EZQMECEU.COM PRESENTS…..The Importance of the Neurologic Examination

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PRESENTED BY:

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Additional Programs Available from EZQMECEU.COM:

- Medical-Legal Report Writing and Technique of the QME Examination (6 hours)
- Gait Disturbance & Assistive Devices (3 hours)
- The Non-Physiologic Examination (3 hours)
- The Deposition Matrix (6 hours)
- 21 Secrets of the Most Persuasive QME's (6 hours)
- Upper Extremity Impairments – Entrapment Neuropathies (6 hours)
- Lower Extremity Impairments due to Peripheral Nerve Lesions (6 hours)

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Medical-Legal Report Writing and Technique of the QME Examination (6 hours)

Topics Include:

- Section 1 – Medical Legal Report Writing
- Section 2 – The QME Panel Process
- Section 3 – Technique of the QME Examination

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Gait Disturbance & Assistive Devices (3 hours):

Topics Include:

- AMA Guides – Descriptions of Gait Disturbances in Chapters 13 and Chapters 17 and Permanent Impairments due to gait disturbance under the *strict* application of the AMA Guides
- Procedure for the Gait Analysis and Observation

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Section 2 Gait Disturbance & Assistive Devices Topics (cont.):

- Description of the Phases of “Normal” Gait and “Pathologic” Gait
- Causes of Deviations from the Normal Gait
- Named Gait Signs
- Assistive Devices – canes, crutches, pick up frames, ankle foot orthosis, knee ankle foot orthosis
- Gait Conclusions

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The Non-Physiologic Examination (3 hours)

Topics Include:

- Practical Considerations for the Quantification of Pain
- Activities of Daily Living Assessments – a Practical Method
- Malingering – Waddell's Signs and DSM-IV (Diagnostic and Statistical Manual of Mental Disorders) Criteria
- Medical Records, and Interview Findings of Inconsistency
- Physical Examination Findings of Inconsistency

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The "Deposition Matrix" (6 Hours):

Philosophy: Reasons <u>why</u> Depositions are called – Applicant Attorney vs. Defense Attorney

- Rules for Deposition: Combination of tips and suggestions from 1) my own experience plus 2) communication tips from a Certified Court Reporter
- Case Examples:
  - Mechanism of Injury:
  - Clinical Course:
  - Permanent Impairment/Apportionment Opinions
  - Deposition Questions and the responses

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UPPER EXTREMITY IMPAIRMENTS – PERIPHERAL NEUROPATHIES

Topics Include:

- Neurology 101
- Entrapment Neuropathies
- Exam Procedures
- Impairment Calculations
- Case Examples

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Lower Extremity Impairments – Peripheral Nerve Lesions

Topics Include:

- Neurology 101
- Entrapment Neuropathies
- Exam Procedures
- Impairment Calculations
- Case Examples

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21 Secrets of the Most Persuasive QME's (6 Hours)

Topics:

- Preparatory Secrets (3)
- Interview/Exam Secrets (10)
- Report Writing Secrets (4)
- Deposition Secrets (4)

21 Secrets of the Most Persuasive QME's

Topics:

- Section 1 – Preparatory Secrets of the Most Persuasive QME's
  - Secret # 1 – Prepare, prepare, prepare
  - Secret #2 – Review the Medical Records
  - Secret #3 – Prepare the Tone of the Examination

21 Secrets of the Most Persuasive QME's

Topics:

Section 2 – Interview/Physical Examination Secrets of the Most Persuasive QME's

- Secret #1 – Do Activities of Daily Living Interview as part of the face to face evaluation
- Secret #2 – Know the Impairments and Examine for them
- Secret #3 – Perform every single Objective Test
- Secret #4 – Perform a formal Gait Analysis
- Secret #5 – Perform a Non-Physiologic Exam
- Secret #6 – Focus on the Neurologic Exam
- Secrets #-7-9: Diagnostic Studies:
  - #7 – Order Appropriate Diagnostic Studies
  - #8 – Consult with the Radiologist
  - #9 – Analyze for "Loss of Motion Segment Integrity"
- Secret #10 – Do a formal Pain Impairment Analysis

21 Secrets of the Most Persuasive QME's

Topics:

- Section 3 – Report Writing Secrets of the Most Persuasive QME's
  - Secret #1 – Format Report Clearly
  - Secret #2 – Do a thorough Review of Records
  - Secret #3 – Convey "Certainty"
  - Secret #4 – State the Reasons for your opinion(s)

21 Secrets of the Most Persuasive QME's

Topics:

- Section 4 – Deposition Secrets of the Most Persuasive QME's
  - Secret # 1 – Know the Codes
  - Secret #2 – Know why Depositions are scheduled
  - Secret #3 – Know Apportionment as it applies to your case
  - Secret #4 – Review your Permanent Impairment opinion
  - Secret #5 – Defend your Report as Substantial Medical Evidence

21 Secrets of the Most Persuasive QME's

Topics:

- Section 5 – Final Thoughts
  - Plus, 2 bonus secrets that will bring together all of the material – given at the end of the Program.

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The Importance of the Neurologic Examination (6 hours)

- Part 1
- AMA Guides references to “Neurology”
- Neurology 101:
  - Development of CNS & PNS
  - Spinal Cord, Spinal Nerves, and the Plexuses (4)
  - Named Peripheral Nerves of the Upper & Lower Extremities

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The Importance of the Neurologic Examination (6 hours)

- Part 2
- Exam Procedures:
  - General Neurologic Exam (Chapter 13)
  - Spinal Exam (Chapter 15)
  - Upper Extremity Exam (Chapter 16)
  - Lower Extremity Exam (Chapter 17)
- “Special Tests”

AMA Guides – References to "Neurology"

- Neurologic Examination – is required for the determination of impairment of:
  - 1. The Central and Peripheral Nervous Systems (Chapter 13)
  - 2. The Spine (Chapter 15)
  - 3. The Upper Extremities (Chapter 16)
  - 4. The Lower Extremities (Chapter 17)
  - 5. Pain (Chapter 18)

AMA Guides – References to "Neurology"

- Chapter 13 The Central and Peripheral Nervous System:
  - Impairments:
    - Central Nervous System Disorders
    - Cerebral Impairments
    - Cranial Nerves
    - Station, Gait, and Movement Disorders
    - Upper Extremities due to Central Impairment
    - Spinal Cord
    - Chronic Pain
    - Peripheral Nervous System, Neuromuscular Junction, and Muscular System

AMA Guides – References to "Neurology"

- Chapter 15 Spine – Examples:
- Page 373 – "The spine consists of 4 regions, the cervical, thoracic, lumbar, and sacral vertebrae, and associated soft tissues including muscles, ligaments, discs, and neural components"

AMA Guides – References to "Neurology"

- Chapter 15 – Spine Examples (cont.):
- Page 374 – "The history must describe in detail the chief complaint, and the quality, severity, anatomic location, frequency, and duration of symptoms, including **pain, numbness, paresthesias, and weakness**."

- Page 374 – "Examination – Since a targeted neurologic assessment is needed for individuals with back or neck problems, the physician must have a **good grasp of basic neurologic examination techniques and principles** including – reflexes, muscle strength and atrophy, sensory deficits, root tension signs, gait, need for assistive devices."

AMA Guides – References to "Neurology"

- Chapter 15 – Spine Examples (cont.)
- Page 375 – "Neurologic examination procedures based on position of examinee (standing, sitting, recumbent supine, etc."
- Page 375 – Sciatic nerve tension signs
- Page 376 – Sciatic nerve and femoral nerve stretch tests
- Page 376 – Neurologic tests – reflexes/sensory changes/motor changes
- Page 377 – Sensory testing by touch, pinprick, light touch, and vibrating fork – diagram of autonomous zones.

AMA Guides – References to "Neurology"

- Chapter 15 – Spine Examples (cont.)
- Page 380 – Neurologic basis for using ROM method:
- "Multilevel disc herniations, stenosis with radiculopathy at multiple levels or bilaterally"
- "Recurrent radiculopathy caused by a recurrent (new) disc herniation"
- "Other episodes of other pathologies producing radiculopathy"

AMA Guides – References to "Neurology"

- Chapter 15 – Spine Examples (cont.)
- Page 385 – DRE Methods also focus on Neurology – Review Lumbar Spine DRE Categories:

Table 15-3 Criteria for Rating Impairment Due to Lumbar Spine Injury

DRE Lumbar Category I **0% Impairment of the Whole Person**	**DRE Lumbar Category II** **5%- 8% Impairment of the Whole Person**	**DRE Lumbar Category III** **10%-13% Impairment of the Whole Person**	**DRE Lumbar Category IV** **20%-23% Impairment of the Whole Person**	**DRE Lumbar Category V** **25%-28% Impairment of the Whole Person**
No significant clinical findings, no observed muscle guarding or spasm, no documentable neurologic impairment, no documented alteration in structural integrity, and no other indication of impairment related to injury or illness; no fractures	Clinical history and examination findings are compatible with a specific injury; findings may include significant muscle guarding or spasm observed at the time of the examination, asymmetric loss of range of motion, or nonverifiable radicular complaints, defined as complaints of radicular pain without objective findings; no alteration of the structural integrity and no significant radiculopathy ***or*** individual had a clinically significant radiculopathy and has an imaging study that demonstrates a herniated disk at the level and on the side that would be expected based on the previous radiculopathy, but no longer has the radiculopathy following conservative treatment ***or*** fractures: (1) less than 25% compression of one vertebral body; (2) posterior element fracture without dislocation (not developmental spondylolysis) that has healed without alteration of motion segment integrity; (3) a spinous or transverse process fracture with displacement without a vertebral body fracture, which does not disrupt the spinal canal	Significant signs of radiculopathy, such as dermatomal pain and/or in a dermatomal distribution, sensory loss, loss of relevant reflex(es), loss of muscle strength or measured unilateral atrophy above or below the knee compared to measurements on the contralateral side at the same location; impairment may be verified by electrodiagnostic findings ***or*** history of a herniated disk at the level and on the side that would be expected from objective clinical findings, associated with radiculopathy, or individuals who had surgery for radiculopathy but are now asymptomatic ***or*** fractures: (1) 25% to 50% compression of one vertebral body; (2) posterior element fracture with displacement disrupting the spinal canal; in both cases, the fracture has healed without alteration of structural integrity	Loss of motion segment integrity defined from flexion and extension radiographs as at least 4.5 mm of translation of one vertebra on another or angular motion greater than 15° at L1-2, L2-3, and L3-4, greater than 20° at L4-5, and greater than 25° at L5-S1 (Figure 15-3); may have complete or near complete loss of motion of a motion segment due to developmental fusion, or successful or unsuccessful attempt at surgical arthrodesis ***or*** fractures: (1) greater than 50% compression of one vertebral body without residual neurologic compromise	Meets the criteria of DRE lumbosacral categories III and IV; that is, both radiculopathy and alteration of motion segment integrity are present; significant lower extremity impairment is present as indicated by atrophy or loss of reflex(es), pain, and/or sensory changes within an anatomic distribution (dermatomal), or electromyographic findings as stated in lumbosacral category III and alteration of spine motion segment integrity as defined in lumbosacral category IV ***or*** fractures: (1) greater than 50% compression of one vertebral body with unilateral neurologic compromise

AMA Guides – References to "Neurology"

- Chapter 15 – Spine Examples (cont.)
- Page 385 –Thoracic and cervical spine Pages 389 and 392) DRE definitions are similar.

AMA Guides – References to "Neurology"

- Chapter 16 – Upper Extremity Neurology References –
- Section 16.3 Sensory Impairment due to Digital Nerve Lesions – this section talks about "specialized receptor organs" and "free nerve endings" – we discuss these here shortly

AMA Guides – References to "Neurology"

- Section 16.5 Peripheral Nerve Disorders – Includes both Sensory and Motor dysfunction – large sections that discusses the brachial plexus, and the major peripheral nerves, and many different types of conditions – including CRPS
- This Section discusses neurology in a progression from spinal cord to spinal nerves, to the brachial plexus, to peripheral nerves, all the way to the digital sensory nerves.

AMA Guides – References to "Neurology"

- Chapter 17 – Lower Extremity Neurology references –
- Section 17.2d – Muscle Atrophy – possibly due to peripheral nerve injury
- Section 17.2l – Peripheral Nerve Injuries – Includes both Sensory and Motor dysfunction – large section that discusses the lumbosacral plexus, and the major peripheral nerves, and many different types of conditions – including CRPS

AMA Guides – References to "Neurology"

- Pain (Chapter 18) Neurology references –
- Pain Syndromes (Table 18-1): Headaches, post-herpetic neuralgia, tic douloureux, injury to the nervous system – all are neurologic
- Associated Pain Syndromes (Table 18-20: Postparaplegic pain, brachial plexus avulsion pain, nerve entrapment syndromes, peripheral neuropathy

NEUROLOGY 101

- Neurology, Neurology, Neurology!!! Because so much of the AMA Guides and the QME examination are focused on the Neurology – We're going to review a few basic general principles of 1) the Nervous System, and 2) the Neurologic Examination including:

1. Neurology 101
   - Development of the Nervous System
   - Divisions of the Nervous System (Central Nervous System/Peripheral Nervous System
   - Dermatomes and myotomes
   - Spinal cord, spinal nerves, plexuses, and named peripheral nerves (upper and lower extremity)

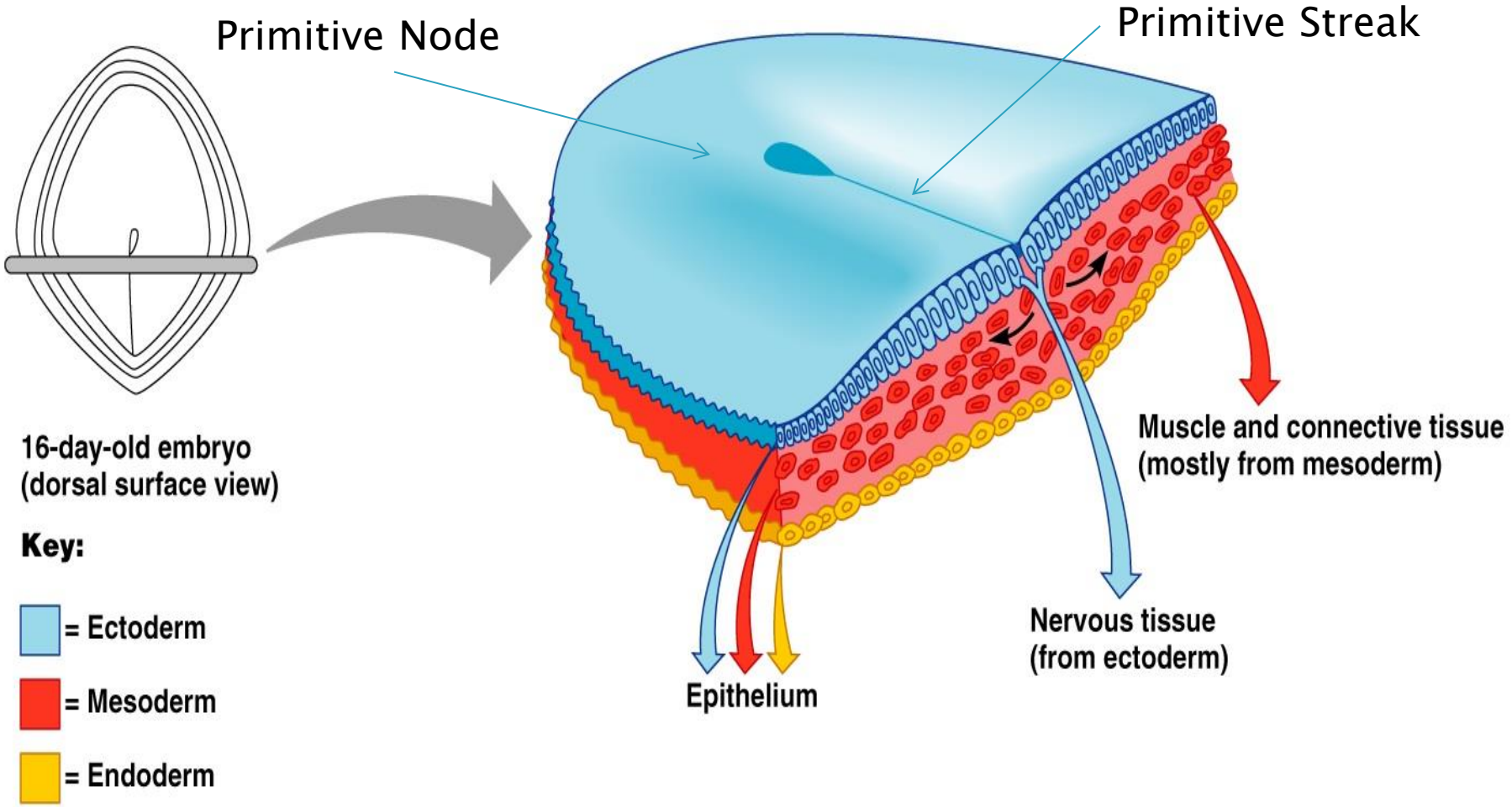
THE NEUROLOGIC EXAMINATION

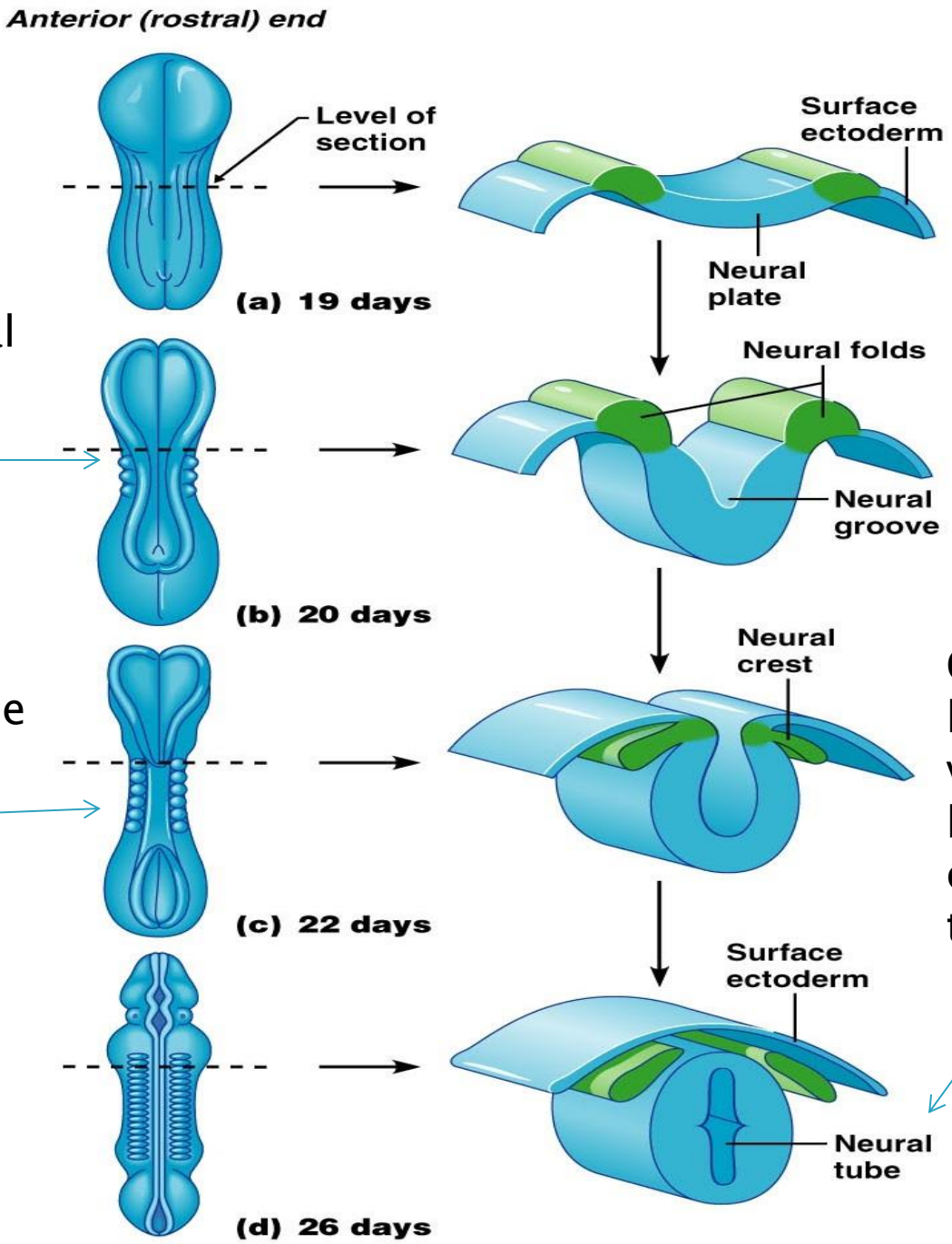
2. The Neurologic Examination:
   - General Principle of the sensory and motor examinations
   - Components of the neurologic exam by body region
   - Equipment needed for the neurologic exam
   - Specific Neurologic techniques:
     1. General Neurologic Exam
     2. Spine Exam (cervical spine)
     3. The Upper Extremity Examination
     4. The Lower Extremity Examination

Neurology 101

- Development of the Nervous System:
  - Formation of Tri-Laminar Disc and Formation of Neural Tube:
  - Formation of the Primary and Secondary Brain Vesicles
  - Appearance of the Somites and Development of the 1) Dermatome, 2) Myotome, and 3) Sclerotome
- PNS – Cranial Nerves and Spinal Nerves
- Cervical, Brachial, Lumbar, and Sacral Plexuses

Embryonic Development

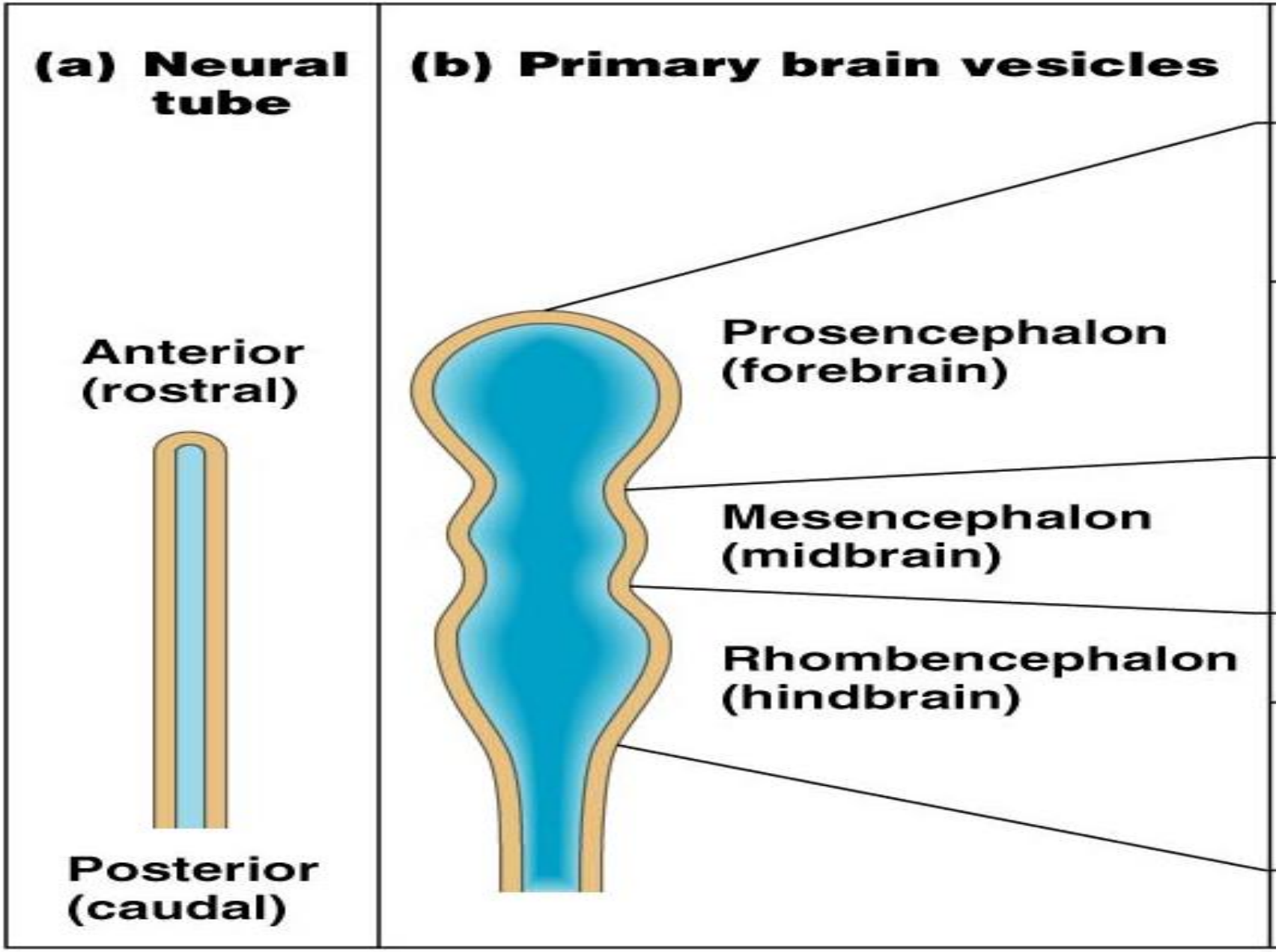


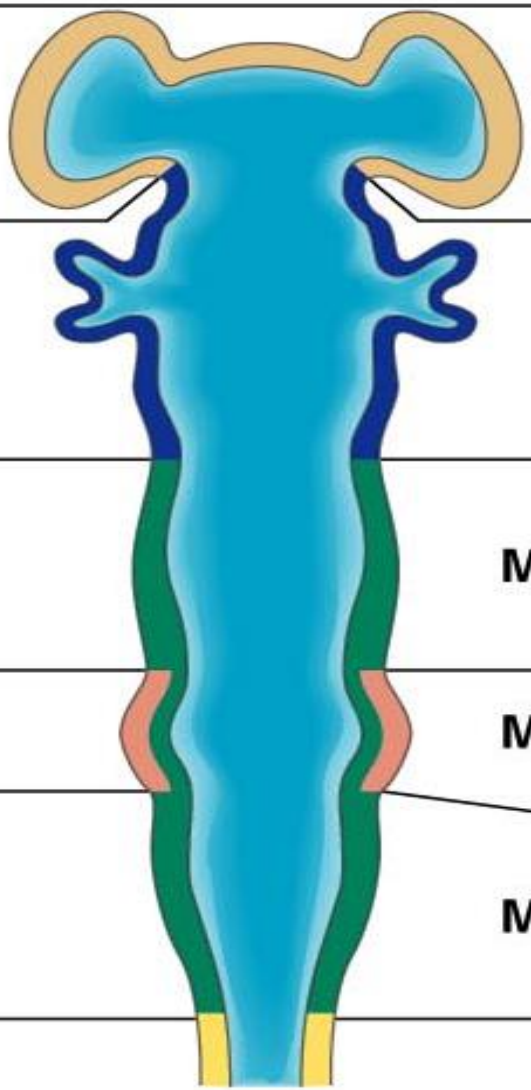


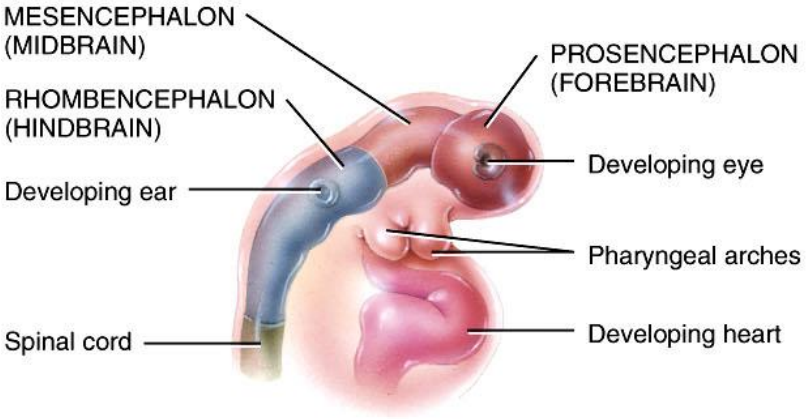
Future Occiputal region

Closes first at the level of C5

Closed tube becomes the ventricles of the brain and the central canal of the spinal cord

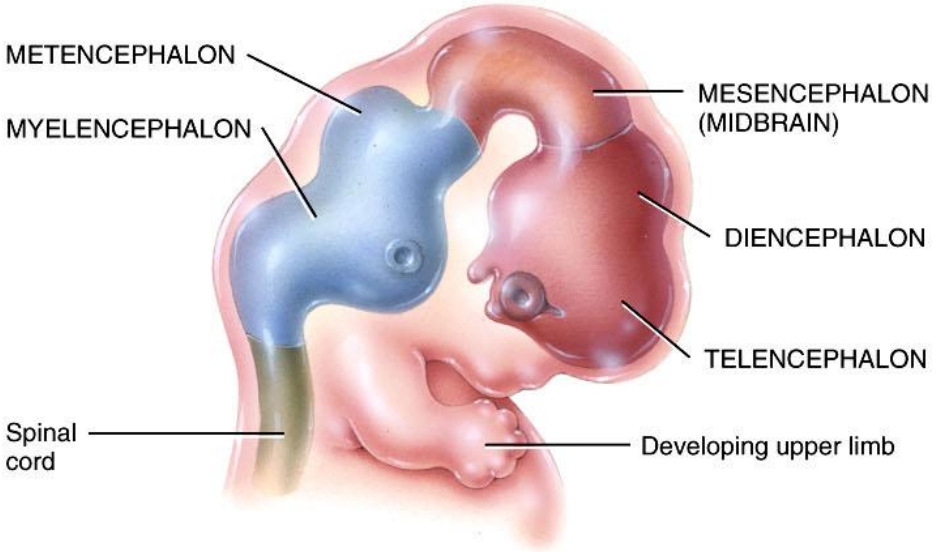

(a) Neural tube
(b) Primary brain vesicles
Anterior (rostral)
Posterior (caudal)
Prosencephalon (forebrain)
Mesencephalon (midbrain)
Rhombencephalon (hindbrain)

(c) Secondary brain vesicles	(d) Adult brain structures
 Telencephalon	Cerebrum: cerebral hemispheres (cortex, white matter, basal nuclei)
Diencephalon	Diencephalon (thalamus, hypothalamus, epithalamus), retina
Mesencephalon	Brain stem: midbrain
Metencephalon	Brain stem: pons
	Cerebellum
Myelencephalon	Brain stem: medulla oblongata
	Spinal cord

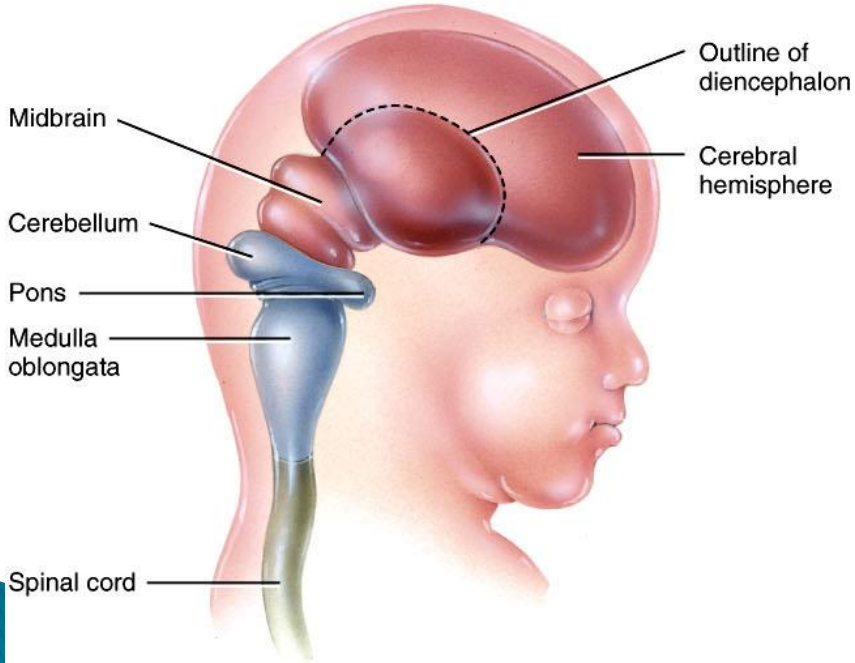


Lateral view of right side

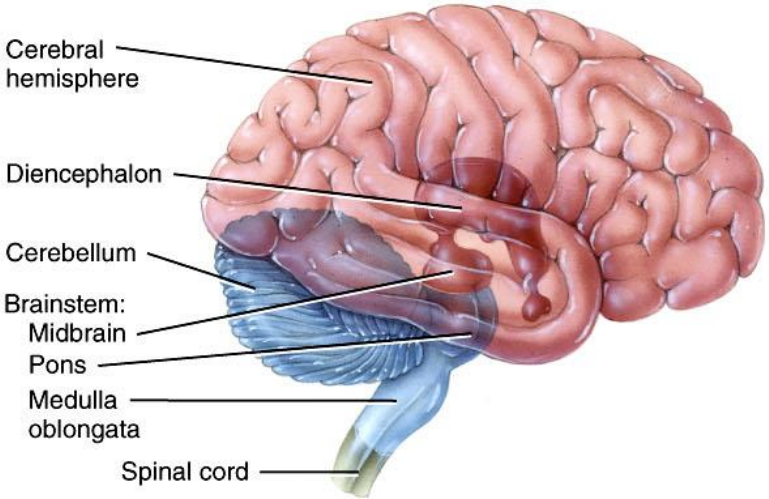
(a) Three-four week embryo showing primary brain vesicles



(b) Seven-week embryo showing secondary brain vesicles



(c) Eleven-week fetus showing expanding cerebral hemispheres overgrowing the diencephalon



