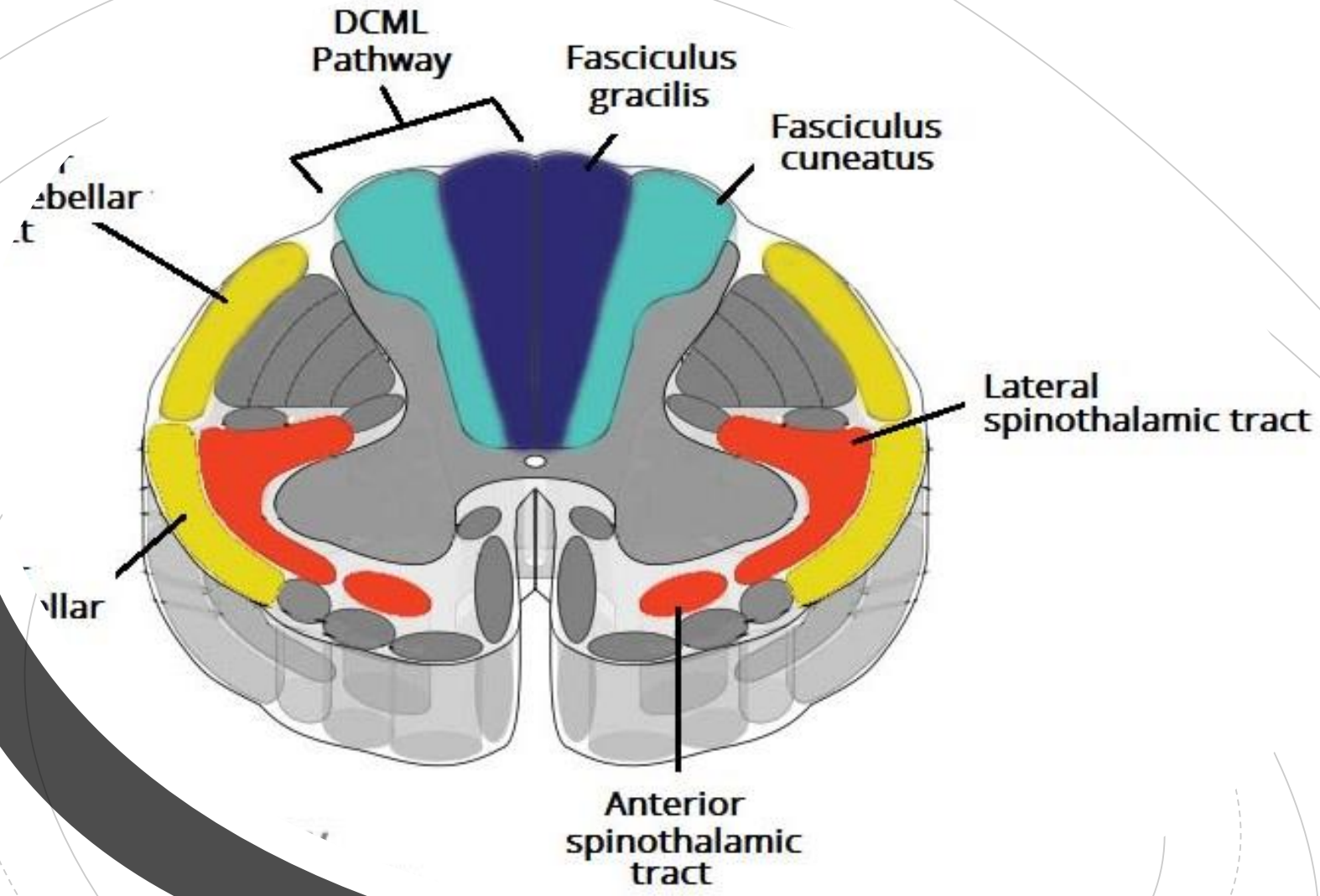


Tracts of the Spinal cord

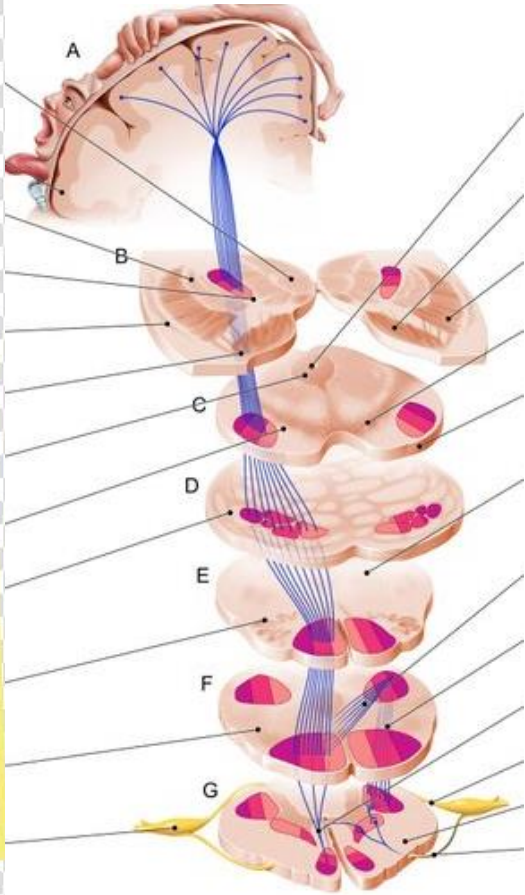
Dr AMAL ALBTOOSH

TRACT OF SPINAL CORD

TRACT OR fascicle bundle of structures, such as nerve or muscle fibres or conducting vessels in plants.

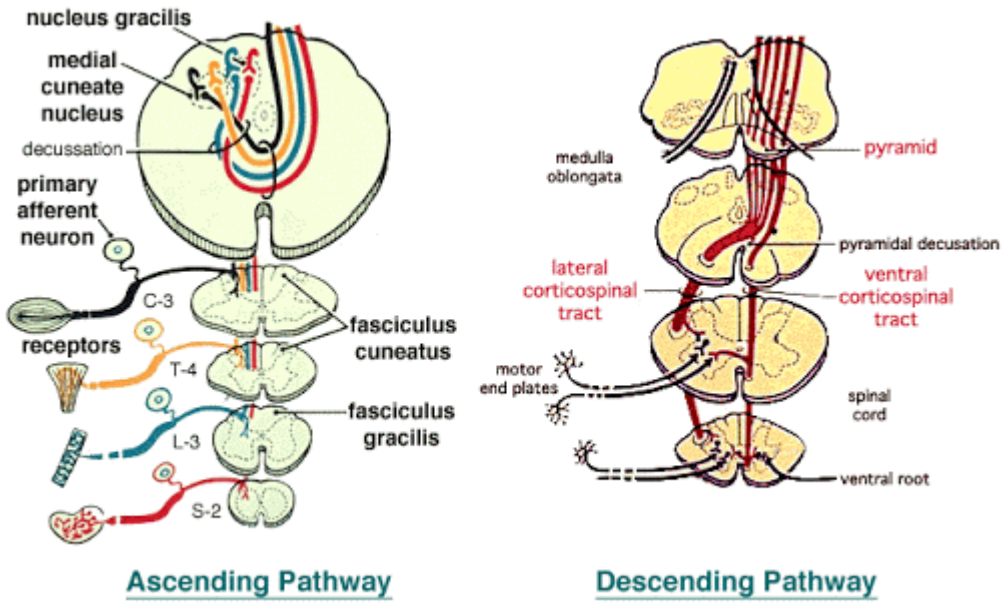
- *Consist of fiber bundles that have*
- ✓ *a common origin*
- ✓ *a common termination*
- ✓ *A common course*

