

# **Brainstem**

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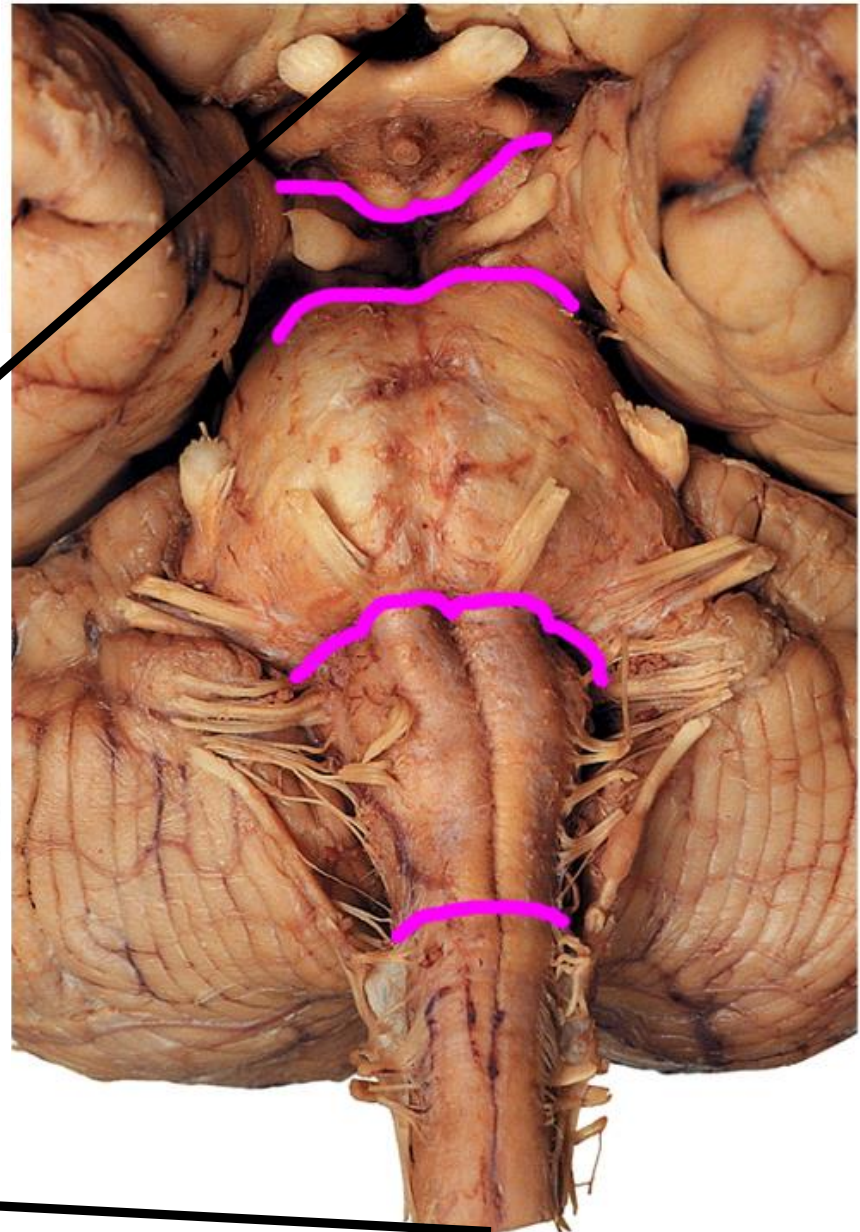
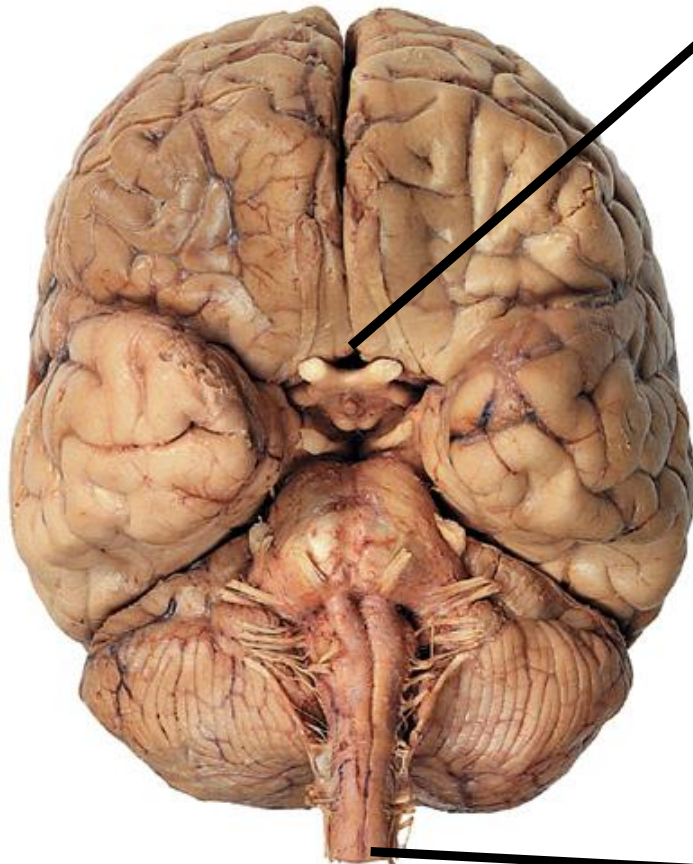
## Goal Today

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- Know the regions of the brainstem.
- Know major landmarks of each region and be able to identify each region in cross section.
- Understand the continuity of axon tracts from region to region.