(d) Brain at birth (the diencephalon and superior portion of the brain stem have been projected to the surface)

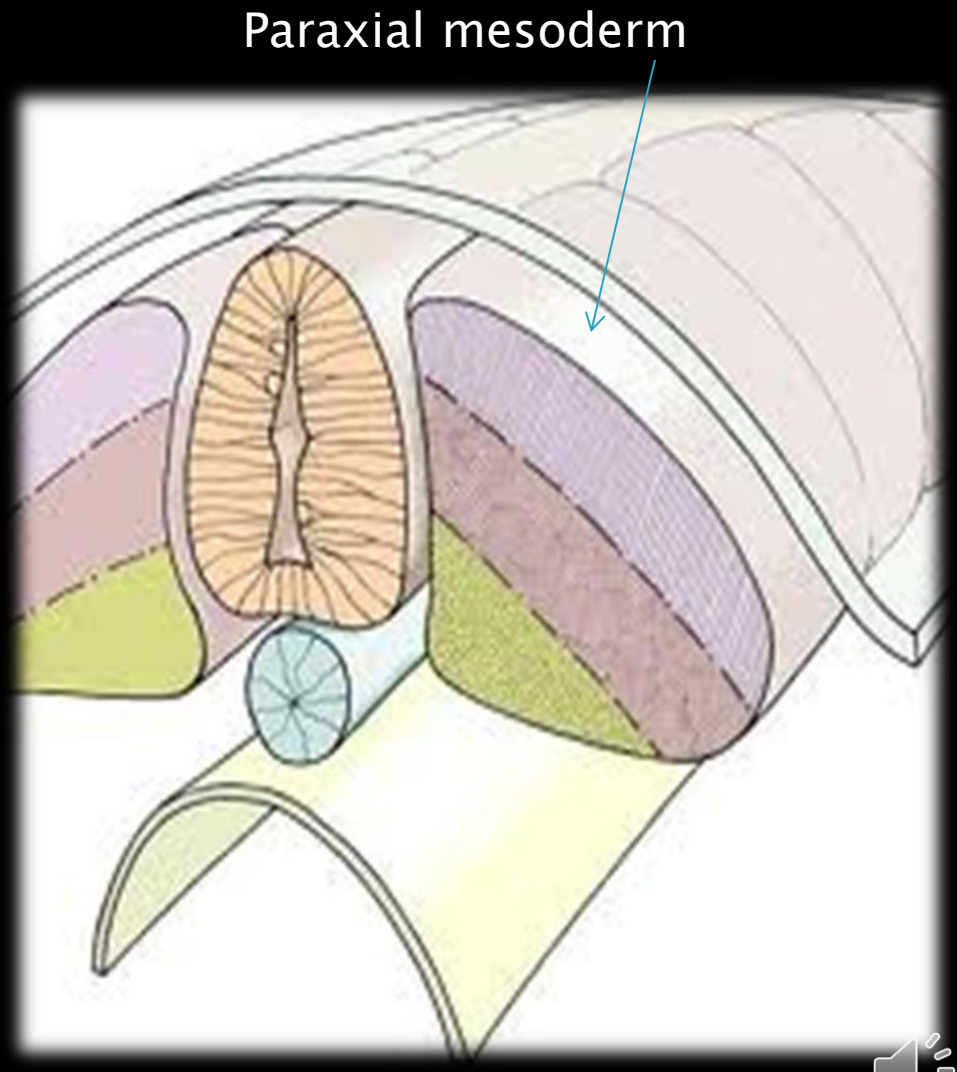
DEVELOPMENT OF MESODERM

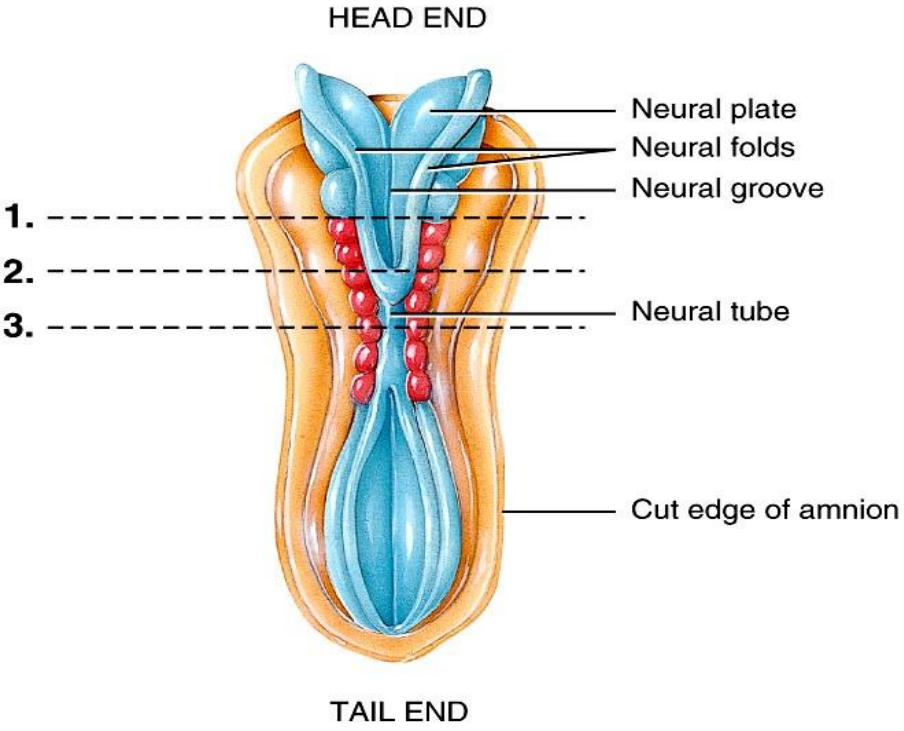
- Meanwhile (Simultaneously) – Ectodermal Cells proliferate and push downward and fill the middle layer of the trilaminar disc. Cells proliferate quickly and pile up on both sides of the neural tube. This becomes the mesoderm.
- Mesoderm separates out into 3 distinct areas:
  1. Paraxial Mesoderm (Future somites)
  2. Intermediate Mesoderm (Future kidneys urogenital system)
  3. Lateral Plate Mesoderm (Parietal and visceral layers of mesoderm). This forms the body wall lining, and the linings of the viscera and heart (respectively) .

SOMITES

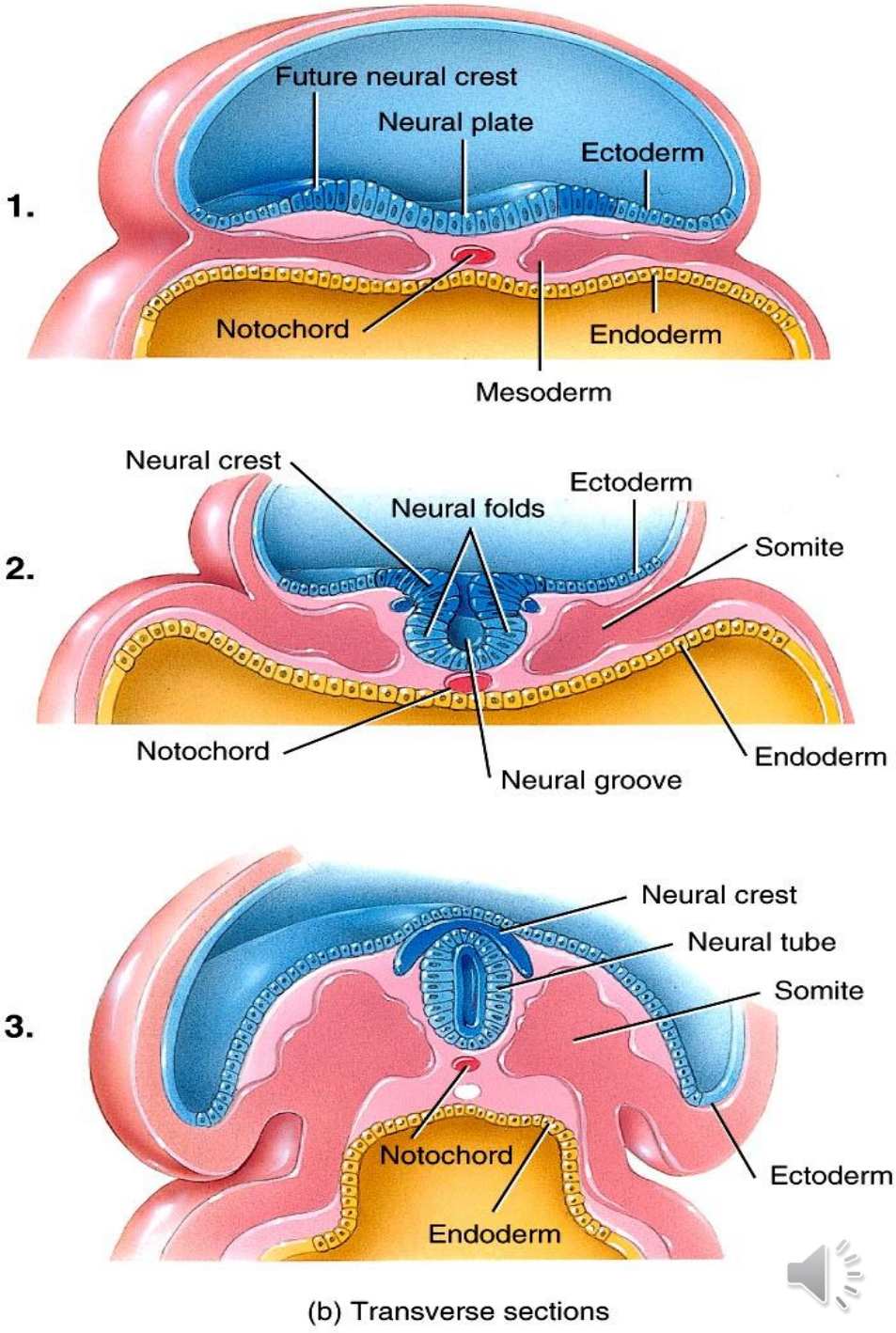
Embryonic Somites – Development of dermatomes and myotomes

- Paraxial Mesoderm gives us the Somites:
- A Somite is a mass of mesoderm distributed along the two sides of the neural tube that will eventually differentiate and divide into the dermis (giving us the dermatomes), the skeletal muscle (giving us the myotomes), and the sclerotome (which becomes the vertebrae of the spine and bones of axial and appendicular skeleton)

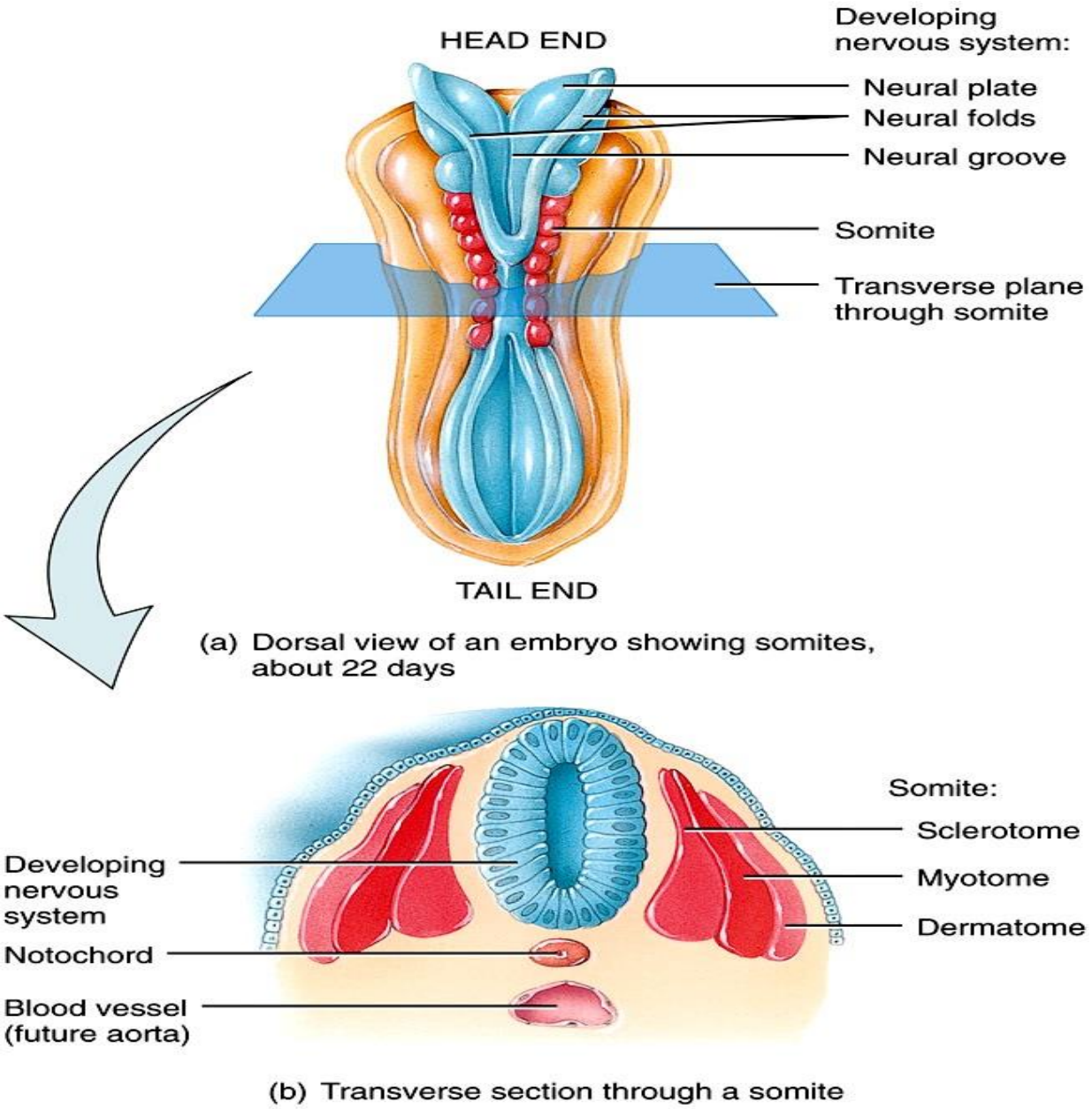




(a) Dorsal view



(b) Transverse sections


HEAD END
Developing nervous system:
Neural plate
Neural folds
Neural groove
Somite
Transverse plane through somite
TAIL END
(a) Dorsal view of an embryo showing somites, about 22 days
Somite:
Sclerotome
Myotome
Dermatome
Developing nervous system
Notochord
Blood vessel (future aorta)
(b) Transverse section through a somite

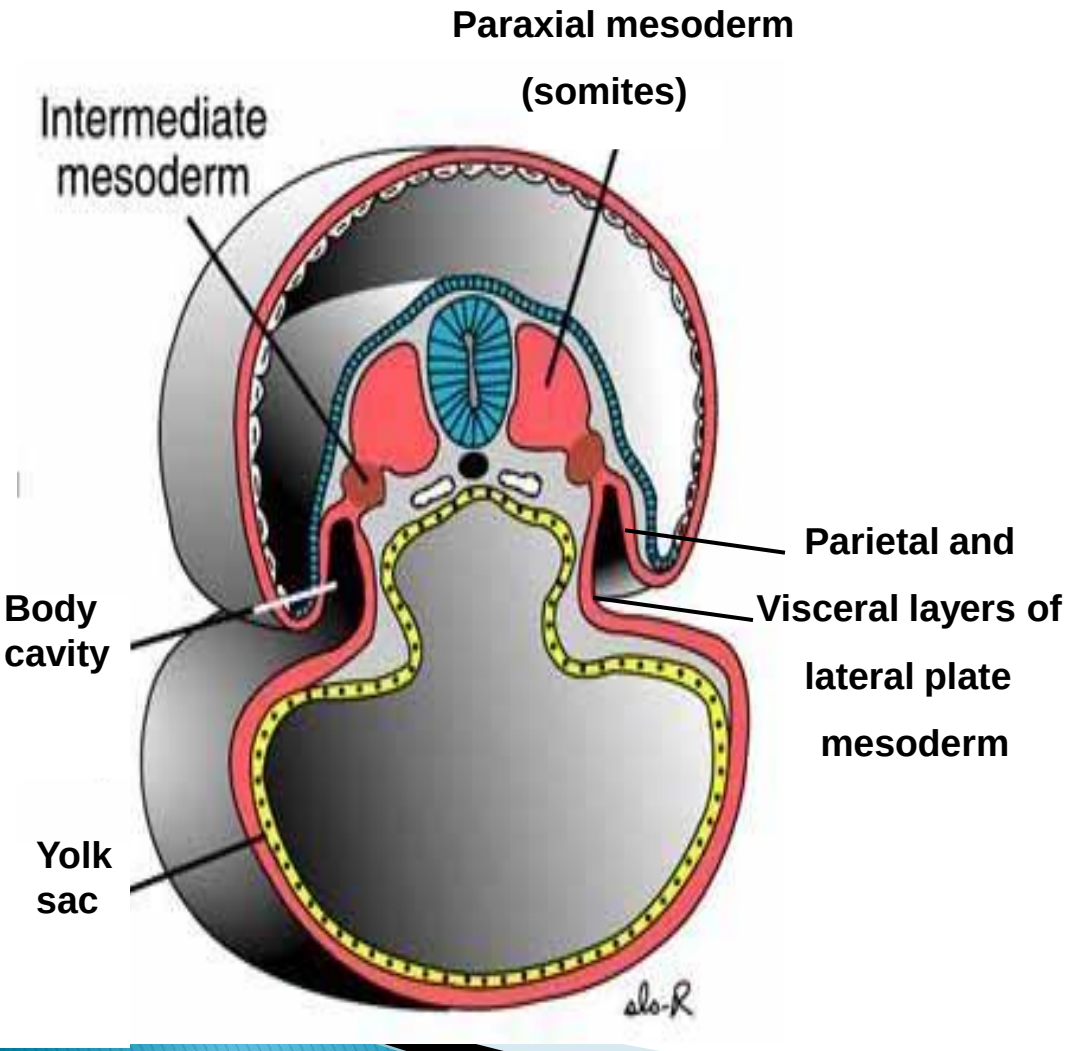
ECTODERMAL CELLS

- Ectodermal germ layer gives rise to organs and structures that maintain contact with the outside world:
- Central nervous system
- Peripheral nervous system
- Sensory epithelium of ear, nose and eye (Special Senses of hearing/balance, smell, and sight)
- Epidermis (including hair and nails)
- Subcutaneous glands (including breast)
- Pituitary gland
- Enamel of teeth

NEURAL CREST CELLS

- Dorsal Root Ganglia (sensory) – all spinal nerves and CN 5 (V1/V2), 7, 9, 10 (not "special sensory" neurons CN 1, 2, 8)
- Sympathetic chain, peripheral ganglia, adrenal medulla
- Schwann cells and glial cells (astrocytes/microglial cells/ependymal cells/oligodendrocytes – CNS)
- Melanocytes (pigment)
- "C" cells of the thyroid gland
- Meninges – dura, arachnoid, and pia mater
- Odontoblasts (teeth)
- Cartilages of pharyngeal arches
- Septum of truncus arteriosus
- Dermis of face and neck
- Connective tissue and bones of face and skull

MESODERMAL CELLS



Origins of Muscles

Skeletal Muscle: Paraxial mesoderm

Smooth Muscle (gut and derivatives): Visceral layer, lateral plate mesoderm around gut tube

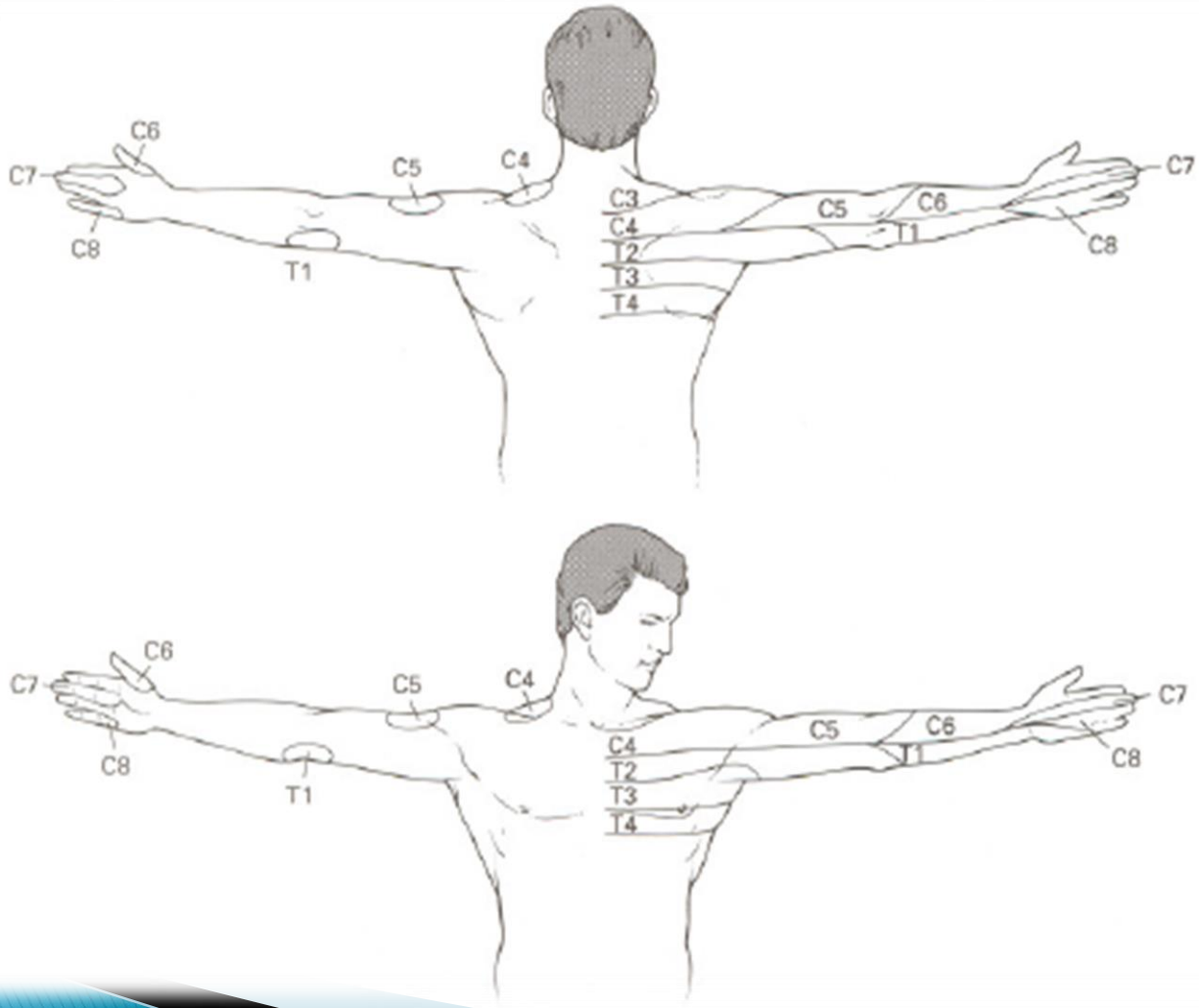
Cardiac: Visceral layer, lateral plate mesoderm around heart tube

EXCEPTION!: Smooth (pupil, mammary, and sweat glands): Ectoderm

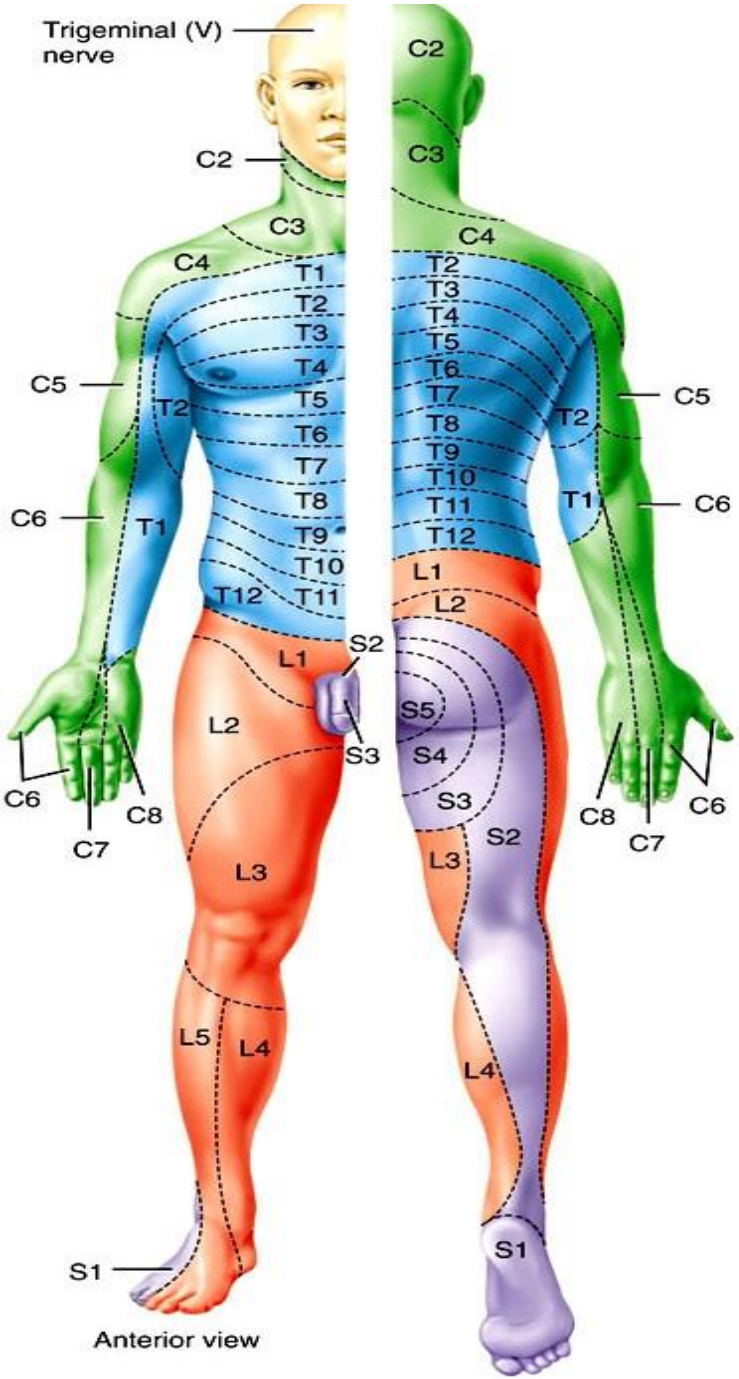
DERMATOMES

- A "**dermatome**" is an area of skin that is supplied by a single spinal nerve.
- There are:
  - 8 cervical nerves
  - 12 thoracic nerves
  - 5 lumbar nerves
  - 5 sacral nerves.
- Each of these nerves relay sensations (including pain) from a particular region of skin to the brain.

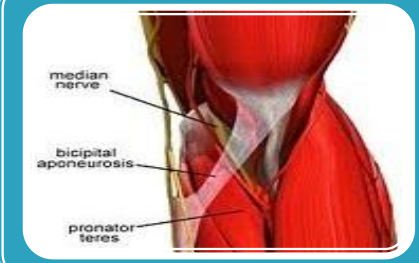
UPPER EXTREMITY DERMATOMES (AMA GUIDES P. 377)



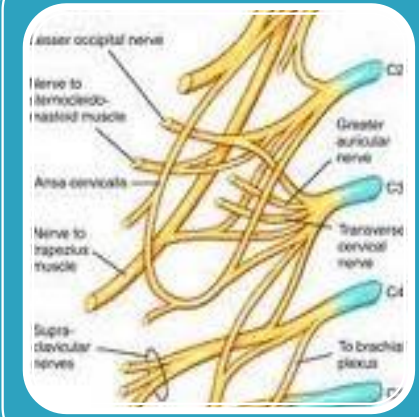
LOWER EXTREMITY DERMATOMES (AMA GUIDES P. 377)


Trigeminal (V) nerve
C2
C3
C4
C5
C6
C7
C8
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
Anterior view

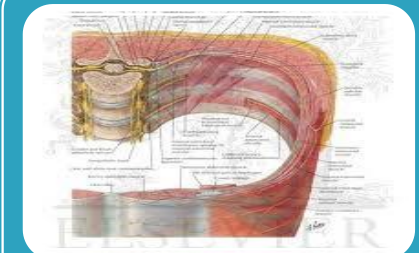
MYOTOMES



Myotome – In embryonic development , a **myotome** is a group of tissues formed from SOMITES that develop into the body wall muscle. We use the term "myotome" to describe all the muscles served by a single spinal nerve root. It is the motor equivalent of a dermatome.



Law of Original Innervation: Wherever a somite derivative (dermatome/myotome/sclerotome) migrates it retains its original somite nerve (For example, the myotomes of cervical somites 3, 4, and 5 migrate and combine to form the *diaphragm – they migrate to the level of T12 and drag their somite nerves, united as the phrenic nerves along with them)* Even when a muscle or bone receives contributions from several somites, each spinal nerve continues to innervate only the tissue that derived directly from its original somite.



Because of a lack of limbs, the thoracoabdominal wall retains all the nerves, muscles, ribs, and intercostal vessels in their primordial somite sequences without migrating.

DERMATOMES/MYOTOMES

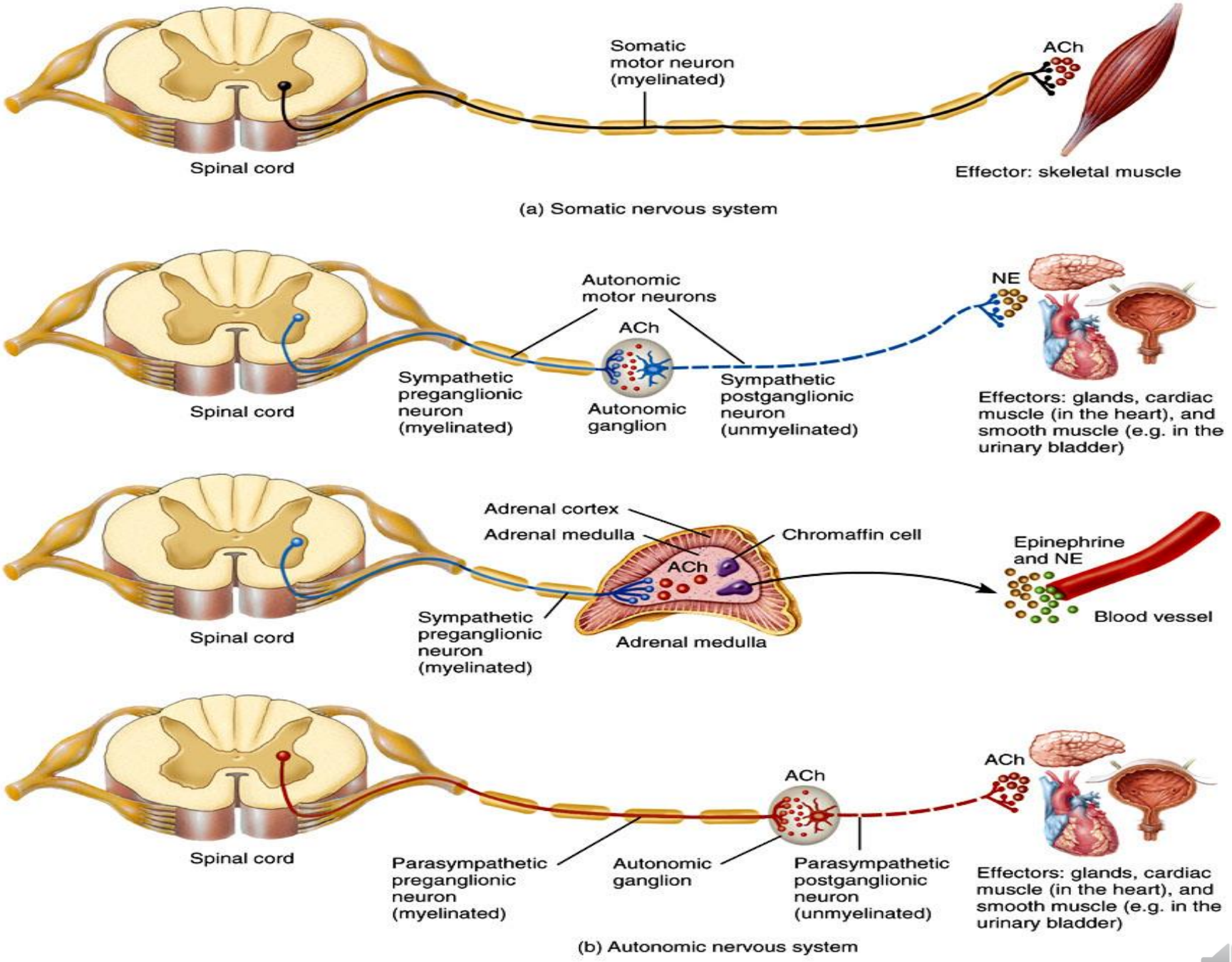
So we test the dermatomes with our sensory examination. We test the myotomes with our motor examination.

Dermatomes transmit impulses to the spinal cord via the sensory neurons. Myotomes receive impulses from the spinal cord via motor neurons. Sensory and motor neurons travel in the same spinal nerve root.

