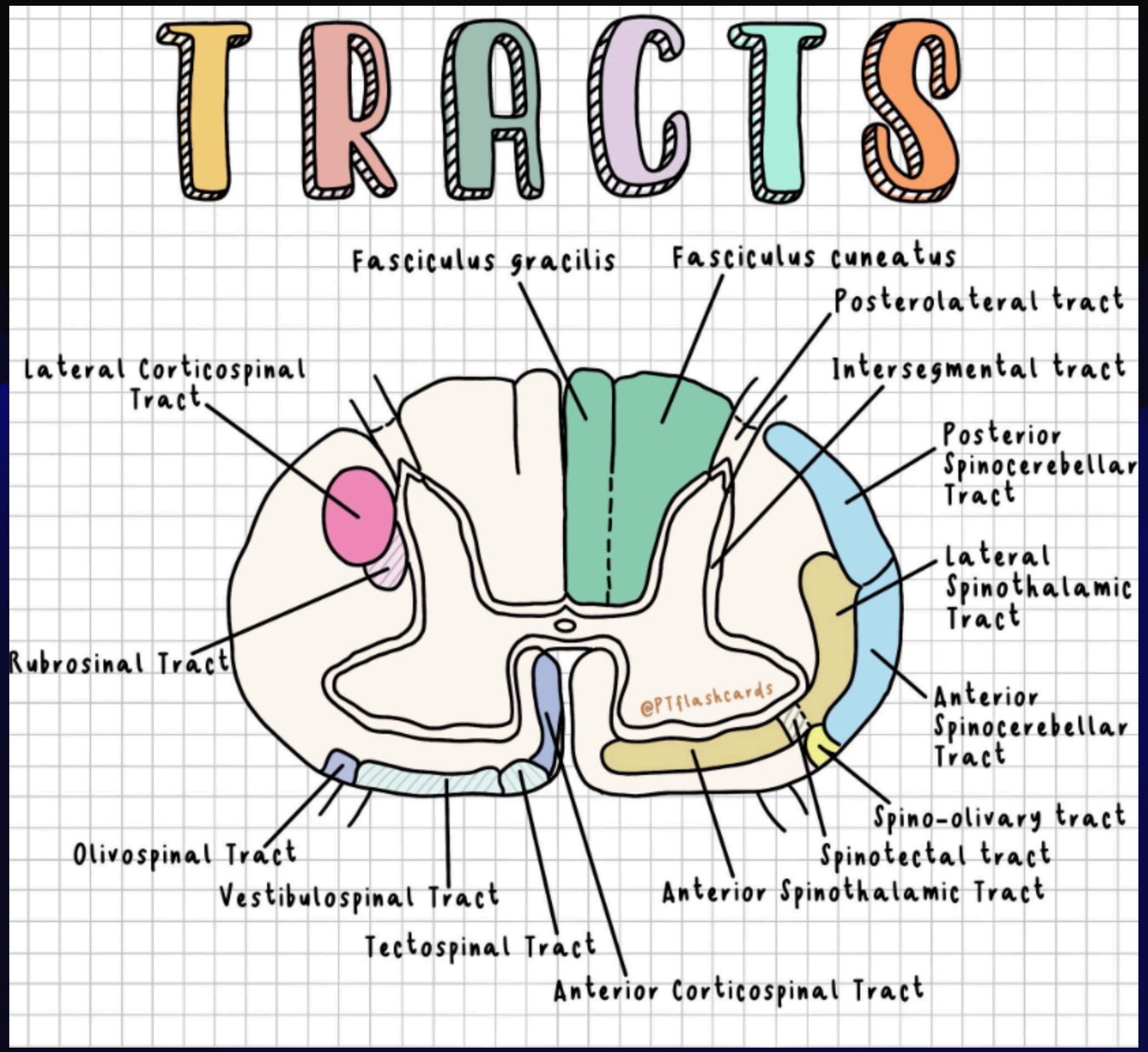
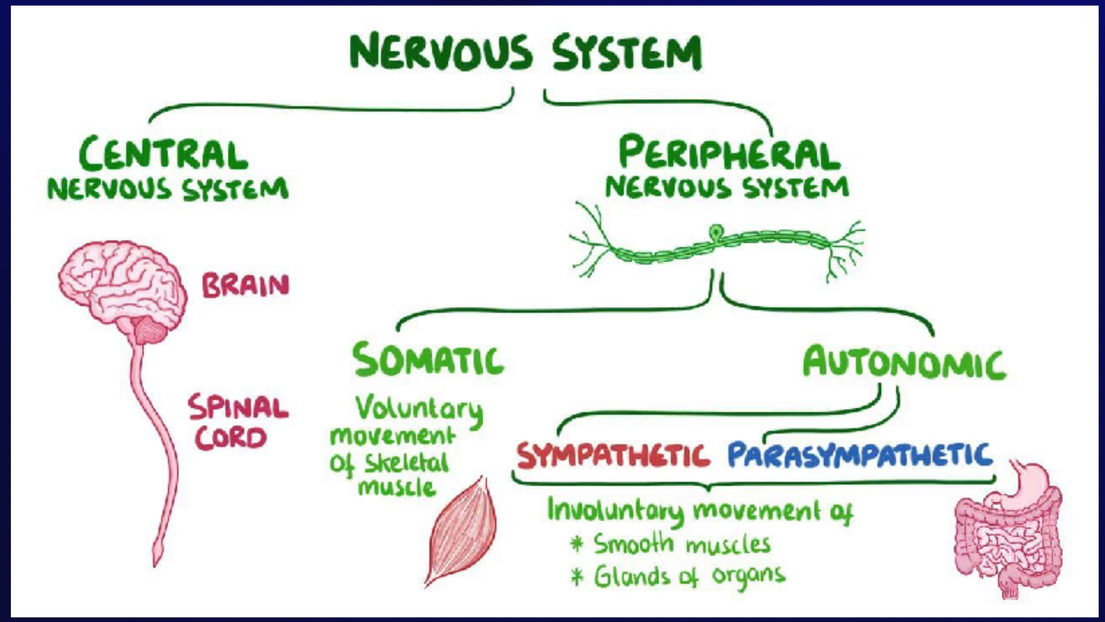
Neuro Tracts



