

Spinal Cord and Reflexes

An Introduction

Vertebra

Nerve S Pairs

C₁₋₇

C₁₋₈

cervical enlargement

T₁₋₁₂

T₁₋₁₂

L₁₋₅

L₁₋₅

Lumbar enlargement

Conus medullaris



L₁

Cauda equina



L₅

S_{1-4 or 5}

S₁₋₅

Filum terminale

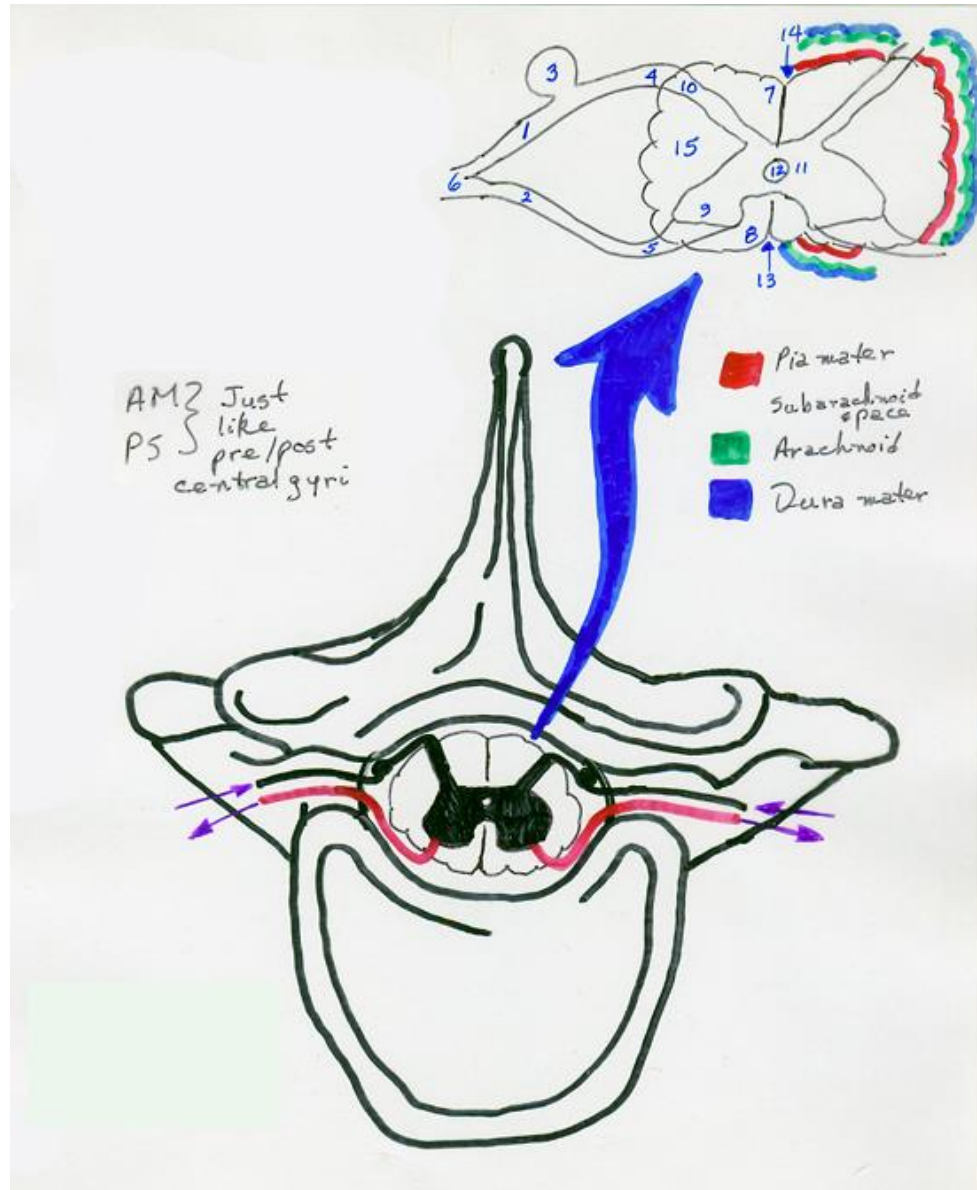
C_{01-3 or 4}

C₀₁

C₀₁

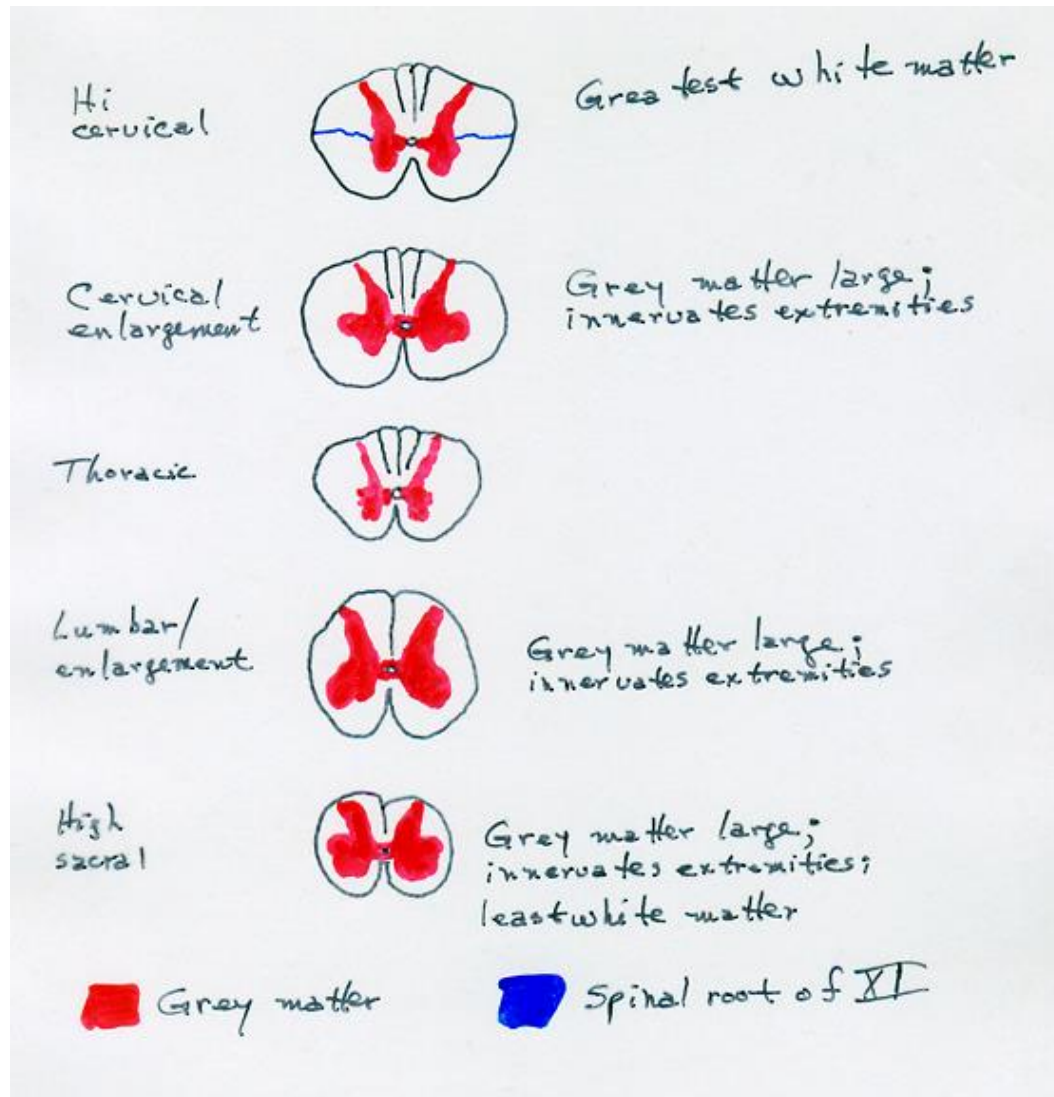


Spinal Cord – Cross Section

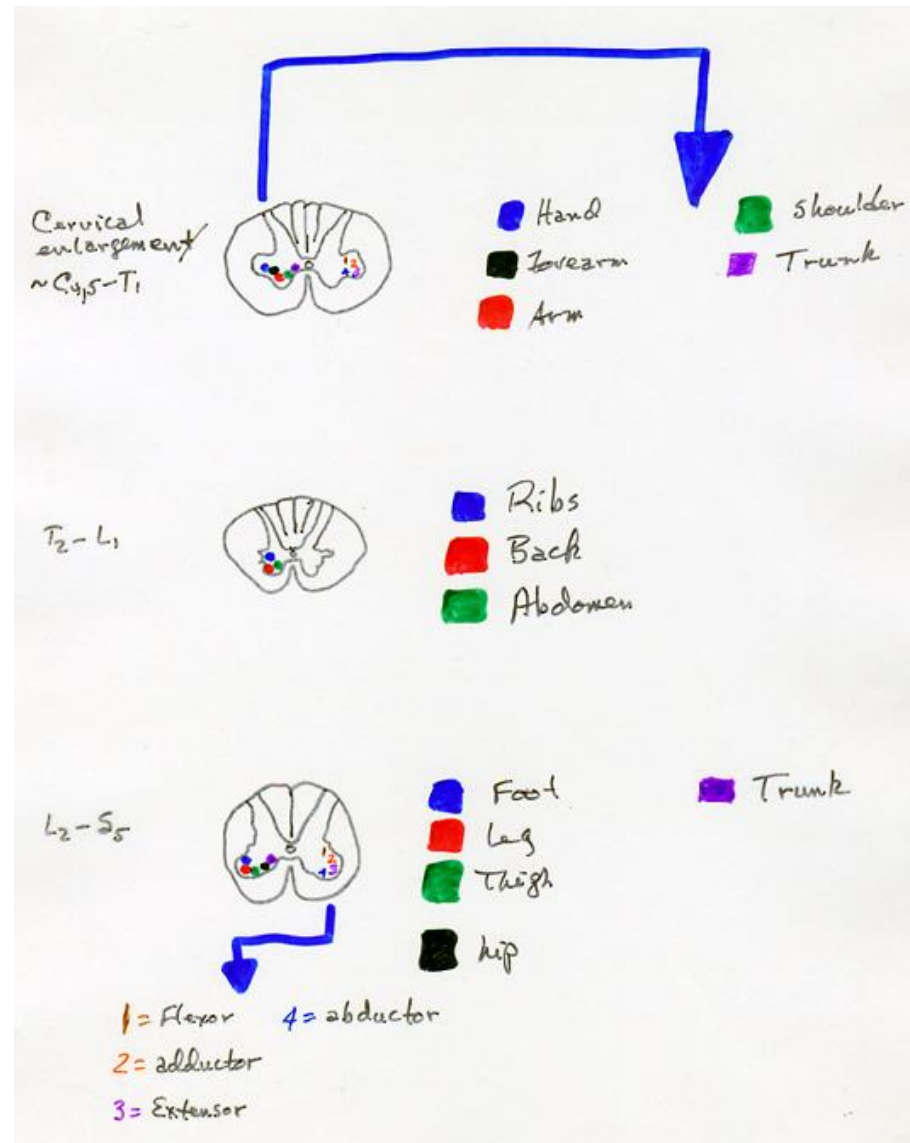


1. Sensory nerve
2. Motor nerve
3. Posterior root ganglion
4. Posterior root
5. Anterior root
6. Spinal nerve
7. Posterior white column
8. Anterior white column
9. Anterior grey horn
10. Posterior grey horn
11. Grey commissure
12. Central canal
13. Anterior median fissure
14. Posterior median fissure
15. Lateral white column

