UNIVERSITÀ DEGLI STUDI DI TRIESTE

DEPARTMENT OF MEDICINE, SURGERY AND HEALTH SCIENCES

NEUROLOGY UNIT

Course of
Human Neuroanatomy

Master of Neuroscience, University of Trieste
2026-27

Dr. Federica Palacino

Spinal cord: from embryogenesis to adulthood

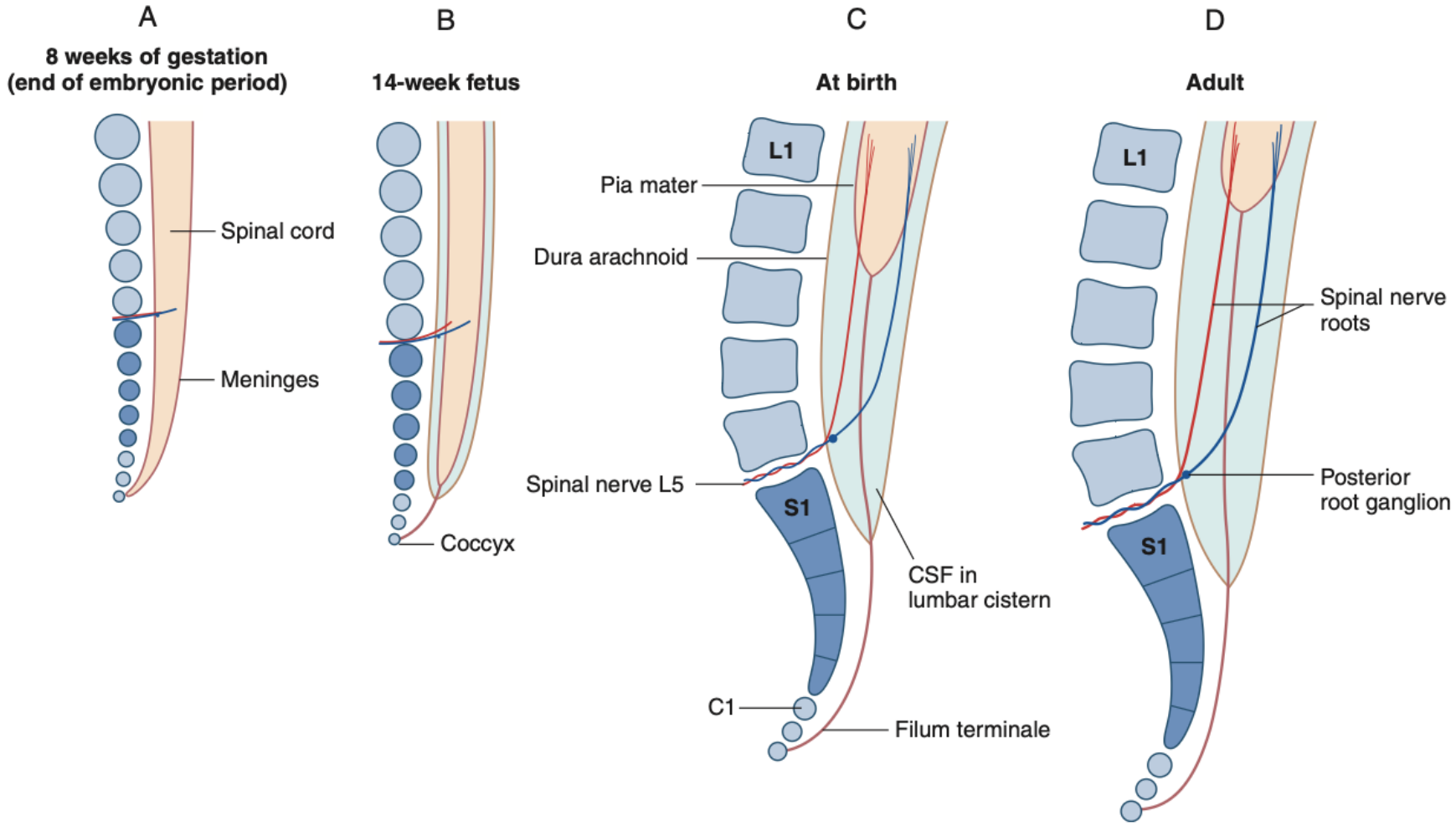


FIGURE 14.2 **(A, B)** Regression of coccygeal segments of the spinal cord creates the filum terminale. **(C, D)** Ascent of the spinal cord. (*Note:* Recent evidence indicates that, as represented here, the number of embryonic coccygeal vertebrae does not exceed three or four.)

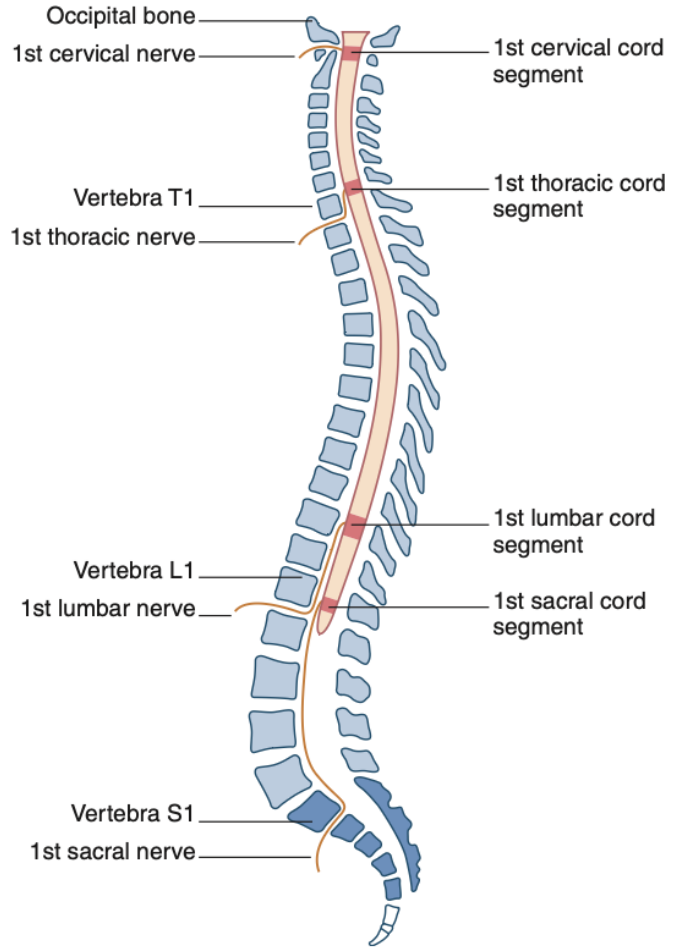
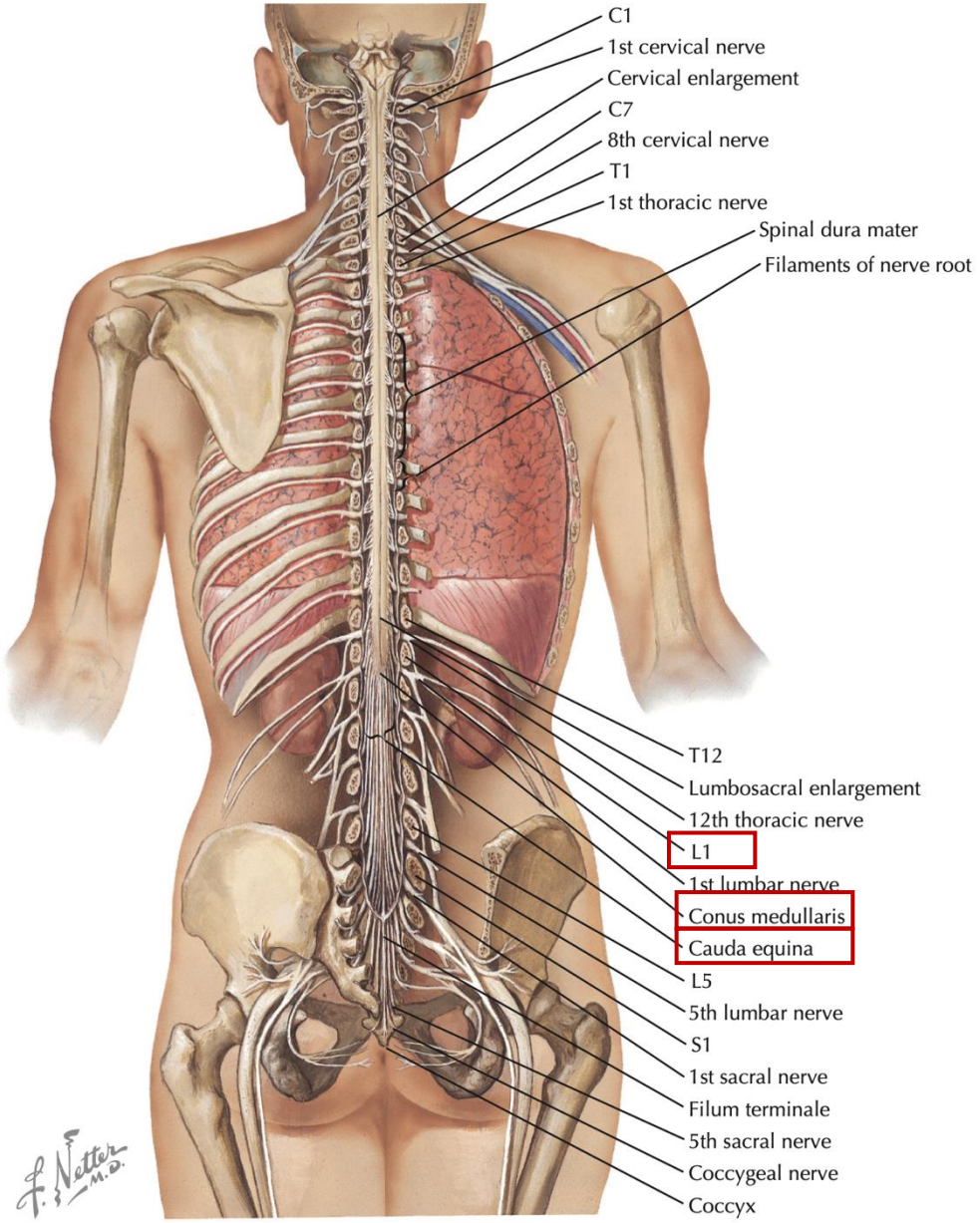
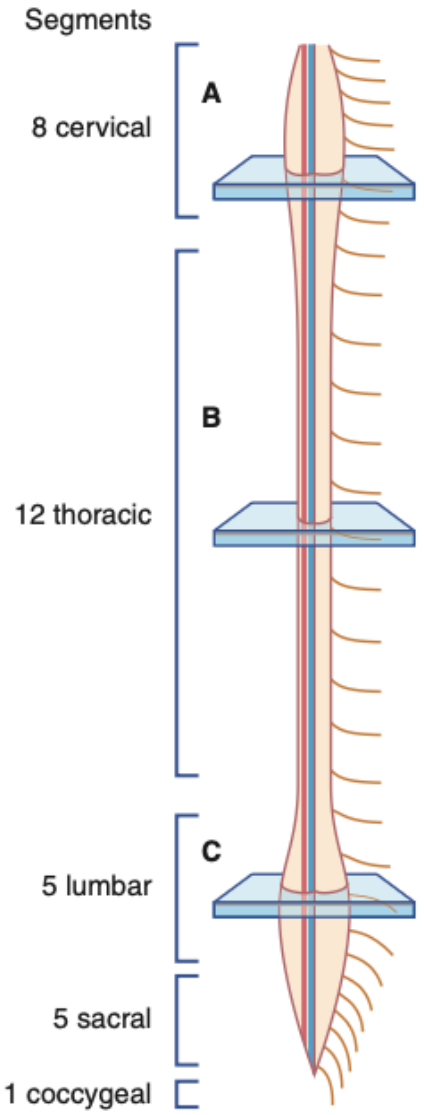


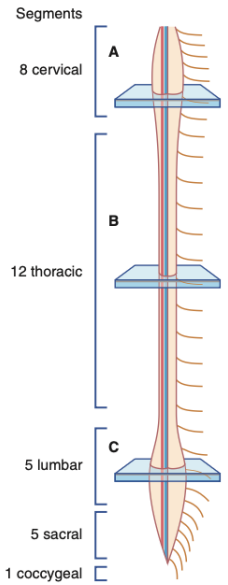
FIGURE 14.3 Segmental and vertebral levels compared. Spinal nerves 1 to 7 emerge above the corresponding vertebrae; the remaining spinal nerves emerge below.

Spinal cord: coronal section, dorsal view





Spinal cord



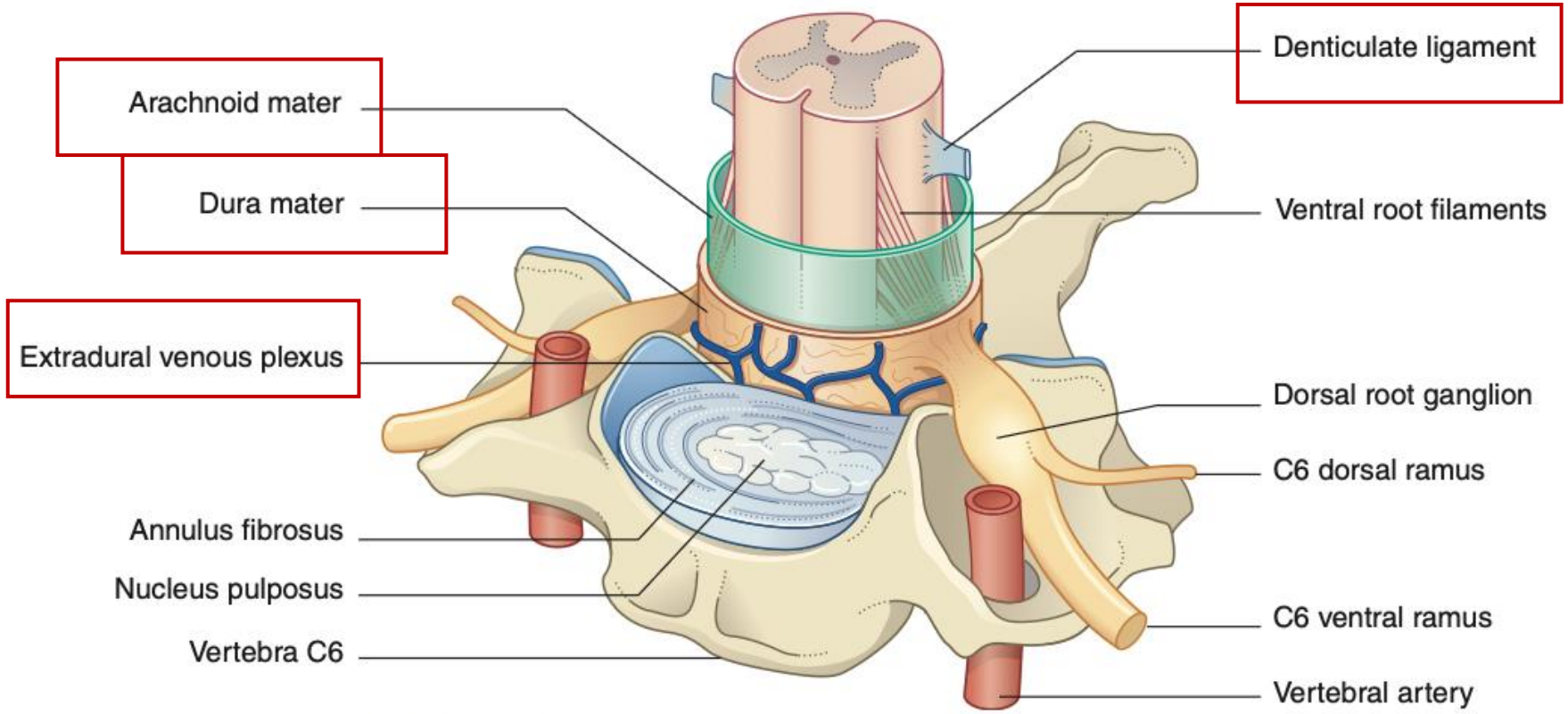


FIGURE 14.7 Relationships of the sixth cervical spinal nerve.

Spinal cord

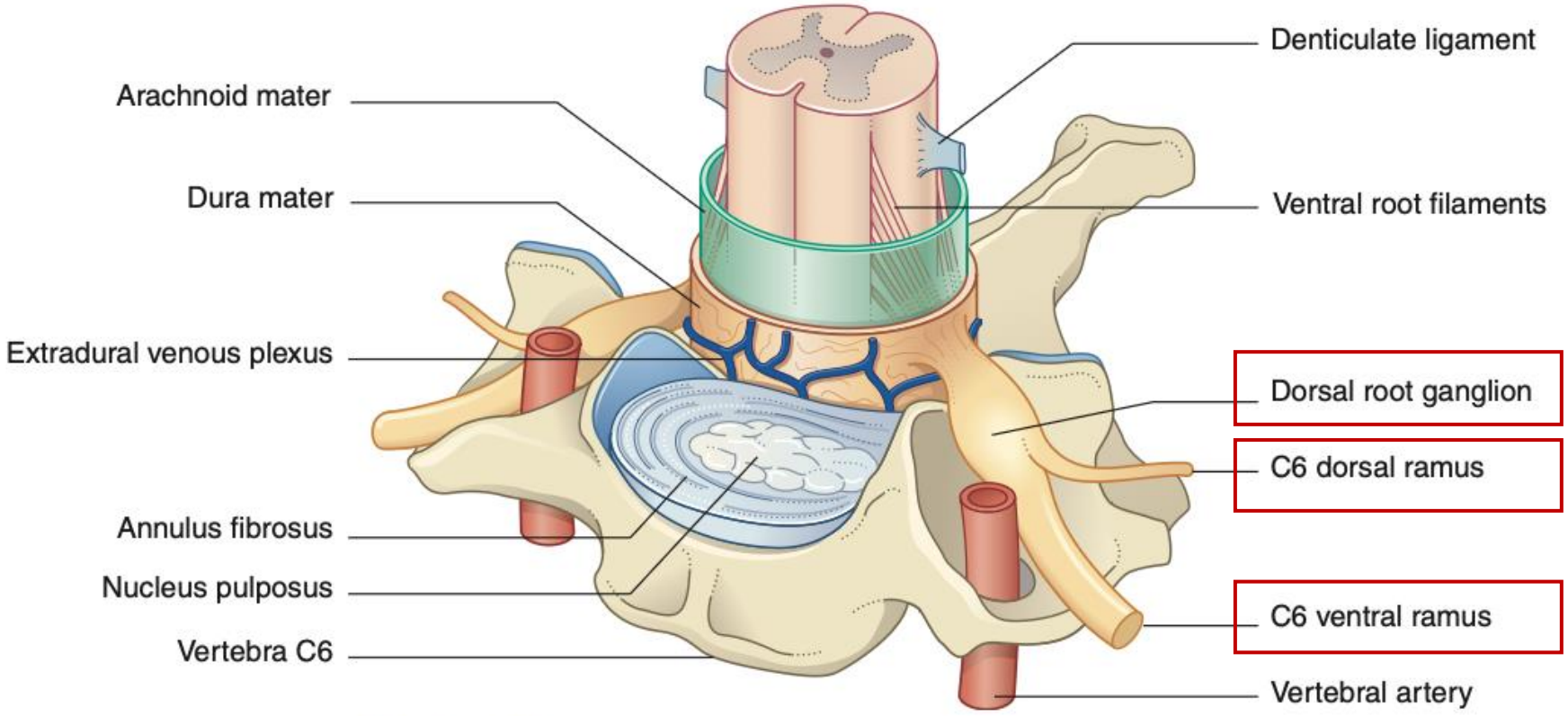
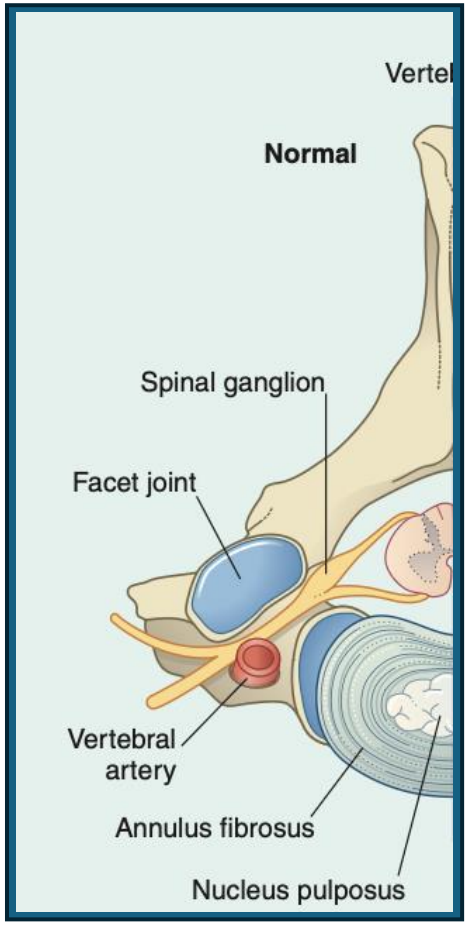
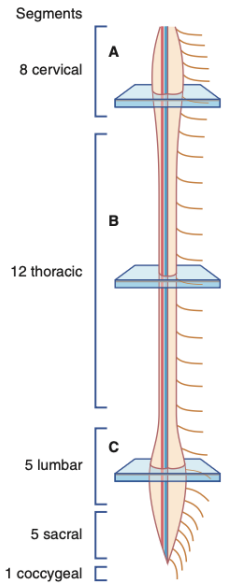


FIGURE 14.7 Relationships of the sixth cervical spinal nerve.



Spinal cord



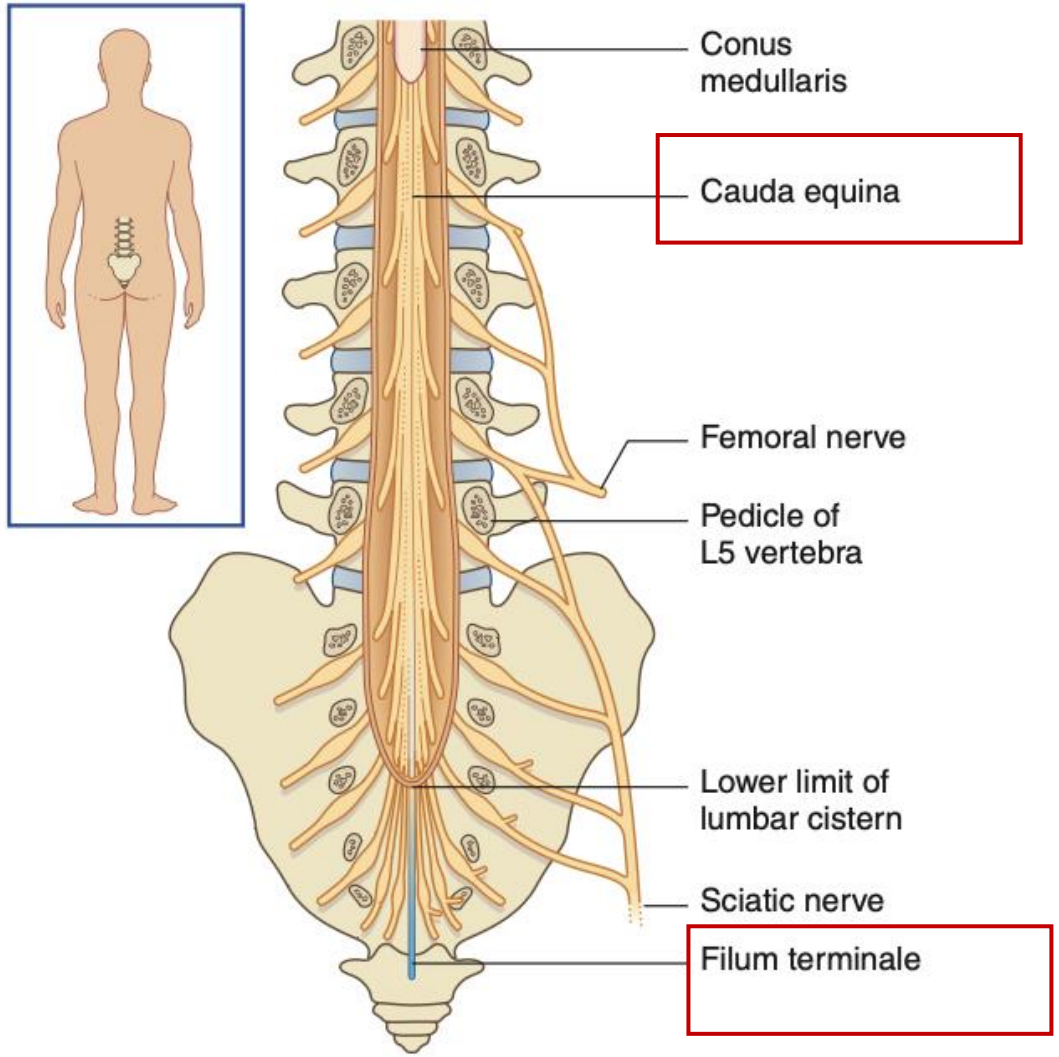
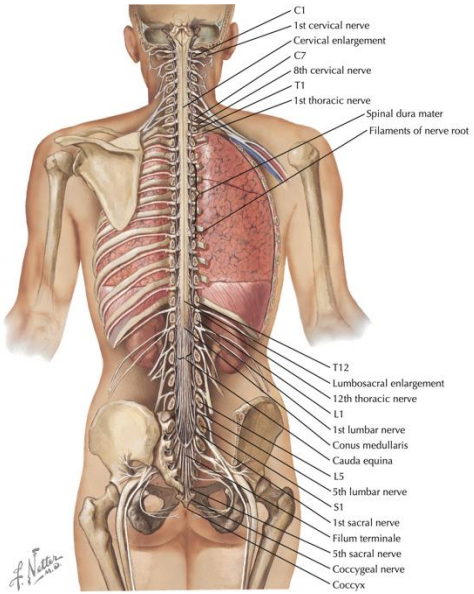
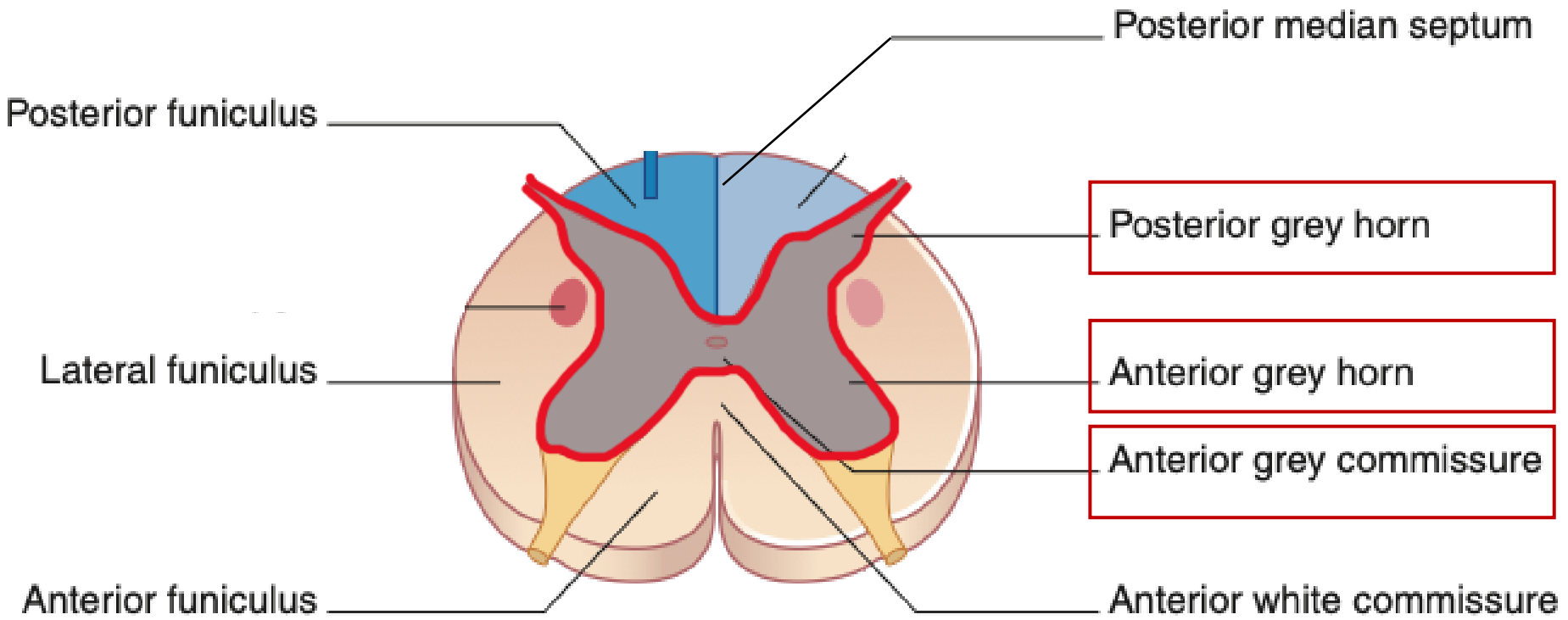


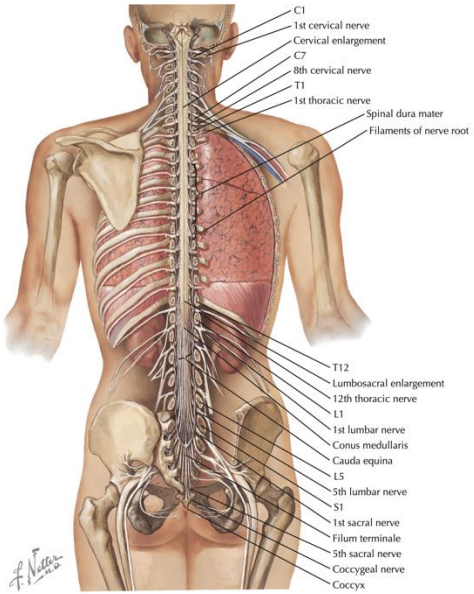
FIGURE 14.8 The cauda equina in the lumbar cistern. Contributions to the femoral and sciatic nerves are shown on the right side.

