NeuroAnatomy

Spinal Cord 1

SEPTEMBER 23RD, 2025

Objectives

At the end of this lecture, you will be able to:

- Describe the functional organization of the spinal cord
- Determine the location of neuronal groups in gray matter and tracts in white matter
- Know the definition of lower and upper motor neurons
- Be familiarized with signs and symptoms associated with the lower motor neuron syndrome

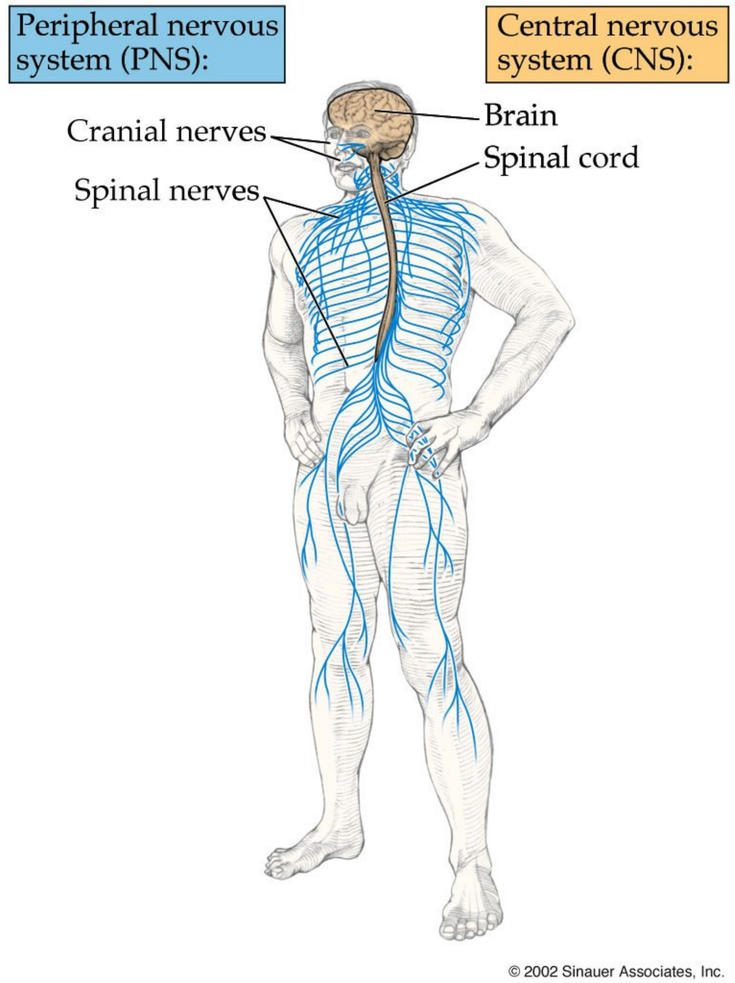
Overview

The spinal cord is a part of the central nervous system regulating **3 basic functions from the neck down**:

Motor: Long motor output pathways from the brain to muscles (and glands)

Sensory: From long input pathways from neck down (peripheral sensory organs for touch/pain and proprioception).

Integrative: Evokes numerous spinal reflexes

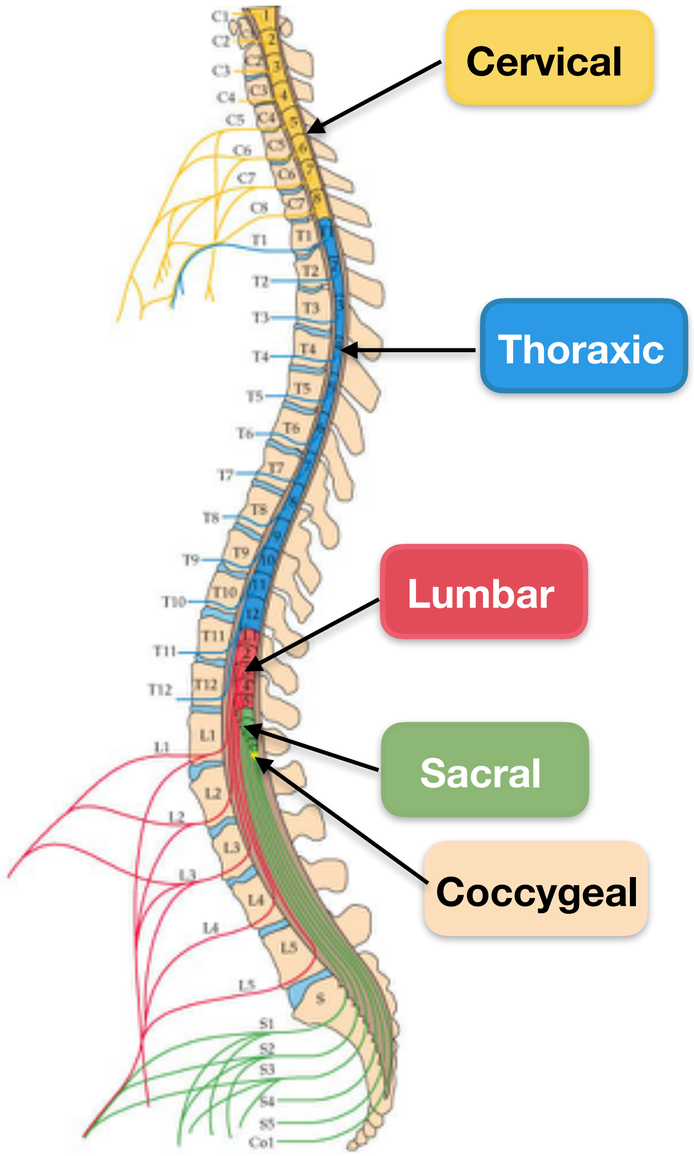


Spinal Cord Levels

- The spinal cord is a cylindrical structure found coursing through the **vertebral column**.

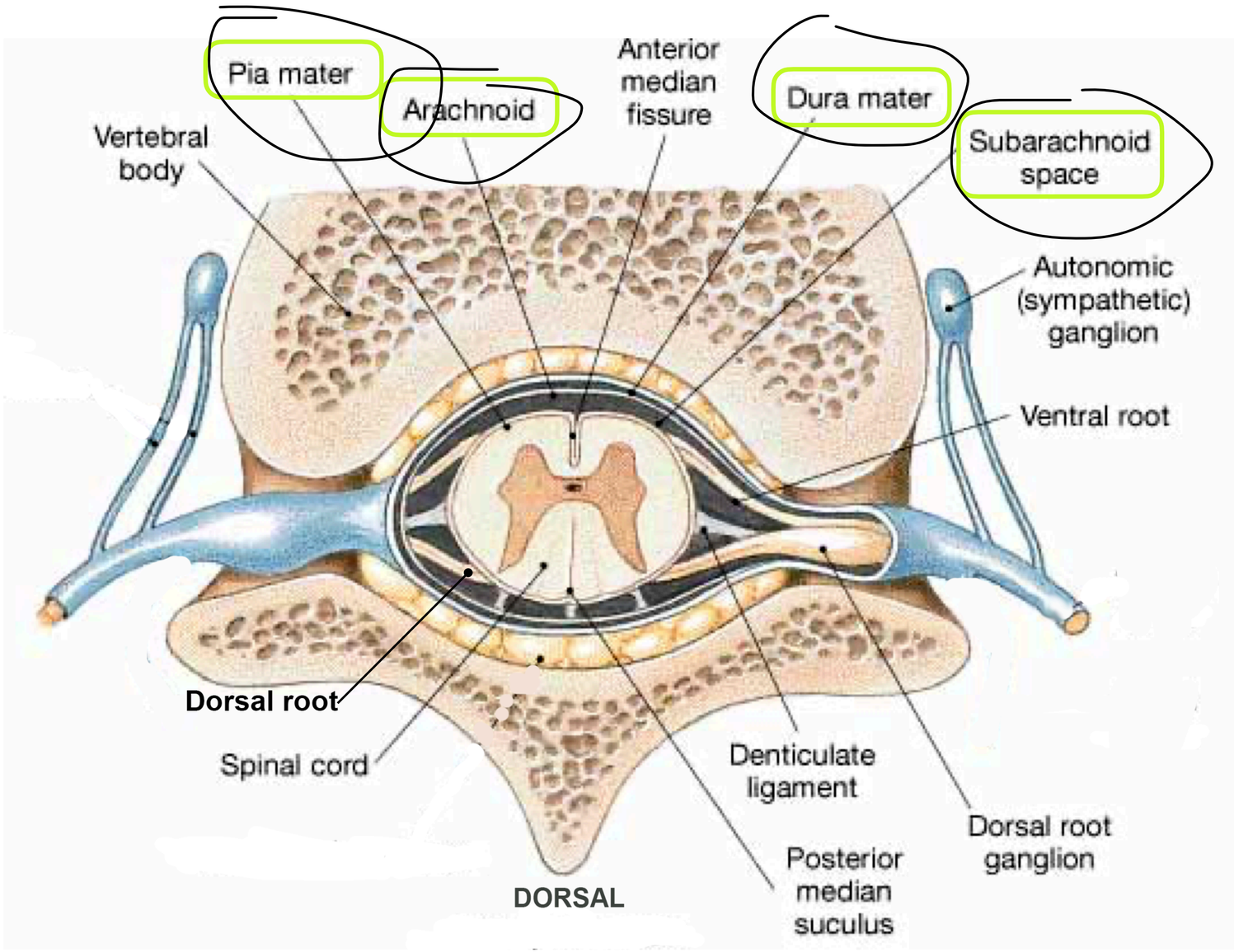
- There are **31 pairs of spinal cord segments** that are defined by the spinal nerves:

8 cervical
12 thoracic
5 lumbar
5 sacral
1 coccygeal



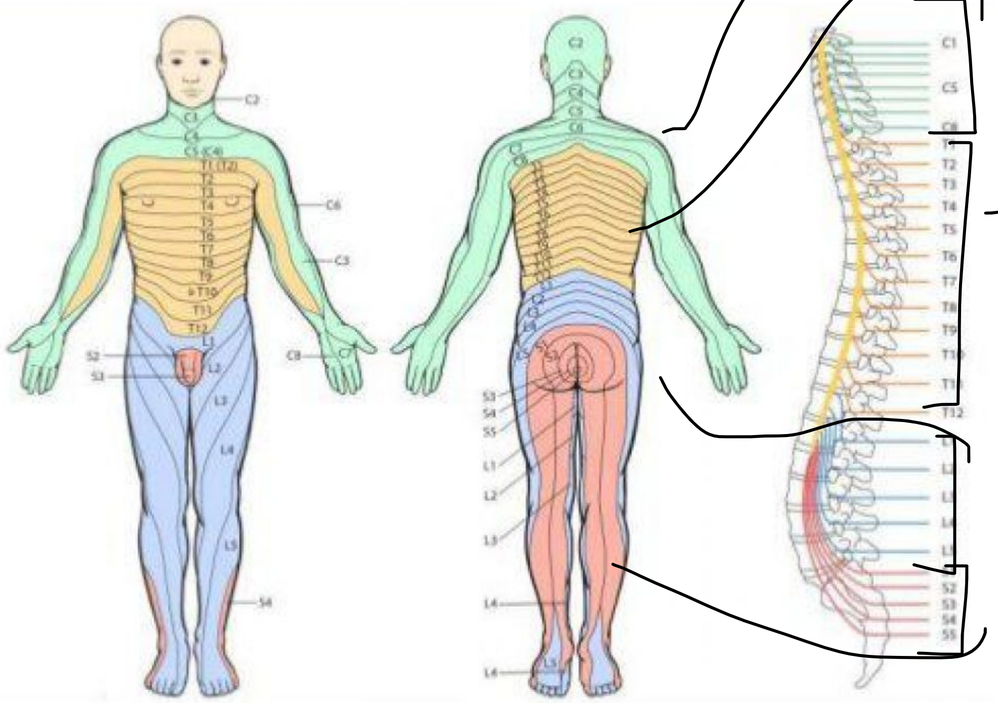
FROM ROSTRAL TO CAUDAL

SC Coverings



SIMILAR TO BRAIN

Somatotopy

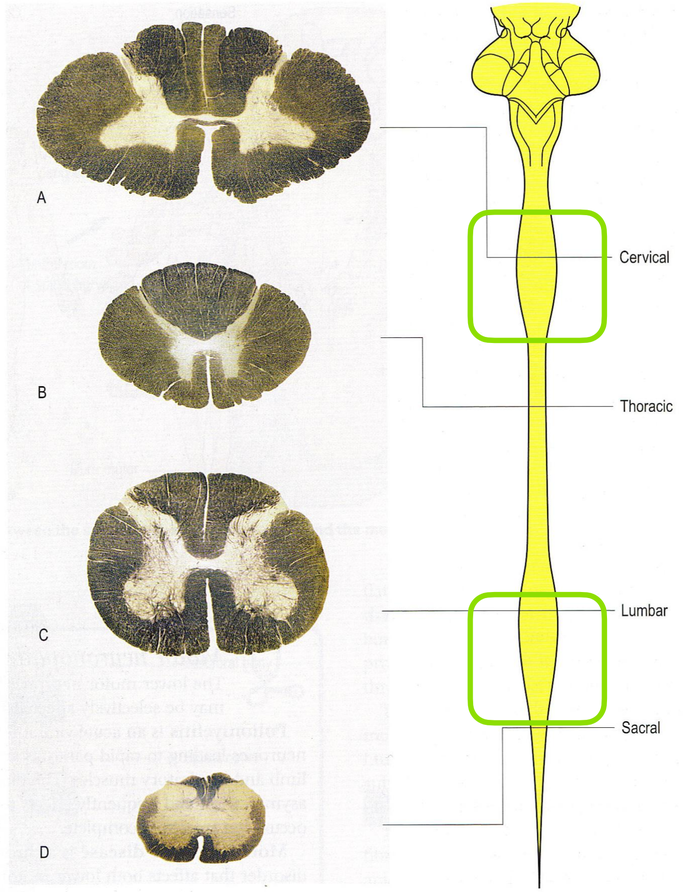


Sensory

Motor

Has similar somatotropic arrangement

Motor



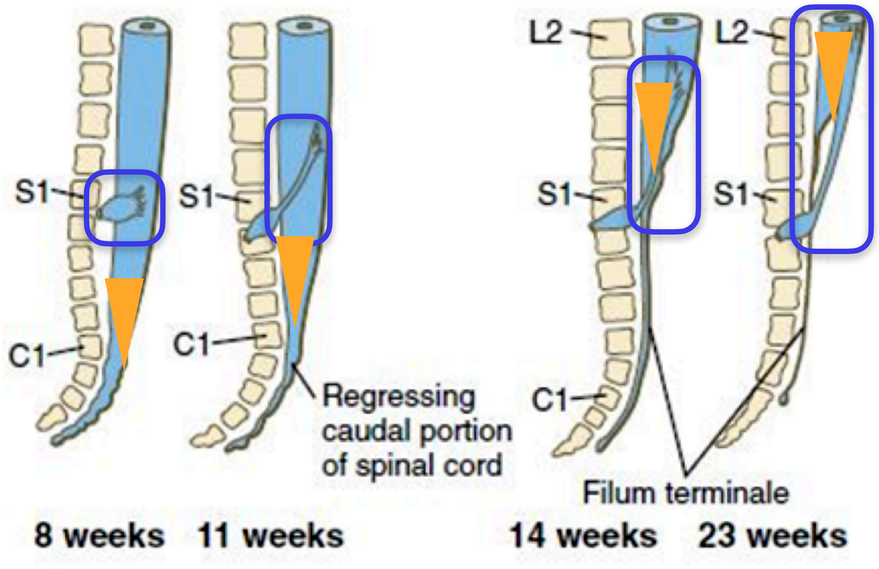
Two enlargements:

Cervical enlargement (C4-T1 segments) Increased amount of spinal nerves needed to innervate the arms