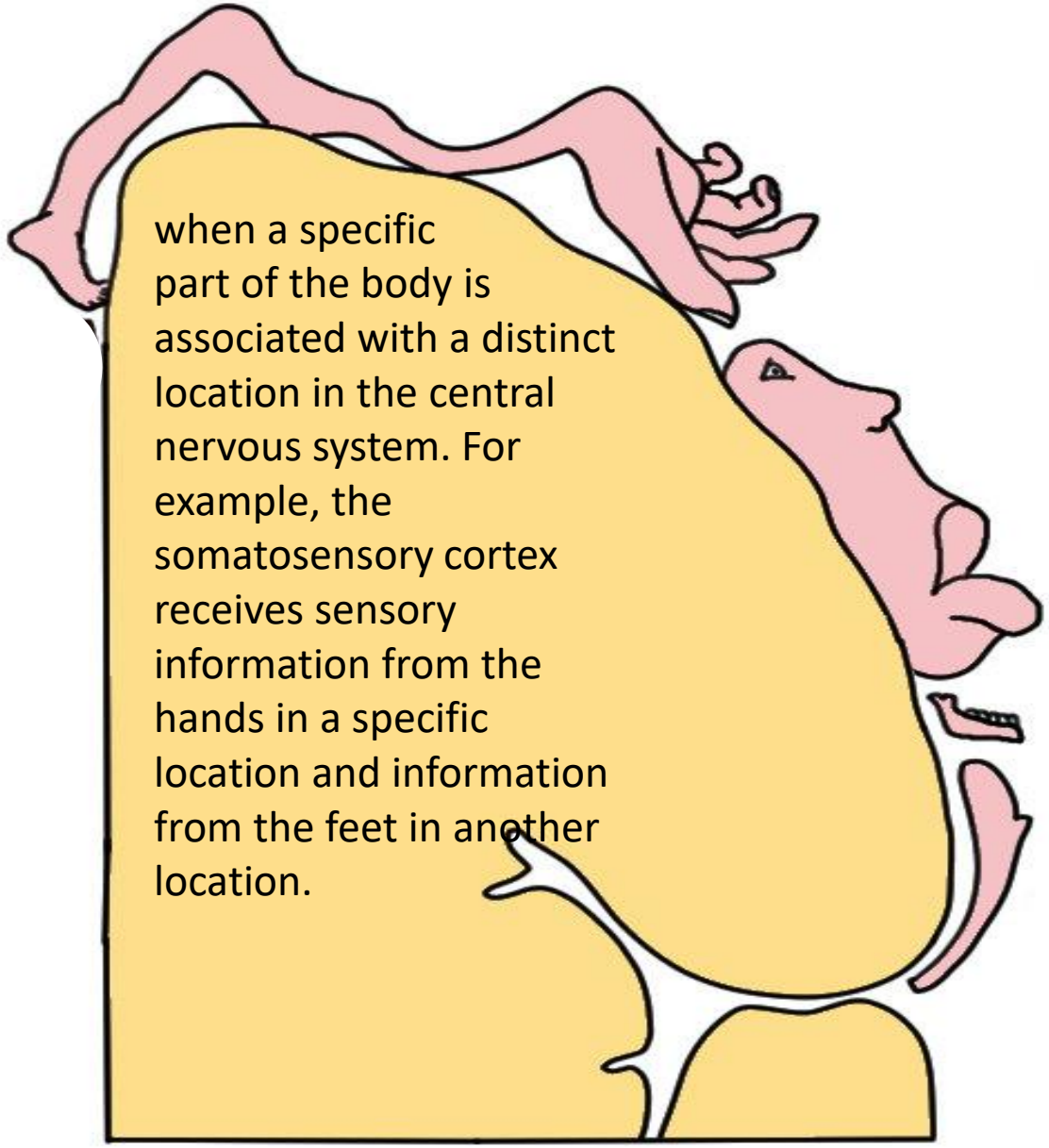
  - The tracts are often named according to their origin and termination; for example, the **CORTICOSPINAL TRACT** consists of fibres running from the cerebral cortex in the brain to the spinal cord.



Tracts of the Spinal Cord

- *are somatotopically organized.*
- *are divided into ascending and descending pathways.*

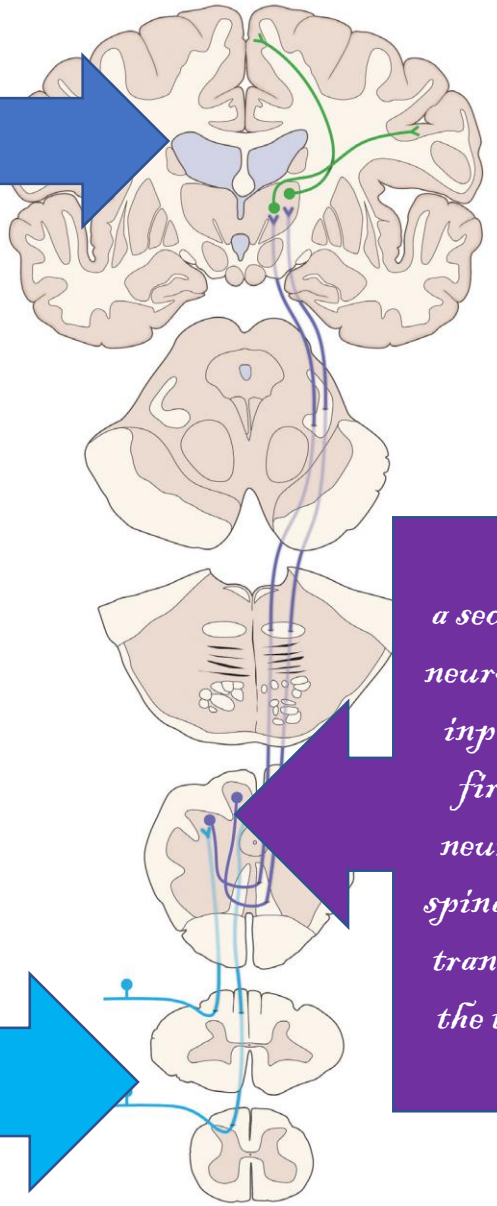




Ascending Tracts

- Represent functional pathways that convey sensory information from soma or viscera to higher levels of the neuraxis.
- Usually consist of a chain of three neurons: first-, second-, and third-order neurons. The first order neuron is always in the dorsal root ganglion.

Third order neuron receives input from a second-order neuron in the thalamus and transmits it to higher centres

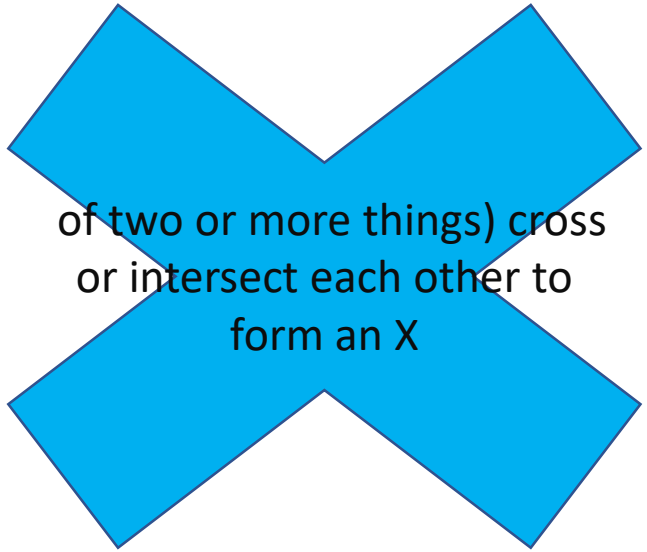


a second-order neuron receives input from a first-order neuron in the spinal cord and transmits it to the thalamus.

the first-order neuron receives peripheral input (e.g., sensations from the skin) and transmits it to the spinal cord.

Ascending Tracts

- May decussate before reaching their final destination.
- Give rise to collateral branches that serve in local spinal reflex arcs.



Ascending Tracts

Include six major tracts:

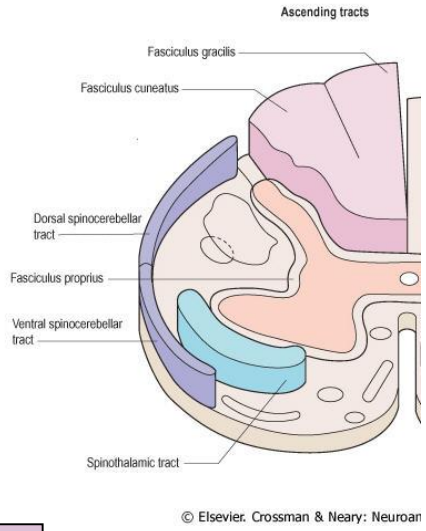
- ❖Dorsal column–medial lemniscus pathway
- ❖Ventral spinothalamic tract
- ❖Lateral spinothalamic tract
- ❖Dorsal spinocerebellar tract
- ❖Ventral spinocerebellar tract
- ❖Cuneocerebellar tract

A **lemniscus** (Greek for ribbon or band) is a bundle of secondary sensory fibers in the brainstem.