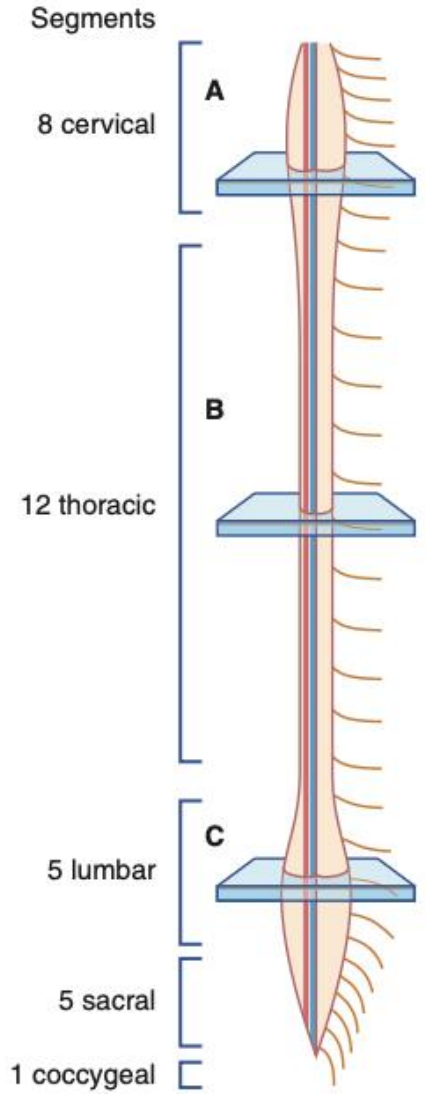
Spinal cord: transverse section, GM

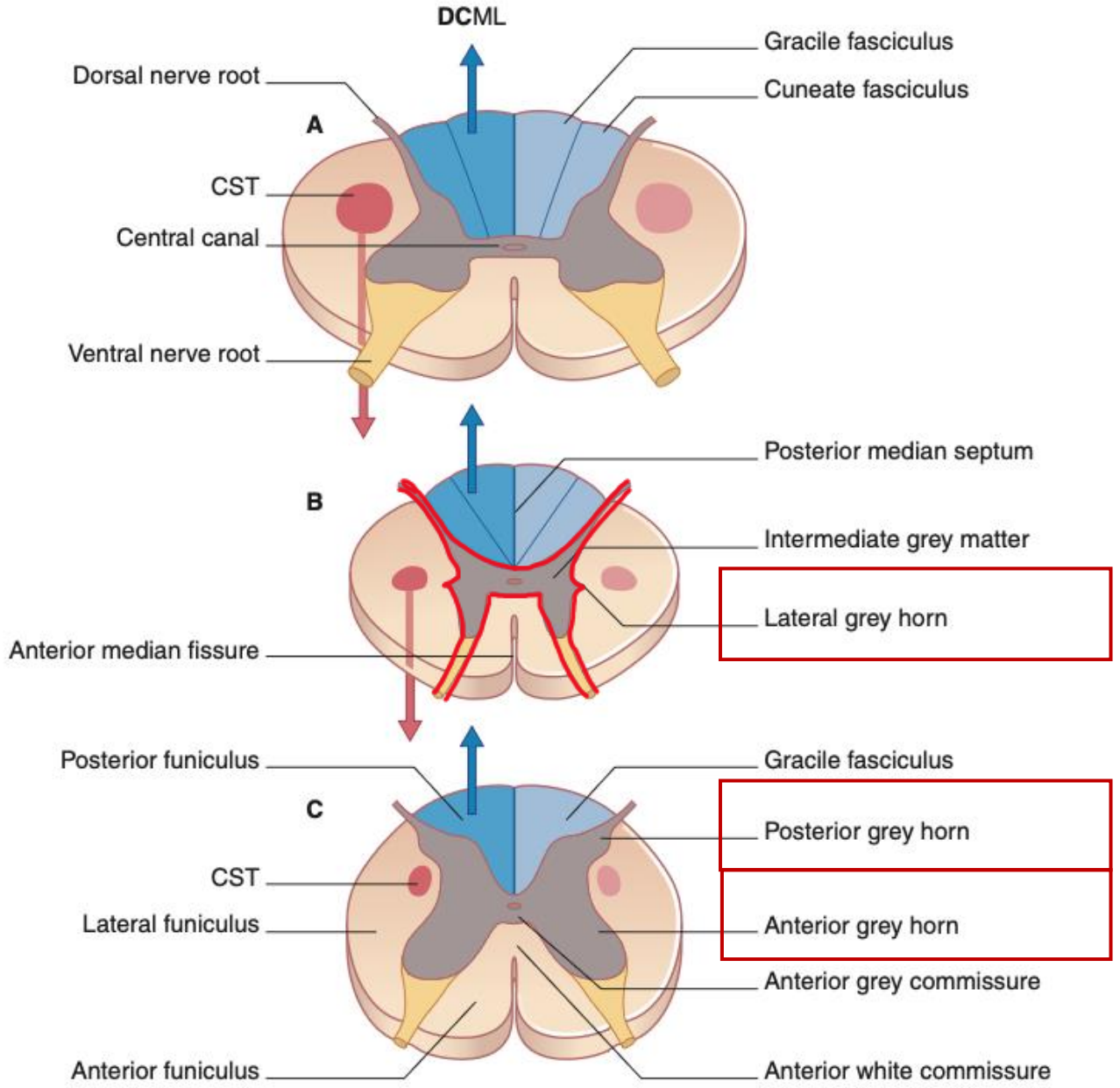




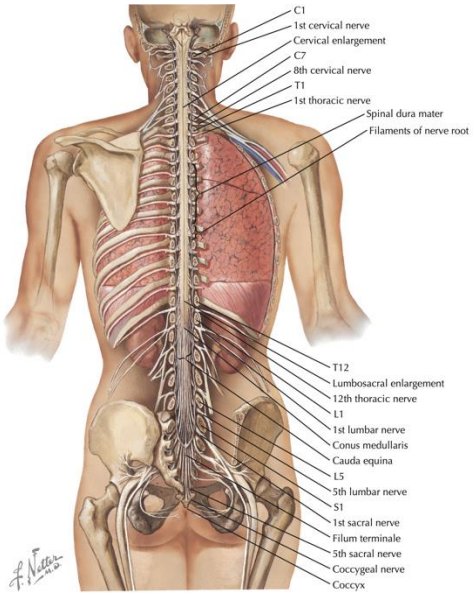
Spinal cord: transverse section, GM

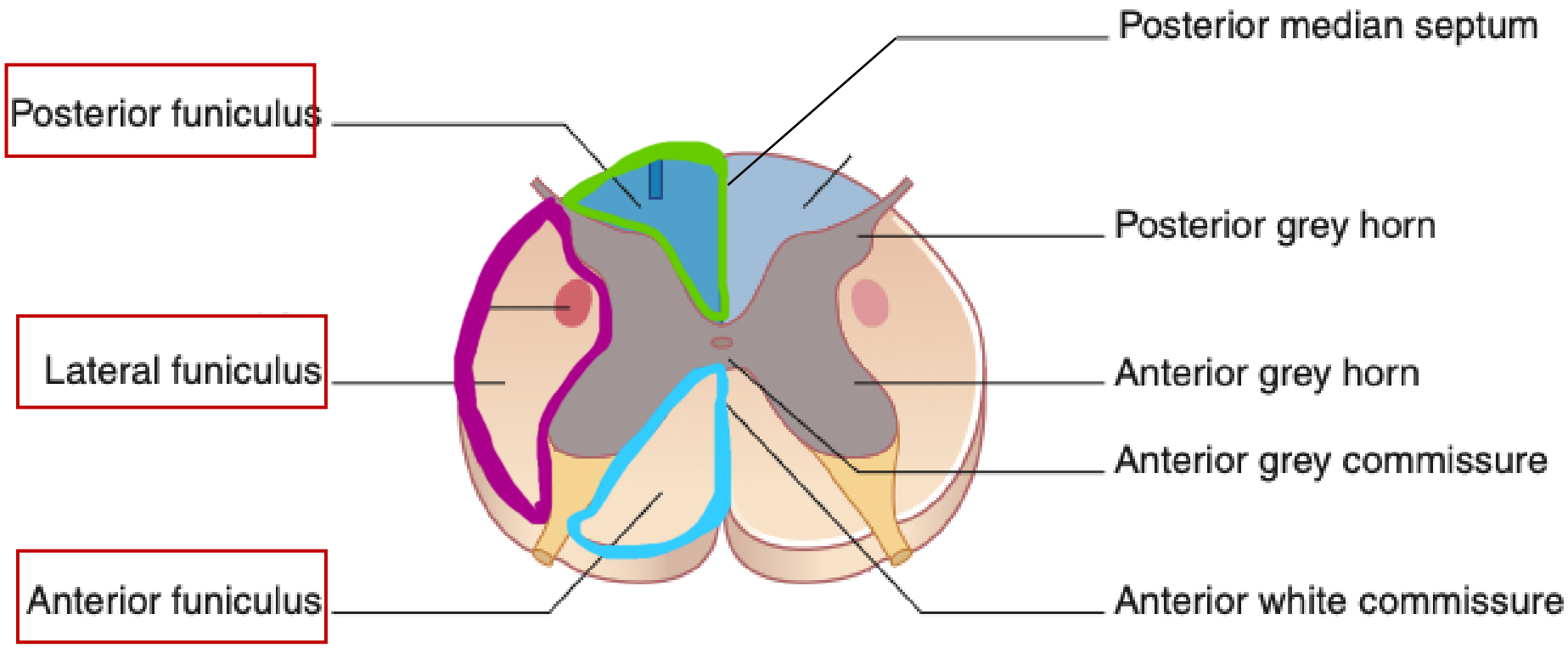




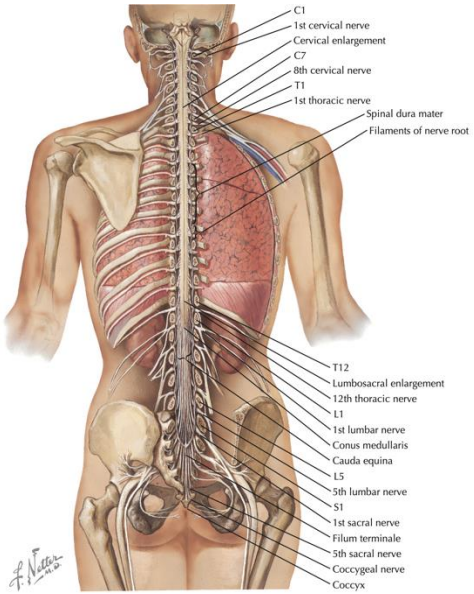


Spinal cord: transverse section, WM

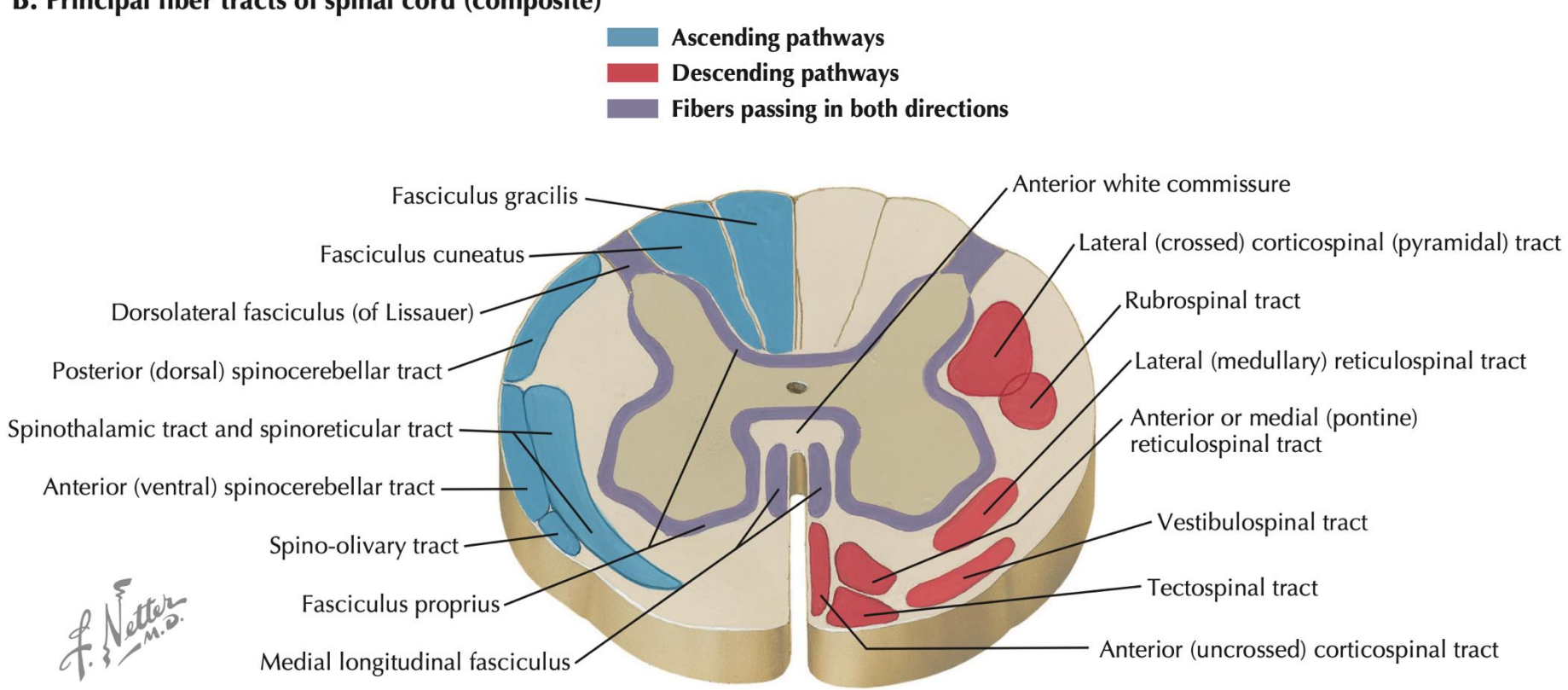




Spinal cord: transverse section, WM







Spinal cord: transverse section

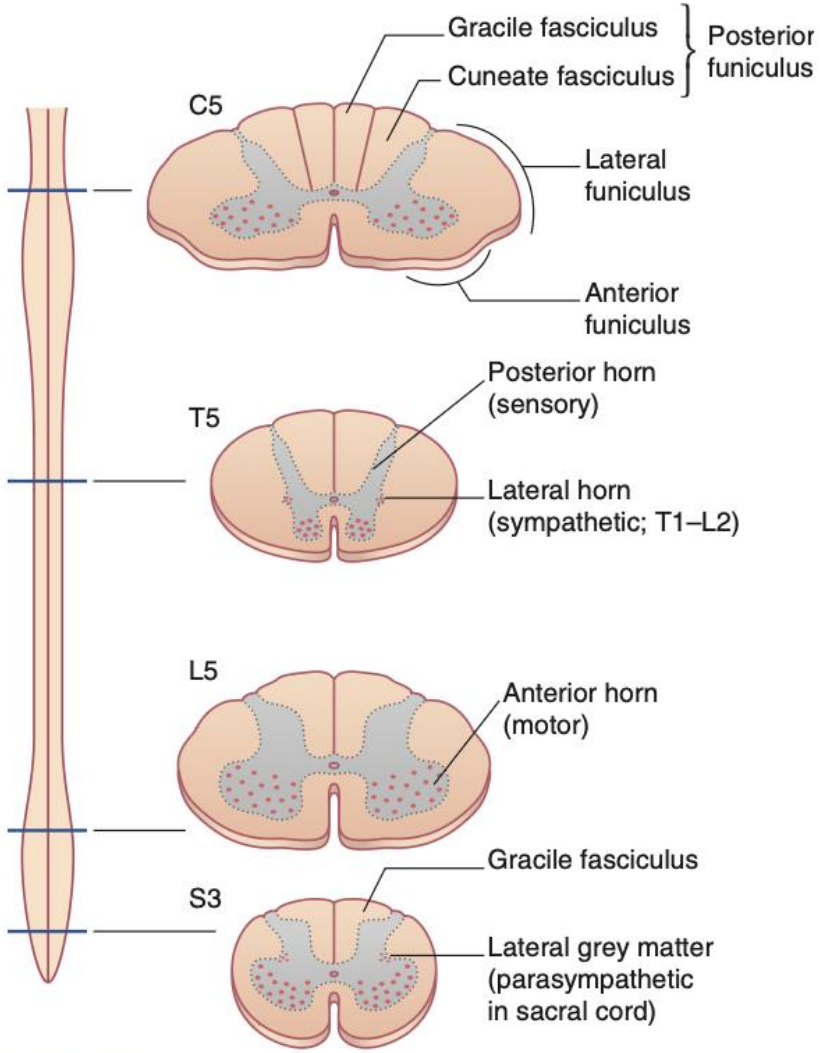


FIGURE 15.1 Representative transverse sections of the spinal cord.

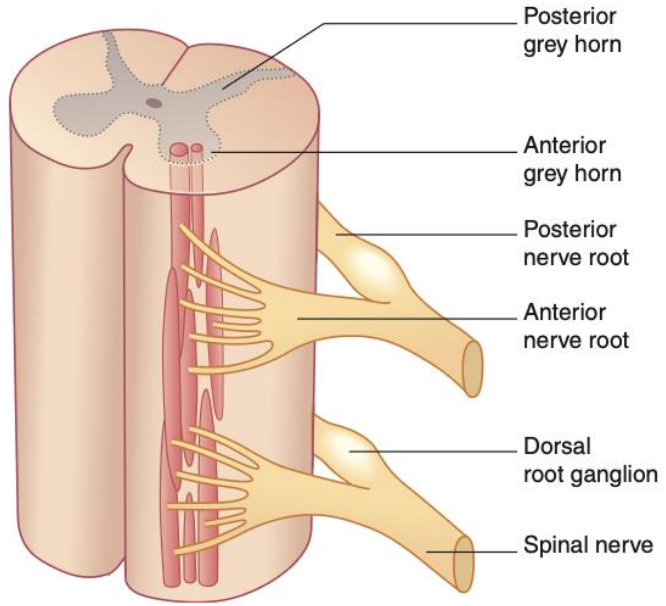


FIGURE 15.2 Two segments of the spinal cord, showing cell columns in the ventral grey horn.

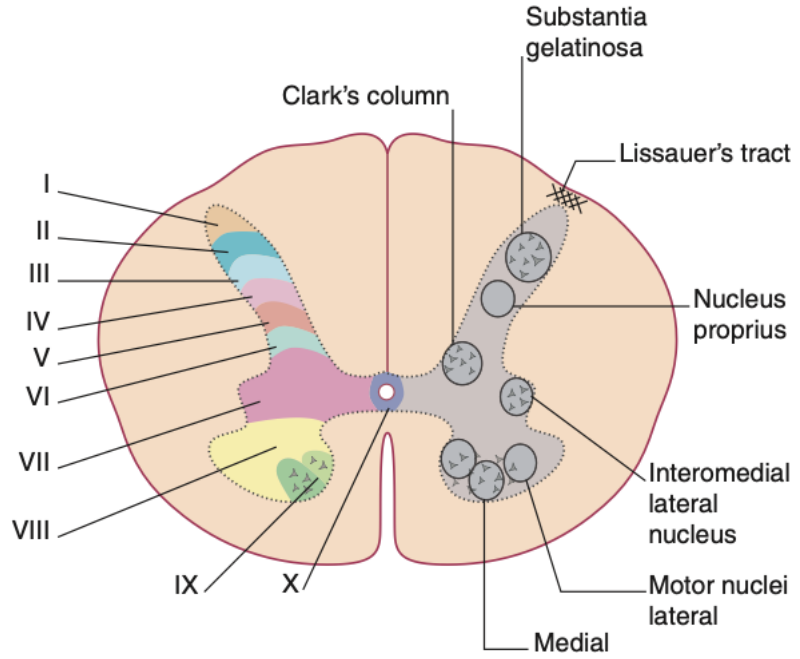


FIGURE 15.3 Laminae (I to X) and named cell groups at midthoracic level.

Spinal cord: transverse section

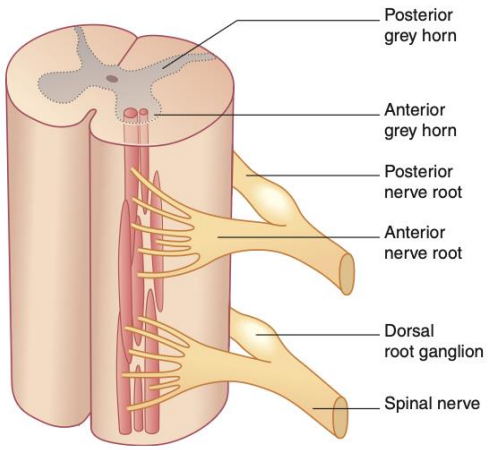


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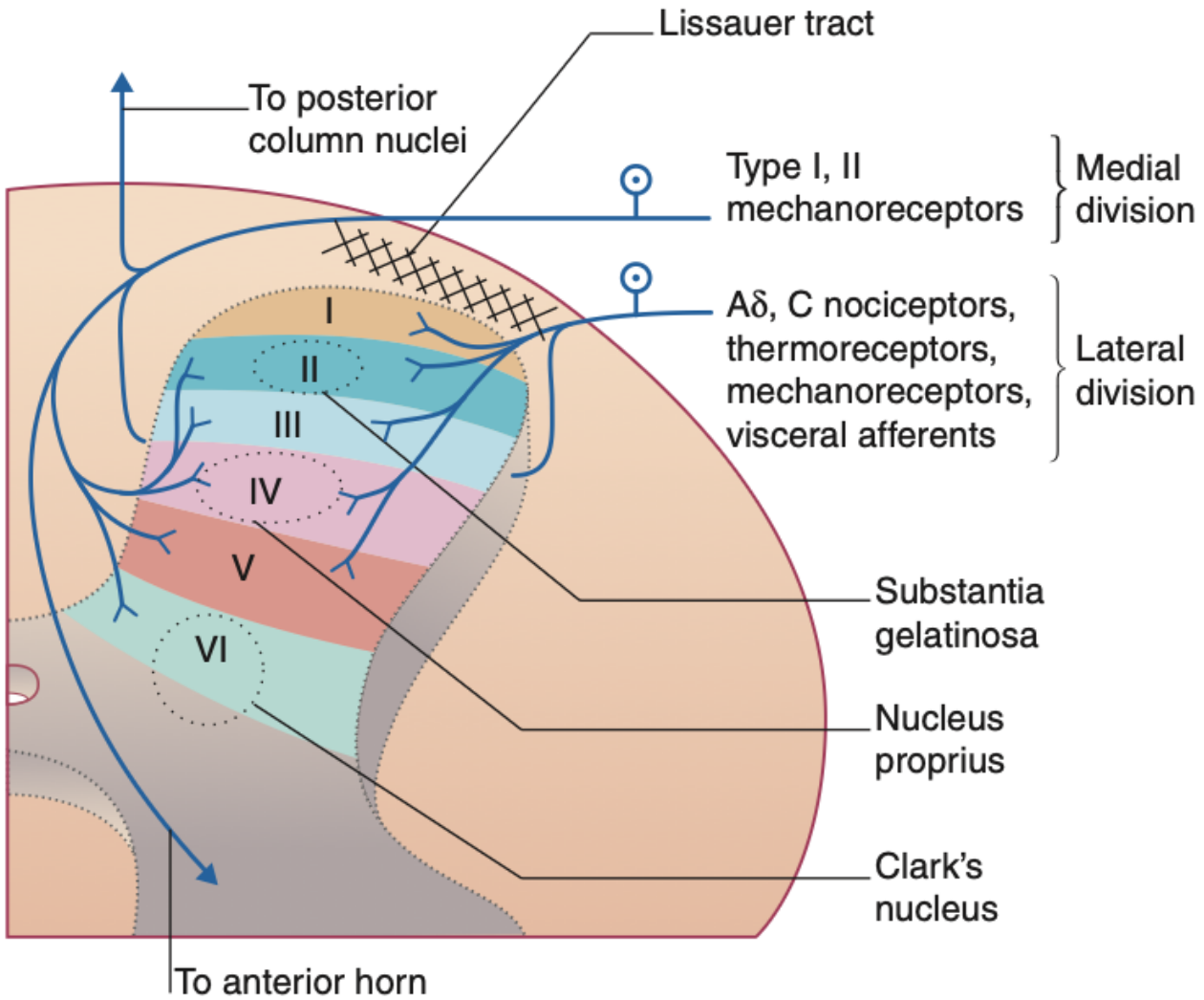


FIGURE 15.5 Targets of primary afferent neurons in the dorsal grey horn.

Spinal cord: transverse section

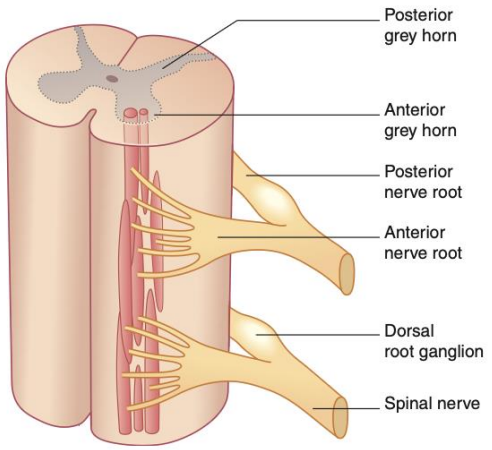


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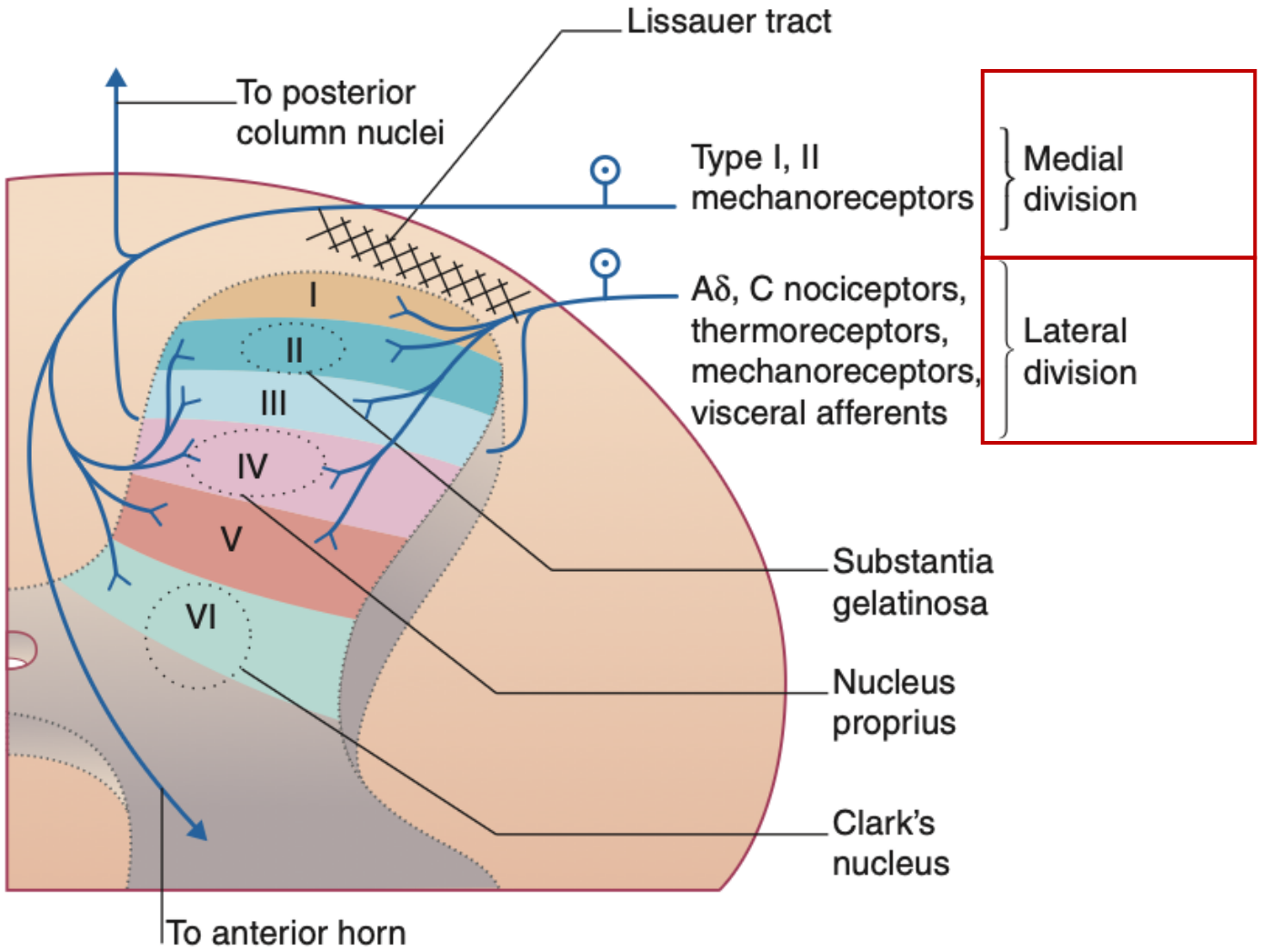


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Spinal cord: transverse section

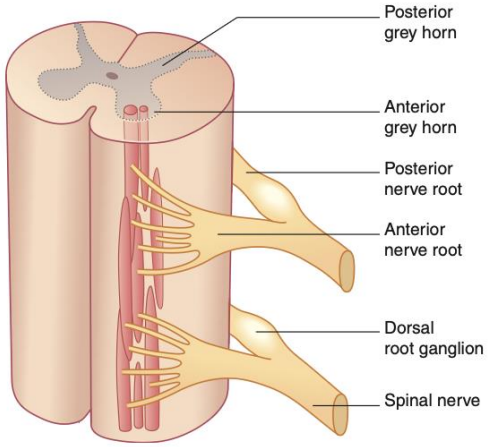


FIGURE 15.2 Two segments of the spinal cord, showing cell columns in the ventral grey horn.

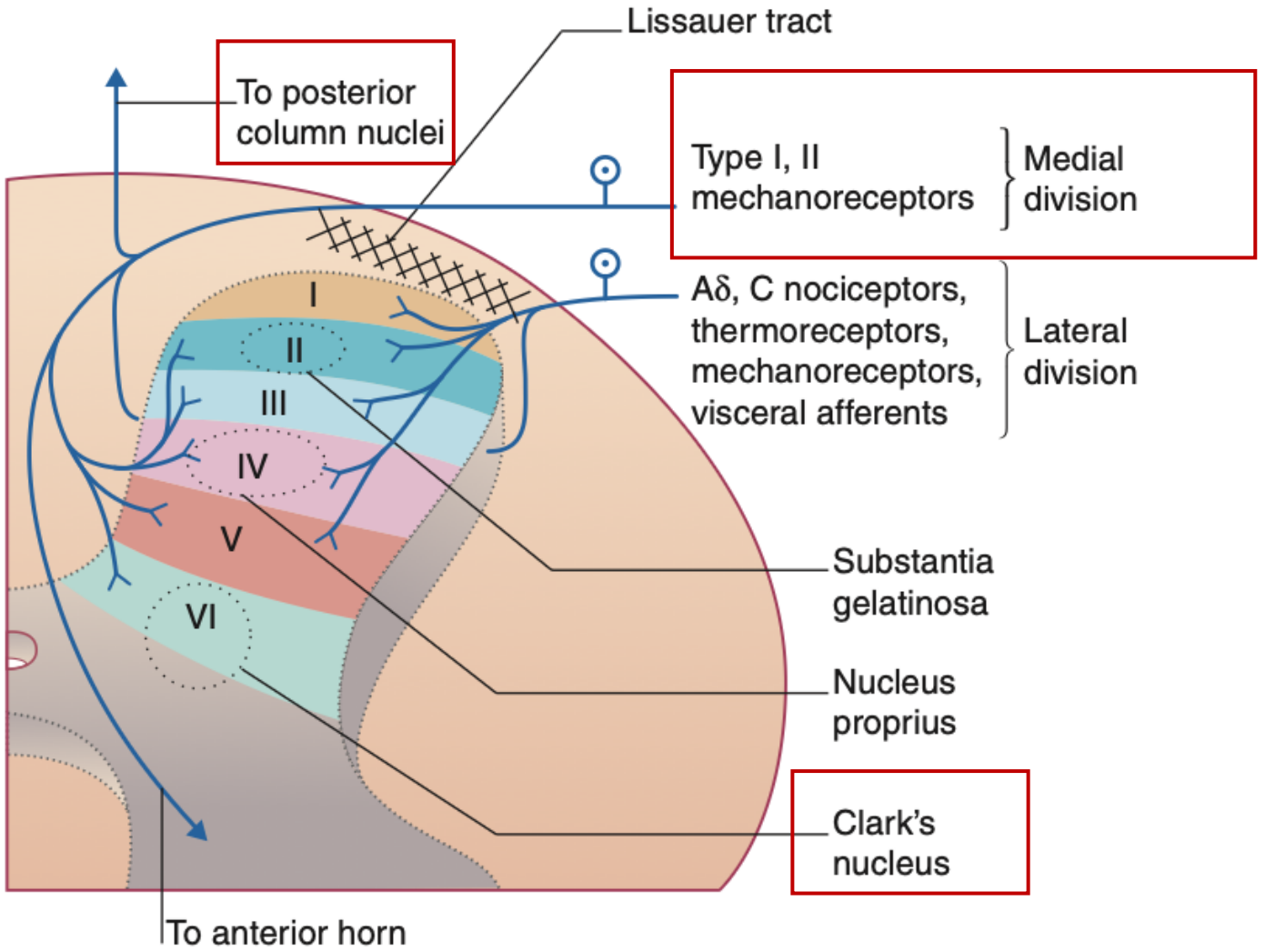


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Spinal cord: transverse section

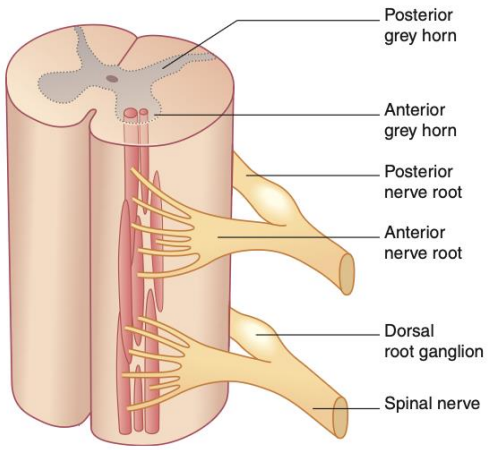


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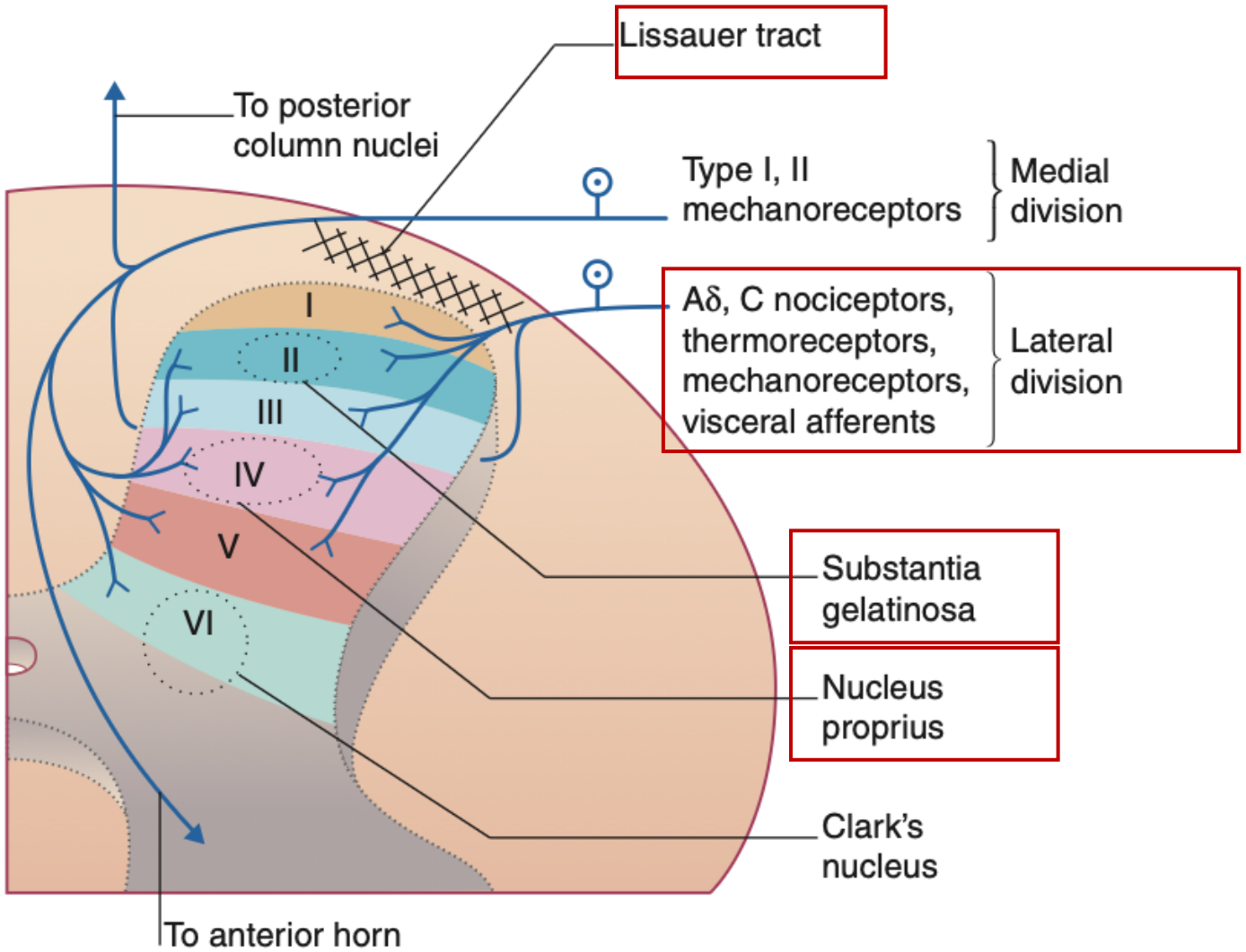


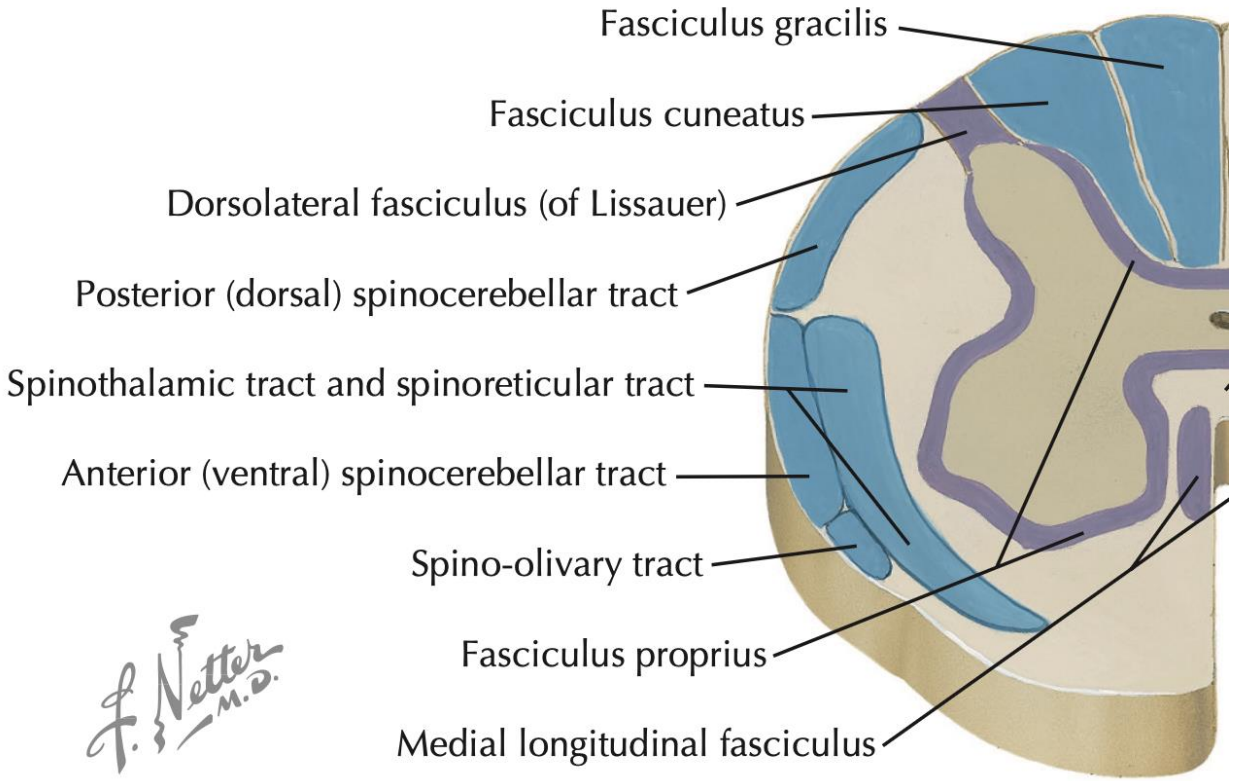
FIGURE 15.5 Targets of primary afferent neurons in the dorsal grey horn.

Ascending sensory pathways

Types of sensation:

- Conscious sensations, that are perceived at the level of the cerebral cortex,

- Unconscious sensations, that are not perceived and relayed to the cerebellum.

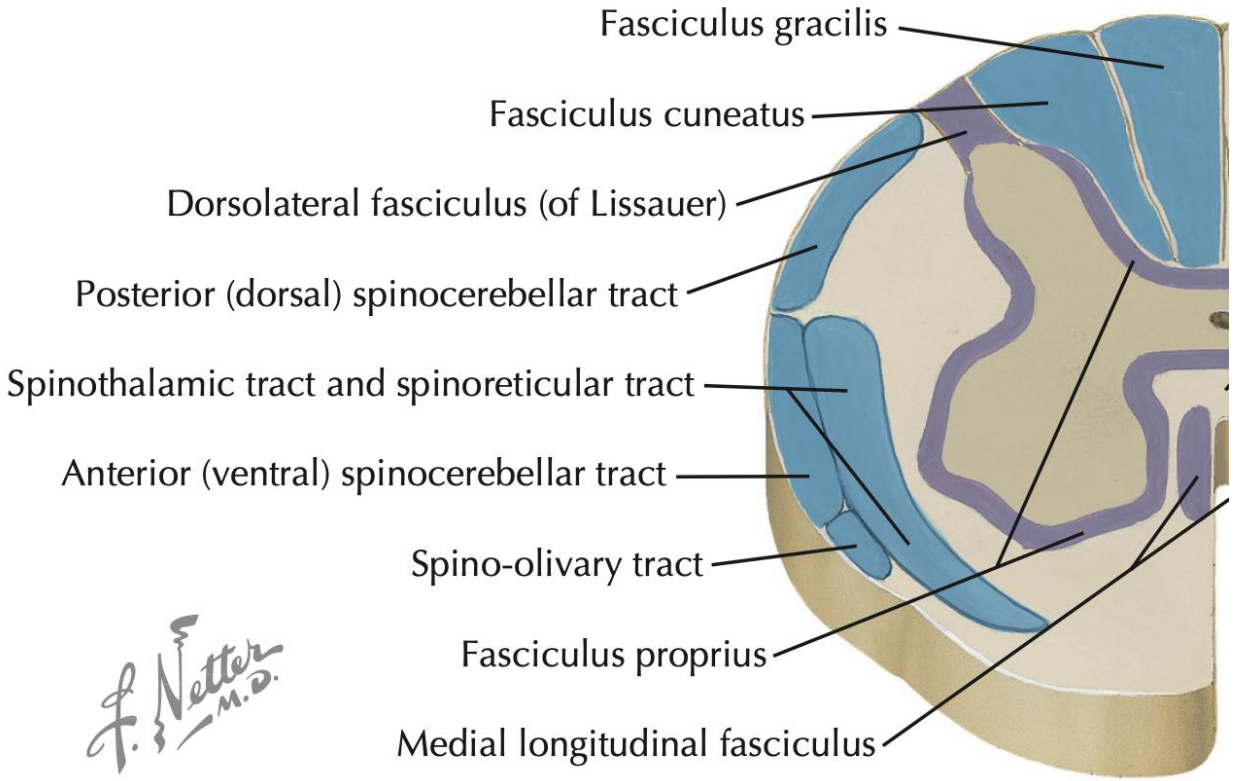


Ascending sensory pathways

Types of sensations:

- Conscious sensations, that are perceived at the level of the cerebral cortex
  - Exteroceptive sensations
  - Propioceptive sensations

- Unconscious sensations, that are not perceived and relayed to the cerebellum.