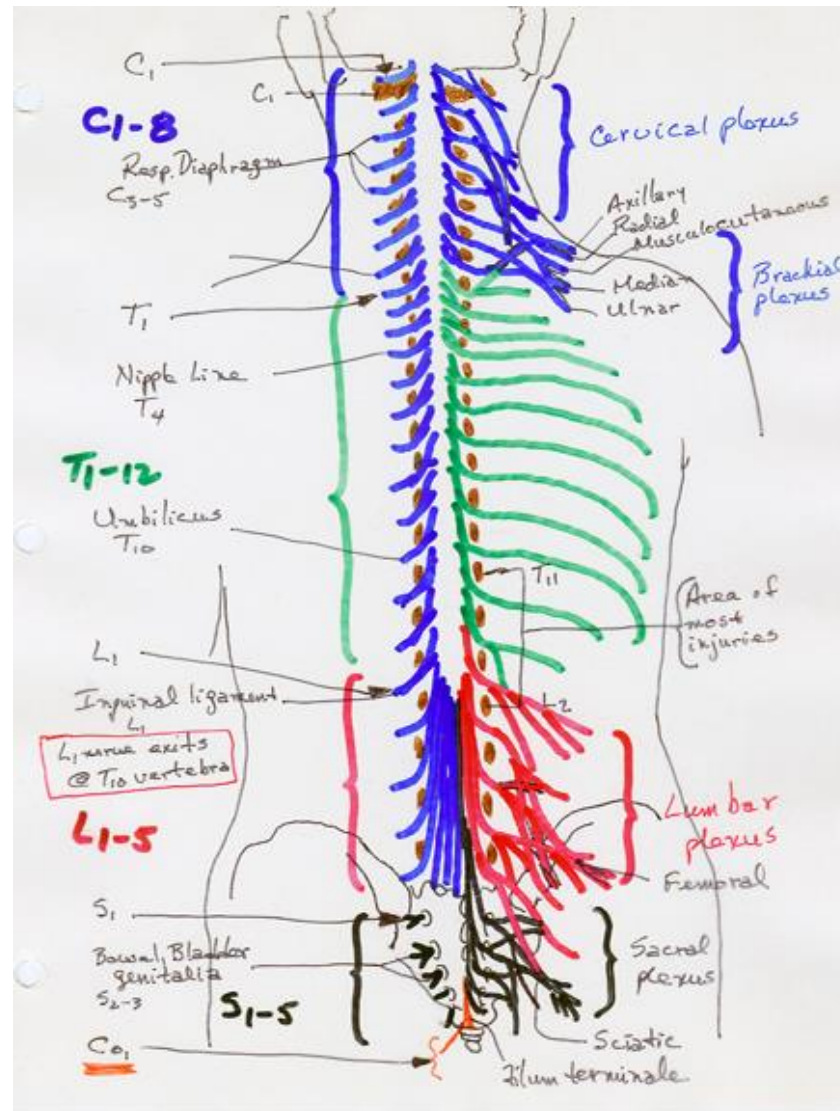
Spinal Cord Levels -- Anatomy



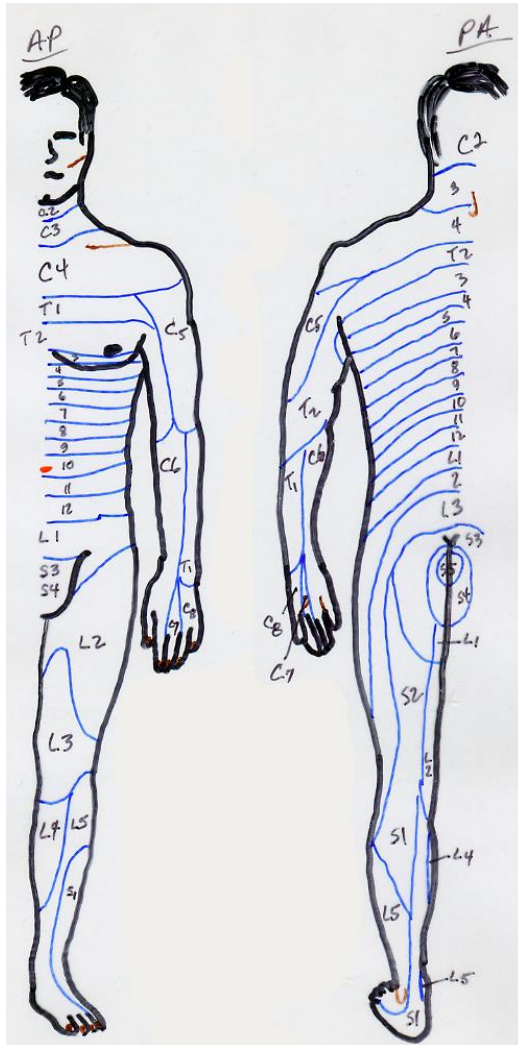
Spinal Cord Levels -- Physiology



Spinal Cord Levels – Clinical Applications



Dermatomes



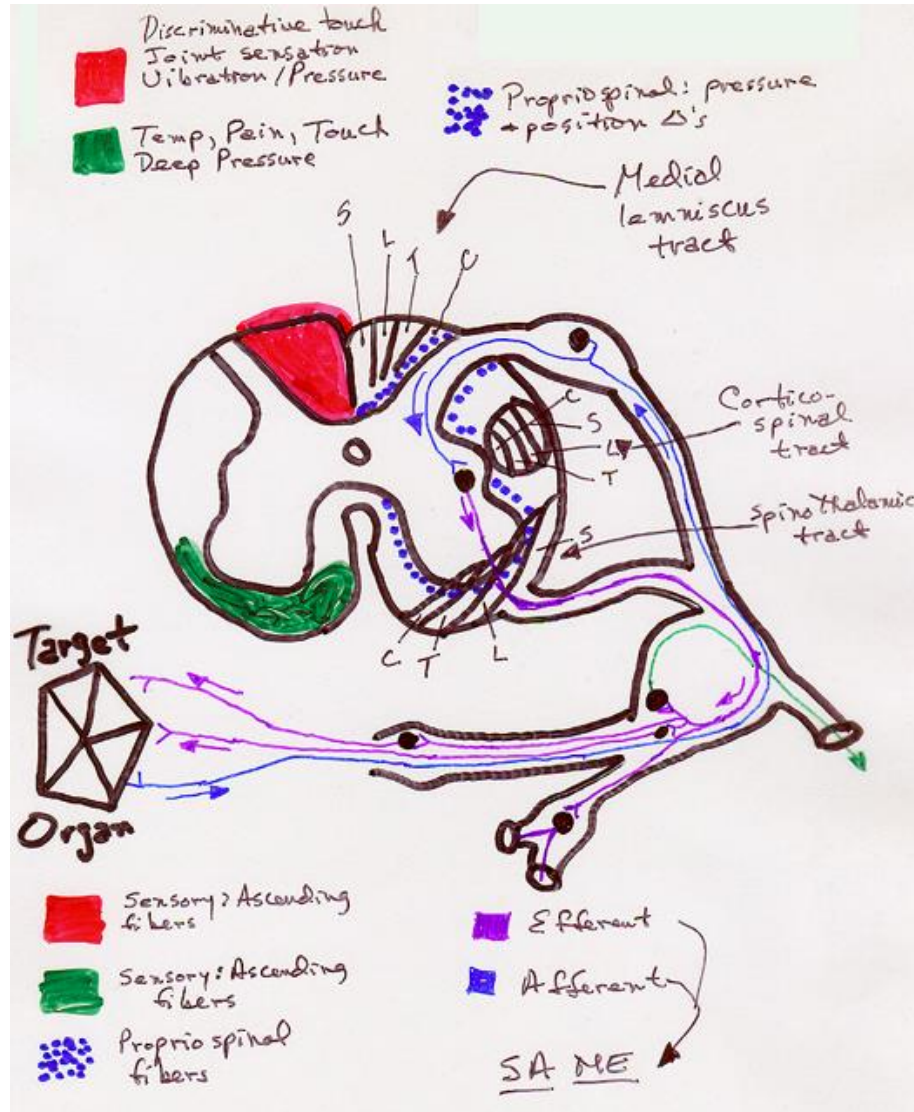
Dermatomes

1. Considerable overlap between neighboring dermatomes – as much as up to 8 dermatomes away
2. Borders are not exactly the same for touch as for pain and temperature
3. Dermatomes for pain and temp somewhat less extensive
4. Touch fibers belonging to a dorsal root overlap with those from neighboring roots moreso than do fibers for pain and temp.

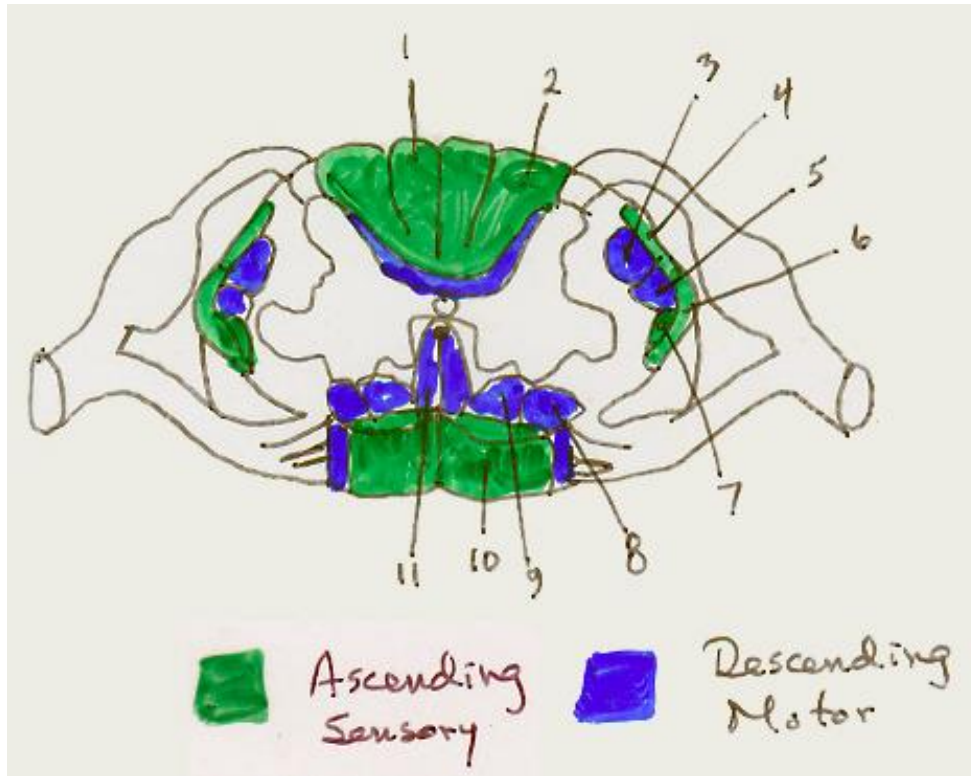
Applications of Dermatomes

- Intact Dermatomes
 1. C3-5 = diaphragm = ok
 2. C4 = shoulder shrugs = ok
 3. C5 = deltoid and elbow flexes = ok
 4. C7 = wrist flexes = ok
 5. C5-6 = biceps reflex = ok
 6. C7 = triceps reflex = ok
 7. L2 = hip flexes = ok
 8. L3-4 = knee extends = ok
 9. L5-S1 = dorsiflexion = ok
 10. S1-S2 = plantarflexion = ok
- Lesions and Functional Goals
 1. C5 → run electric wheelchair with mouth
 2. C6 → feed self with clip-ons
 3. C7 → drive car with hand controls
 4. C8 → transfer by self to/from bed, auto, toilet
 5. T1-8 → transfers self to/from tub
 6. T9-12 → ambulate with braces and crutches
 7. S1-2 → ambulate with cane