PNS

- The peripheral nervous system (PNS) is everything outside of the CNS (the brain, brainstem and spinal cord)
- It includes 12 cranial nerves, and the paired spinal nerves
- The PNS is divided into afferent (sensory) and efferent (motor) nervous system
  - The efferent nervous system is divided into somatic and autonomic nervous system
  - The autonomic nervous system is divided into sympathetic and parasympathetic nervous system



Somatic vs Autonomic Nervous System

The somatic nervous system

- Associated with voluntary body movement
- Consists of nerve fibres that control voluntary actions and convey sensory information input from
  - The skin, skeletal muscle and joints

- There are 5 spinal plexuses -
  - Cervical (CI-C4), brachial (C5-TI), lumbar (LI-L4), sacral and coccygeal (L4-S4)

The autonomic nervous system

- Controls all the involuntary processes of the body
  - Eg heart rate, digestion and breathing
  - Consists of sympathetic and parasympathetic nervous system
-

Somatic vs Autonomic Nervous System

SYMPATHETIC & PARASYMPATHETIC NERVOUS SYSTEMS OVERVIEW

	NEURONS	FIBER LENGTH	NEURO-TRANSMITTERS	RECEPTORS
SYMPATHETIC NERVOUS SYSTEM	Preganglionic	Short	ACh	Muscarinic
	Postganglionic	Long	Norepinephrine, ATP, neuropeptide Y	Adrenergic (α_1, α_2, β_1, β_2)
PARASYMPATHETIC NERVOUS SYSTEM	Preganglionic	Long	ACh	Nicotinic (N_n, N_m)
	Postganglionic	Short	ACh	Muscarinic (M_1, M_2, M_3, M_4, M_5)

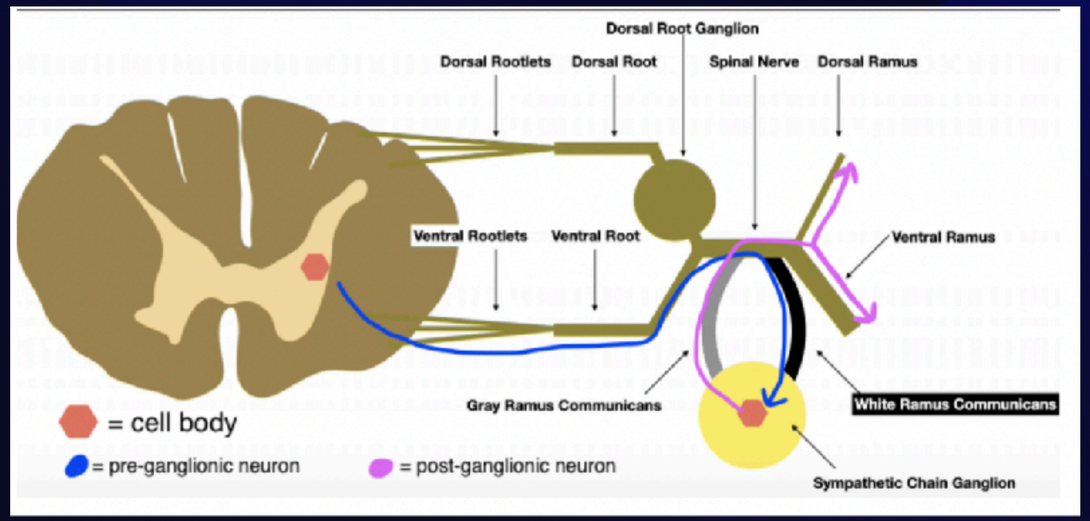
- Sympathetic -> short pre and long post
- Parasympathetic -> long pre and short post

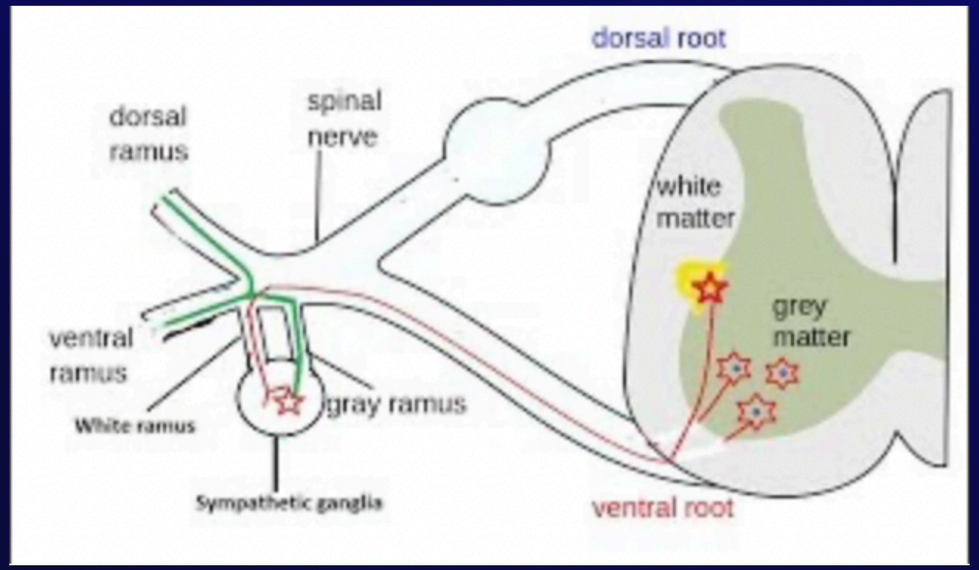
Ganglia and Rami

Rami communicans

- A communicating branch that connects 2 other nerves
- Grey rami communicans
  - unmyelinated , post ganglionic nerve fibres
- White rami communicans
  - Myelinated , pre ganglionic nerve fibres

Pre ganglionic fibres enter the sympathetic ganglia through white rami communicans! Post ganglionic fibres enter the sympathetic ganglia via grey rami communicans!