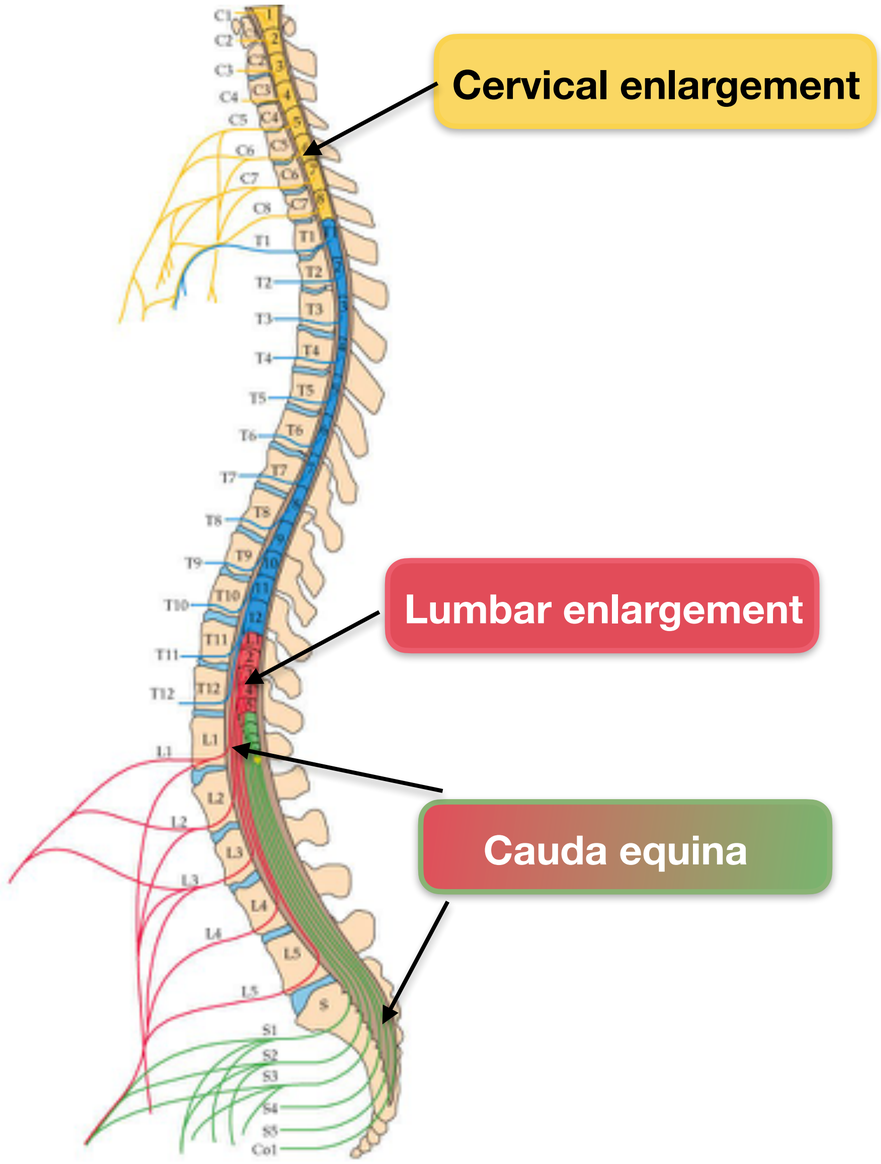
Lumbar enlargement (L1-S3 segments) Increased amount of spinal nerves needed to innervate the legs

Cauda Equina

- During development, the **bony vertebrae** continue to grow after the spinal cord has reached its full size.
- The spinal cord ends at vertebrae L1-L2 in adults (newborn at L3). The termination portion is called the **conus medullaris**.
- The bundles of spinal nerve roots below the conus medullaris are called: **cauda equina** (horse's tail).



Filum terminale: Anchors SC

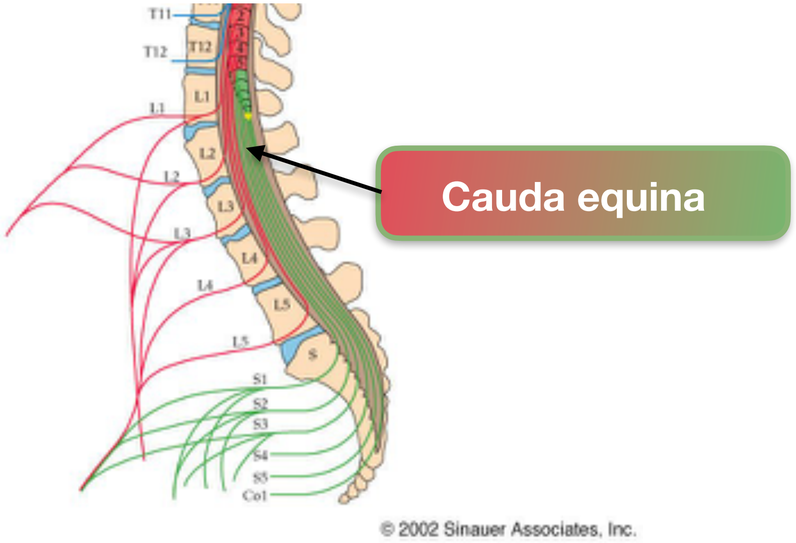


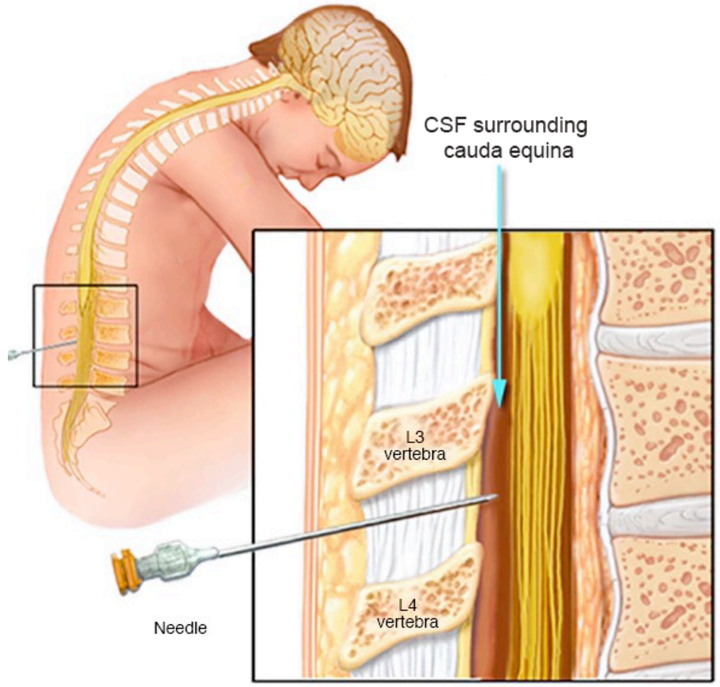
Spinal Tap

One of England’s loudest bands!

CIRCA 1979

Lumbar Puncture (Spinal Tap)



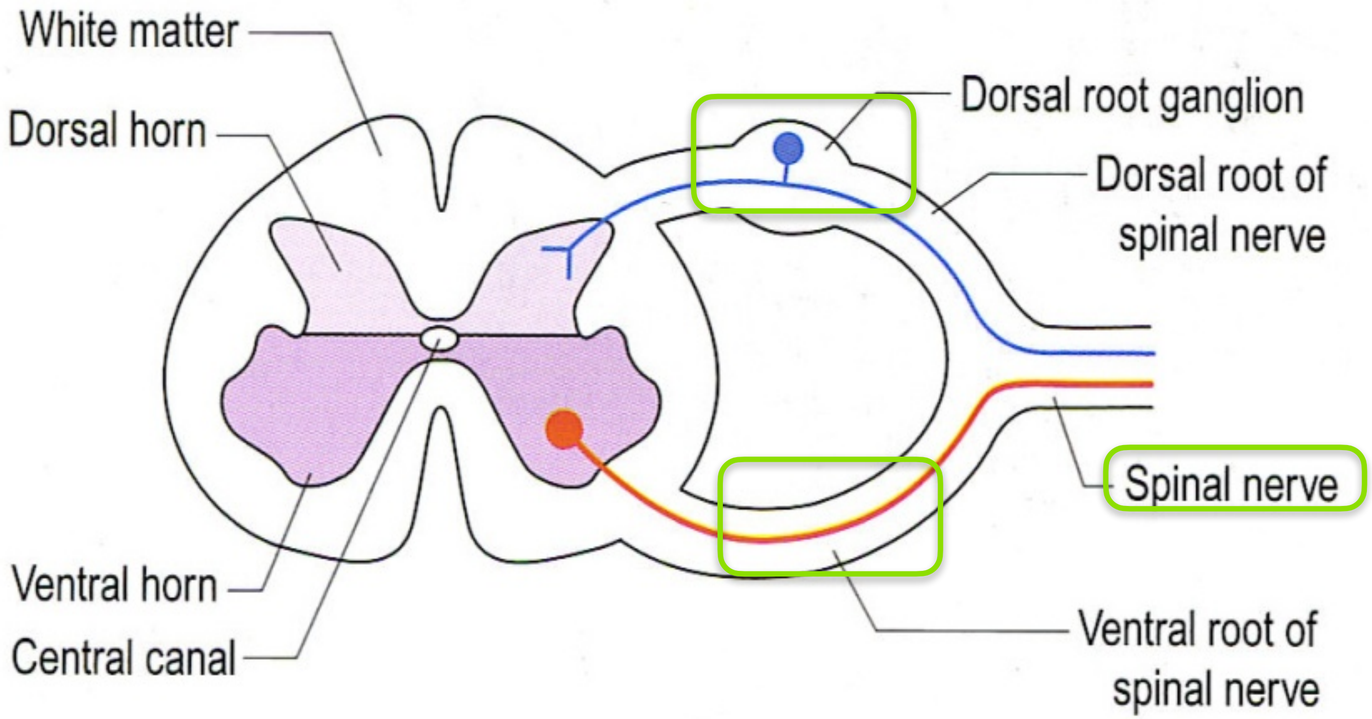


- A needle is inserted between two lumbar bones below the *conus medullaris* (L3/L4 adults, L4/L5 children) to remove a sample of CSF from the subarachnoid space.
- A lumbar puncture can help diagnose serious infections, such as meningitis, MS, cancers of the brain or spinal cord or subarachnoid hemorrhages.
- Sometimes a lumbar puncture is used to inject anesthetic medications or chemotherapy drugs into the cerebrospinal fluid.