## Brainstem Geography

- Brainstem includes the medulla, pons and midbrain.
- All regions are visible on the ventral side of the brain.



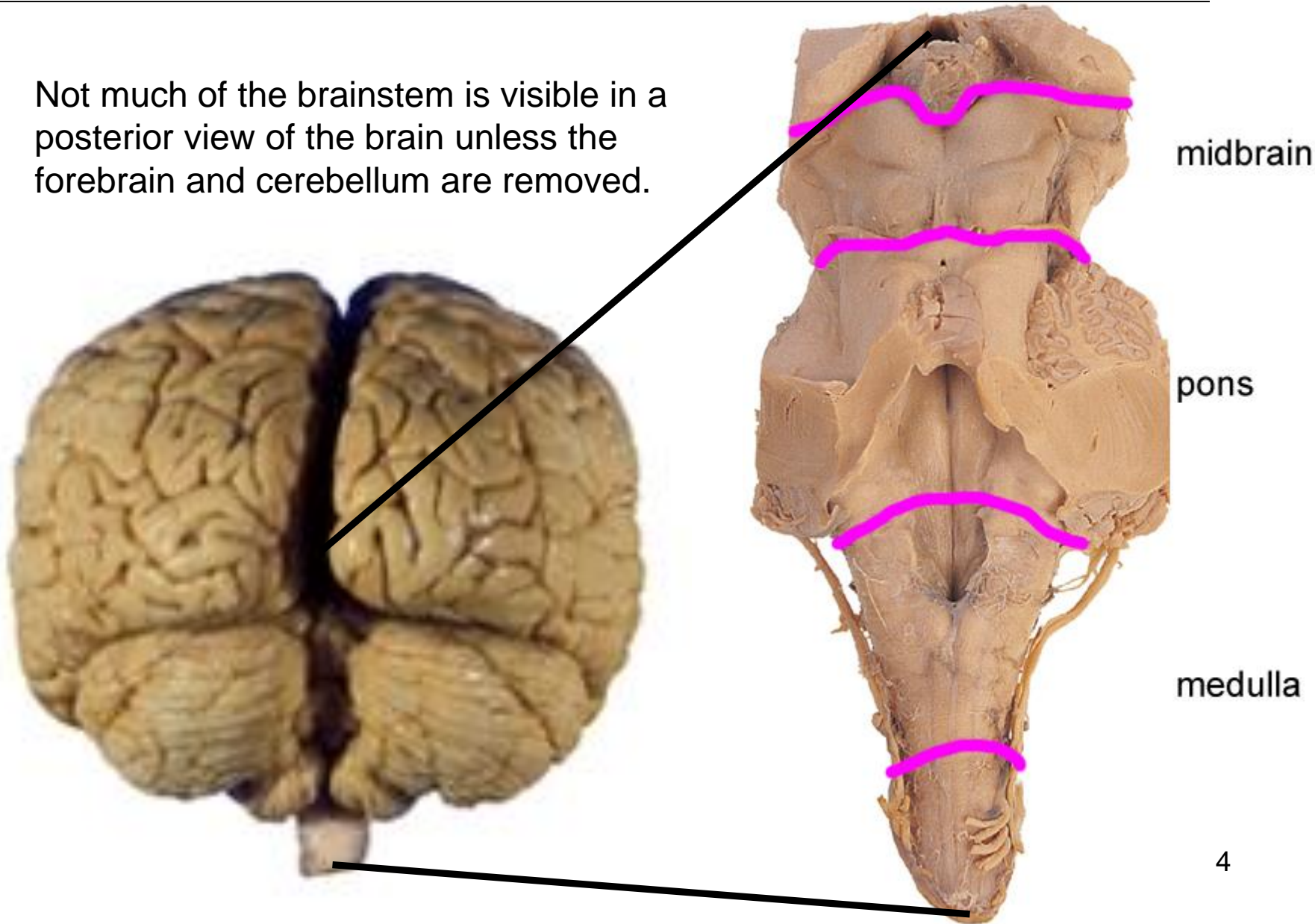
midbrain

pons

medulla

## Brainstem Geography

- Not much of the brainstem is visible in a posterior view of the brain unless the forebrain and cerebellum are removed.