There are FOUR (4) Neuro Tracts we need to known by the end of this ppt

(3 somatosensory + 1 motor)

The somatosensory system

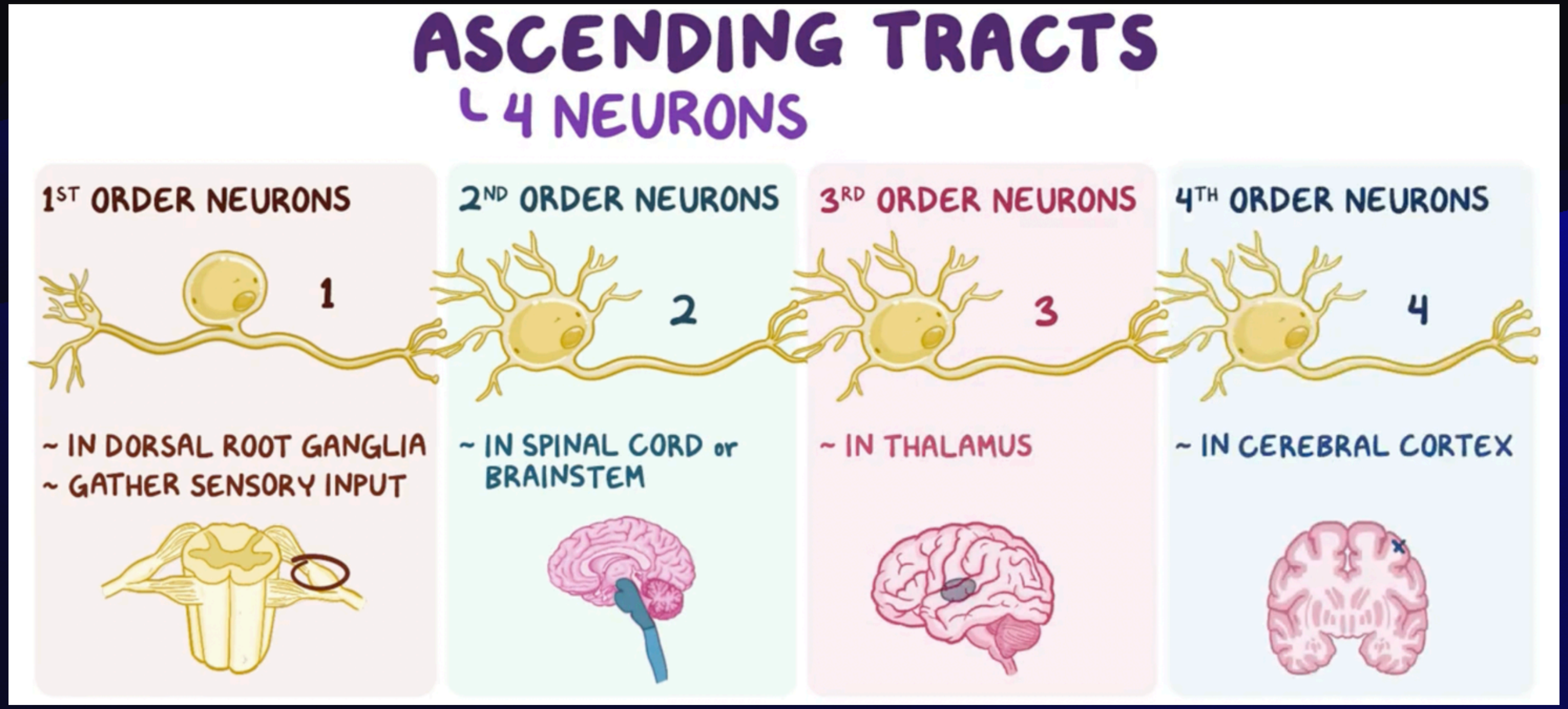
- A sensory network in the body used for proprioception, touch perception, temperature, and pain
- Proprioception -
  - Lets you know where different parts of ur body are
- The somatosensory cortex is located in the POST CENTRAL GYRUS
- There are many receptors that are involved in the somatosensory system ...
  - Stretch receptors - in muscle and golgi tendon apparatus
  - Visceral stretch receptors - in heart, carotid, lungs and gut

Examples of some receptors -

- Free nerve endings - pain/temp/chemical
- Meissner corpuscles - touch (short term)
- Merkel discs - touch (sustained)
- Pacinian corpuscles - pressure
- Nociceptors - pain
- Root hair plexus - touch (hair movement)
- Ruffini endings - deep skin receptors

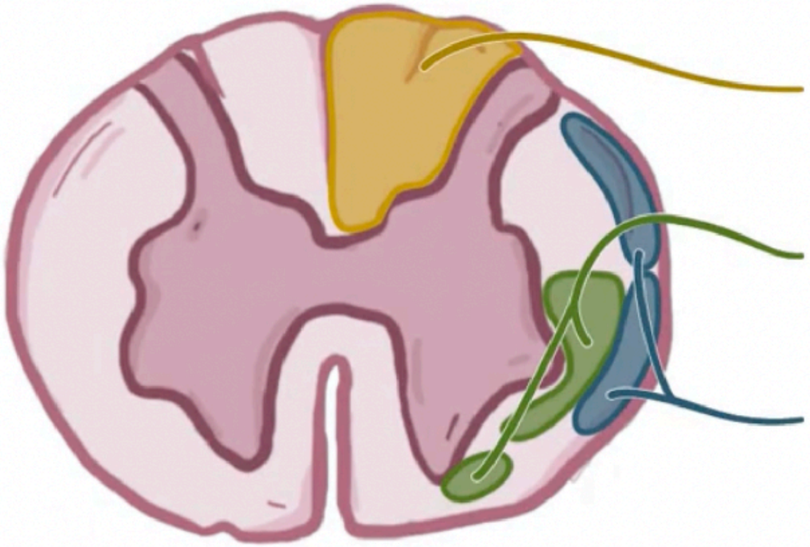
There are THREE (3) tracts which are part of the somatosensory system

Before we start firm this table:



ASCENDING TRACTS

* SENSORY PATHWAYS
* SPINAL CORD → CEREBRAL CORTEX
* THREE TYPES:



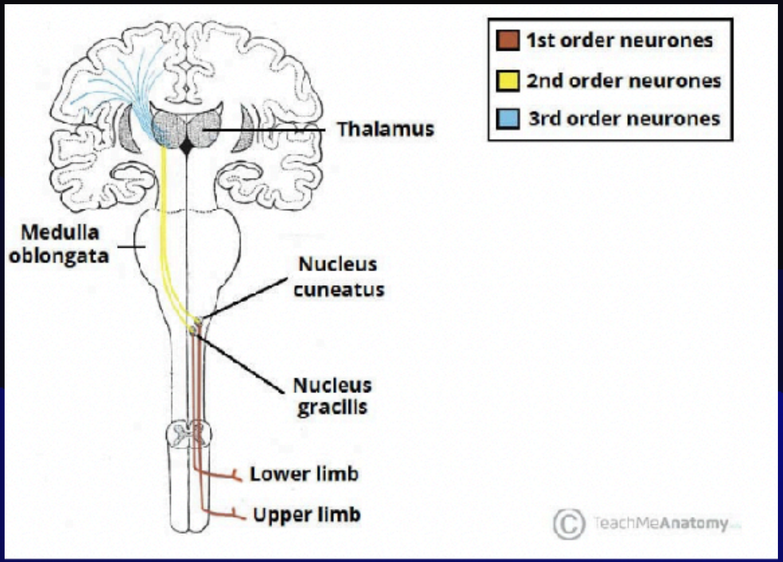
DORSAL COLUMN–MEDIAL LEMNISCUS SYSTEM

SPINOTHALAMIC (ANTEROLATERAL) SYSTEM

SPINOCEREBELLAR SYSTEM

Dorsal Column Medial Lemniscus

- Function: proprioception , two point touch, fine touch and vibration
- Up or down: Ascending
- Where and to: From receptors to the primary somatosensory
- cortex in the post-central gyrus
- Think or no: Conscious (yes)

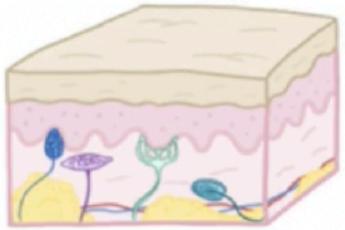


1. Ist order neurones (in different areas of the body) collect in the DRG and then enter the spinal cord. Either into the fasciculus cuneatus (ABOVE T6) or fasciculus gracilis (BELOW T6).
2. These impulses travel up the spinal cord and reach the medulla where they join onto 2nd order neurones (Medial Lemniscus part of the pathway)
3. In the medulla, these neurones DECUSSATE (switch side)
4. From the medulla, they head to the ventral posterolateral nucleus of the thalamus, then head to the primary somatosensory cortex in post-central gyrus

DORSAL COLUMN-MEDIAL LEMNISCUS SYSTEM

* VIBRATION, PROPRIOCEPTION, TWO-POINT DISCRIMINATION, TOUCH

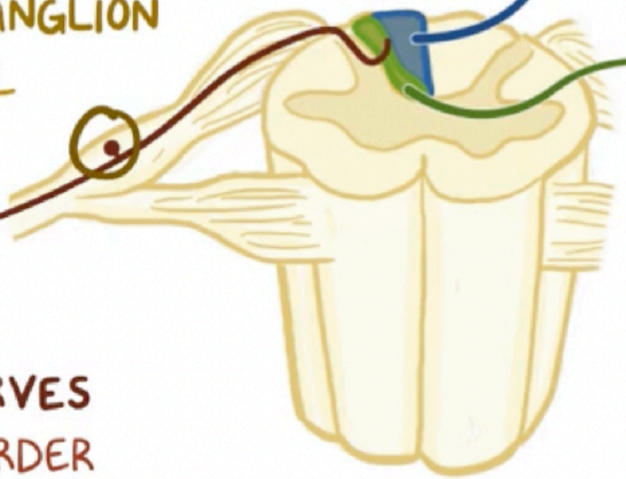
MECHANORECEPTORS



DORSAL ROOT GANGLION
- 1ST ORDER CELL BODIES

PROPRIOCEPTORS

PERIPHERAL NERVES
- AXONS of 1ST ORDER NEURONS



DORSAL COLUMN

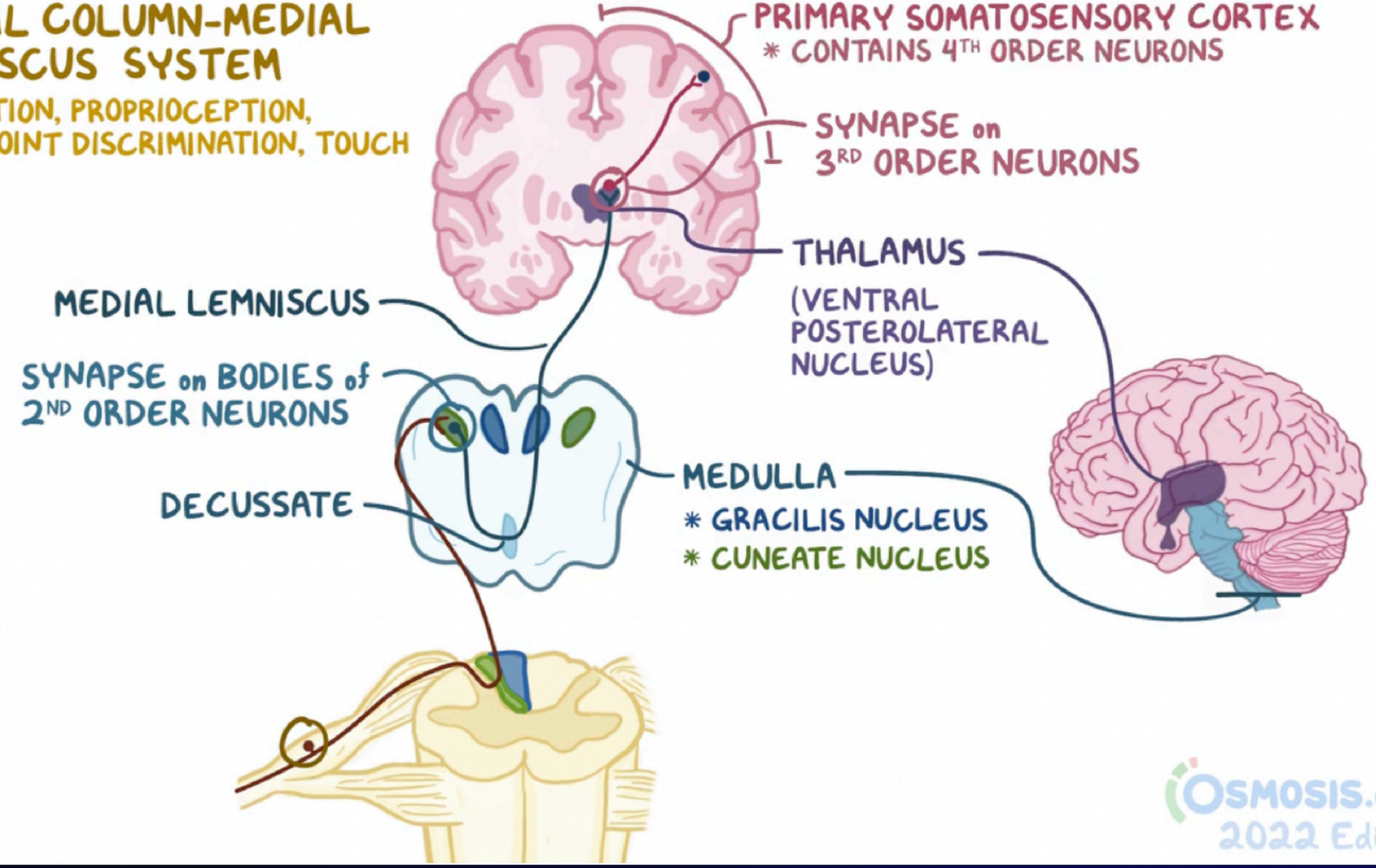
GRACILIS FASCICLE
* SENSATION from LOWER BODY