Sensory and Motor

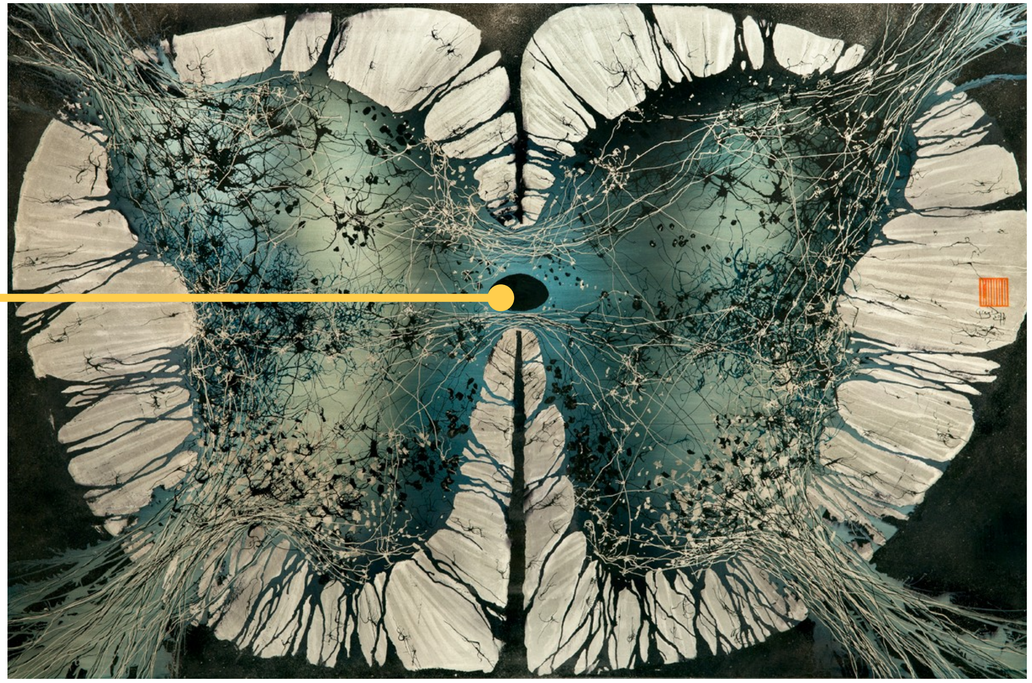
The spinal cord and its spinal nerves:

- Sensory afferent input (dorsal)
- Motor efferent output (ventral)