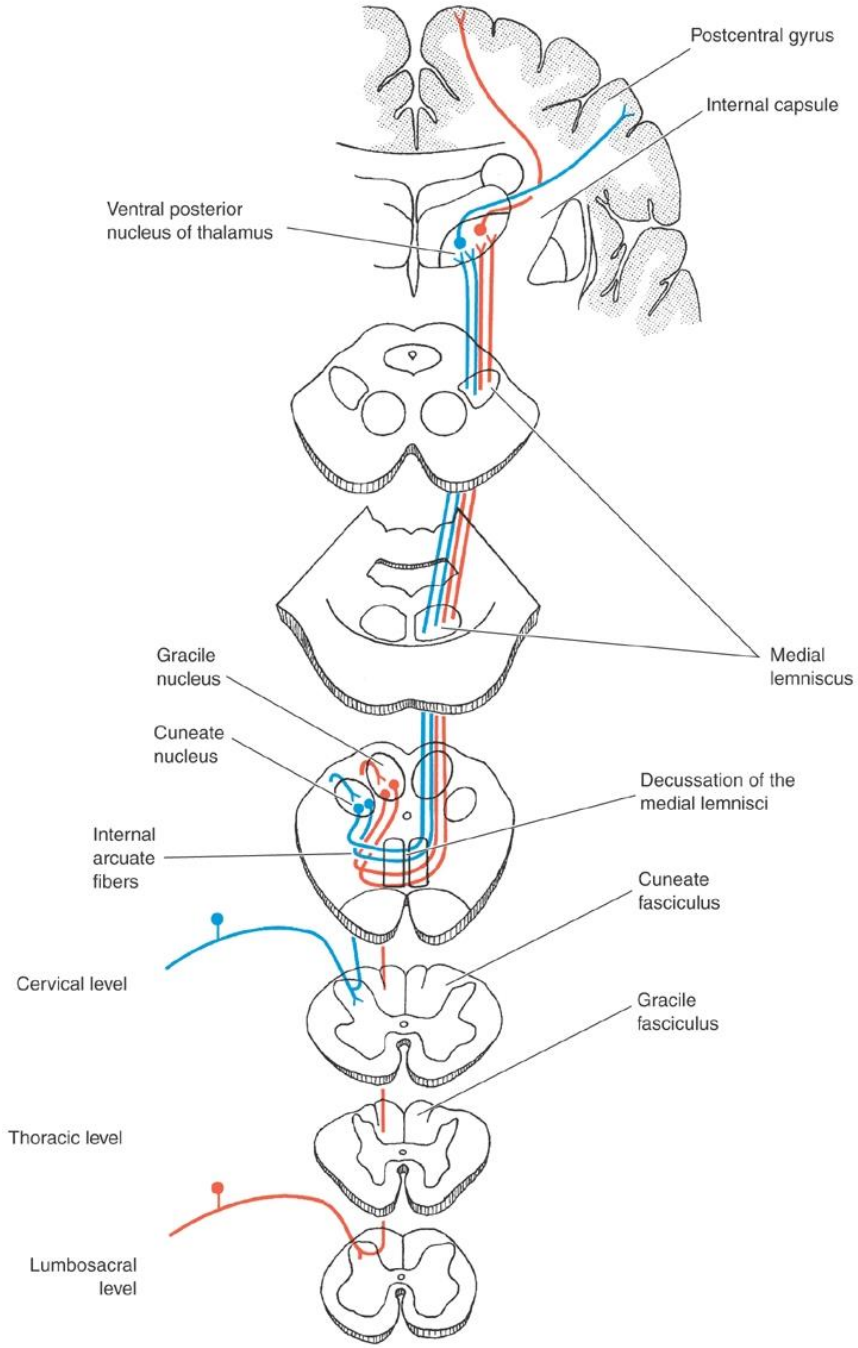
DORSAL

Tactile discrimination is the ability to differentiate information through the sense of touch.

- mediates tactile discrimination, vibration, form recognition, and joint and muscle sensation.
- mediates conscious proprioception.



Dorsal column

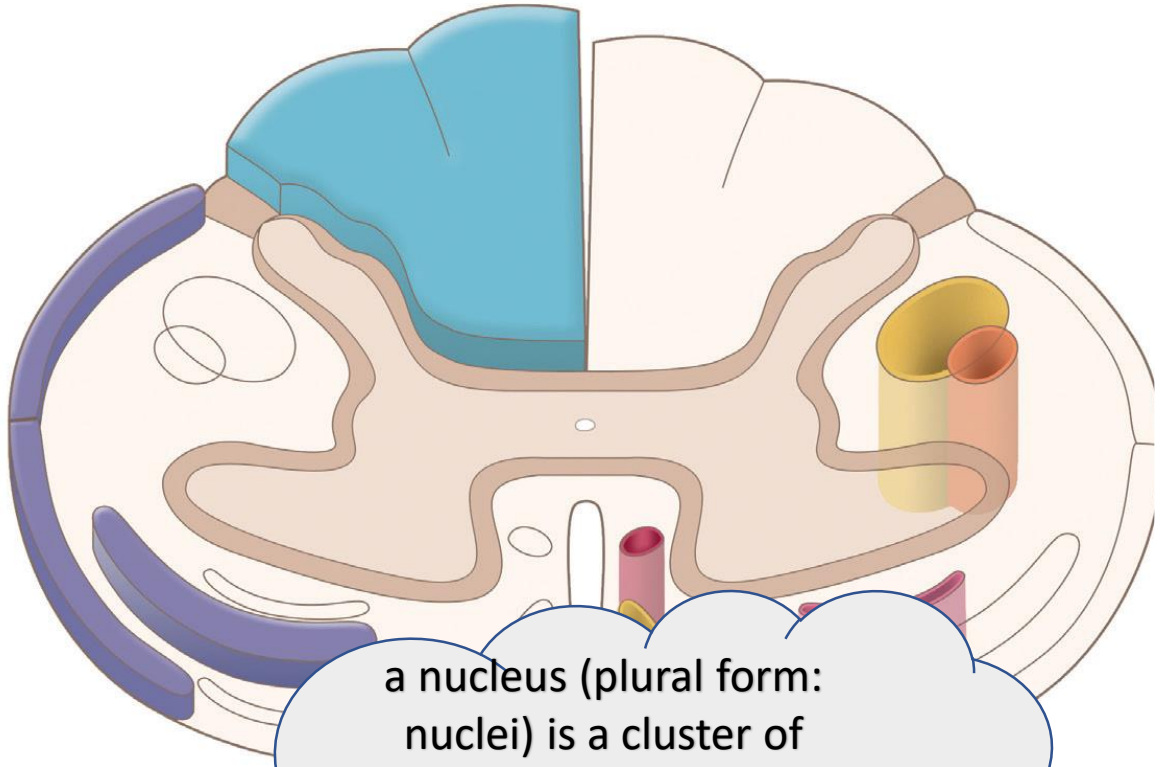


DORSAL COLUMN–MEDIAL LEMNISCUS PATHWAY

1. FIRST-ORDER NEURONS

- Are located in dorsal root ganglia at all levels.
- Give rise to the fasciculus Gracilis from the lower extremity
- Give rise to the fasciculus cuneatus from the upper extremity.
- Give rise to axons that ascend in the dorsal columns and terminate in the gracile and cuneate nuclei of the medulla

A nerve **fascicle**, or **fasciculus** is a bundle of funiculi. A funiculus is a bundle of axons

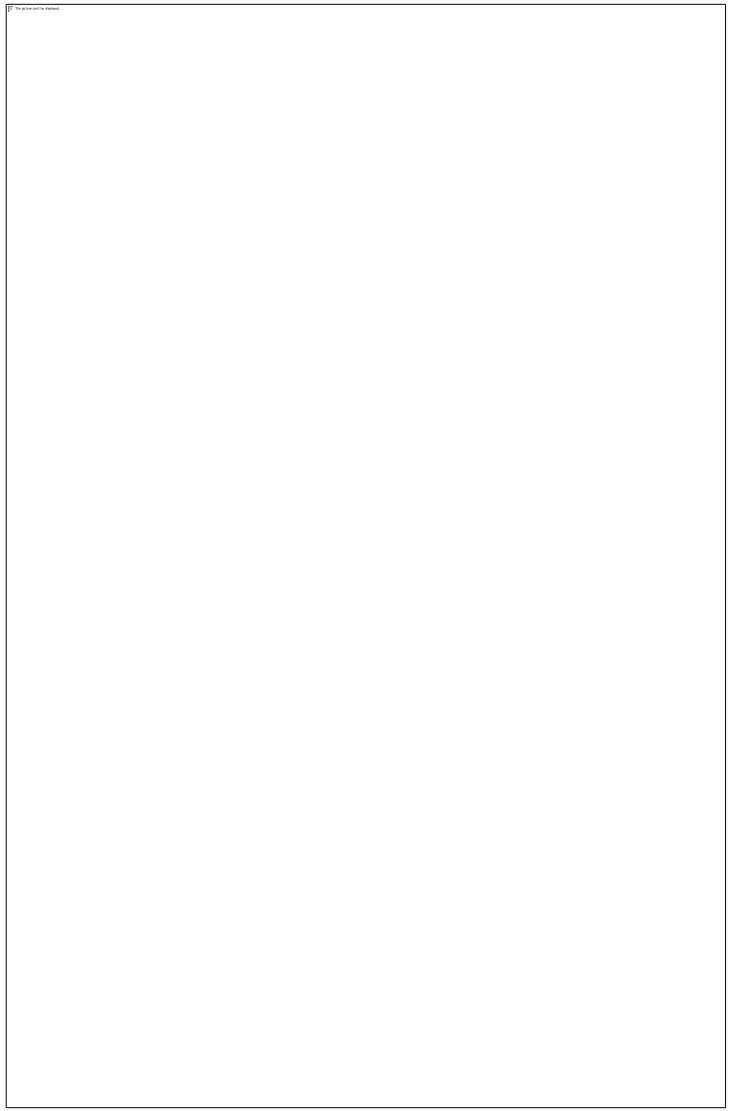


a nucleus (plural form: nuclei) is a cluster of neurons in the central nervous system, located deep within the cerebral hemispheres and brainstem

DORSAL COLUMN–MEDIAL LEMNISCUS PATHWAY

2. SECOND-ORDER NEURONS

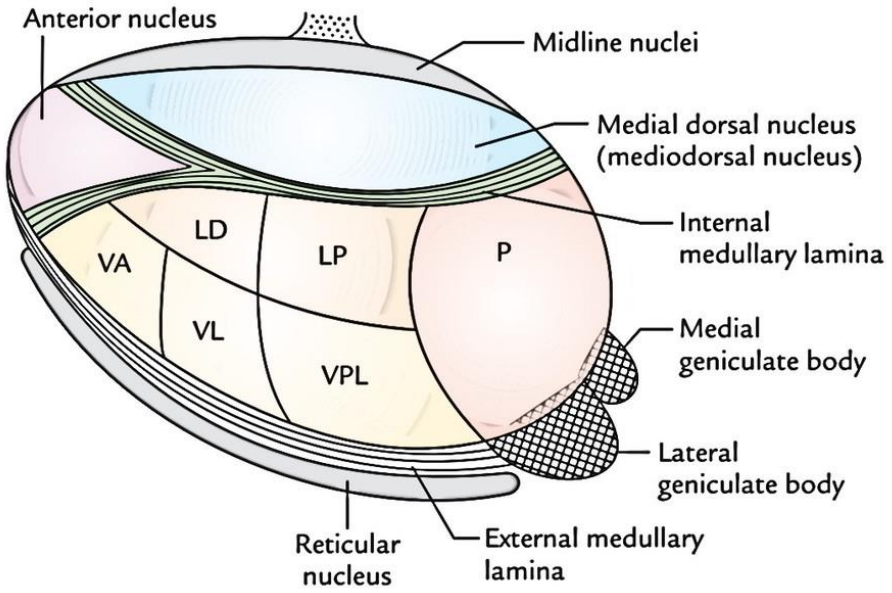
- *Are located in the gracile and cuneate nuclei of the caudal medulla.*
- *Give rise to axons, internal arcuate fibers that decussate and form a compact fiber bundle,The medial lemniscus.*
- *The medial lemniscus ascends through the contralateral Brainstem to terminate in the ventral posterolateral (VPL) nucleus of the thalamus.*