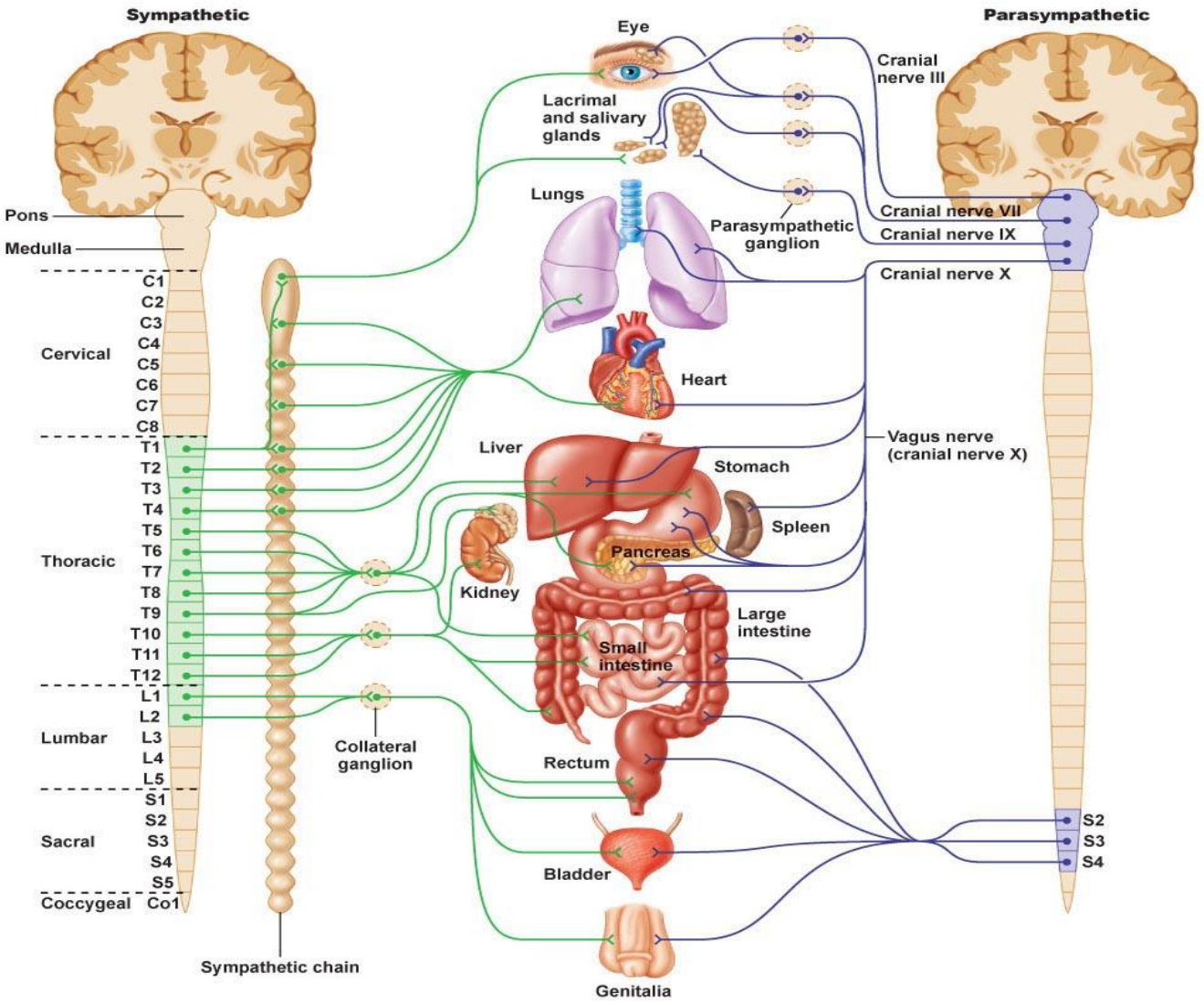
Examination Procedures discussed in Part 2 of this Program.

PERIPHERAL NERVOUS SYSTEM

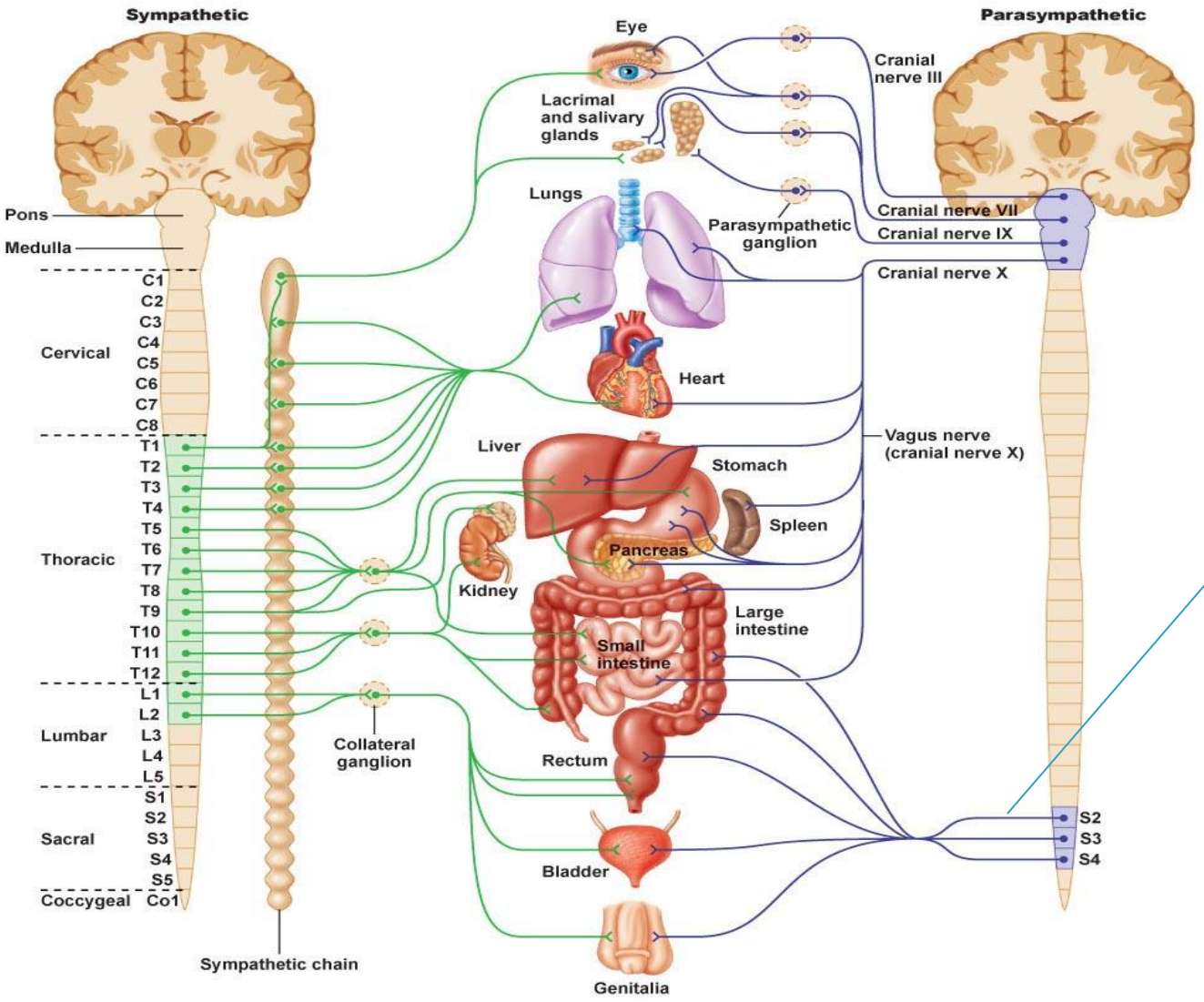
- ANATOMY REVIEW:
  - AUTONOMIC NERVOUS SYSTEM
  - CRANIAL NERVES (12 PAIRS)
  - SPINAL NERVES (31 PAIRS)
  - NERVE PLEXUSES (4)
  - NAMED PERIPHERAL NERVES:
    - Upper Extremity
    - Lower Extremity


Somatic
motor neuron
(myelinated)
ACh
Spinal cord
Effector: skeletal muscle
(a) Somatic nervous system
Autonomic
motor neurons
ACh
NE
Sympathetic
preganglionic
neuron
(myelinated)
Autonomic
ganglion
Sympathetic
postganglionic
neuron
(unmyelinated)
Spinal cord
Effectors: glands, cardiac
muscle (in the heart), and
smooth muscle (e.g. in the
urinary bladder)
Adrenal cortex
Adrenal medulla
Chromaffin cell
ACh
Epinephrine
and NE
Sympathetic
preganglionic
neuron
(myelinated)
Adrenal medulla
Blood vessel
Spinal cord
ACh
ACh
Parasympathetic
preganglionic
neuron
(myelinated)
Autonomic
ganglion
Parasympathetic
postganglionic
neuron
(unmyelinated)
Spinal cord
Effectors: glands, cardiac
muscle (in the heart), and
smooth muscle (e.g. in the
urinary bladder)
(b) Autonomic nervous system

SYMPATHETIC TRUNK



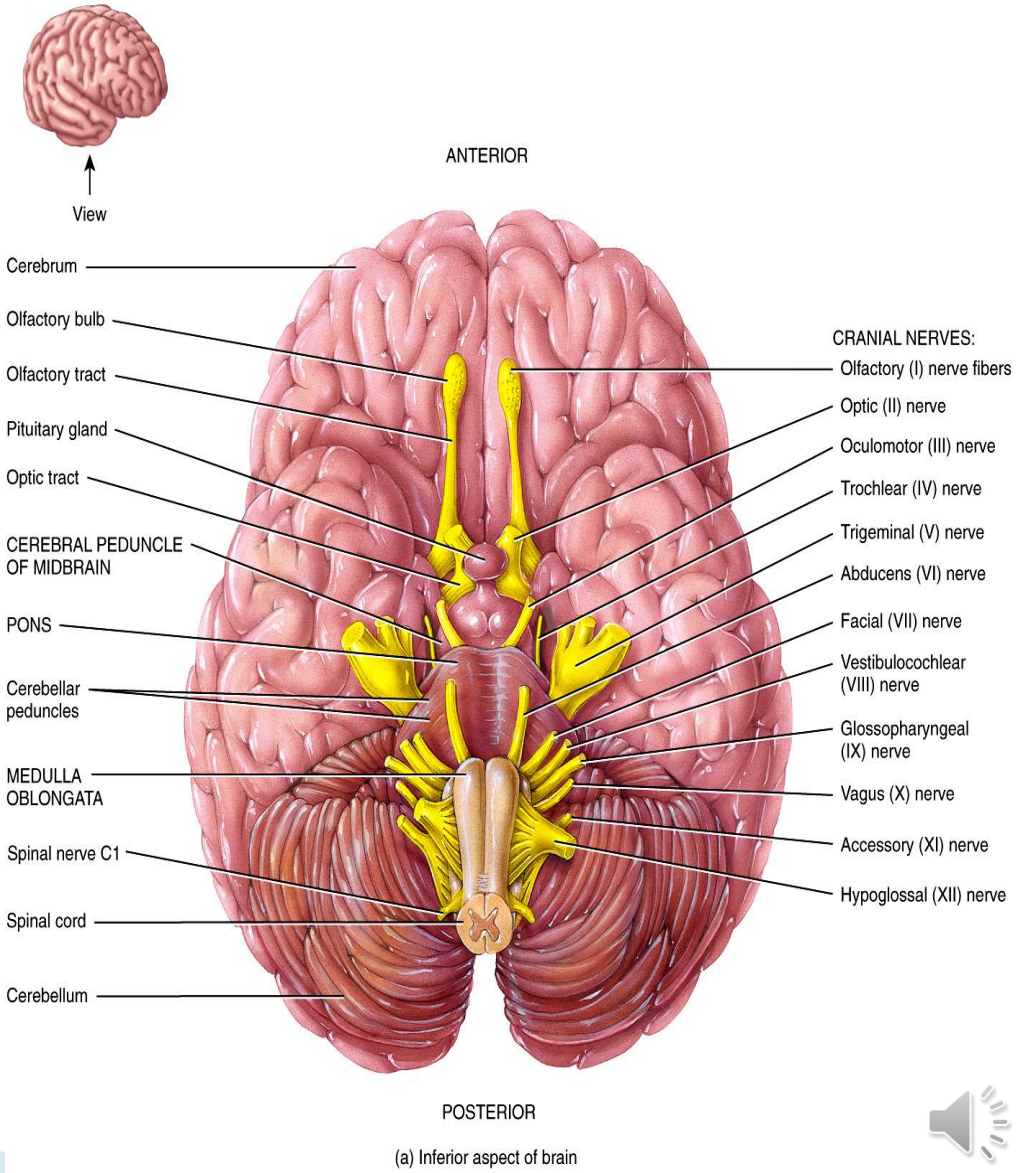
PARASYMPATHETIC TRUNK



Nervi Erigentes

CRANIAL NERVES

- First two pairs of cranial nerves attach to the forebrain, the rest originate from the brain stem.
- Other than the vagus nerves (which extends into the abdomen), cranial nerves serve only head and neck structures.



(a) Inferior aspect of brain

Cranial Nerve	Foramen
Cr. N I (Olfactory nerve)	Tiny sensory nerve filaments of smell which run from nasal mucosa to synapse with olfactory bulbs. Olfactory bulbs and tracts are brain structures
Cr. N II (Optic nerve)	Optic Foramen (sphenoid bone)
Cr. N III (Oculomotor)	Enters the orbit via the superior orbital fissure (between lesser and greater wings of sphenoid bone)
Cr. N IV (Trochlear)	Enters the orbit via the superior orbital fissure (between lesser and greater wings of sphenoid bone)
Cr. N V (Opthalmic Branch – V1)	Enters the orbit via the superior orbital fissure (between lesser and greater wings of sphenoid bone)
Cr. N V (Maxillary Branch – V2)	Foramen Rotundum (sphenoid bone)
Cr. N V (Mandibular Branch – V3)	Foramen Ovale (sphenoid bone)

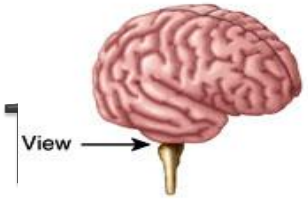
Cranial Nerve	Foramen
Cr. N VI (Abducens nerve)	Enters the orbit via the superior orbital fissure (between lesser and greater wings of sphenoid bone)
Cr. N VII (Facial)	Leaves the skull via the stylomastoid foramen
Cr. N VIII (Vestibulocochlear)	Exits the inner skull via the internal auditory meatus in the temporal bone.
Cr. N IX (Glossopharyngeal)	Exits skull via jugular foramen
Cr. N X (Vagus)	Exits skull via jugular foramen
Cr. N XI (Spinal Accessory)	Enters skull through the foramen magnum, exits skull via jugular foramen along with IX, and X
Cr. N XII (Hypoglossal)	Exits skull through hypoglossal canal of occipital bone

Cranial Nerve	Type of Nerve Fibers	Function
I. Olfactory	Special Sensory	Smell
II. Optic	Special Sensory	Vision
III. Oculomotor	Motor Sensory Parasympathetic	Superior, Inferior, & Medial Rectus, Inferior oblique Proprioception Iris (pupillary constriction) and lens (accomodation)
IV. Trochlear	Motor Sensory	Superior oblique Proprioception
V. Trigeminal	Motor Sensory	Chewing muscles Proprioception, Sensation on face

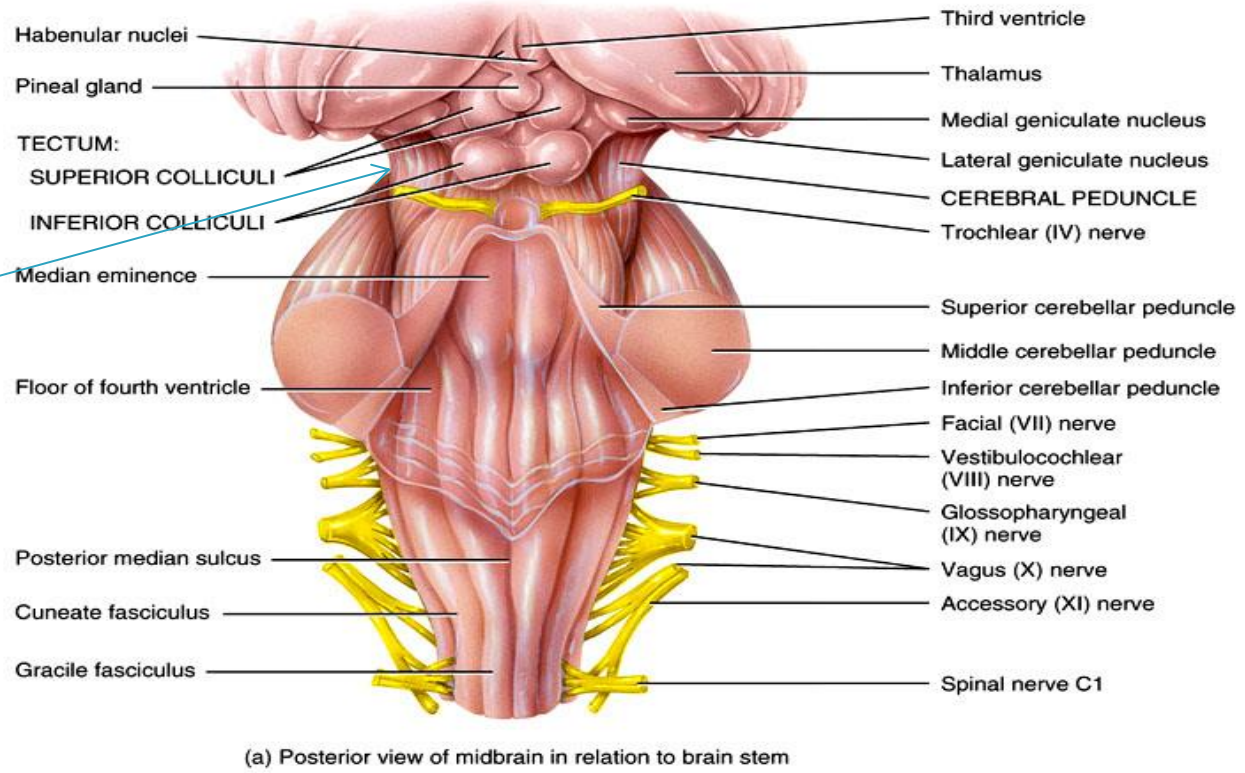
Cranial Nerve	Type of Nerve Fibers	Function
VI. Abducens	Motor Sensory	Lateral rectus Proprioception

Cranial Nerve	Type of Nerve Fibers	Function
VII. Facial	Motor Sensory – Somatic & "Special" Parasympathetic	Muscles of facial expression Proprioception, taste from ant. 2/3 tongue Lacrimal glands, submandibular & sublingual glands
VIII. Vestibulo-cochlear	Special Sensory	Vestibular division– balance/equilibrium Cochlear division - hearing
IX. Glossopharyngeal	Motor Sensory – Somatic & "Special" Parasympathetic	Muscles to tongue and pharynx Proprioception; taste from post. tongue Parotid gland
X. Vagus	Motor Sensory – Somatic & "Special" Parasympathetic	Muscles of pharynx and larynx Proprioception; taste from pharynx Heart, lungs, abdominal viscera

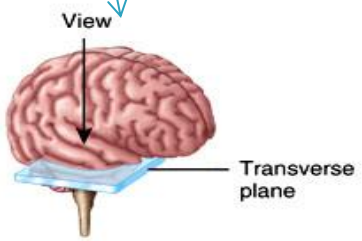
Cranial Nerve	Type of Nerve Fibers	Function
XI. Accessory	Motor Sensory	Pharynx, larynx, soft palate, trapezius, sternocleidomastoid Proprioception
XII. Hypoglossal	Motor Sensory	Muscles of tongue Proprioception
"Special Sensory" Nerves:	Cr. N I, Cr. N II, Cr. N VII, Cr. N VIII, Cr. N IX, Cr. N X	Smell, Vision, Taste (ant. 2/3 of tongue), Hearing/Equilibrium, Taste (post. 1/3 of tongue), Taste (pharynx)
Parasympathetic Fibers:	Cr. III, Cr. N. VII, Cr. N IX, Cr. N X	
Somatic:		
Branchiomotor:		

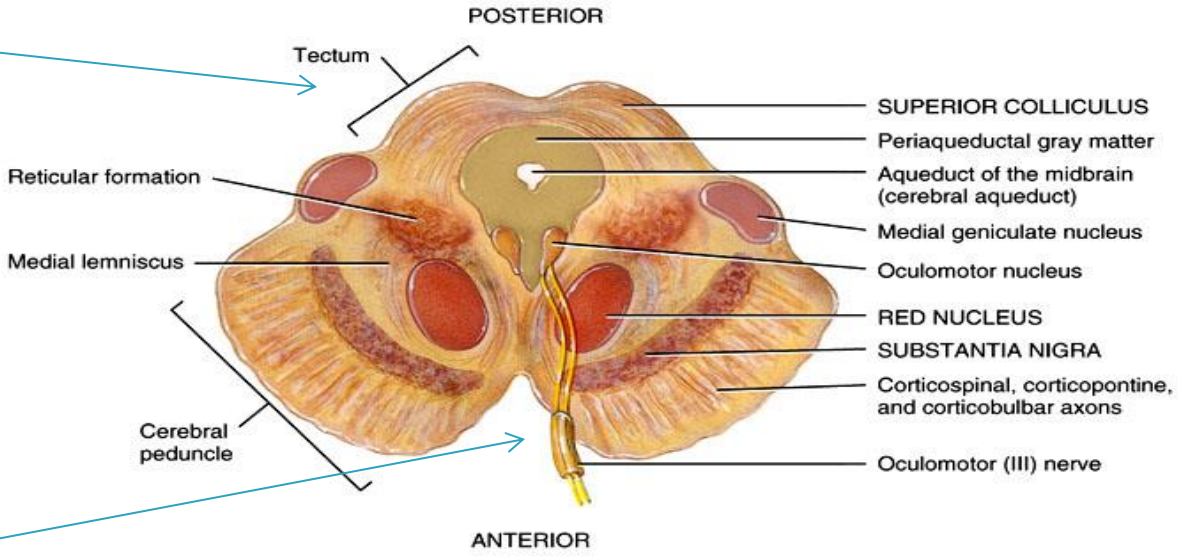


Transverse Section through cerebral peduncle



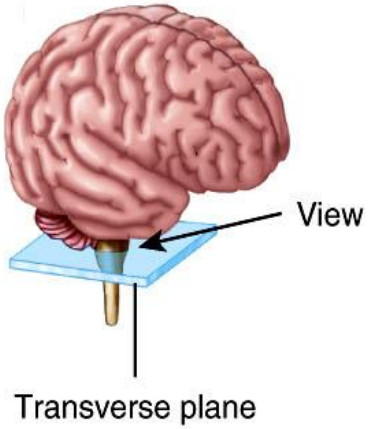
(a) Posterior view of midbrain in relation to brain stem



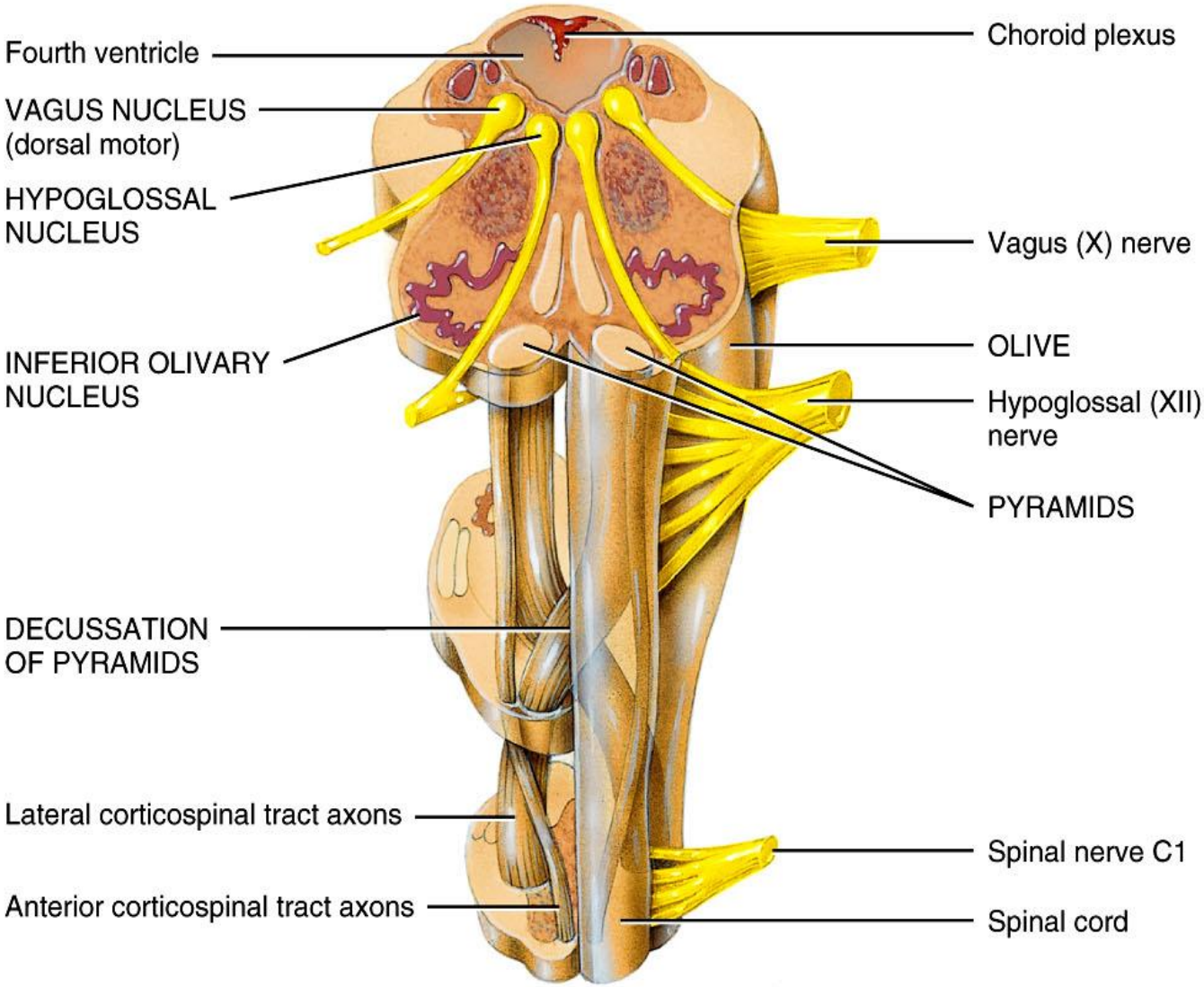


(b) Transverse section of midbrain

Oculomotor nerve comes off anteriorly!



Cr. N. XI not shown



Transverse section and anterior surface of medulla oblongata

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

SPINAL NERVES

- 31 Pairs of Spinal Nerves:
  - 8 Cervical
  - 12 Thoracic
  - 5 Lumbar
  - 5 Sacral
  - 1 Coccygeal
- In cervical spine, spinal nerve roots are named for the vertebra below the nerve root. Throughout the remainder of the spine the nerve roots are named for the vertebra above the nerve root.

SPINAL NERVE ROOTS

AMA Guides (page 480):

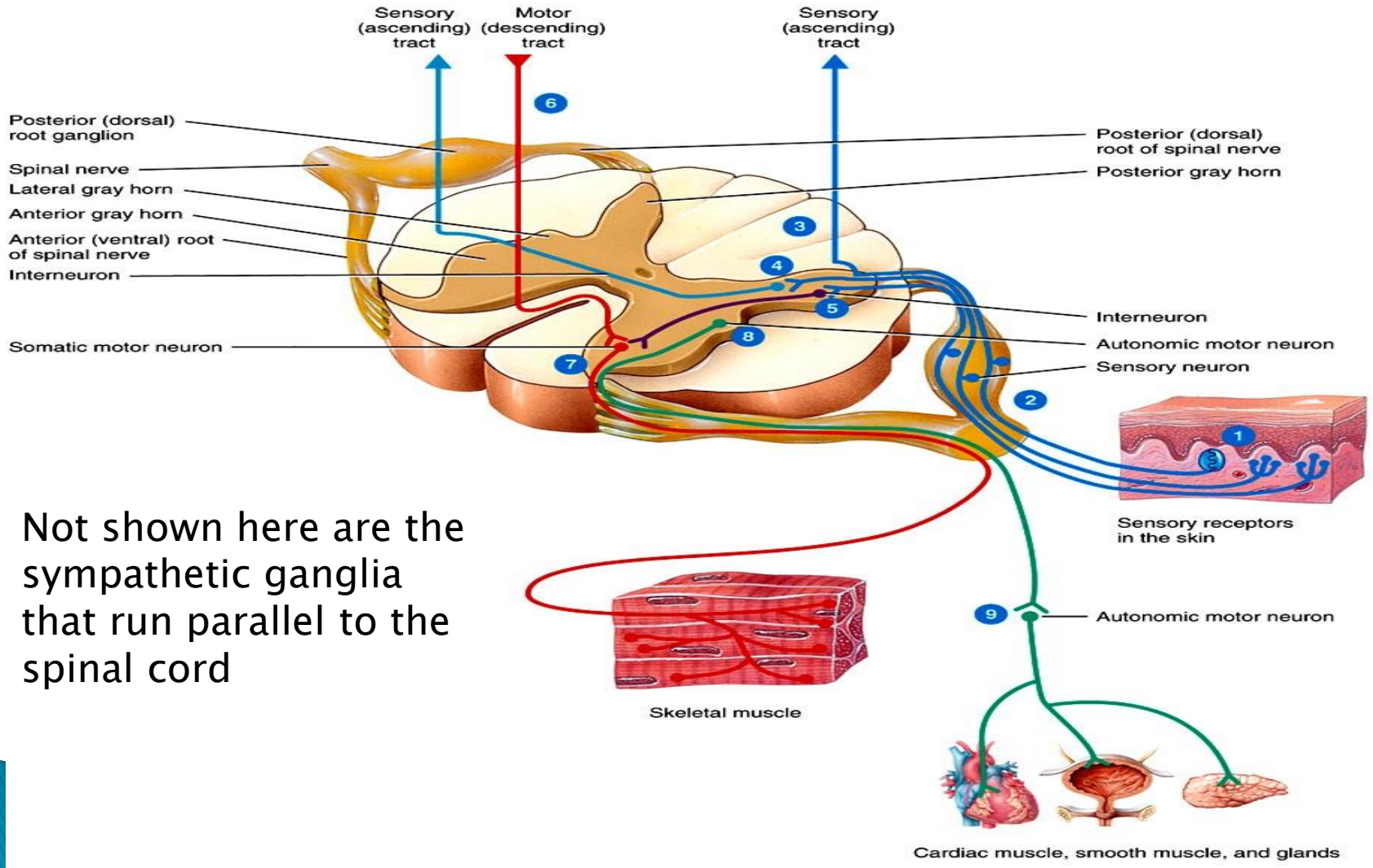
- The spinal nerves (31 pairs) contain 3 main groups of fibers:
  - Sensory (afferent) fibers that carry to the CNS impulses arising from various receptors in the skin, muscles, tendons, ligaments, bones (periosteum/mineralized bone/bone marrow), and joints (mechanoreceptors). (Afferent fibers from the dermatome, myotome, and sclerotome with all cell bodies located in the dorsal root ganglion). GSA = general somatic afferent.

SPINAL NERVE ROOTS

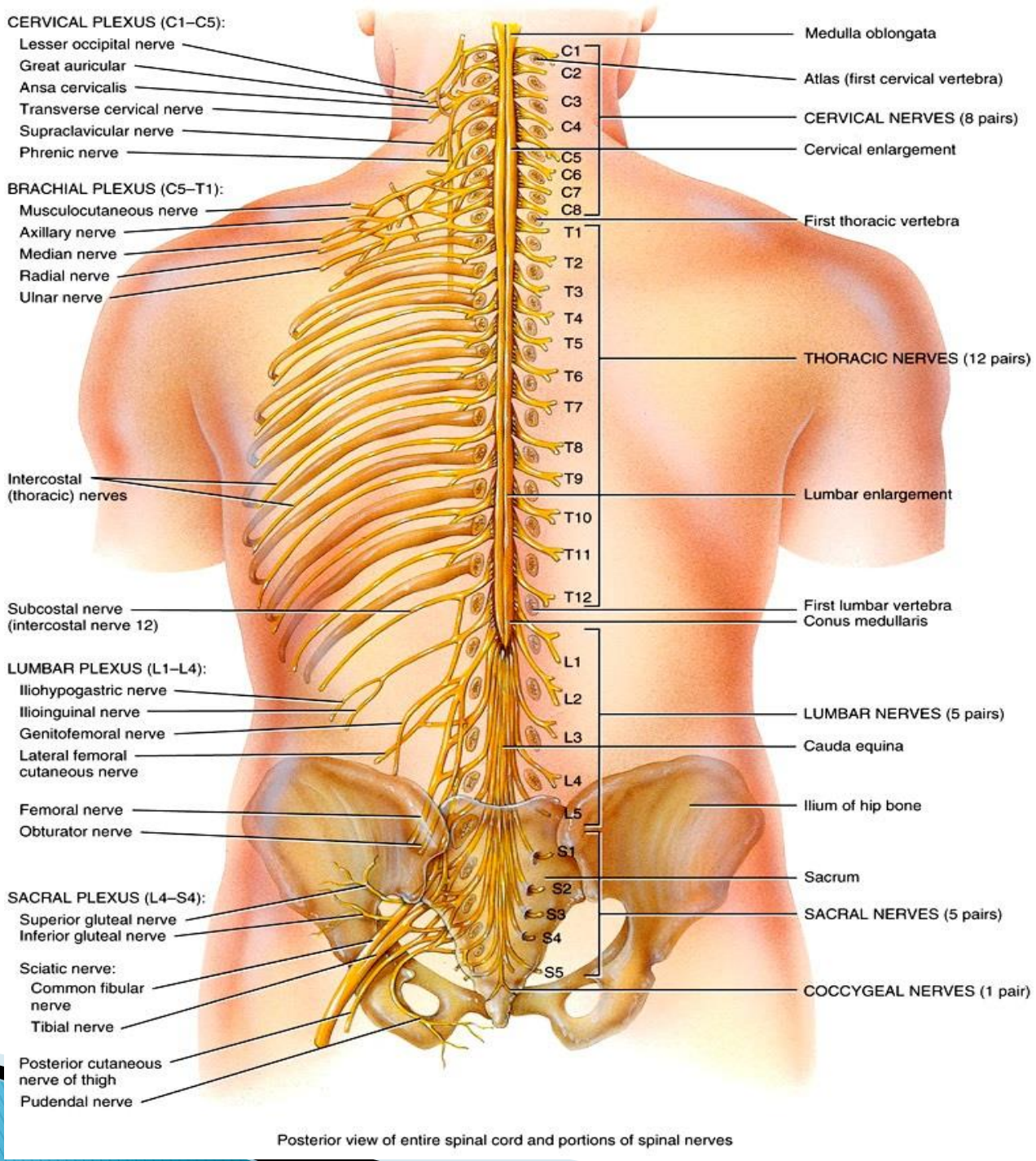
AMA Guides (page 480):

- Motor (efferent) fibers (GSE), which include large *alpha* motor neuron fibers conducting impulses from the spinal cord to skeletal muscles fibers, and smaller *gamma* motor neuron fibers carrying impulses to muscle spindles for feedback control and,
- Autonomic system fibers, which are efferent (GVE) and are concerned with the control of smooth muscles and glands. (Not mentioned are that there are autonomic sensory fibers from the viscera – GVA = general visceral afferent – either sympathetic or parasympathetic).