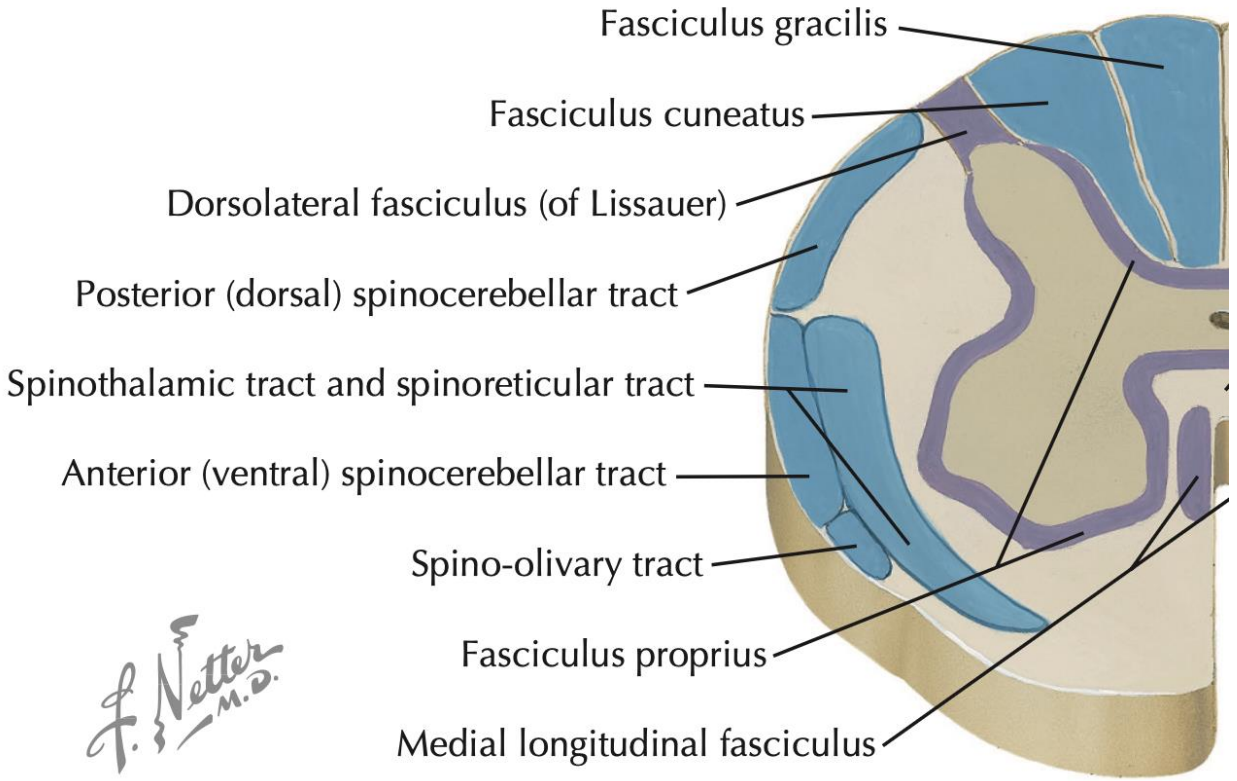


Ascending sensory pathways

Types of sensations:

- Conscious sensations, that are perceived at the level of the cerebral cortex
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- Unconscious sensations, that are not perceived and relayed to the cerebellum.
  - Unconscious propioception
  - Interoception

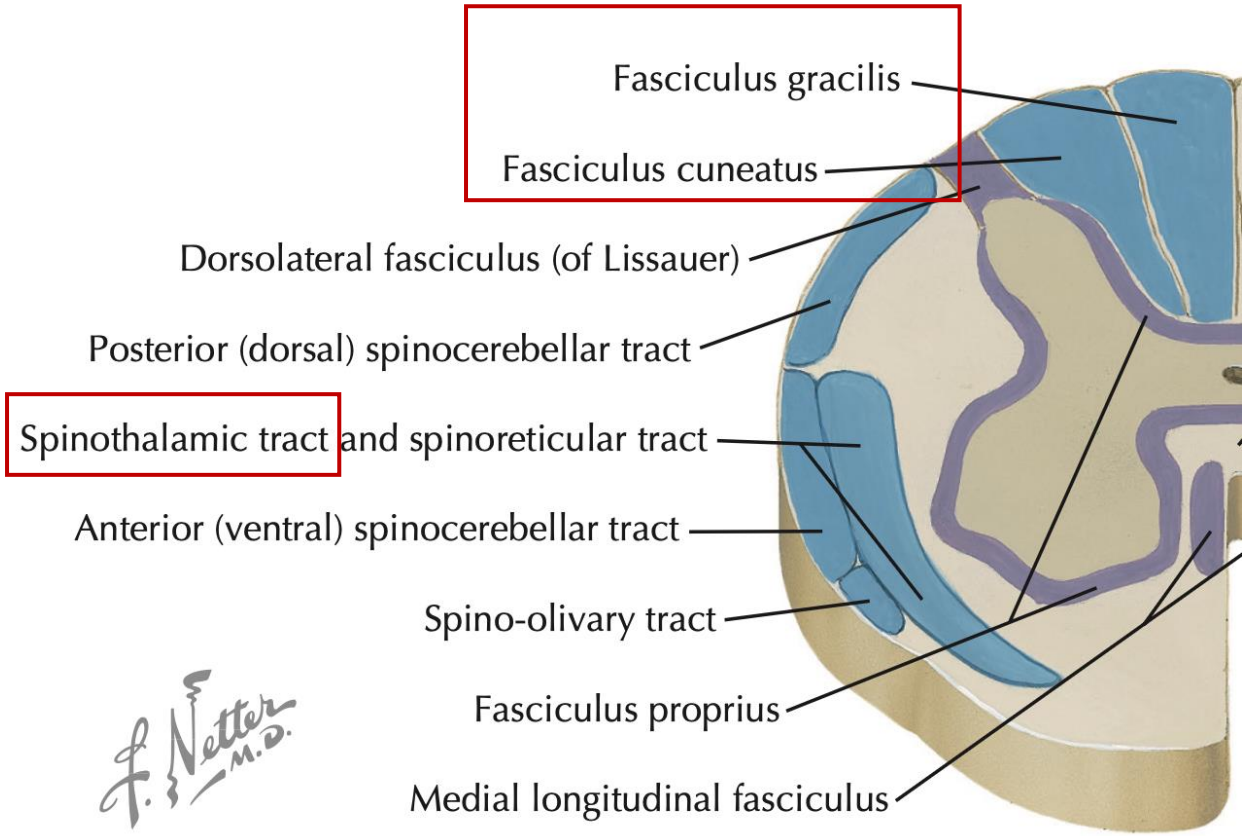


Ascending sensory pathways

Types of sensations:

- Conscious sensations, that are perceived at the level of the cerebral cortex
  - **Exteroceptive sensations (Spinothalamic tract)**
  - Propioceptive sensations (**DCML)**

- Unconscious sensations, that are not perceived and relayed to the cerebellum.
  - Unconscious propioception
  - Interoception



Ascending sensory pathways

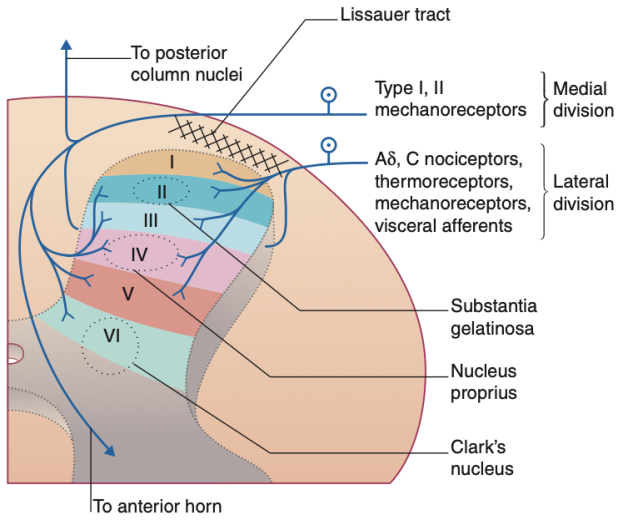
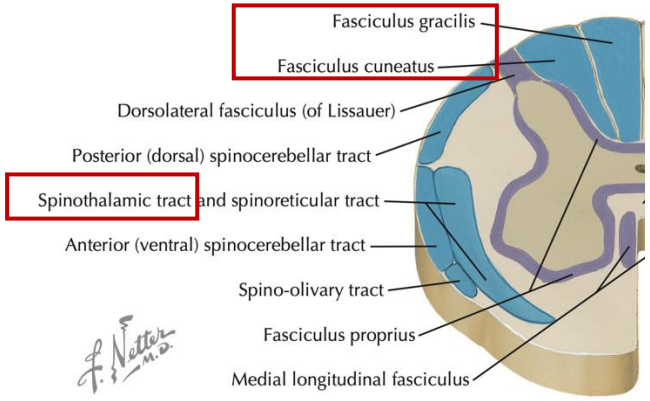


FIGURE 15.5 Targets of primary afferent neurons in the dorsal grey horn.



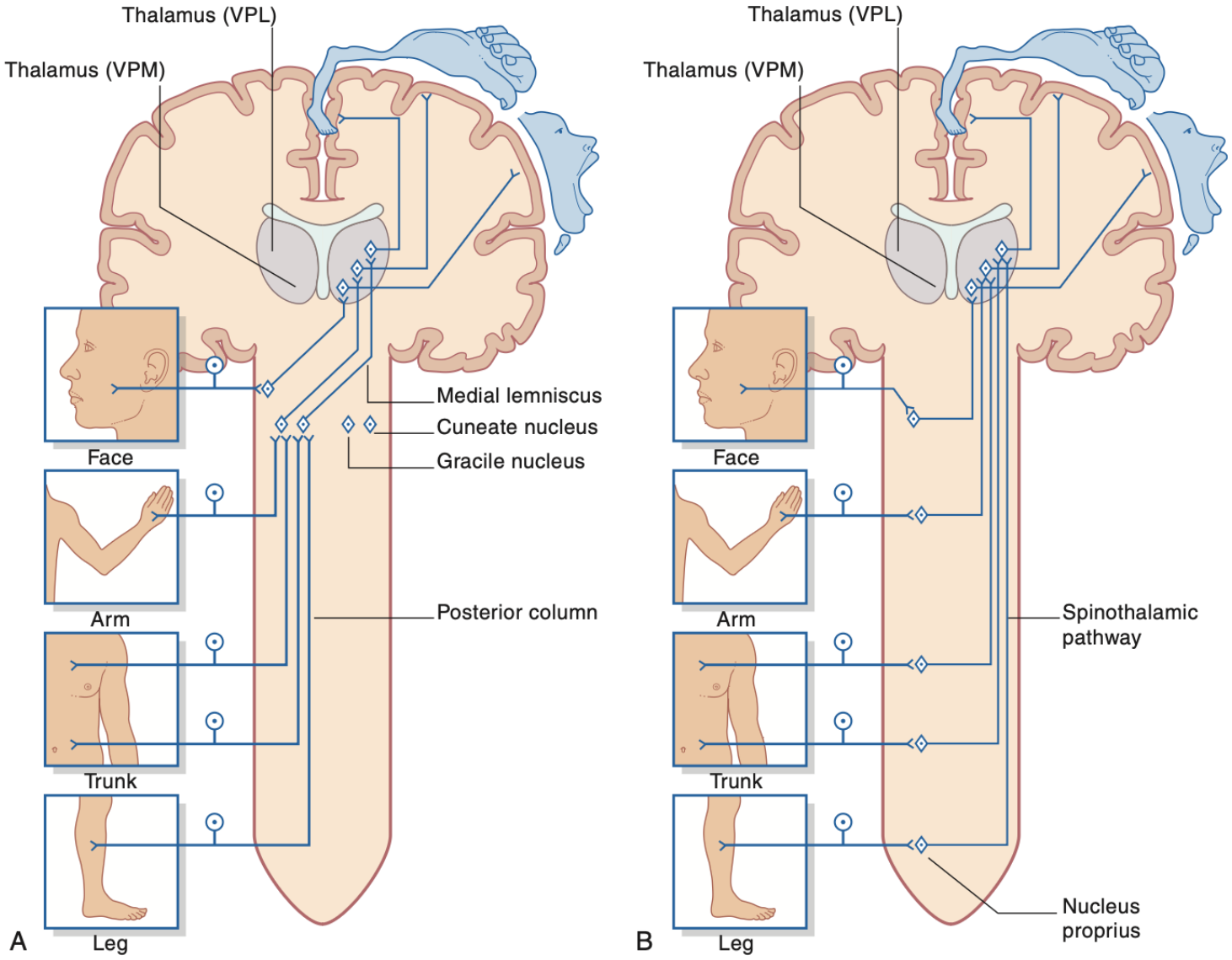


FIGURE 15.7 Basic plans of the **(A)** dorsal column–medial lemniscal pathway and **(B)** spinothalamic tract. VPL, VPM, ventral posterolateral, ventral posteromedial nuclei of the thalamus.

Ascending sensory pathways

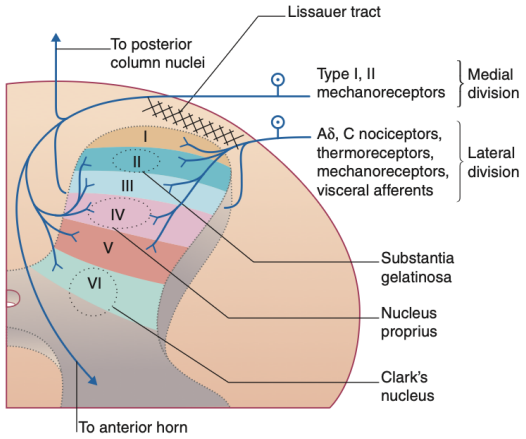


FIGURE 15.5 Targets of primary afferent neurons in the dorsal grey horn.

- The somas of the first-order neurons, or primary afferents, occupy the dorsal root ganglia.
- The somas of the second-order neurons occupy CNS grey matter on the same side as the first-order neurons.
- The second-order axons cross the midline and then ascend to terminate in the thalamus.
- The third-order neurons project from the thalamus to the somato-sensory cortex.
- They are somatotopic: an orderly map of body parts can be identified experimentally in the grey matter at each of the three loci of fibre termination.
- Synaptic transmission from primary to secondary neurons and from secondary to tertiary neurons can be modulated (inhibited or enhanced) by other neurons.

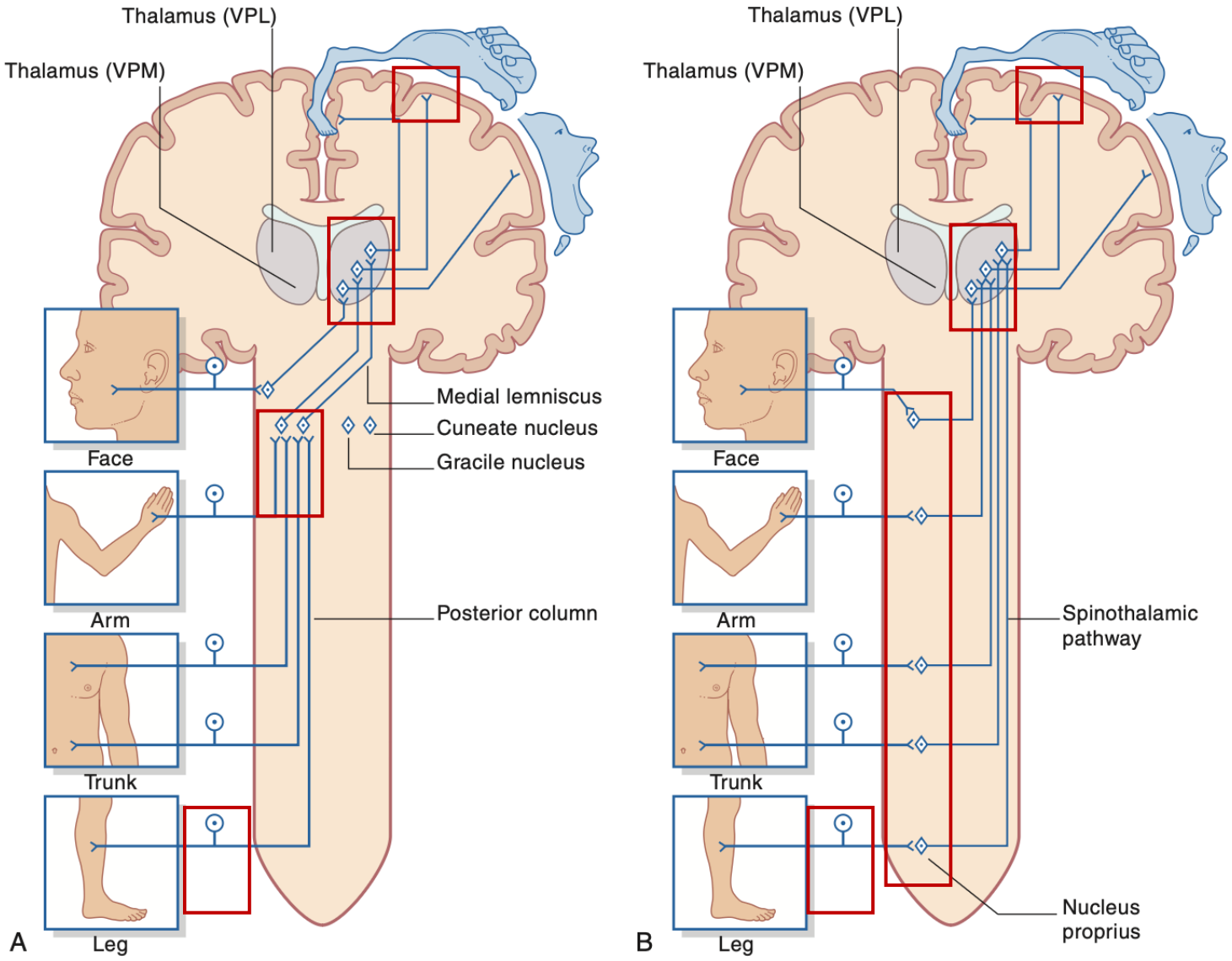


FIGURE 15.7 Basic plans of the **(A)** dorsal column–medial lemniscal pathway and **(B)** spinothalamic tract. VPL, VPM, ventral posterolateral, ventral posteromedial nuclei of the thalamus.

Dorsal column–medial lemniscal pathway

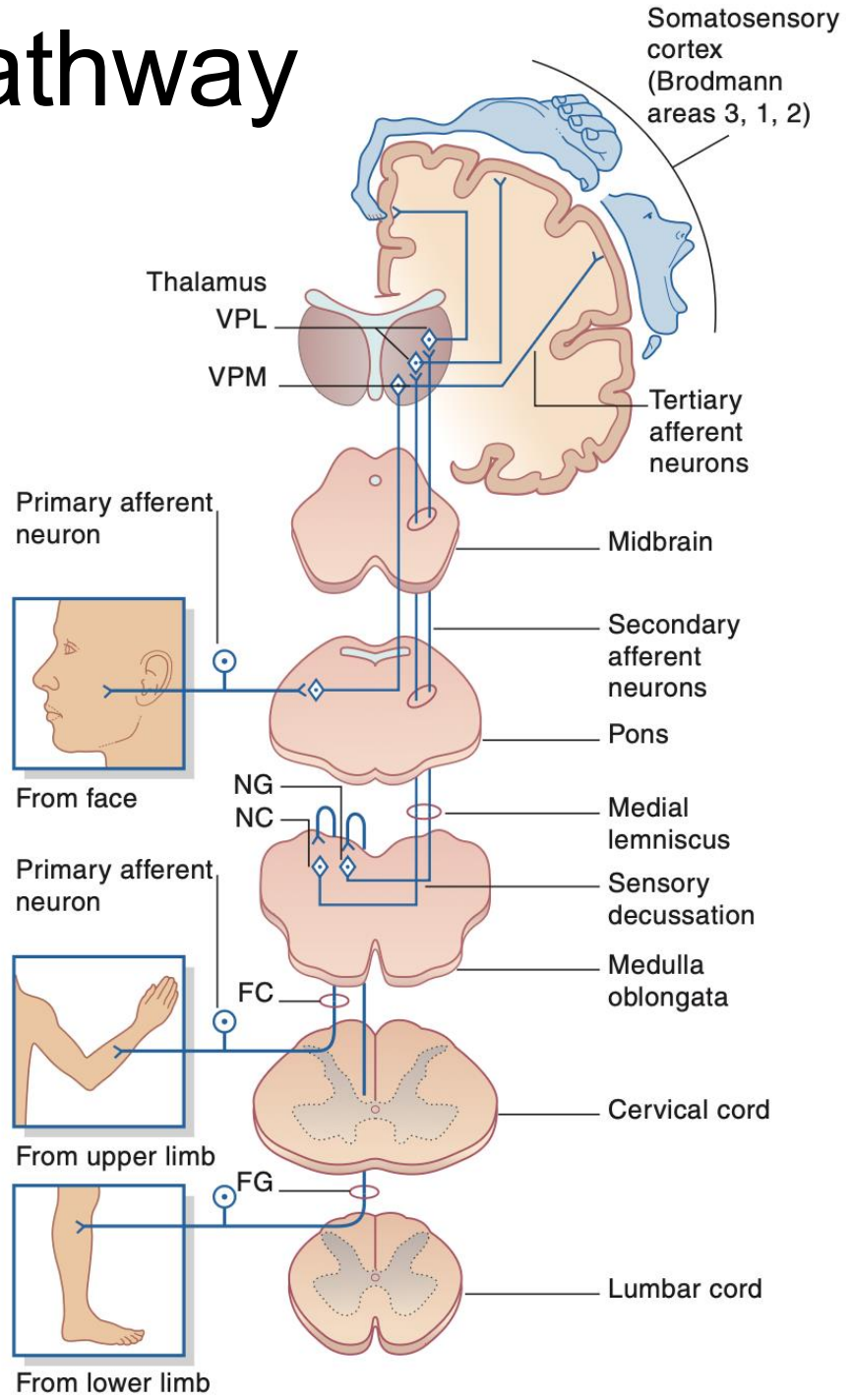
- Sensory receptors: Meissner and Pacini corpuscles, Ruffini endings and Merkel cell–neurite complexes, neuromuscular spindles, and Golgi tendon organs.
- First order neurons, or psudounipolar (T) cells (dorsal root ganglia):
  - cells supplying the lower limb and lower trunk give branches to the spinal cord grey matter before ascending as the fasciculus gracilis to reach the nucleus gracilis in the medulla oblongata
  - cells supplying the upper limb and upper trunk run in the fasciculus cuneatus to reach the nucleus cuneatus.

Synapsis in the gracile and cuneatus nuclei

- Second order neurons:They commence in the dorsal column nuclei (the nucleus gracilis and nucleus cuneatus) They pass ventrally in the tegmentum of the medulla oblongata before crossing in the sensory decussation. Having crossed the midline, the fibres turn rostrally and ascend as the medial lemniscus. The medial lemniscus diverges from the midline as it ascends through the tegmentum of the pons and midbrain. It terminates in the lateral part of the ventral posterior nucleus of the thalamus (ventral posterolateral nucleus).
- Trigeminal lemniscus, which serves the head region, terminates in the medial part of the same nucleus (ventral posteromedial nucleus)

Synapsis in the thalamus

- The third-order neurons: They project from the thalamus to the somatosensory cortex (Brodmann areas 3, 1, and 2)



Dorsal column–medial lemniscal pathway

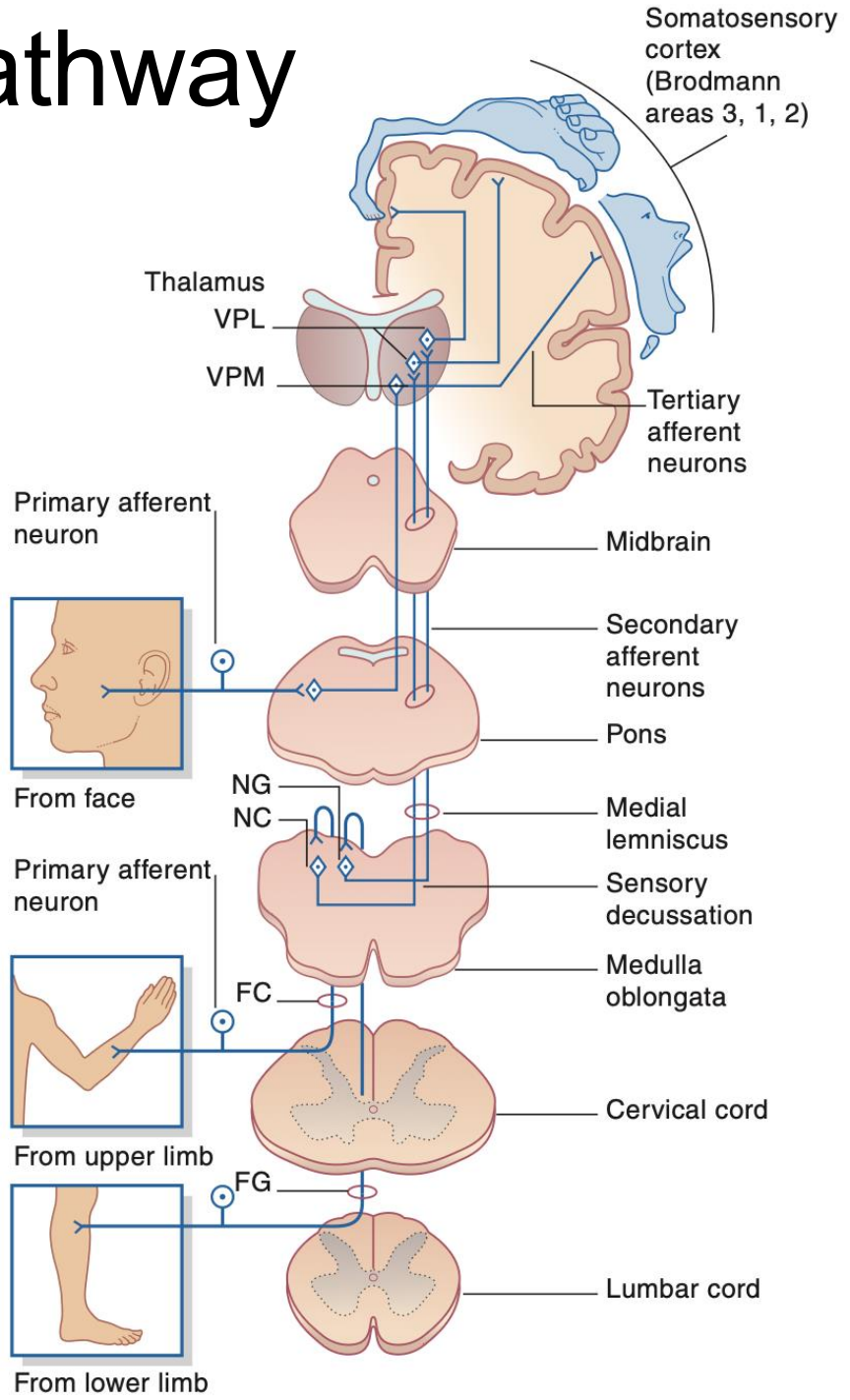
Fuctions:

Functions of the DCML pathway are those of conscious proprioception, two-point discrimination, and vibration sense.

Together, these attributes provide the parietal lobe with an instantaneous body image so that we are are constantly aware of the position of body parts both at rest and during movement.



FIGURE 15.9 The 'stomping' gait of sensory ataxia.



Spinothalamic tract

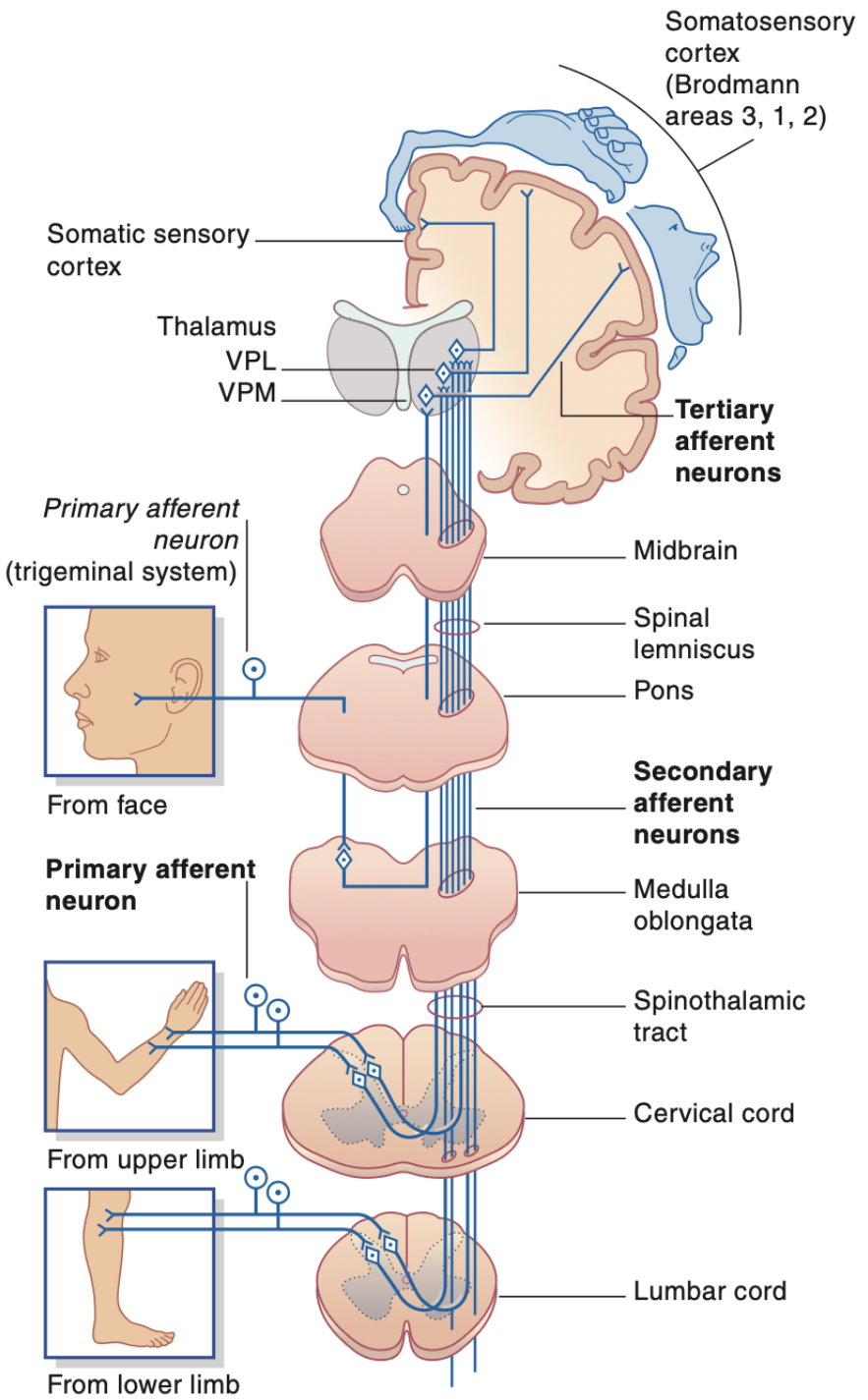
- Sensory receptors: nociceptors, thermoceptors, mechanoceptors, visceral afferent
- First order neurons or pseudounipolar (T) cells (dorsal root ganglia):
  - Cells supplying the lower and the upper limbs, the lower and the upper trunk enter in the dorsal grey horn and go to the nucleus propius.
  - Receive excitatory and inhibitory synapses from neurons of the substantia gelatinosa.

Synapsis in the nucleus proprius

- Second order neurons: Axons from those neurons within the dorsal grey horn cross the midline in the ventral commissure at all segmental levels. Having crossed they run upward in the anterolateral part of the cord and form a somatotopic organisation until the ventral posterior nuclei of the thalamus thalamus (those from the lower spinal cord segments are more dorsal and lateral, while more rostral levels are more ventral and medial)
- Trigeminal afferents, which serve the head region, join the spinothalamic tract of the controlateral side, and they accompany the medial lemniscus to the ventral posterior nuclei of the thalamus, terminating immediately behind the medial lemniscus.

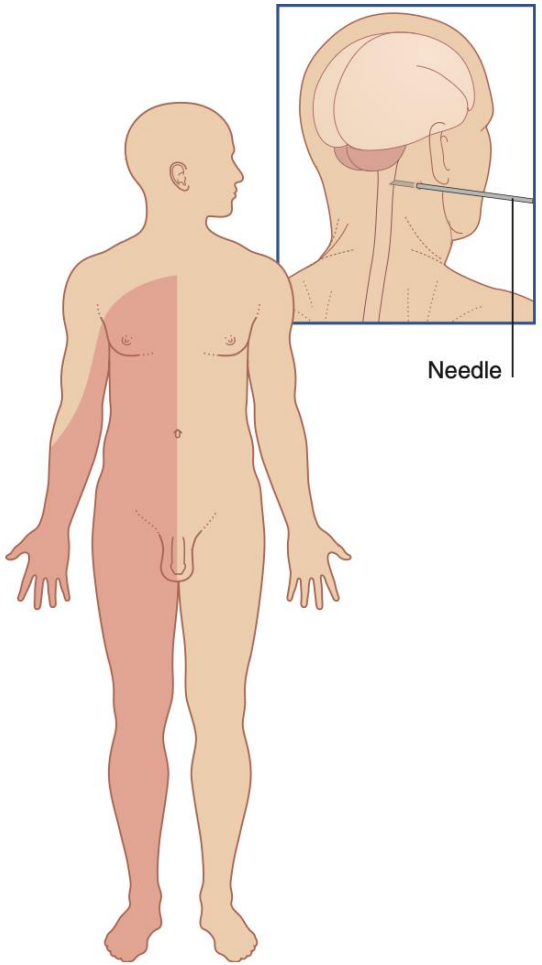
Synapsis in the thalamus

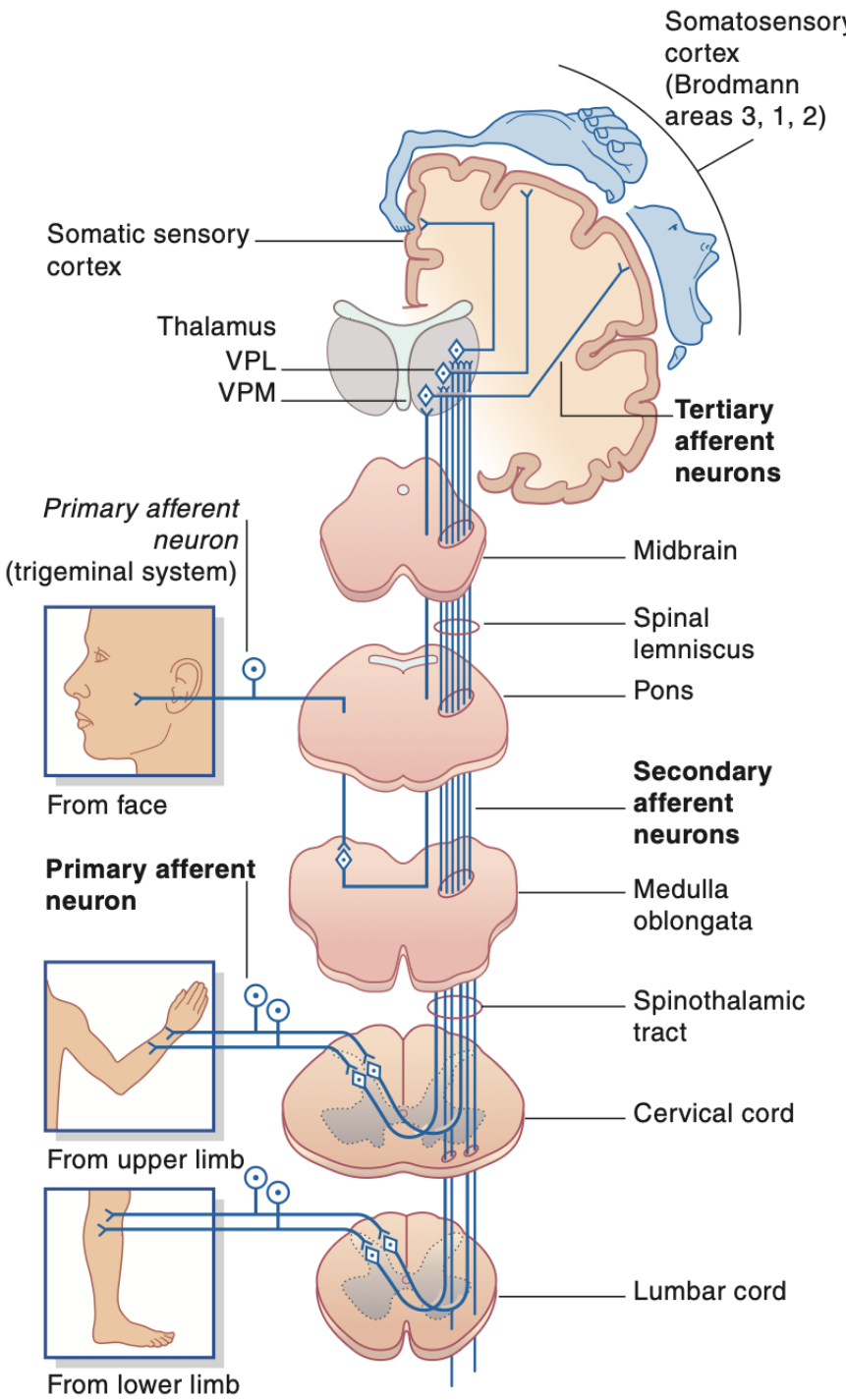
- The third-order neurons: They project from the thalamus to the somatosensory cortex (Brodmann areas 3, 1, and 2)



Spinothalamic tract

Functions:
The spinothalamic tract is primarily responsible for the localisation of and the intensity of pain, temperature, and touch sensation.