Cord Overview



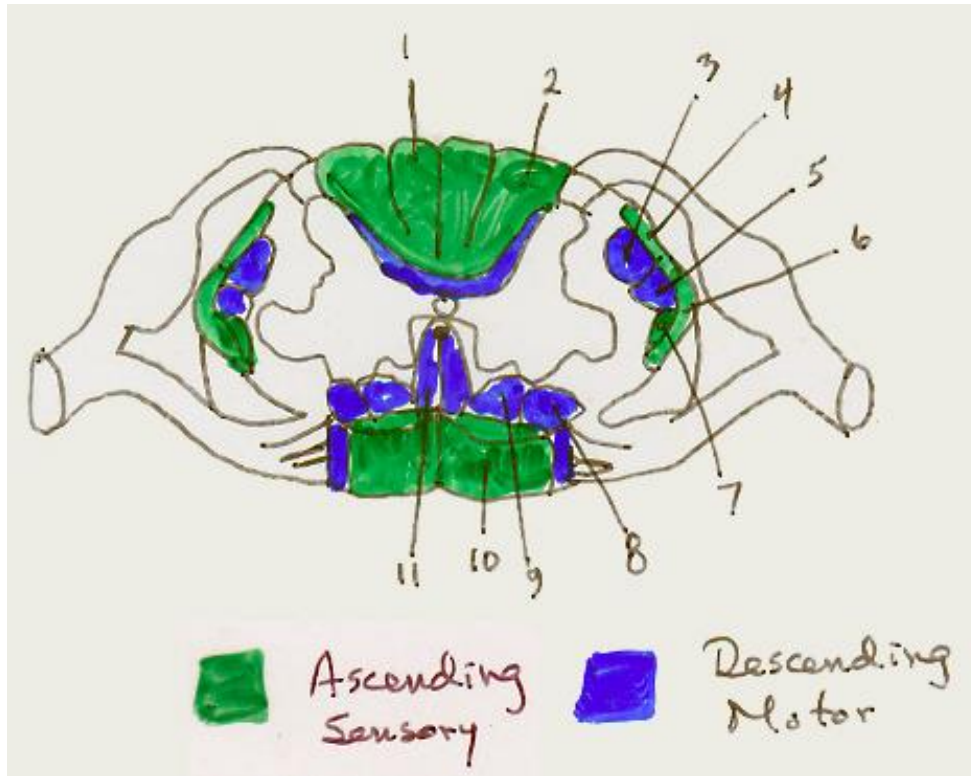
Spinal Cord Tracts – Physiology, too --



1. Gracile fasciculi – **to medulla**; body position, recognize touch, shape, texture, size
2. Cuneate fasciculi – **ibid.**
4. Posterior spinocerebellar tract – **to cerebellum**; movement and posture
6. Anterior spinocerebellar tract – **ibid.**
9. Vestibulospinal tract – **from vestibular nuclei**; equilibrium and balance

Ipsilateral activity

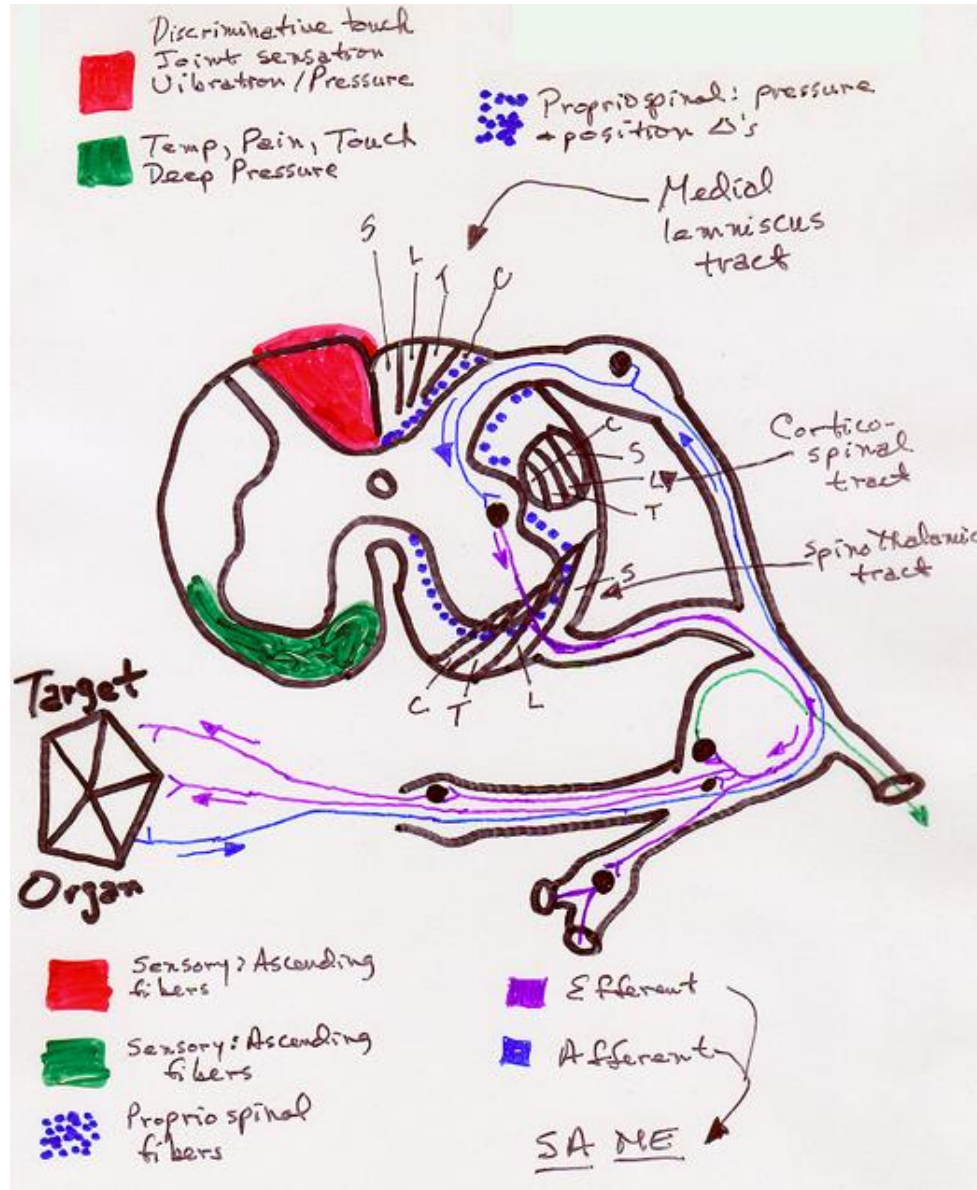
Spinal Cord Tracts – Physiology, too --



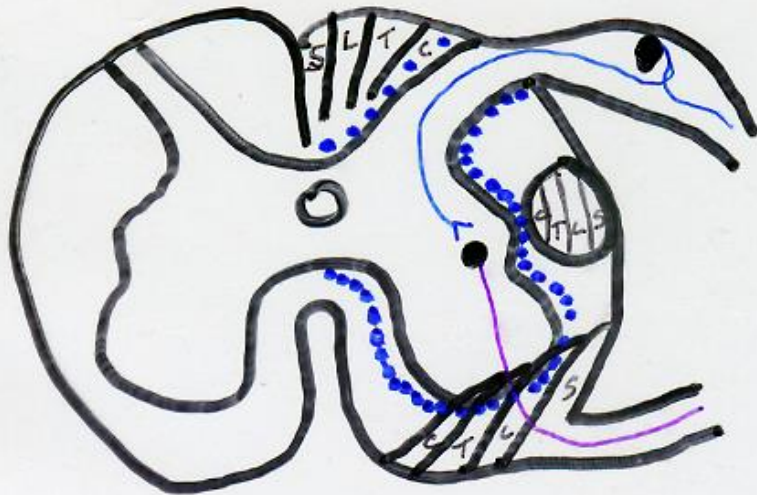
3. Lateral corticospinal tract – aka **pyramidal tract**; voluntary movements
5. Rubrospinal tract – **from red nucleus**; movement and posture
7. Lateral spinothalamic tract – **to thalamus**; pain and temperature
8. Reticulospinal tract – **from reticular activating system**; increases motor activity
10. Anterior spinothalamic tract – **to thalamus**; pressure, crude touch, posture and muscle action
11. Anterior corticospinal tract – part of pyramidal tract; **from motor cortical area**; voluntary movements