Internal Structure

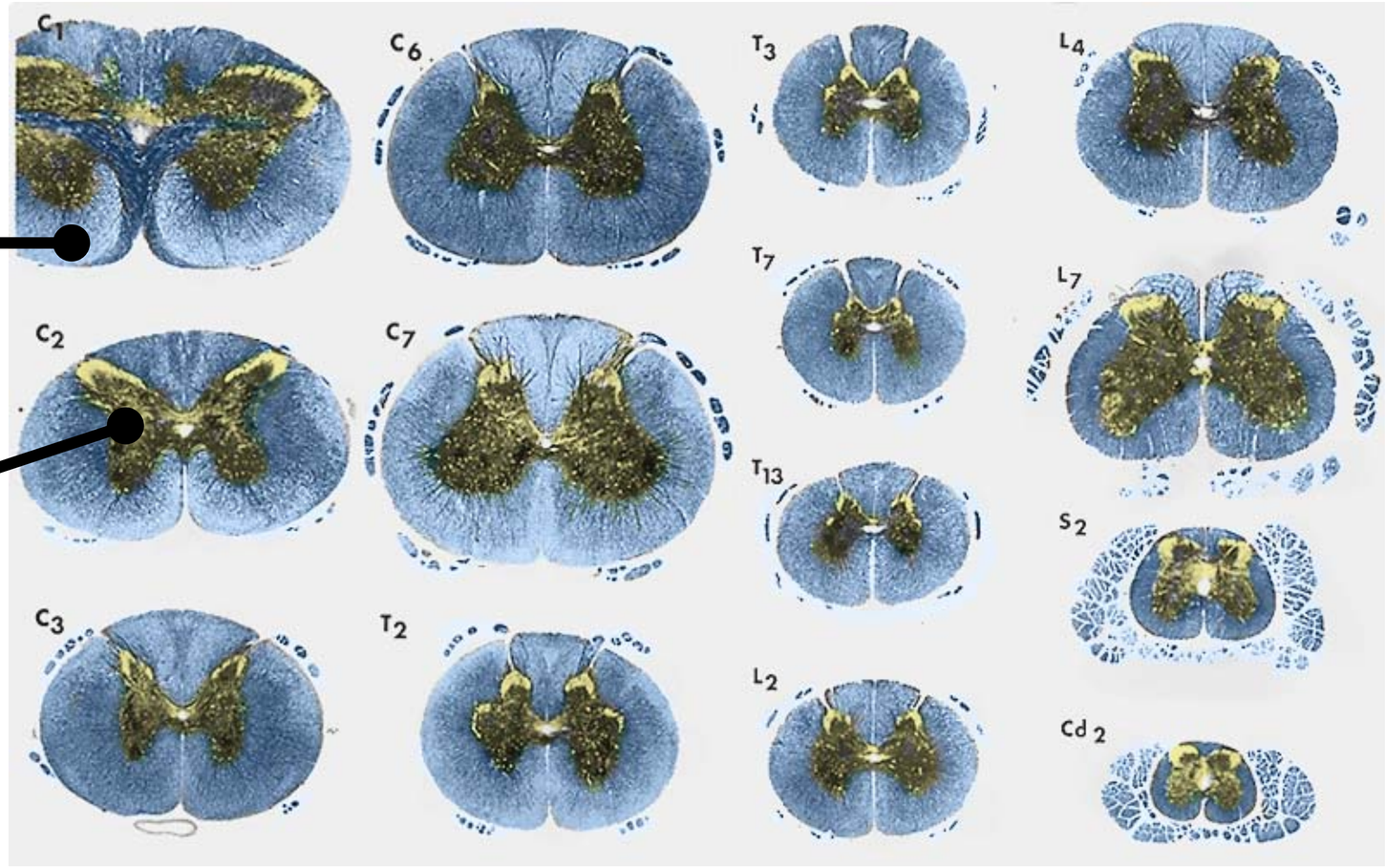
Central Canal



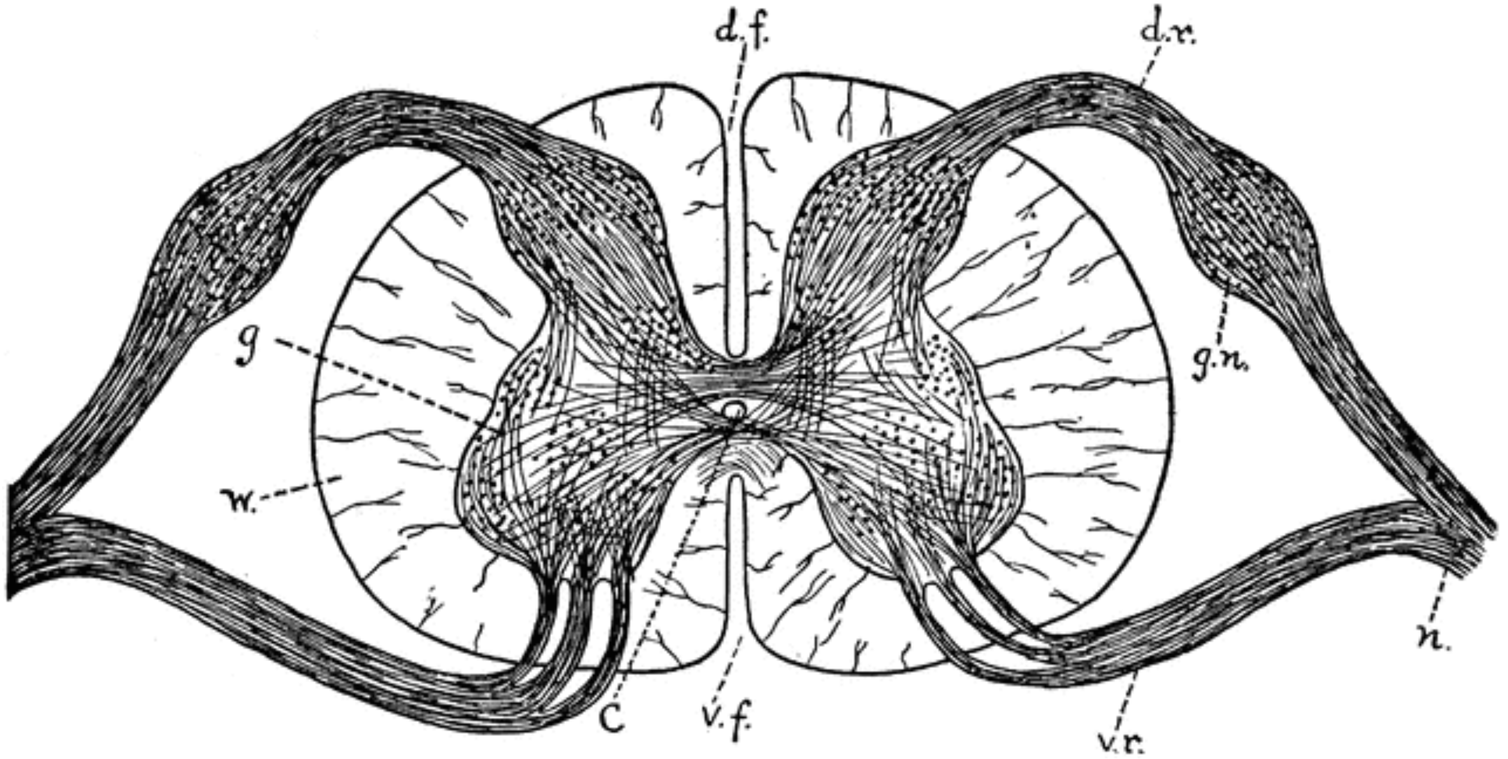
White matter-Gray matter

White matter (fiber tracts) are on the outside

Gray matter (neuron cell bodies) are on the inside

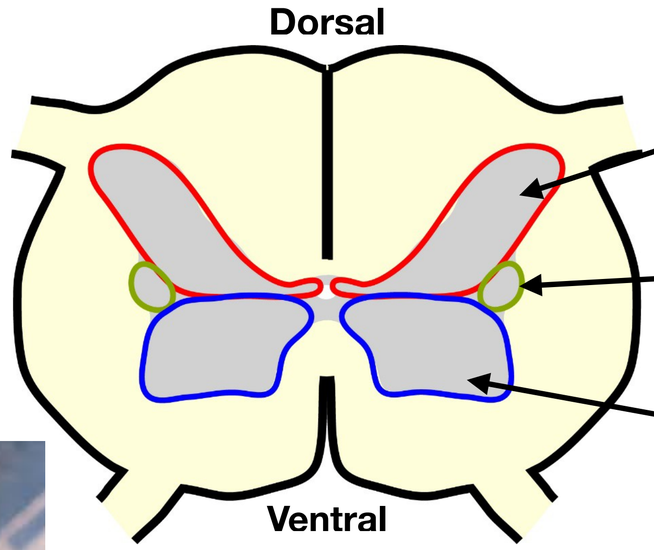


Sensory-Motor Integration



GALLOWAY CIRCA 1915

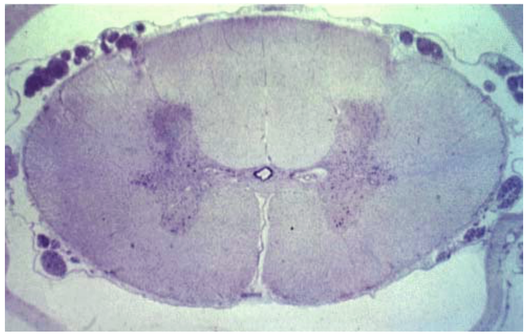
Gray matter: Gross Morphology

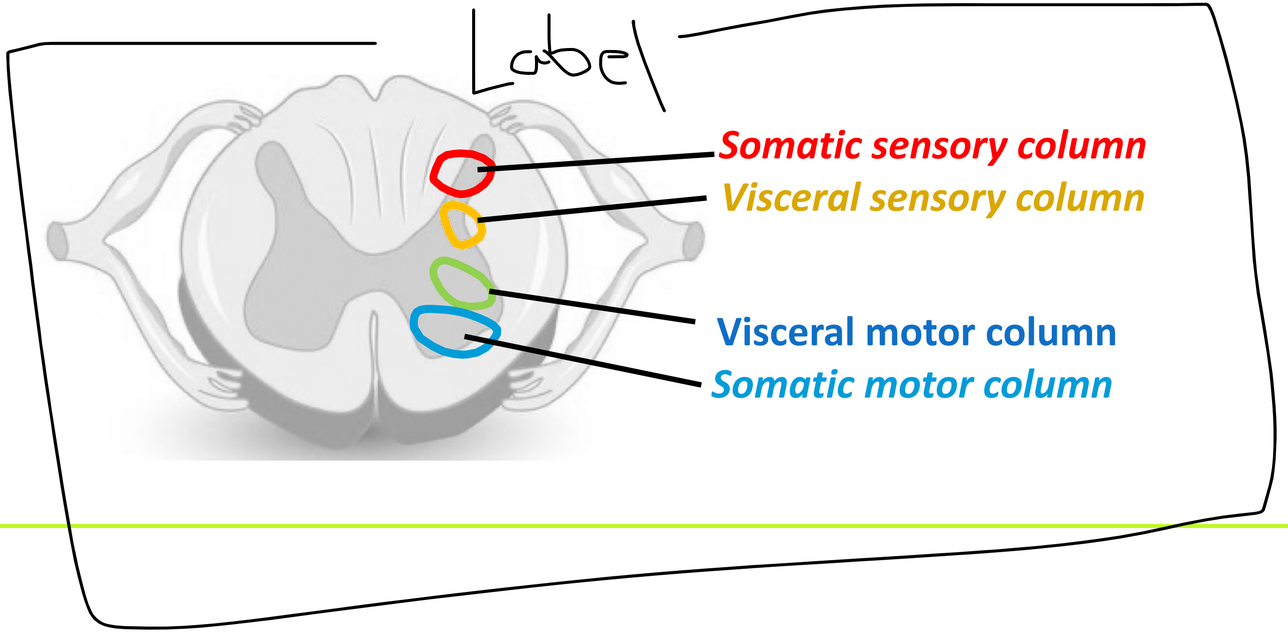


Dorsal horn: contains neuronal cell bodies involved in somatosensory processing

Lateral horn: only present in **T1-L2** spinal cord. Contains output neurons to autonomic system controlling sympathetic visceral function