Spinal Nerve Root



Not shown here are the sympathetic ganglia that run parallel to the spinal cord



Posterior view of entire spinal cord and portions of spinal nerves

SPINAL NERVE ROOTS

- Spinal Nerve Roots coalesce into the Named Peripheral Nerves of the Upper and Lower Extremities through either 1) the cervical plexus (C1-C5 plus a branch from CrN XII, 2) the brachial plexus (C4/C5 – T1/T2), 3) the lumbar plexus (L1-L5), or 4) the sacral plexus (L4-S4).

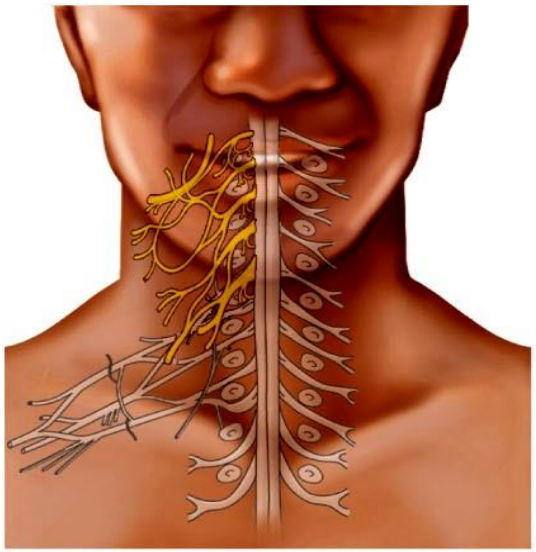
PLEXUSES OF SPINAL NERVE ROOTS

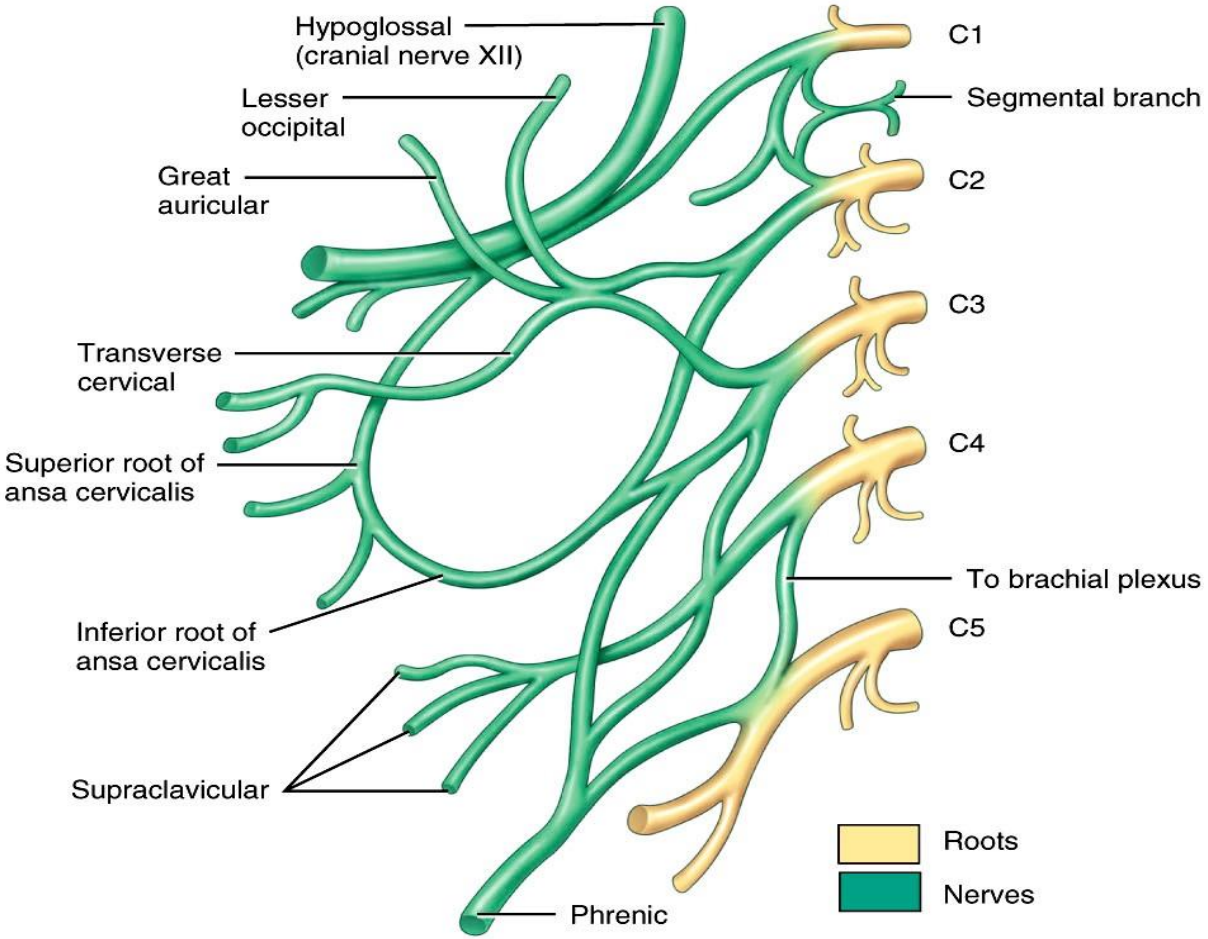
Plexus	Nerve Root Contributions
Cervical Plexus	C1-C5 plus a branch from CrN XII
Brachial Plexus	C5-T1(occasional C4/T2)
Lumbar Plexus	L1-L5
Sacral Plexus	L4-S3 (and S4 if you consider the pudendal nerve to be a part of the sacral plexus)
All of these nerve roots are mixed in that they carry all 3 (or even 4) types of fibers (Somatic – GSA/GSE, Autonomic – sensory/motor).	

IMPORTANT PERIPHERAL NERVES

Plexus	Named Peripheral Nerves
Cervical Plexus	Supraclavicular nerve, phrenic nerve
Brachial Plexus	Suprascapular, Axillary, Musculocutaneous, Radial, Median, Ulnar
Lumbar Plexus	Ilioinguinal, iliohypogastric, genitofemoral, LFCN, femoral, obturator
Sacral Plexus	Inferior gluteal, superior gluteal, tibial, common peroneal, posterior cutaneous nerve of thigh

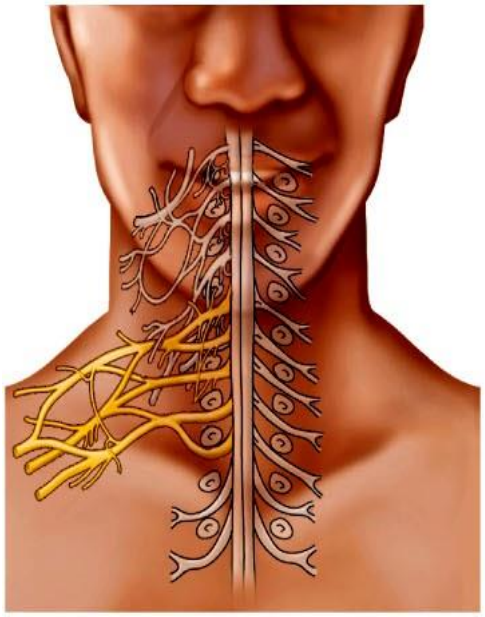
CERVICAL PLEXUS

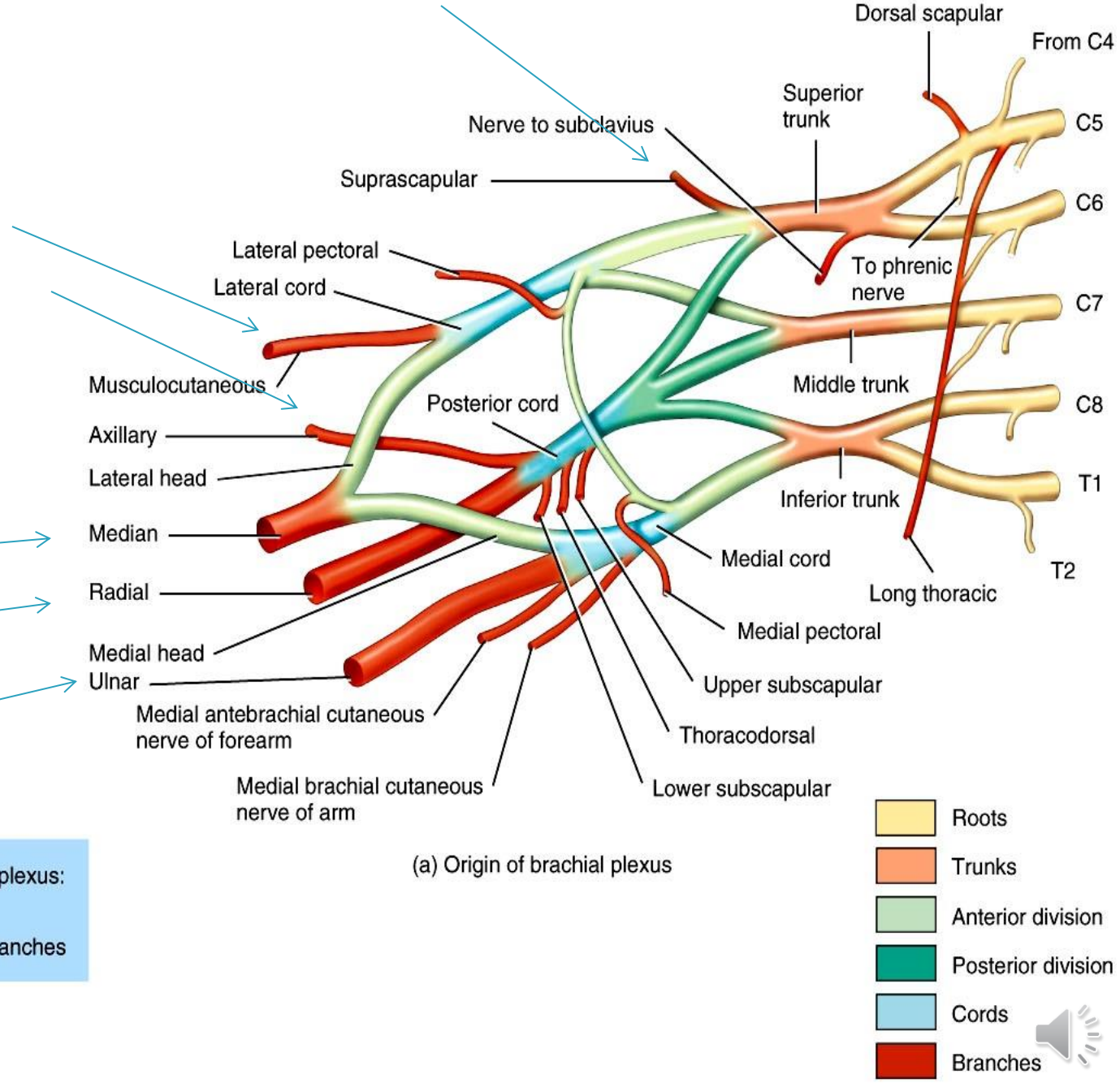




Origin of cervical plexus

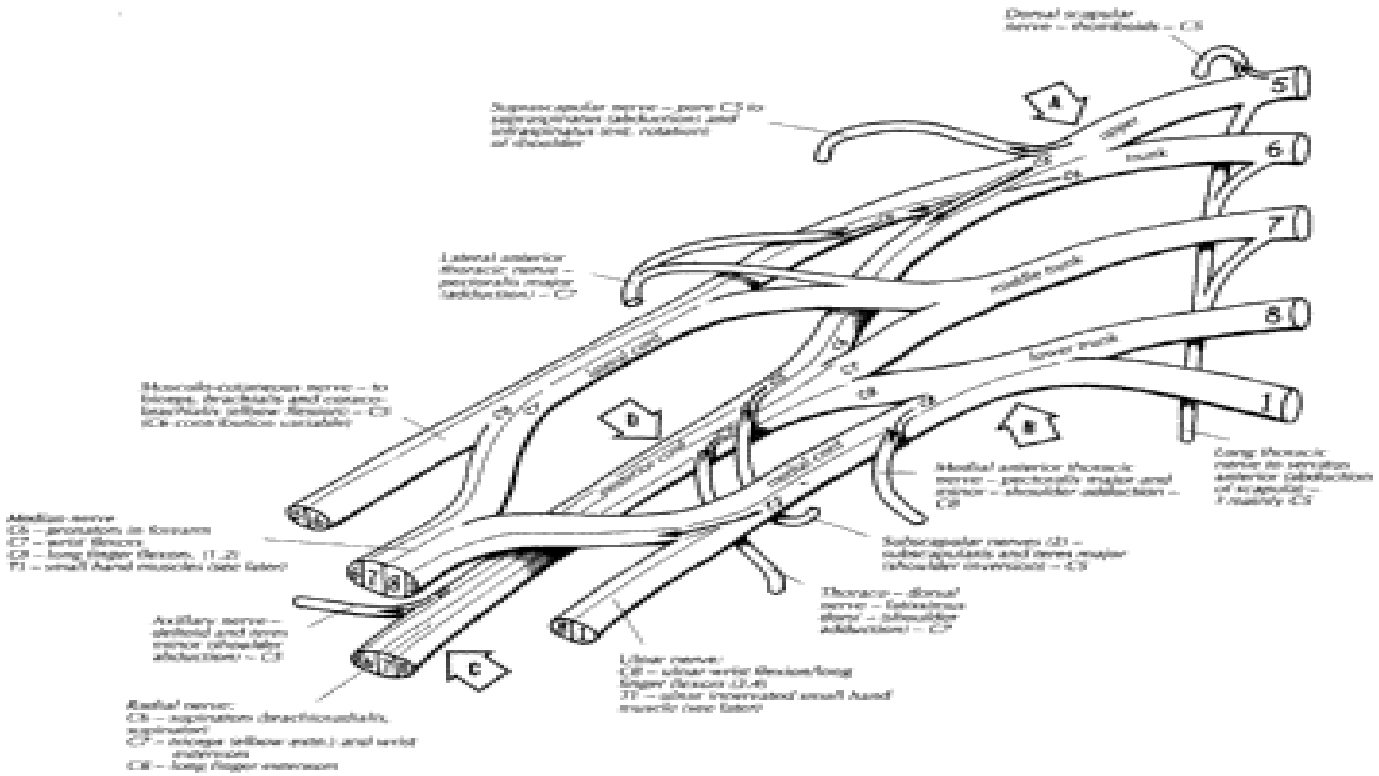
CrN XI – Spinal Accessory Nerve receives contribution from C1, C2





(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



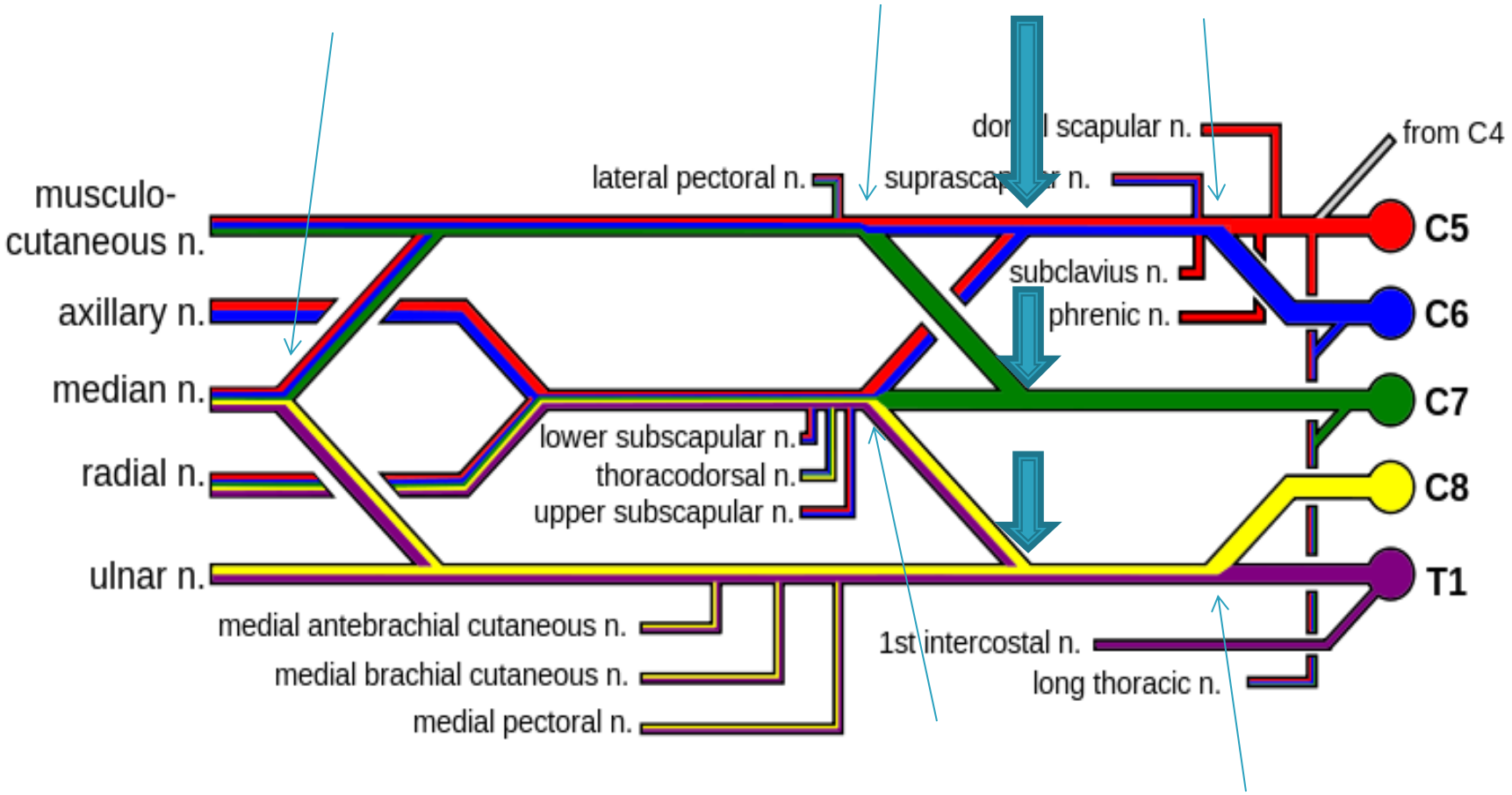
16.10 Anatomy of the brachial plexus, showing the eventual destinations of all root components.

the shoulder, elbow flexion and radial wrist extension owing to weakness in the extensor carpi radialis longus and brevis. The biceps and supinator jerks are absent. Note that as the lesion is distal to the roots it will spare the rhomboid muscles, which are supplied by a branch from the C5 root, and the serratus magnus, which is supplied by branches also arising from the C5, C6 and C7 roots via the long thoracic nerve.

Lesions of the Lower Trunk (B)

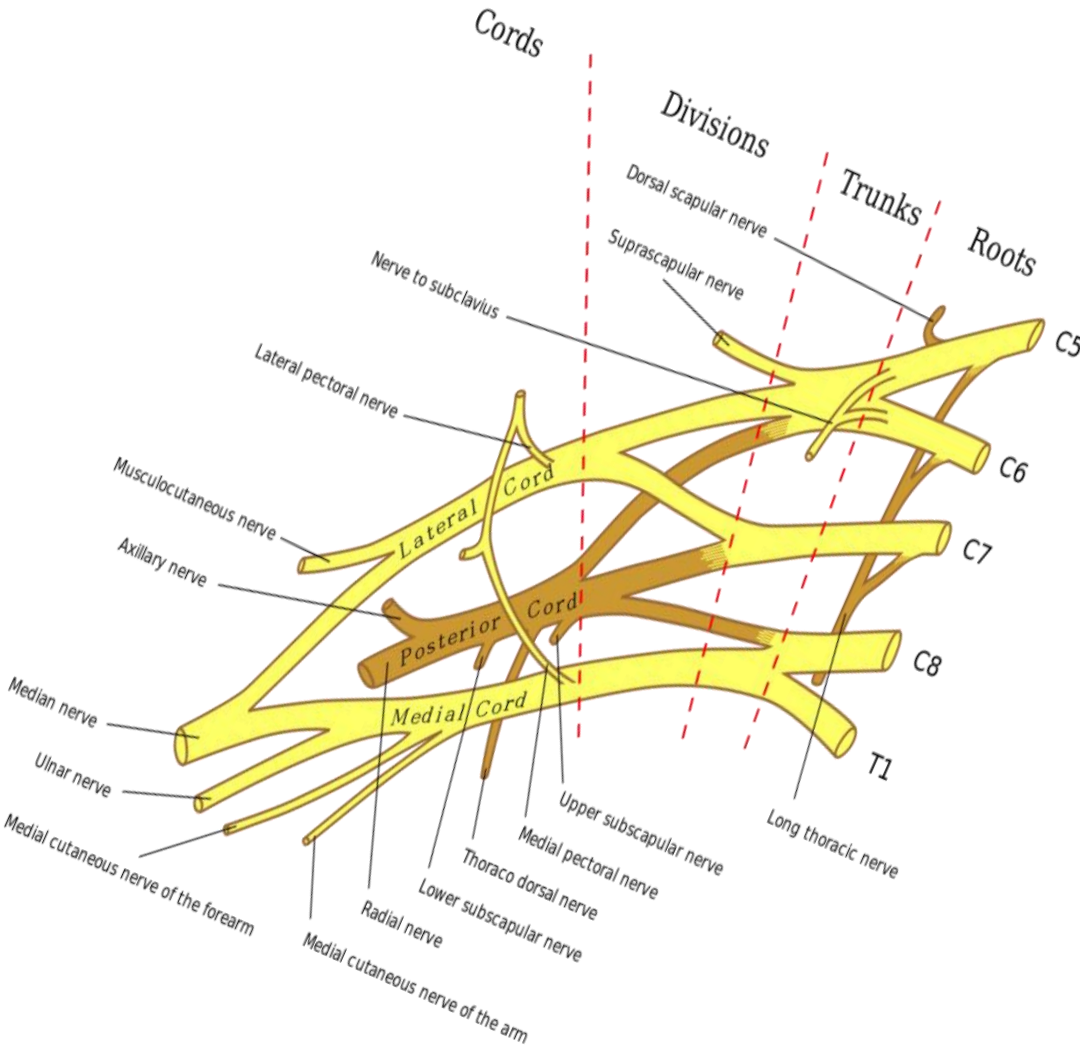
Damage to this area has already been described to some extent in connection with cervical rib syndrome. This is also the area of the plexus that can be damaged by carcinoma of the lung apex extending through the apical pleura (Pancoast's syndrome) and metastatic disease in the axillary glands, from malignant disease in the breast or elsewhere. The clinical picture consists of severe pain in the shoulder, which is particularly severe when lying in bed at night and which may drive the patient to sleep sitting up. This will be accompanied by tingling and numbness down the medial arm and forearm into the little and ring fingers. Weakness of the finger flexors and extensors and the intrinsic muscles of the hand follows.

“MIXING” OF NERVE ROOTS



BRACHIAL PLEXUS

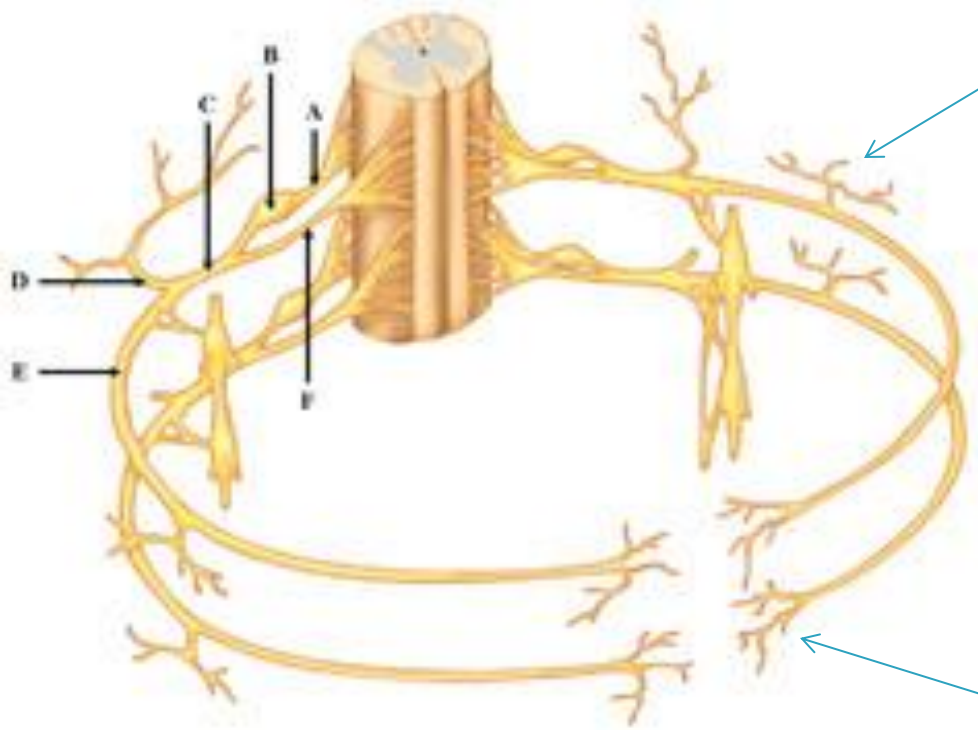
- The *posterior cord* is formed from the three posterior divisions of the trunks (C5-C8,T1)
- The *lateral cord* is the anterior divisions from the upper and middle trunks (C5-C7)
- The *medial cord* is simply a continuation of the anterior division of the lower trunk (C8,T1)



INTERCOSTAL NERVES

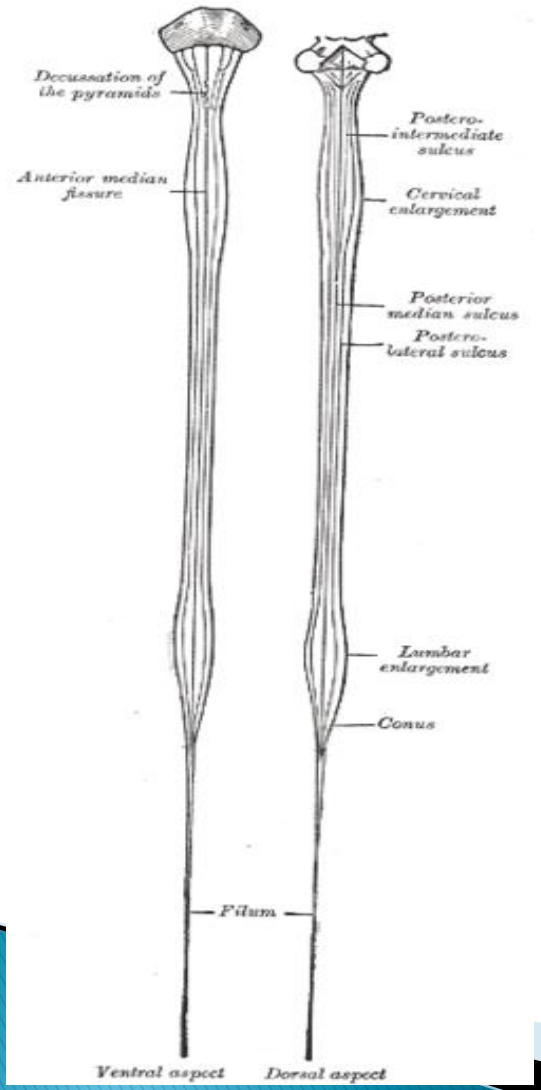
- As the spinal cord descends down the spinal canal, the nerve roots descend greater and greater distances to reach their exit foramen.
- In the thoracic spine, there are no plexuses because there are no limbs to innervate, and therefore, there is no migration of the dermatome, myotome, or sclerotome – all of which remain at the original segmental level. The somite derivatives are innervated by the *intercostal nerves – T1–T11.*

INTERCOSTAL NERVES



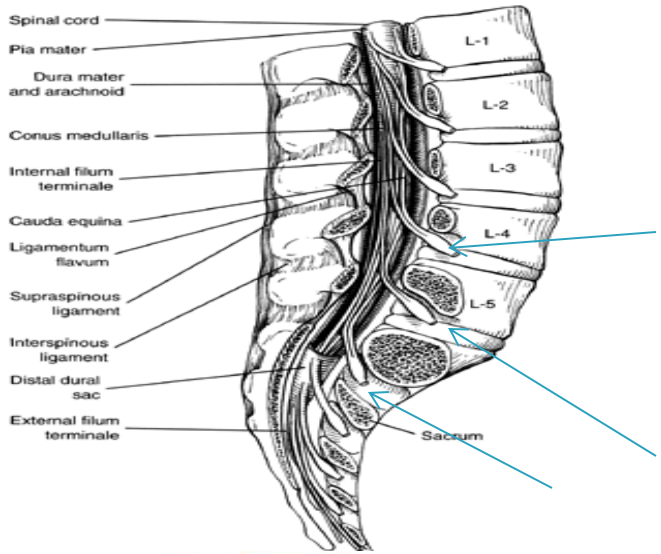
Cutaneous Branches

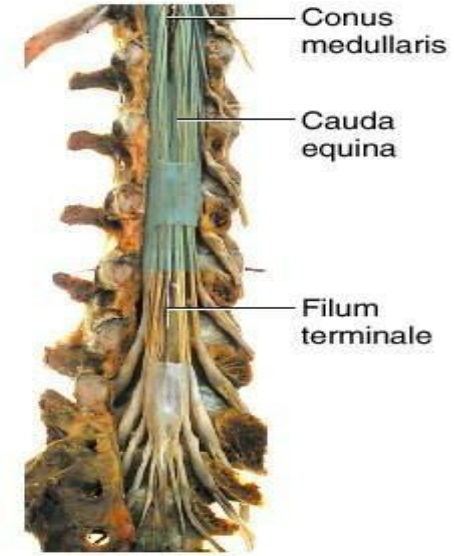
CONUS MEDULLARIS



- In the lumbar spine – the spinal cord ends at about the level of L1–L2 because the growth of the spinal column exceeds the growth of the spinal cord
- Lumbar enlargement: Commences about the level of T11, and reaches its maximum circumference, of about 33 mm., at L1, below which it tapers rapidly into the conus medullaris. Contains spinal nerve segments L1–S3.