Contralateral activity

Cord Overview -- Again

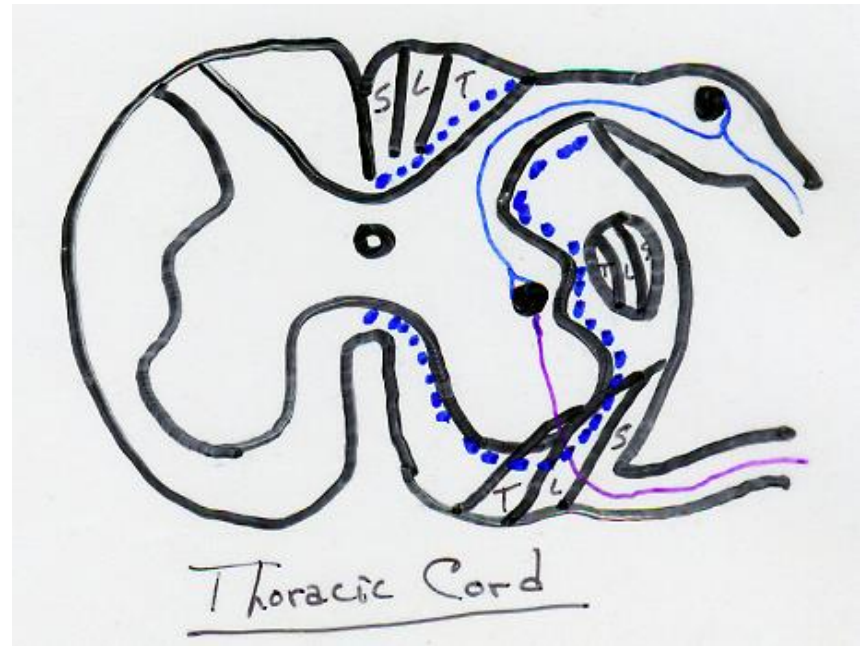


Cord by Region



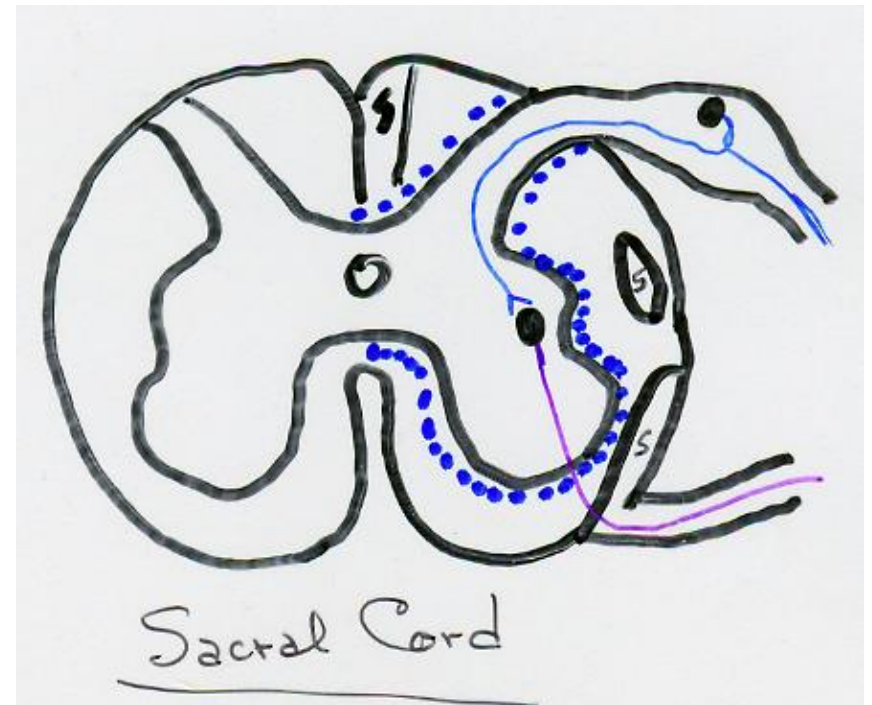
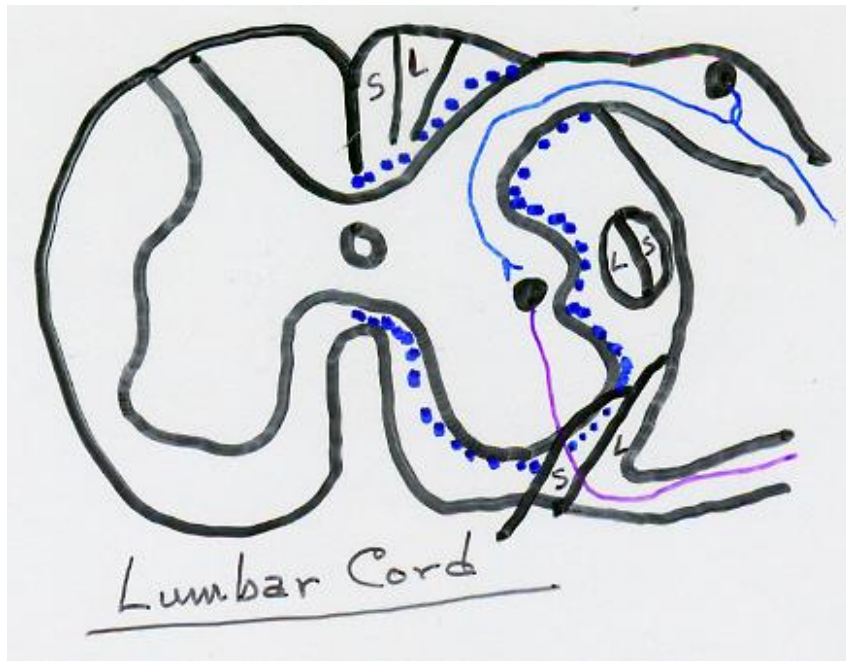
Cervical Cord

C = shortest, thinnest axons
S = longest, thickest axons

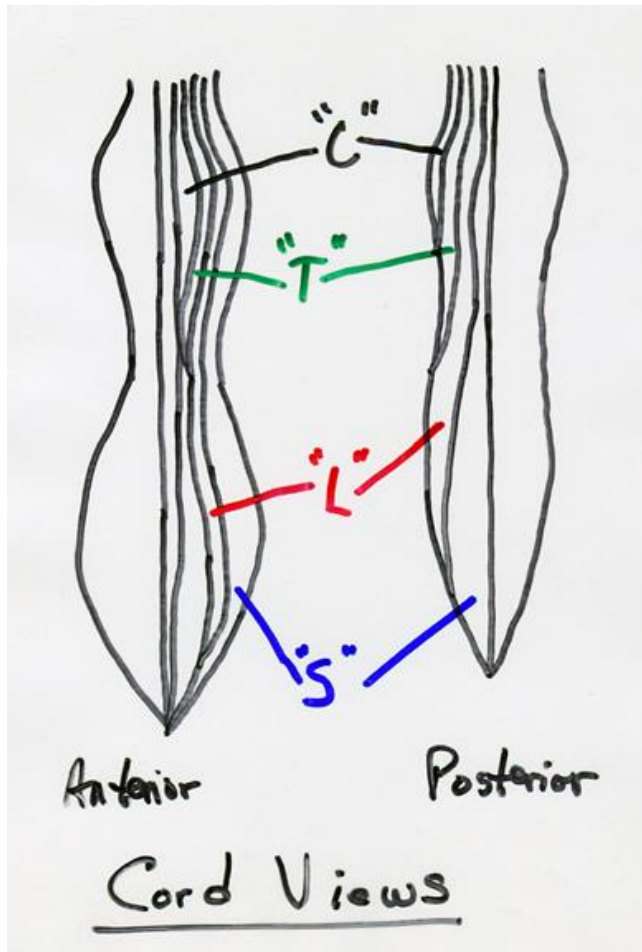


Thoracic Cord

Cord by Region -- 2



Cord by Region -- 3



- Note “lamination” of regions
- Note “loss” of regions as the cord goes farther down
- Note orientation of laminates between AP and PA views

Sensory Abnormality Problems and Patterns

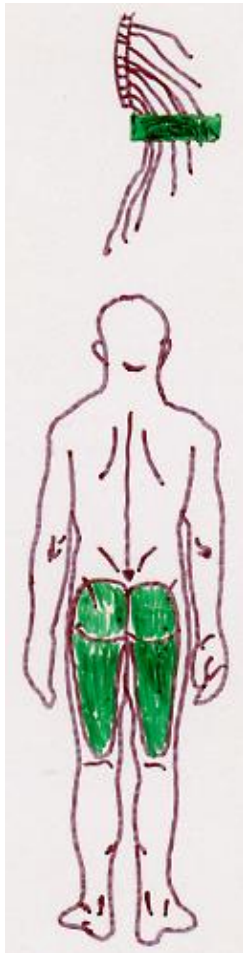
An Elementary Overview

Thalamic Lesion



- Complete hemianalgesia (The inability to feel pain on one side of the body.)