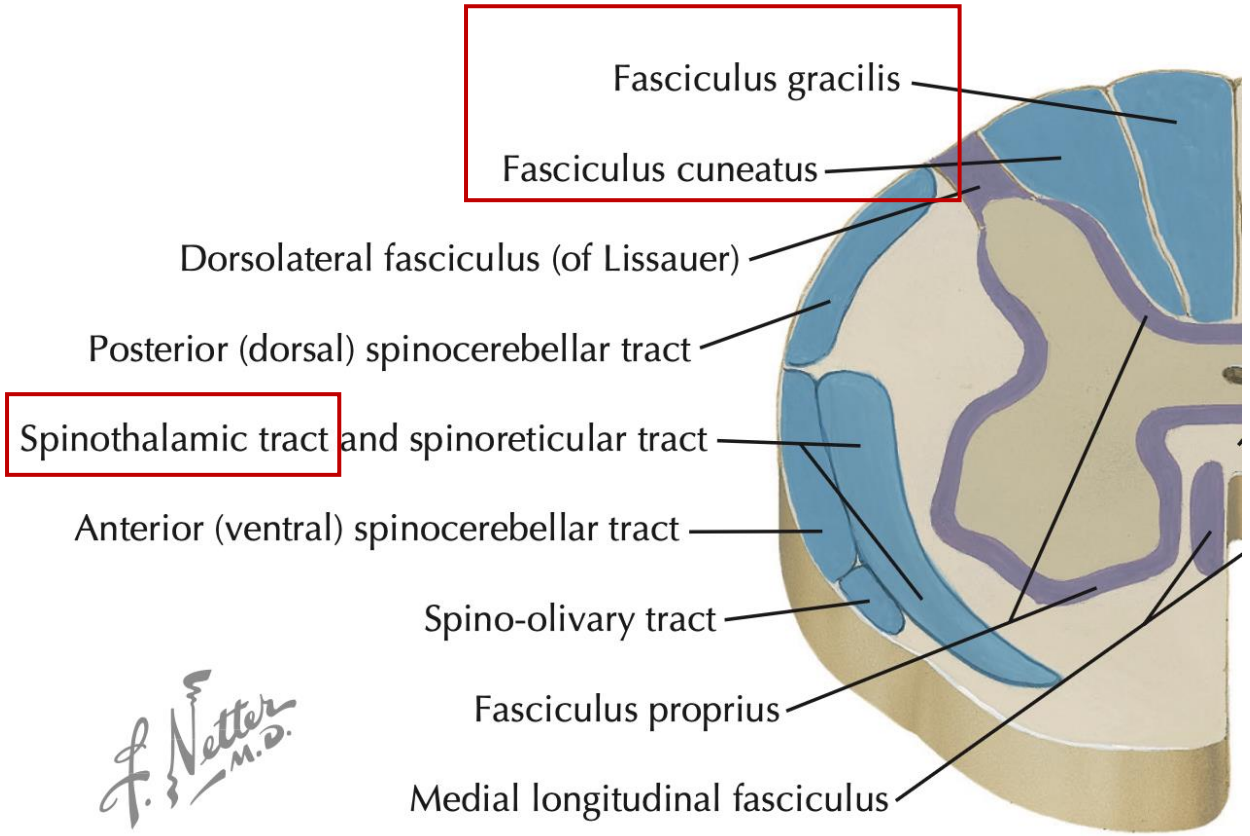


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Types of sensations:

- Conscious sensations, that are perceived at the level of the cerebral cortex
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  - Interoception

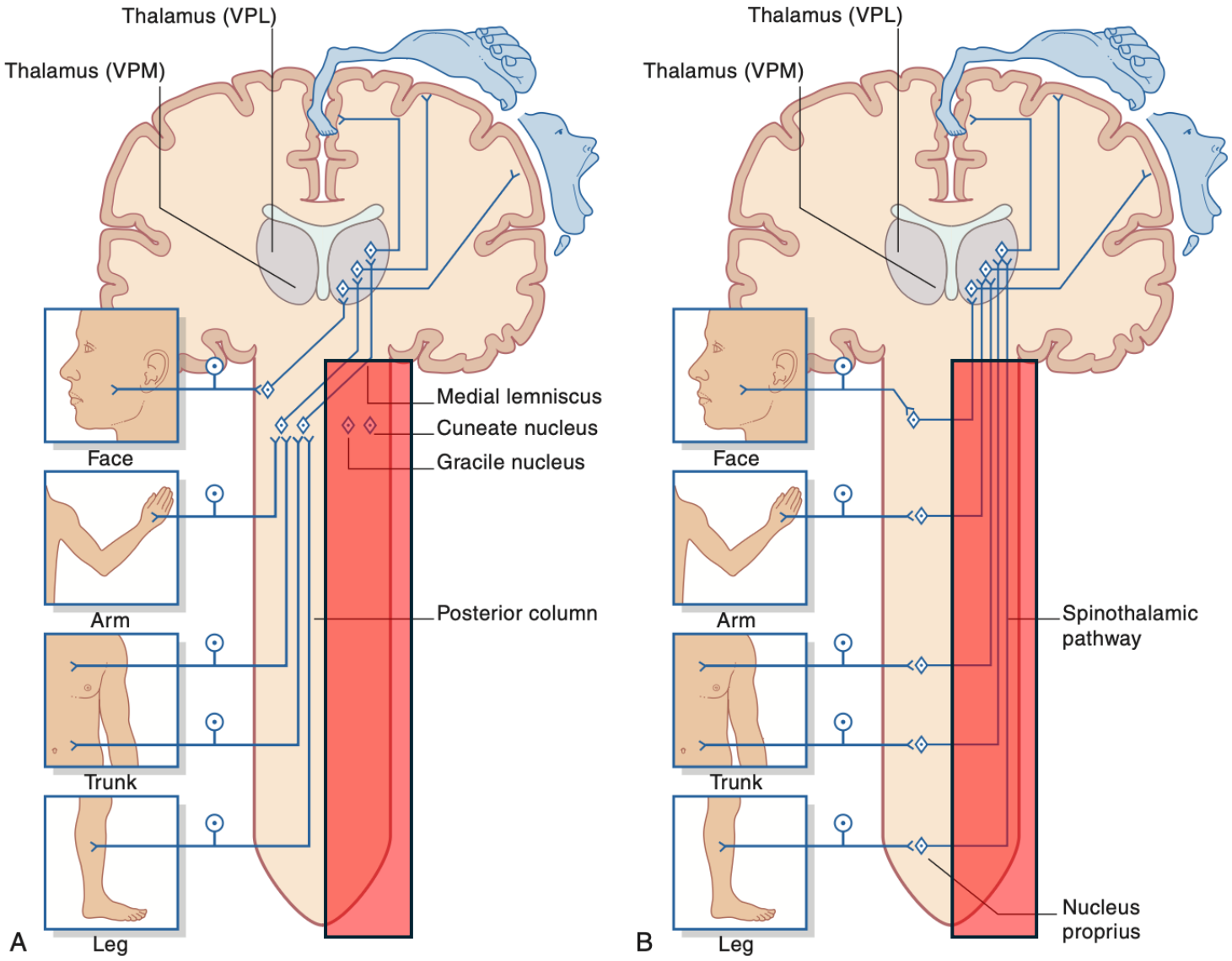
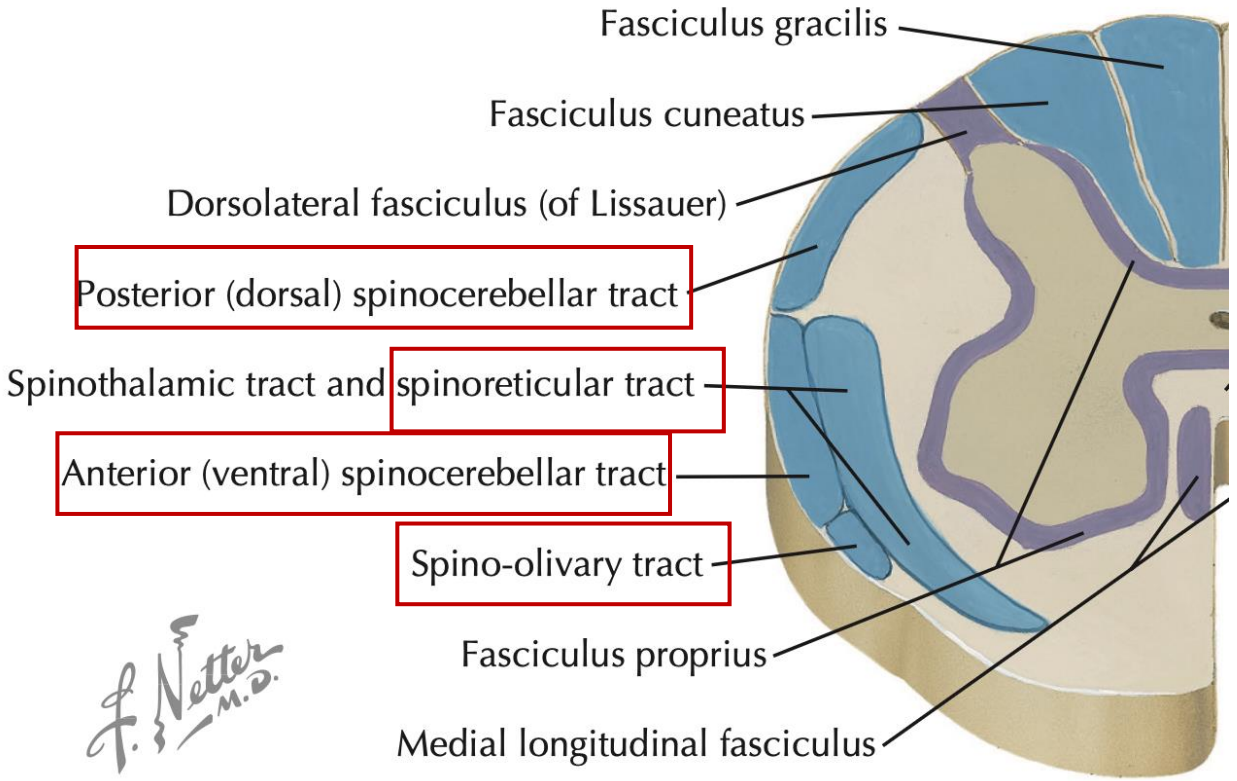


FIGURE 15.7 Basic plans of the **(A)** dorsal column–medial lemniscal pathway and **(B)** spinothalamic tract. VPL, VPM, ventral posterolateral, ventral posteromedial nuclei of the thalamus.

Ascending sensory pathways

Other ascending tracts are:
- Spinoreticulat tract
- Spinocerebellar tract
- Spinoolivary tract
- Spinotectal tract



Spinoreticular tract

The spinoreticular tract is the phylogenetically oldest somatosensory pathway.
Spinoreticular fibres originate in laminae V to VII and accompany the spinothalamic tract as far as the brainstem.

At least half of the spinoreticular fibres may be uncrossed.

The spinoreticular tract terminates at all levels of the brainstem and is not somatotopically arranged.

Impulse traffic is continued rostrally to the thalamus in a component of the ascending reticular activating system

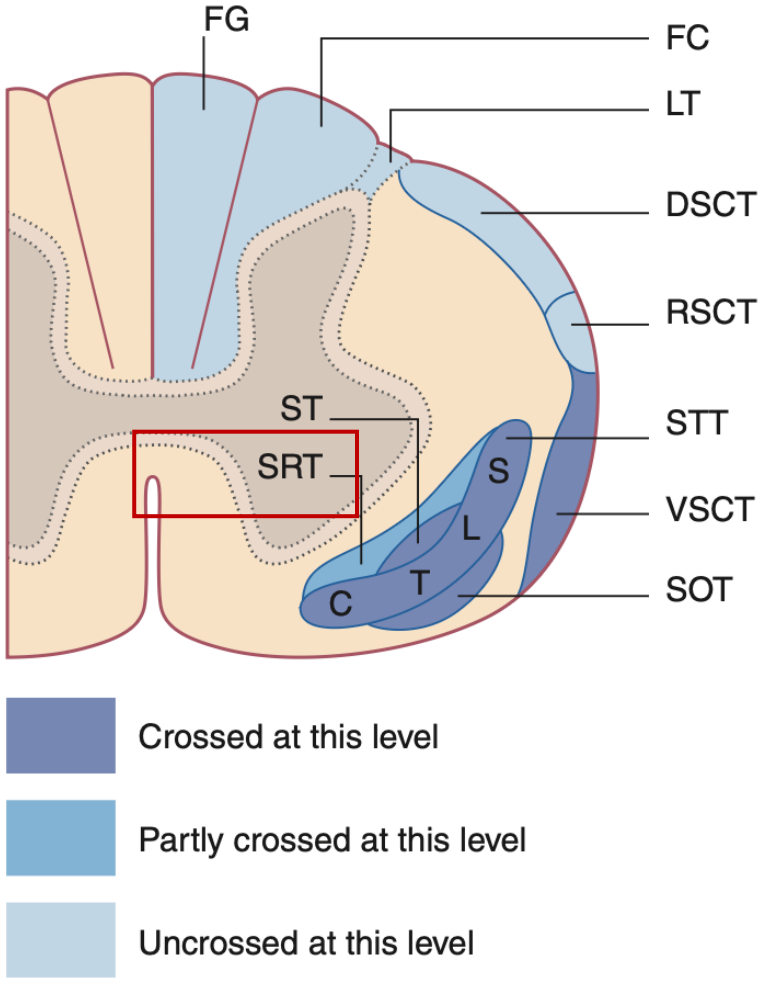


FIGURE 15.13 Ascending pathways at the upper cervical level. DSCT, dorsal spinocerebellar tract; FC, fasciculus cuneate; FG, fasciculus gracile; LT, Lissauer tract; SOT, spinoolivary tract; ST, spinotectal tract; SRT, spinoreticular tract; STT, spinothalamic tract (lamination of fibres within is shown with C, cervical, being ventral and medial while S, sacral, are dorsal and lateral; T, thoracic, and L, lumbar, are interposed as shown); VSCT, ventral spinocerebellar tract.

Spinoreticular tract

Functions:
1. Arouse the cerebral cortex, that is, to induce or maintain the waking state
2. Report to the limbic cortex of the anterior cingulate gyrus about the nature of a stimulus. The emotional response may be pleasurable or aversive

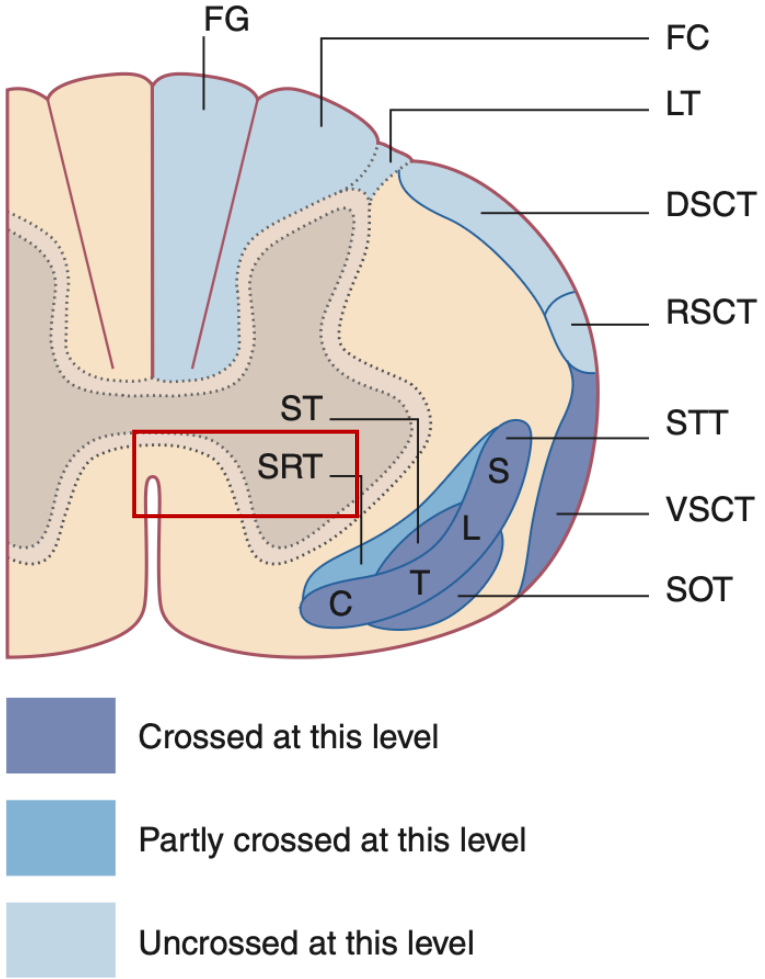


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Spinocerebellar tract

Four fibre tracts run from the spinal cord to the cerebellum:

- Dorsal spinocerebellar tract -> unconscious proprioception for lower limb and lower trunk.
- Cuneocerebellar tract -> unconscious proprioception for upper limb and upper trunk.
- Ventral spinocerebellar tract -> reporting activity of the interneurons of the spinal cord for the lower limb (spinal arc reflex).
- Rostral spinocerebellar tract -> reporting the activity of theinterneurons of the spinal cord for the upper limb .

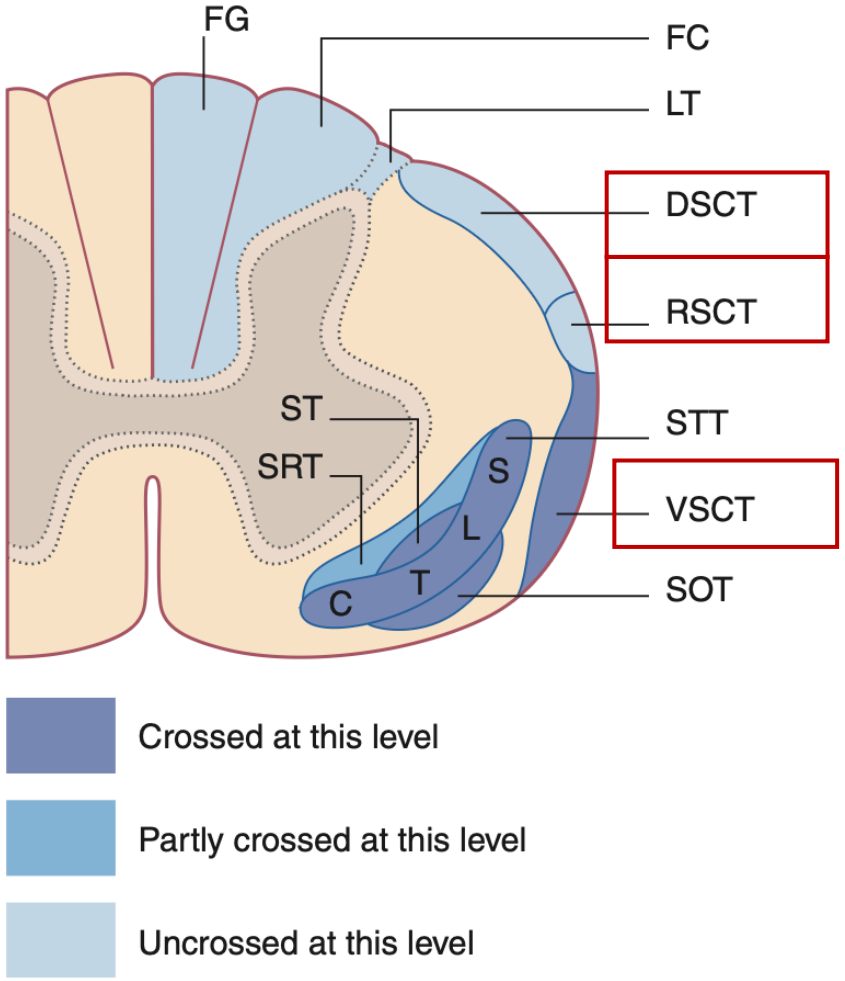


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Spinocerebellar tract

Four fibre tracts run from the spinal cord to the cerebellum:

- Dorsal spinocerebellar tract -> unconscious proprioception for lower limb and lower trunk. From the dorsal nucleus it ascends the spinal cord and enters in the inferior cerebellar peduncle.
- Cuneocerebellar tract -> unconscious proprioception for upper limb and upper trunk. From the accessory cuneate nucleus it ascends the spinal cord and enters in the inferior cerebellar peduncle.
- Ventral spinocerebellar tract -> reporting activity of the interneurons of the spinal cord for the lower limb (spinal arc reflex). It ascends the spinal cord and enters in the superior cerebellar peduncle and re-cross within the cerebellar white matter.
- Rostral spinocerebellar tract -> reporting the activity of theinterneurons of the spinal cord for the upper limb . It ascends uncrossed and enters the cerebellum via the inferior and superior cerebellar peduncles.

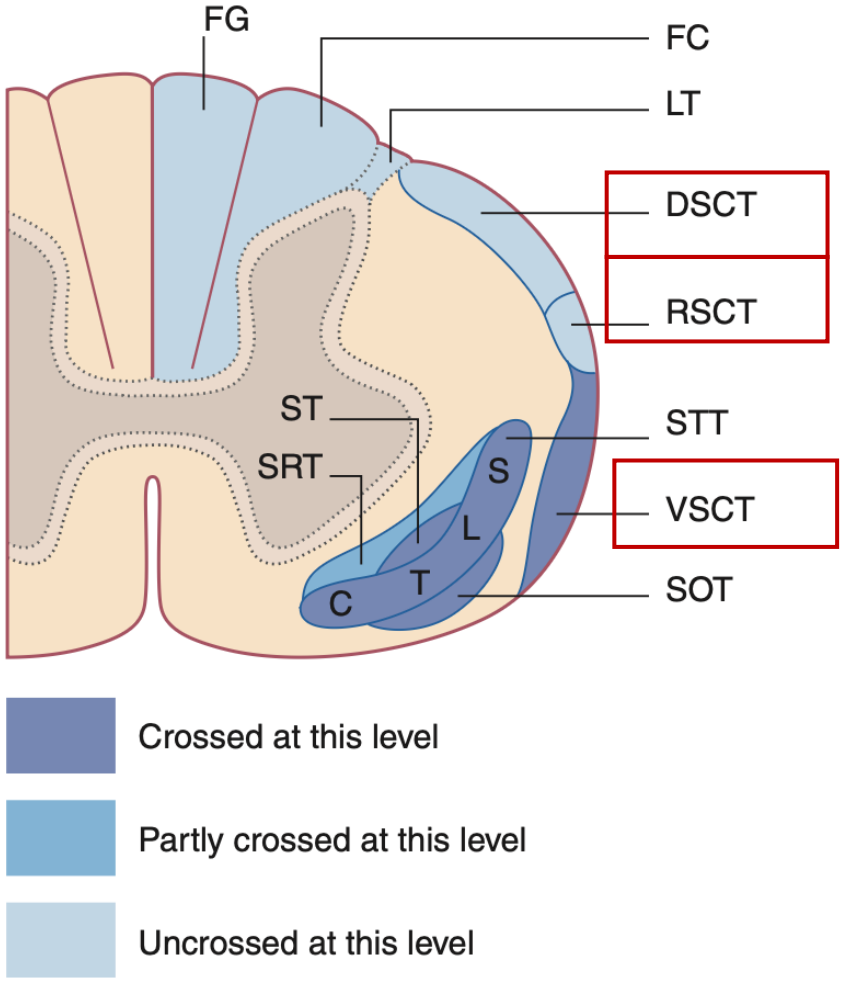


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Spinotectal and spinolivary tracts

- The spinotectal tract -> visuospatial reflex (turning the eyes/head/trunk towards sources of sensory stimulation). It ends in he superior colliculus

- The spinoolivary tract -> motor learning through its action on the contralateral cerebellar cortex (motor adaptation). It ends in the inferior olivary nucleus in the medulla oblongata.

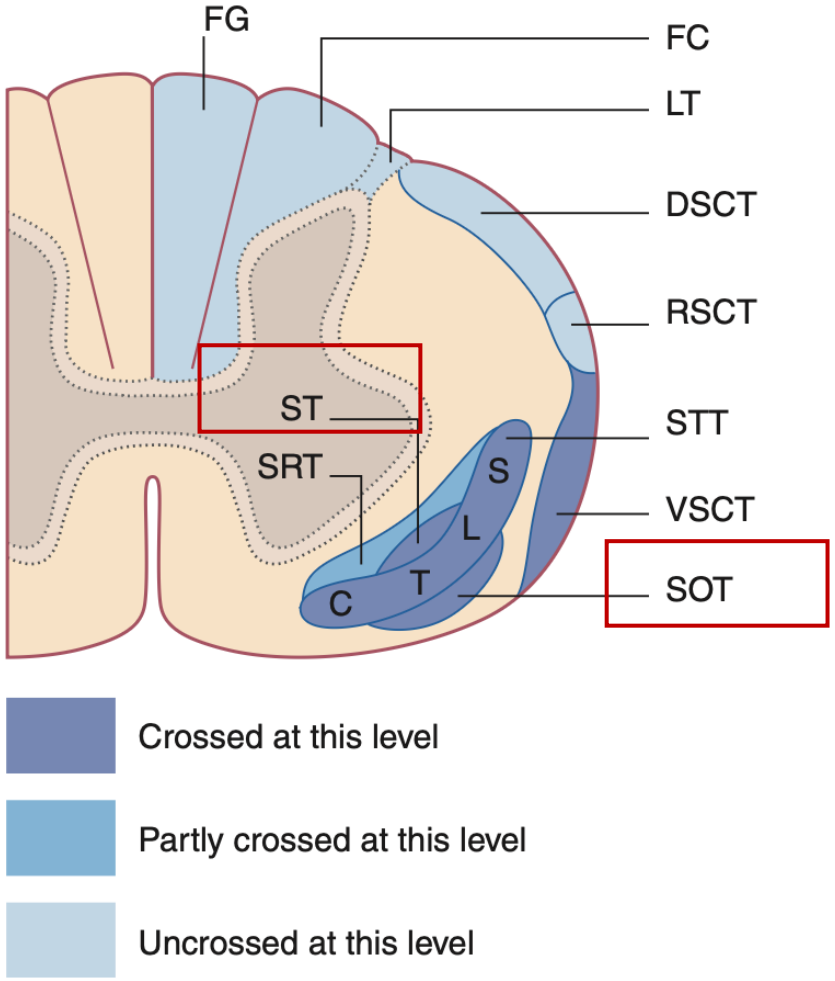
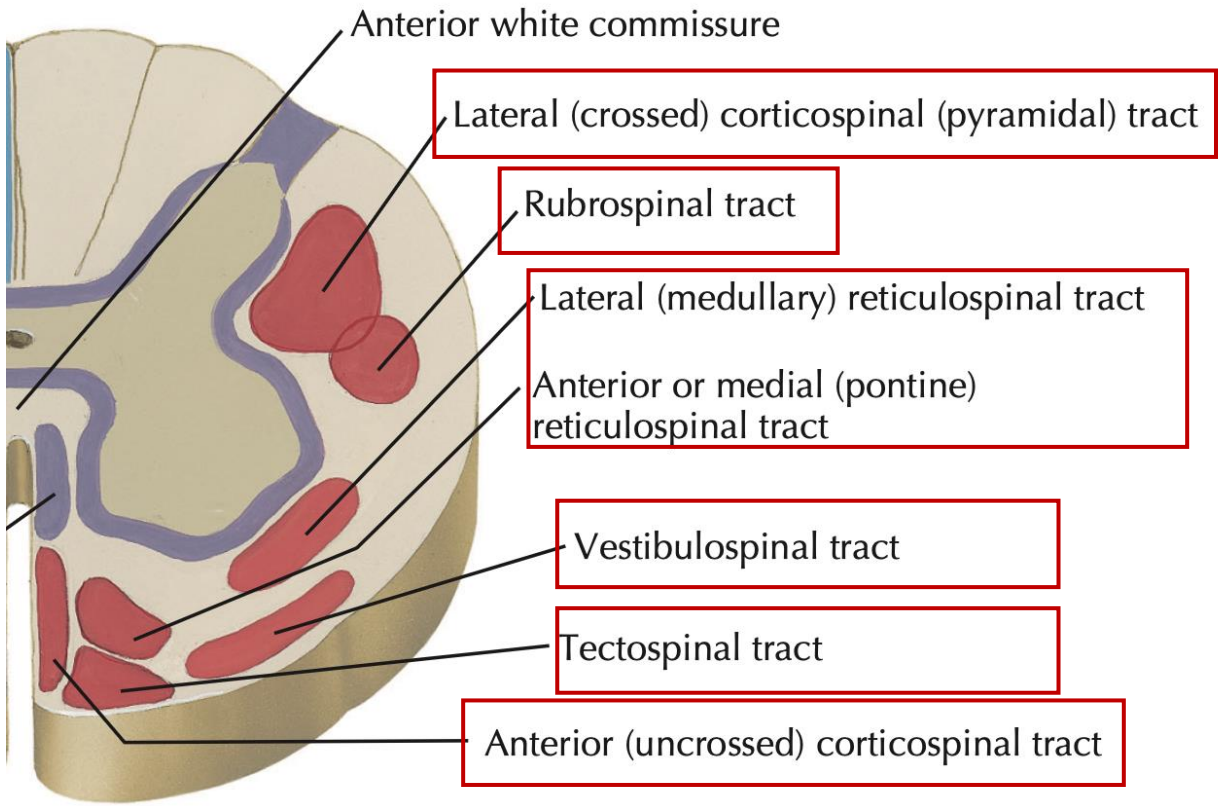


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Descending pathways



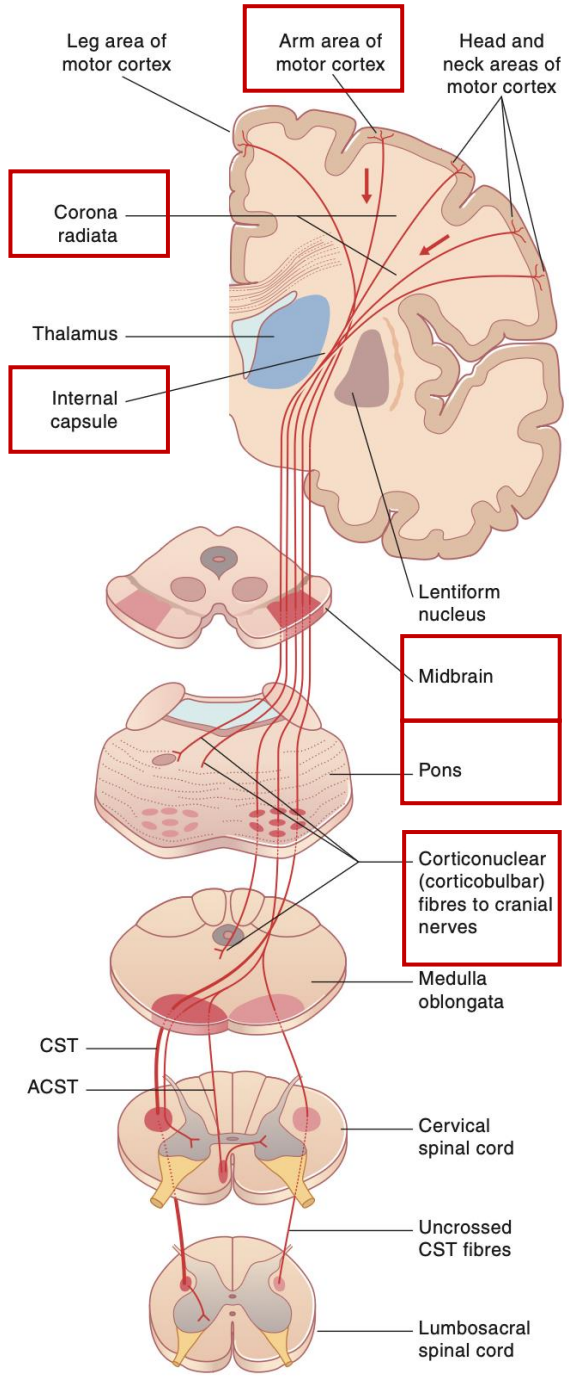
mportant pathways descending to the spinal cord are the following:

- Corticospinal (pyramidal) pathway
- Rerticulospinal (extrapyramidal) pathway
- Vestibulospinal pathway
- Tectospinal pathway
- Raphespinal pathway
- Aminergic pathway
- Autonomic pathway
- Rubrospinal pathway

Corticospinal tract

The corticospinal tract is the great voluntary motor pathway.

- First motoneuron: Motor cortex (40%), or supplementary motor area, or premot cortex, or parietal lobe, or cingulate gyrus.
  The corticospinal tract descends through the corona radiata and posterior limb of the internal capsule to reach the brainstem.
  It continues through
  - the crus (or cerebral peduncle) of the midbrain and
  - the basilar pons
  - To cross and give off fibres that activate motor cranial nerve nuclei (corticobulbar or corticonuclear tract).
  - To and reach the medulla oblongata, forming the pyramids (piramidal tract):
    - About 80% of the fibers crossing the midline in the pyramidal decussation and forming the lateral corticospinal tract
    - About 20% of the fibers not decussating and descending in the ventral portion of the spinal cord
      - Half of these non decussating fibers enter in the anterior corticospinal tract These fibers cross in the white commissure and supply motor neurons serving muscles in the anterior and posterior abdominal walls.
      - The other half enter the lateral corticospinal tract on the same side.



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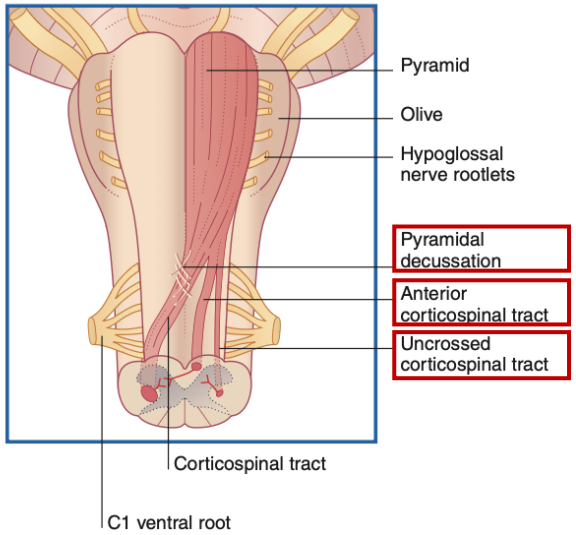


FIGURE 16.5 Ventral view of medulla oblongata and upper spinal cord, showing the three spinal projections of the left pyramid.

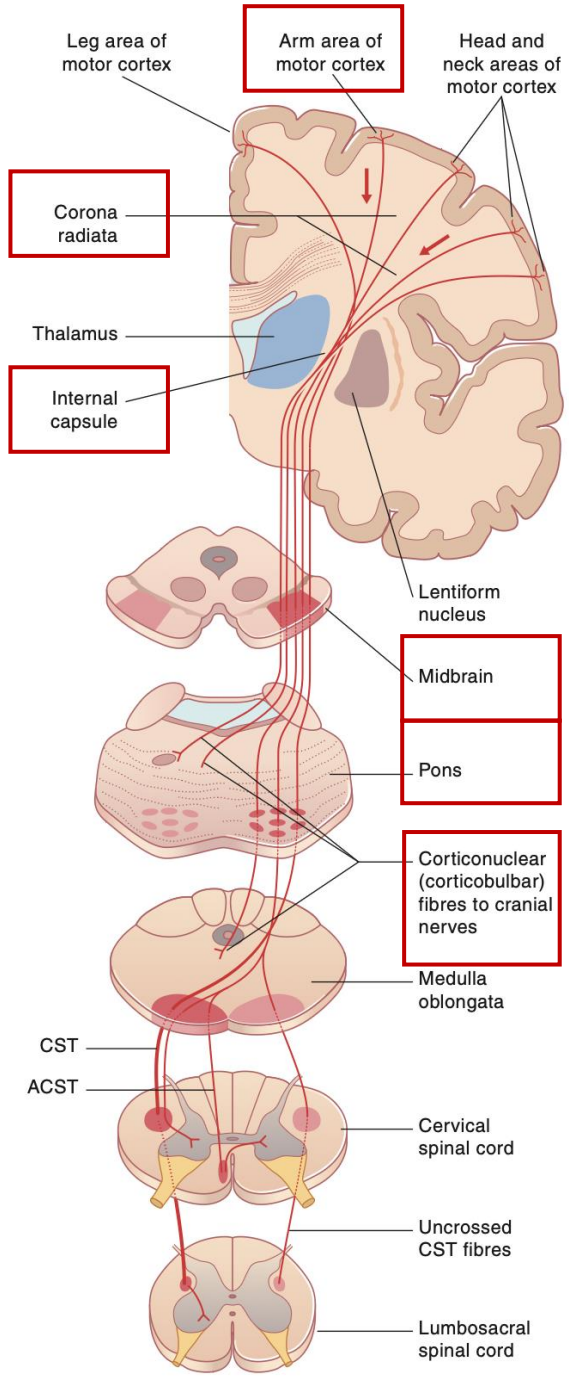
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        - The other half enter the lateral corticospinal tract on the same side.

Synapsis in the ventral horn of grey matter

- Second motoneuron: it exits from the ventral horn of grey matter through the ventral root.