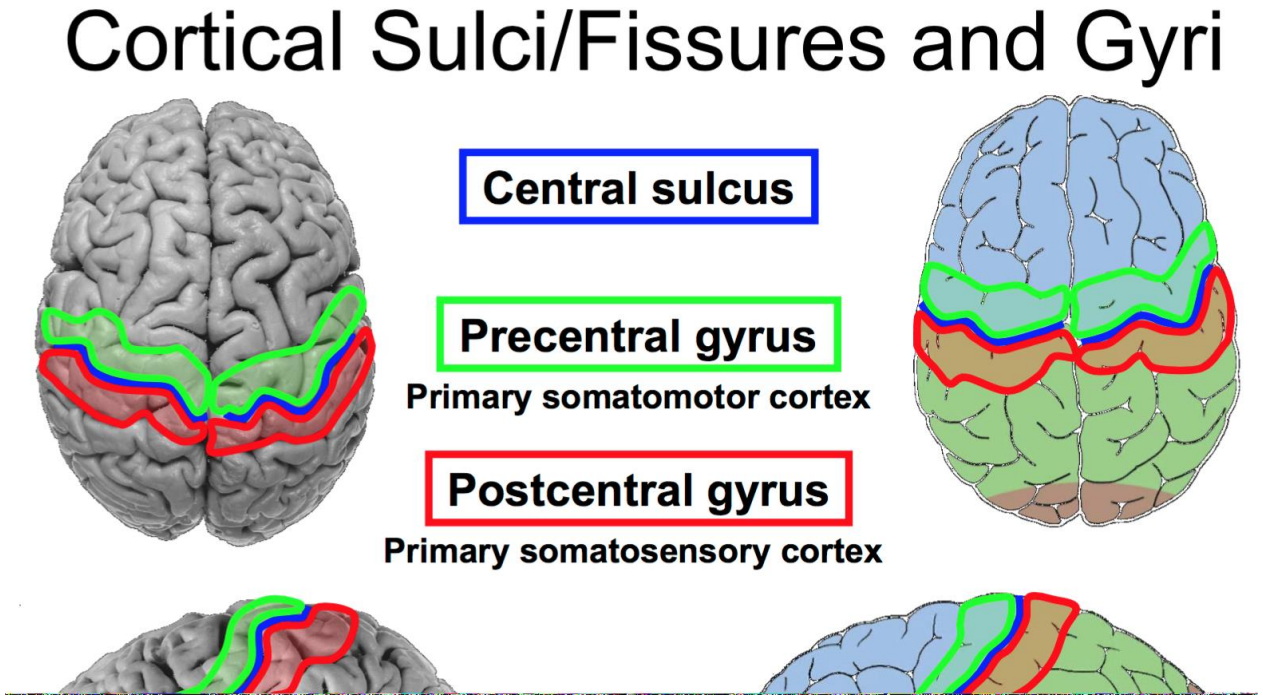


DORSAL COLUMN–MEDIAL LEMNISCUS PATHWAY

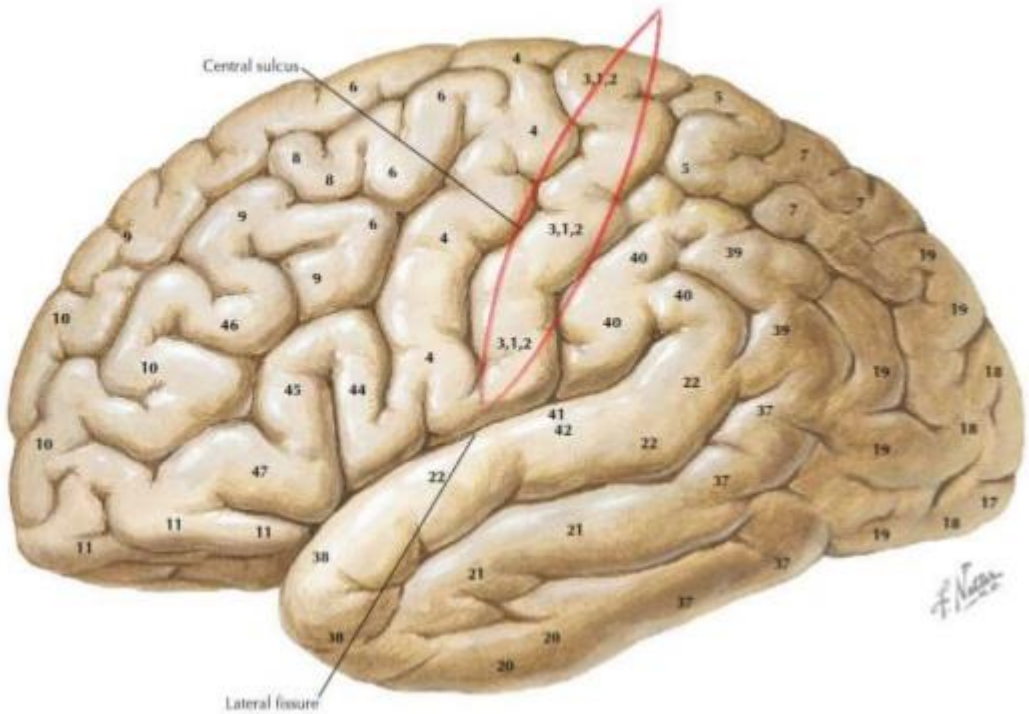
3. THIRD-ORDER NEURONS

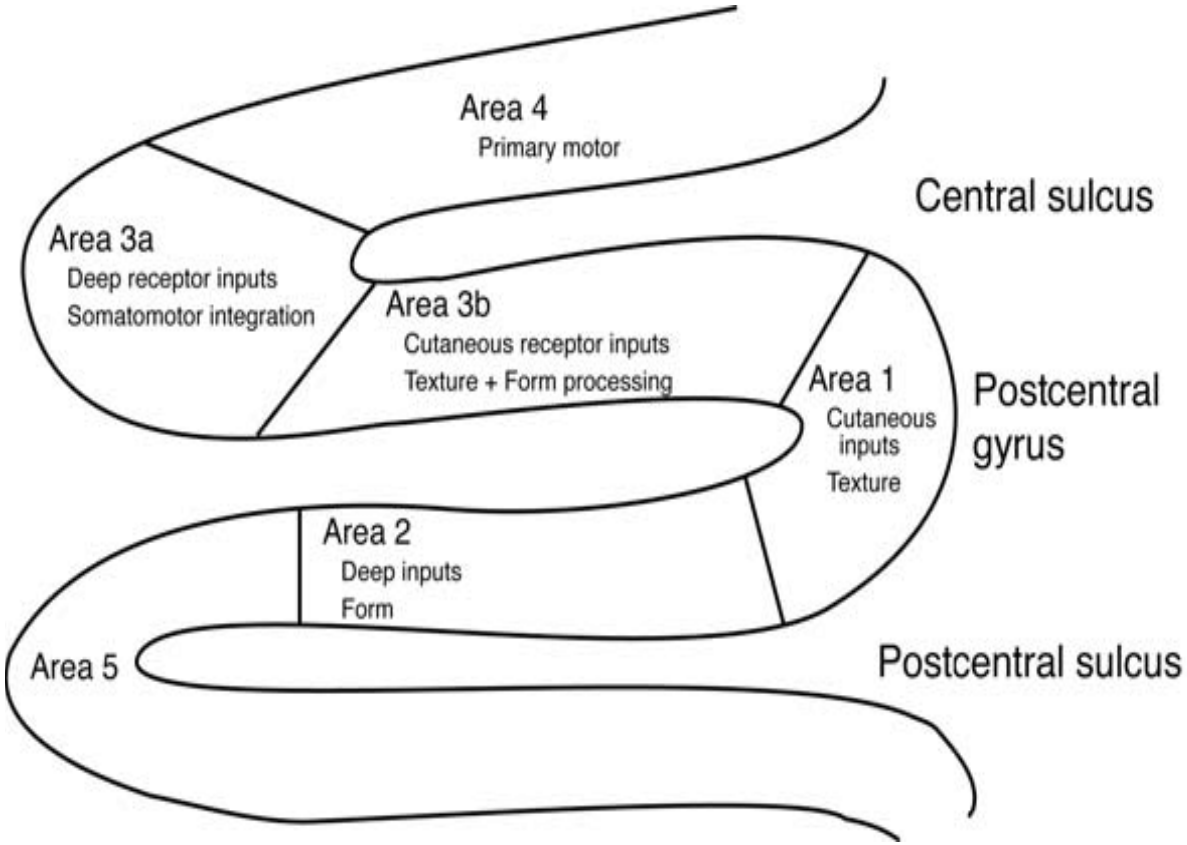
- ARE LOCATED IN THE VPL NUCLEUS OF THE THALAMUS.
- PROJECT VIA THE POSTERIOR LIMB OF THE INTERNAL CAPSULE TO THE POSTCENTRAL GYRUS, THE SOMATOSENSORY CORTEX (AREAS 3, 1, AND 2).