Cauda equina Lesion



- Loss of sensation over sacral segments
- May be unilateral – usually bilateral
- Referred to as “saddle sensory disturbances” in a generic sense

Central cord Lesion



- Temperature and pain sensation loss
- Normal touch

Half-cord Lesion



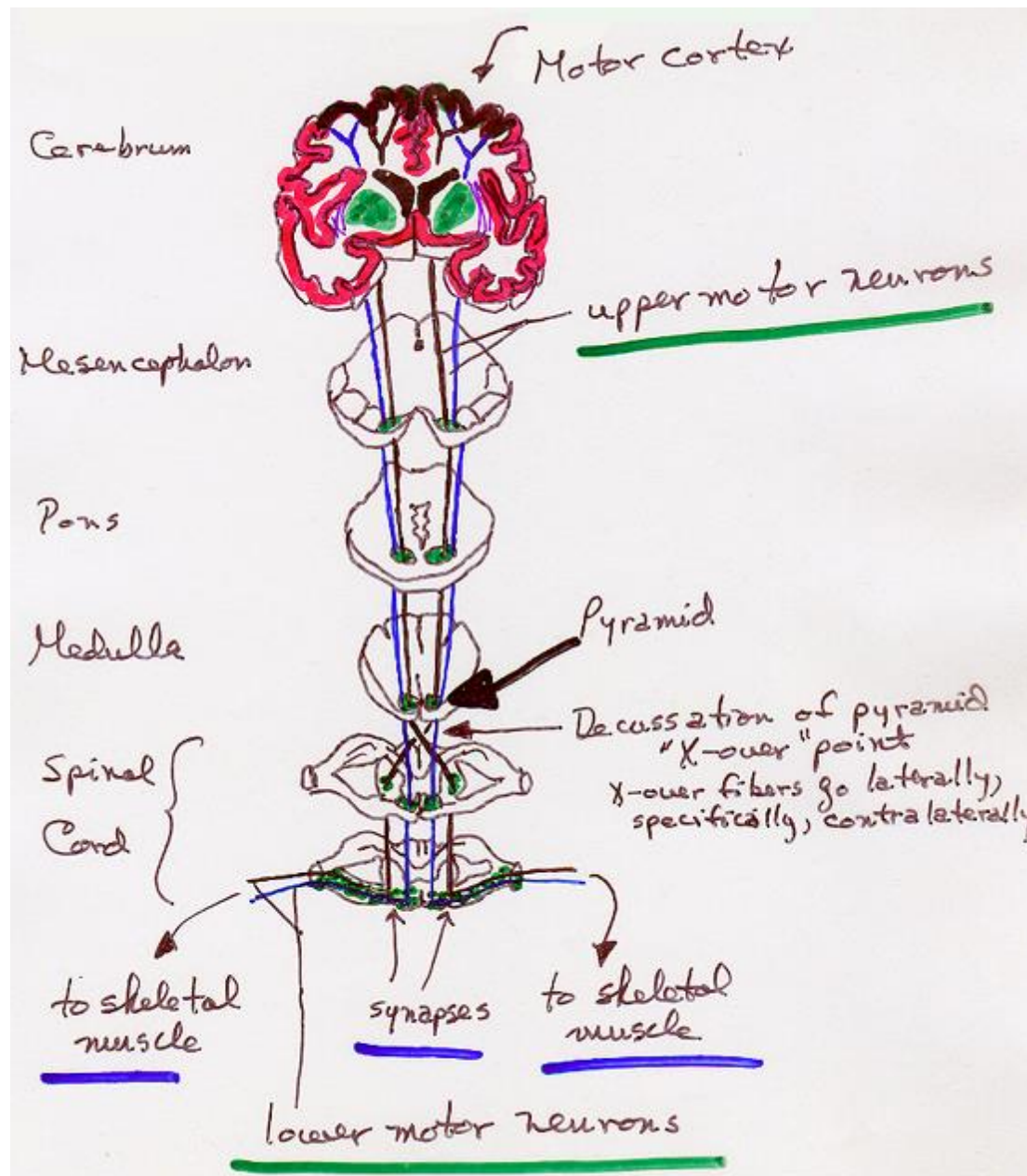
1. Pain/Temp sensation loss
2. Positional/vibrational loss

Whole-cord Lesion



- Complete loss of sensation at a specific level
- May not make 100% sense given overlap of dermatome and myotome activities

Pyramidal Tracts – aka Corticospinal Tracts



Motor Neurons

Upper Motor Neurons

- Found in corticospinal (or pyramidal tract) in brain/spinal cord

Clinical Signs:

1. Loss of voluntary movement
2. Spasticity
3. Sensory loss
4. Pathological reflexes (2+ is “normal”; >2+)

Injury:

1. Hemiplegia (paralysis of half of the body)
2. Paraplegia (paralysis of lower portion of body and both legs)
3. Quadriplegia (paralysis of all 4 limbs – aka tetraplegia)