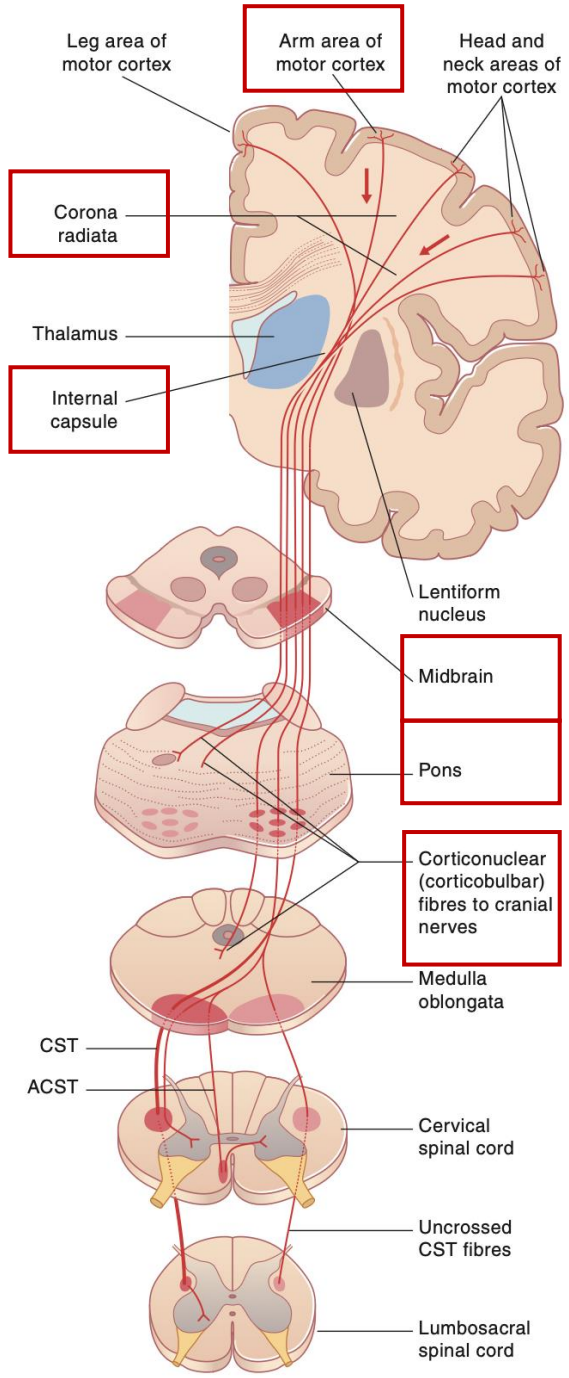
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  It continues through
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  - To cross and give off fibres that activate motor cranial nerve nuclei (corticobulbar or corticonuclear tract).
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    - About 20% of the fibers not decussating and descending in the ventral portion of the spinal cord.
      - Half of these non decussating fibers enter in the ventral corticospinal tract These fibers cross in the white commissure and supply motor neurons serving muscles in the anterior and posterior abdominal walls.
      - The other half enter the lateral corticospinal tract on the same side.

Synapsis in the ventral horn of grey matter

- Second motoneuron: it exits from the ventral horn of grey matter through the ventral root.



Reticulospinal tract

The reticulospinal tracts originate in the reticular formation of the pons and medulla oblongata. They are partially crossed.

- The pontine reticulospinal tract descends ipsilaterally in the anterior funiculus,
- The medullary reticulospinal tract descends, partly crossed, in the lateral funiculus

Both tracts act, via inter-neurons shared with the corticospinal tract, upon motor neurons supplying axial (trunk) and proximal limb muscles.

Both pathways exert reciprocal inhibition.

The reticulospinal system is involved in two different kinds of motor behaviour: locomotion and postural control.

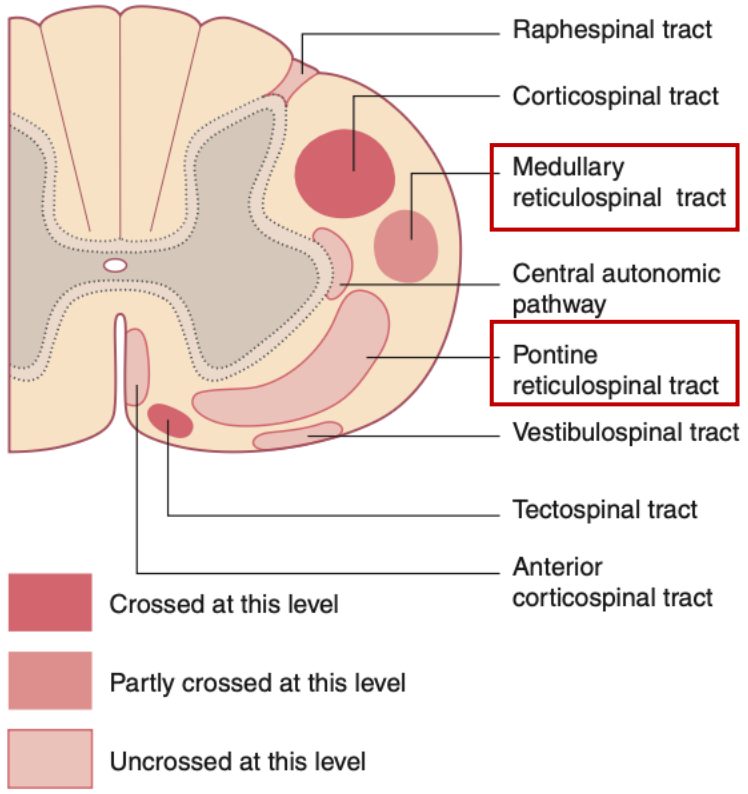


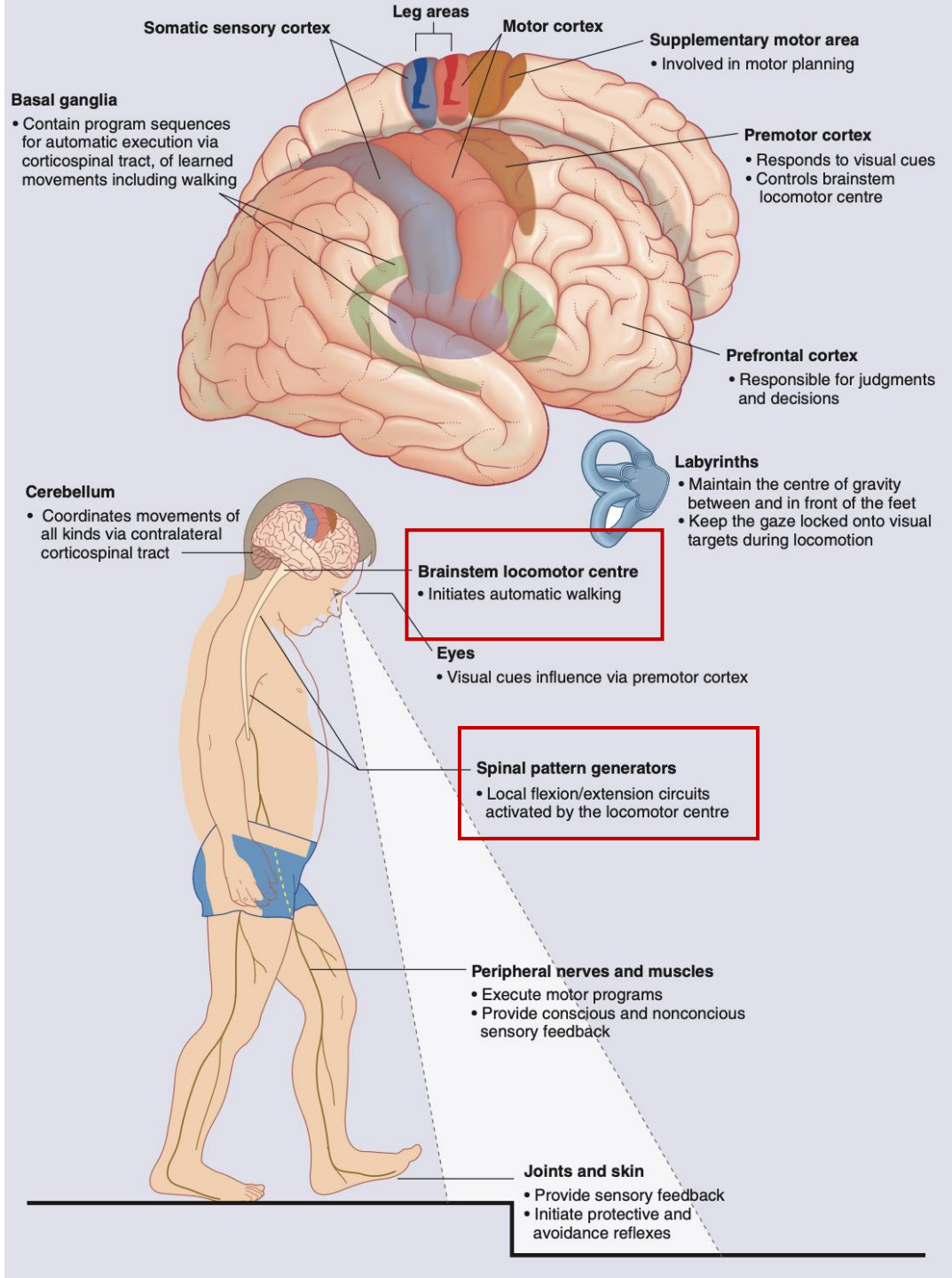
FIGURE 16.9 Descending pathways at the upper cervical level. *Notes:* The ventral corticospinal tract/anterior corticospinal tract crosses partially at the lower cervical level and engages ventral horn cells supplying postural muscles of the trunk. Some 10% of corticospinal tract fibres descend ipsilaterally.

Reticulospinal tract

Functions:

- Locomotion
  - Pattern generators
  - Brainsteam locomotor centre
  - Cortex motor areas

  It is subserved by two motor system:
  - Pyramidal pathway
  - Extrapyramidal pathway
- Postural Control

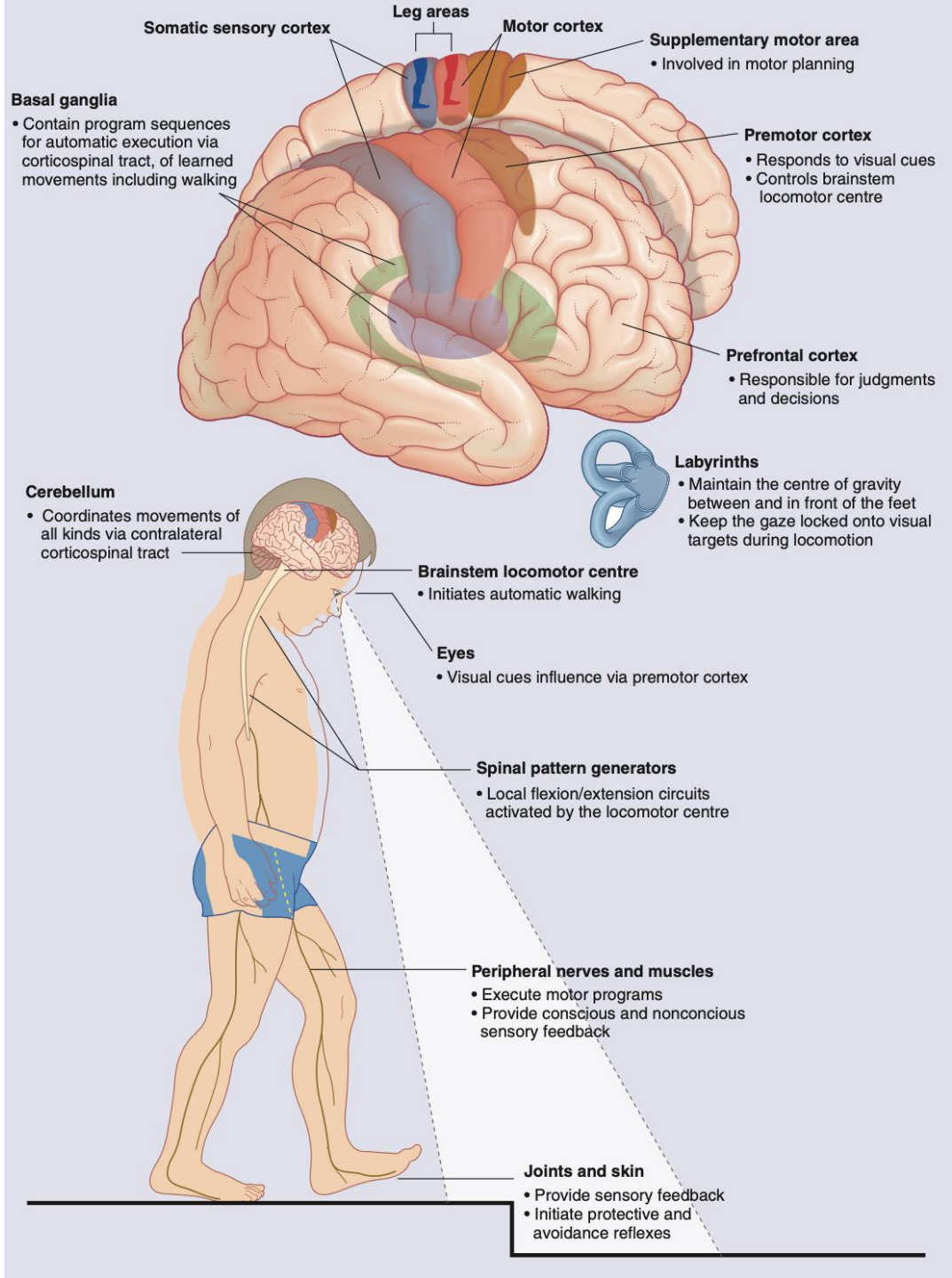


Reticulospinal tract

Functions:

- Locomotion
- Postural Control

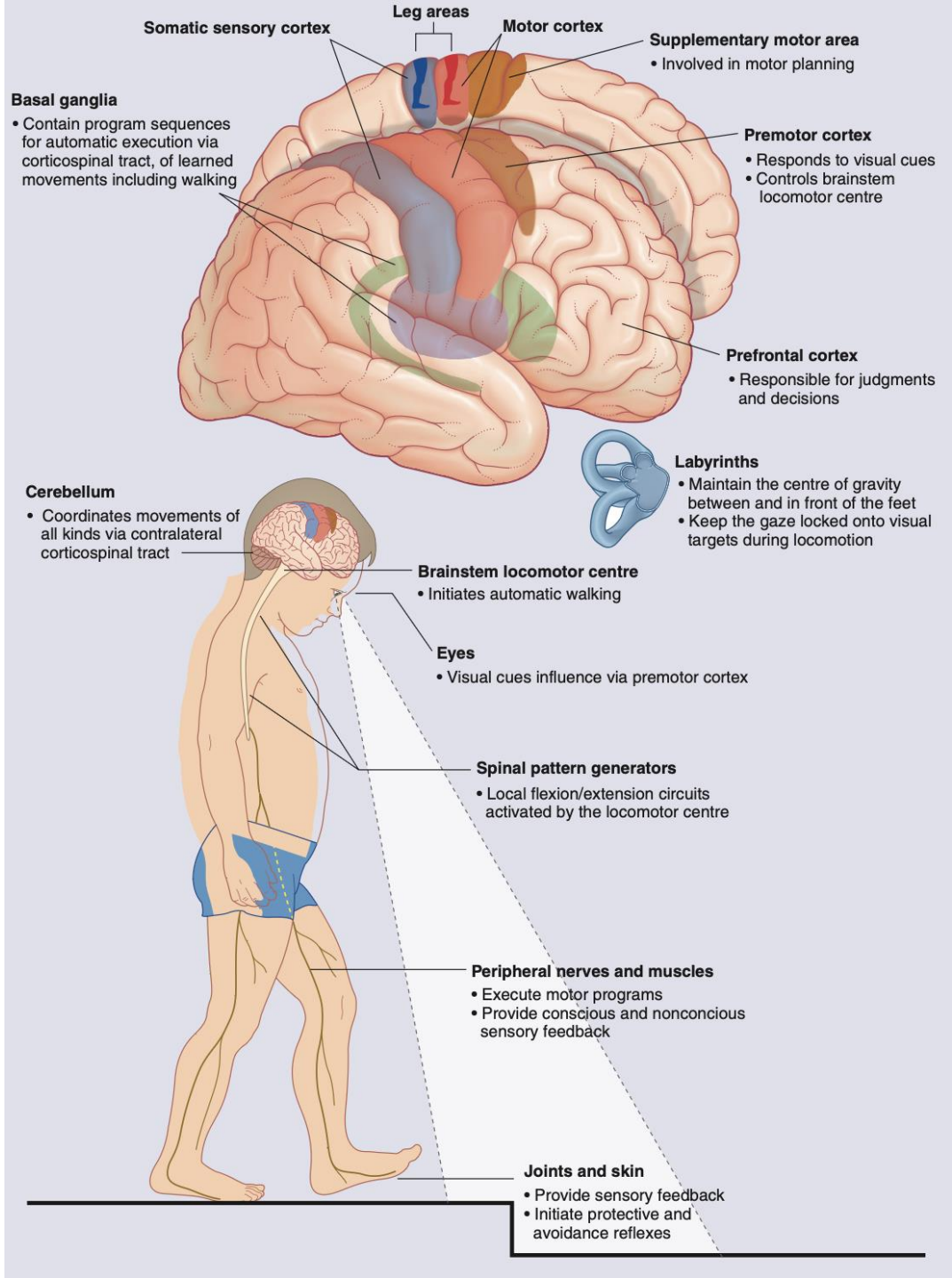
  in the general context, it is the position held between movements
  in the local contex, it is the postural fixation



Motor function

The interpolation of interneurons between the two main motor pathways (pyramidal and extrapyramidal pathway) acting upon motor neurons serving axial and proximal limb muscles means that either pathway may be in command for a particular movement sequence.

- The extrapyramidal (reticulospinal) pathway for routine tasks (such as walking along a clear path)
- The pyramidal (corticospinal) pathway for tasks requiring close attention (such as picking one's way along a path strewn with rubble)



Tectospinal tract

The tectospinal tract is a crossed pathway descending
- from the tectum of the midbrain
- to the medial part of the ventral grey horn at cervical and upper thoracic levels.

This tract is an important motor pathway in the reptilian brain, being responsible for orienting the head/trunk towards sources of visual stimulation (superior colliculus) or auditory stimulation (inferior colliculus).
It is likely to have similar automatic functions in humans.

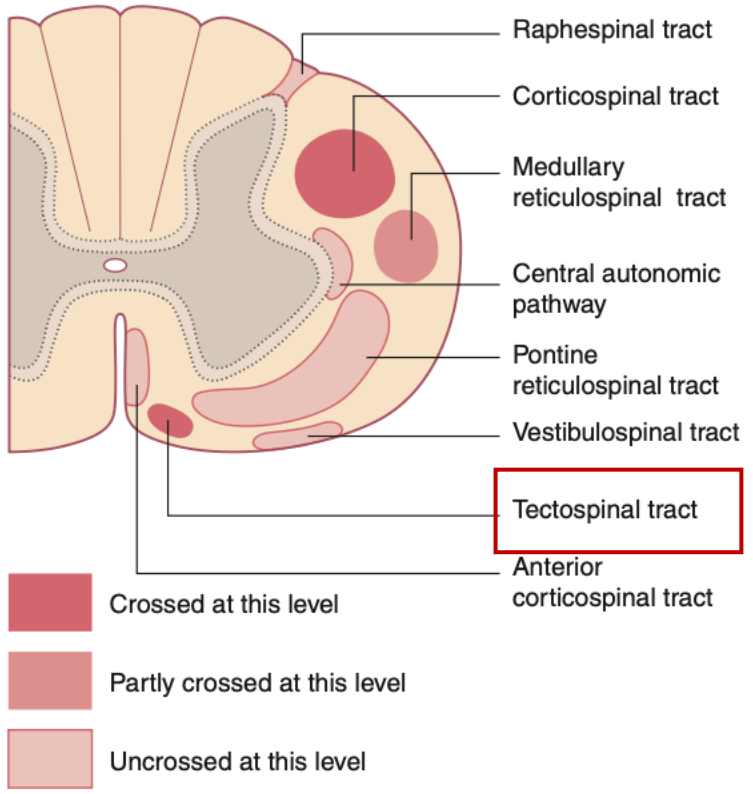


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Vestibulospinal tract

The vestibulospinal tract is an important uncrossed pathway.
It originates in the vestibular nucleus in the medulla oblongata and descends in the anterior funiculus.

Its function is to keep the centre of gravity between the feet.

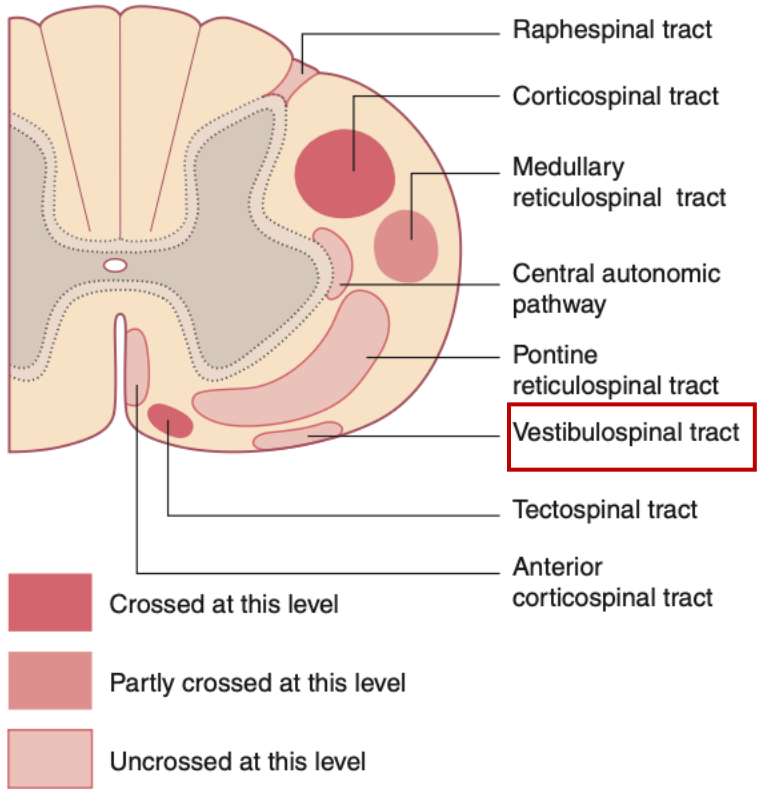


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Raphespinal tract

The raphespinal tract originates in and beside the raphe nucleus, that is situated in the midline in the medulla oblongata.
It descends on both sides within the dorsolateral tract of Lissauer.

Its function is to modulate sensory transmission between first-order and second-order neurons in the dorsal grey horn—particularly with respect to pain.

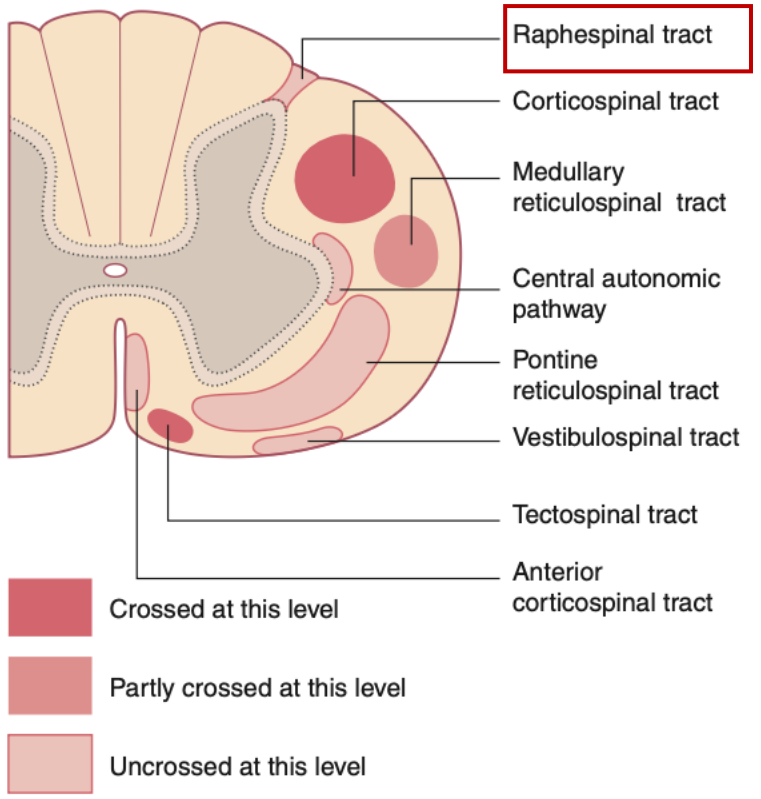


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Aminergic pathways

Aminergic pathways descend from specialised cell groups in the pons and medulla oblongata.

The principal neurotransmitters involved are norepinephrine and serotonin.

The aminergic pathways descend in the outer parts of the ventral and lateral funiculi and are distributed widely in the spinal grey matter.

They have inhibitory effects on sensory neurons and facilitatory effects on motor neurons.

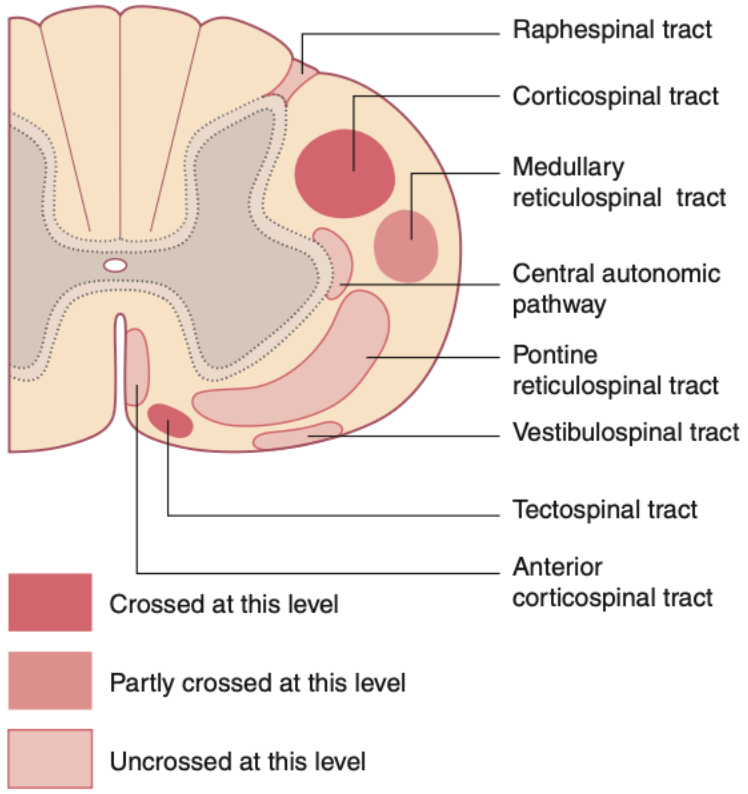


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Central autonomic pathways

Central sympathetic and parasympathetic fibres descend laterally to the intermediate grey matter.

- Sympathetic fibres originate from autonomic control centres in the hypothalamus. They terminate in the intermediolateral cell columns that give rise to the preganglionic sympathetic fibres. The intermediolateral cell columns reside in the lateral horn (from T12 through to L2). The central sympathetic pathway is required for normal baroreceptor reflex activity.

- Parasympathetic fibres originate from several nuclear groups in the brainstem. They synapse on specific sacral nuclei, which control the function of various pelvic structures.
  The fibres concerned originate in the reticular formation, mainly at the level of the pons. The pontine micturition centre has a tonic inhibitory action on the sacral parasympathetic system.

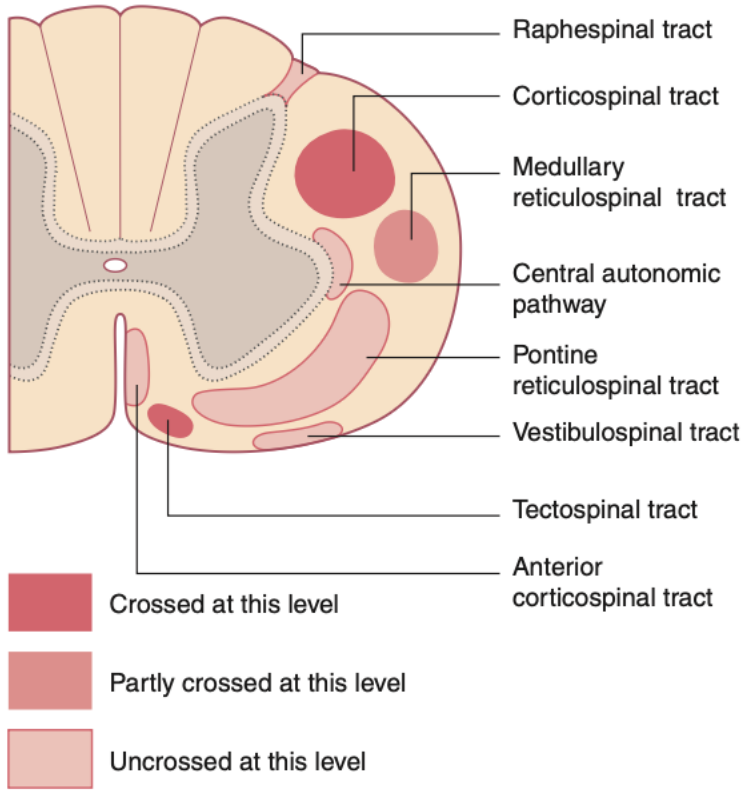
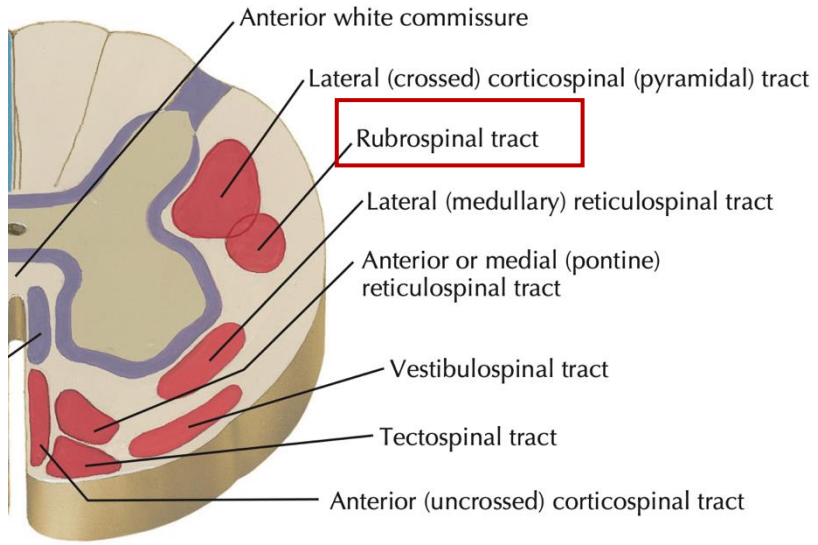


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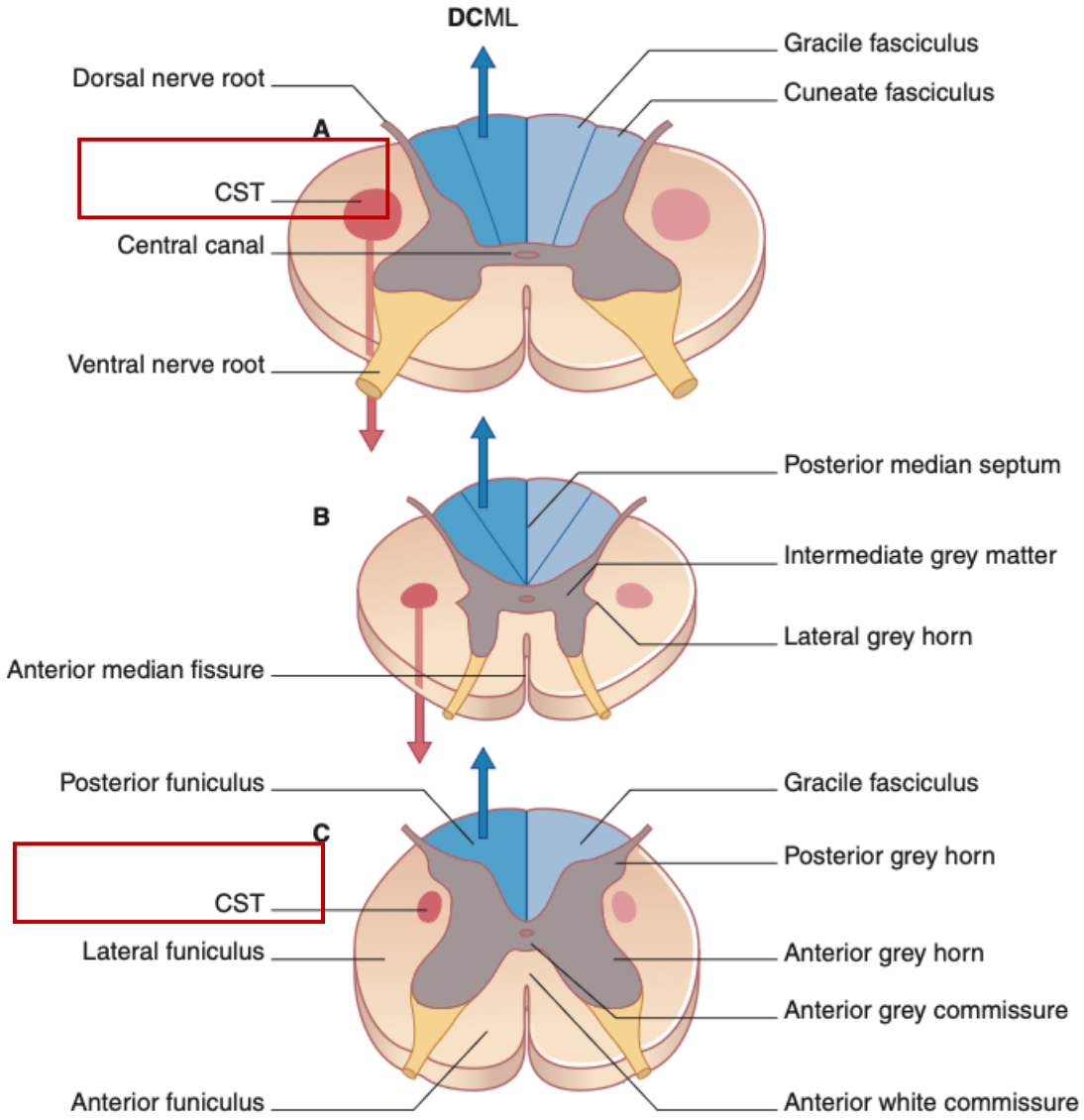
Rubrospinal tract

The rubrospinal tract is one of several motor control pathways.
It has fewer axons than the corticospinal tract.
The tract iscthought to be responsible for large muscle movement.
It is believed to primarily facilitate extensor motor neurons and inhibit flexor motor neurons in the upper extremities.

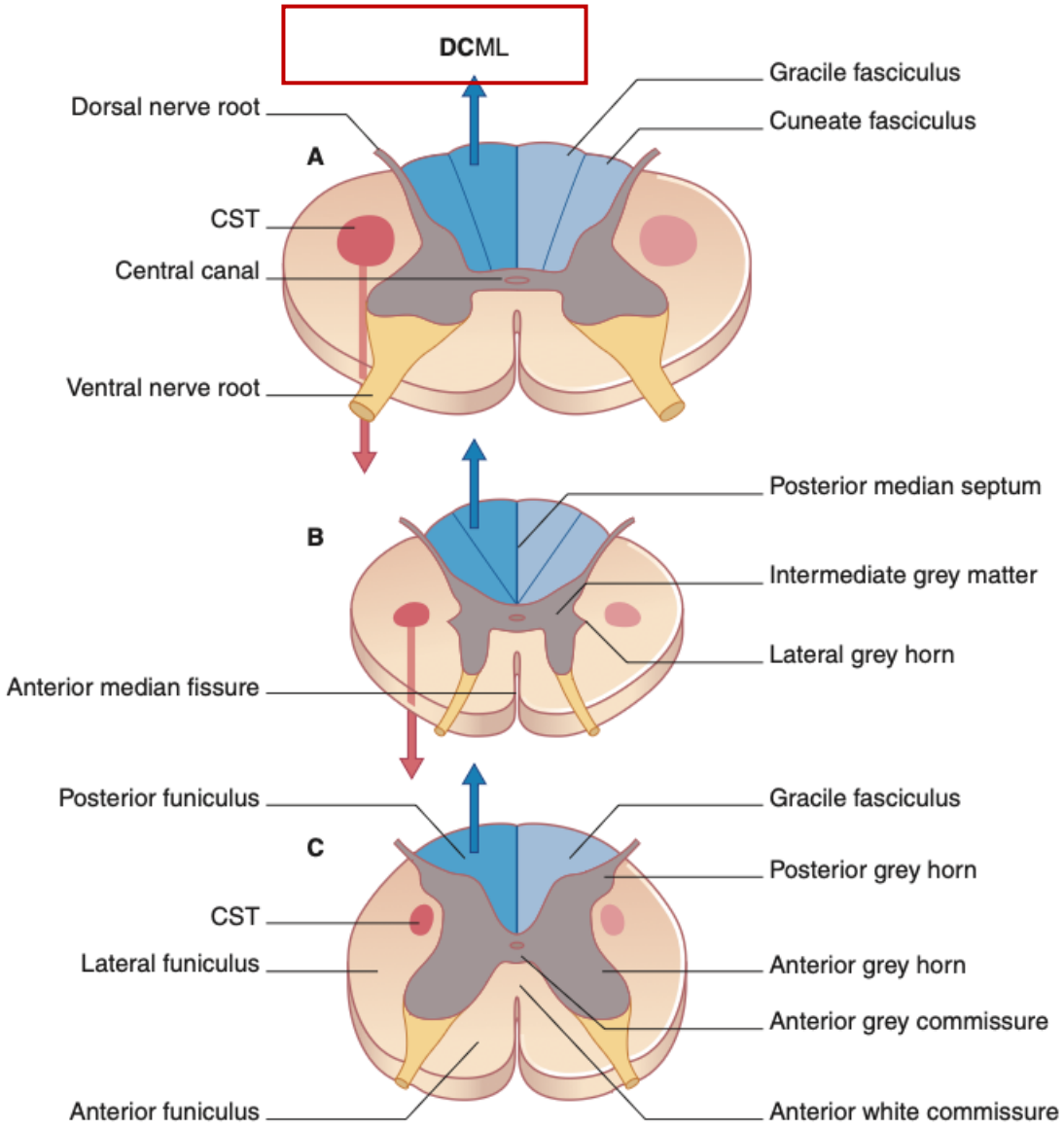
It originates in the magnocellular red nucleus of the midbrain, crosses to the other side of the midbrain, and descends in the lateral part of the brainstem tegmentum.
In the spinal cord it travels through the lateral funiculus of the spinal cord anterior to or overlapping the corticospinal tract.