CUNEATE FASCICLE
* SENSATION from UPPER BODY

TOPOGRAPHIC ORGANIZATION

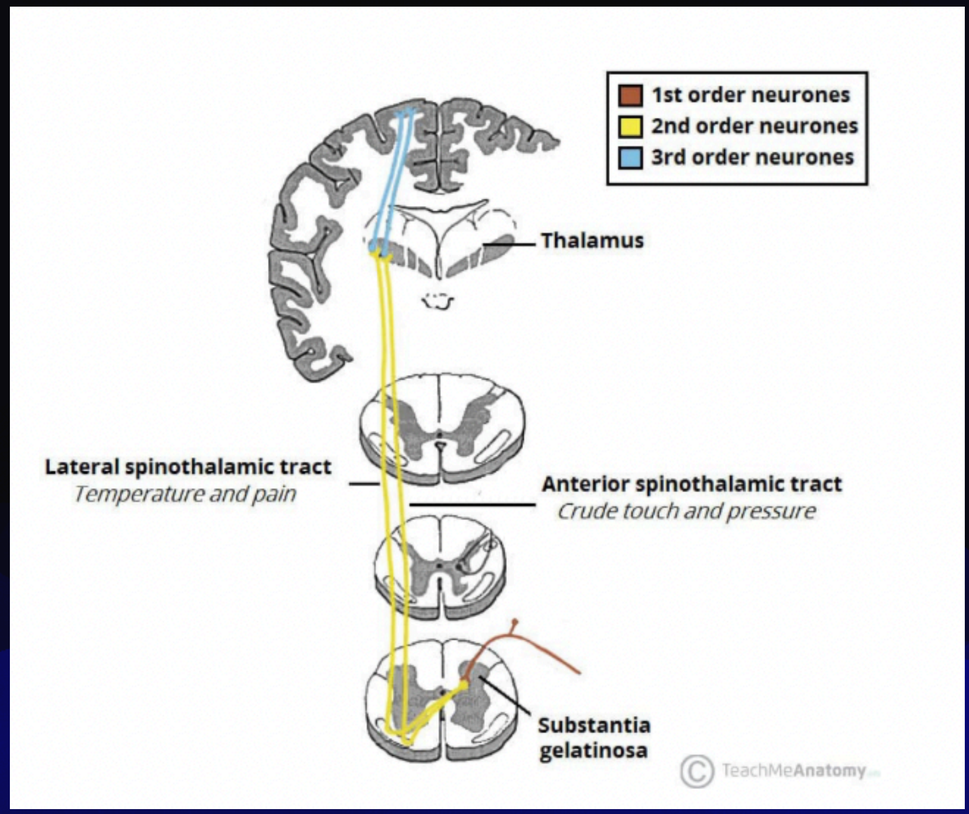
DORSAL COLUMN-MEDIAL LEMNISCUS SYSTEM

* VIBRATION, PROPRIOCEPTION, TWO-POINT DISCRIMINATION, TOUCH



Spinothalamic

- Function: Pain, temperature, crude touch and pressure
- Up or down: Ascending
- Where and to: From receptors in skin to the thalamus,
- ending in the primary somatosensory cortex
- Think or no: Conscious (yes)