Ventral horn: contains neurons involved in somatic motor function





Sensory Inputs

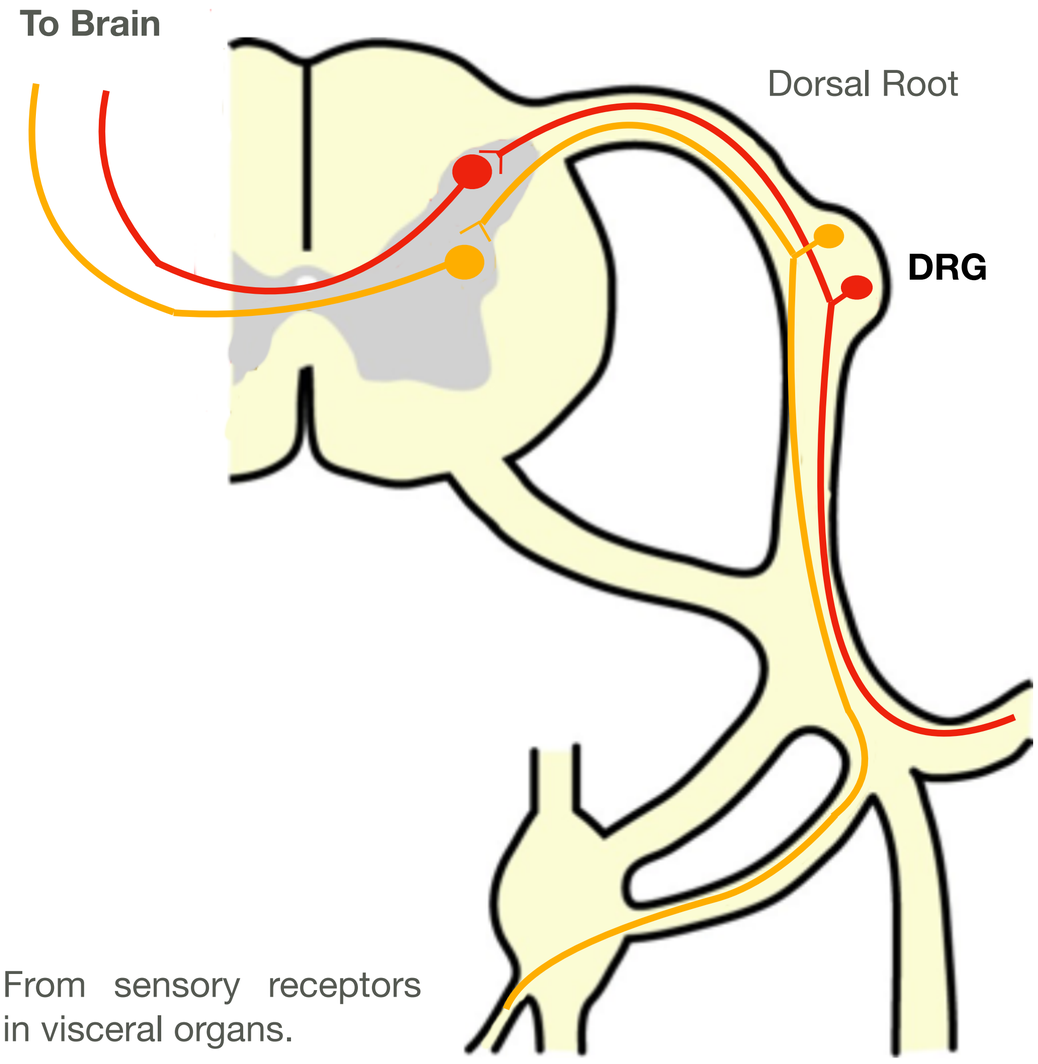
1. Somatic afferents: Convey sensory input from skin, muscle, and joints

2. Visceral afferents: Convey sensory input from visceral organs

The cell bodies of sensory afferents are located in the **dorsal root ganglion (DRG)**

The afferents enter the spinal cord to the **dorsal horns**

These sensory axons either synapse *onto* neurons in the **dorsal horn,** or *ascend* directly to the brainstem.



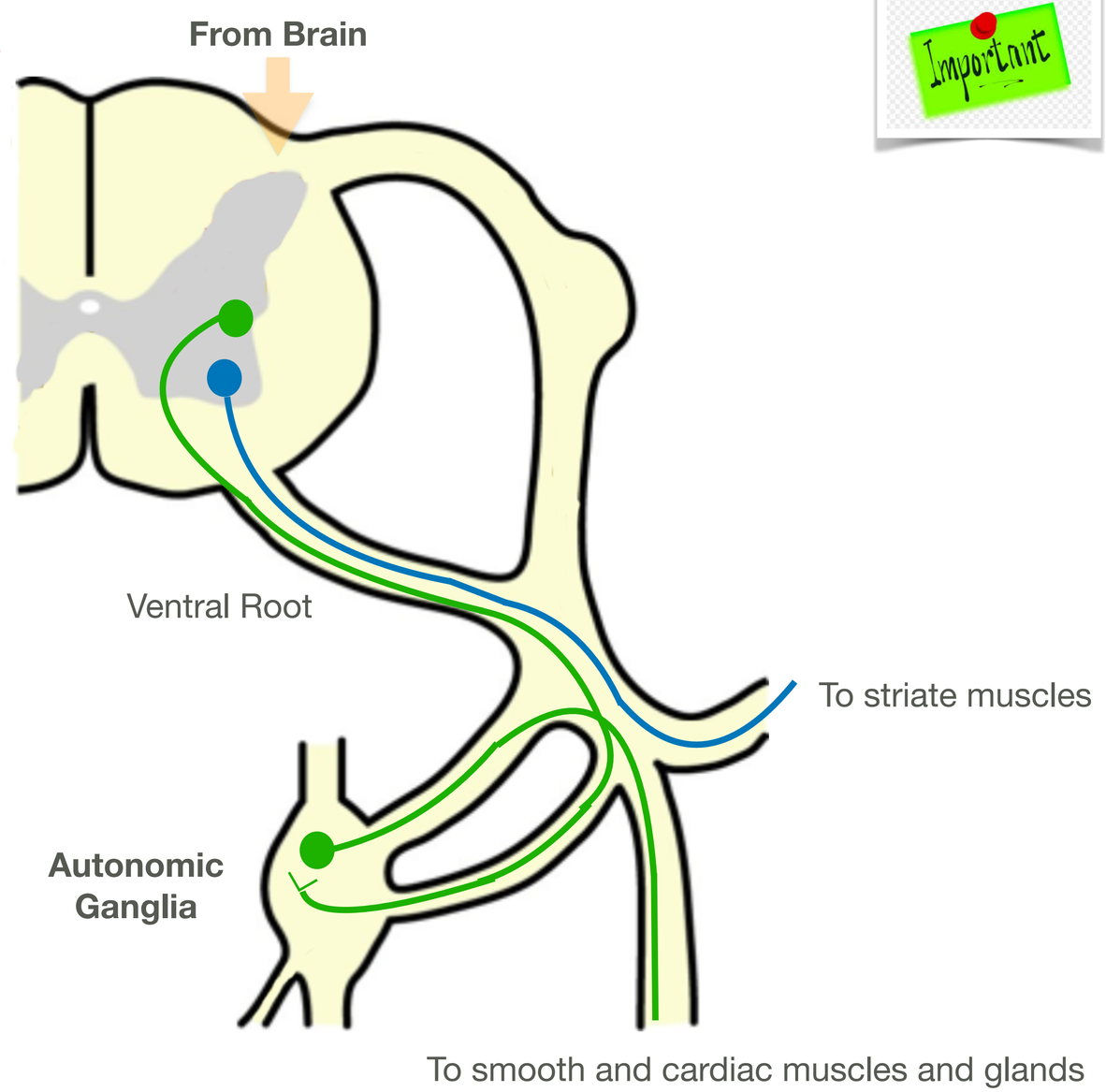
Motor Output

3. Somatic efferents: Convey motor output to **skeletal muscles**

4. Visceral efferents: Conveys motor output to **sympathetic/ parasympathetic ganglia** that will then control **glands and smooth/cardiac muscles**

These efferents are axons of motor neurons in the ventral and lateral horns

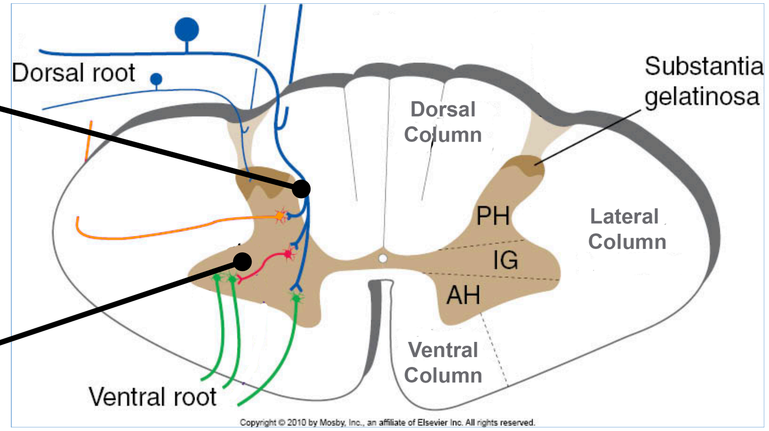
They emerge from the spinal cord in the **ventral root**