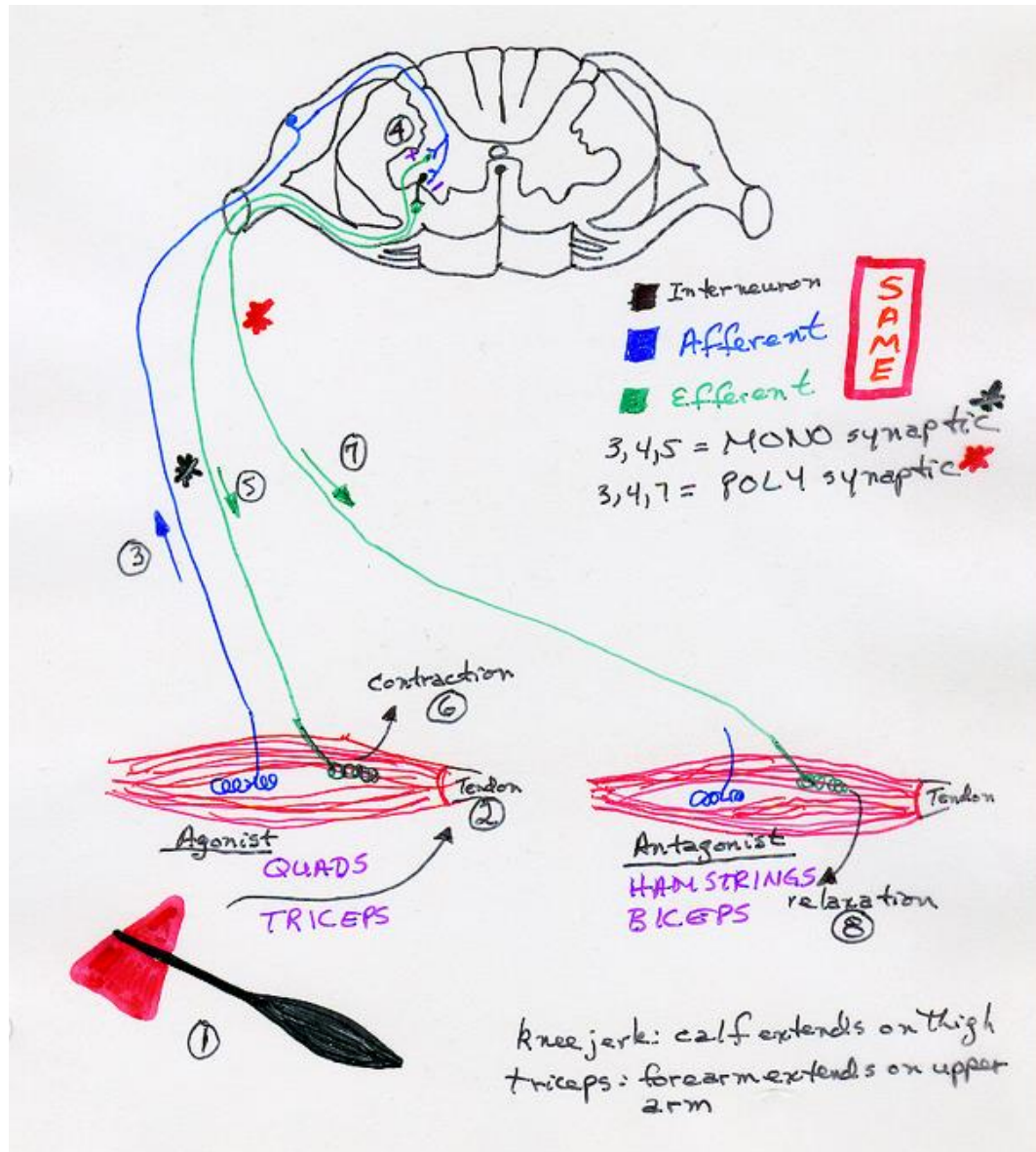
Lower Motor Neurons

- Include anterior horn cells, nerve roots, peripheral nervous system cells

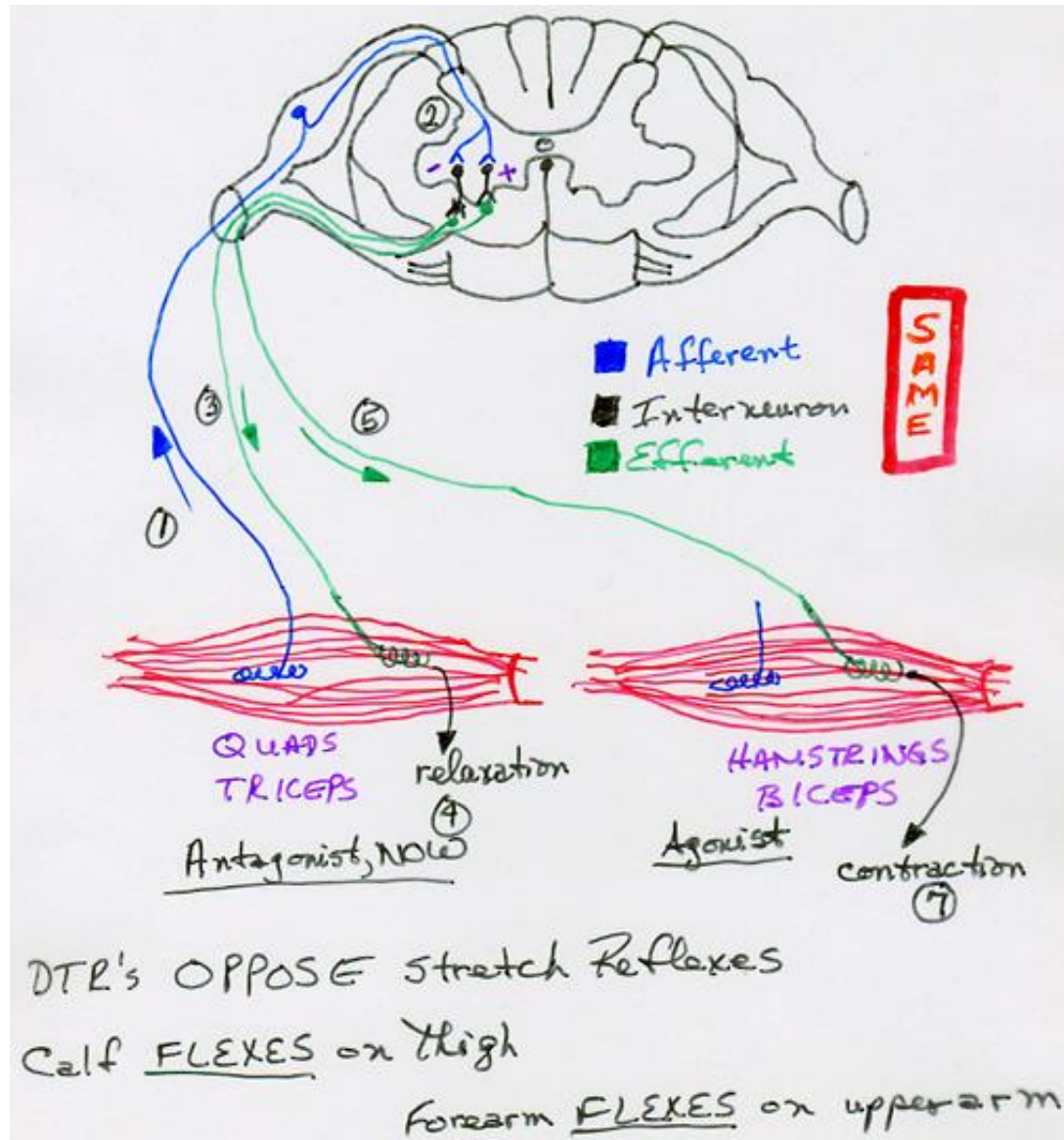
Injury

1. Diminished reflexes (< 2+)
2. Flaccid paralysis
3. Muscular atrophy

Stretch Reflex – Mono-Synaptic

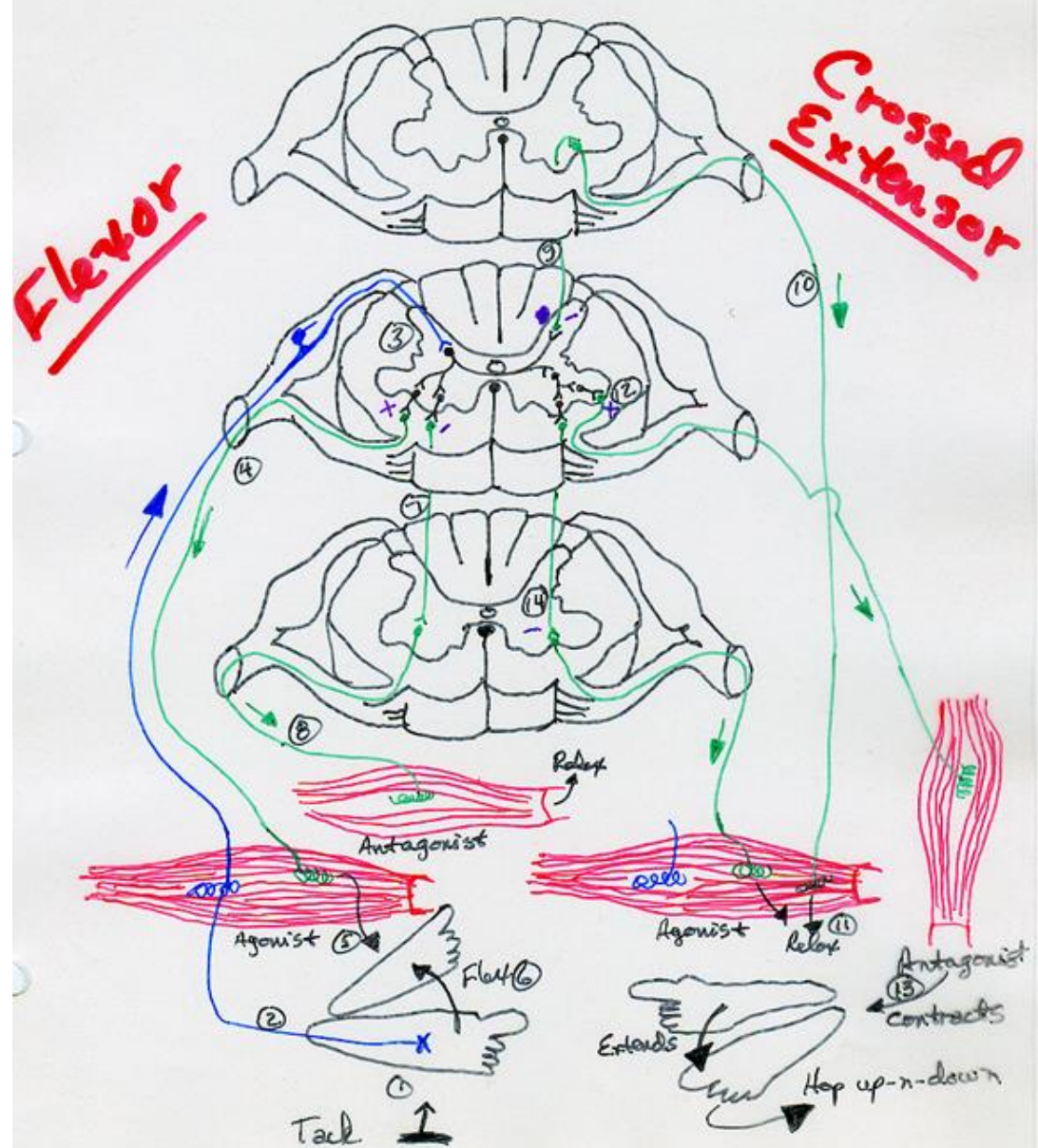


Deep Tendon Reflexes – DTR's – Polysynaptic – Reverses Stretch Reflex



Crossed Extensor/Flexor Mixed Reflex

- The “Defend-Yourself” Reflex
- The “Step On-A-Tack” Reflex



Reflexes

An Introduction

Achilles' Tendon Reflex

- Percuss the Achilles' tendon
- Foot plantar flexes
- The flexion is exaggerated with upper motor neuron damage
- Flexion is decreased or absent with lower motor neuron damage
- aka ankle jerk reflex