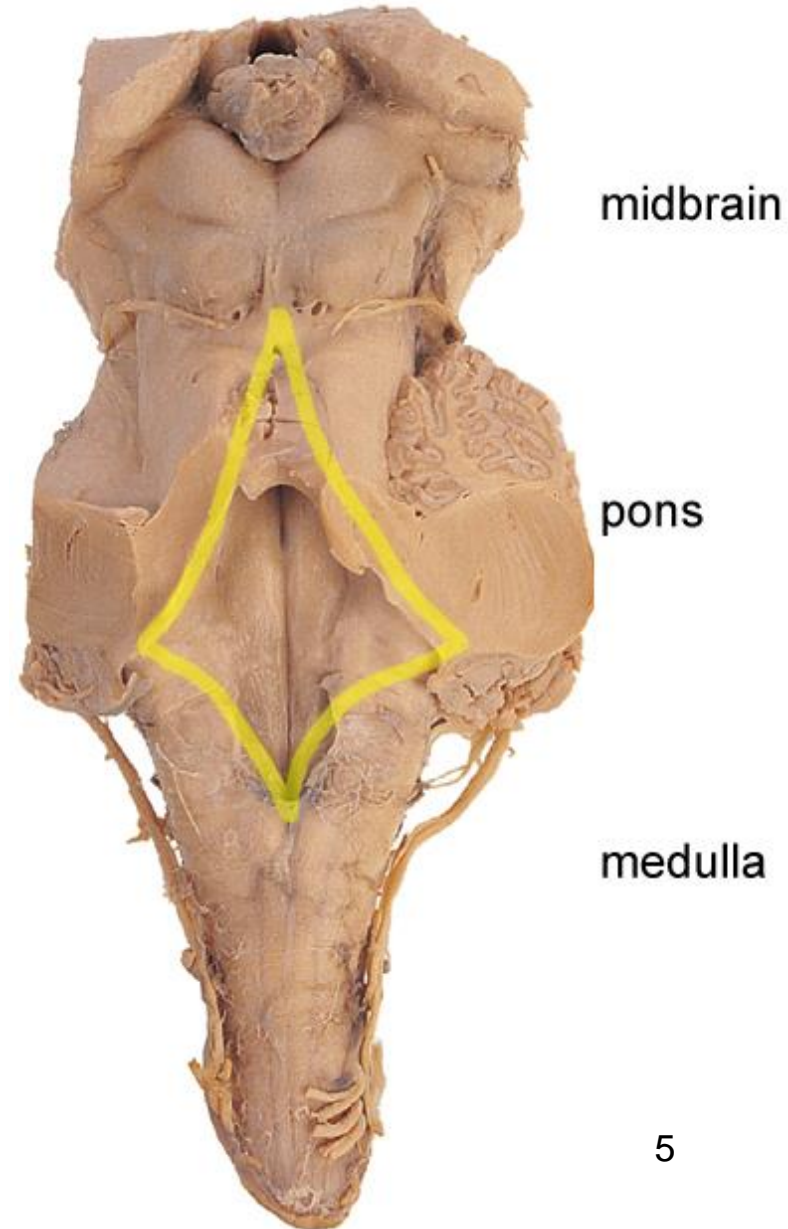




# Brainstem Geography

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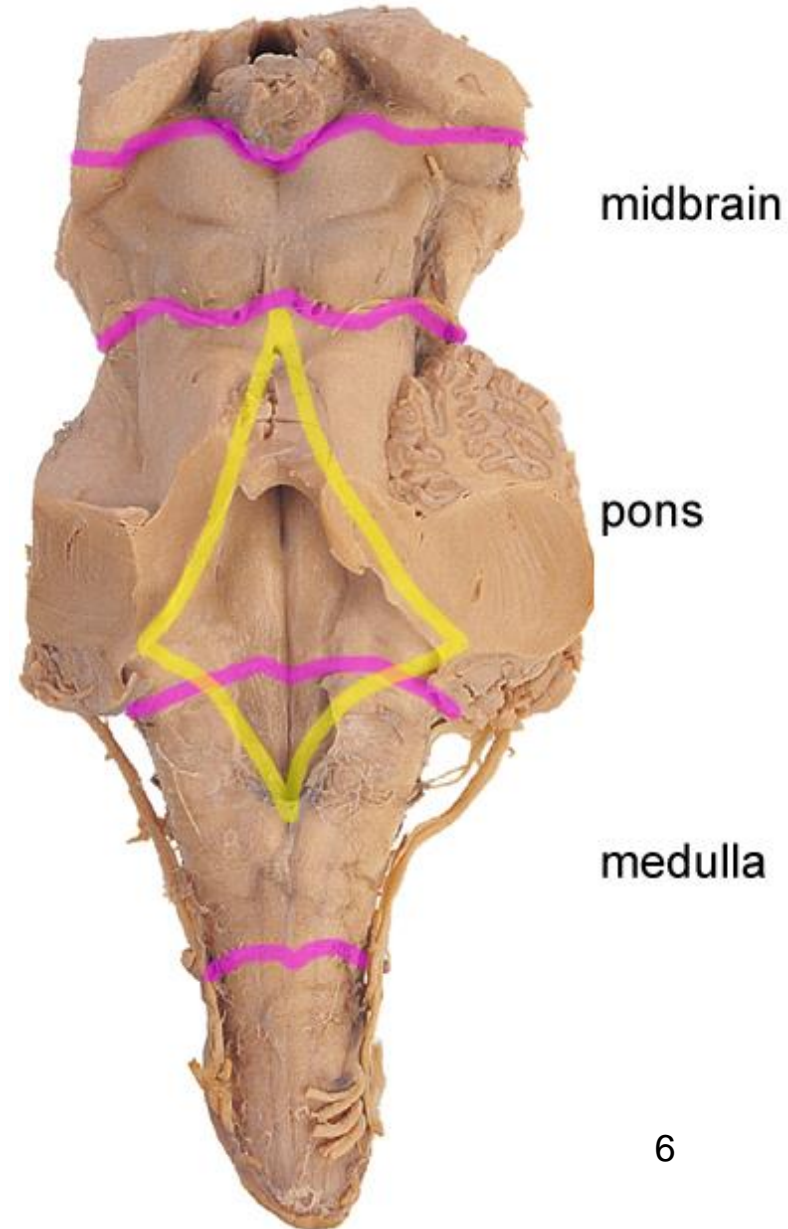
- The cerebellum covers the IV ventricle on the dorsal surface of the brainstem.



