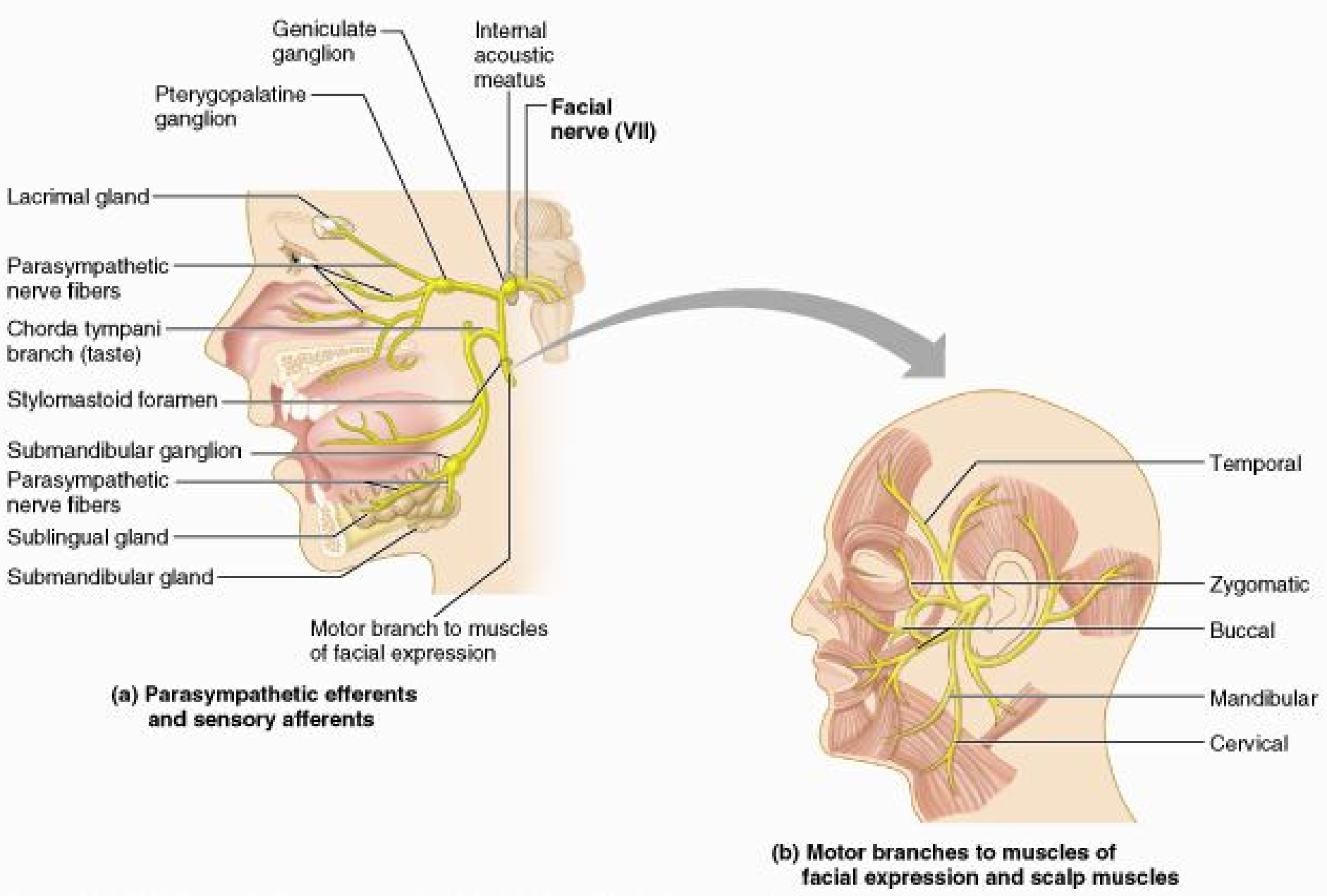


CN7
Facial Nerves

- Sensory, motor, or mixed?
- Originates at the pons
- Convey motor impulses to facial skeletal muscles – except for chewing muscles.
- Convey parasympathetic motor impulses to tear, nasal, and some salivary glands.
- Convey sensory info from taste buds on anterior