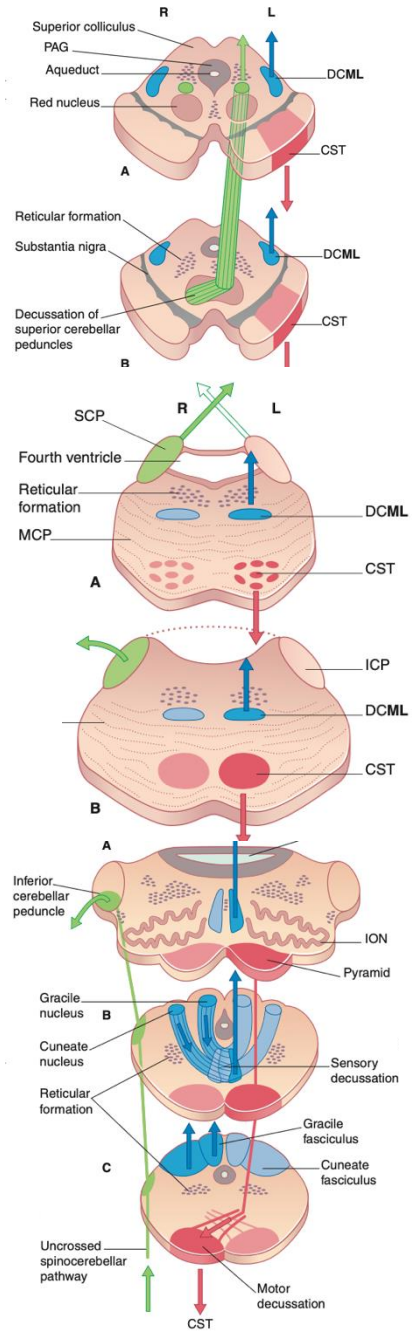
Spinal cord: CST



Spinal cord: DCML



Brainstem: DCML



Midbrain

FIGURE 3.4 Transverse sections of midbrain. **(A)** At the level of superior colliculi. **(B)** At the level of inferior colliculi. In this and following diagrams, the corticospinal tract (CST) and dorsal column–medial lemniscal (DC**ML**) pathway connected to the *left* cerebral hemisphere are highlighted. PAG, periaqueductal grey matter.

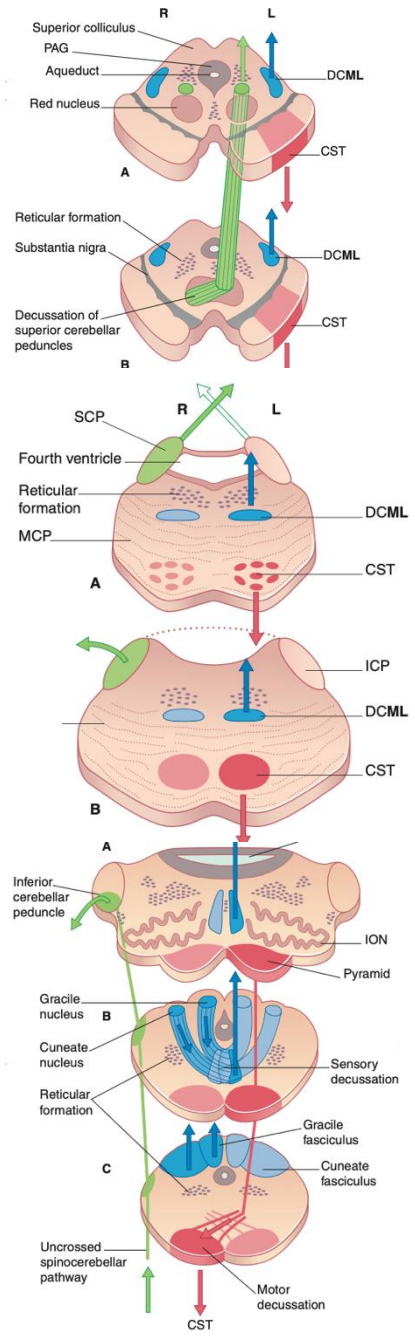
Pons

FIGURE 3.5 Transverse sections of pons. **(A)** Upper pons. **(B)** Lower pons. SCP, MCP, ICP, superior, middle, inferior cerebellar peduncles, respectively; CST, corticospinal tract; DC**ML**, dorsal column–medial lemniscal pathway.

Medulla oblongata

FIGURE 3.6 Transverse sections of medulla oblongata. **(A)** Level of inferior olivary nucleus (ION). **(B)** Level of sensory decussation. **(C)** Level of motor decussation. CST, corticospinal tract; ICP, inferior cerebellar peduncle; DC**ML**, dorsal column–medial lemniscal pathway.

Brainstem:CST



Midbrain

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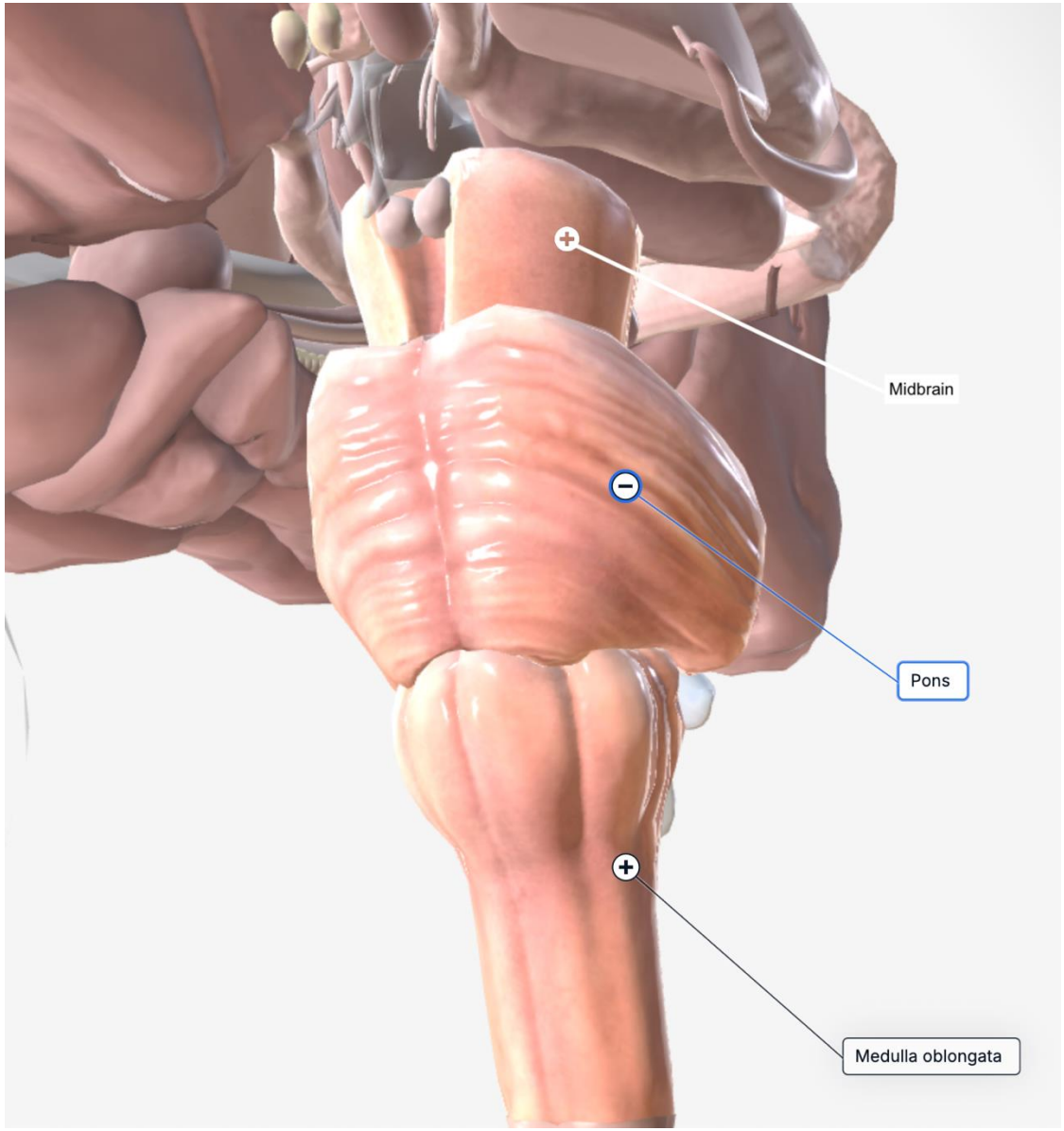
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FIGURE 3.5 Transverse sections of pons. **(A)** Upper pons. **(B)** Lower pons. SCP, MCP, ICP, superior, middle, inferior cerebellar peduncles, respectively; CST, corticospinal tract; DC**ML**, dorsal column–medial lemniscal pathway.

Medulla oblongata

FIGURE 3.6 Transverse sections of medulla oblongata. **(A)** Level of inferior olivary nucleus (ION). **(B)** Level of sensory decussation. **(C)** Level of motor decussation. CST, corticospinal tract; ICP, inferior cerebellar peduncle; DC**ML**, dorsal column–medial lemniscal pathway.

Brainstem

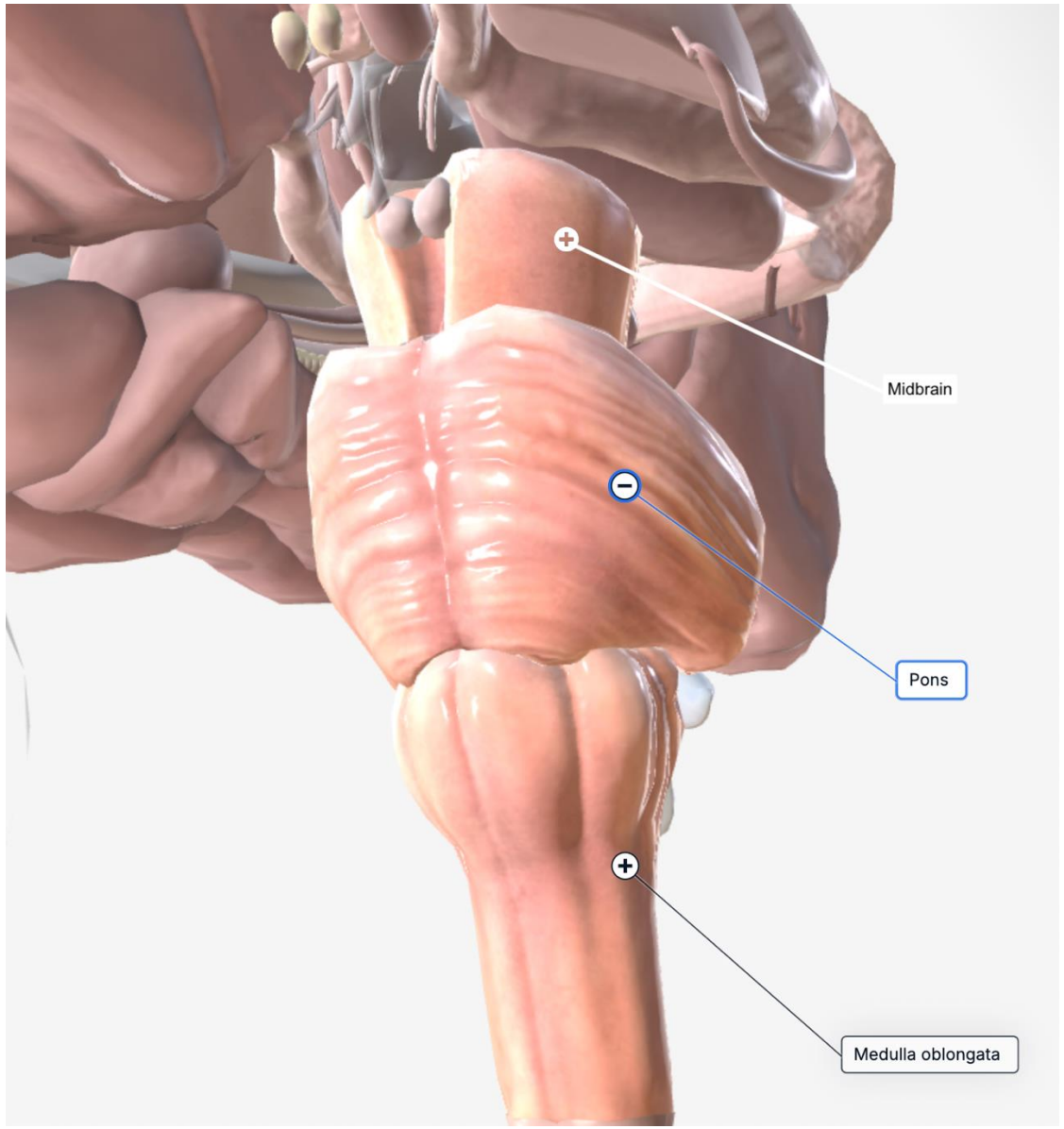


The brainstem consists of:
- Midbrain
- Pons
- Medulla

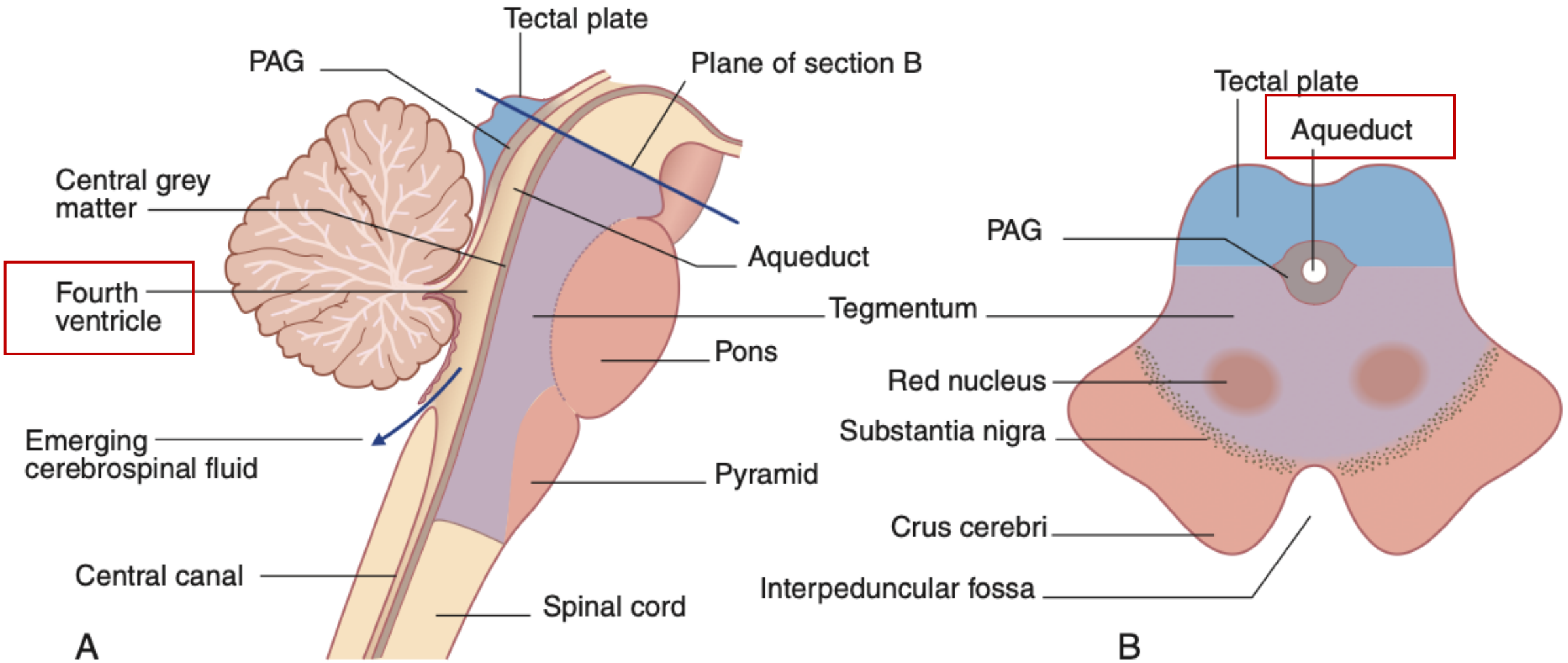
It has three principal functions:
1. Conduit for ascending and descending tracts
2. Cranial nerve nuclei
3. Vital autonomic centers

It is structurally compact and functionally dense.

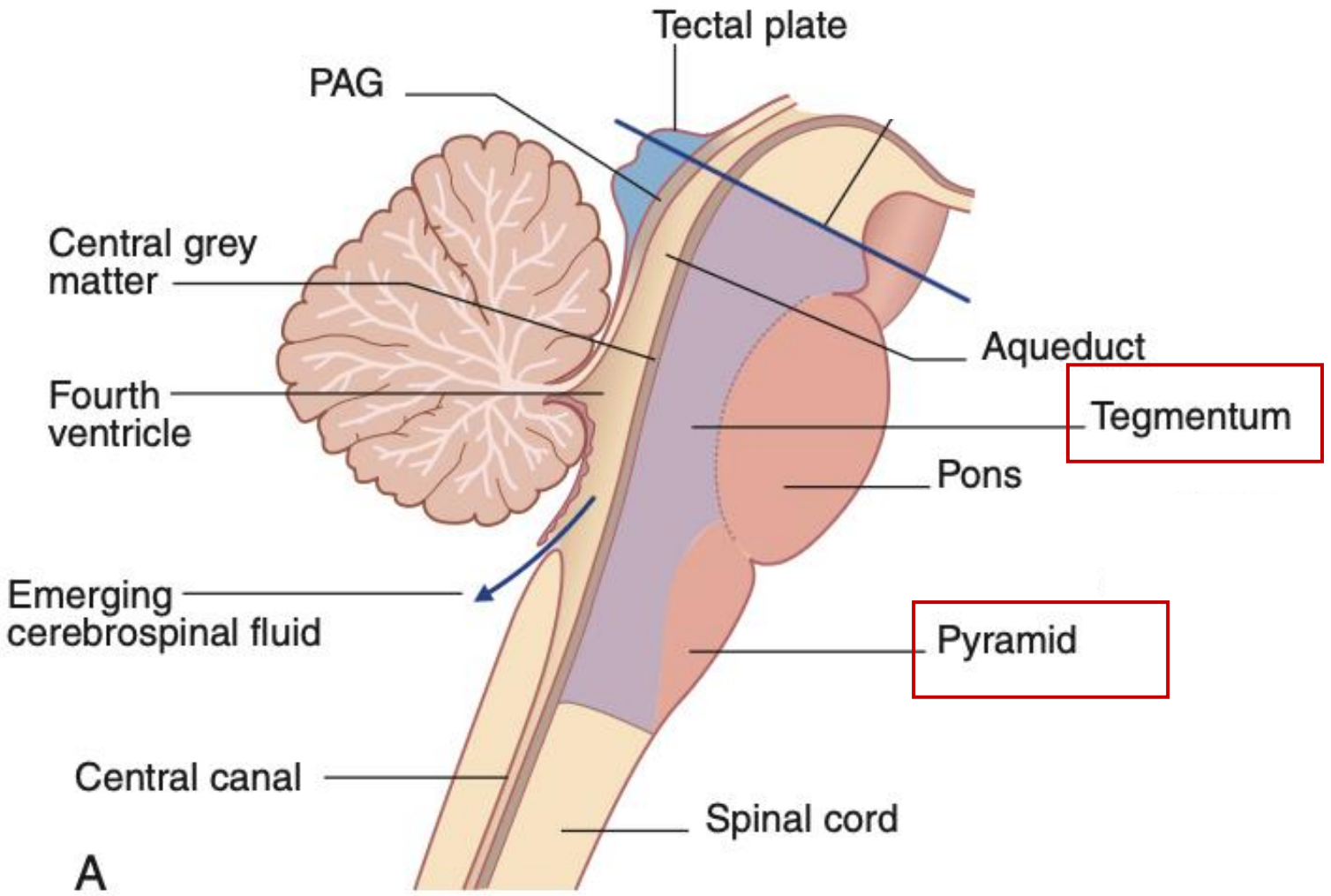
Brainstem



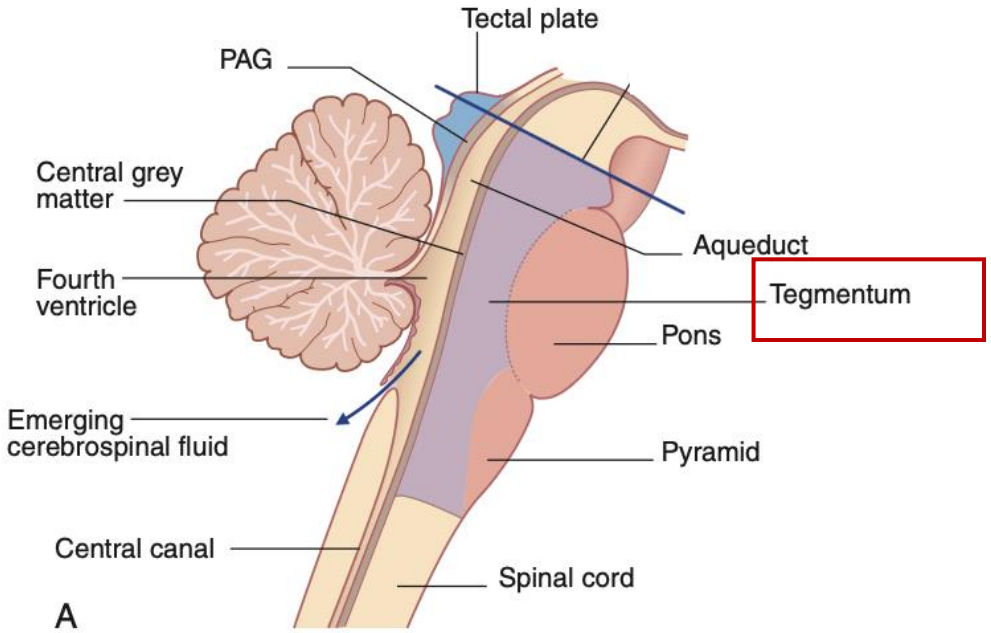
Brainstem


Tectal plate
PAG
Plane of section B
Central grey matter
Aqueduct
Fourth ventricle
Tegmentum
Pons
Emerging cerebrospinal fluid
Pyramid
Central canal
Spinal cord
A
Tectal plate
Aqueduct
PAG
Tegmentum
Red nucleus
Substantia nigra
Crus cerebri
Interpeduncular fossa
B

Brainstem


Tectal plate
PAG
Central grey matter
Fourth ventricle
Aqueduct
Tegmentum
Pons
Emerging cerebrospinal fluid
Pyramid
Central canal
Spinal cord
A

Brainstem



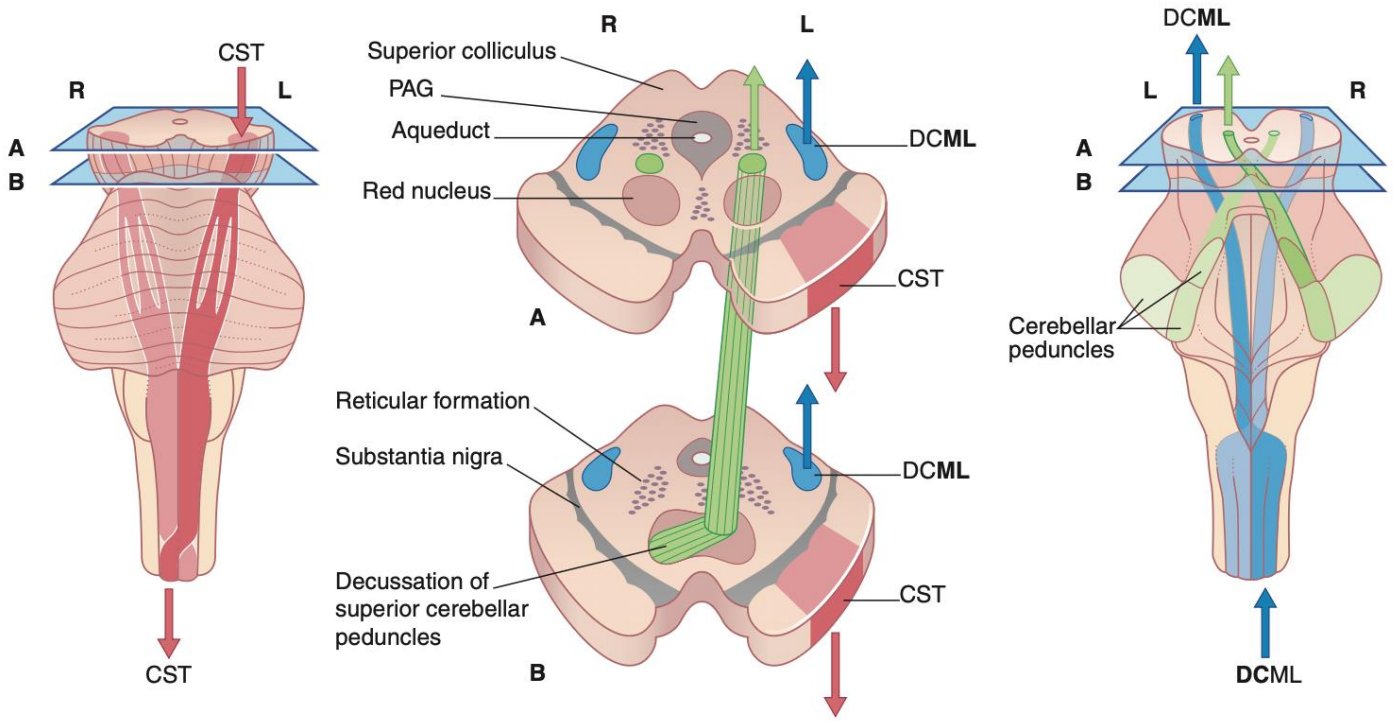
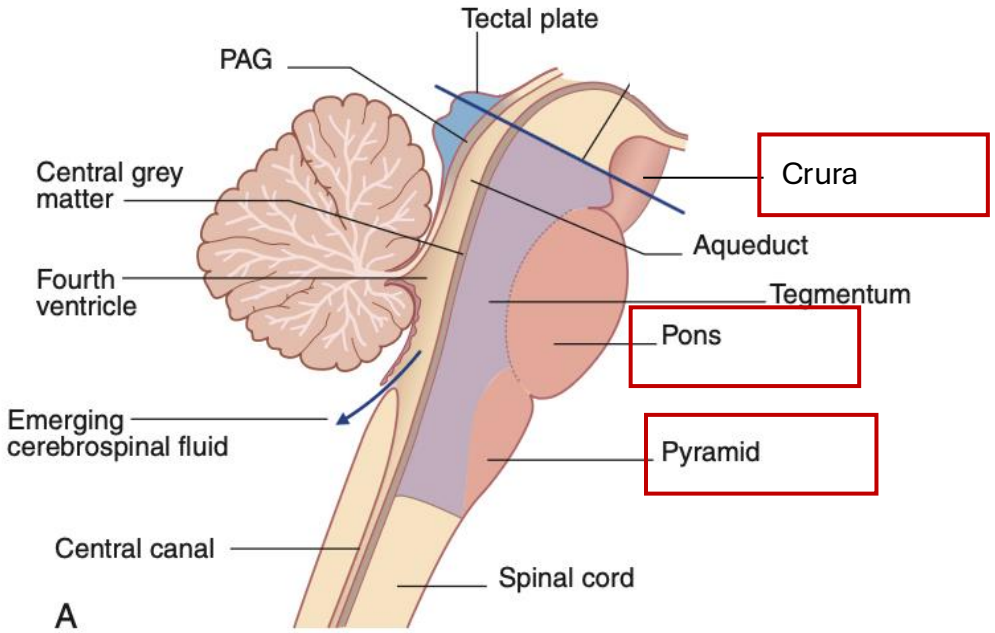


FIGURE 3.4 Transverse sections of midbrain. **(A)** At the level of superior colliculi. **(B)** At the level of inferior colliculi. In this and following diagrams, the corticospinal tract (CST) and dorsal column–medial lemniscal (DC**ML**) pathway connected to the *left* cerebral hemisphere are highlighted. PAG, periaqueductal grey matter.

Brainstem



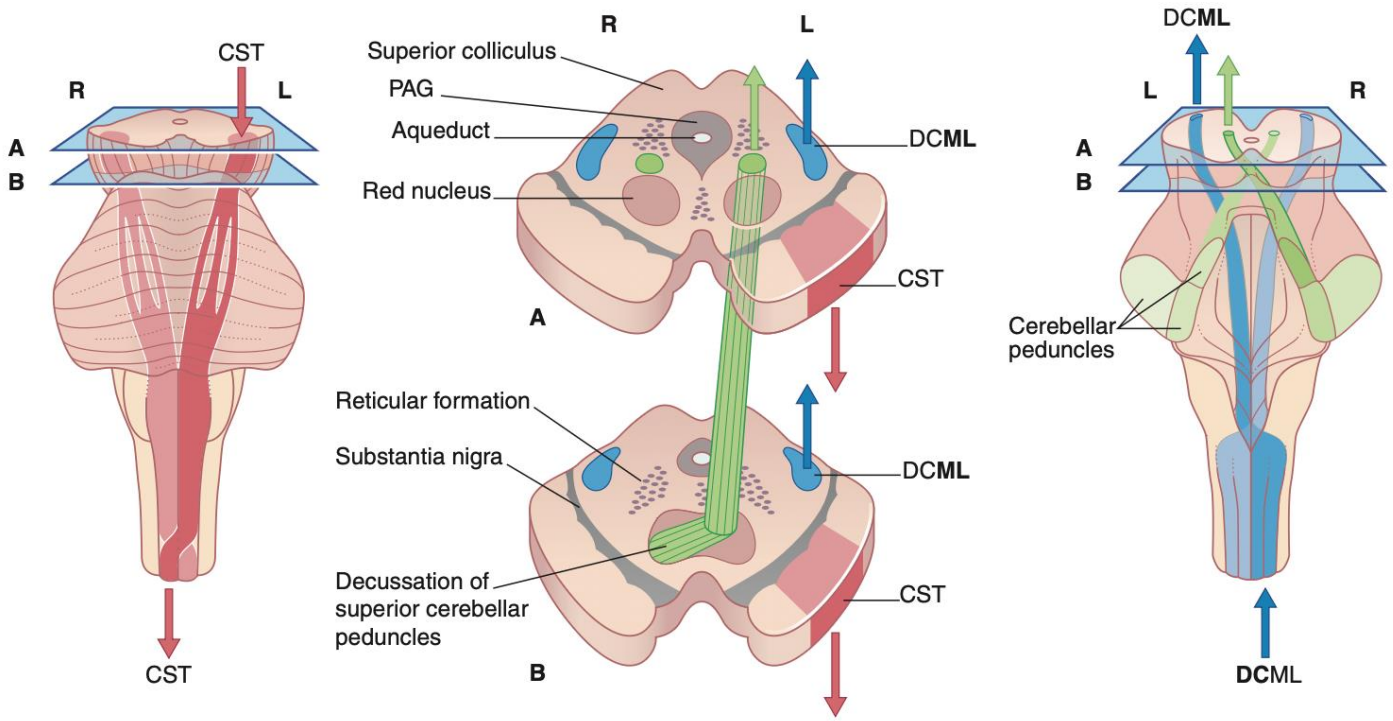
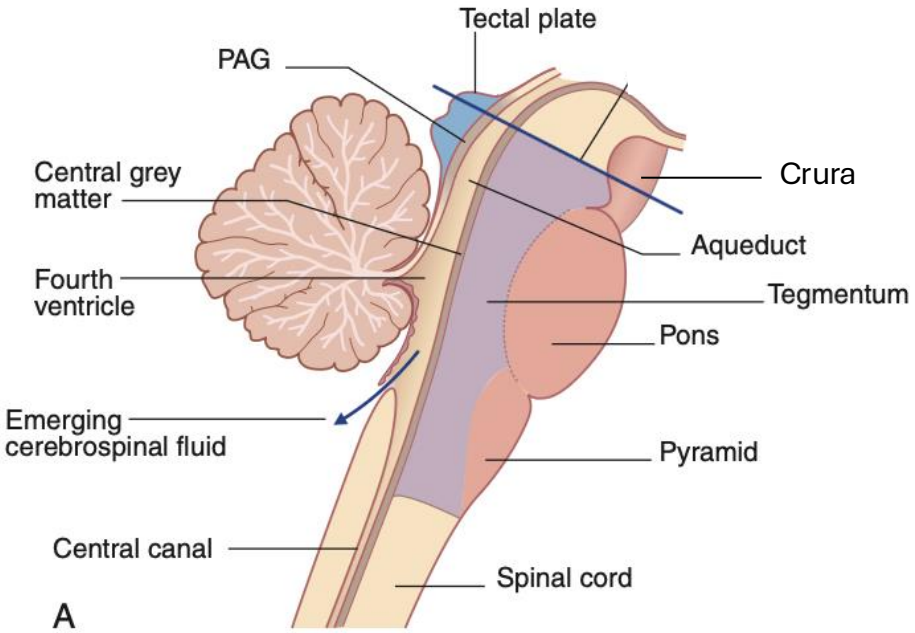


FIGURE 3.4 Transverse sections of midbrain. **(A)** At the level of superior colliculi. **(B)** At the level of inferior colliculi. In this and following diagrams, the corticospinal tract (CST) and dorsal column–medial lemniscal (DC**ML**) pathway connected to the *left* cerebral hemisphere are highlighted. PAG, periaqueductal grey matter.