# Brainstem Geography

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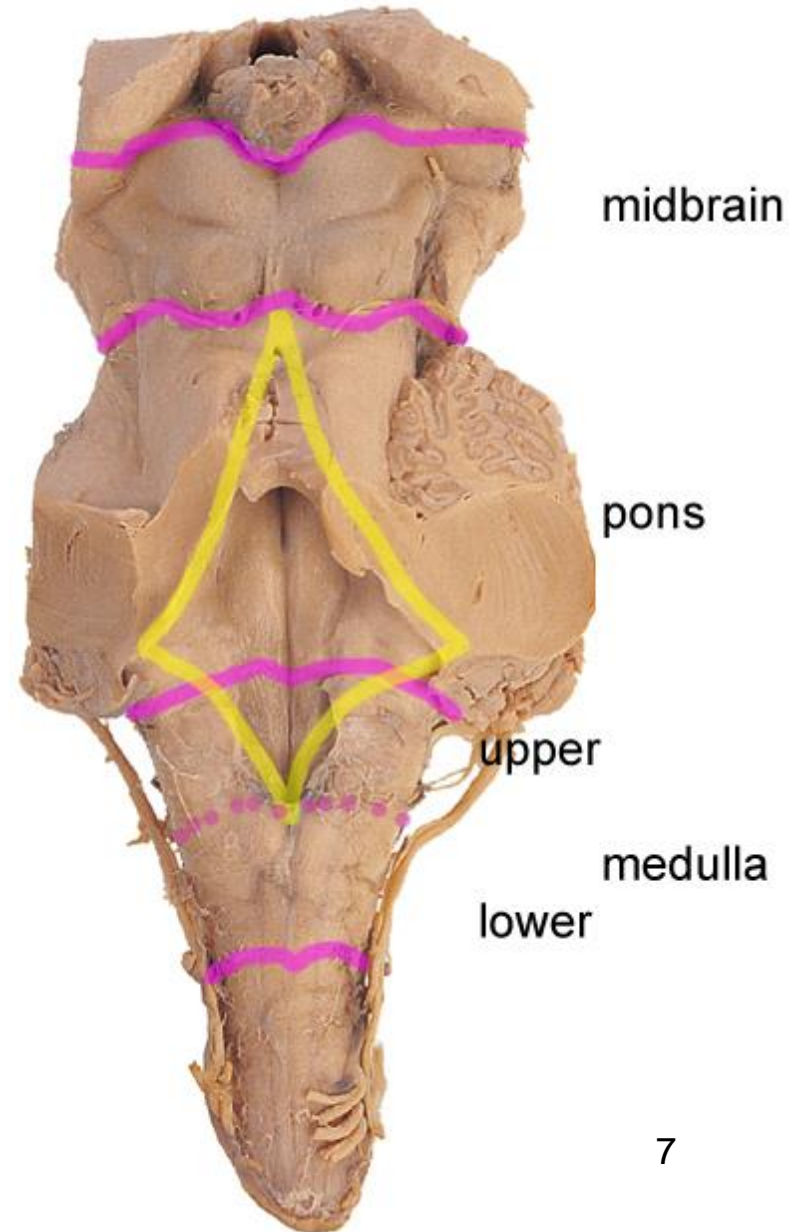
- The IV ventricle spans the entire pons and upper half of the medulla.



# Brainstem Geography

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- The presence of the ventricle is used to distinguish upper and lower medulla.