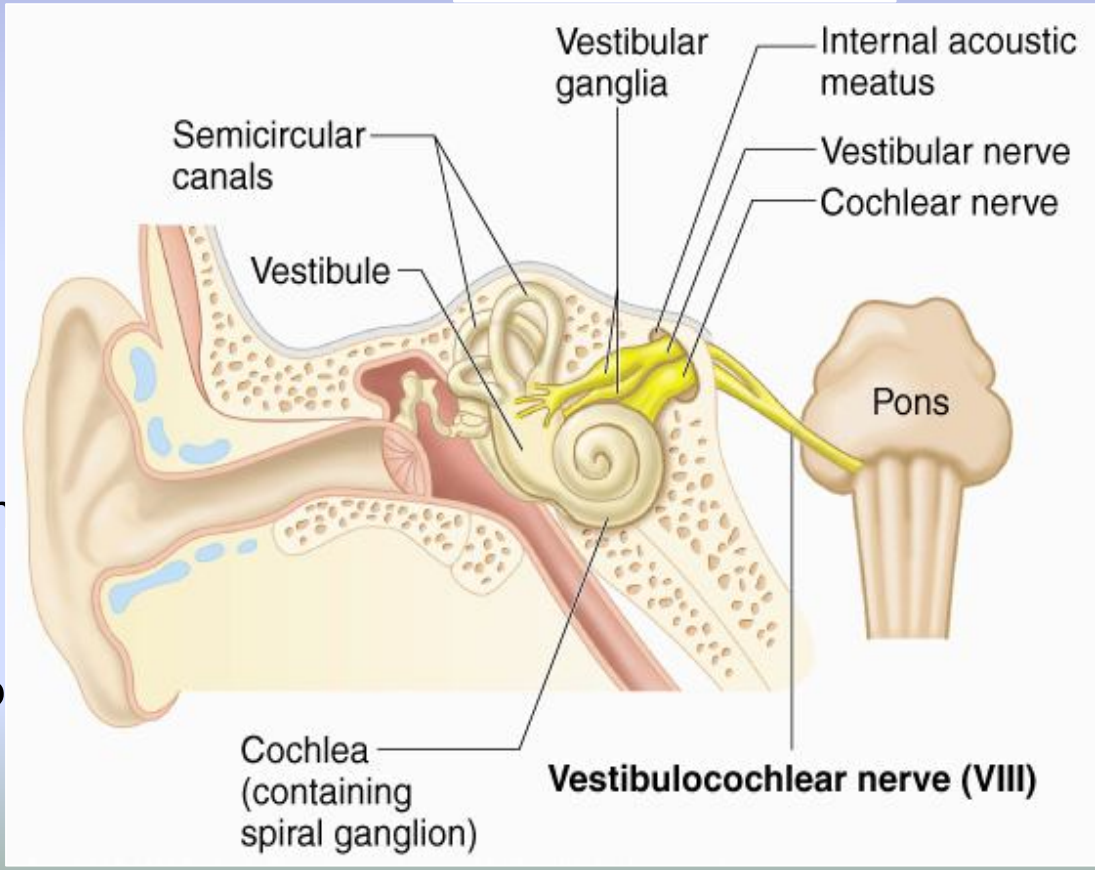
  2/3 of the tongue.
- Facial nerve damage may yield Bell's palsy, total ipsilateral hemifacial paralysis




Geniculate ganglion
Internal acoustic meatus
Pterygopalatine ganglion
Facial nerve (VII)
Lacrimal gland
Parasympathetic nerve fibers
Chorda tympani branch (taste)
Stylomastoid foramen
Submandibular ganglion
Parasympathetic nerve fibers
Sublingual gland
Submandibular gland
Motor branch to muscles of facial expression
(a) Parasympathetic efferents and sensory afferents
Temporal
Zygomatic
Buccal
Mandibular
Cervical
(b) Motor branches to muscles of facial expression and scalp muscles