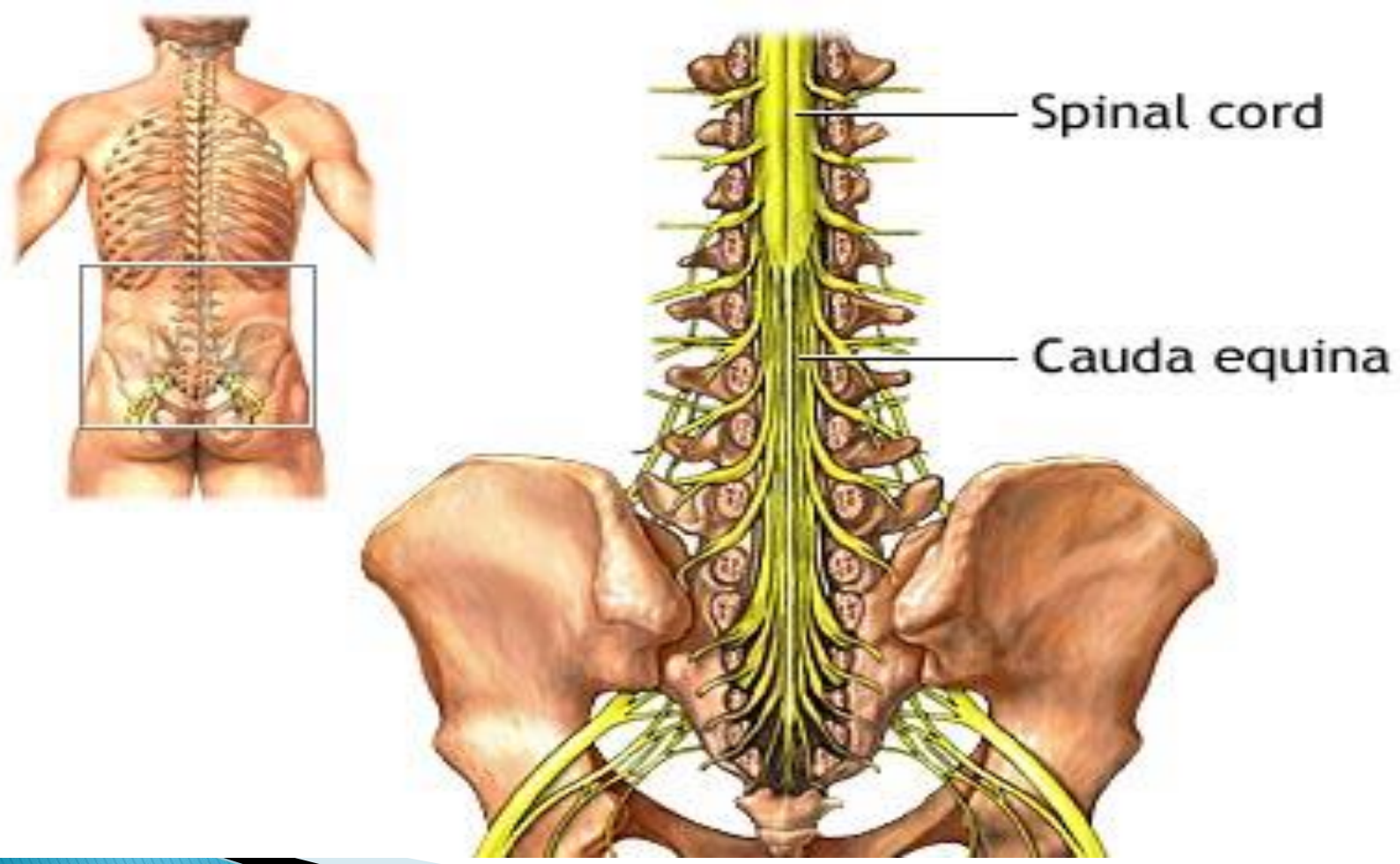
CONUS MEDULLARIS



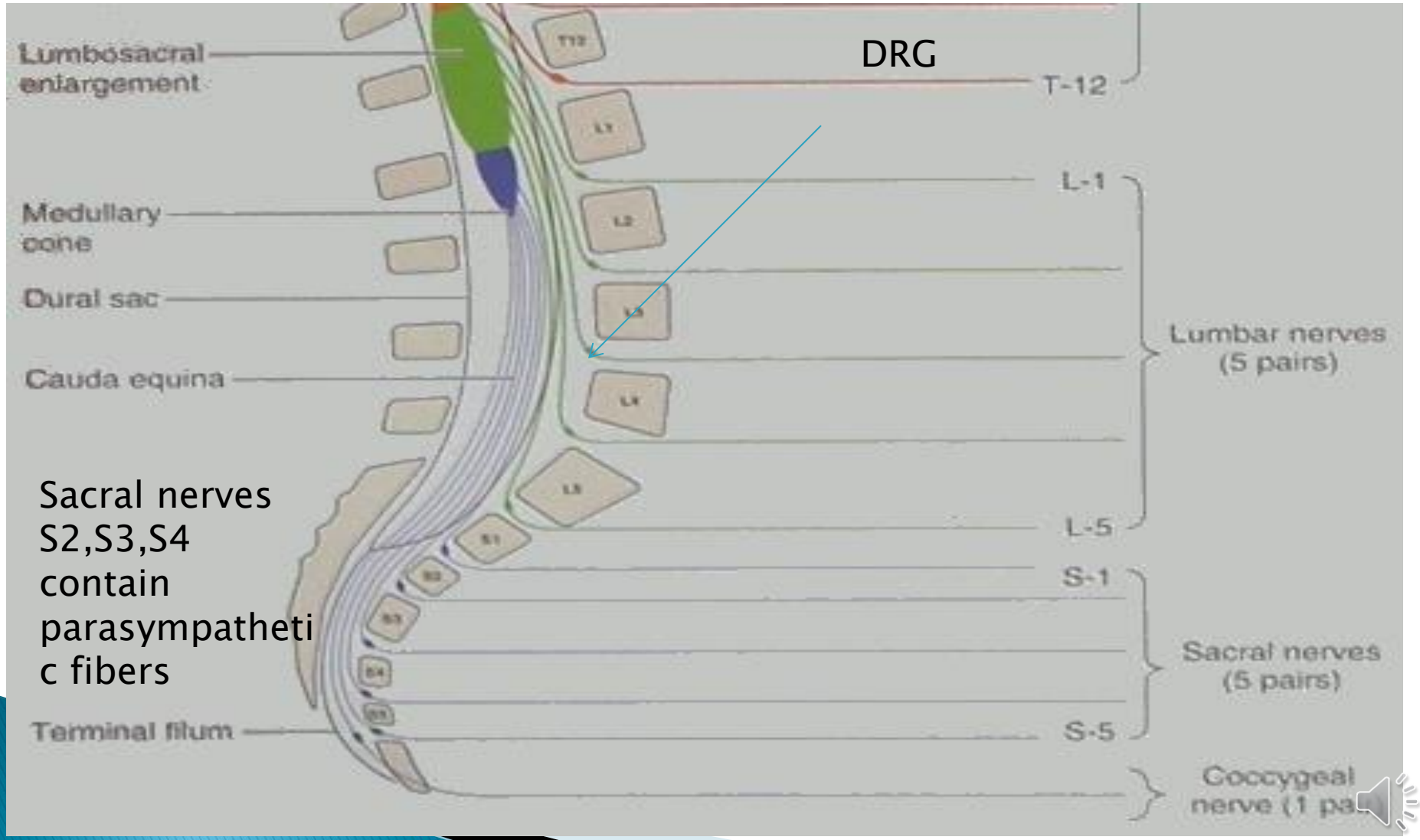


- The conus medullaris is the terminal end of the spinal cord. It occurs near L1 and L2. After the spinal cord terminates, the spinal nerves continue as dangling nerves called the “cauda equina.” Each root has to traverse several inches in the spinal canal before reaching its exit foramen. The root can be damaged anywhere along its intradural course. Most commonly it is damaged at its exit foramen by a disc lesion.

CONUS MEDULLARIS

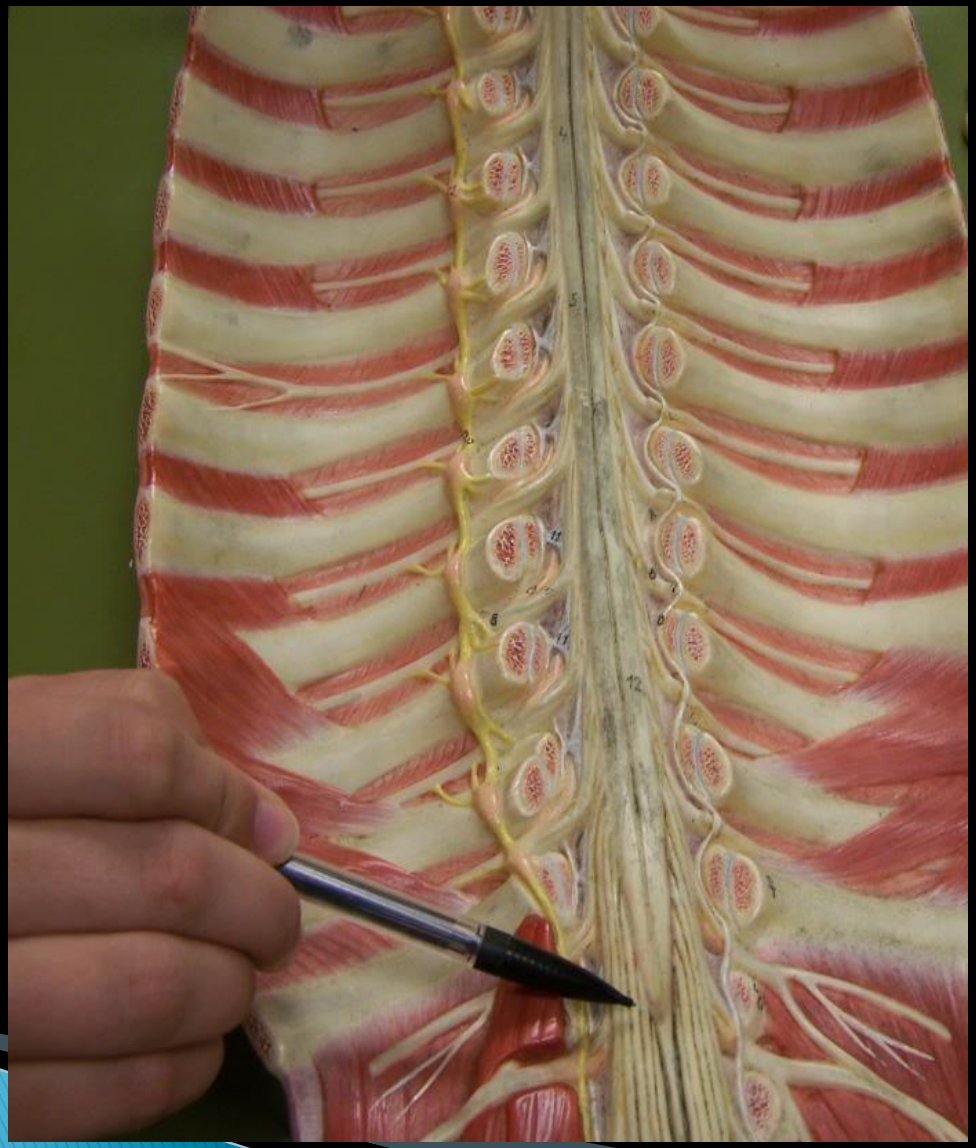


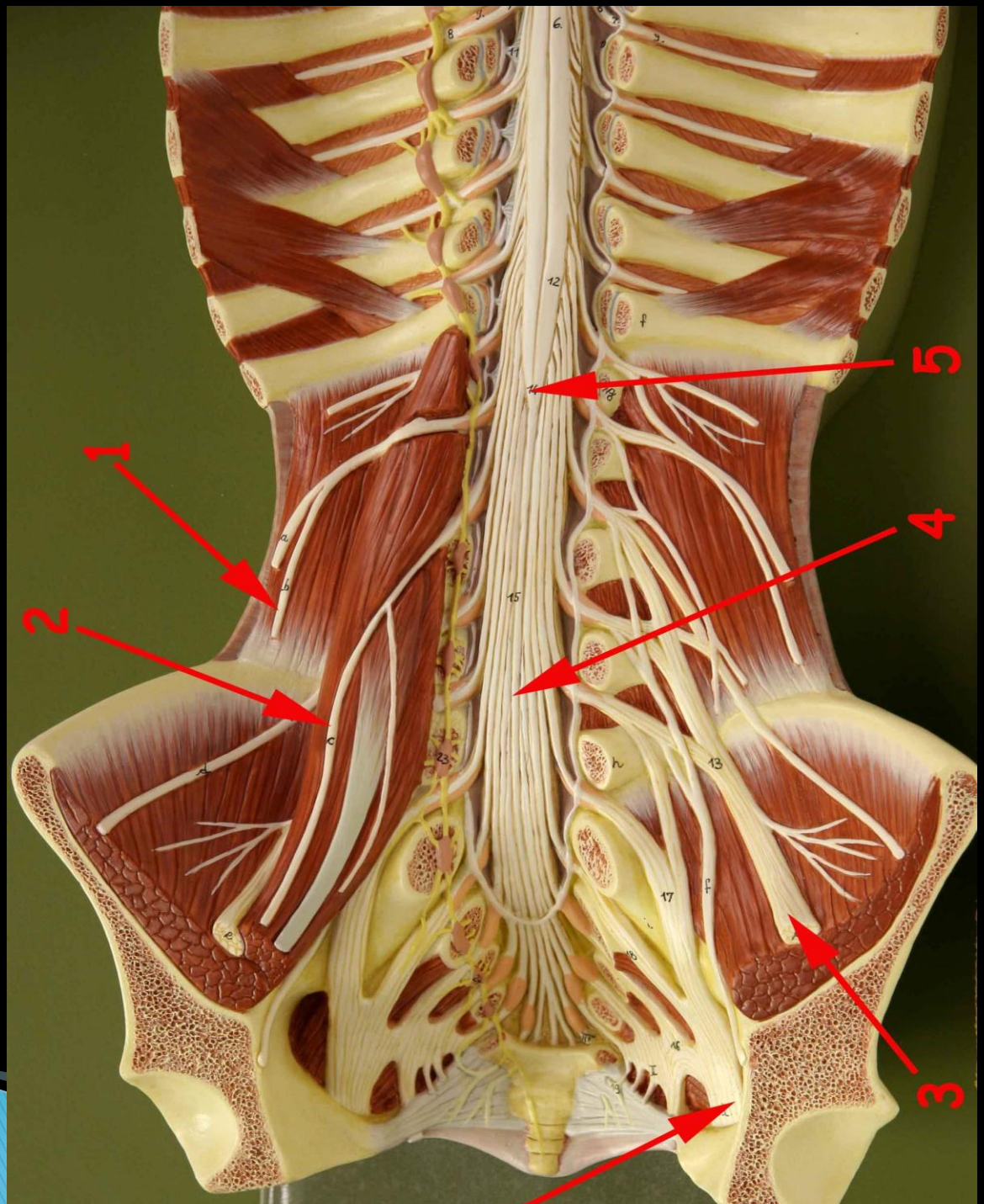
CONUS MEDULLARIS



Sacral nerves S2,S3,S4 contain parasympatheti c fibers

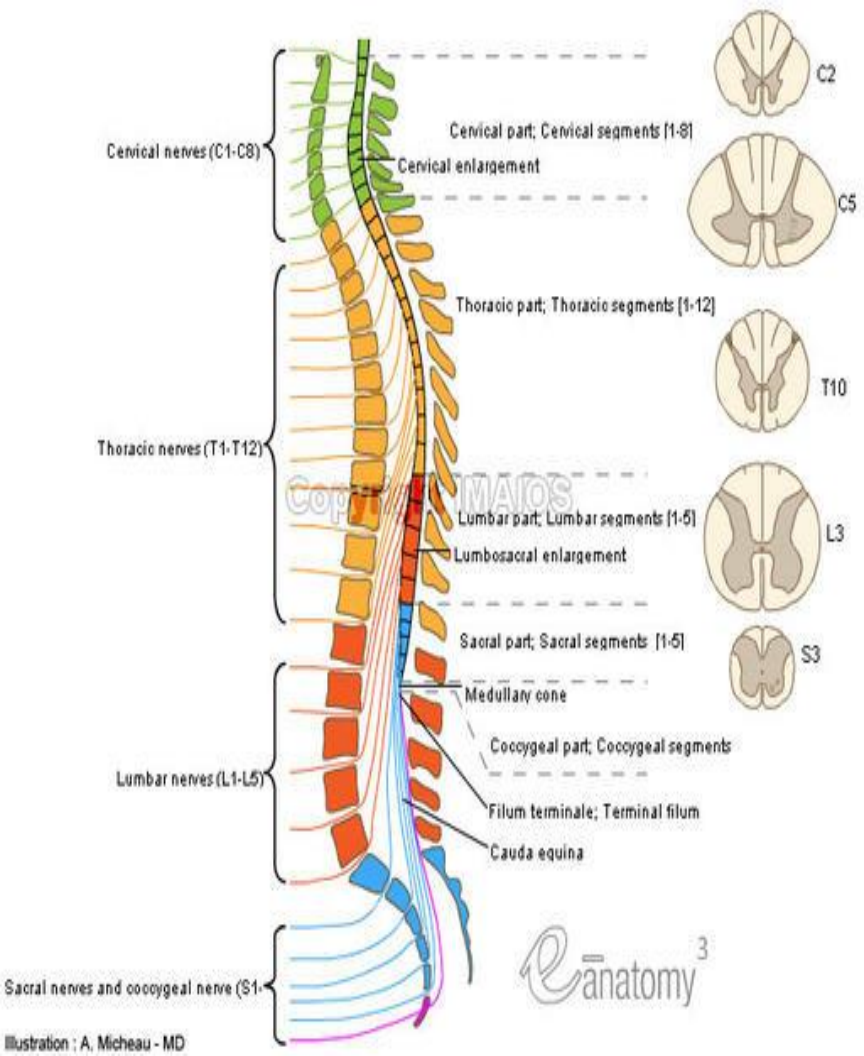
CONUS MEDULLARIS





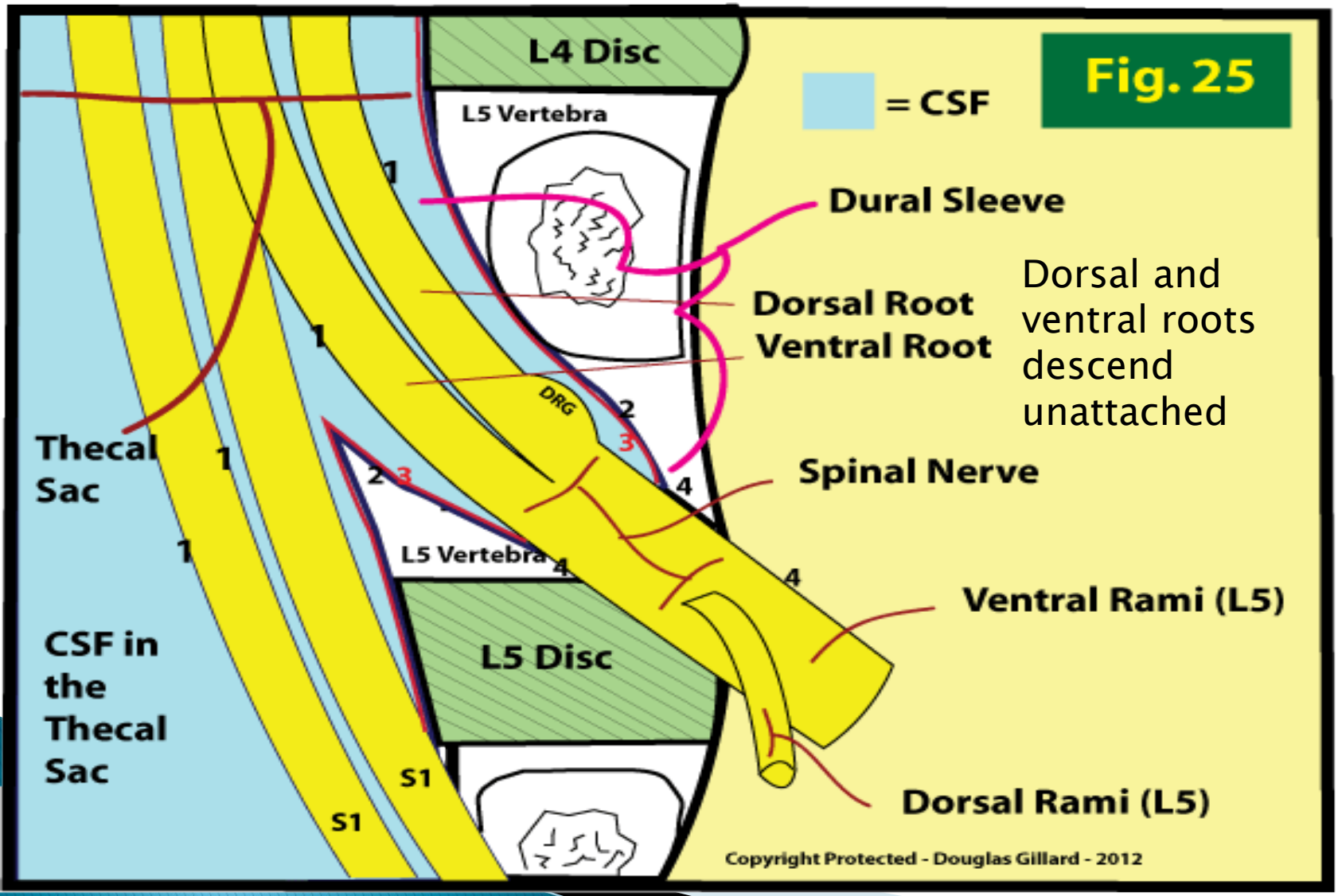
Note location of all of the dorsal root ganglia = extradural

CONUS MEDULLARIS



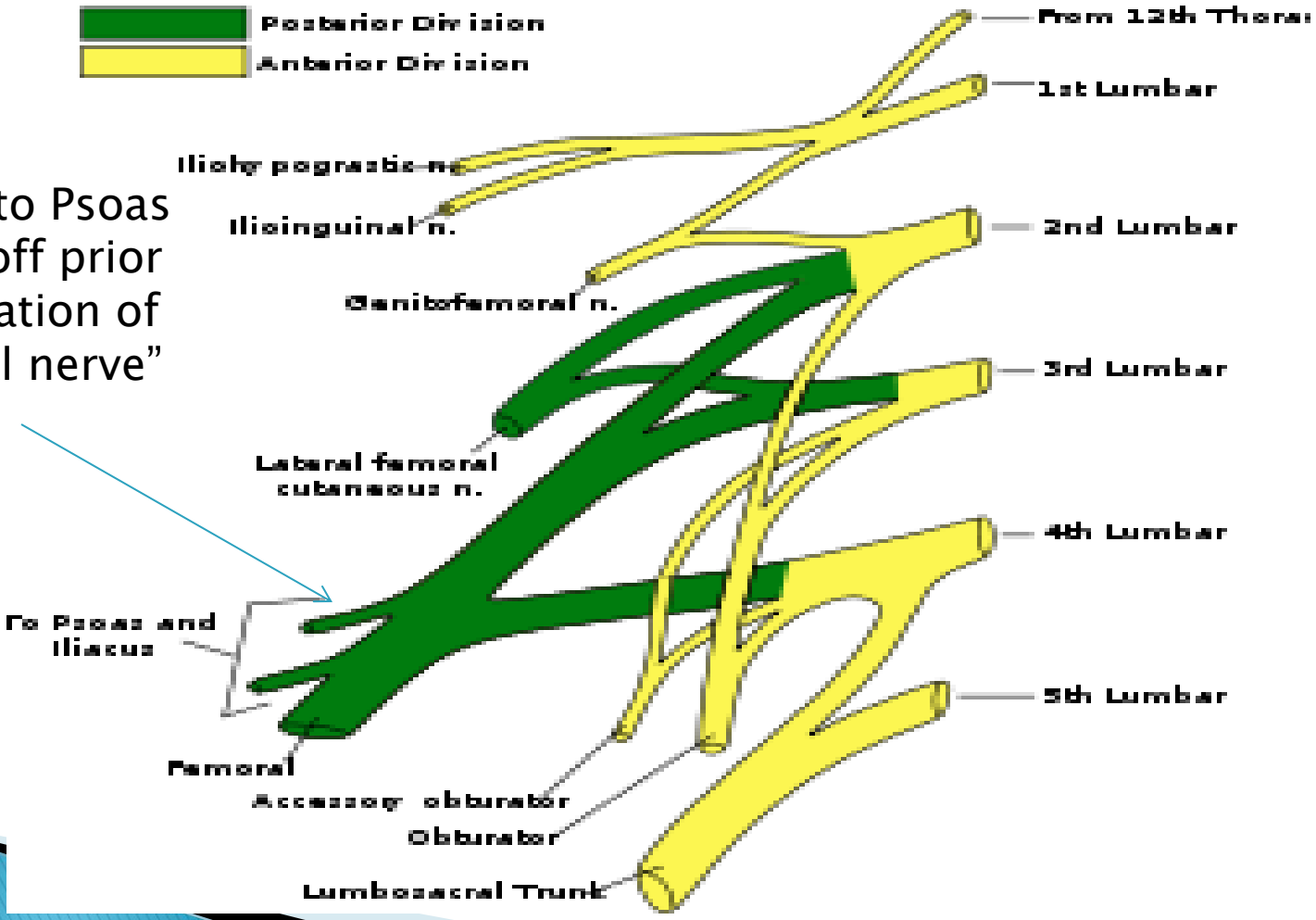
- At Lumbosacral enlargement:
  - Gray matter increases
  - Least amount of white matter
  - Intermediolateral cell column is present only from T1-L2 (or L3)

CONUS MEDULLARIS



LUMBAR PLEXUS

Branch to Psoas comes off prior to formation of "femoral nerve"



BRANCHES OF LUMBAR PLEXUS

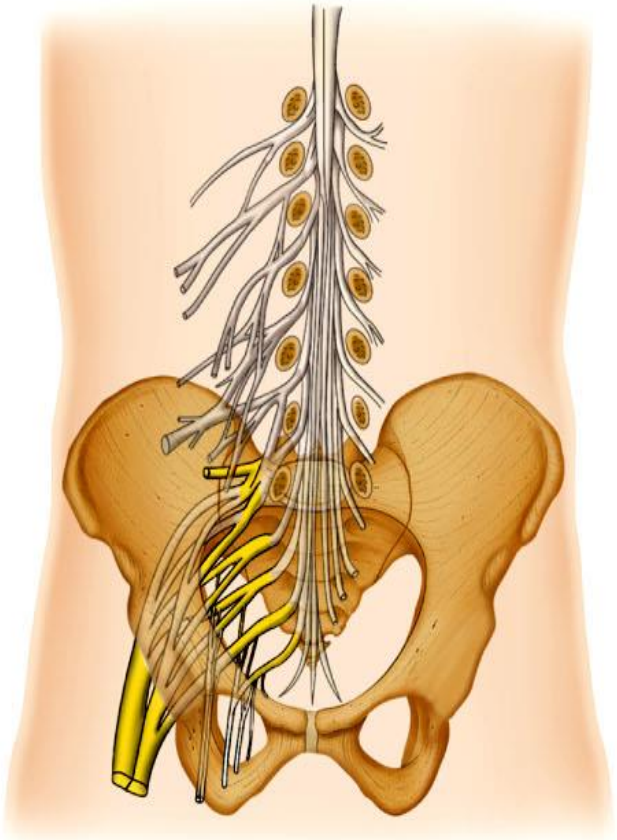
- L1 ROOT has 2 named branches:
  - Iliohypogastric: Sensory to pubis and medial inguinal ligament
  - Ilioinguinal: Sensory to penis and scrotum – or labia
- L1 & L2 roots combine to form the genitofemoral nerve:
  - Sensory to skin over femoral triangle
  - Motor to cremaster muscle in spermatic cord

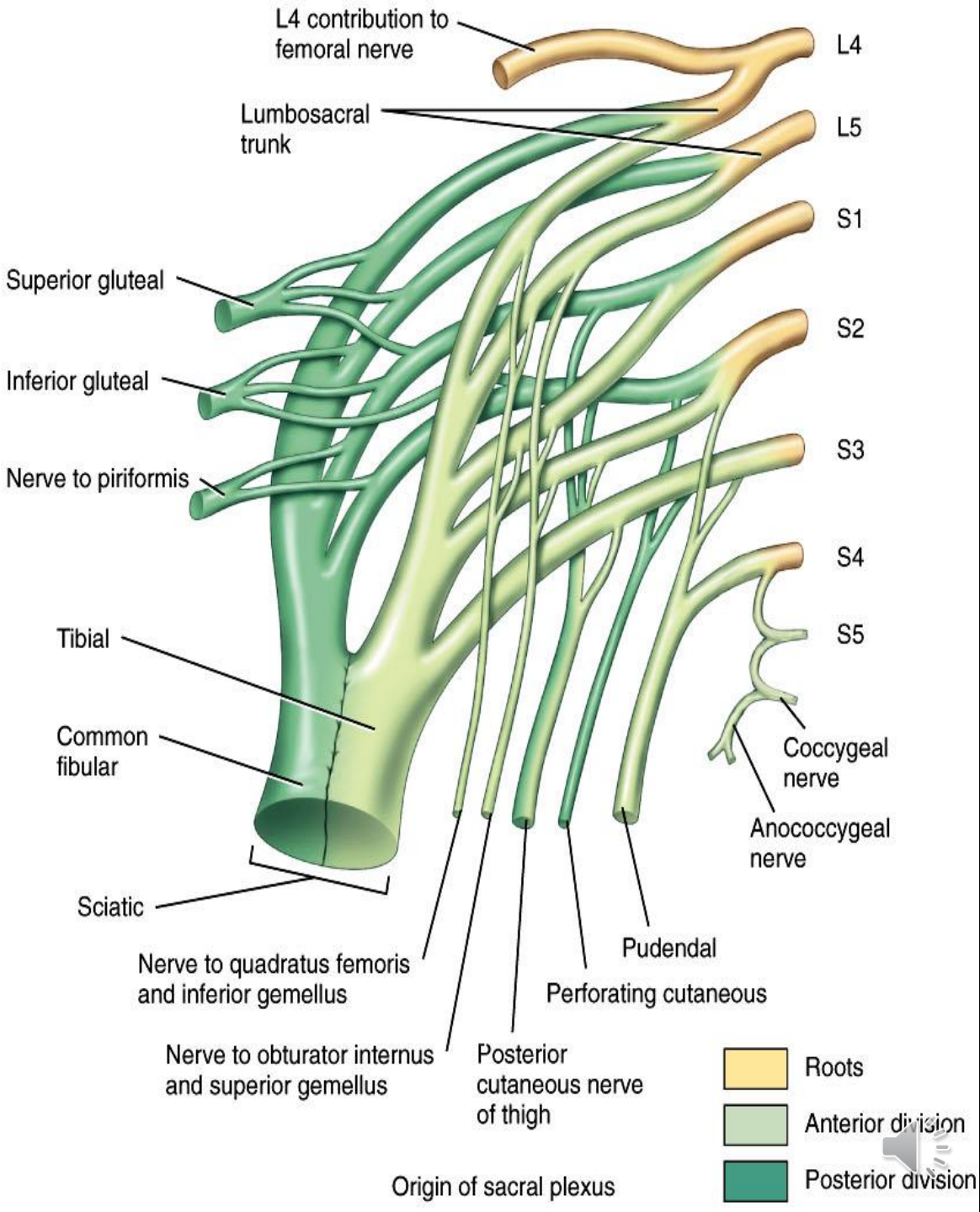
BRANCHES OF LUMBAR PLEXUS

- L2 & L3 (Posterior Divisions) – Lateral femoral cutaneous nerve:
  - Enters thigh under lateral part of the inguinal ligament
  - Sensory to lateral thigh down as low as the knee
- L2, L3, and L4 (Posterior Divisions) – Femoral Nerve:
  - Sensory to anteromedial thigh (anterior cutaneous nerve
  - Sensory to medial leg (saphenous nerve) to include the medial malleolus
  - Motor to 1) iliopsoas, 2) rectus femoris, 3) sartorius, 4) vastus lateralis/intermedius

BRANCHES OF LUMBAR PLEXUS

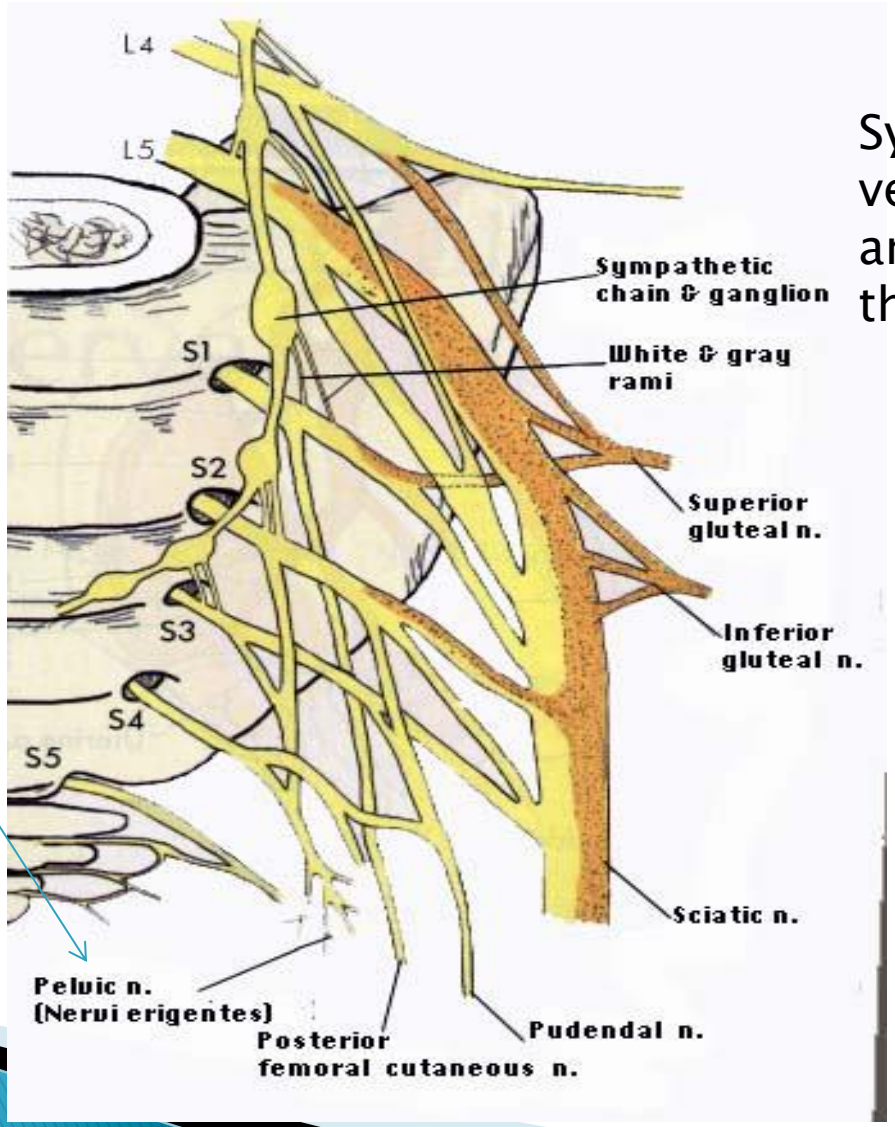
- L2, L3, and L4 (Anterior Divisions) – Obturator Nerve:
  - Sensory to medial aspect of knee
  - Motor to 1) pectineus, 2) adductor brevis, 3) adductor longus, 4) adductor magnus, 5) gracilis (hip adductors)