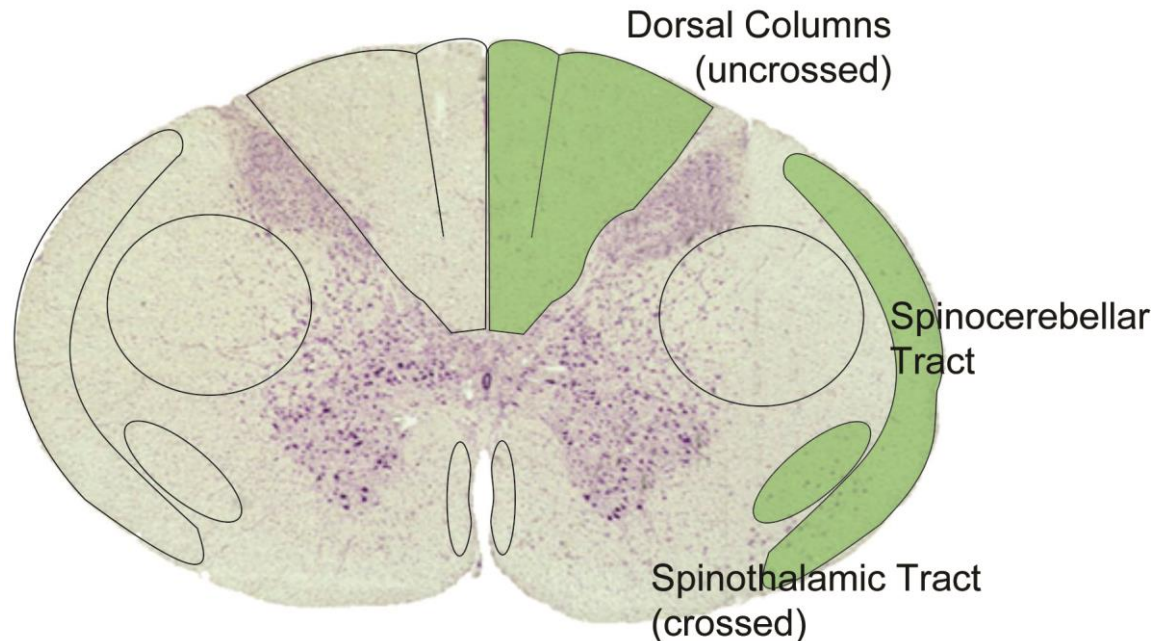


# Spinal Cord Review

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Tracts of ascending axons carrying sensory information:

- Spinocerebellar tracts carrying proprioception
- Dorsal columns carrying proprioception and deep touch (uncrossed)
- Spinothalamic tract carrying pain, temperature and light touch (crossed)