BROADMANN AREA 1,2,3





Ventral spinothalamic tract

• With lateral spinothalamic tract comprises anterolateral system.

• Is concerned with light touch, the sensation produced by stroking **GLABROUS SKIN** with a wisp of cotton.

• Receives input from free nerve endings and from merkel tactile disks.

1. First-order neurons

• Are found in dorsal root ganglia at all levels.

• Project axons into the medial root entry zone to second-order neurons in the dorsal horn.

2. Second-order neurons

• Are located in the dorsal horn.

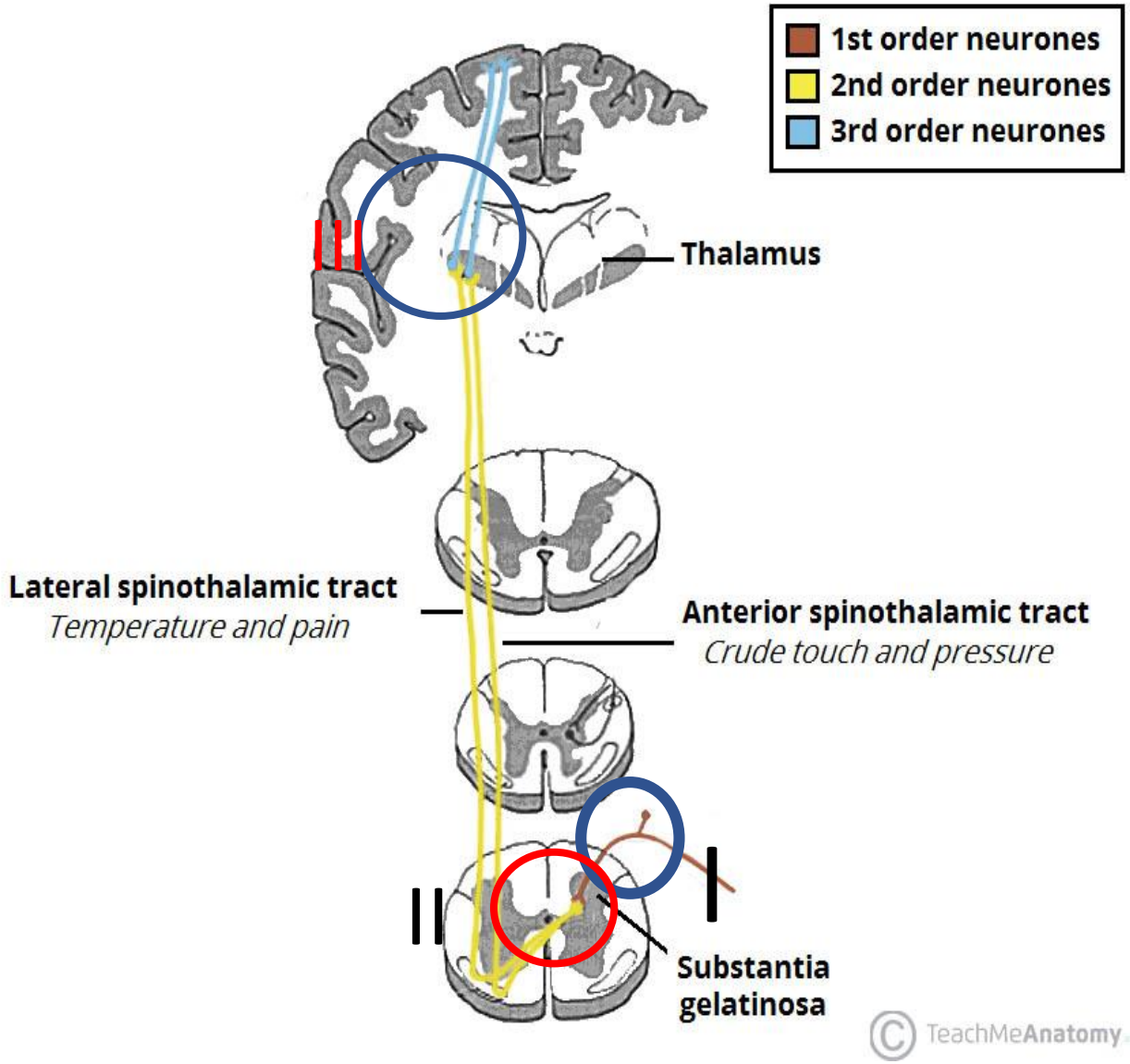
• Give rise to axons that decussate in the ventral white commissure and ascend in the contralateral ventral funiculus.

• Terminate in the VPL nucleus of the thalamus.

3. Third-order neurons

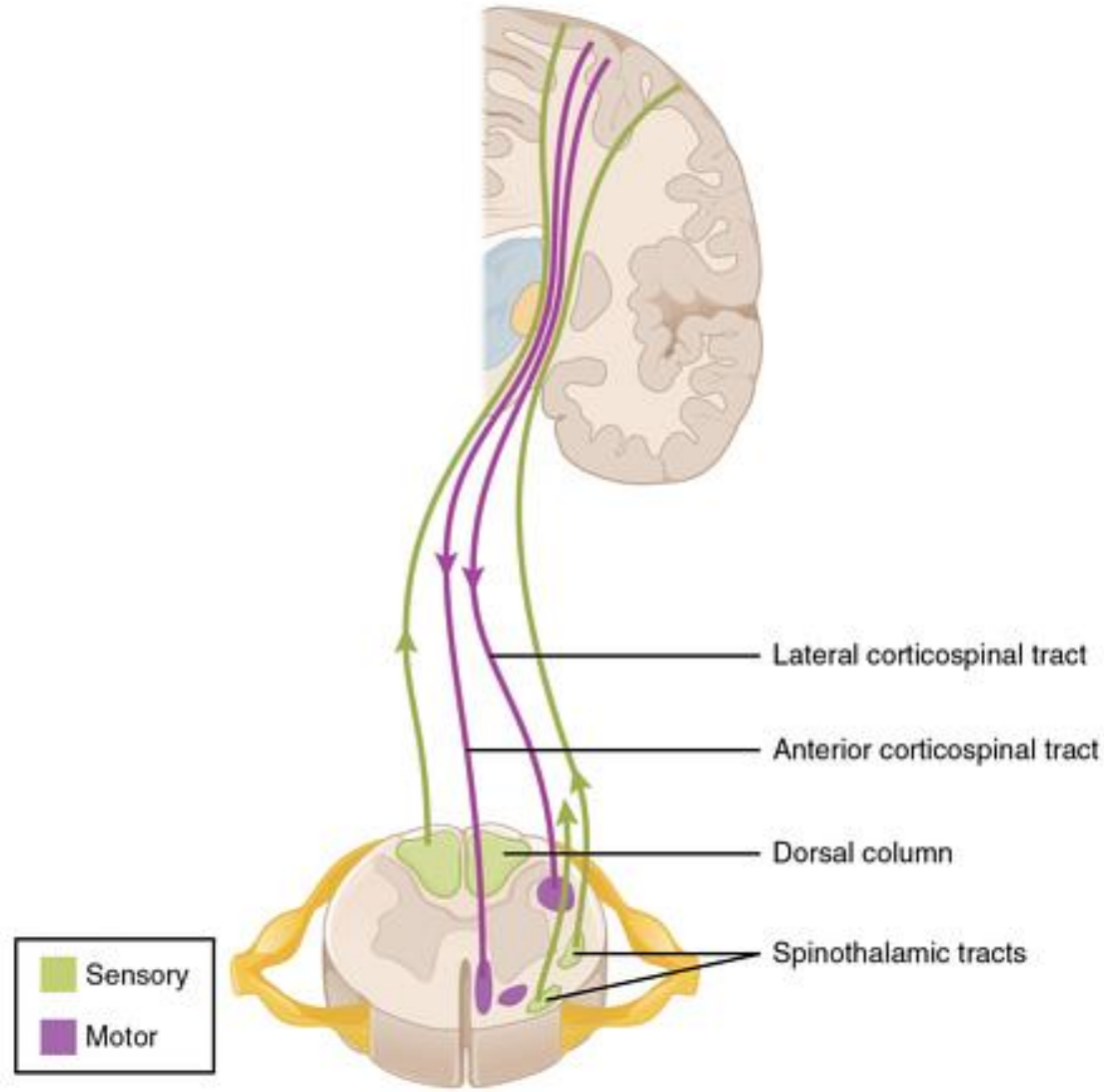
• Are found in the VPL nucleus of the thalamus.

• Project via the posterior limb of the internal capsule and corona radiata to the postcentral Gyrus (areas 3, 1, and 2).



Lateral spinothalamic tract

- *mediates itch, pain, and temperature sensation.*
- *receives input from free nerve endings and thermal receptors.*
- *receives input from A-δ and C fibers (i.e., fast- and slow-conducting pain fibers, respectively).*
- *is somatotopically organized with sacral fibers dorsolaterally and cervical fibers ventromedially.*



Lateral spinothalamic tract

1. First-order neurons
• are found in dorsal root ganglia at all levels.
• project axons via the dorsolateral tract of Lissauer
second-order neurons in the
dorsal horn.
• synapse with second-order neurons in the dorsal
2. Second-order neurons
• Are found in the dorsal horn.
• Give rise to axons that decussate in the ventral white commissure and ascend in the
Ventral half of the lateral funiculus.
• Project collaterals to the reticular formation.
• Terminate contralaterally in the VPL nucleus and bilaterally in the intralaminar nuclei of the thalamus.
3. Third-order neurons
• are found in the VPL nucleus and in the intralaminar nuclei.
a. VPL neurons
• project via the posterior limb of the internal capsule to the somatesthetic cortex of the postcentral gyrus (areas 3, 1, and 2).
b. Intralaminar neurons
• project to the caudatoputamen and to the frontal and parietal cortex.