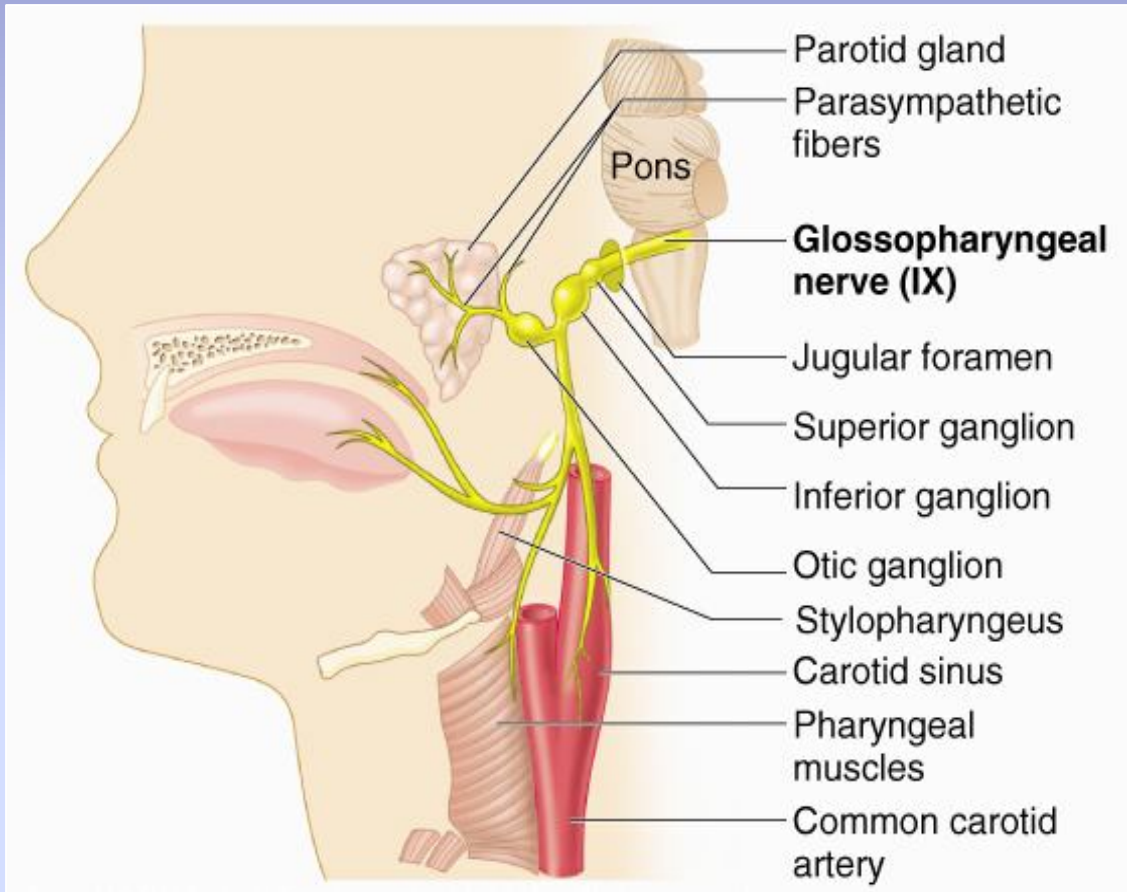
CN8 Auditory/Vestibulocochlear Nerves

- Sensory, motor, or mixed?
- Originates at the pons
- 2 divisions:
  - Cochlear
    - Afferent fibers from cochlea in the inner ear
    - HEARING
  - Vestibular
    - Afferent fibers from equilibrium receptors in ir ear
    - BALANCE
- Functional impairment?