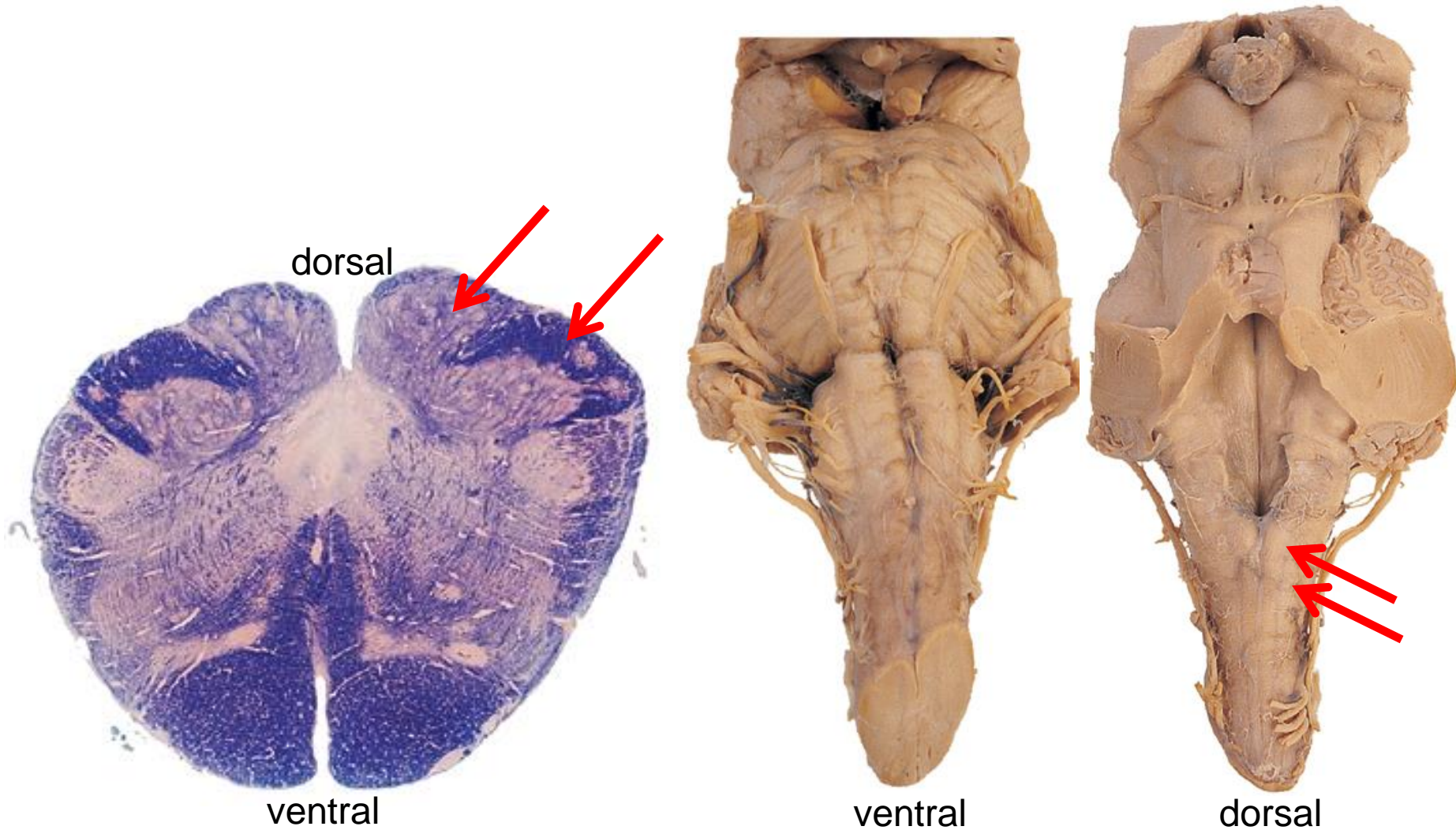




## Lower Medulla

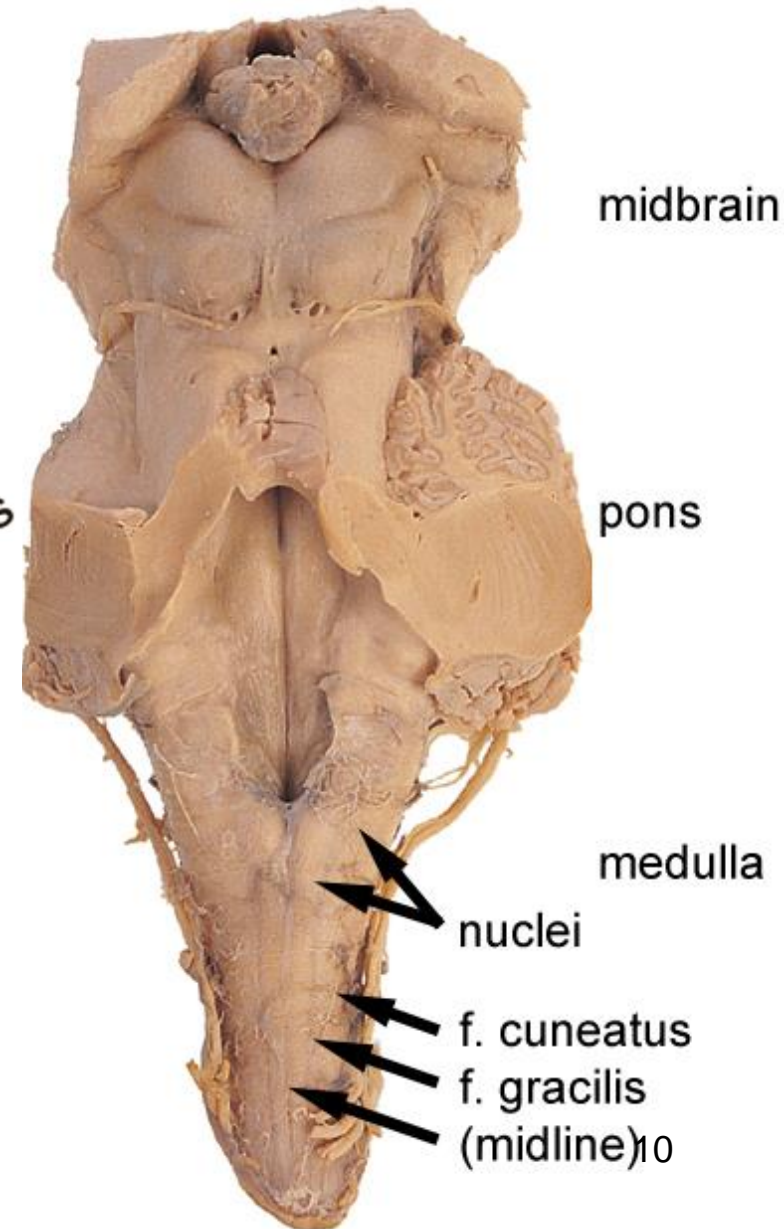
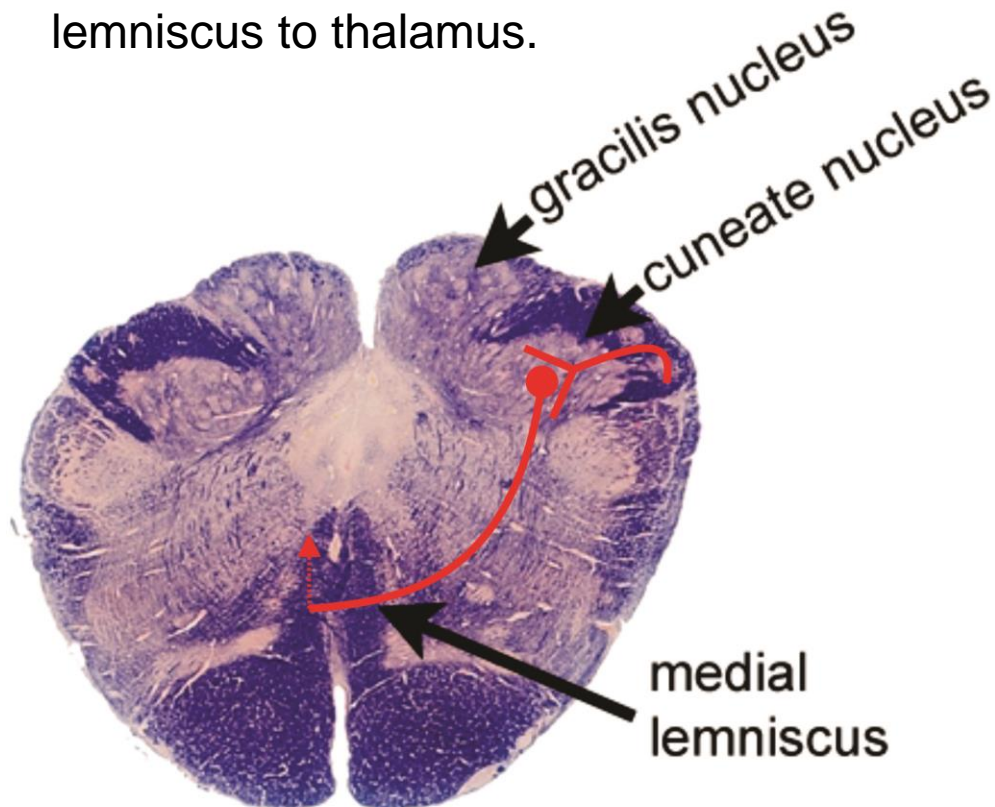
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- Dorsal columns and dorsal column nuclei