Brainstem



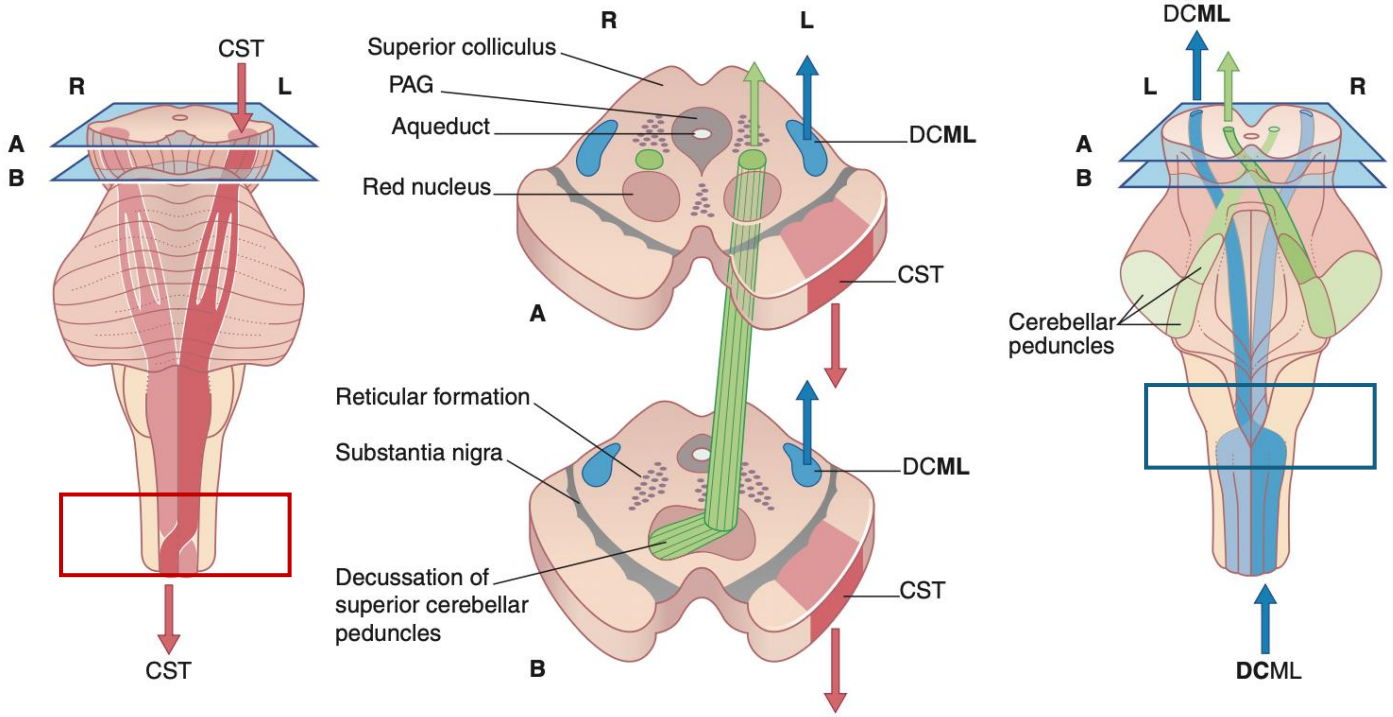
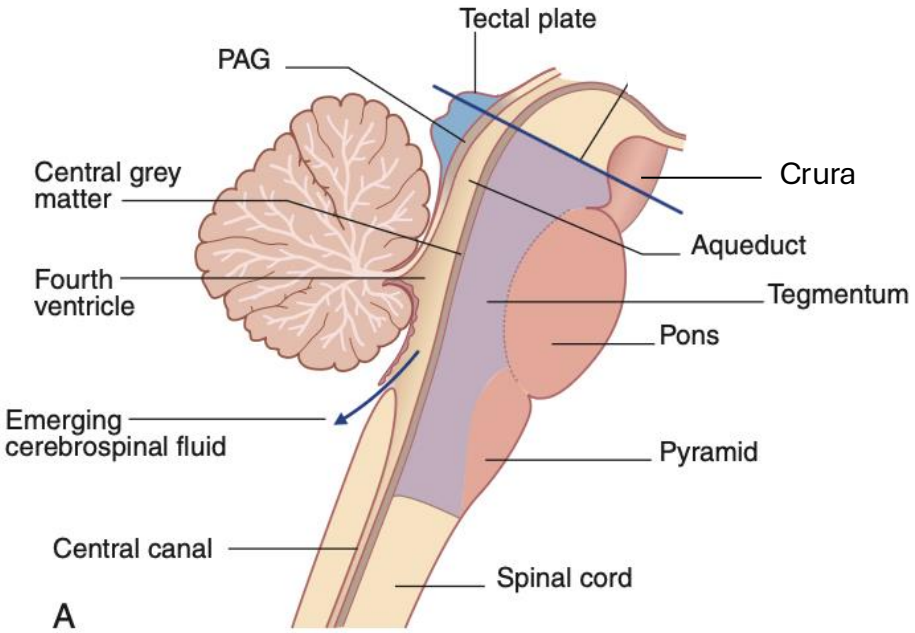


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Brainstem



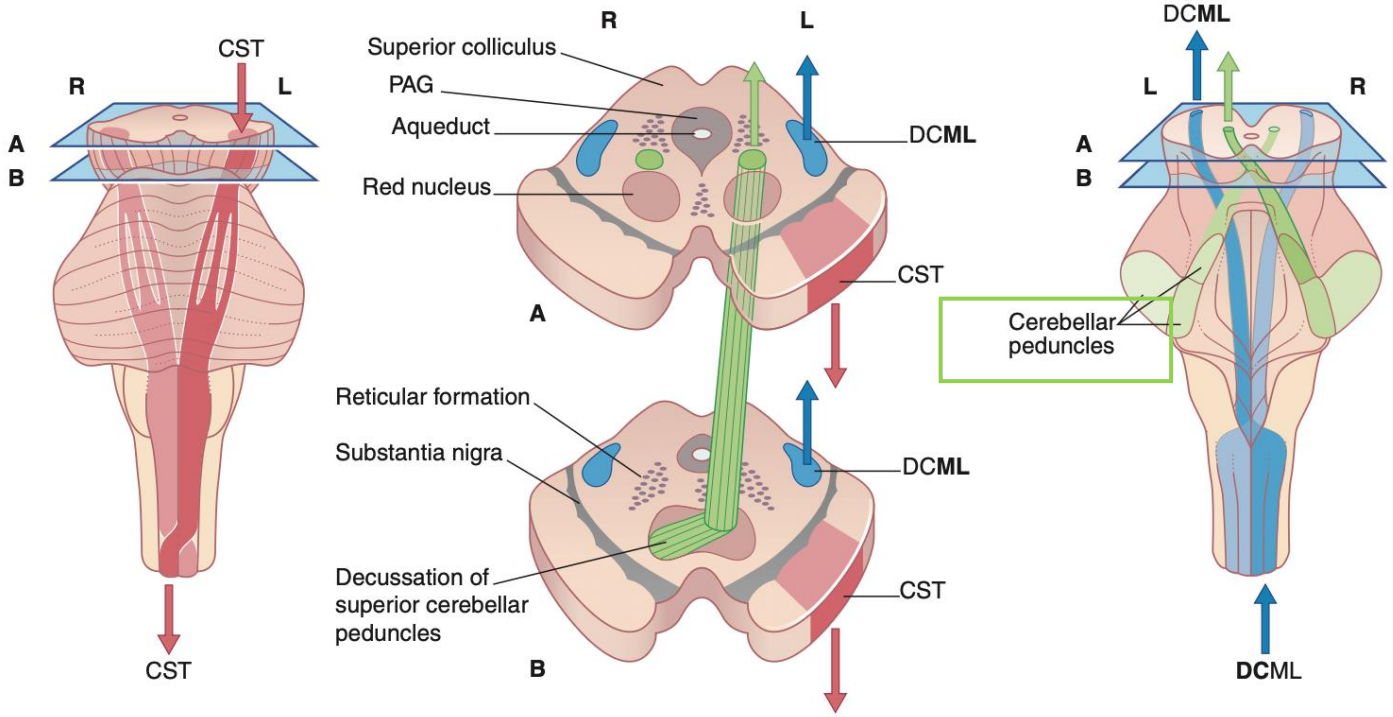
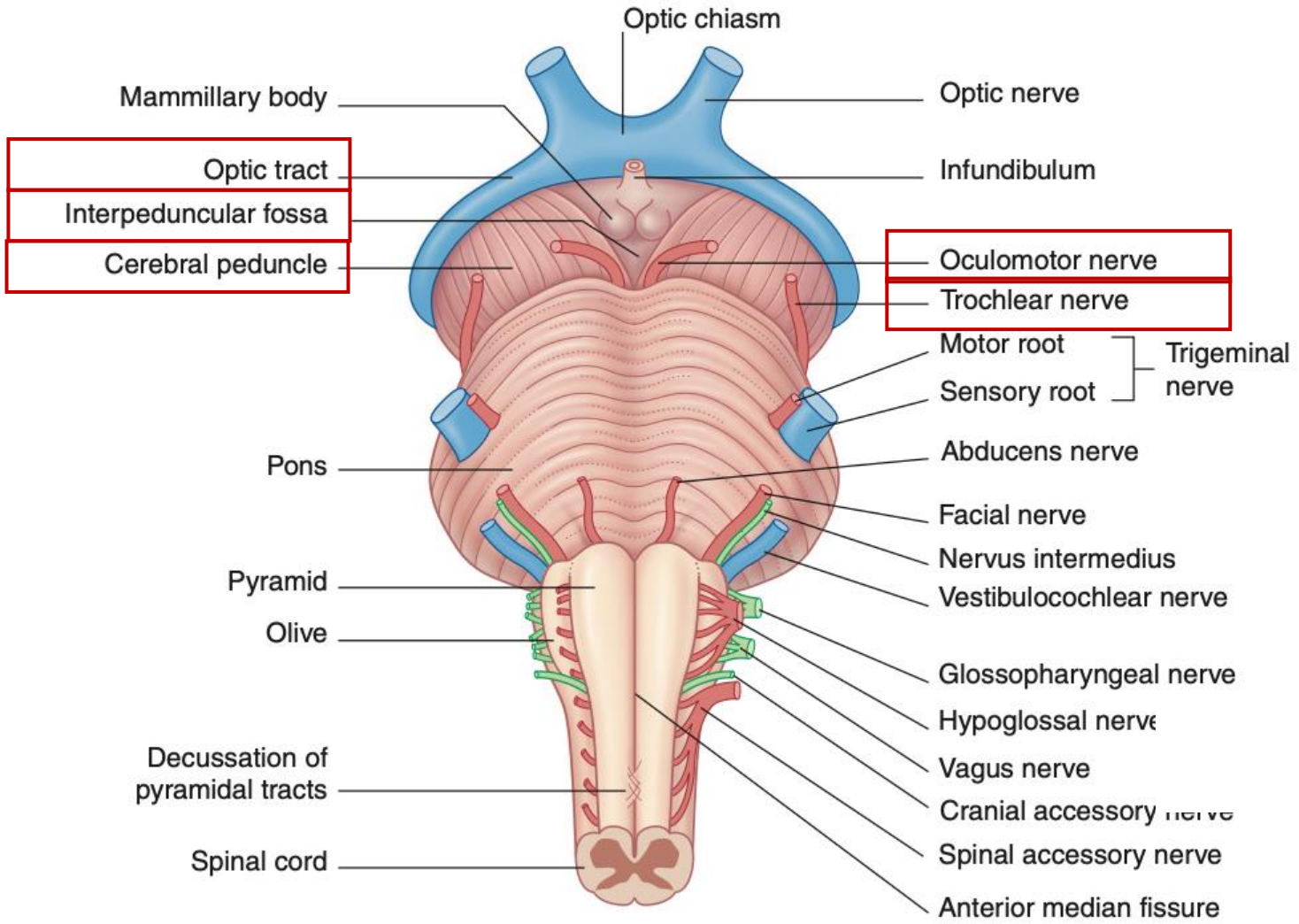


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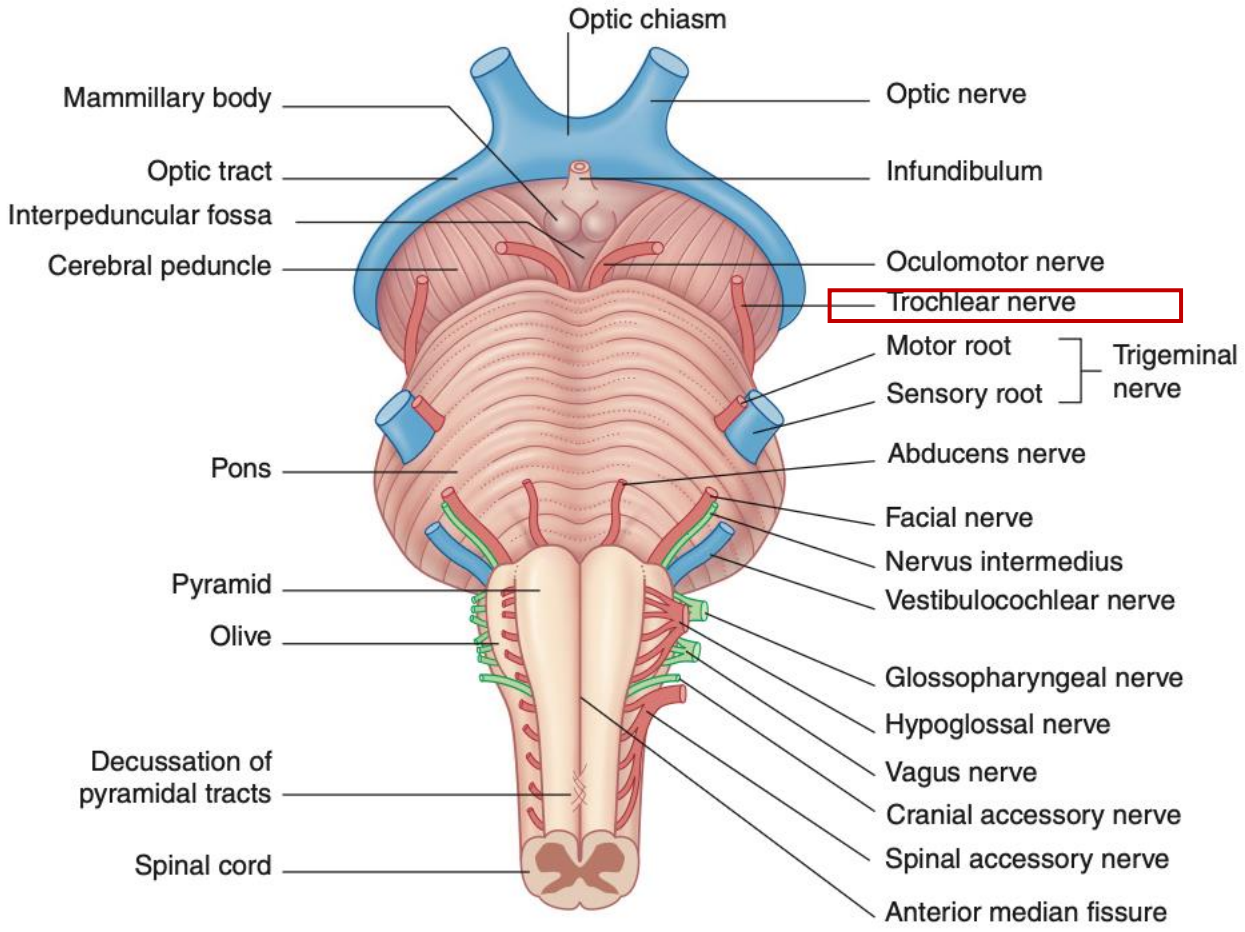
Brainstem: Midbrain

Ventral view

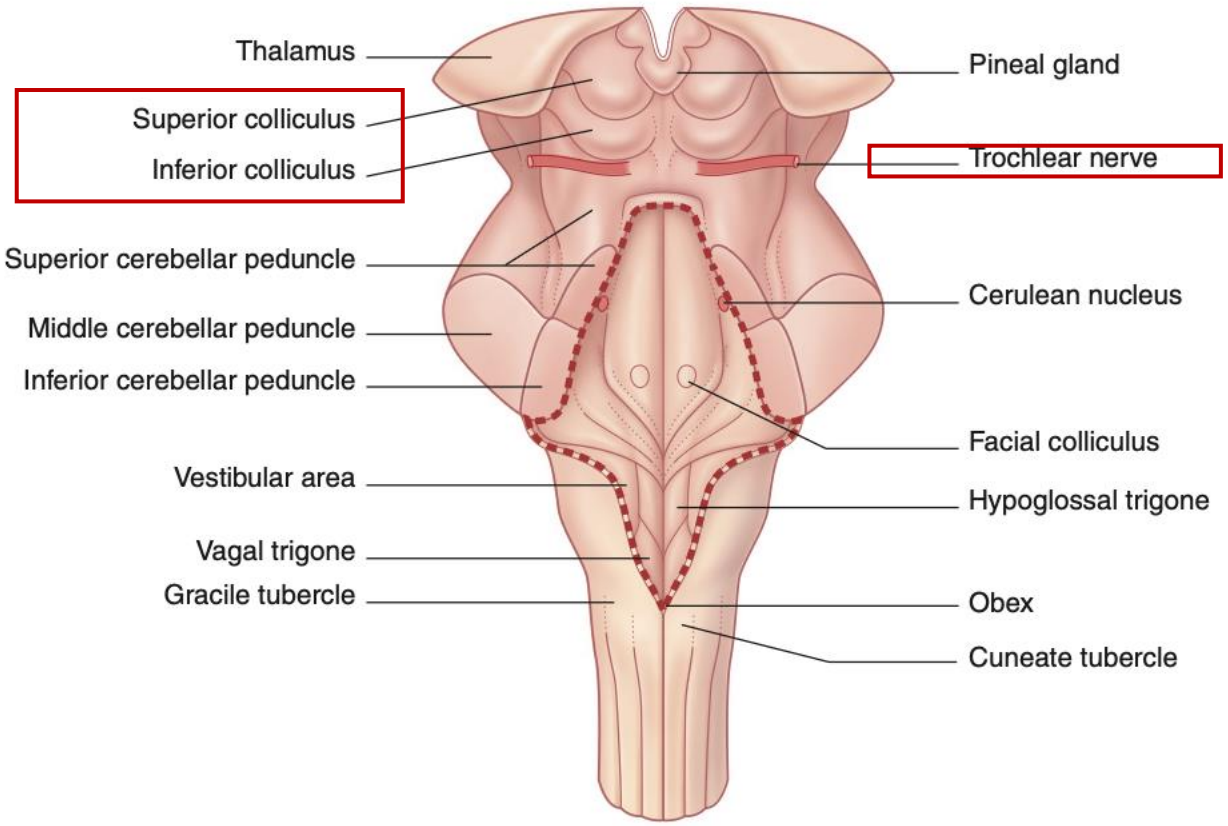


Brainstem: Midbrain

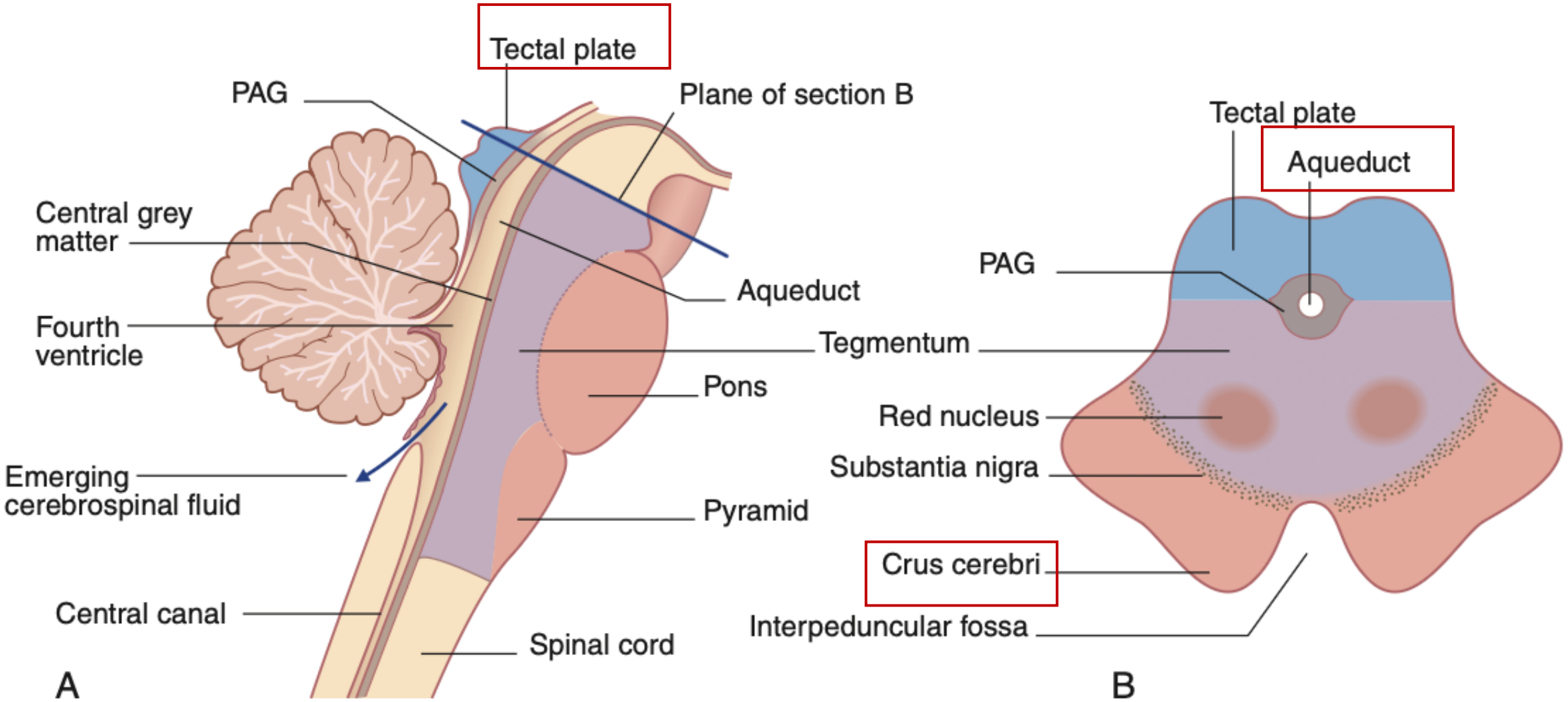
Ventral view



Dorsal view



Brainstem: midbrain



Brainstem: Midbrain

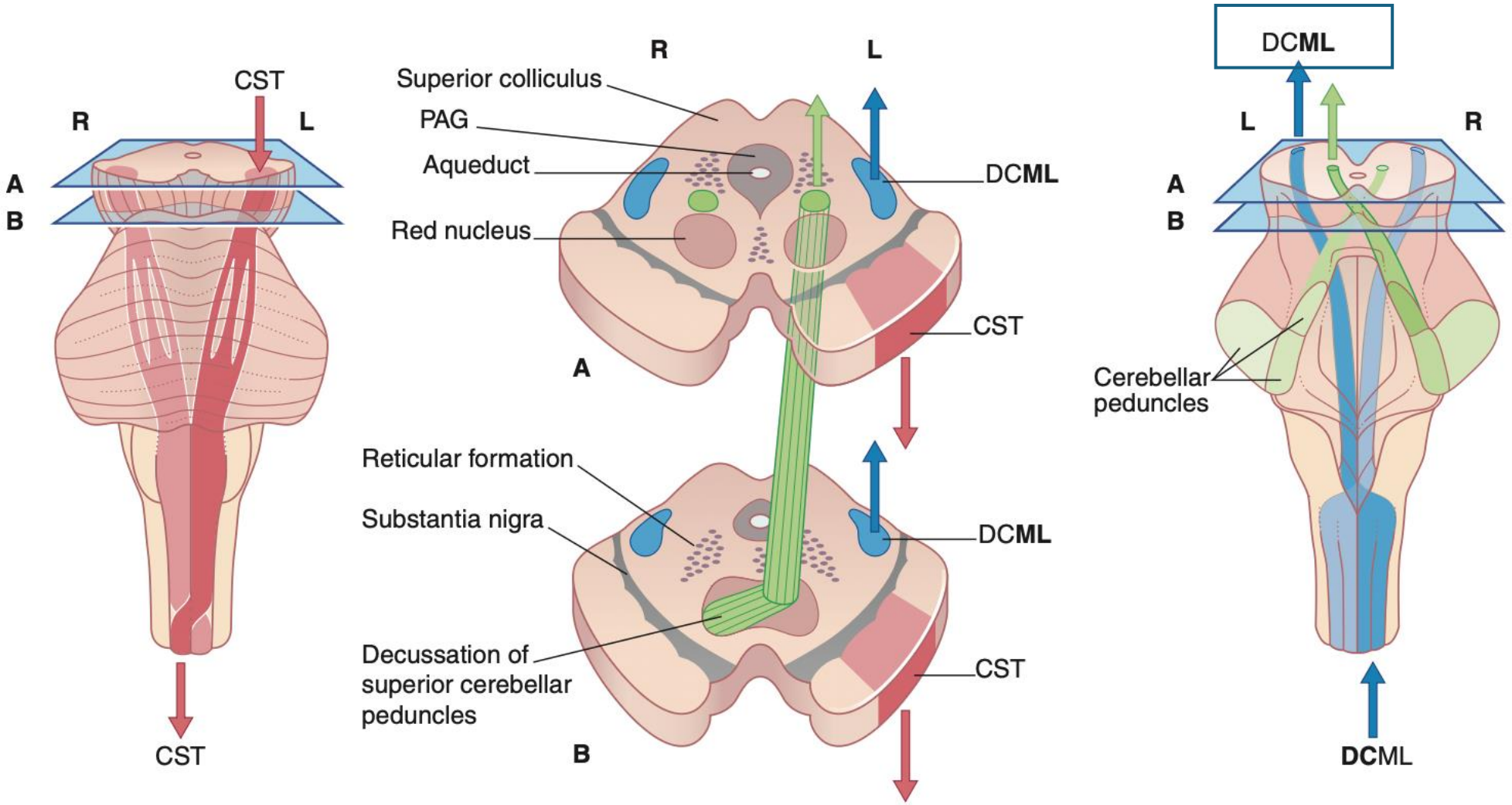


FIGURE 3.4 Transverse sections of midbrain. **(A)** At the level of superior colliculi. **(B)** At the level of inferior colliculi. In this and following diagrams, the corticospinal tract (CST) and dorsal column–medial lemniscal (DC**ML**) pathway connected to the *left* cerebral hemisphere are highlighted. PAG, periaqueductal grey matter.

Brainstem: Midbrain

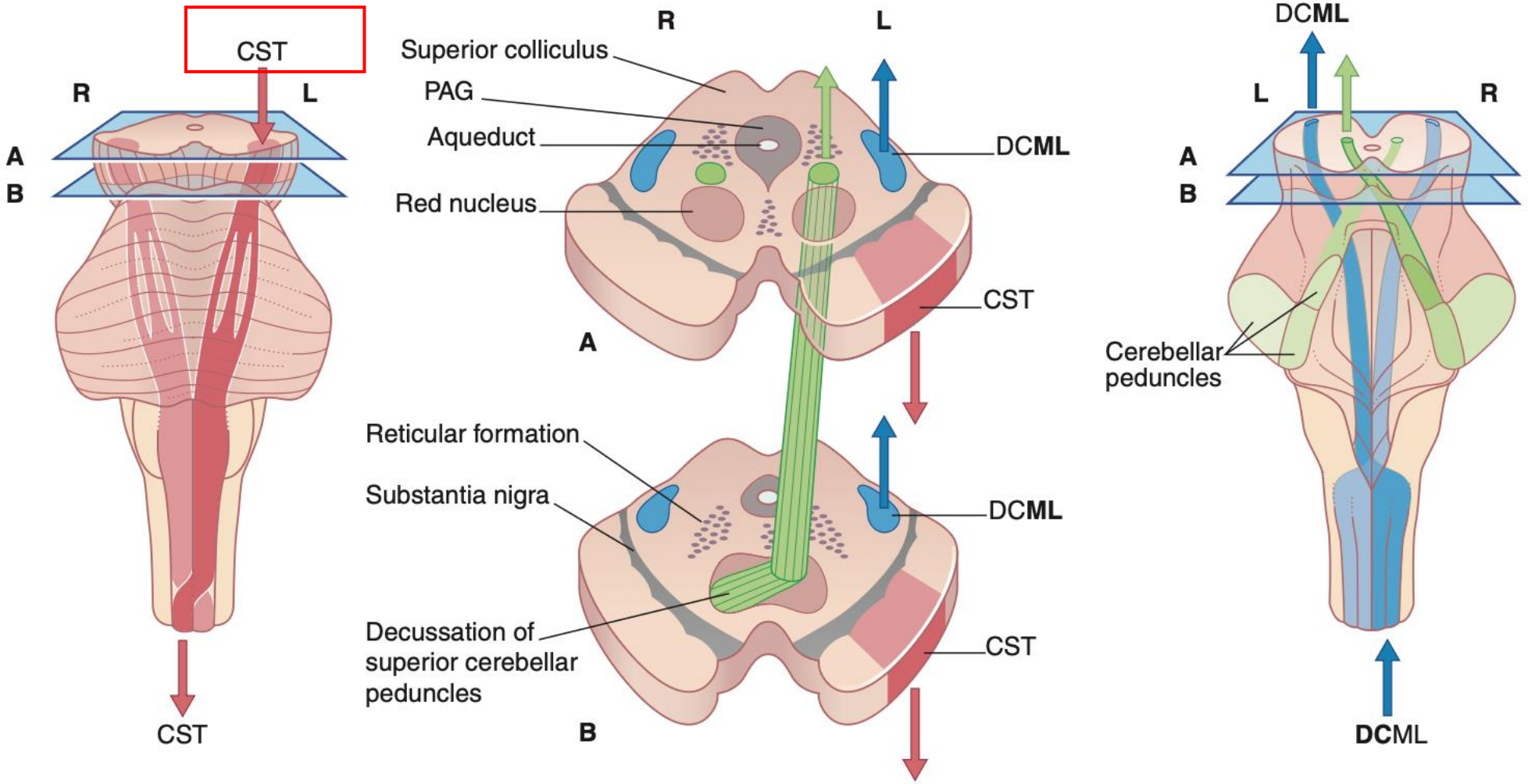


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Brainstem: Midbrain

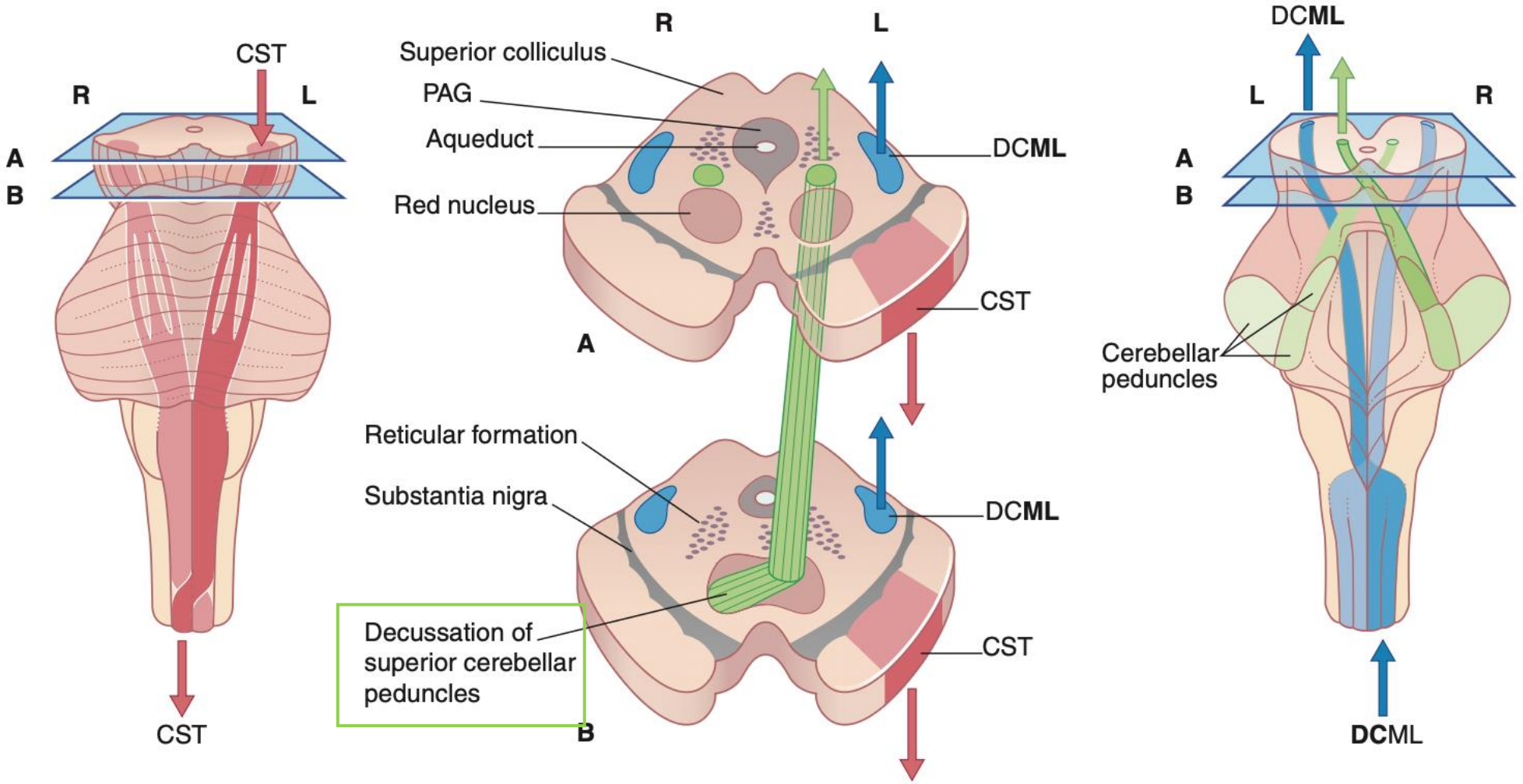
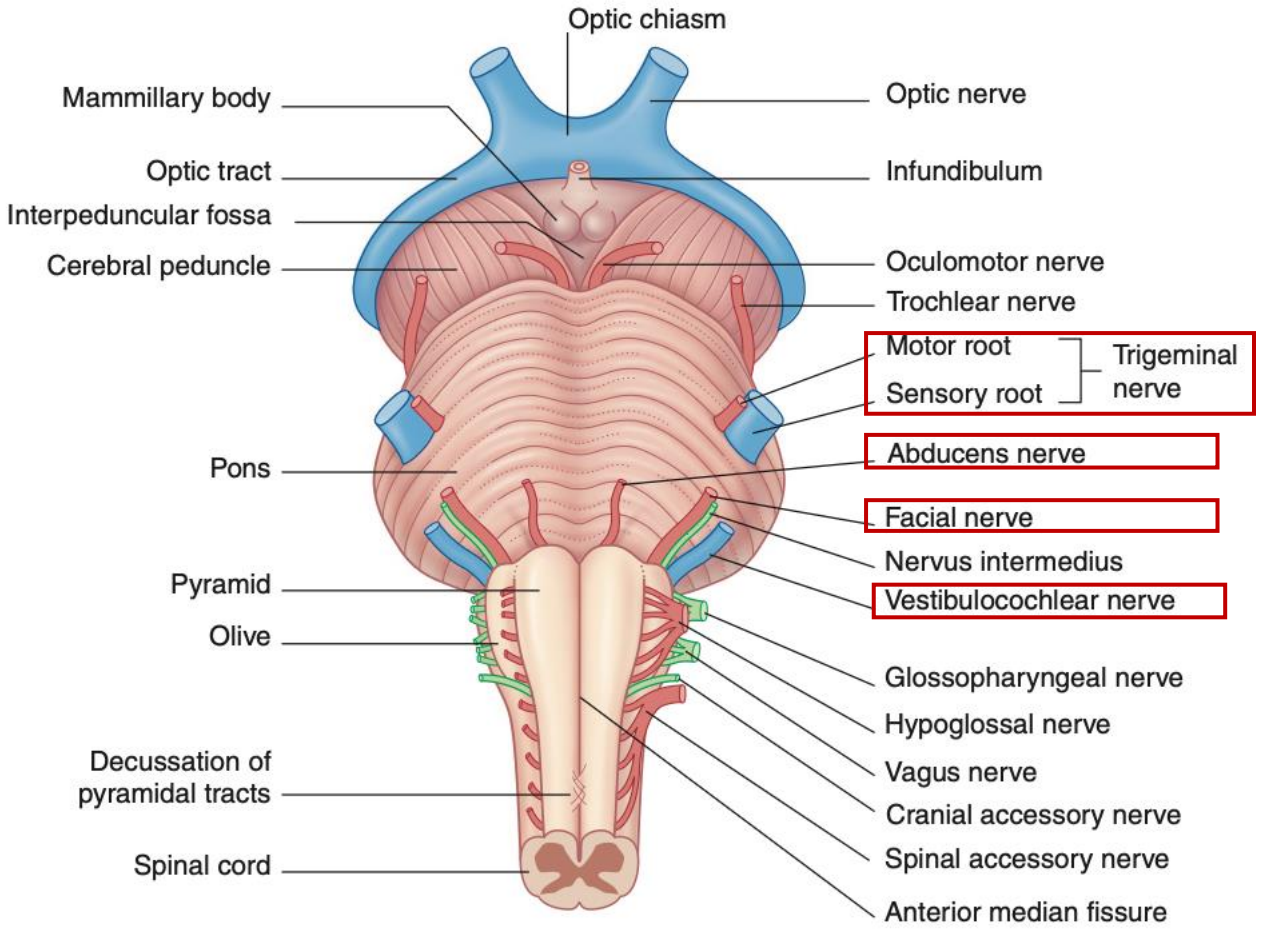


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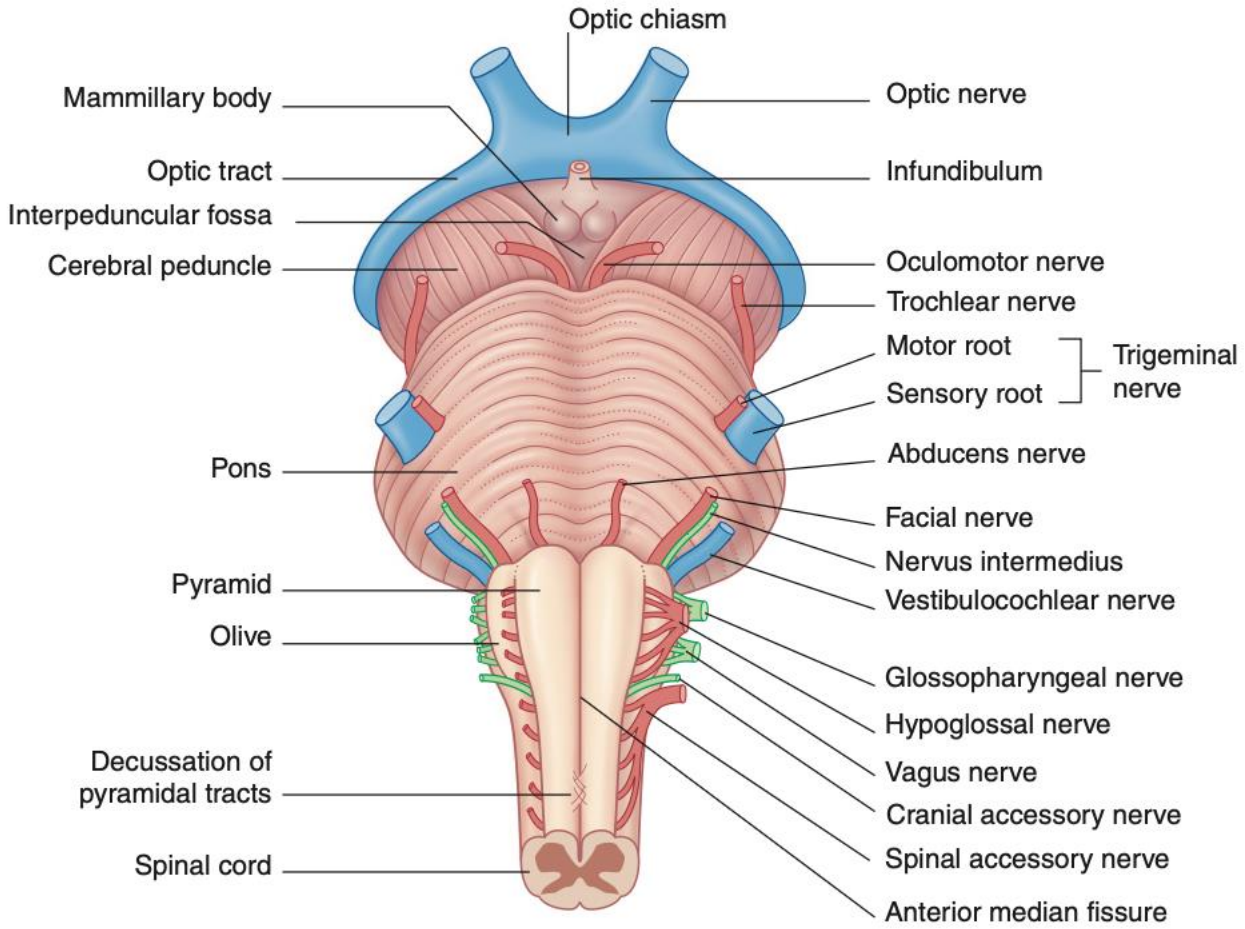
Brainstem: Pons