- May percuss as above
- May percuss as shown in lab

Babinski – A Busy Feller

Babinski's Reflex

- Dorsiflexion of Toe #1 following lateral to medial stroking of the sole (normal)
- If toe extends and outer toes flare = + for pyramidal tract lesions
- Abnormal response is present in infants until right at 6 months' of age

Babinski's Sign

- Decreased or absent achilles' tendon reflex in sciatica

Biceps Reflex

- Percuss the biceps brachii insertion tendon
- Forearm flexes (may need to feel tendon jerk under thumb)
 - May percuss as shown to the right
 - May percuss as shown in lab

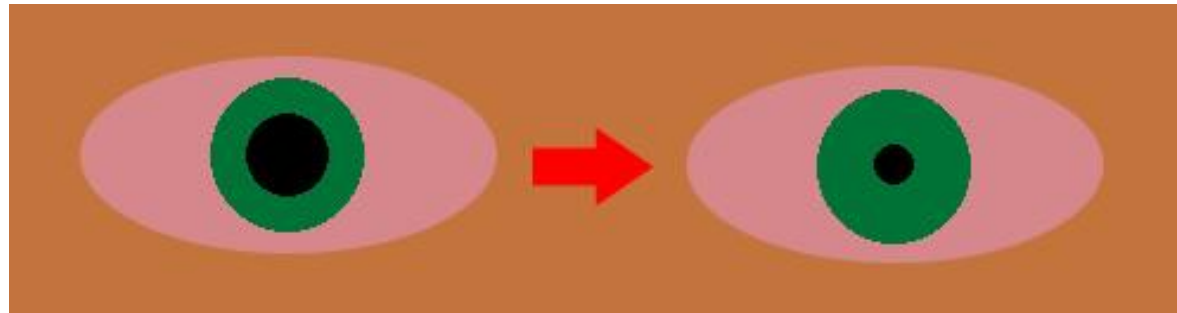


“C” Reflexes

Ciliospinal	Corneal	Cremasteric
Stroke/pinch/ scratch skin of back of neck	Eyelids close due to corneal irritation	Stroke front of inner thigh
Observe pupillary dilation		Causes testicular retraction

Light Reflex

- Pupil constricts with light shone into it



Moro Startle Reflex

- Blow in face
- Blow on top of abdomen
- Infant responds with rapid abduction/extension of arms with adduction of arms (embracing/hugging)
- Disappears after 1-2 months' of age
- If absent or unilateral, the presence of this reflex may suggest brain damage or a birth-originated injury

Patellar Reflex

- aka knee jerk
- Percuss patellar ligament
- Lower leg extends
- In lower motor neuron damage:
diminished/abolished reflex
- In upper motor neuron damage: muscle tone/response is greatly increased (pathological reflex)

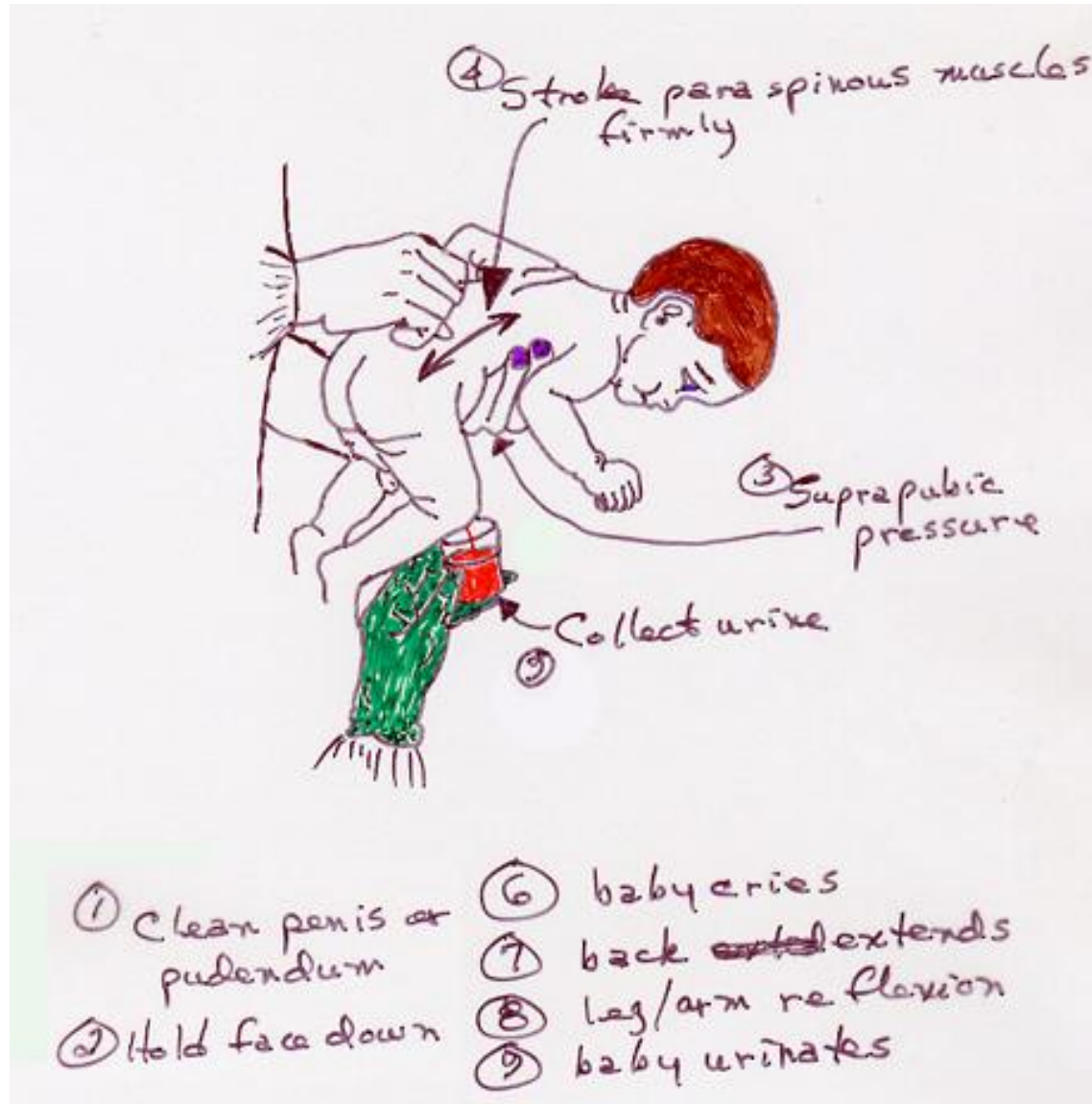


- May percuss as above.
 - May percuss as demonstrated in lab.

“P” Reflexes

Pilomotor	Plantar/palmar grasp
Goose flesh due to skin cooling rapidly or after emotional reaction	Lightly stroke the palm
	Grasps at stimulus; Present at birth; Gone by about 6 months' of age

Perez Reflex



“R” Reflexes

Red Light Reflex

- Reflected red light on ophthalmological exam (photos, too).
- Generally indicates a lack of cataracts.

Rooting Reflex

- Stroke cheek.
- Mouth moves to stimulus.
- Present at birth.
- Gone by 4 months’ of age if awake when tested.
- Gone by 7 months’ of age if asleep when tested.

Triceps Reflex

- Percuss triceps insertion tendon.
- Causes forearm extension (sort of) while arm is held loosely in bent position.
- May percuss as shown, right.
- May percuss as shown in lab.