## Somatosensory Pathway: Dorsal Columns for Proprioception and Touch

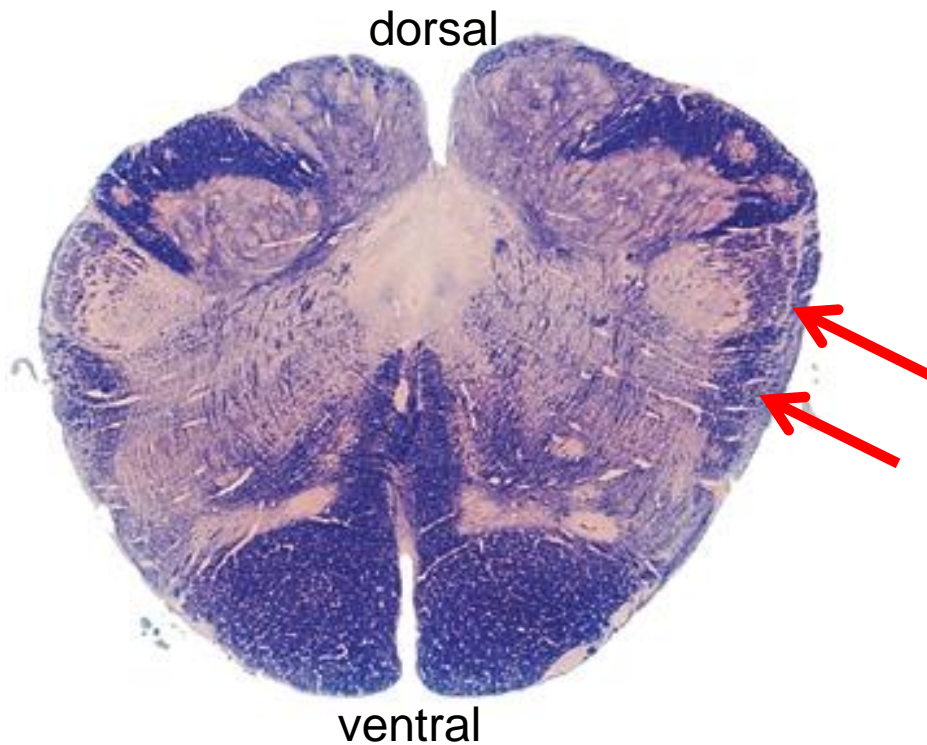
- The dorsal column axons synapse in nucleus gracilis and cuneatus.
- The axons of these neurons cross the midline and form the medial lemniscus to thalamus.



## Lower Medulla

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- Axons in the spinothalamic and spinocerebellar tracts continue up through the medulla.