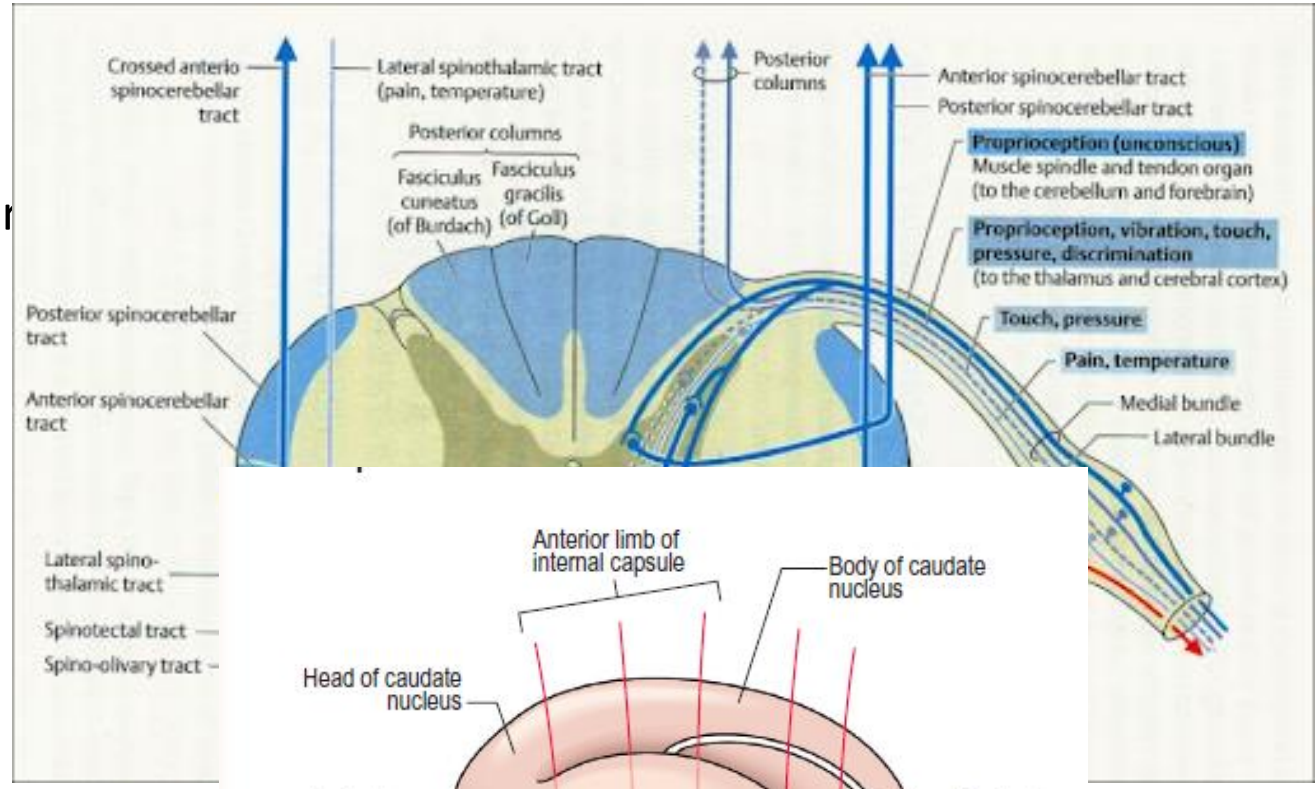
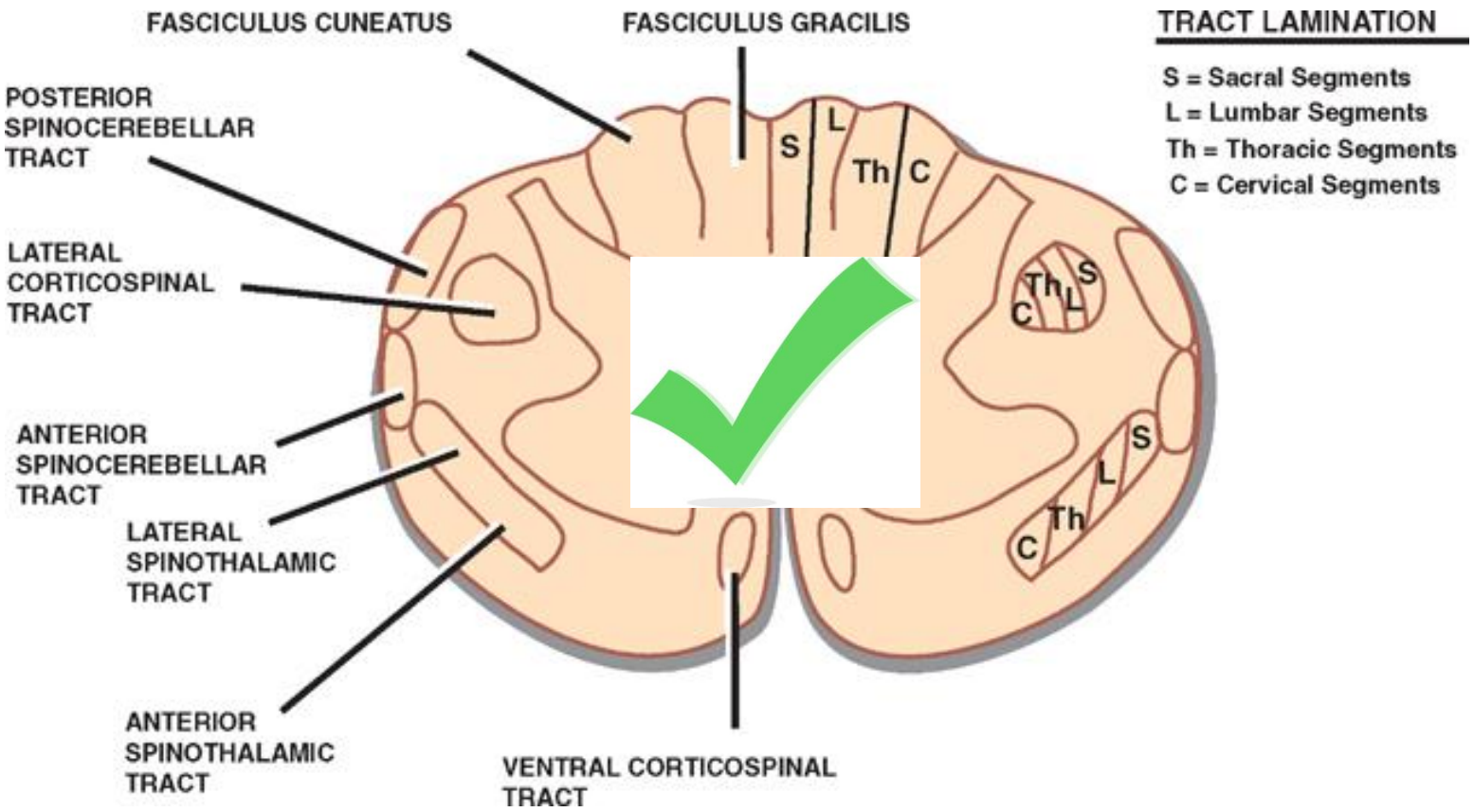


Figure 14.4 **Lateral aspect of the left caudate nucleus, putamen, amygdala and thalamus.** The globus pallidus is obscured by the putamen. The course of the internal capsule is shown in red. The putamen and the head of the caudate nucleus are separated by the anterior limb of the internal capsule, except at their most rostral extent where the two are in continuity. The posterior limb of the internal capsule separates the globus pallidus and putamen from the thalamus.

ANTERIO-Lateral spinothalamic tract

is somatotopically organized with sacral fibers dorsolaterally and cervical fibers ventromedially.