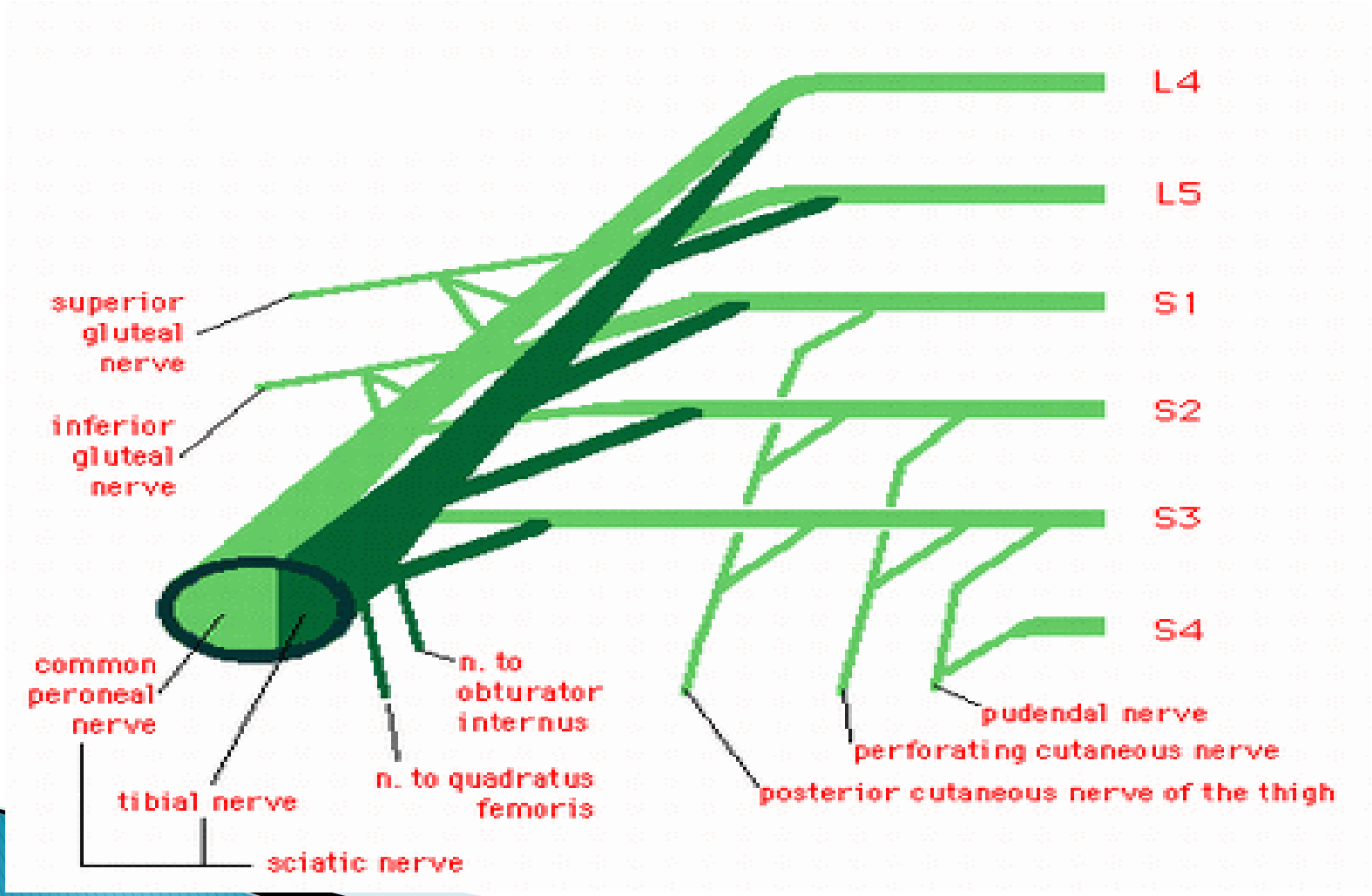

L4 contribution to femoral nerve
L4
Lumbosacral trunk
L5
S1
Superior gluteal
S2
Inferior gluteal
S3
Nerve to piriformis
S4
S5
Tibial
Common fibular
Coccygeal nerve
Anococcygeal nerve
Sciatic
Nerve to quadratus femoris and inferior gemellus
Pudendal
Perforating cutaneous
Nerve to obturator internus and superior gemellus
Posterior cutaneous nerve of thigh
Roots
Anterior division
Posterior division
Origin of sacral plexus

SACRAL PLEXUS

Pelvic Splanchnic Nerves – Parasympathetics



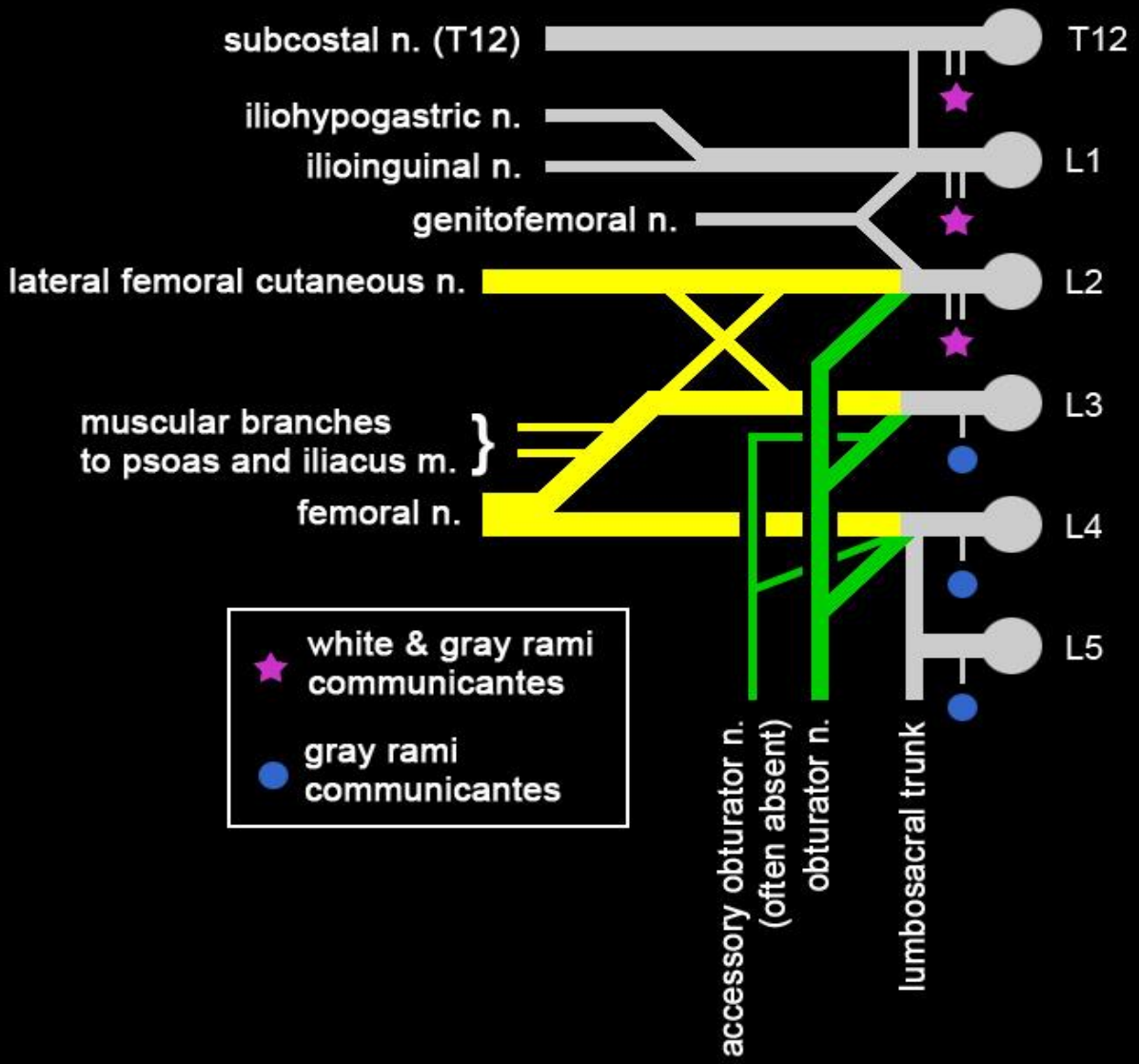
Sympathetics to blood vessels, sweat glands, arrector pili muscles of the somatic structures.


L4
L5
S1
S2
S3
S4
superior gluteal nerve
inferior gluteal nerve
common peroneal nerve
tibial nerve
sciatic nerve
n. to obturator internus
n. to quadratus femoris
pudendal nerve
perforating cutaneous nerve
posterior cutaneous nerve of the thigh

BRANCHES OF SACRAL PLEXUS

- Leaves the pelvis by way of the greater sciatic foramen
- Main Branches:
  - L4, L5, S1, S2 Gluteal Nerves (3)
  - L4, L5, S1, S2 (Posterior Division) Peroneal Nerve (a.k.a. “Common Fibular Nerve” or “Lateral Popliteal Nerve”)
  - L4, L5, S1, S2, (and S3) (Anterior Division) Tibial Nerve
  - Peroneal and Tibial are invested in the same fascia – Peroneal component 6 times more likely to be damaged than the tibial component
  - S1, S2, S3 Posterior Cutaneous Nerve
  - S2, S3, S4 Pudendal Nerve

SYMPATHETIC TRUNK



QME NEUROLOGIC EXAMINATION

- General Neurologic Examination
- Cranial Nerve Examination
- Cervical Spine Neurologic Examination
- Upper Extremity Peripheral Nerve Examination
- Thoracic Spine Neurologic Examination
- Lumbar Spine Neurologic Examination
- Lower Extremity Peripheral Nerve Examination

GENERAL NEUROLOGIC EXAMINATION

- Mental Status Examination
- Speech Evaluation
- Head and Face Examination
- Periperhal Nervous System Examination
  - Cranial Nerve Examination
  - Somatic Sensory Examination
  - Somatic Motor Examination
- Cerebellar Functions

GENERAL NEUROLOGIC EXAMINATION

- Mental Status Exam:
- “Throughout the interview and History, Mr. Jones was coherent and demonstrated good communication skills. His general behavior was within normal limits and he did not appear to be hyperactive, agitated, quiet, or immobile. Stream of talk was normal with appropriate tone inflection and spontaneity. Mood and affective responses were normal and he was not euphoric, agitated, giggling, weeping, or angry. His mood was appropriate to the topic of conversation. Content of thought was appropriate without illusions or obsessions. Intellectual capacity appeared to be normal. He was able to recall past presidents beginning from Barack Obama and remembering back to James Carter. He had difficulty in counting backward from 100 by 7 although in context of his other indicators of normal function, I considered this more of a difficulty with math than loss of mental function.”

GENERAL NEUROLOGIC EXAMINATION

- Speech Evaluation:
- “Mr. Vasquez is Hispanic – having been born in Mexico. However, he completed High School here in the United States and has good command of English. He did not demonstrate dysphonia (difficulty in producing sounds), dysarthria (difficulty in articulating the individual sounds or units of speech), dysprosody (difficulty with the melody and rhythm of speech), or dysphasia (difficulty in expressing or understanding words as the symbols of communication).”

GENERAL NEUROLOGIC EXAMINATION

- Head and Face: In general, Mr. Jones made normal facial expressions. To inspection, the head was symmetrically rounded. The palpebral fissures were symmetric bilaterally (see photograph – page 1 of this report). Contours and proportions of the nose, mouth, chin, and ears were symmetric. To palpation of the skull, Mr. Jones reported tenderness to palpation over the occipital bone where he struck his head. There was no deformity, edema, bruising, or scar tissue formation detected.

GENERAL NEUROLOGIC EXAMINATION

- CRANIAL NERVES:
- Olfactory Nerve (Cranial Nerve I): Olfaction was intact to coffee in the left nasal cavity and peppermint in the right nasal cavity.
- Optic Nerve (Cranial Nerve II): tested 20/30 uncorrected bilateral vision (with each eye individually and then together) using the Snellen Eye Chart. With his eyeglasses on, he tested bilaterally (with each eye individually and then together). Direct and consensual responses and accommodation were normal.
- Oculomotor, Trochlear, and Abducens (Cranial Nerves III, IV, and VI): Range of eye movements was complete and symmetric bilaterally in the 6 cardinal planes of gaze.
- Trigeminal Nerve (Cranial Nerve V): Muscle bulk and strength of the masseter and temporalis muscles were normal and symmetric bilaterally. Sensation was intact over the eyebrows bilaterally, along both cheeks, and along the sides of the jaws bilaterally (ophthalmic, maxillary, and mandibular divisions of the trigeminal nerve).

GENERAL NEUROLOGIC EXAMINATION

- CRANIAL NERVES:
- Facial Nerve (Cranial Nerve VII): Forehead wrinkling, eyelid closure, mouth retraction, puffing out of cheeks and wrinkling of the skin in the front of the neck was normal and symmetric bilaterally. Taste over the anterior 2/3 of the tongue was accurate to sweet (sugar) testing.
- Vestibulocochlear Nerve (Cranial Nerve VIII): Hearing (cochlear division) was normal to forced whisper at 10 feet bilaterally. Romberg's test (vestibular division) was normal for stability.
- Glossopharyngeal and Vagus Nerves (Cranial Nerves IX and X): Phonation, articulation, and swallowing were normal.
- Spinal Accessory Nerve (Cranial Nerve XI): Sternocleidomastoid and trapezius muscle strength was normal and symmetric bilaterally.
- Hypoglossal Nerve (Cranial Nerve XII): Tongue movements in protrusion and lateral movements were normal and symmetric bilaterally.

GENERAL NEUROLOGIC EXAMINATION

- **Cerebellar Exam**:
- Finger to nose and rapid alternating hand movements were disrupted in that the finger to nose maneuver was inaccurate and alternating hand movements showed early disruption of pattern.
- Past pointing was abnormal and inaccurate bilaterally.
- Heel to knee movement was normal and symmetric bilaterally.

GENERAL NEUROLOGIC EXAMINATION

- Somatic sensory and Somatic motor evaluations are discussed below under Cervical Spine and Lumbar Spine Examination sections.
  - General Principles of Sensory Examination –
  - General Principles of Motor Examination –
  - General Priniciples of Reflex Examination –

SENSORY EXAMINATION PRINCIPLES

- Sensory examination:
- Classifications (3) of Sensory Receptors:

1. Type of stimulus detected:
   - Mechanoreceptors – respond to tissue deformation
   - Thermoreceptors – respond to changes in temperature
   - Photoreceptors – respond to photons (light)
   - Chemoreceptors – respond to chemical changes
   - Nociceptors – respond to tissue damage and potentially damaging stimuli (pain)

SENSORY EXAMINATION PRINCIPLES

- Classifications (3) of Sensory Receptors:

2. Location in the body/Location of activating stimulus
   - Interoreceptors: Respond to stimuli within the body (viscera/blood vessels) – usually unconscious
   - Exteroreceptors: Respond to stimuli outside the body – near the body surface (touch/pressure/temperature/pain/vision/hearing/equilibrium/ taste smell
   - Proprioceptors: Respond to degree of stretch of the organs they occupy. Found in skeletal muscls, tendons, joints, ligaments, and connective tissue coverings of muscles and bones. Constantly advise the brain of body movements.

SENSORY EXAMINATION PRINCIPLES

- Sensory examination:
- Classification of Sensory Receptors:

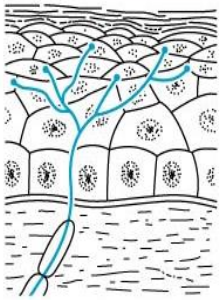
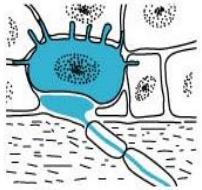
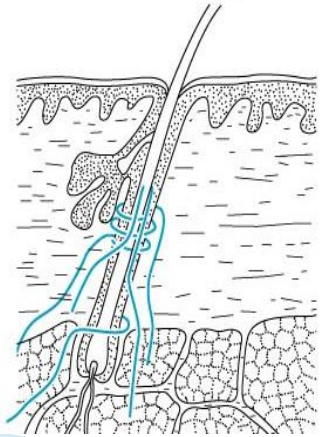
3. Structural Complexity – simple vs. complex (list):

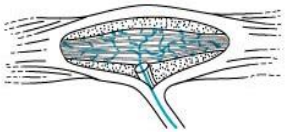
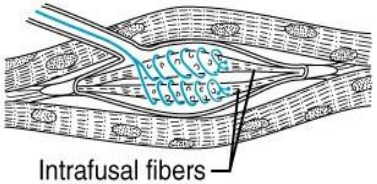
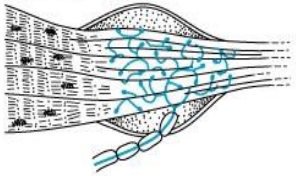
- Simple: Found throughout the body and monitor most types of general sensory information
- Complex: Are actually sense *organs* – and consist of localized collections of cells associated with the special senses

SENSORY EXAMINATION PRINCIPLES

- Sensory examination:
- Brief Review of “Simple receptors”
- 2 basic structural classifications of simple sensory receptors that we will be involved with –

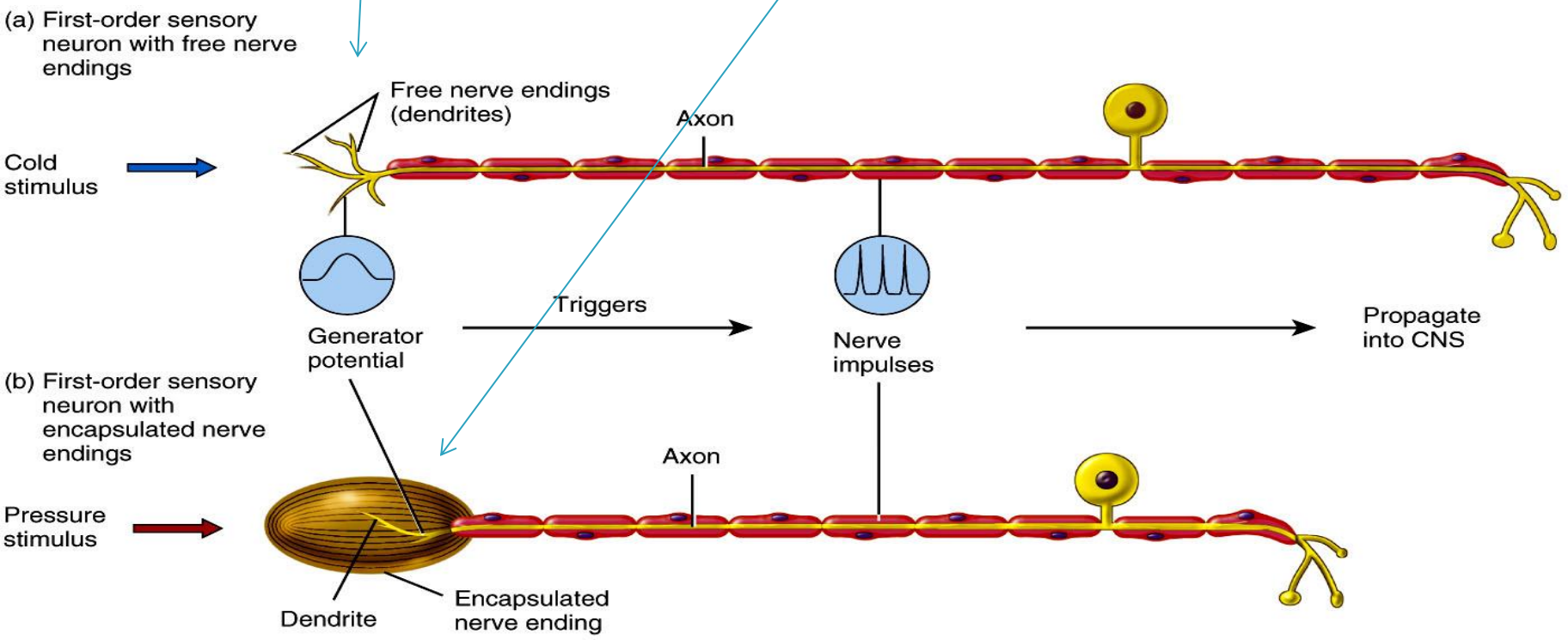
1. Unencapsulated Receptors
   - Free Nerve Endings
   - Modified free nerve endings (Merkel discs/tactile discs)
   - Hair follicle receptors
2. Encapsulated Receptors –
   - Meissner corpuscles
   - Ruffini corpuscles
   - Pacini corpuscles
   - Krause end bulbs
   - Golgi tendon organs
   - Muscle spindles

STRUCTURAL CLASS	ILLUSTRATION	FUNCTIONAL CLASSES ACCORDING TO LOCATION (L) AND STIMULUS TYPE (S)	BODY LOCATION
UNENCAPSULATED			
Free nerve endings of sensory neurons		L: Exteroceptors, interoceptors, and proprioceptors S: Thermoreceptors (warm and cool), chemoreceptors (itch, pH, etc.), mechanoreceptors (pressure), nociceptors (pain, hot, cold, pinch, and chemicals)	Most body tissues; most dense in connective tissues (ligaments, tendons, dermis, joint capsules, periostea) and epithelia (epidermis, cornea, mucosae, and glands)
Modified free nerve endings: Merkel discs (tactile discs)		L: Exteroceptors S: Mechanoreceptors (light pressure); slowly adapting	Basal layer of epidermis of skin
Hair follicle receptors		L: Exteroceptors S: Mechanoreceptors (hair deflection); rapidly adapting	In and surrounding hair follicles

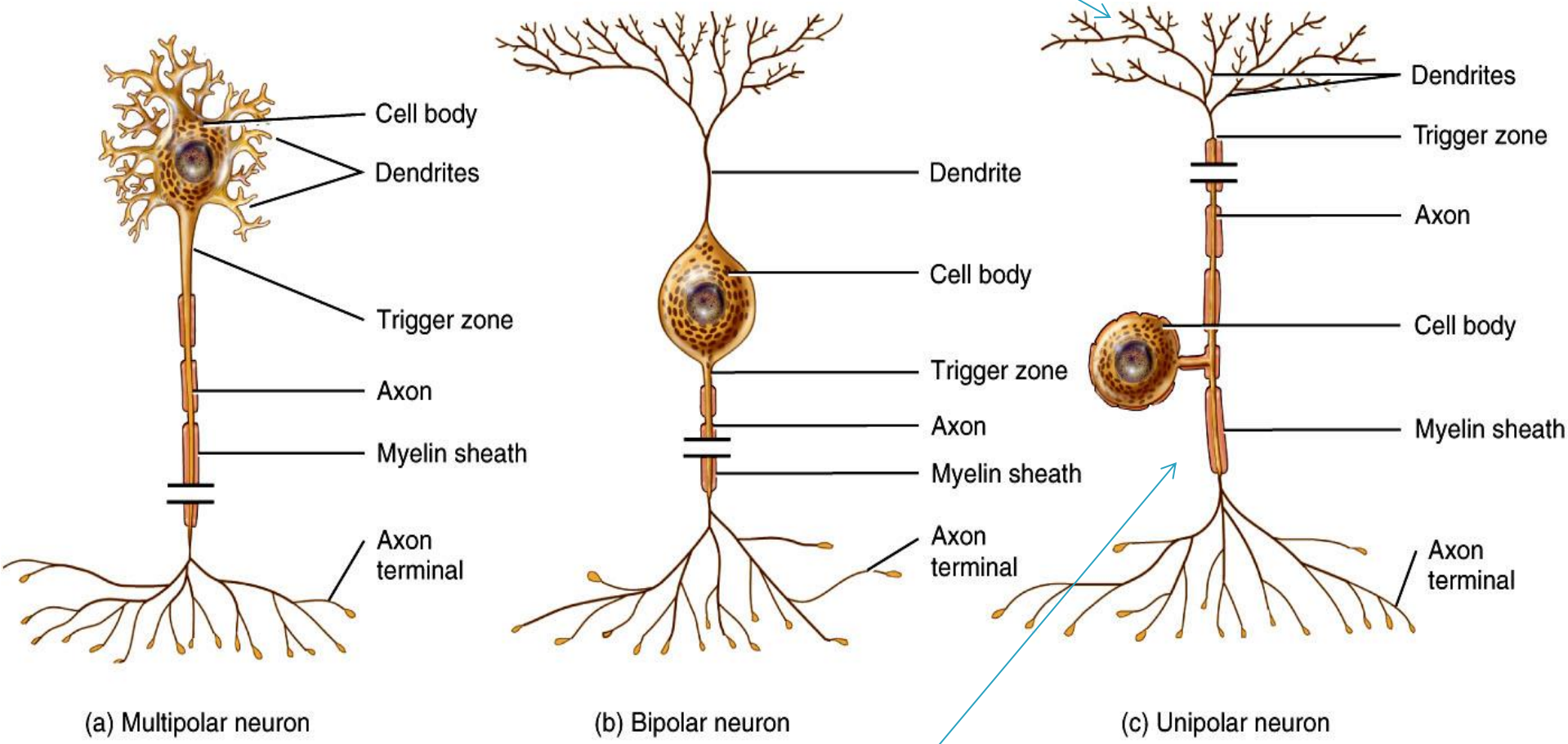
STRUCTURAL CLASS	ILLUSTRATION	FUNCTIONAL CLASSES ACCORDING TO LOCATION (L) AND STIMULUS TYPE (S)	BODY LOCATION
ENCAPSULATED			
Meissner's corpuscles (tactile corpuscles)		L: Exteroceptors S: Mechanoreceptors (light pressure, discriminative touch, vibration of low frequency); rapidly adapting	Dermal papillae of hairless skin, particularly nipples, external genitalia, fingertips, soles of feet, eyelids
Pacinian corpuscles (lamellated corpuscles)		L: Exteroceptors, interoceptors, and some proprioceptors S: Mechanoreceptors (deep pressure, stretch, vibration of high frequency); rapidly adapting	Dermis and hypodermis; periostea, mesentery, tendons, ligaments, joint capsules; most abundant on fingers, soles of feet, external genitalia, nipples
Ruffini endings		L: Exteroceptors and proprioceptors S: Mechanoreceptors (deep pressure and stretch); slowly or nonadapting	Deep in dermis, hypodermis, and joint capsules
Muscle spindles		L: Proprioceptors S: Mechanoreceptors (muscle stretch, length)	Skeletal muscles, particularly those of the extremities
Golgi tendon organs		L: Proprioceptors S: Mechanoreceptors (tendon stretch, tension)	Tendons
Joint kinesthetic receptors		L: Proprioceptors S: Mechanoreceptors and nociceptors	Joint capsules of synovial joints

Unencapsulated ending

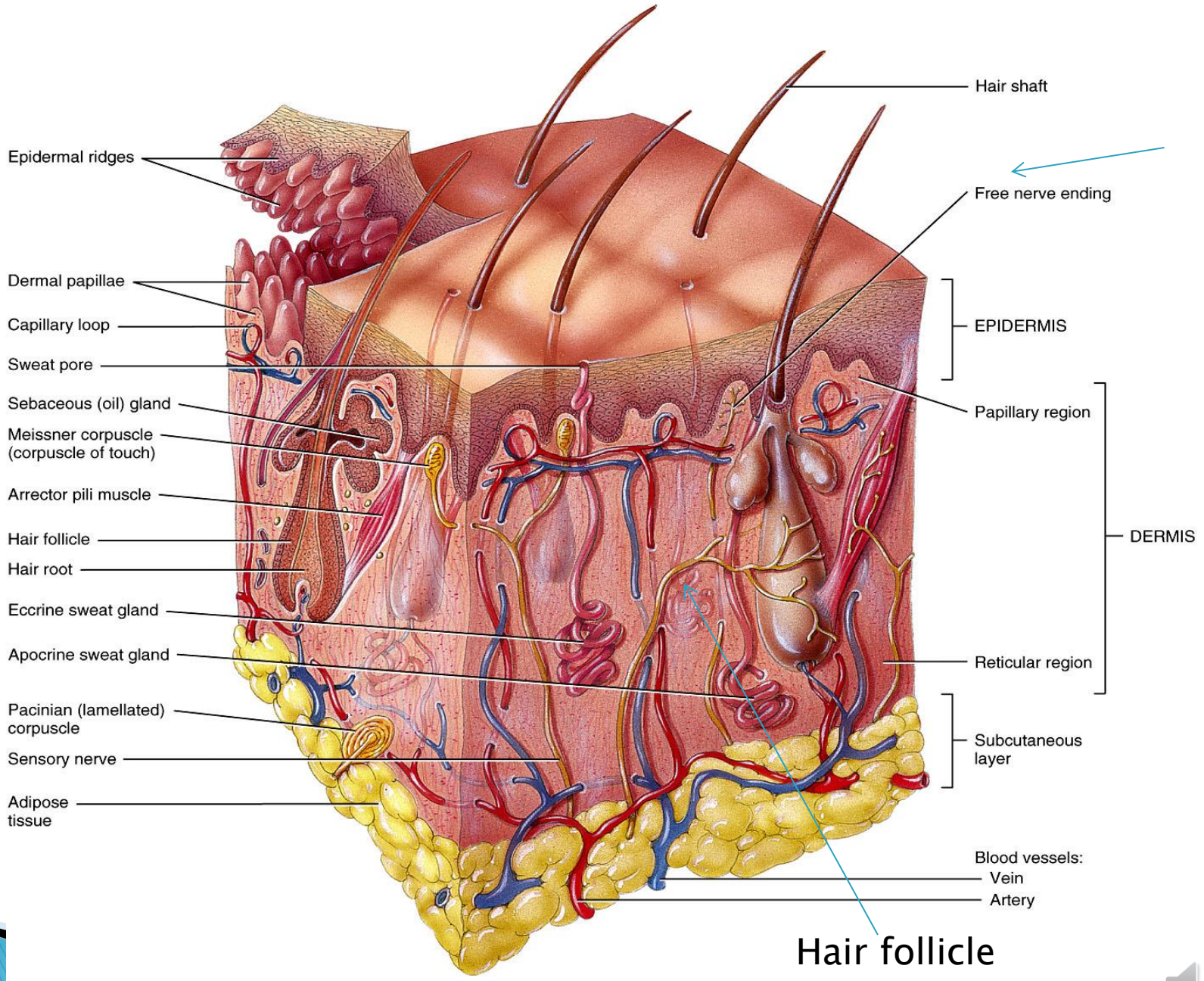
Encapsulated ending



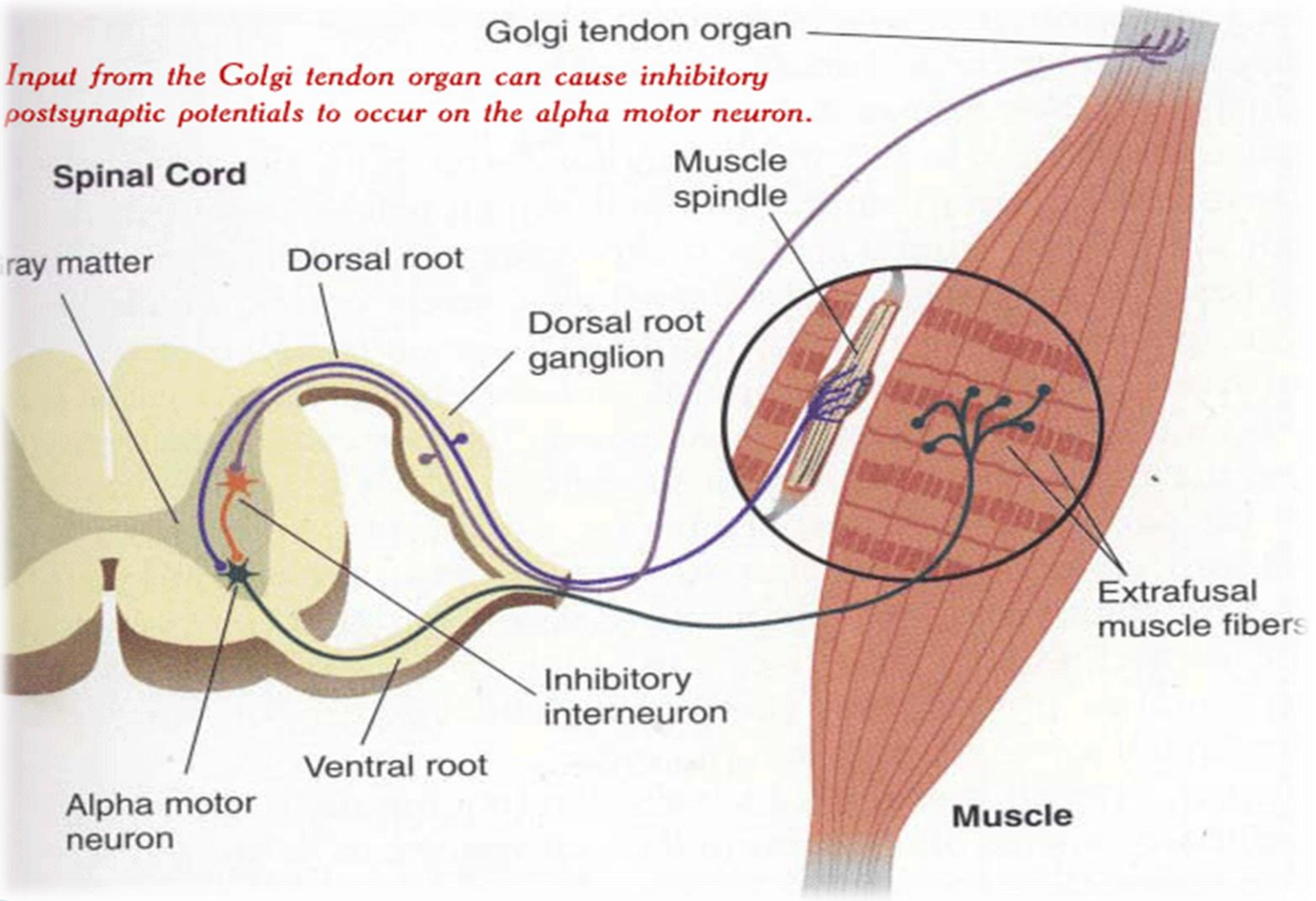
Peripheral Process



Central Process



(a) Sectional view of skin and subcutaneous layer


Golgi tendon organ
Input from the Golgi tendon organ can cause inhibitory postsynaptic potentials to occur on the alpha motor neuron.
Spinal Cord
Muscle spindle
ray matter
Dorsal root
Dorsal root ganglion
Extrafusal muscle fibers
Inhibitory interneuron
Ventral root
Alpha motor neuron
Muscle

QME EXAM PROCEDURES – SENSORY EXAM

The Sensory Examination consists of procedures to test the sensory modalities of 1) light touch, 2) pain, 3) two point discrimination, and 4) joint position sense as follows:

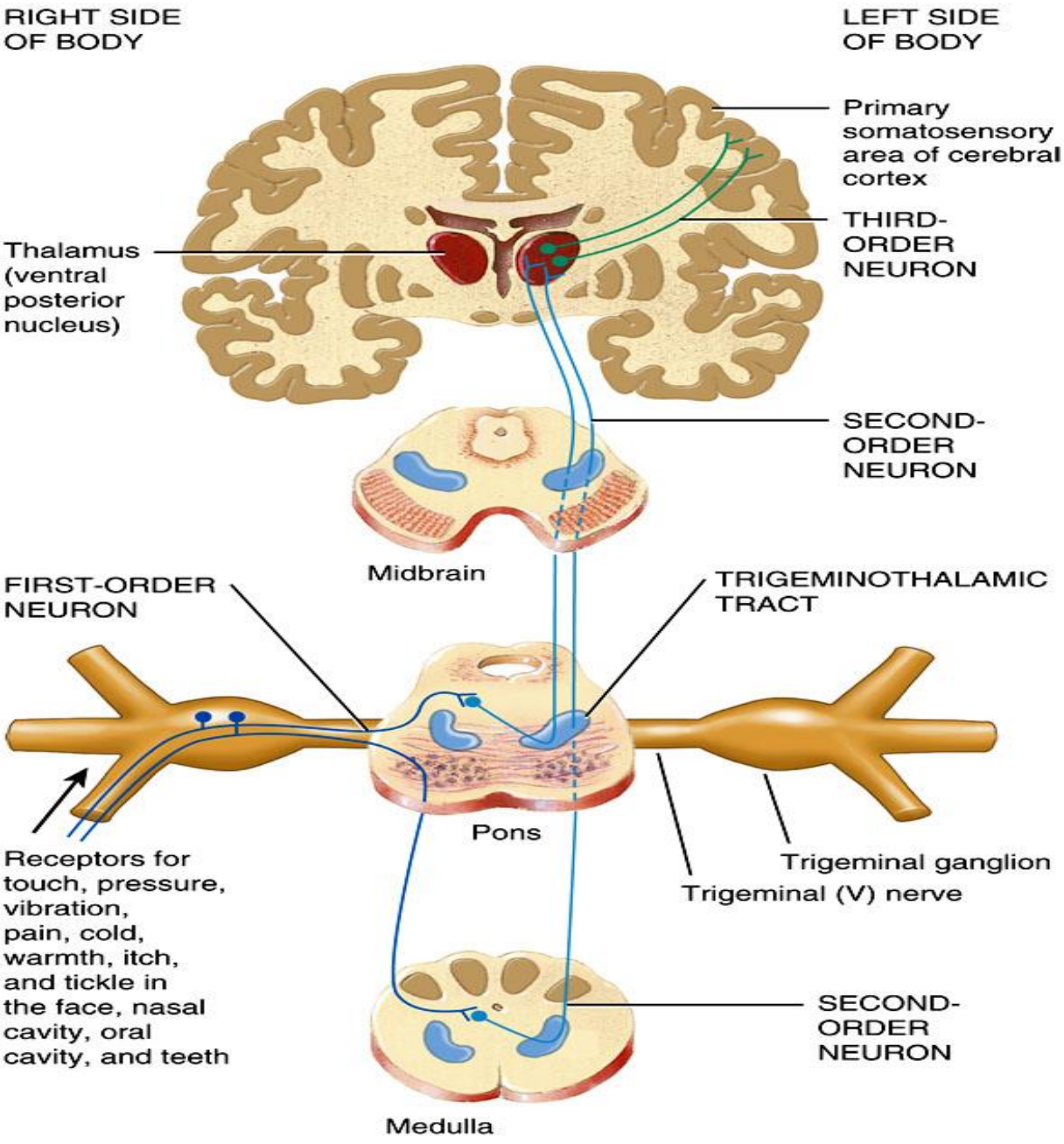
Superficial Tactile Sensibility (Light Touch) – This Sensory Exam was performed using a Semmes Weinstein monofilament.