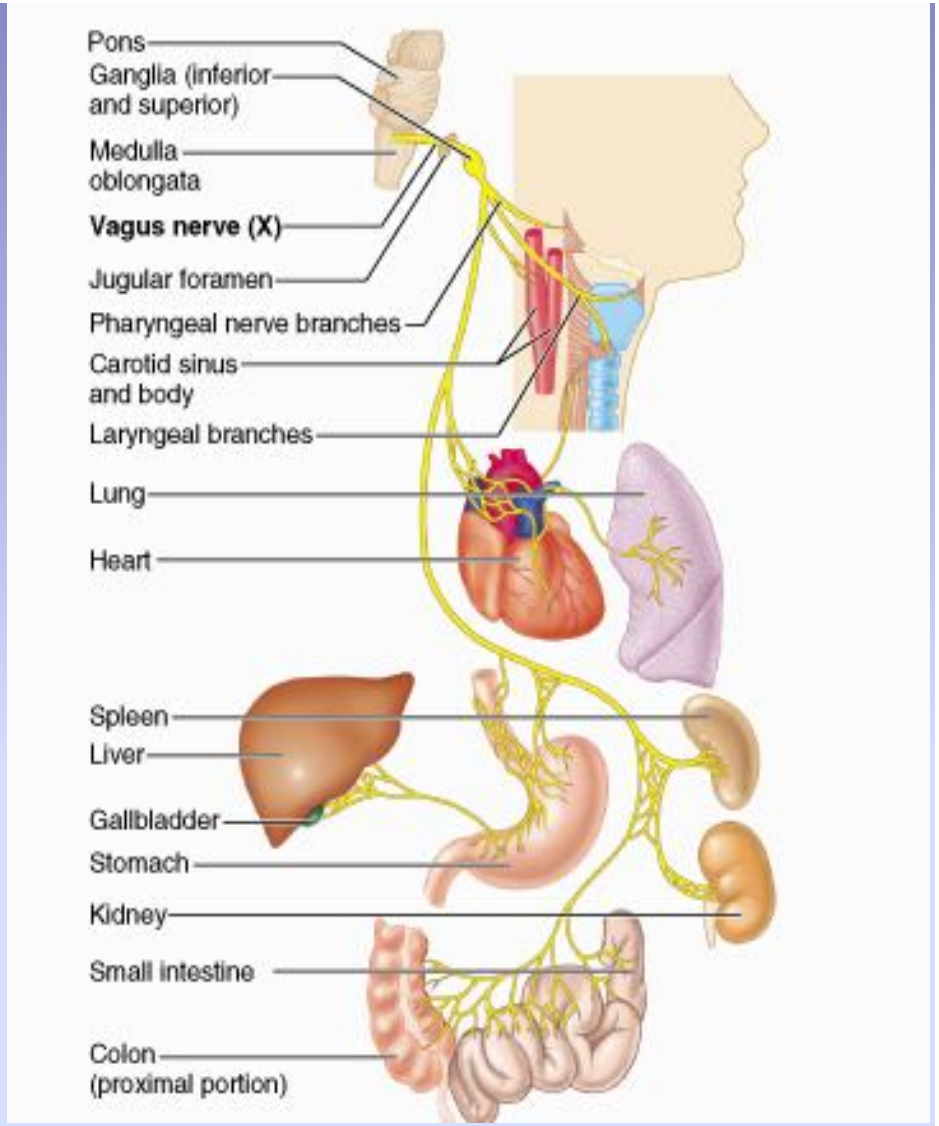
CN9
Glossopharyngeal Nerves

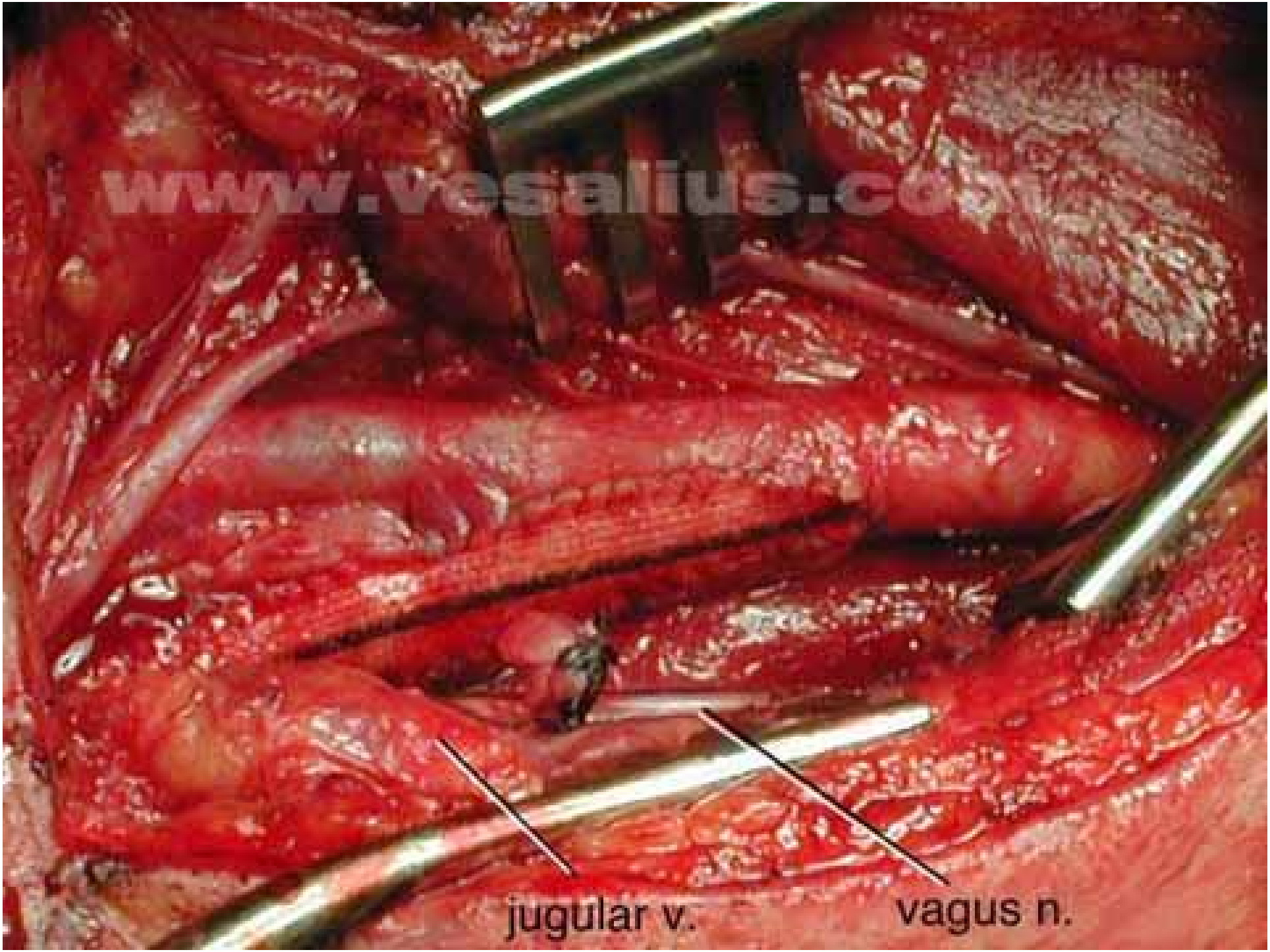
- Sensory, motor, or mixed?
- Fibers run emerge from medulla and run to the throat.
- Motor Functions:
  - Motor fibers to some swallowing muscles
  - Parasympathetic fibers to some salivary glands
- Sensory Functions:
  - Taste, touch, heat from pharynx and posterior tongue.
  - Info from chemoreceptors on the level of O_2 and CO_2 in the blood. Info from baroreceptors on BP.
    - Chemoreceptors and baroreceptors are located in the carotid sinus – a dilation in the internal carotid artery.