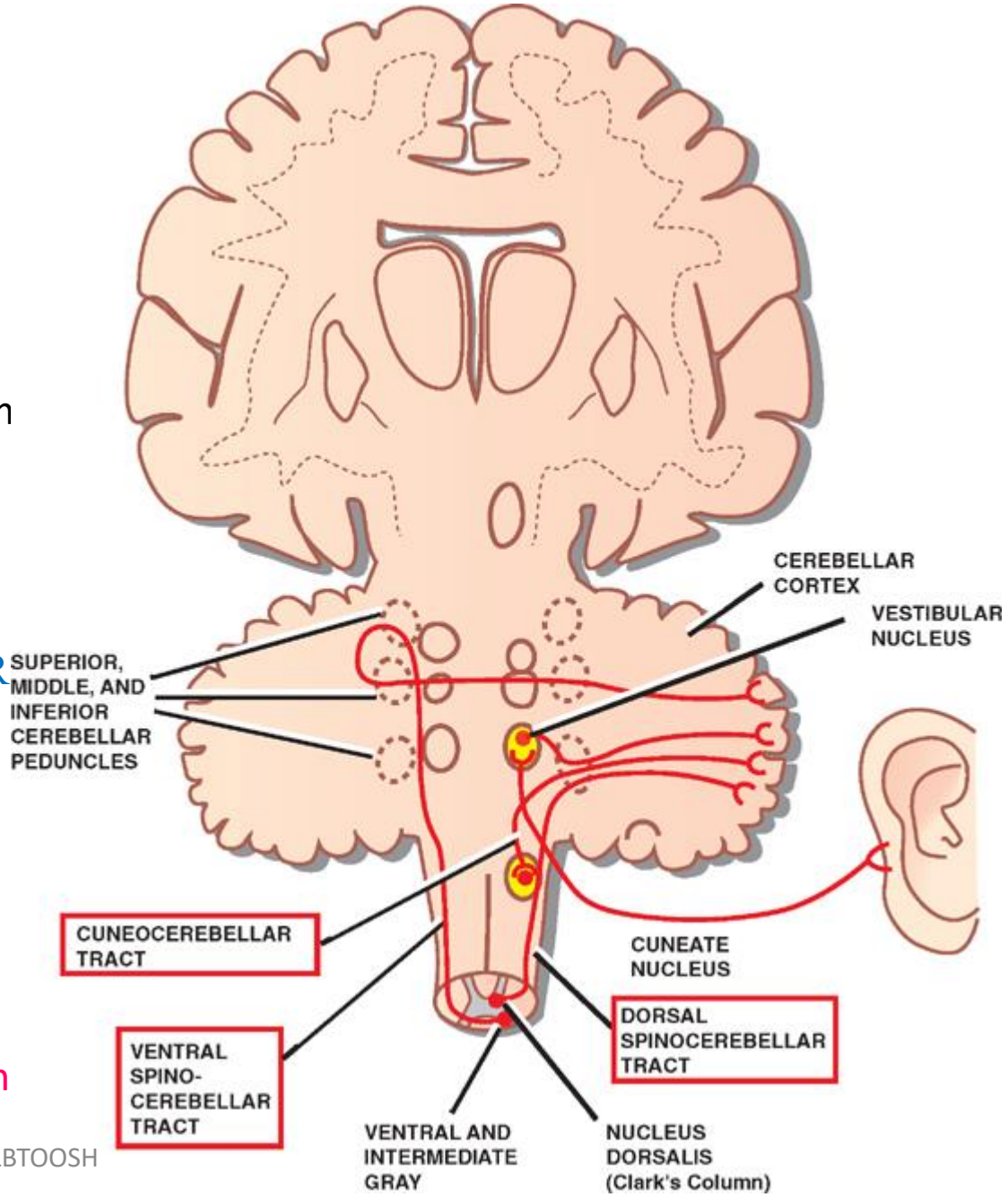


DORSAL SPINOCEREBELLAR TRACT

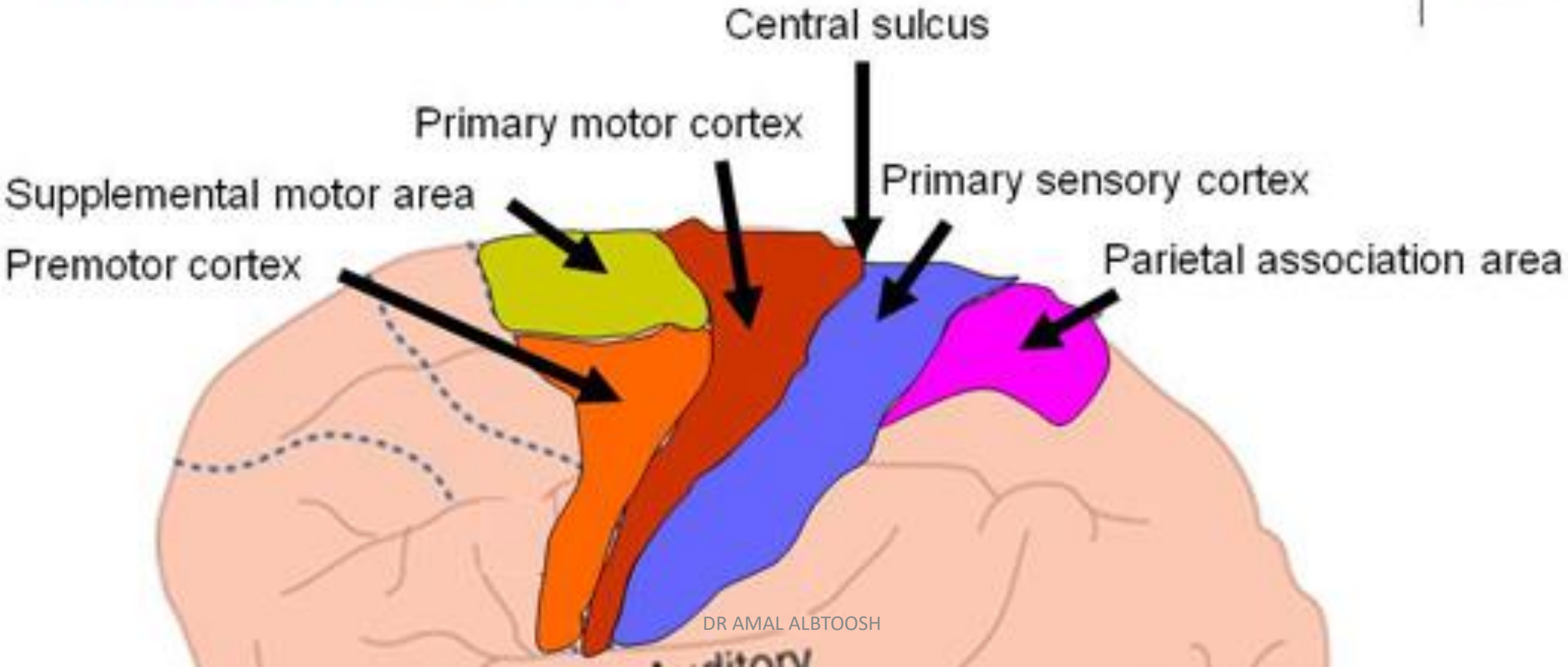
- Transmits unconscious proprioceptive information to the cerebellum.
- Receives input from muscle spindles, GTOs, and pressure receptors.
- Is involved in fine coordination of posture and the movem of individual muscles of the lower extremity.
- IS AN UNCROSSED TRACT.

1. First-order neurons
- Are found in dorsal root ganglia from **C8 to S3.**
- Provide the afferent limb for muscle stretch reflexes (MSR (e.g., the patellar reflex).
- Project via the medial root entry zone to synapse in the nucleus dorsalis of Clarke.

2. Second-order neurons
- are found in the nucleus dorsalis of Clarke (C8–L3).
- give rise to axons that ascend in the lateral funiculus and reach the cerebellum via the inferior cerebellar peduncle.
- contain axons that terminate ipsilaterally as mossy fibers in the cortex of the rostral and caudal cerebellar vermis.



Primary Sensory and Motor Areas



Ventral spinocerebellar tract

- Transmits unconscious proprioceptive information to the cerebellum.
- is concerned with coordinated movement and posture of the entire lower extremity.
- receives input from muscle spindles, GTOs, and pressure receptors.
- IS A CROSSED TRACT.

muscle stretch reflexes (MSR)=deep tendon reflexes" There are 6 MSR that are commonly tested: biceps, triceps, brachioradialis, knee, ankle, and jaw jerk.

1. First-order neurons

- are found in the dorsal root ganglia from **L1 to S2**.
- provide the afferent limb for MSRs (e.g., the patellar reflex).
- synapse on spinal border cells.

2. Second-order neurons

- are spinal border cells found in the ventral horns (L1–S2).
- give rise to axons that decussate in the ventral white commissure and ascend lateral to the lateral spinothalamic tract in the lateral funiculus.
- give rise to axons that enter the cerebellum via the superior cerebellar peduncle and terminate contralaterally as mossy fibers in the cortex of the rostral cerebellar vermis.

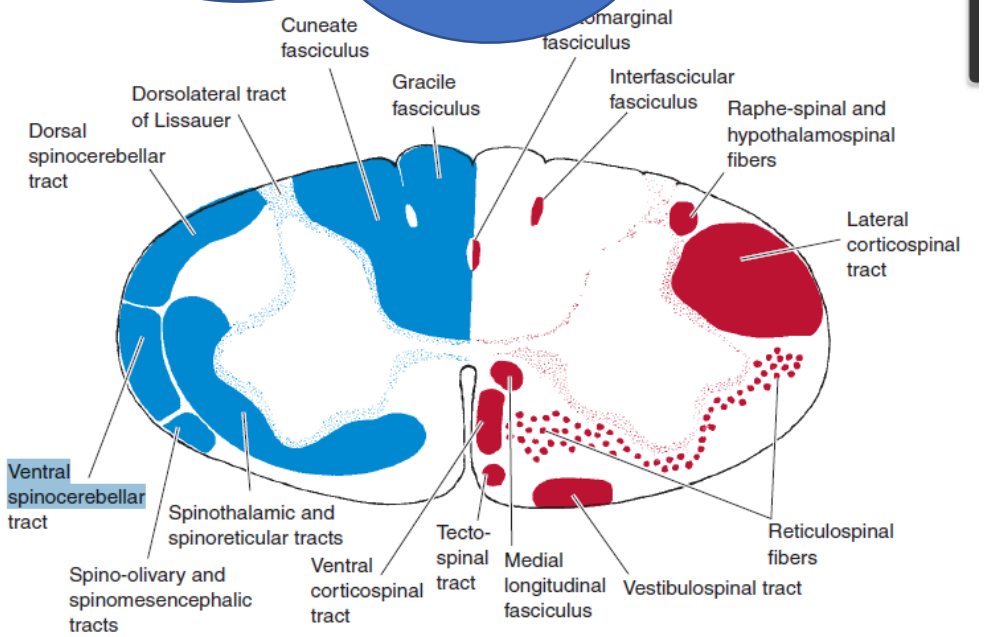


FIGURE 5-10 Major tracts of the spinal white matter at midcervical level. Ascending tracts (blue) are on the lef descending tracts (red) are on the right. The stippled areas adjacent to the gray matter indicate propriospinal fibers.