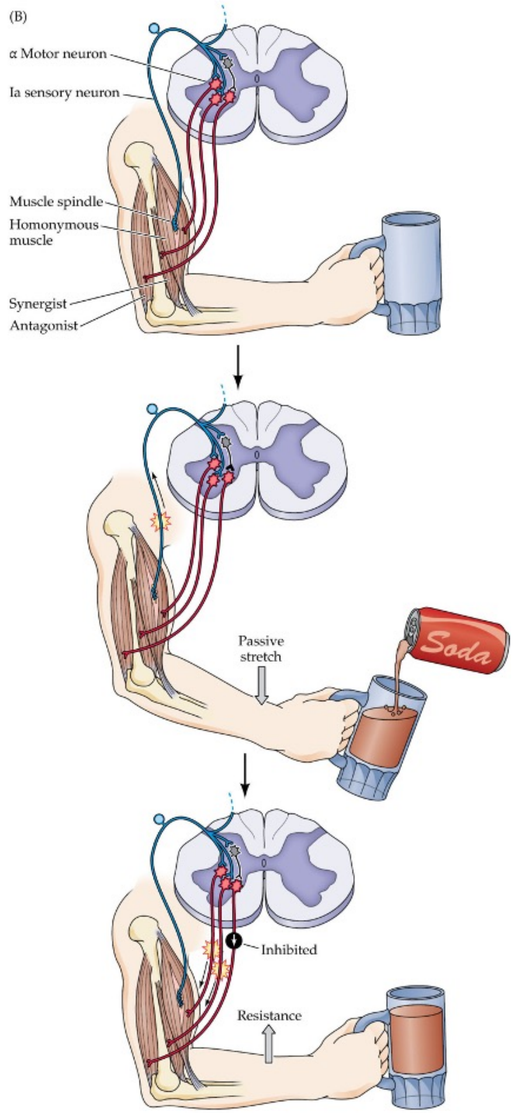


Stretch Reflex

Excitatory synapse
(*flexor muscles*)

Inhibitory synapse
(*extensor muscles*)





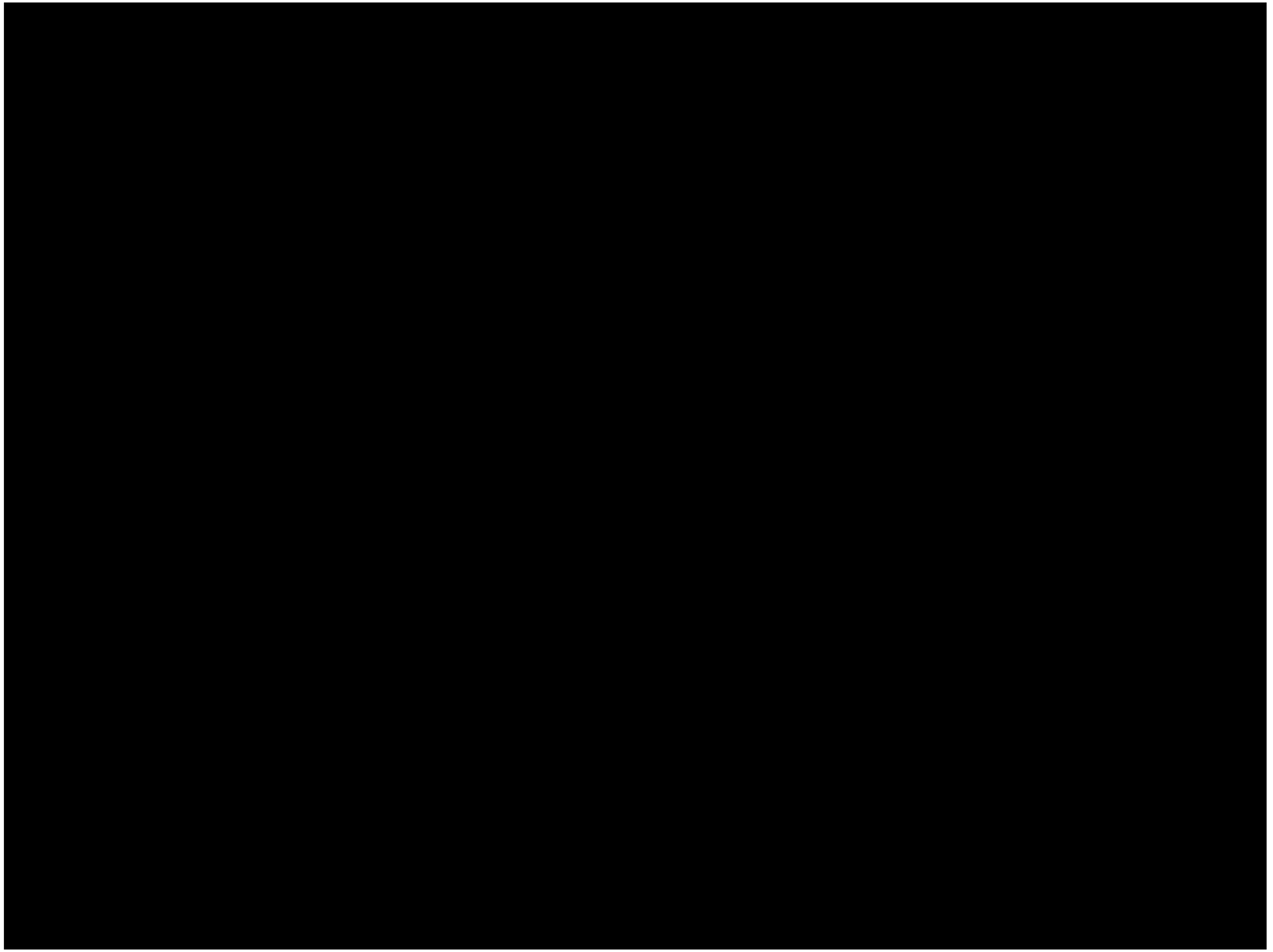
- Sensory afferent - Motor neuron = excitation (agonist)
- Sensory afferent - interneuron - motor neuron = inhibition (antagonist)