Ventral view

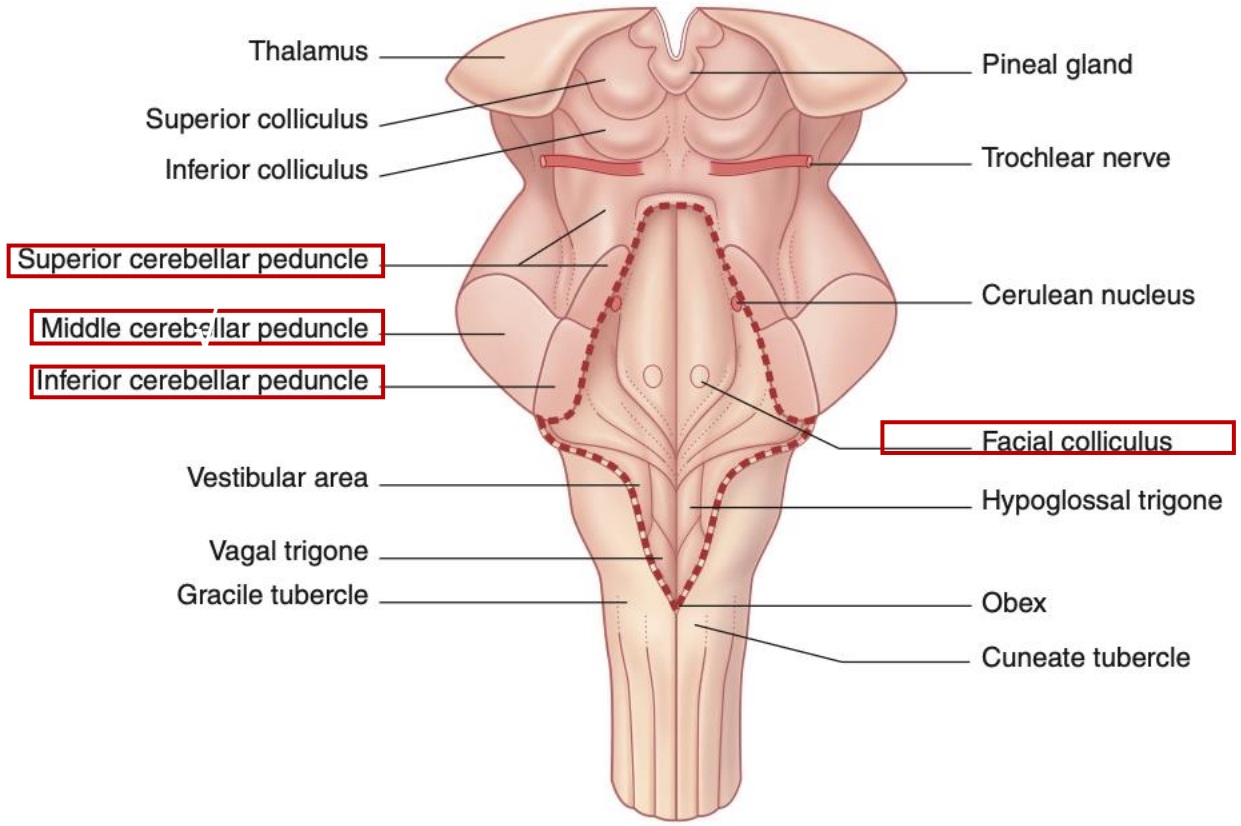


Brainstem: Pons

Ventral view



Dorsal view



Brainstem: Pons

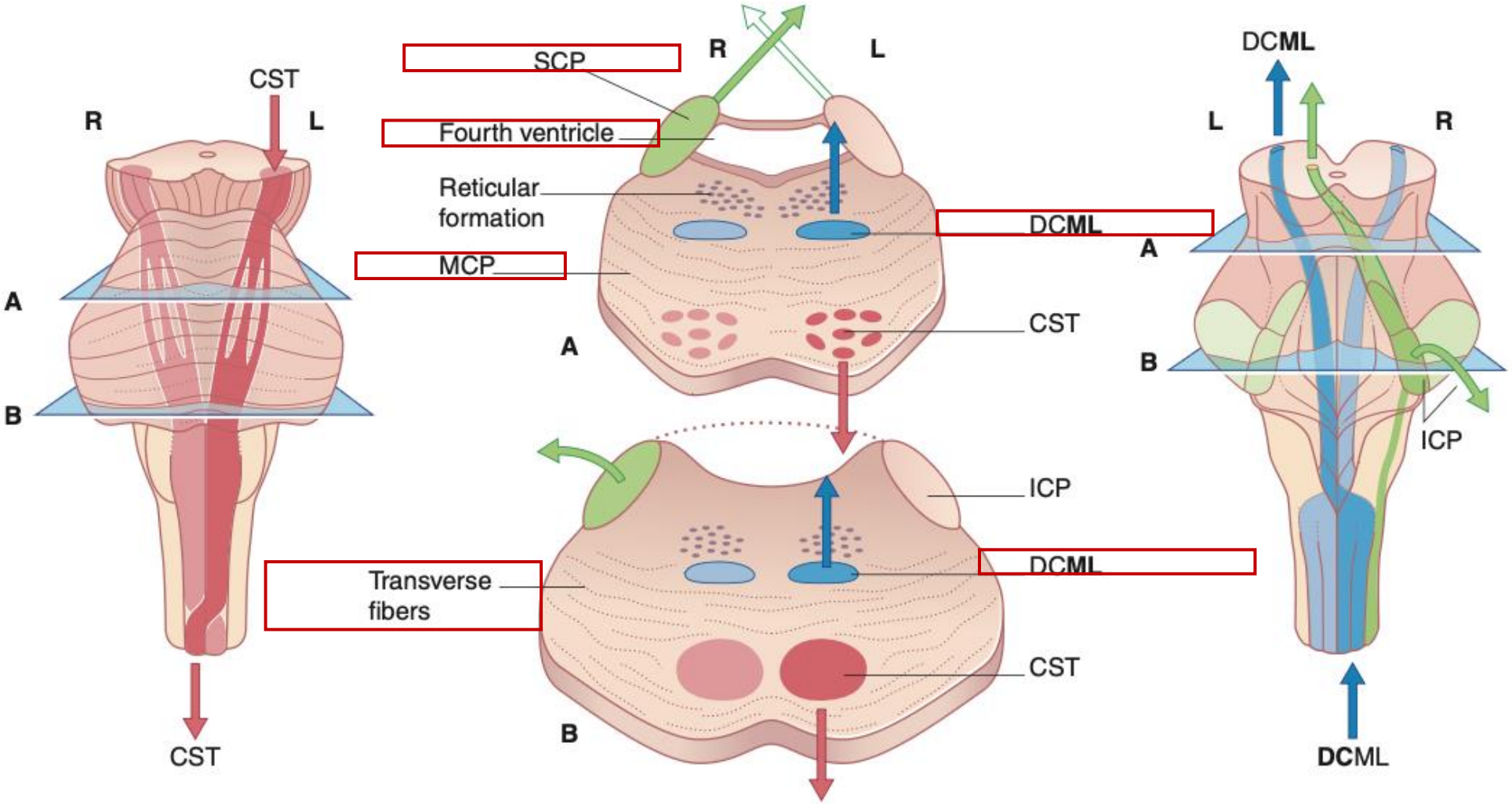
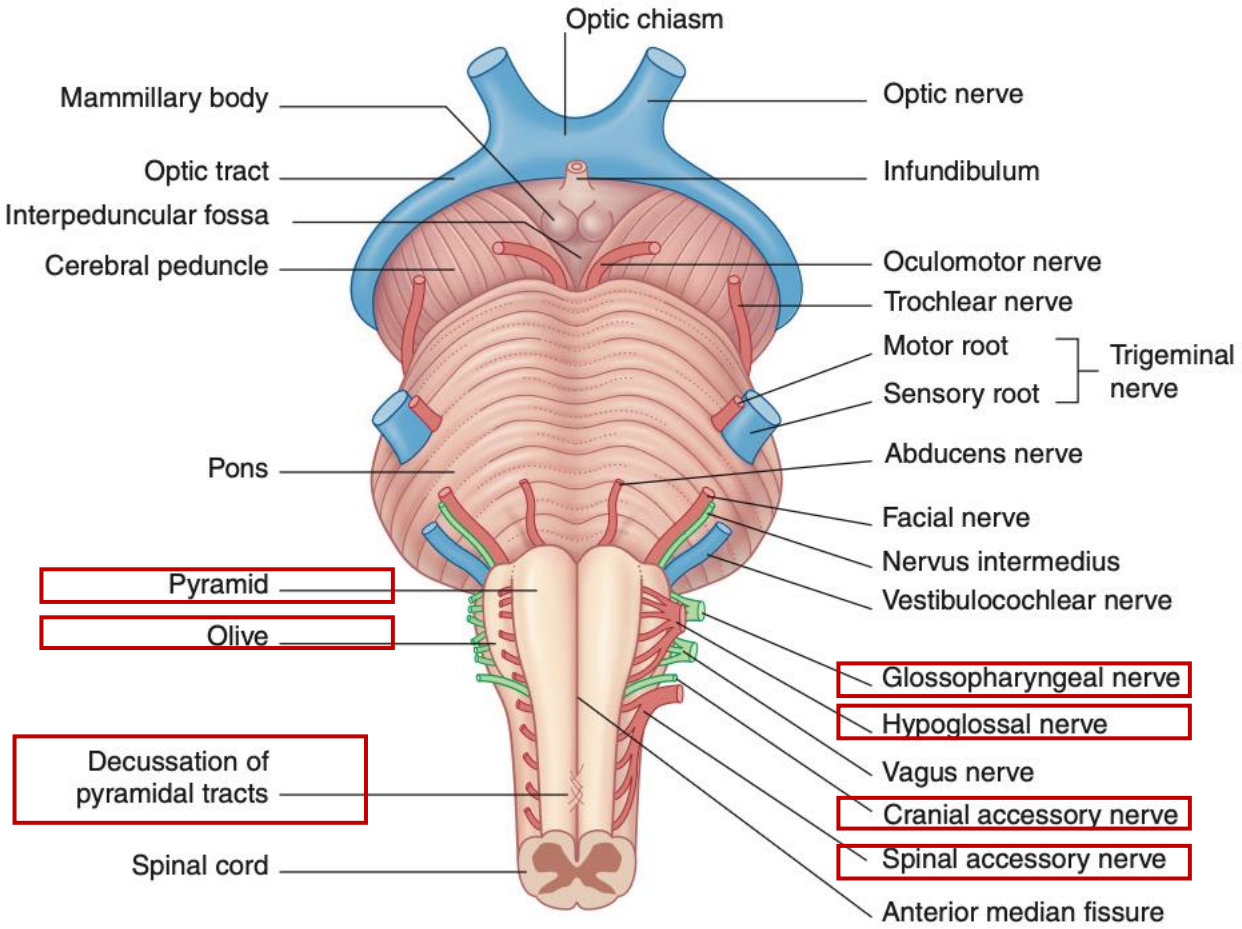


FIGURE 3.5 Transverse sections of pons. **(A)** Upper pons. **(B)** Lower pons. SCP, MCP, ICP, superior, middle, inferior cerebellar peduncles, respectively; CST, corticospinal tract; DC**ML**, dorsal column–medial lemniscal pathway.

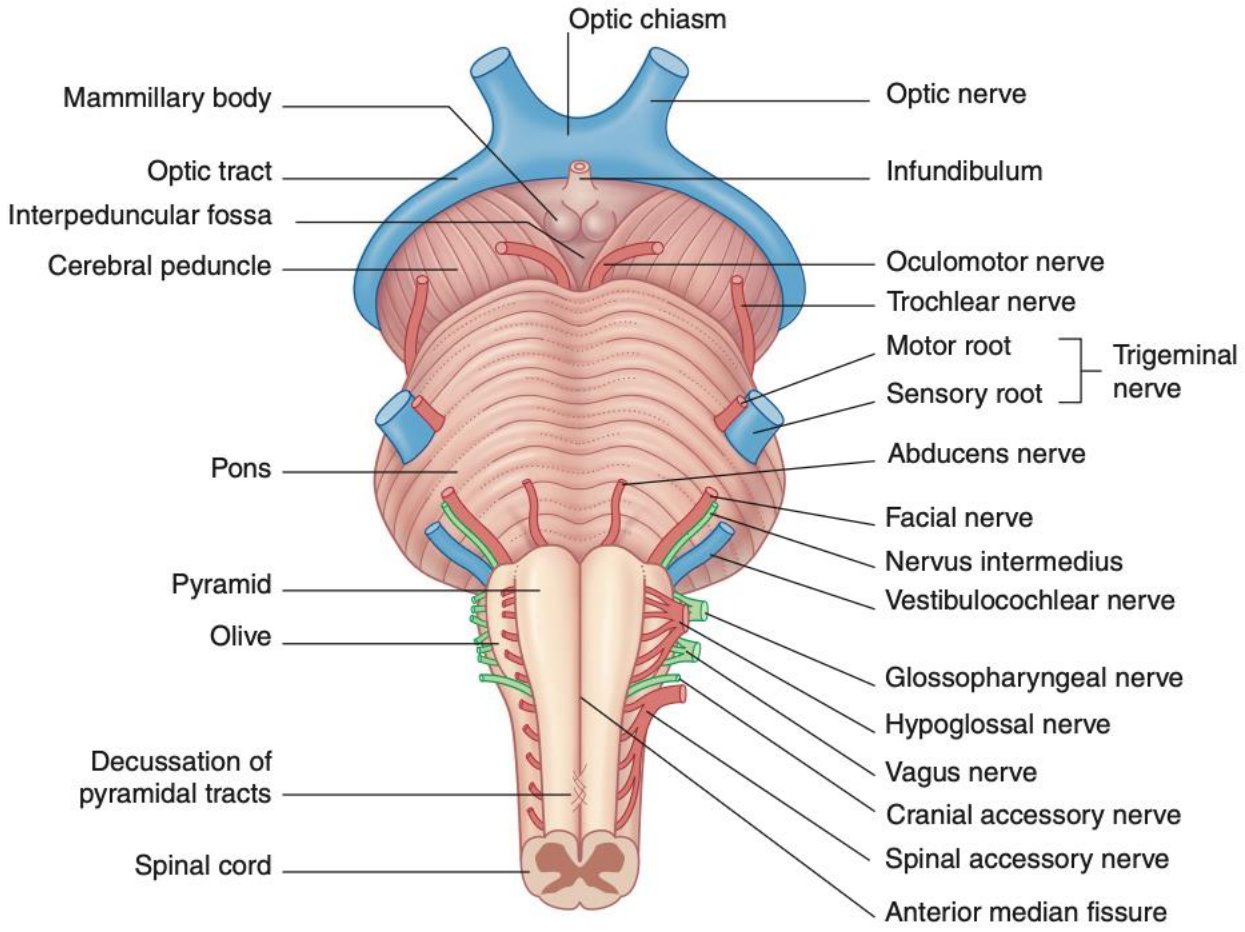
Brainstem: Medulla oblongata

Ventral view

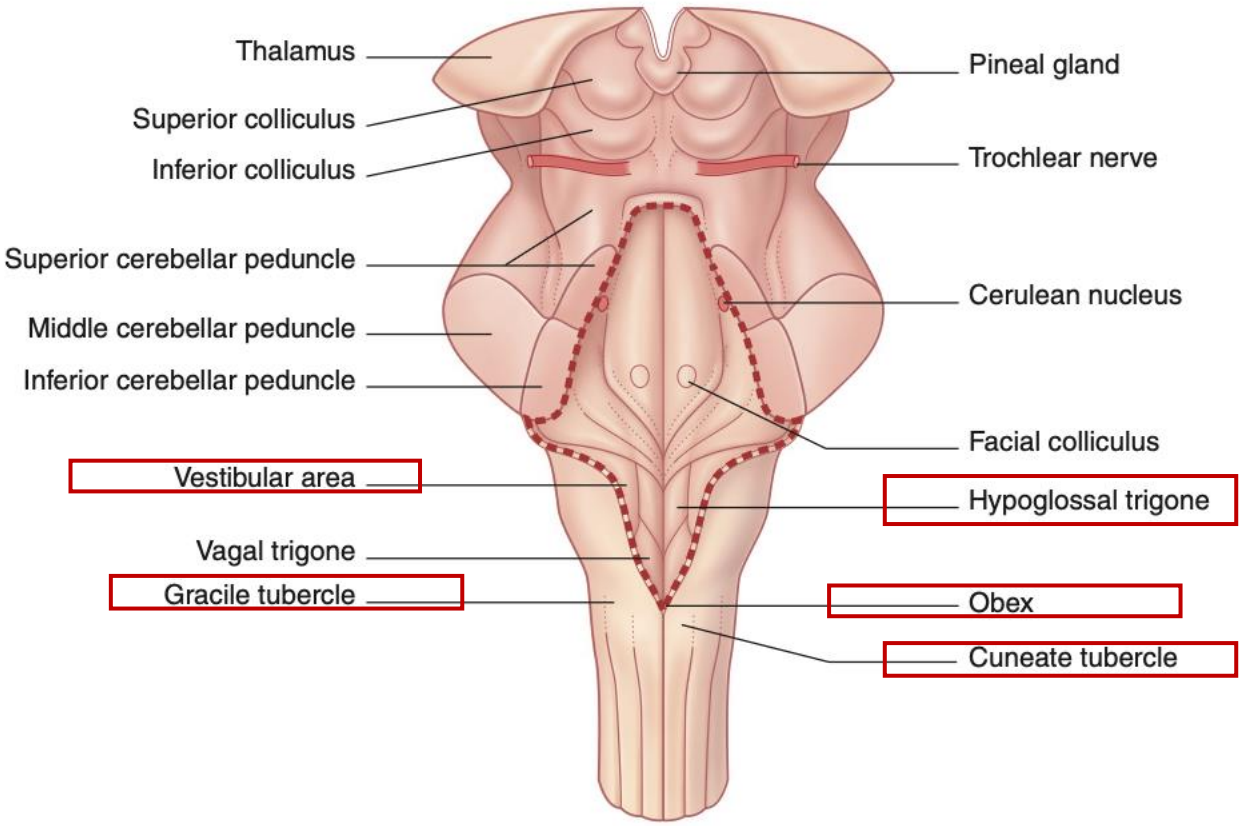


Brainstem: Medulla oblongata

Ventral view



Dorsal view



Brainstem: Medulla oblongata

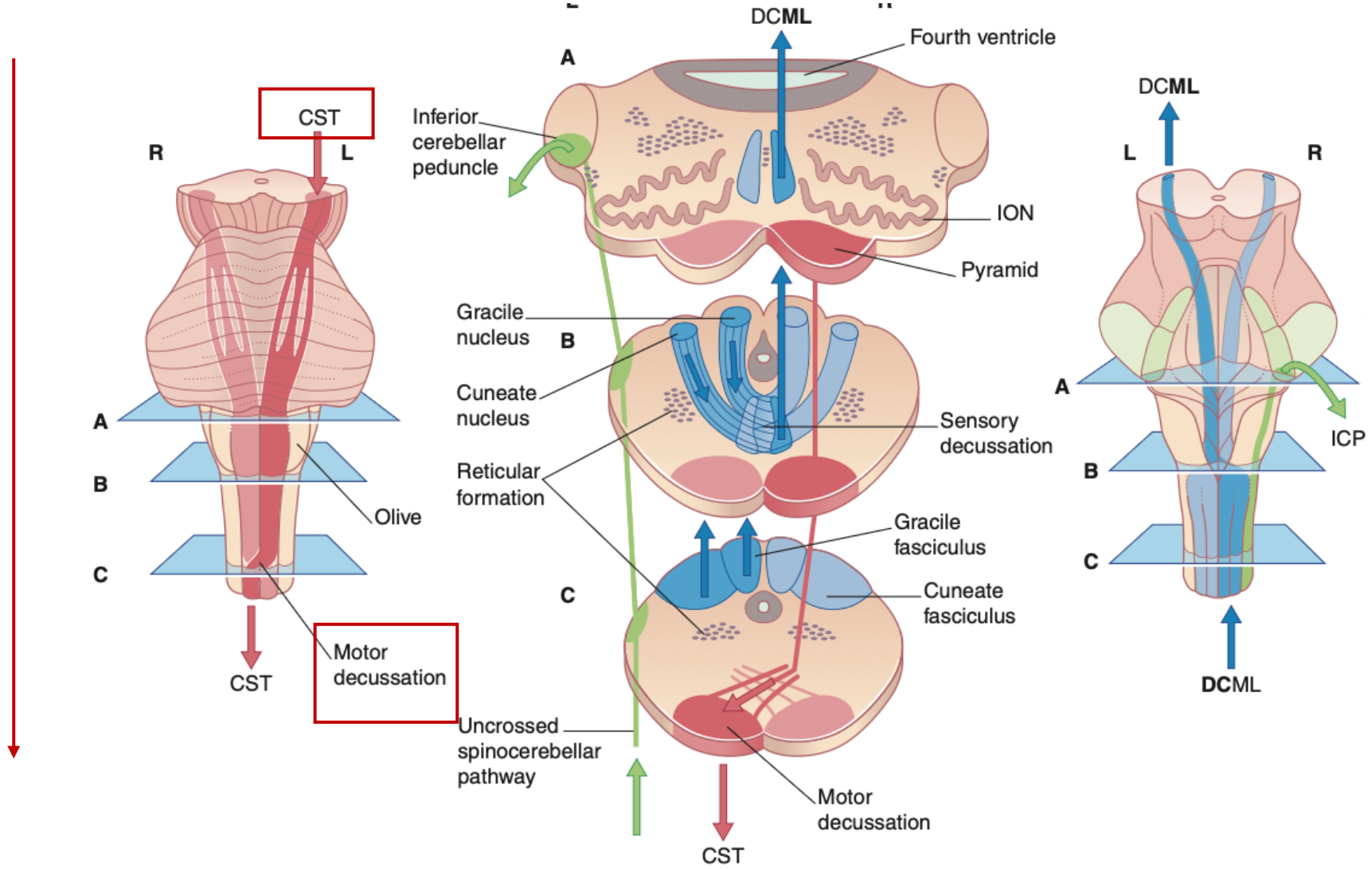


FIGURE 3.6 Transverse sections of medulla oblongata. **(A)** Level of inferior olivary nucleus (ION). **(B)** Level of sensory decussation. **(C)** Level of motor decussation. CST, corticospinal tract; ICP, inferior cerebellar peduncle; DC**ML**, dorsal column–medial lemniscal pathway.

Brainstem: Medulla oblongata

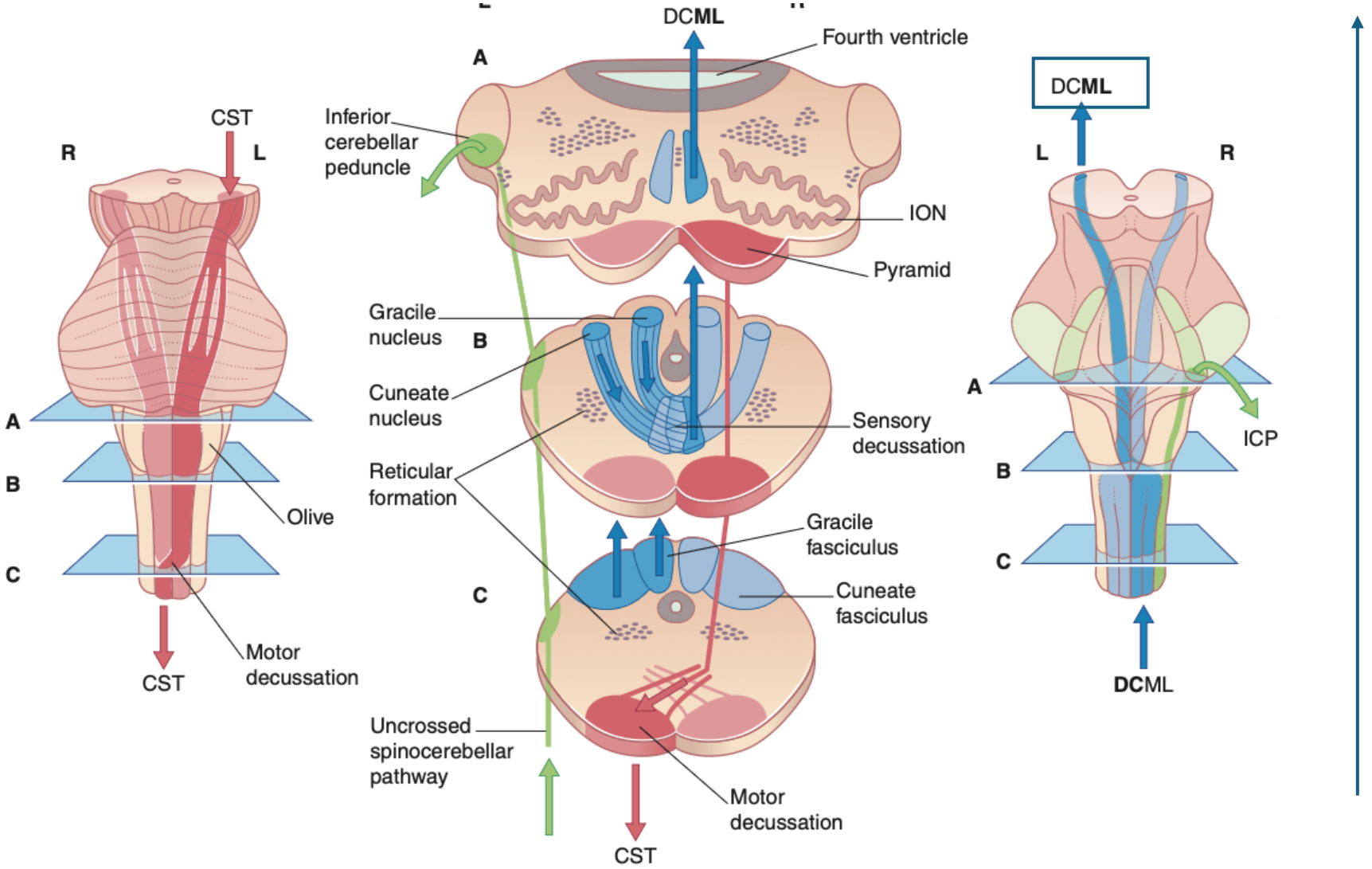


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Brainstem: Medulla oblongata

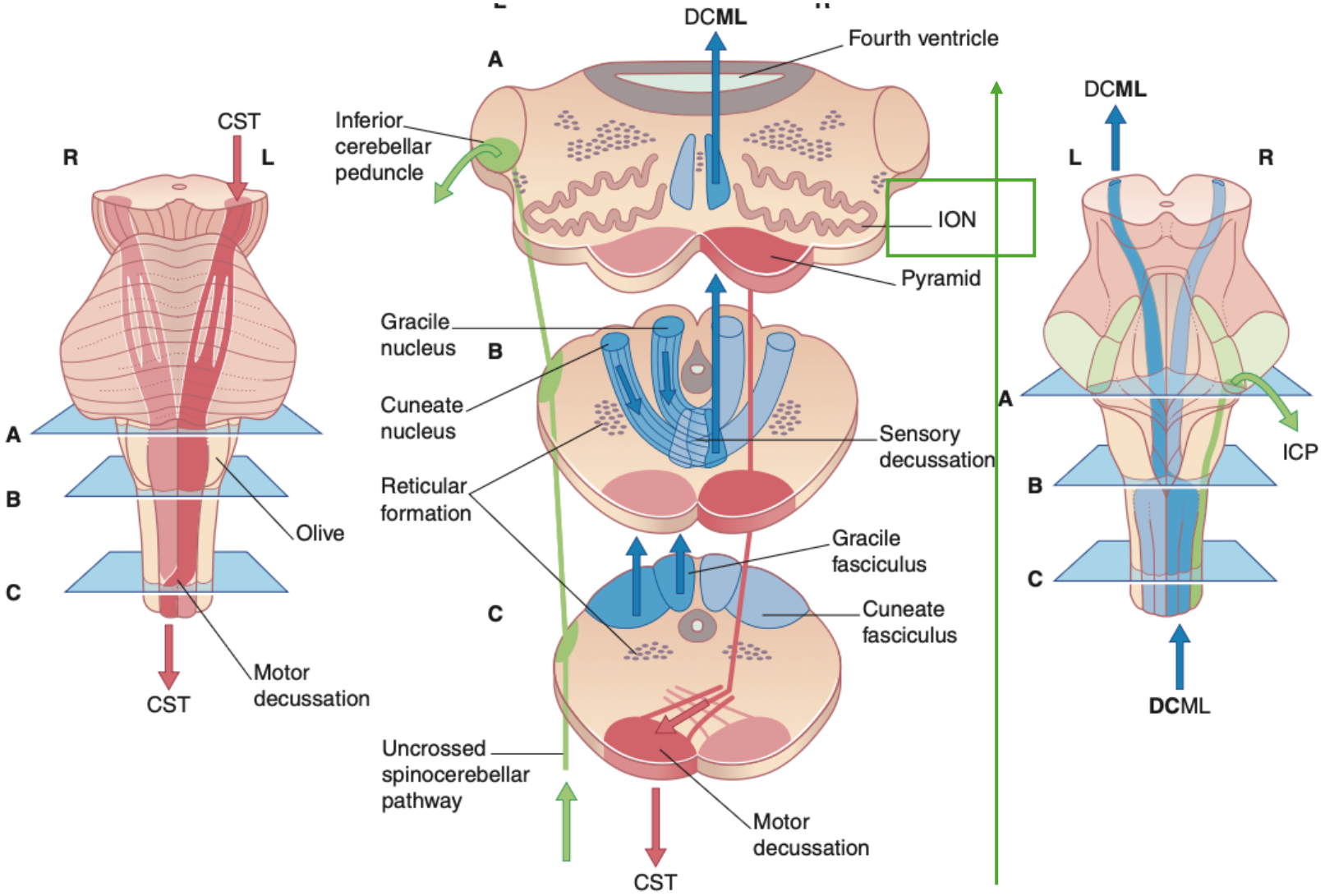
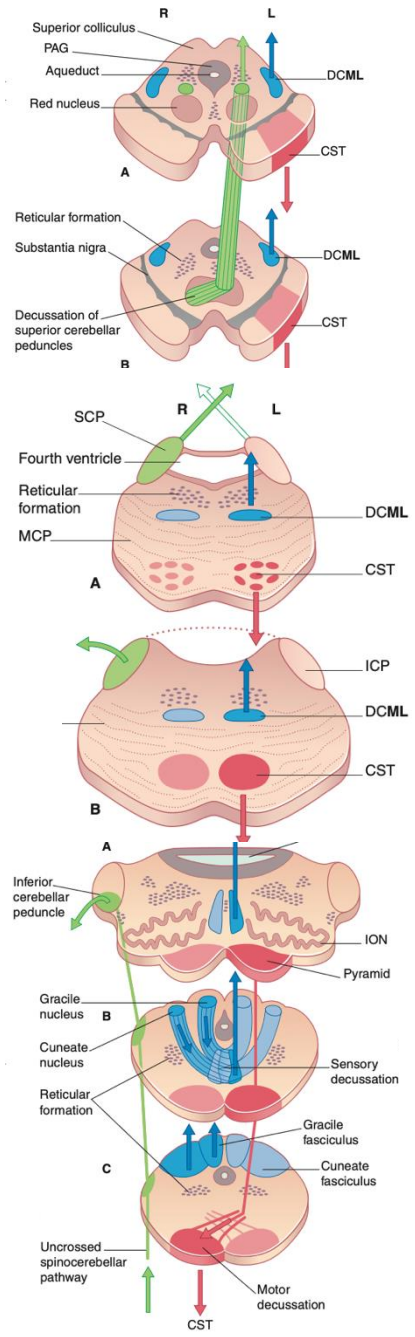


FIGURE 3.6 Transverse sections of medulla oblongata. **(A)** Level of inferior olivary nucleus (ION). **(B)** Level of sensory decussation. **(C)** Level of motor decussation. CST, corticospinal tract; ICP, inferior cerebellar peduncle; DC**ML**, dorsal column–medial lemniscal pathway.

Brainstem:CST



Midbrain

FIGURE 3.4 Transverse sections of midbrain. **(A)** At the level of superior colliculi. **(B)** At the level of inferior colliculi. In this and following diagrams, the corticospinal tract (CST) and dorsal column–medial lemniscal (DC**ML**) pathway connected to the *left* cerebral hemisphere are highlighted. PAG, periaqueductal grey matter.

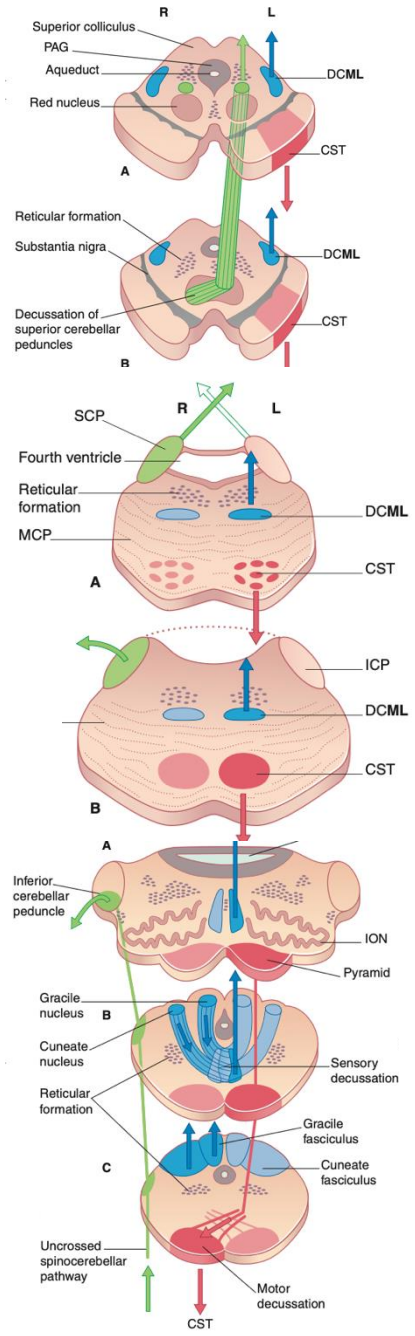
Pons

FIGURE 3.5 Transverse sections of pons. **(A)** Upper pons. **(B)** Lower pons. SCP, MCP, ICP, superior, middle, inferior cerebellar peduncles, respectively; CST, corticospinal tract; DC**ML**, dorsal column–medial lemniscal pathway.

Medulla oblongata

FIGURE 3.6 Transverse sections of medulla oblongata. **(A)** Level of inferior olivary nucleus (ION). **(B)** Level of sensory decussation. **(C)** Level of motor decussation. CST, corticospinal tract; ICP, inferior cerebellar peduncle; DC**ML**, dorsal column–medial lemniscal pathway.

Brainstem: DCML



Midbrain

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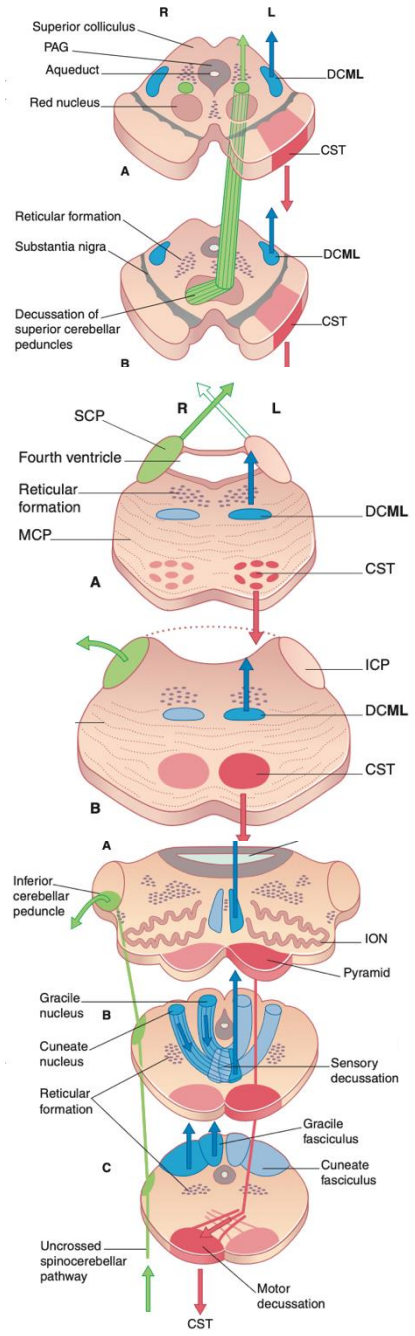
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FIGURE 3.5 Transverse sections of pons. **(A)** Upper pons. **(B)** Lower pons. SCP, MCP, ICP, superior, middle, inferior cerebellar peduncles, respectively; CST, corticospinal tract; DC**ML**, dorsal column–medial lemniscal pathway.

Medulla oblongata

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Brainstem: DCML



Midbrain

FIGURE 3.4 Transverse sections of midbrain. **(A)** At the level of superior colliculi. **(B)** At the level of inferior colliculi. In this and following diagrams, the corticospinal tract (CST) and dorsal column–medial lemniscal (DC**ML**) pathway connected to the *left* cerebral hemisphere are highlighted. PAG, periaqueductal grey matter.

Pons

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Thanks for your attention