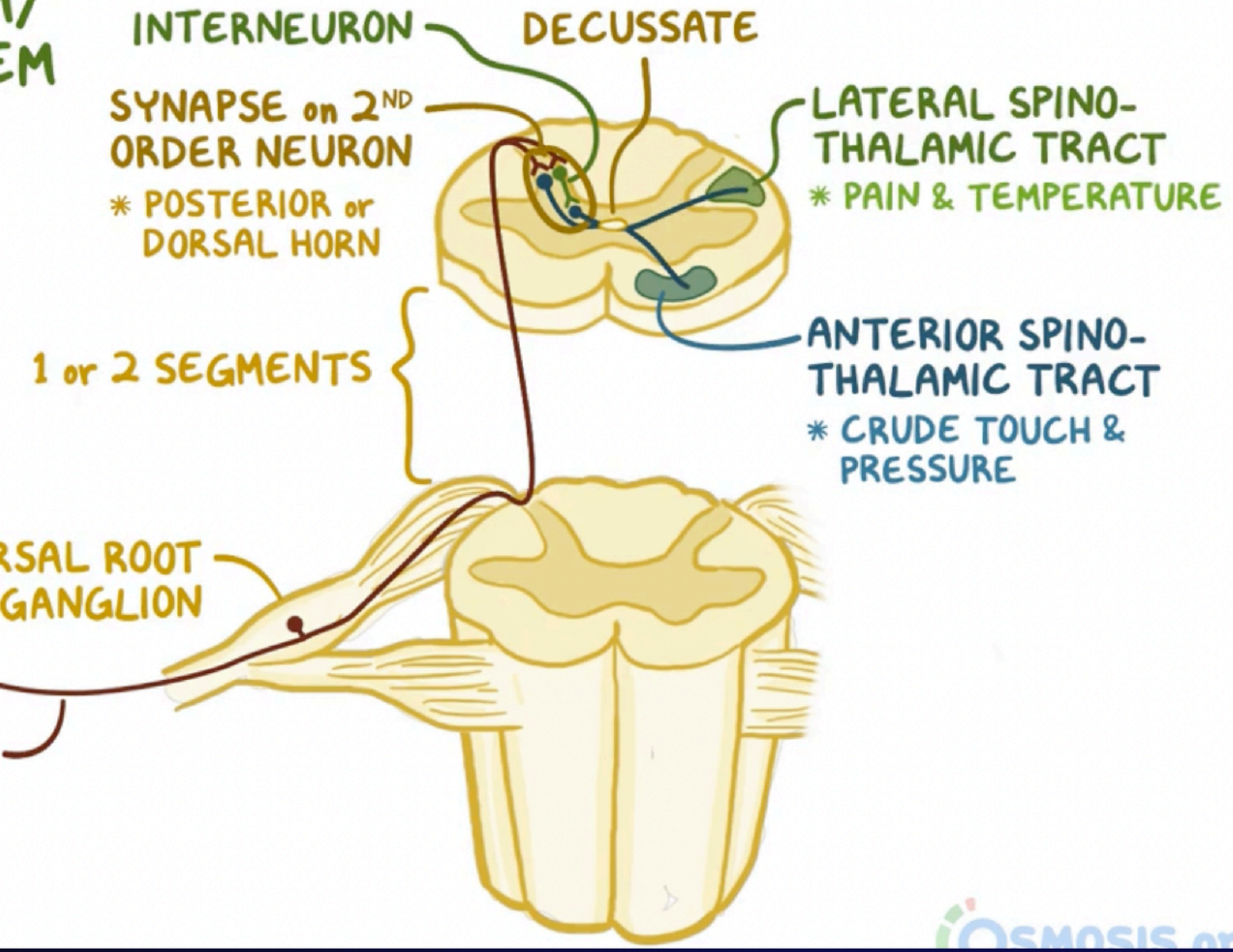


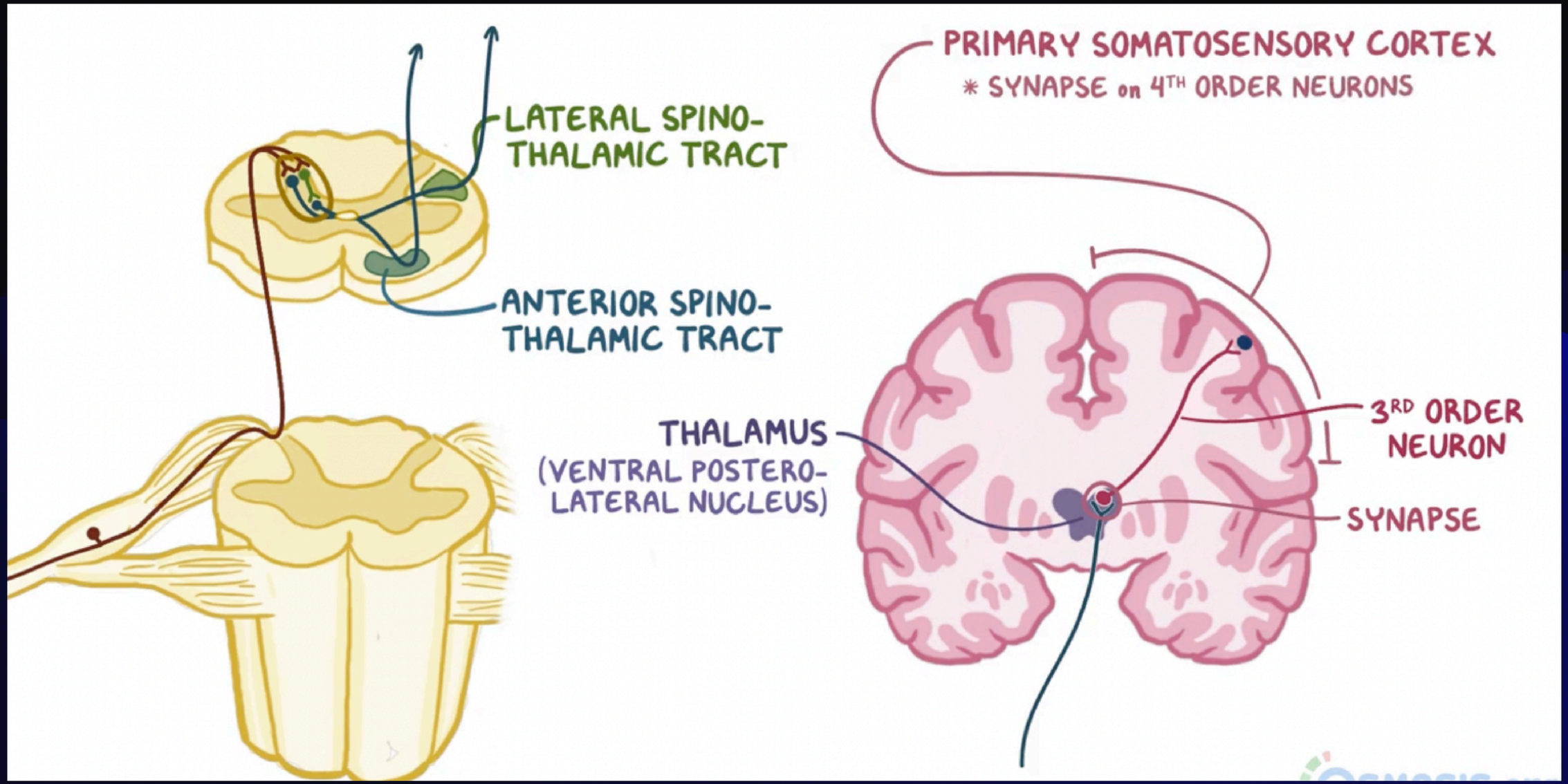
- LATERAL tract is pain and temp
- VENTRAL (or anterior) tract is crude touch and pressure