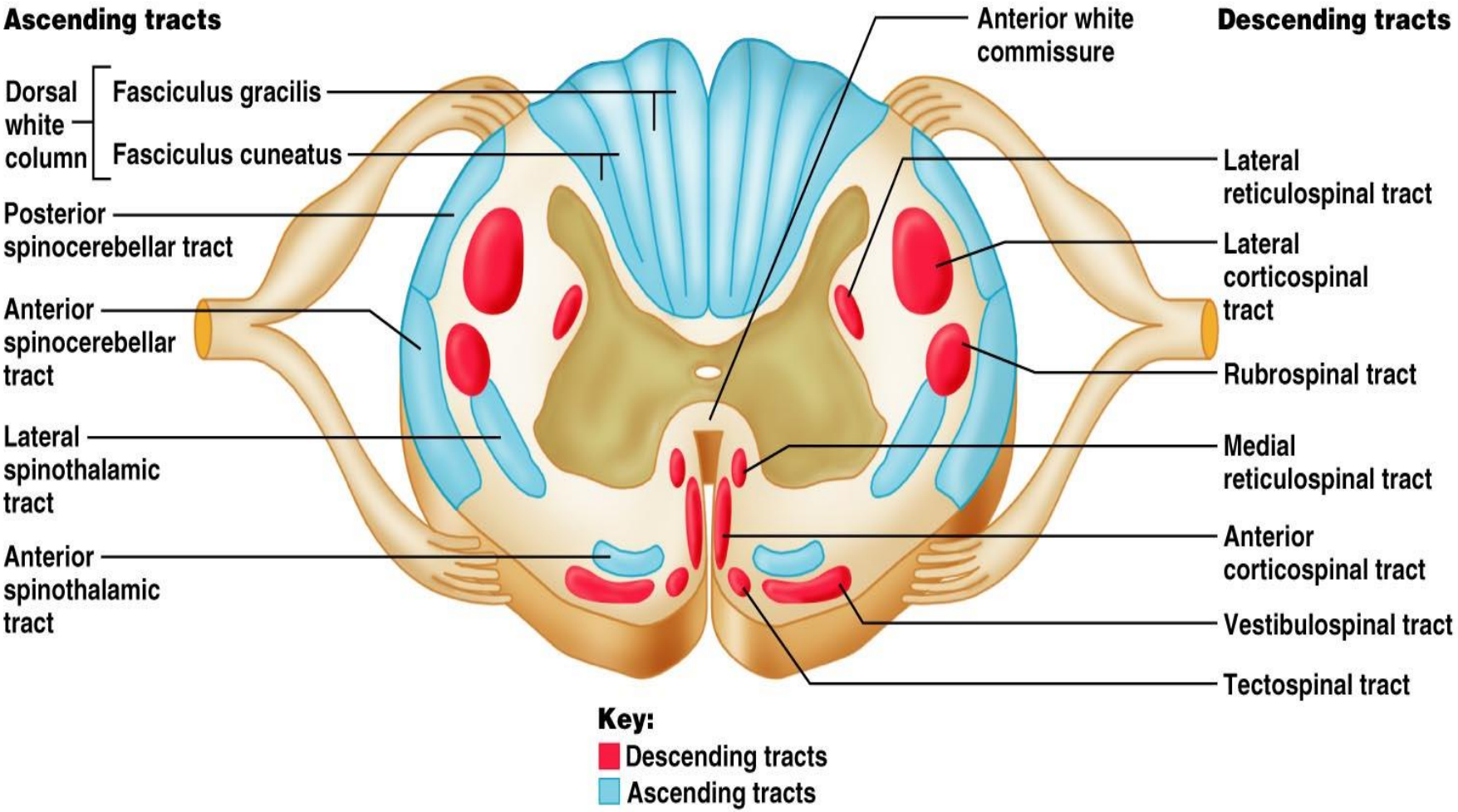
Pain – This Sensory Exam was performed using the Whartenburg pinwheel with sharp and dull sides.

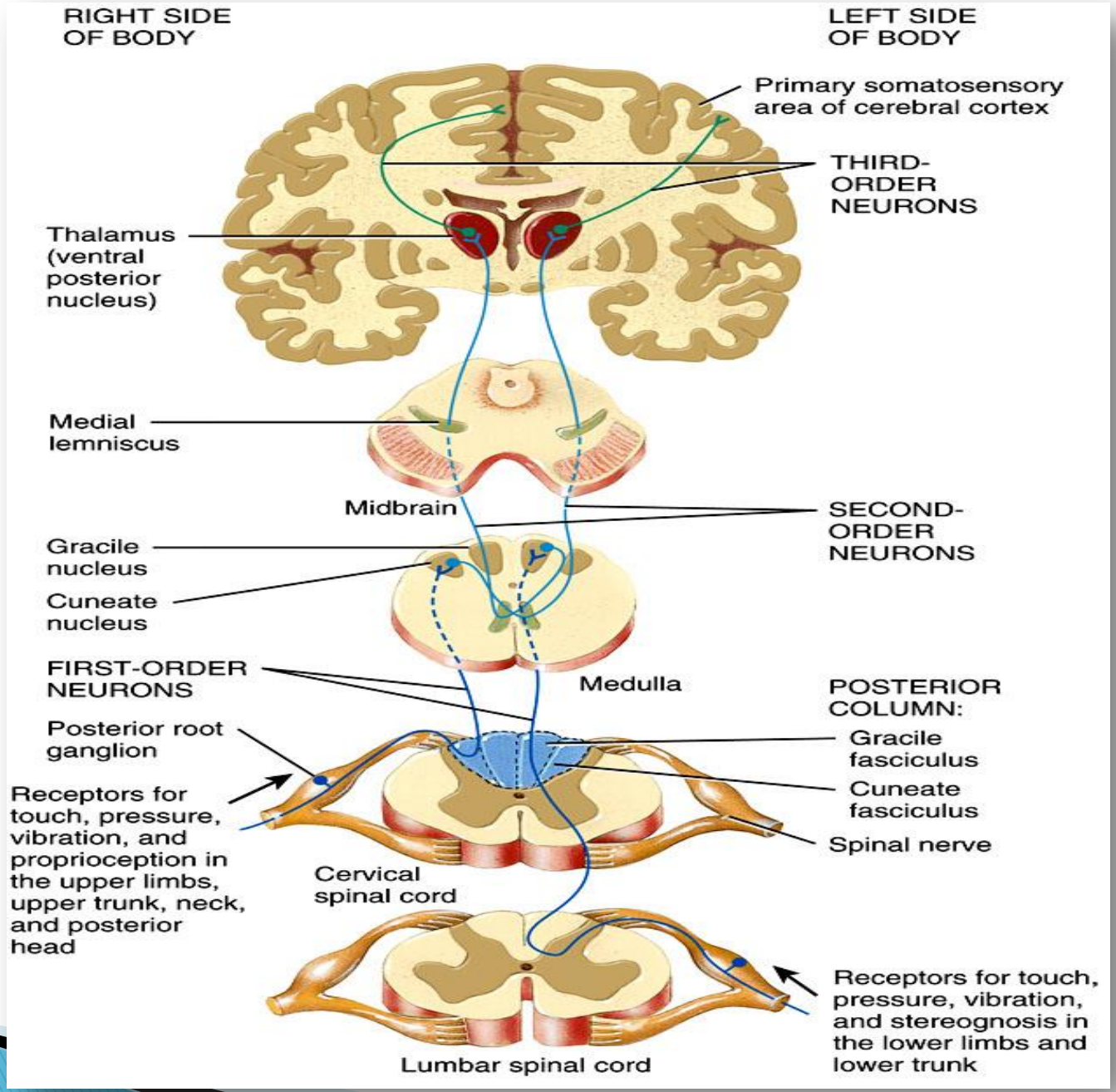
Two Point Discrimination –The AMA Guides two-point discrimination testing for the upper extremity but do not describe two point discrimination testing for the lower extremity.

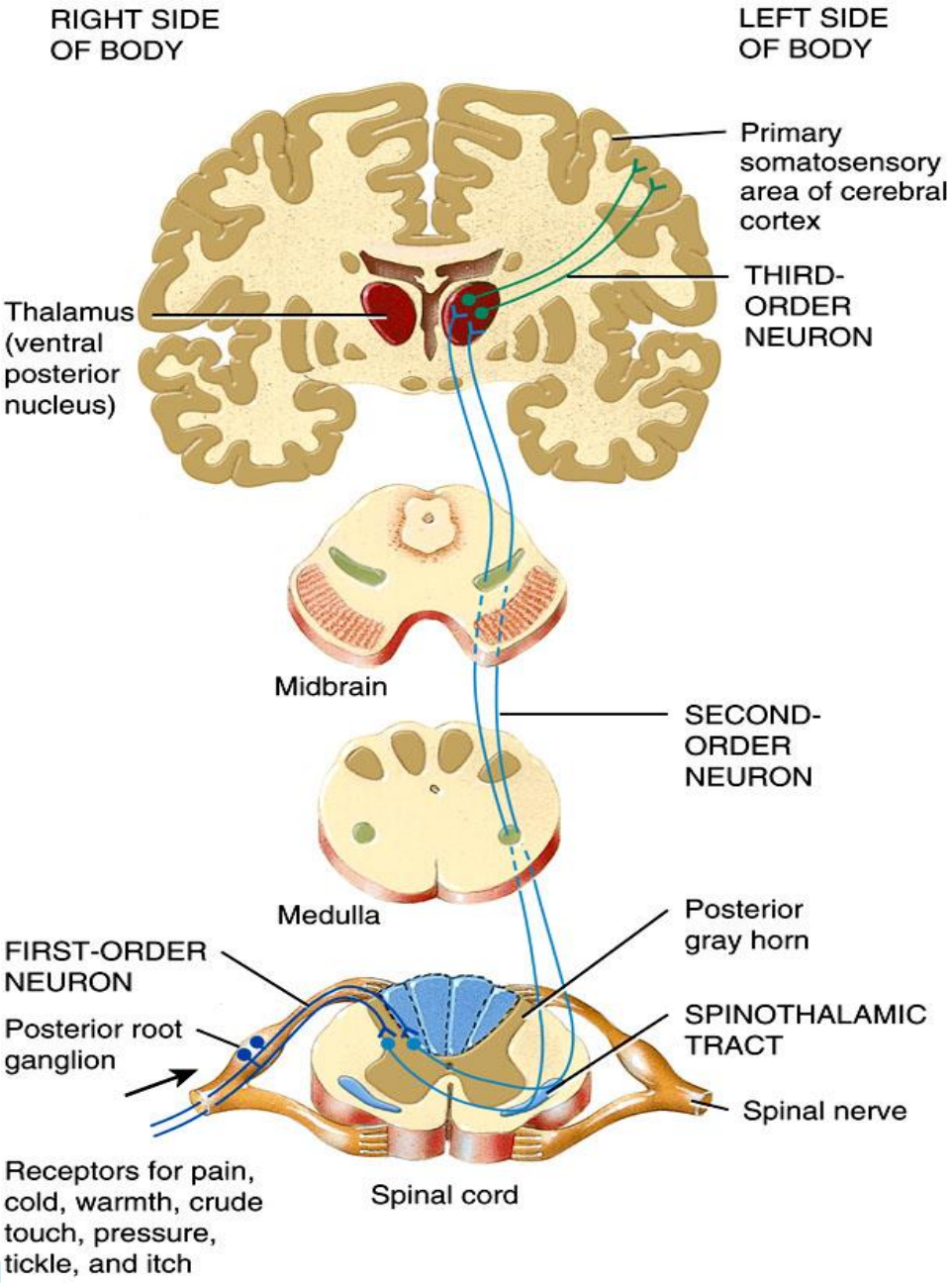
SENSORY EXAMINATION PRINCIPLES

- Ascending Pathways:
  - Pathways (“specific”) for touch, pressure, vibration, and stereognosis from the lower extremities and trunk (up to about T6), ascend in the fasciculus gracilis.
  - Pathways (“specific”) for touch, pressure, vibration, and proprioception from the upper trunk (above T6), the arms, head, and neck, ascend in the fasciculus cuneatus (“specific”).
  - Pathways (“non-specific”) for pain, pressure, temperature, tickle, itch, and crude touch ascend in the anterior and lateral spinothalamic tracts (we are aware of these sensations although they are difficult to localize) .

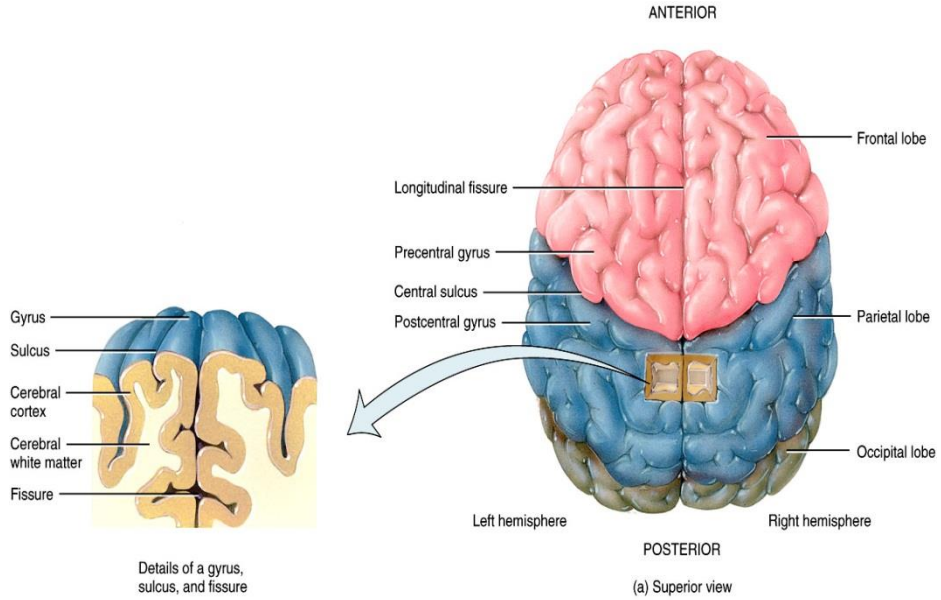

RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Primary somatosensory area of cerebral cortex
THIRD-ORDER NEURON
Thalamus (ventral posterior nucleus)
SECOND-ORDER NEURON
Midbrain
FIRST-ORDER NEURON
TRIGEMINOTHALAMIC TRACT
Pons
Receptors for touch, pressure, vibration, pain, cold, warmth, itch, and tickle in the face, nasal cavity, oral cavity, and teeth
Trigeminal ganglion
Trigeminal (V) nerve
SECOND-ORDER NEURON
Medulla


Ascending tracts
Dorsal white column
Fasciculus gracilis
Fasciculus cuneatus
Posterior spinocerebellar tract
Anterior spinocerebellar tract
Lateral spinothalamic tract
Anterior spinothalamic tract
Anterior white commissure
Descending tracts
Lateral reticulospinal tract
Lateral corticospinal tract
Rubrospinal tract
Medial reticulospinal tract
Anterior corticospinal tract
Vestibulospinal tract
Tectospinal tract
Key:
Descending tracts
Ascending tracts


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

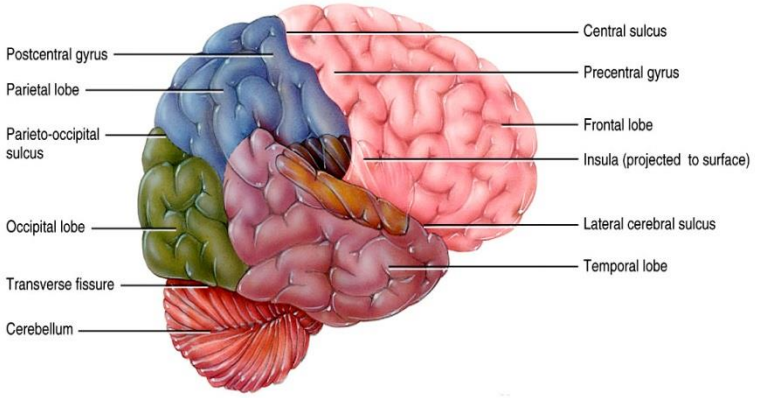

RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Primary somatosensory area of cerebral cortex
THIRD-ORDER NEURON
Thalamus (ventral posterior nucleus)
Midbrain
SECOND-ORDER NEURON
Medulla
Posterior gray horn
FIRST-ORDER NEURON
SPINOTHALAMIC TRACT
Posterior root ganglion
Spinal nerve
Receptors for pain, cold, warmth,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

SENSORY HOMUNCULUS

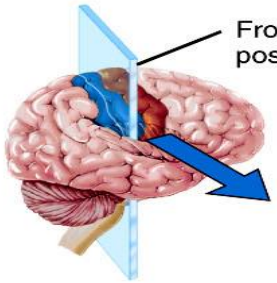


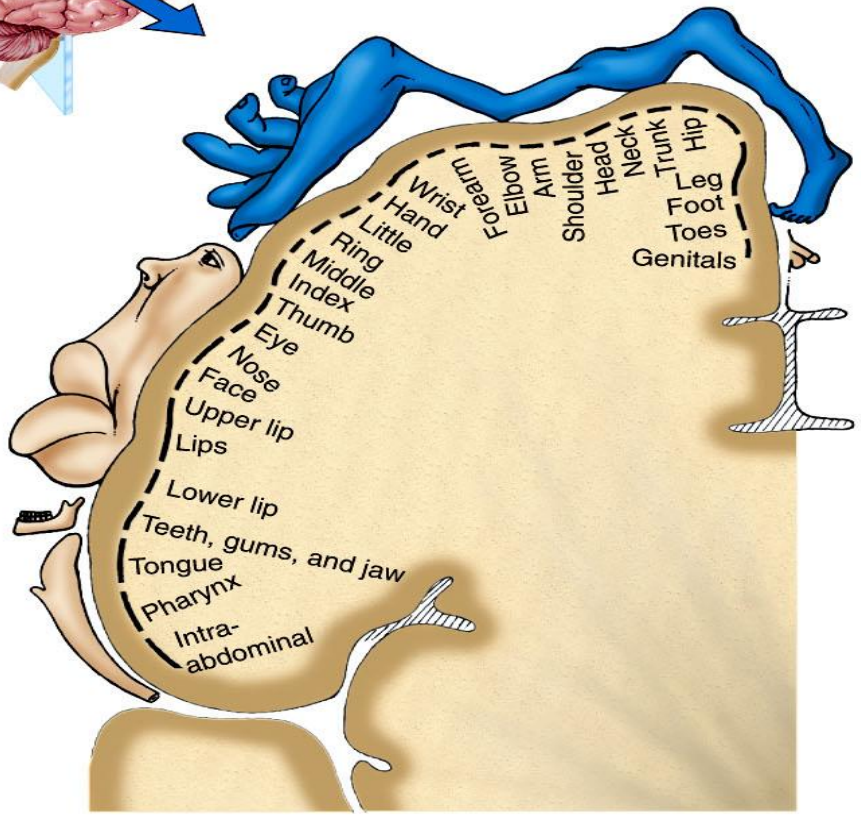
Details of a gyrus, sulcus, and fissure

(a) Superior view



(b) Right lateral view





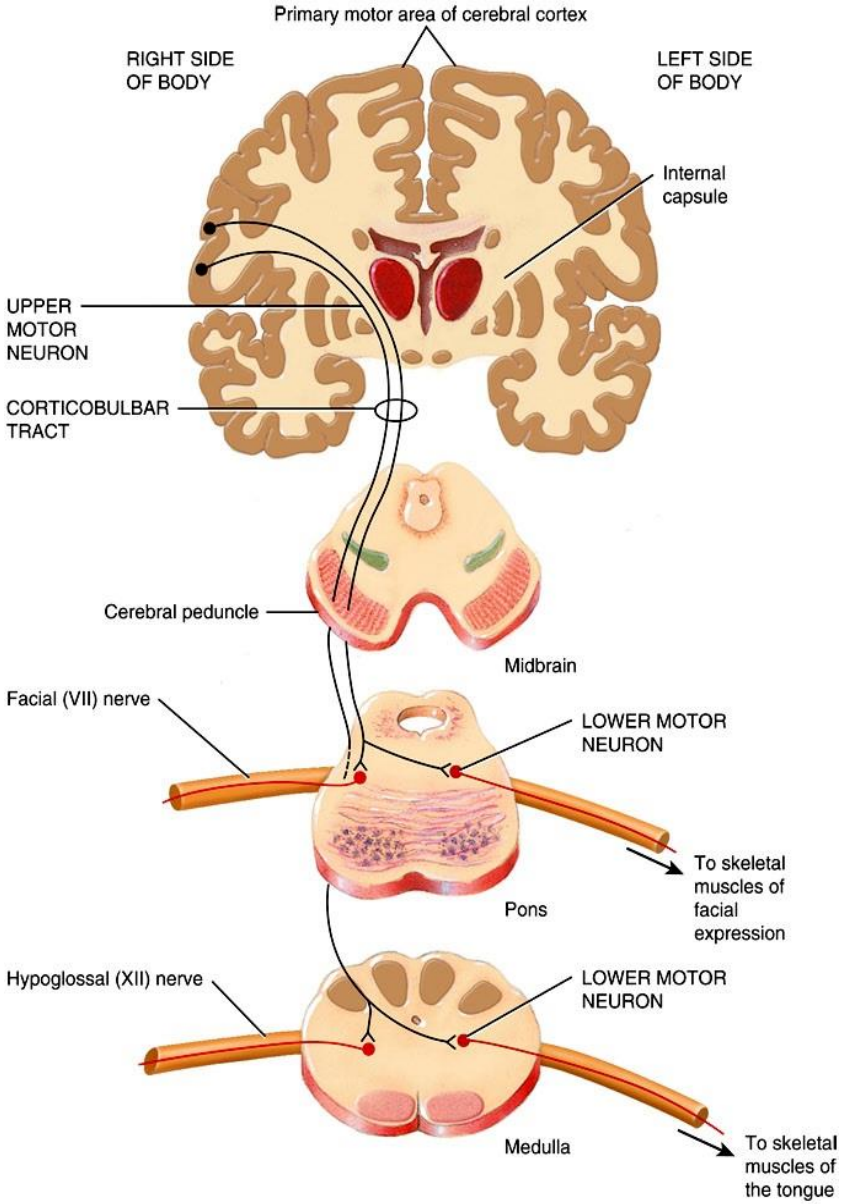
(a) Frontal section of primary somatosensory area in right cerebral hemisphere

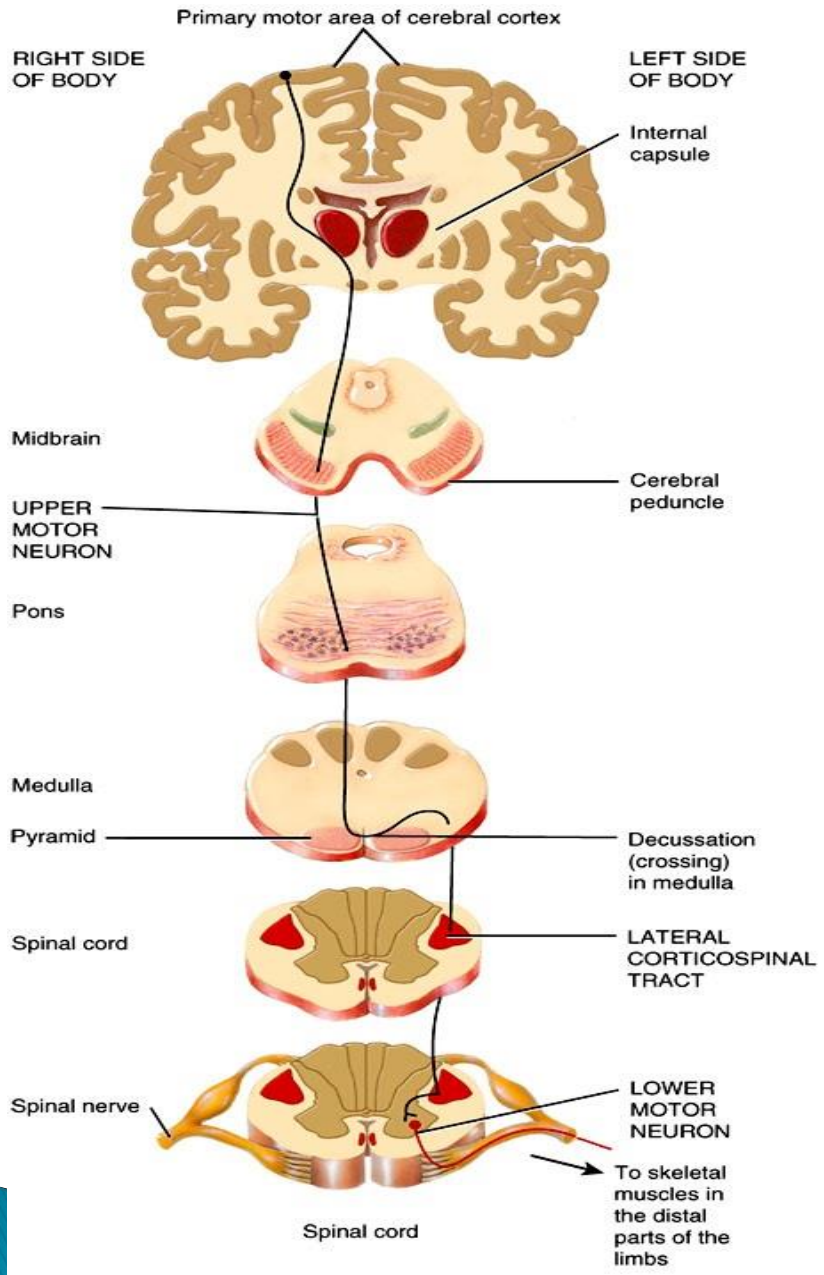
QME EXAM PROCEDURES – MOTOR EXAM

- Motor Examination – consists of:
  - Manual muscle testing
  - Reflexes
  - Girth measurements.

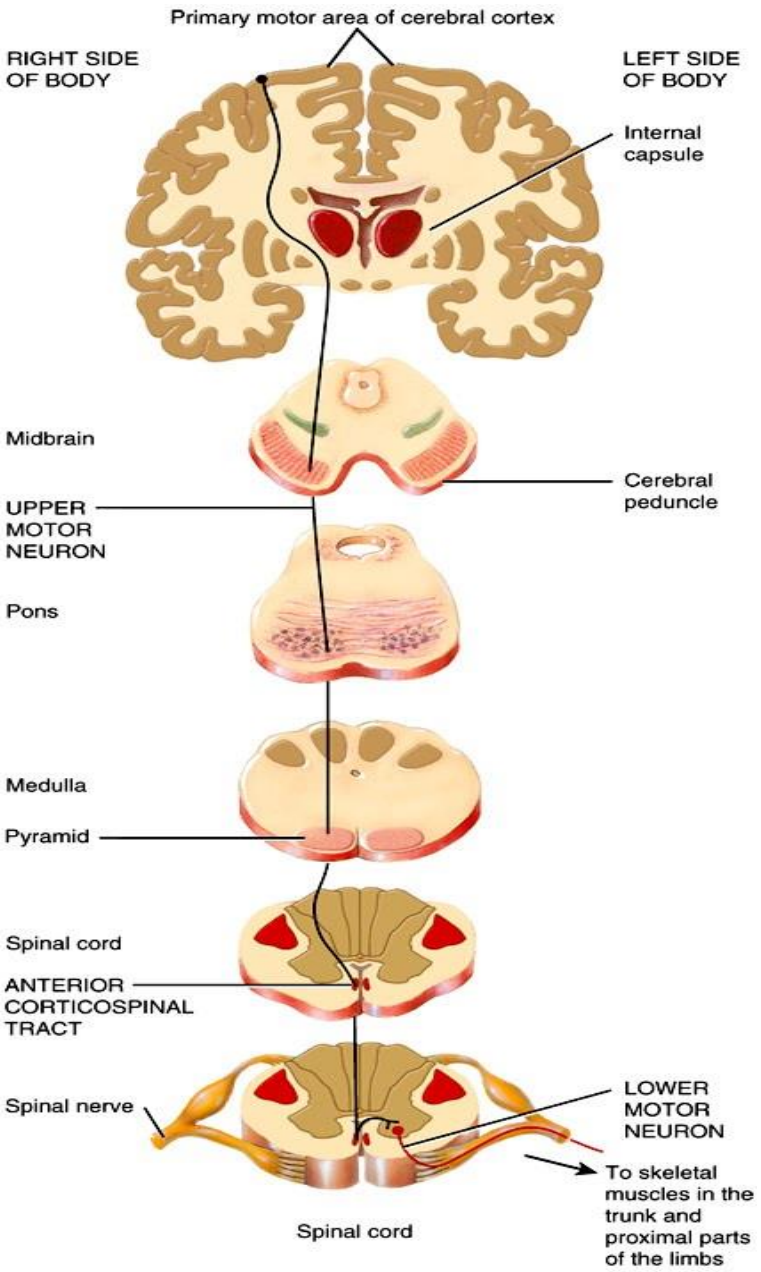
MOTOR EXAMINATION PRINCIPLES

- Manual muscle testing
  - AMA Guides: No specific mention of the technique for manual muscle testing
  - Relevant References:
    - Technique of the Neurologic Examination – DeMeyer
    - Fundamentals of Musculoskeletal Assessment Techniques – Palmer & Epler
    - Muscles: Testing and Function, with Posture and Pain – Florence Kendall (2005)
    - Muscle Testing – Techniques of Manual Examination – Daniels and Worthingham


Primary motor area of cerebral cortex
RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Internal capsule
UPPER MOTOR NEURON
CORTICOBULBAR TRACT
Cerebral peduncle
Midbrain
Facial (VII) nerve
LOWER MOTOR NEURON
To skeletal muscles of facial expression
Pons
Hypoglossal (XII) nerve
LOWER MOTOR NEURON
Medulla
To skeletal muscles of the tongue



(a) The lateral corticospinal pathway



(b) The anterior corticospinal pathway

MOTOR EXAMINATION PRINCIPLES

- Procedures for Manual Muscle Testing:
- General Principles:

1. Select movements for the examinee to resist that would just about match your arm and hand strength. Select movements that are neither too strong for you to possibly overcome nor too weak for you to judge their resistance.