CN10
Vagus Nerves

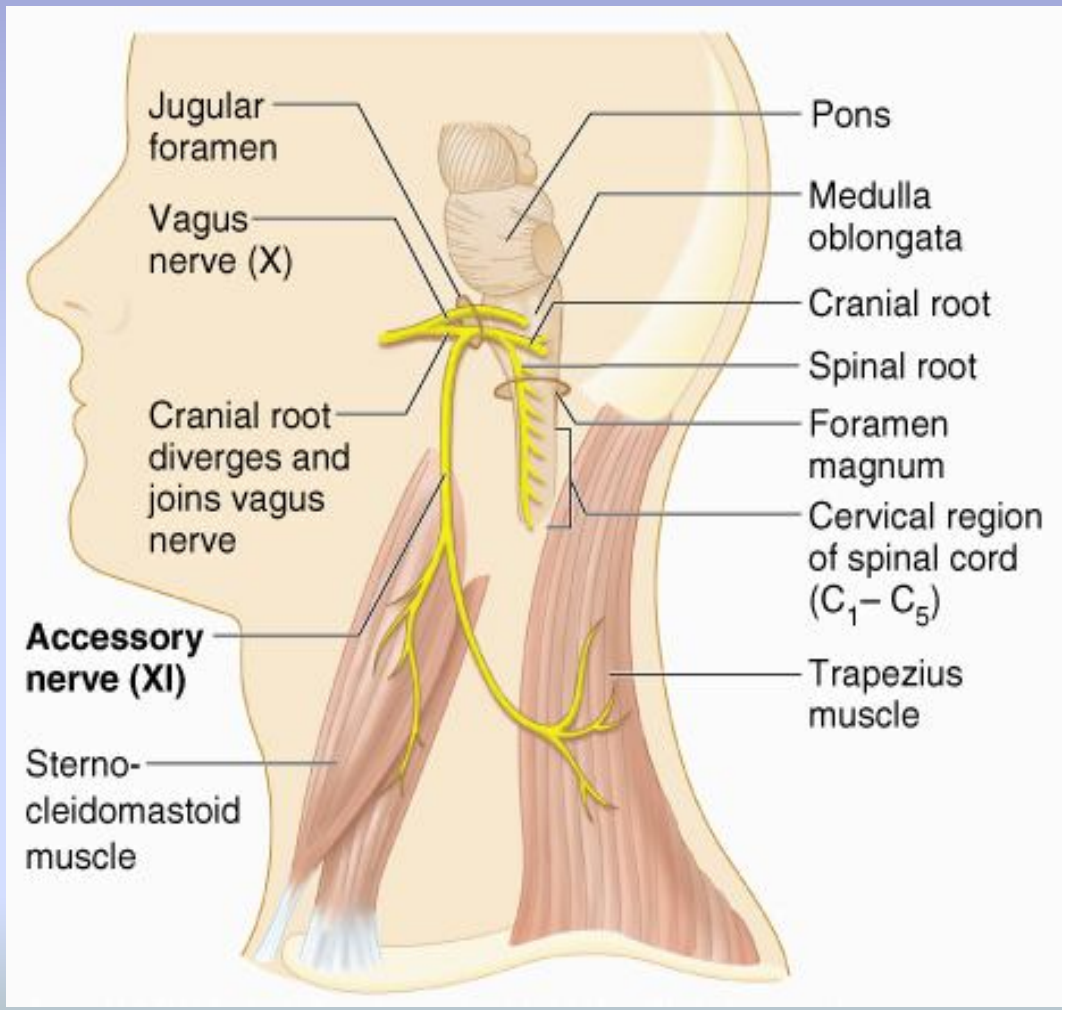
- Sensory, motor, or mixed?
- Only cranial nerves to extend beyond head and neck.
  - Fibers emerge from medulla, leave the skull, and course downwards into the thorax and abdomen.
- Motor Functions:
  - Parasympathetic efferents to the heart, lungs, and abdominal organs.
- Sensory Functions:
  - Input from thoracic and abdominal viscera; from baro- and chemoreceptors in the carotid sinus; from taste buds in posterior tongue and pharynx

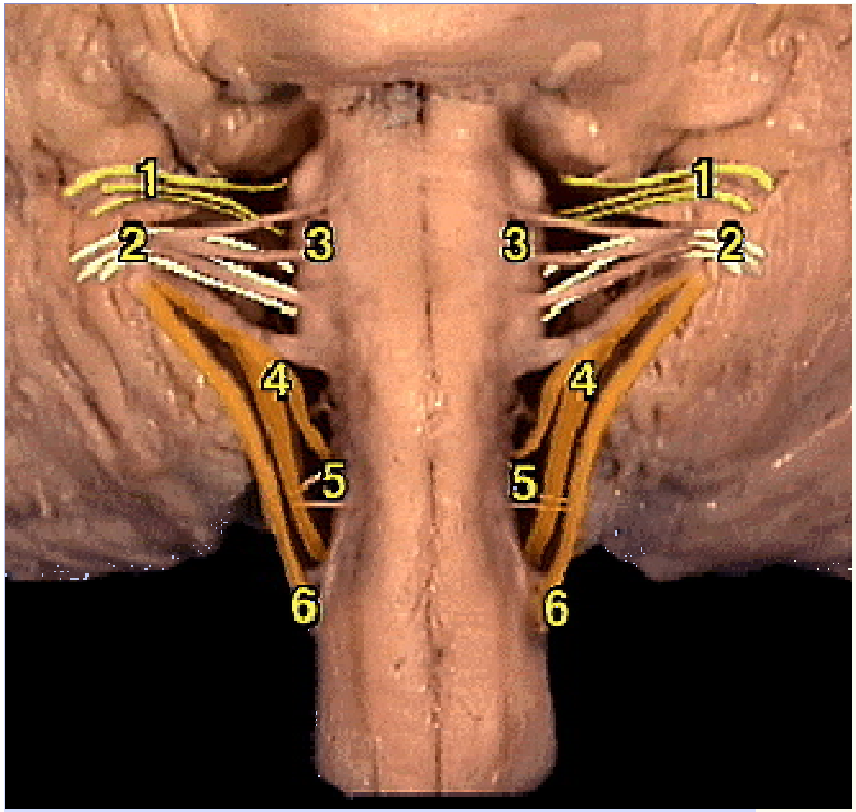



jugular v.
vagus n.