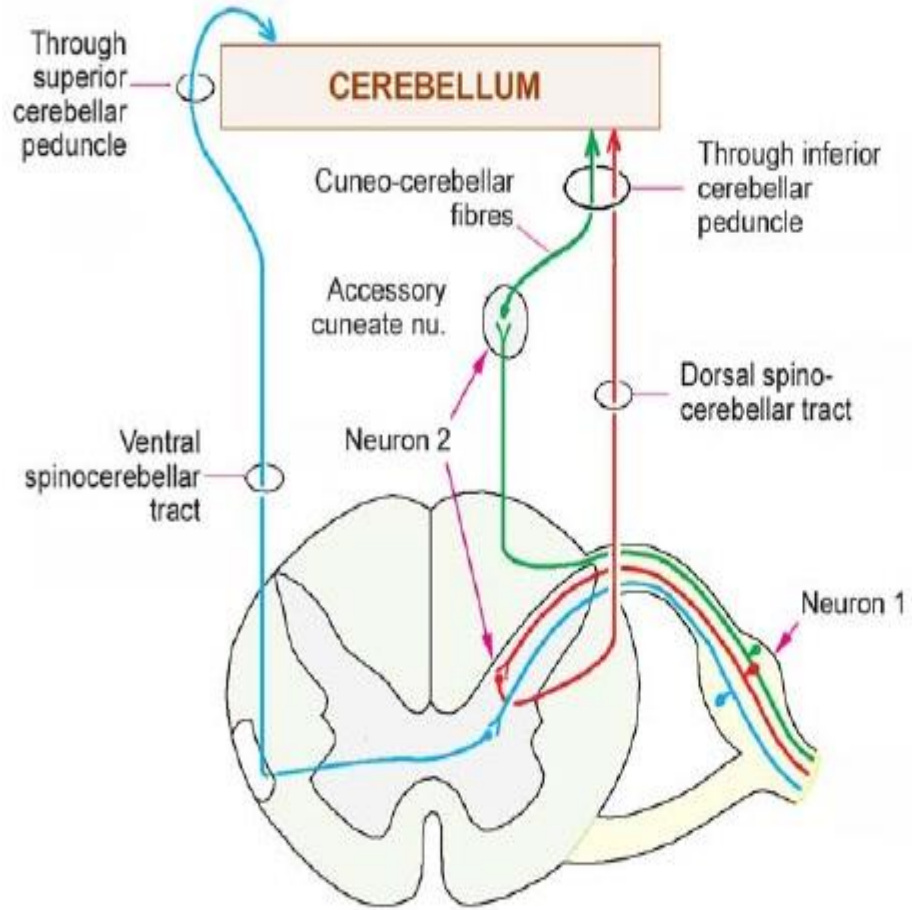


Fig. 9.8.
Scheme to show the main features of the spinocerebellar pathways.

CUNEOCEREBELLAR TRACT

• is the upper-extremity equivalent of the dorsal spinocerebellar tract.

1. First-order neurons

• Are found in the dorsal root ganglia from C2 to T7.

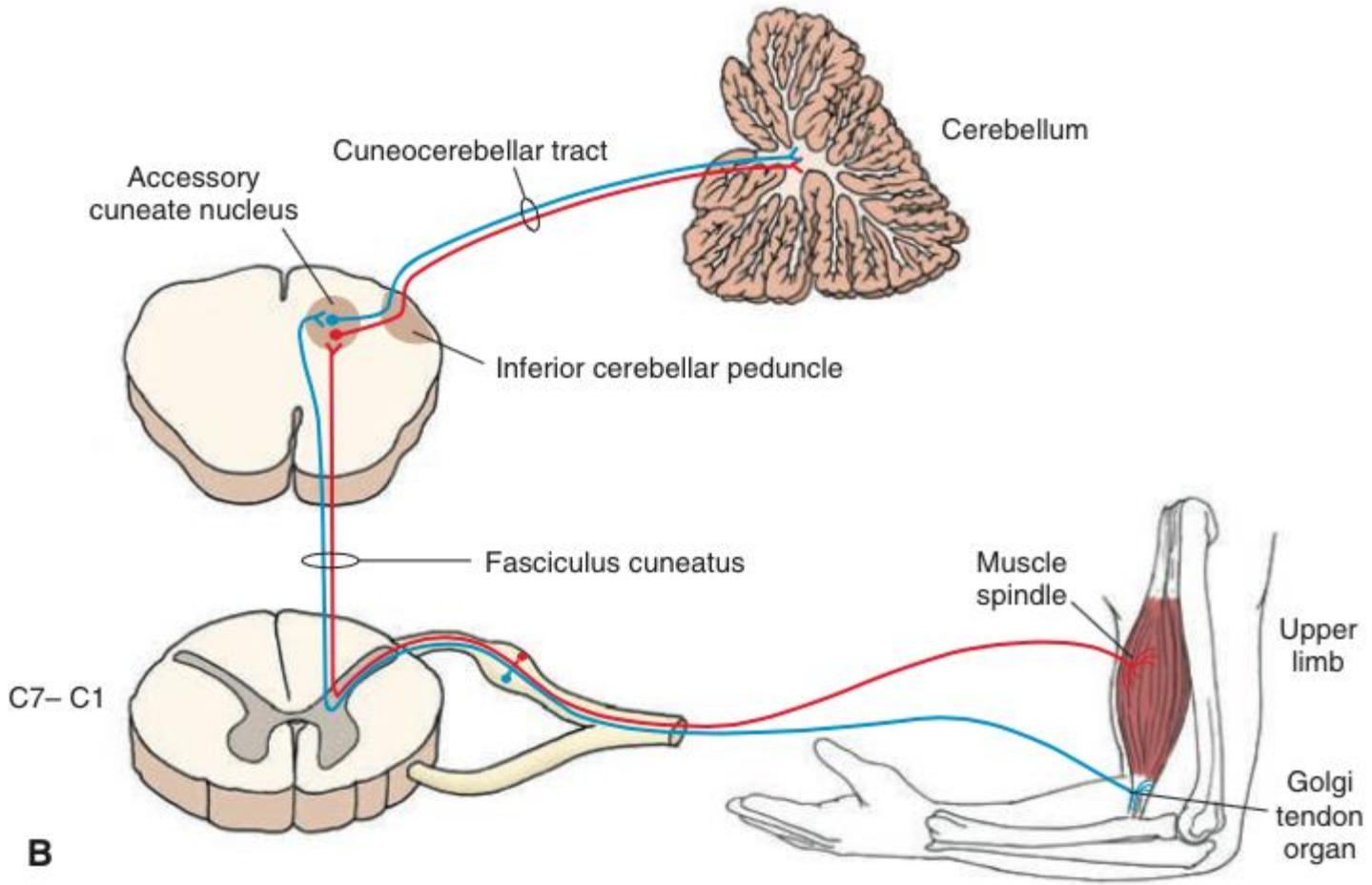
• Project their axons via the fasciculus cuneatus to the caudal medulla, where they synapse in the accessory cuneate nucleus, a homolog of the nucleus dorsalis of Clarke.

2. Second-order neurons

• Are located in the accessory cuneate nucleus of the medulla.

• Give rise to axons that project to the cerebellum via the inferior cerebellar peduncle.

- These axons terminate ipsilaterally in the arm region of the anterior lobe of the cerebellum.



TRACT	RECEPTORS	TRANSMITS?	CROSSED?	1ST ORDER	2ND ORDER	3RD ORDER	TEREMINATES
DC-ML	Pacini, Meissner corpuscles, joint receptors, muscle spindles, (GTOs).	tactile discrimination, vibration, form recognition, joint and muscle sensation, conscious proprioception.	YES	DRG ALL LEVEL	gracile and cuneate nuclei	CONTRA, VPL	POSTCENTRAL GYRUS
Ventral spinothalamic tract	free nerve endings, Merkel tactile disks.	light touch	YES	DRG ALL LEVEL	in the dorsal horn	CONTRA, VPL	POSTCENTRAL GYRUS
Lateral spinothalamic tract	free nerve endings , thermal receptors	itch, pain, and temperature sensation.	YES	DRG ALL LEVEL	in the dorsal horn	CONTRA. VPL neurons	postcentral gyrus
						Intralaminar neurons	Caudatoputamen+ frontal+ parietal cortex
Dorsal Spino-cerebellar Tract	muscle spindles, GTOs, pressure receptors	unconscious proprioceptive/posture OF LOWER LIMB	NO	DRG C8-S3	nucleus dorsalis of Clarke.C8-L3	NO [CEREBELLUM→INF. PEDUNCLE	Ipsi.as mossy fibers / cortex / rostral and caudal cerebellar vermis.
Ventral Spino-cerebellar Tract	muscle spindles, GTOs, pressure receptors	unconscious proprioceptive/posture OF LOWER LIMB	YES	DRG L1 -S2	spinal border cells L1-S2	NO [CEREBELLUM→SUP. PEDUNCLE	Contra. as mossy fibers/ cortex /rostral cerebellar vermis
Cuneo-cerebellar Tract	muscle spindles, GTOs, pressure receptors	unconscious proprioceptive/posture UPPER LIMB	NO	DRG C2-T7	Accessory Cuneate Nucleus /Medulla.	NO CEREBELLUM→ INF. PEDUNCLE	IPSI. arm region/ANT. LOBE/ cerebellum.