1. Ist order neurones enter the DRG then enter the spinal cord through the grey horn
2. The fibres DECUSSATE through the anterior white commissure on the level of the spinal cord they entered - becoming 2nd order neurones
3. Ascend the tract, through the medulla, onto the ventral posterolateral nucleus of the thalamus - becoming 3rd order neurones
4. These 3rd order neurones head to the somatosensory cortex

SPINOTHALAMIC SYSTEM/ ANTEROLATERAL SYSTEM

* CRUDE TOUCH
  ~ FREE NERVE ENDINGS
* PAIN
  ~ NOCICEPTORS
* PRESSURE
  ~ MECHANORECEPTORS
* TEMPERATURE
  ~ THERMORECEPTORS

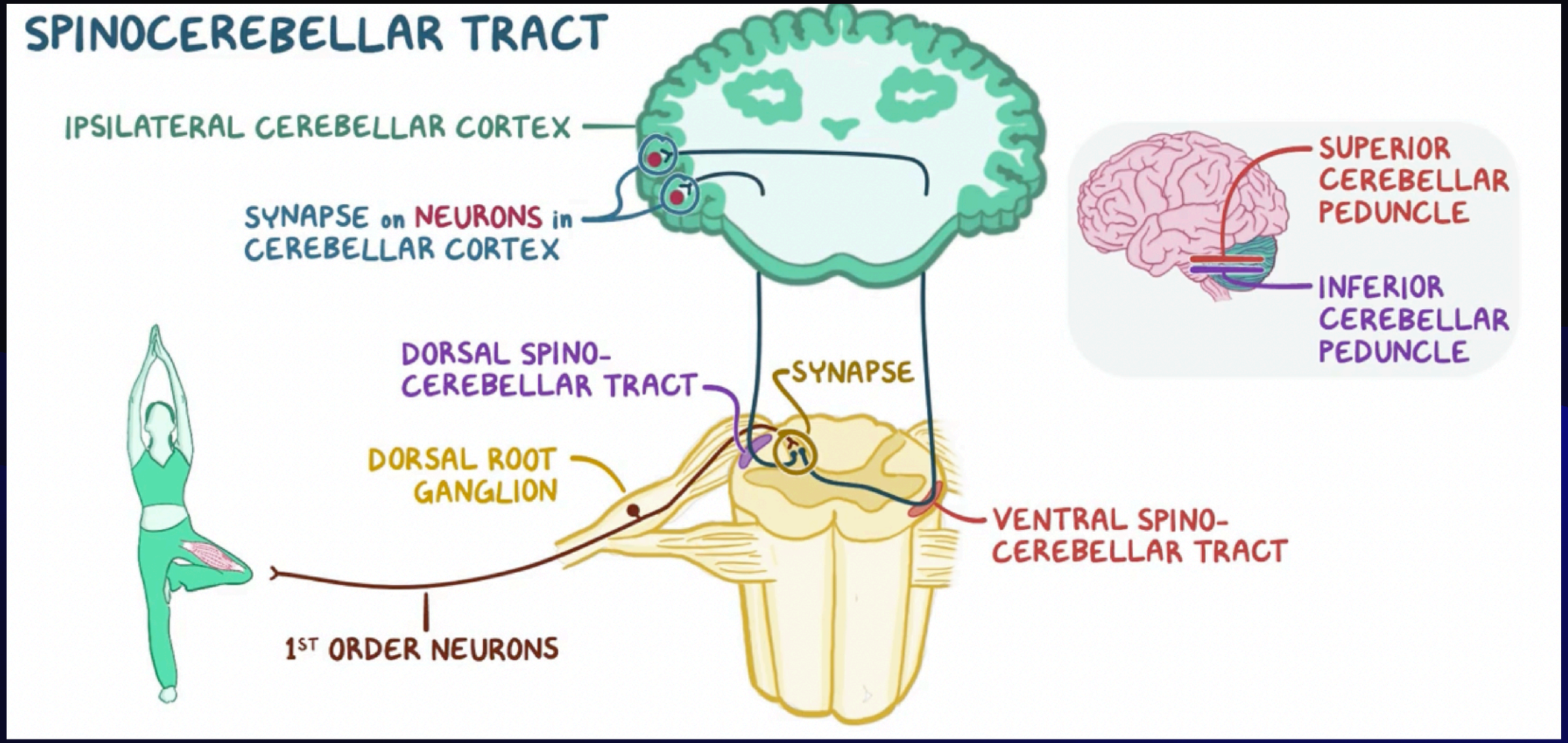



PRIMARY SOMATOSENSORY CORTEX
* SYNAPSE on 4TH ORDER NEURONS
LATERAL SPINO-THALAMIC TRACT
ANTERIOR SPINO-THALAMIC TRACT
THALAMUS
(VENTRAL POSTERO-LATERAL NUCLEUS)
3RD ORDER NEURON
SYNAPSE

Spinocerebellar

- Function: Proprioception, touch, pressure
- Up or down: Ascending
- Where and to: From receptors in the skin to the cerebellum
- Think or no: UNCONSCIOUS
- spinocerebellar is IPSILATERAL

1. Impulses enter the DRG then into the spinal cord where they decussate (FOR THE FIRST TIME) becoming 2nd order neurones
2. Travel up the spinal cord, through the medulla, reaching the cerebellum
3. Here they decussate AGAIN - cuneocerebellar and dorsal cerebellar through the inferior cerebellar peduncle, and the ventral cerebellar tract decussates through the superior cerebellar peduncle



also for extra info uno the ventral decussates twice but the dorsal stays ipsilateral throughout

The Motor System

- Primary Motor Cortex is located in the PRE CENTRAL GYRUS
- Also the tract for the motor system is DESCENDING cos the brain is telling ur body what to do

- There are TWO (2) sections to a motor tract:
  I) PYRAMIDAL
  - from cerebral cortex to spinal cord/brainstem. GENERATE voluntary muscle movement
  2) EXTRAPYRAMIDAL
  - from brainstem to spinal cord. COORDINATE voluntary muscle movement

Tract	Function	
Corticospinal (pyramidal)	Fine voluntary motor control of the limbs. The pathway also controls voluntary body posture adjustments.	Important tha you know these in detail!
Corticobulbar (pyramidal)	Control of facial and masticatory musculature, movements of the tongue and swallowing	
Rubrospinal (Extrapyramidal)	Involved in involuntary adjustment of arm position in response to balance information; support of the body.	You need to know these exist but not in great detail!
Reticulospinal (Extrapyramidal)	Regulates various involuntary motor activities and assists in balance (leg extensors). Some pattern movements e.g. stepping	
Vestibulospinal (Extrapyramidal)	It is responsible for adjusting posture to maintain balance	
Tectospinal (Extrapyramidal)	Controls head and eye movements, Involved in involuntary adjustment of head position in response to visual information.	