CN11
Accessory Nerves

- Sensory, motor, or mixed?
- Formed by the union of a cranial root and a spinal root.
  - CR arises from medulla while SR arises from superior spinal cord. SR passes thru the FM and joins with CR to form the accessory nerve. They then leave the skull via the jugular foramen.
  - Cranial division then joins vagus and innervates larynx, pharynx, and soft palate.
  - Spinal division innervates sternocleidomastoids and trapezius.

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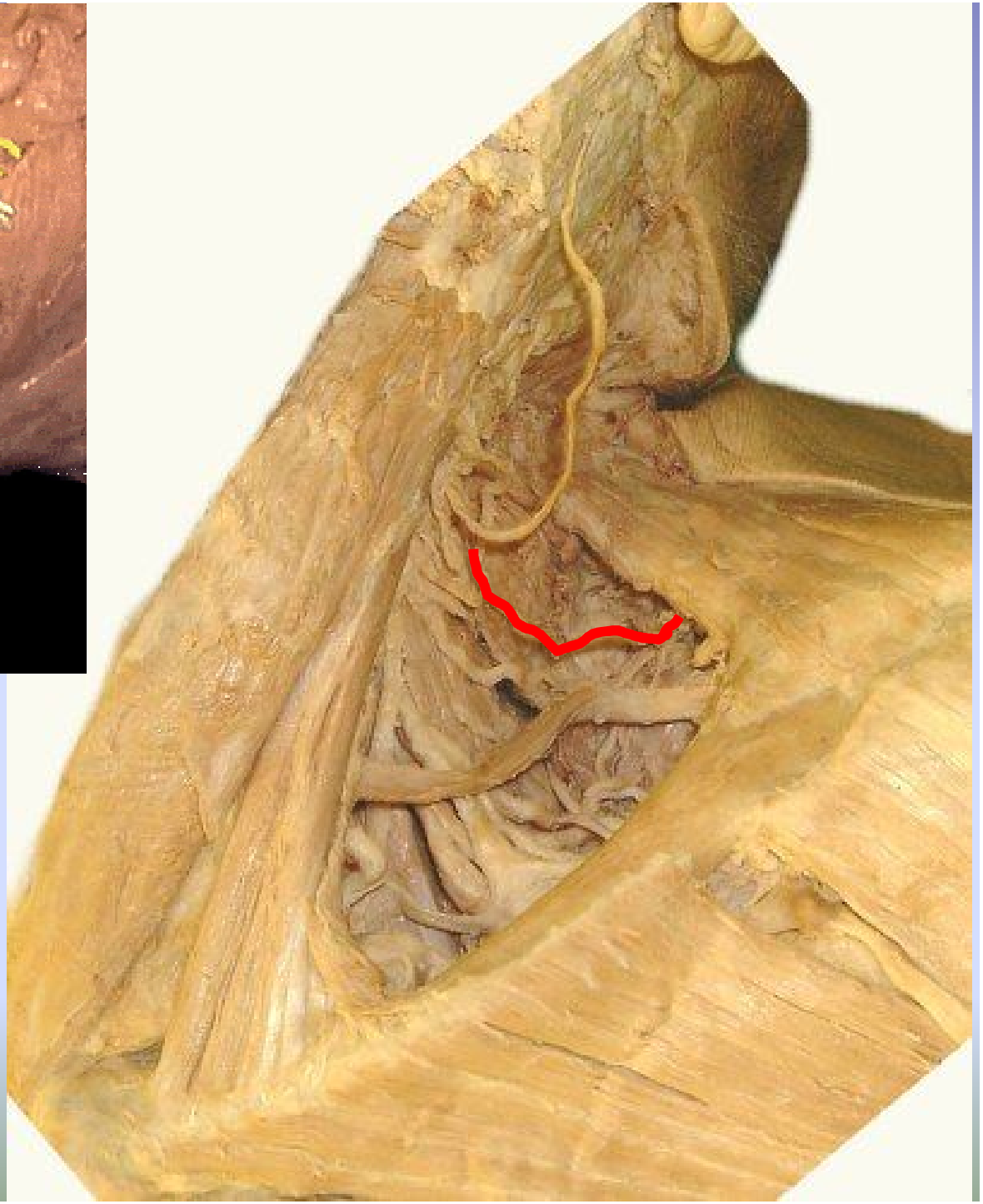
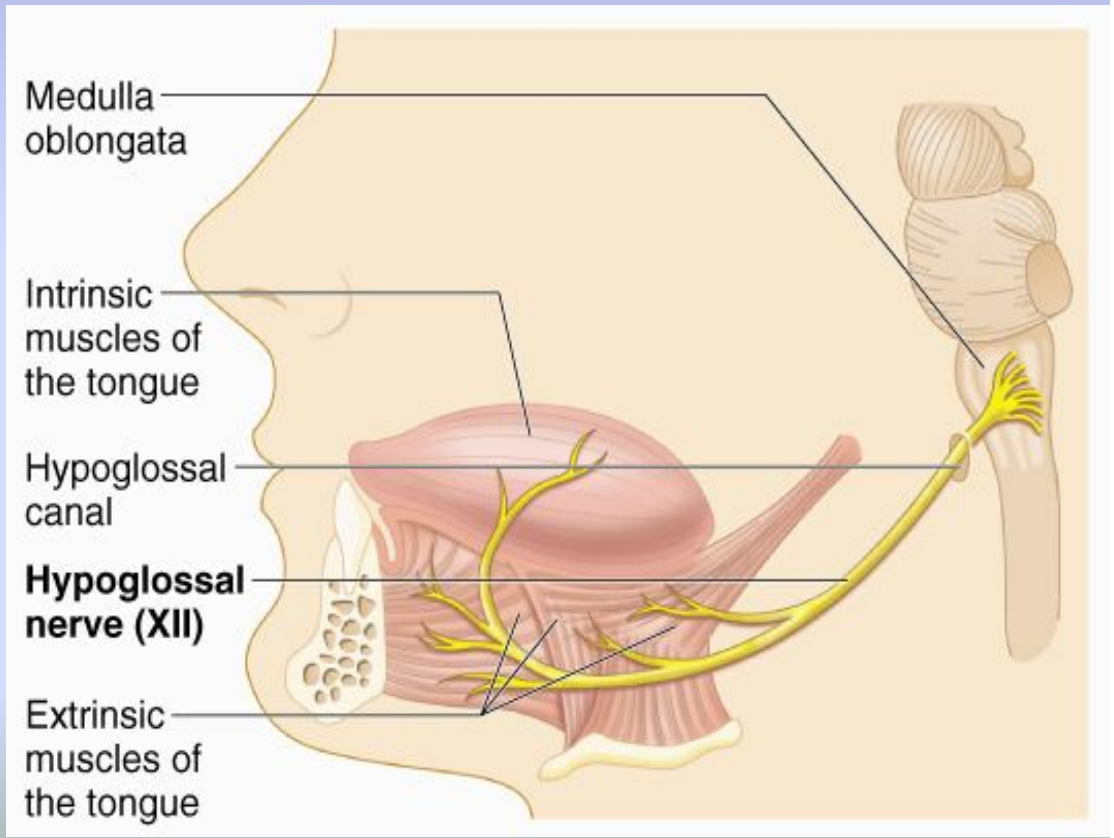


CN12
Hypoglossal Nerves

- Sensory, motor, or mixed?
- Arise from the medulla and exit the skull via the hypoglossal canal and innervate the tongue.
- Innervate the intrinsic & extrinsic muscles of the tongue.
  - Swallowing, speech, food manipulation.
- Damage?



Peripheral Nervous System

- Now that we've looked at spinal and cranial nerves, we can examine the divisions of the PNS.
- The PNS is broken down into a sensory and a motor division.
- We'll concentrate on the motor division which contains the somatic nervous system and the autonomic nervous system.