MOTOR EXAMINATION PRINCIPLES

- Manual Muscle Testing (cont.):

  2. Understand that muscles are strongest when acting from their shortest length, and have little or no strength when acting from their longest position. Therefore, to test muscle of weak or modest strength, start with the muscle in a position of strength. To test very strong muscles, place the muscle in a position of disadvantage to bring them within your own range of strength.

MOTOR EXAMINATION PRINCIPLES

- Manual Muscle Testing (cont.):

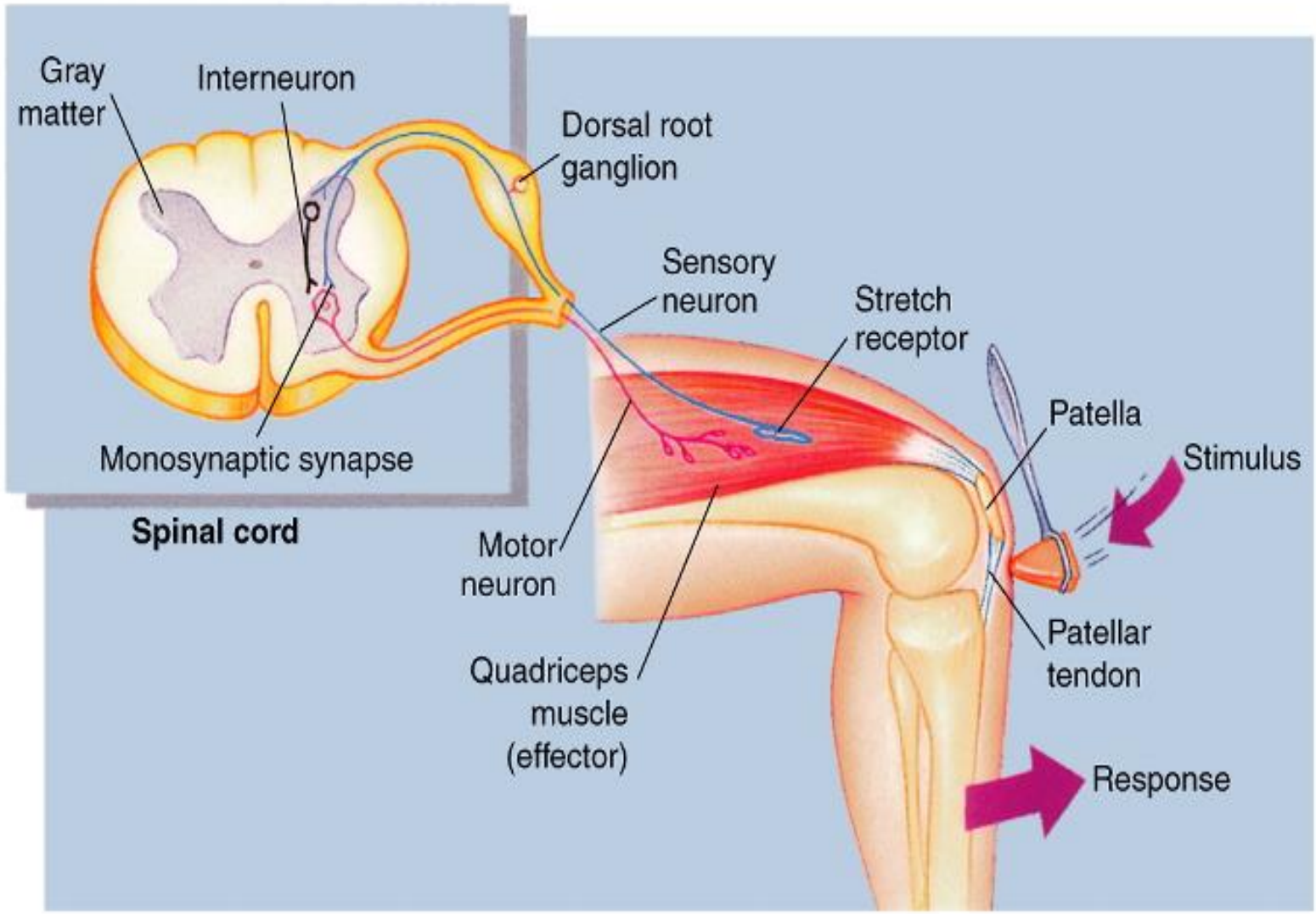
3. Engage the examinee and get their competitive spirit into the game. Encourage them to put forth their best effort.
4. Test in a repeatable superior to inferior direction.
5. Always stabilize the proximal joint to prevent muscle substitution.
6. Specific manual muscle tests for the spine and for the upper and lower extremity examinations and their methods are described in another module.

MOTOR EXAMINATION PRINCIPLES

- Reflexes
- Components of a Reflex Arc:
  - 1. Stimulus – rapid stretch of muscle/tendon
  - 2. Receptors – muscle spindle in muscle (specialized dendrite)
    - Detect stimulus

MOTOR EXAMINATION PRINCIPLES

- 3. Sensory Nerve – impulses travel up dendrite to the nerve cell body – located (???) – axon ends in the spinal cord
- 4. Control center (brain or spinal cord) – Decides the correct response
- 5. Motor nerve – carries impulse back to the effector (muscle) – chemicals released from NMJ
- 6. Effector – A muscle or gland that carries out the response (quadricep – in the case of the knee reflex – muscle shortens)


Gray matter
Interneuron
Dorsal root ganglion
Sensory neuron
Stretch receptor
Patella
Stimulus
Monosynaptic synapse
Spinal cord
Motor neuron
Quadriceps muscle (effector)
Patellar tendon
Response
S
P
D
I

REFLEX	LEFT	RIGHT
Jaw Jerk (Cr. N V trigeminal nerve)	+2 (normal)	+2 (normal)
Finger Flexion reflex (C7-T1) through the median nerve)		
Biceps Reflex (C5 through musculocutaneous nerve)	+2 (normal)	+2 (normal)
Brachioradialis reflex (C6 through the radial nerve)	+2 (normal)	+2 (normal)
Triceps reflex (C7 through the radial nerve)	+2 (normal)	+2 (normal)

REFLEX	LEFT	RIGHT
Adductor Jerk (L3 through obturator nerve)	+2 (normal)	+2 (normal)
Knee Jerk (L4 through femoral nerve)	+2 (normal)	+2 (normal)
Ankle Jerk (S1 through tibial nerve)	+2 (normal)	+2 (normal)
Medial and lateral hamstring jerks (Both S1 but medial is tibial and lateral (biceps femoris) is peroneal)	+2 (normal)	+2 (normal)
Plantar Reflex (Afferent – S1, Efferent L5-S1-S2 through the tibial nerve	+2 (normal)	+2 (normal)

REPORTING YOUR FINDINGS

- The lower extremity reflexes were normal and symmetric bilaterally. This indicates preserved function of:

- Left and right quadriceps muscle spindles (stretch receptors)
- Left and right gastrocnemius muscle spindles (stretch receptors)
- Left and right femoral nerve sensory function
- Left and right tibial nerve sensory function
- Left and right femoral nerve motor function
- Left and right tibial nerve motor function
- Left and right quadriceps muscle function
- Left and right gastrocnemius muscle function.
- Same pattern would apply for each component of each of the other deep tendon reflexes (i.e. biceps, brachioradialis, triceps, finger flexion, etc.)

EXAMINATION PROCEDURES BY BODY REGION

- Cervical Spine
- Thoracic Spine
- Lumbar Spine
- Upper Extremity Peripheral nerves
- Lower Extremity Peripheral nerves

CERVICAL SPINE NEUROLOGIC EXAMINATION

- Manual Muscle testing of cervical spine paraspinal muscles
- Sensory Examination of cervical spine dermatomes
- Motor Examination of cervical spine myotomes
- Reflexes
- Girth Measurements

CERVICAL SPINE MANUAL MUSCLE TESTING

Movement	Muscles Tested	Associated Nerves
Cervical Flexion	Sternocleidomastoid	Cr. XI, C2, C3
Cervical Extension	1. Trapezius 2. Semispinalis capitis 3. Splenius capitis	1. Cr. XI, C3, C4 2. Dorsal primary divisions of cervical nerves 3. Dorsal primary divisions of C4-C8
Left Lateral Flexion	1. Scalenus Anterior 2. Scalenus Medius 3. Scalenus Posterior	1. C5, C6 2. C3, C4, C5, C6, C7, C8 3. C6, C7, C8
Right Lateral Flexion	1. Scalenus Anterior 2. Scalenus Medius 3. Scalenus Posterior	1. C5, C6 2. C3, C4, C5, C6, C7, C8 3. C6, C7, C8
Left Rotation	Right Sternocleidomastoid	Cr. XI, C2, C3
Right Rotation	Left Sternocleidomastoid	Cr. XI, C2, C3

CERVICAL SPINE DERMATOMES

- The Sensory Examination consisted of procedures to test the sensory modalities of light touch, pain, two point discrimination, and joint position sense (also temperature and/or vibration).
-
- *Superficial Tactile Sensibility* (Light Touch) – This Sensory Exam was performed using a Semmes Weinstein monofilament (2.83 gauge).
  - C5 sensory dermatome: Normal sensation to light touch testing on the lateral aspect of the right arm from the summit of the shoulder to the elbow.
  - C6 sensory dermatome: Normal sensation to light touch testing on the left lateral forearm, the thumb, the index finger, and one half of the middle finger.
  - C7 sensory dermatome: Normal sensation to light touch testing on the left middle finger.
  - C8 sensory dermatome: Normal sensation to light touch testing on the medial aspect of the left forearm, ring and little finger.
  - T1 sensory dermatome: Normal sensation to light touch testing on the upper half of the medial aspect of the left forearm and medial portion of the arm.

CERVICAL SPINE DERMATOMES

- *Pain* – This Sensory Exam was performed using the Whartenburg pinwheel with sharp and dull sides.
  - C5 sensory dermatome: Normal sensation to pinwheel and dull testing on the lateral aspect of the right arm from the summit of the shoulder to the elbow.
  - C6 sensory dermatome: Normal sensation to pinwheel and dull testing on the right lateral forearm, the thumb, the index finger, and one half of the middle finger.
  - C7 sensory dermatome: Normal sensation to pinwheel and dull testing on the right middle finger.
  - C8 sensory dermatome: Normal sensation to pinwheel and dull testing on the medial aspect of the right forearm, ring and little finger.
  - T1 sensory dermatome: Normal sensation to pinwheel and dull testing on the upper half of the medial aspect of the right forearm and medial portion of the arm.

CERVICAL SPINE DERMATOMES

- Two Point Discrimination – This Sensory Examination was performed using the Aesthesiometer (Instrument) (Normal 2-4 mm. on the fingertips, 4-6 mm. on the dorsum of the fingers, 8-12 mm. on the palm, and 20-30 mm. on the dorsum of the hand).
-
  - C5 sensory dermatome: Two point discrimination was millimeters on the lateral aspect of the left arm from the summit of the shoulder to the elbow.
  - C6 sensory dermatome: Two point discrimination was millimeters on the left lateral forearm, the thumb, the index finger, and one half of the middle finger.
  - C7 sensory dermatome: Two point discrimination was millimeters on the left middle finger.
  - C8 sensory dermatome: Two point discrimination was millimeters on the medial aspect of the left forearm, ring and little finger.
  - T1 sensory dermatome: Two point discrimination was millimeters on the upper half of the medial aspect of the left forearm and medial portion of the arm.

CERVICAL SPINE MYOTOMES

- The Motor Nerve examination was conducted with resisted manual muscle testing of upper extremity muscles.
- C5 Nerve Root – resisted shoulder abduction using the supraspinatus and deltoid muscles were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the C5 portion of the suprascapular and axillary nerves. "The results of this test indicate normal function of these nerves."
- C6 Nerve Root – resisted wrist extension using the extensor carpi radialis longus and brevis were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the C6 portion of the radial nerve. The results of this test indicate normal function of these nerves.
- C7 Nerve Root – resisted wrist flexion using the flexor carpi radialis and flexor carpi ulnaris muscles were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the C7 portion of the median nerve as well as the C8 portion of the ulnar nerve. The results of this test indicate normal function of these nerves.
- C8 Nerve Root – resisted finger flexion using the flexor digitorum superficialis and flexor digitorum profundus muscles was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the C8 portion of the median nerve and the C8 portion of the ulnar nerve. The results of this test indicate normal function of these nerves.
- T1 Nerve Root – resisted finger abduction and adduction using the dorsal and palmar interossei muscles was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the T1 portion of the median and ulnar nerves. The results of this test indicate normal function of these nerves.

CERVICAL SPINE REFLEXES

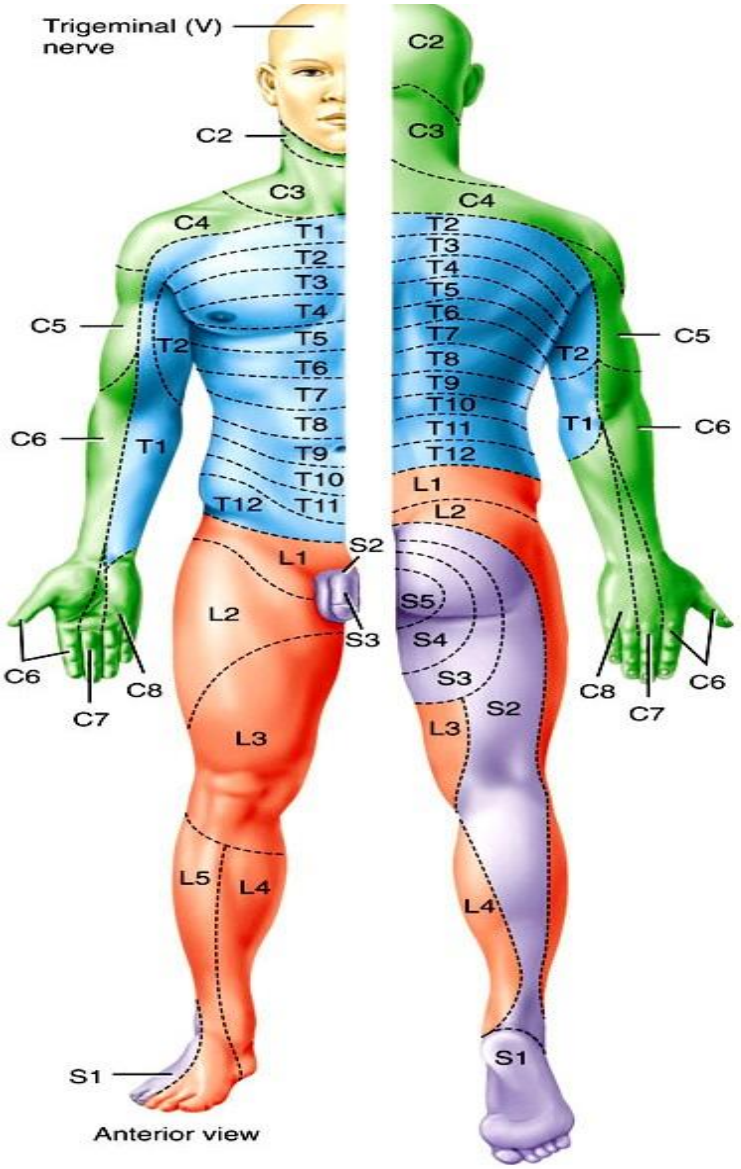
REFLEX	LEFT	RIGHT
Biceps (C5/Musculocutaneous nerve):	+2 (normal)	+2 (normal)
Extensor Digitorum (C6/Radial nerve):	+2 (normal)	+2 (normal)
Triceps (C7/Radial nerve):	+2 (normal)	+2 (normal)

THORACIC SPINE NEUROLOGIC EXAMINATION

- Thoracic outlet testing
- Sensory Examination of thoracic spine dermatomes
- Motor Exam: N/A
- Reflex Exam: N/A
- Girth Measurements: N/A

THORACIC SPINE DERMATOMES

- Landmarks:
- T4 crosses the nipple line
- T7 crosses the xiphoid process
- T10 crosses the umbilicus
- T12 crosses the groin



THORACIC SPINE DERMATOMES

- The Sensory Examination consisted of procedures to test the sensory modalities of light touch and pain.
-
- *Superficial Tactile Sensibility* (Light Touch) – This Sensory Exam was performed using a Semmes Weinstein monofilament (2.83 gauge).
  - There was intact light touch sensation to 2.83 Semmes-Weinstein monofilament testing in the bilateral T1-T12 dermatomes. I concluded that function of the cutaneous branches of the intercostal nerves was intact.

THORACIC SPINE MYOTOMES

- Intercostal muscles – each are innervated by the local segmental motor nerve root. Individual muscles are difficult to isolate and examine.

THORACIC SPINE REFLEXES

- No known reflexes.

LUMBAR SPINE NEUROLOGIC EXAMINATION

- Sensory Examination of lumbar spine dermatomes
- Motor Examination of lumbar spine myotomes
- Reflexes
- Girth Measurements
- Special Tests:
  - Heel/toe walk
  - Sciatic nerve stretch tests

LUMBAR SPINE DERMATOMES

- The Sensory Examination consisted of procedures to test the sensory modalities of light touch, and pain (temperature/two point discrimination/joint position sense).
- *Superficial Tactile Sensibility* (Light Touch) – This Sensory Exam was performed using a Semmes Weinstein monofilament (2.83 gauge). A 2.83 gauge monofilament is similar to a human hair.
- L1 sensory dermatome: Normal sensation to light touch testing on the upper anterior aspect of the left thigh between the anterior superior iliac spine and the groin.
- L2 sensory dermatome: Normal sensation to light touch testing on the middle anterior thigh testing from lateral left thigh to medial thigh.
- L3 sensory dermatome: Normal sensation to light touch testing on the lower anterior thigh testing from lateral left thigh to medial thigh.
- L4 sensory dermatome: Normal sensation to light touch testing on the medial aspect of the calf to the left foot.
- L5 sensory dermatome: Normal sensation to light touch testing on the lateral shin to dorsal medial aspect of the left foot.
- S1 sensory dermatome: Normal sensation to light touch testing on the lateral aspect of the left foot.
- The *Superficial Tactile Sensibility* examination was normal with no loss of sensibility in any of the lower extremity dermatomes tested. He was able to quickly and accurately localize the test stimulus. This indicates preserved and intact sensory function of the lumbar spine nerve roots and lower extremity peripheral nerves.

LUMBAR SPINE DERMATOMES

- The Sensory Examination consisted of procedures to test the sensory modalities of light touch, and pain.
-
-
- *Pain* – This Sensory Exam was performed using the Whartenburg pinwheel with sharp and dull sides.
-
- L1 sensory dermatome: Normal sensation to pinwheel and dull testing on the upper anterior aspect of the right thigh between the anterior superior iliac spine and the groin.
- L2 sensory dermatome: Normal sensation to pinwheel and dull testing on the middle anterior thigh testing from lateral right thigh to medial thigh.
- L3 sensory dermatome: Normal sensation to pinwheel and dull testing on the lower anterior thigh testing from lateral right thigh to medial thigh.
- L4 sensory dermatome: Normal sensation to pinwheel and dull testing on the medial aspect of the calf to the right foot.
- L5 sensory dermatome: Normal sensation to pinwheel and dull testing on the lateral shin to dorsal medial aspect of the left foot.
- S1 sensory dermatome: Normal sensation to pinwheel and dull testing on the lateral aspect of the left foot.
-

LUMBAR SPINE MYOTOMES

- L1/L2/L3 Nerve Roots: resisted hip flexion using the iliopsoas muscle was strong and symmetric bilaterally with no evidence of weakness or giveway. This tests the L1, L2, and L3 nerve roots – and indicates normal function.
- L2/L3/L4 Nerve Roots: resisted knee extension using the quadriceps muscles was strong and symmetric bilaterally with no evidence of weakness or giveway. This tests the L2/L3 and L4 portions of the femoral nerve – and indicates normal function.
- L4 Nerve Root: resisted foot inversion with dorsiflexion using the tibialis anterior muscle was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the L4 portion of the deep peroneal nerve, a branch of the common peroneal nerve, a branch of the sciatic nerve – and indicates normal function.
- L5 Nerve Root: resisted great toe extension and resisted toe extension using the extensor hallucis longus and extensor digitorum longus muscles respectively were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the L5 portion of the deep peroneal nerve, a branch of the common peroneal nerve, a branch of the sciatic nerve – and indicates normal function.
- S1 Nerve Root: resisted foot eversion using the peroneus longus and peroneus brevis muscles were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the S1 portion of the superficial peroneal nerve, a branch of the common peroneal nerve, a branch of the sciatic nerve – and indicates normal function.

LUMBAR SPINE REFLEXES

REFLEX	LEFT	RIGHT
Patellar (L4/femoral nerve):	+2 (normal)	+2 (normal)
Achilles (S1/tibial nerve):	+2 (normal)	+2 (normal)
Others: • **Adductor jerk (L3/obturator nerve)** • **Medial Hamstrings (S1 tibial nerve)** • **Lateral Hamstrings (S1 common peroneal nerve)**		

PERIPHERAL NERVES

- Upper Extremity Peripheral Nerve Sensory Exam:
  - Radial Nerve: Sensory
  - Normal sensation to light touch at the dorsal web space between thumb and index finger bilaterally.
  - Normal sensation to pinwheel and dull testing at the dorsal web space between thumb and index finger bilaterally.
  - Two point discrimination testing was xxx at the dorsal web space between thumb and index finger bilaterally.
  - (Normal 2 point = 20-30 mm. on dorsum of hand)
  - Ulnar Nerve: Sensory
  - Normal sensation to light touch at the distal ulnar aspect of the little finger bilaterally.
  - Normal sensation to pinwheel and dull testing at the distal ulnar aspect of the little finger bilaterally.
  - Two point discrimination testing was at the distal ulnar aspect of the little finger bilaterally (normal = 2-4 mm.)
  -

PERIPHERAL NERVES

- Upper Extremity Peripheral Nerve Sensory Exam:
  -
  - Median Nerve: Sensory
  - Normal sensation to light touch at the distal radial aspect of the index finger bilaterally.
  - Normal sensation to pinwheel and dull testing at the distal radial aspect of the index finger.
  - Two point discrimination testing was at the distal radial aspect of the index finger bilaterally (normal 2-4 mm).
  -
  - Axillary Nerve: Sensory
  - sensation to light touch at the lateral arm and deltoid patch of upper arm bilaterally.
  - sensation to pinwheel and dull testing at the lateral arm and deltoid patch of upper arm bilaterally.
  - Two point discrimination testing was at the distal radial aspect of the index finger bilaterally.
  -
  - Musculocutaneous Nerve: Sensory
  - Normal sensation to light touch at the lateral forearm bilaterally.
  - Normal sensation to pinwheel and dull testing at the lateral forearm bilaterally.
  - Two point discrimination testing was at the lateral forearm bilaterally.

PERIPHERAL NERVES

- Upper Extremity Peripheral Nerve Motor Examination:
- Radial Nerve: Motor
- Resisted wrist extension using the extensor carpi radialis longus and brevis was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral radial nerve.
- Resisted finger extension using the extensor digitorum communis, extensor indicis, and extensor digiti minimi were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral radial nerve.
-
- Ulnar Nerve: Motor
- Resisted abduction of the little finger using the dorsal interossei and abductor digiti minimi was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral ulnar nerve.
-

PERIPHERAL NERVES

- Median Nerve: Motor
- Resisted thumb pinch using the lumbricales and interosseous muscles as well as the long flexors of the thumb and index finger was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral median nerve.
- Resisted thumb opposition using the opponens pollicis and opponens digiti minimi was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral median nerve.
- Resisted thumb abduction using the abductor pollicis (obliquus and transversus) was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral median nerve.
-
- Axillary Nerve:
- Resisted arm abduction using the deltoid and supraspinatus muscles was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral axillary nerve.
-
- Musculocutaneous Nerve.
- Resisted arm flexion using the biceps, brachialis and brachioradialis muscles was strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral musculocutaneous nerve.

PERIPHERAL NERVES

- Lower Extremity Peripheral Nerve Sensory Examination:
- Lateral Femoral Cutaneous Nerve: Sensory
  - Normal sensation to light touch at the lateral aspect of the thigh from the greater trochanter to the knee.
- Genitofemoral Nerve: Sensory
  - Normal sensation to light touch at the anterior aspect of the thigh over the hip joint and to halfway down to the knee.
- Femoral Nerve: Sensory
  - Normal sensation to light touch at the medial and anterior aspect of the thigh above the knee.
- Posterior Femoral Cutaneous Nerve: Sensory
  - Normal sensation to light touch at the posterior aspect of the thigh from the buttock crease to the back of the knee.
- Obturator Nerve: Sensory
  - Normal sensation to light touch at the medial aspect of the knee to a point approximately 6 inches above the knee medially.

PERIPHERAL NERVES

- Saphenous Nerve: Sensory
  - Normal sensation to light touch at the medial aspect of the leg extending from the knee to the medial malleolus bilaterally.
- Lateral Sural Cutaneous Nerve: Sensory
  - Normal sensation to light touch at the lateral aspect of the leg extending from the knee to the lateral malleolus bilaterally.
- Superficial Peroneal Nerve: Sensory
  - Normal sensation to light touch at the dorsum of the foot and over the anterior ankle bilaterally.
- Deep Peroneal Nerve: Sensory
  - Normal sensation to light touch at the dorsal web space between the great toe and second toe bilaterally.
- Sural Nerve: Sensory
  - Normal sensation to light touch at the lateral aspect of the foot and along the fifth metatarsal bone bilaterally.

PERIPHERAL NERVES

At the foot:

- Medial Calcaneal Nerve: Sensory
  - Normal sensation to light touch across the bottom of the heel.
- Medial Plantar Nerve: Sensory
  - Normal sensation to light touch over the bases of the 1st, 2nd, and 3rd metatarsal-phalangeal joints and back to the heel.
- Sural Nerve: Sensory
  - Normal sensation to light touch at the lateral aspect of the heel up to the lateral malleolus.
- Saphenous Nerve: Sensory
  - Normal sensation to light touch at the medial aspect of the arch of the foot up to the medial malleolus.
- Lateral Plantar Nerve: Sensory
  - Normal sensation to light touch at the bases of the 4th and 5th metatarsal-phalangeal joints and back to the heel.

PERIPHERAL NERVES

- Lower Extremity Peripheral Nerve Motor Exam:
- Obturator Nerve – Motor:
  - Resisted hip adduction using the pectineus, adductor brevis, adductor longus, adductor magnus, and gracilis muscles was strong and symmetric bilaterally with no evidence of weakness or give way of the knee. This tests the motor portion of peripheral obturator nerve – and indicates normal function.

- Femoral Nerve: Motor
  - Resisted knee extension using the vastus lateralis and vastus intermedius muscles was strong and symmetric bilaterally with no evidence of weakness of give way of the knee. The tests the motor portion of the peripheral femoral nerve – and indicates normal function.

PERIPHERAL NERVES

- Sciatic – Tibial Nerve: Motor
  - Resisted ankle/foot plantar flexion using the gastrocnemius muscles were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral tibial nerve.
  - Resisted toe flexion using the flexor digitorum longus muscles were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the peripheral tibial nerve.

- Sciatic – Common Peroneal Nerve:
  - Resisted great toe extension using the extensor hallucis longus muscles were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the deep peroneal nerve, a branch of the peripheral common peroneal nerve.
  - Resisted toe extension using the extensor digitorum longus muscles were strong and symmetric bilaterally with no evidence of weakness or give way. This tests the motor portion of the deep peroneal nerve, a branch of the peripheral common peroneal nerve.

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Table 15-1 Physical Examination

Lumbar Spine

Individual Position	Examination
Standing	Posture Scoliosis Lordosis Kyphosis
	Palpation Muscles Tenderness
	Gait
	Range of motion
	Muscle strength screening Heel-toe walk Squatting
Sitting	Neurologic Reflexes (ankle, knee) Strength Sensation
	Nerve tension Straight leg raising (or similar)
Recumbent Supine	Neurologic Reflexes Strength Sensation Straight leg raising (or similar)
	Other Pulses Hip range of motion
Recumbent Prone	Nerve tension Femoral stretch test
	Palpation Muscles Spinous processes

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Thoracic Spine

Individual Position	Examination
Standing	Posture Scoliosis Kyphosis
	Palpation Muscles Tenderness
	Range of motion

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Cervical Spine

Individual Position	Examination
Standing or sitting	Posture Scoliosis Kyphosis Lordosis
	Palpation Muscles Tenderness
	Range of motion
	Other Shoulder motion Cervical compression Foraminal compression (Spurling test)
	Neurologic Reflexes (biceps, triceps, brachioradialis, finger) Motor Sensory

SPECIAL TESTS

- Heel/Toe Walk: Testing for function of L5 (common peroneal) and S1 (tibial) nerve root/peripheral nerve function
- Sciatic Nerve Stretch Tests:
  - Neri's Bowstring Sign
  - Straight Leg Raise
  - Piriformis stretch test (hip internal rotation)
  - Braggard's Sign (dorsiflexion of ankle and all toes)
  - Sicard's Sign (dorsiflexion of great toe)
- Femoral Nerve Stretch Test:
- Gait Analysis:

AMA GUIDES

- Section 16.3 Digital Nerve Lesions:

All clinical tests used to examine the degree of functional loss of sensibility are related to cutaneous touch-pressure sensation. At present, the two-point test for fine discrimination sensibility is most widely used, followed by the monofilament touch-pressure threshold test. The pinprick test can be useful to determine whether pain protective sensation is intact and to identify discrepancies between dermatomal findings and reported symptoms. More accurate assessment is obtained by using the sharp and dull sides of the pin at random. Vibration testing has yet to be associated with functional levels of sensibility.

AMA GUIDES – 16.3 Digital Nerve Lesions

The classic Weber static two-point discrimination test is most valuable. Moberg originally described the use of a paper clip opened and bent into a caliper. The Disk-Criminator, DeMayo 2-Point Discrimination Device, and Boley Gauge are some of the currently available testing instruments. Testing is started distally and proceeds proximally. The distance between the tips of the instrument is set first at 5 mm. As the individual being tested closes his or her eyes, the tips of the testing device are applied lightly to the sides of the pulp of the distal segment of the digit in a random sequence, in a longitudinal orientation. Because it is light-touch discrimination that is being tested, the pressure applied should be very light and must not produce a point of blanching or skin indentation. The interval between applications should be no less than 3 to 5 seconds. A series of touches with one or two points is made, and the individual immediately indicates whether one or two points are felt. Two out of three responses must be accurate for scoring. The distance between the ends is progressively increased until the required accurate responses are elicited, at which time the distance is recorded.

Grade	Description of Sensory Deficit, or Pain – Table 16-10a	% Sensory Deficit
5	No loss of sensibility, abnormal sensation, or pain	0%
4	Distorted superficial tactile sensibility (diminished light touch), with or without minimal abnormal sensations or pain, that is forgotten during activity.	1–25%
3	Distorted superficial tactile sensibility (diminished light touch and diminished two point discrimination), with some abnormal sensations, or slight pain, that interferes with some activities. Normal two point discrimination is 2–4 mm. on the fingertips, 4–6 mm. on the dorsum of the fingers, 8–12 mm. on the palm, and 20–30 mm. on the dorsum of the hand. For median nerve, test on the distal radial tip of the index finger (should be 2–4 mm.). For the ulnar nerve, test on the distal ulnar tip of the pinky finger. For radial nerve, test on the dorsal 1st web space (should be 4–30 mm. = large range). Make sure to compare bilaterally.	26–60%
2	Decreased superficial cutaneous pain and tactile sensibility (decreased protective sensibility), with abnormal sensations or moderate pain, that may prevent some activities.	61–80%
1	Deep cutaneous pain sensibility present, absent superficial pain and tactile sensibility (absent protective sensibility), with abnormal sensations or severe pain, that prevents most activity.	81–99%

Grade	Description of Muscle Function	% Motor Deficit
5	“Complete active range of motion” against gravity with full resistance (may be modified in cases where ROM is not “full” although the restriction to ROM is not due to dysfunction of the nerve).	0%
4	“Complete active range of motion” against gravity with some resistance	1–25%
3	“Complete active range of motion” against gravity only, without resistance	26–50%
2	“Complete active range of motion” with gravity eliminated	51–75%
1	Evidence of slight contractility: no joint movement	76–99%
0	No evidence of contractility	100%

CONCLUSION

- This is Dr. Perry Carpenter. Thank you.
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- Reminder: When you are done with your Course Examination, fax (530-295-9196) or email (admin@ezqmeceu.com) your Examination and your credit for the course will be immediately processed.
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