Basically the Pyramidal makes movements and the extrapyramidal does it.

The Motor System

So u remember those lst order and 2nd order neurones? Yh the motor system don't have them. Instead they got UPPER MOTOR NEURONES and LOWER MOTOR NEURONES

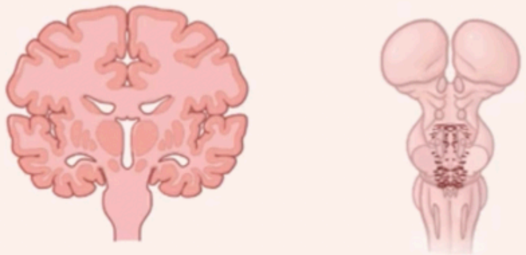
DESCENDING TRACTS

* MOTOR PATHWAYS
* CONTROL MUSCLES of TRUNK and EXTREMITIES

1 UPPER MOTOR NEURONS

~ CEREBRAL CORTEX

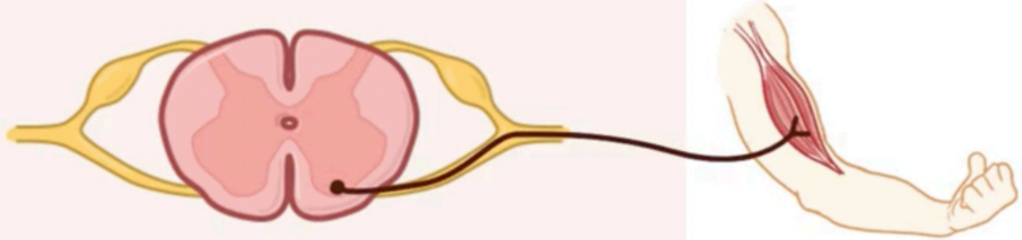
~ DEEP NUCLEI of BRAINSTEM



2 LOWER MOTOR NEURONS

~ ANTERIOR (VENTRAL) HORNS of SPINAL CORD

INNERVATE MUSCLES



The Motor System

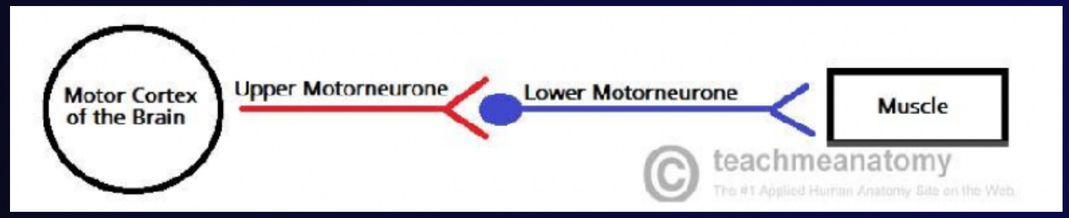
- Theres more you need to know about the UMN and LMN
- They only exist for SOMATIC innervation and skeletal muscles
- They have an excitatory effect and only secrete ACh

UMN

- Cell body inside nucleus
- Axon runs down into spinal cord and synapses with the LMN
  (basically sends impulses from cerebral cortex to spinal cord)
- Lesions can lead to: increased muscle tone, muscle weakness and spastic hyperrefelexia

LMN

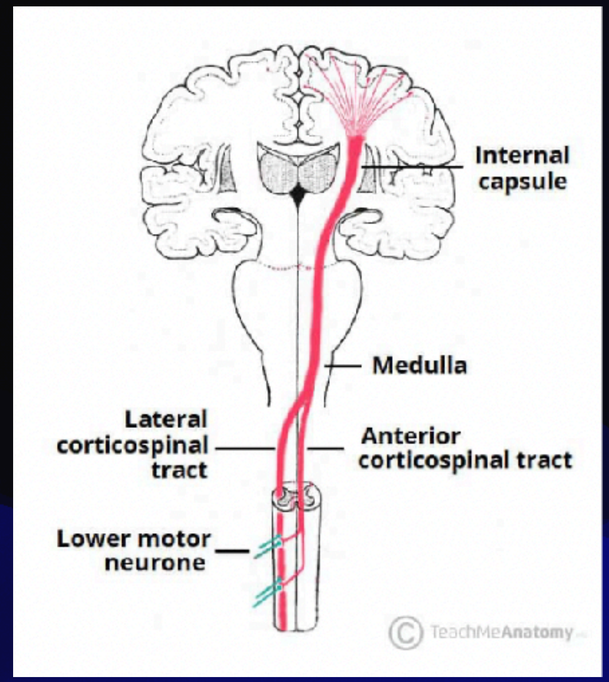
- Cell body is inside brain stem or spinal cord
- Axon extends OUT of CNS and innervates muscle
- Lesions lead to: muscle atrophy, flaccidity, weakness, fasciculations, hyporeflexia



There is only ONE (I) motor tract we need to firm

Corticospinal Tract

- Function: Skeletal muscle movement
- Up or down: DESCENDING
- Where and to: From motor cortex to spinal cord to skeletal muscle
- Think or no: Conscious (yes)
- No receptors involved



1. Prefrontal cortex (motor cortex) stimulates motor areas to send impulses for muscle contraction
2. UMNs head to the brainstem from the motor cortex
3. These reach the medulla and some fibres DECUSSATE (90%) whilst come remain IPSILATERAL (10%)
4. These travel down the spinal cord and exit at the spinal level through ventral grey horn, becoming LMNs!

Corticospinal Tract

90% - They become lateral corticospinal (they are for innervating distal muscle like hands and feet)

10% - They become anterior corticospinal (they are for innervating proximal muscles like the trunk)