- **Stretch reflexes responsible for muscle tone (tension)**

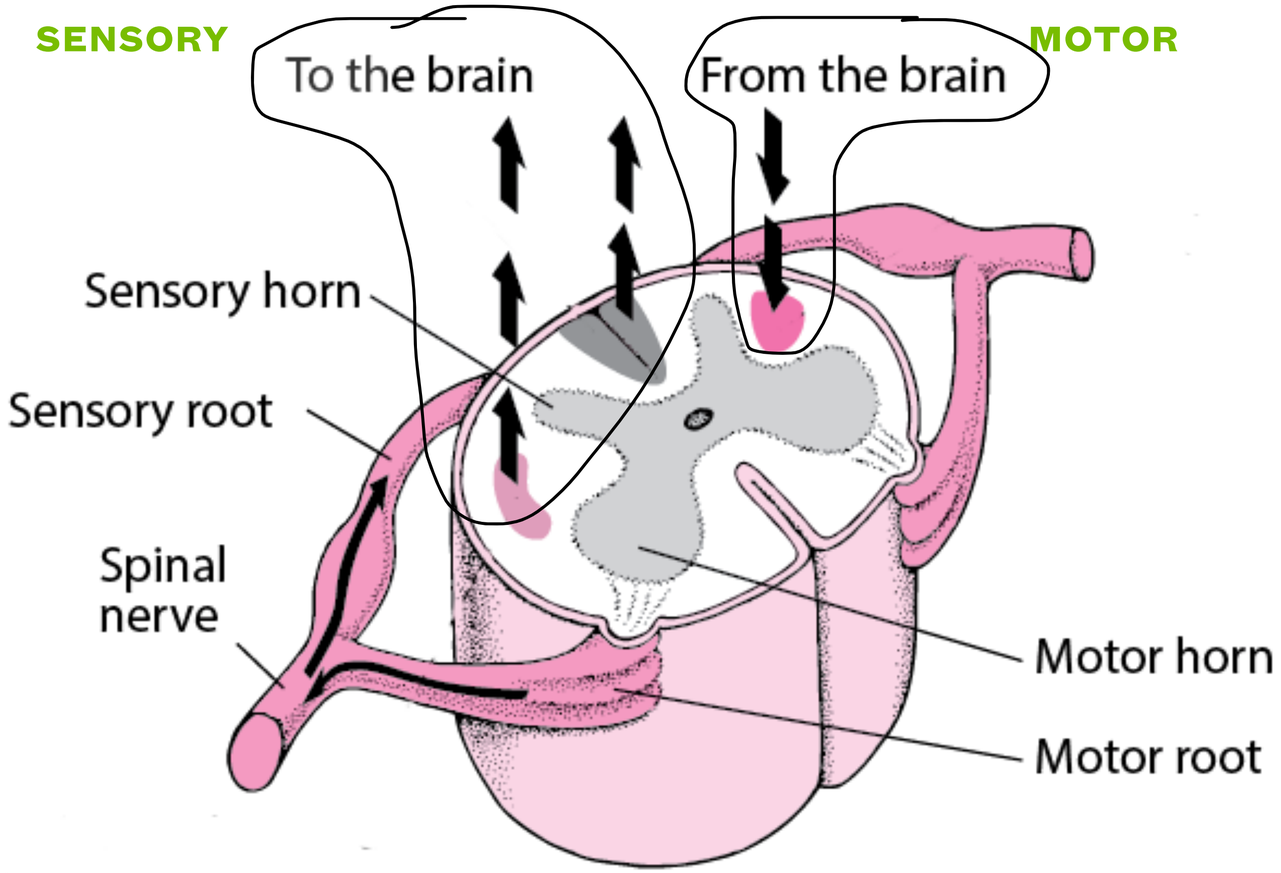
HELPS REGULATE MUSCLE TONE

Reflexes:

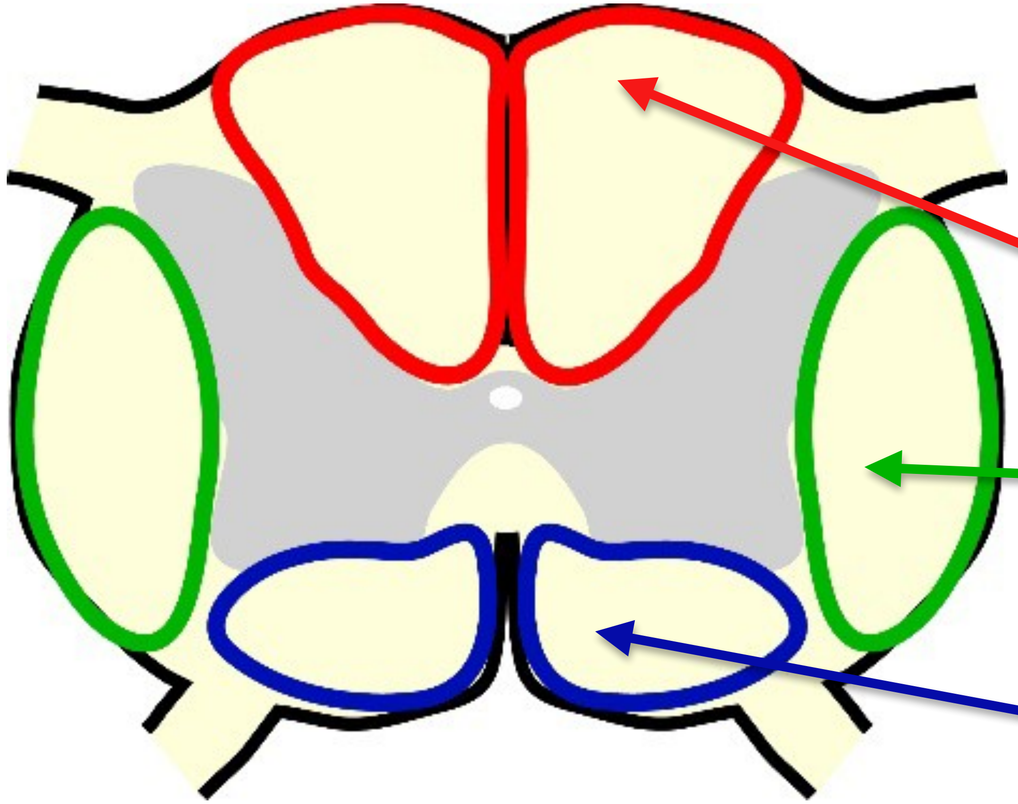
What are they good for?



White Matter Tracts



Basic Organization



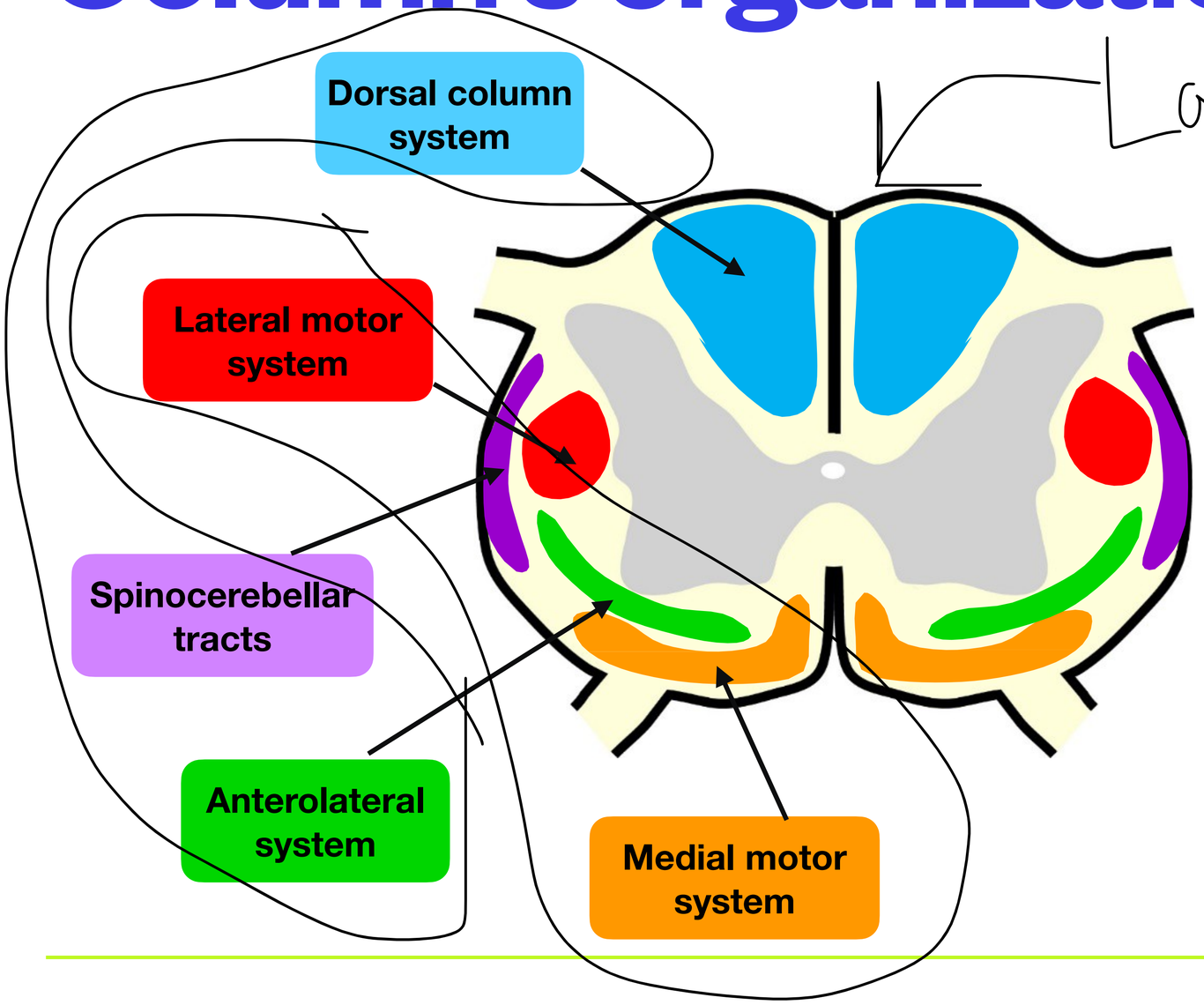
White matter tracts are organized within 3 columns:

Dorsal (posterior) column

Lateral column

Ventral (anterior) column

Column's organization



The white matter columns roughly correspond to functional divisions of ascending and descending tracts

Motor tracts
(descending pathways)

- Lateral motor system
- Medial motor system

Sensory tracts
(ascending pathways)

- Dorsal column system
- Anterolateral system
- Spinocerebellar tracts

Thanks for your Attention