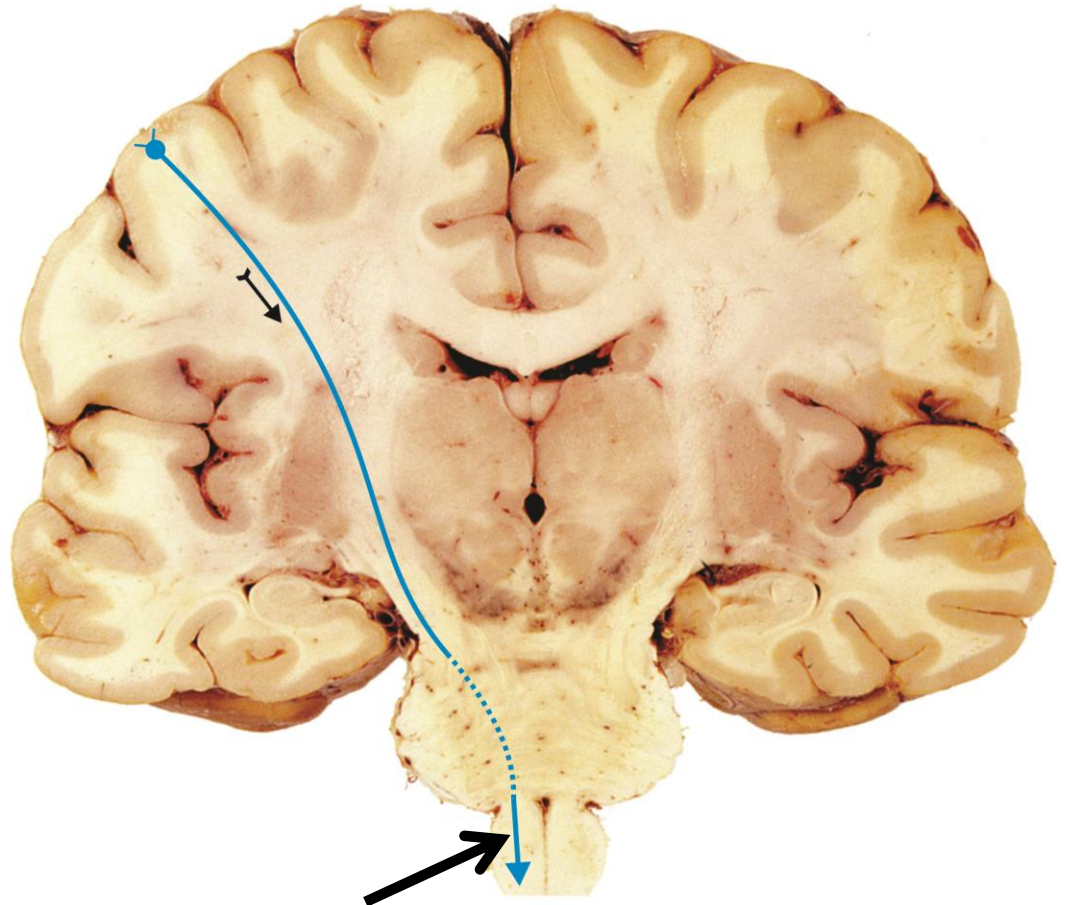
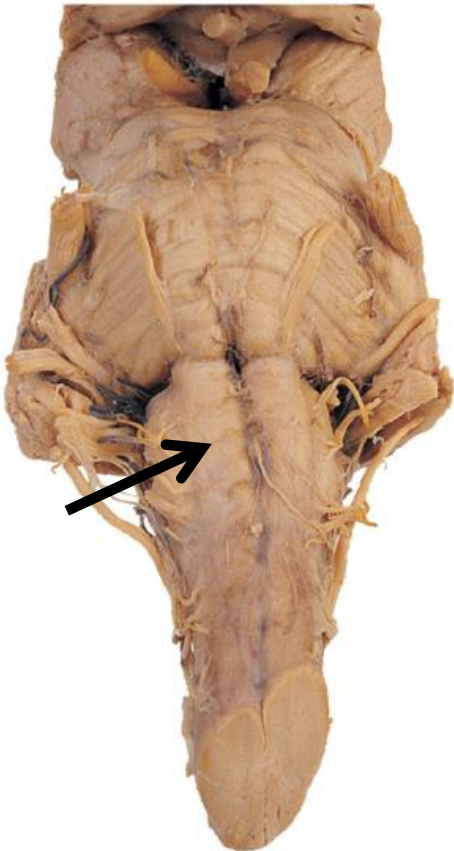
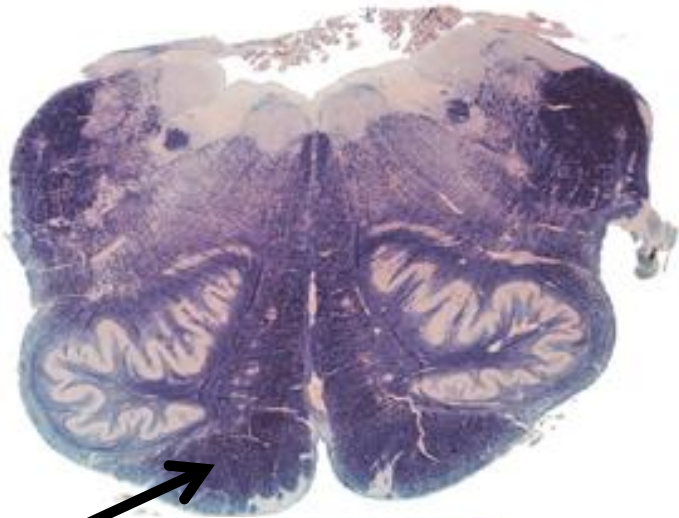




## Lower Medulla

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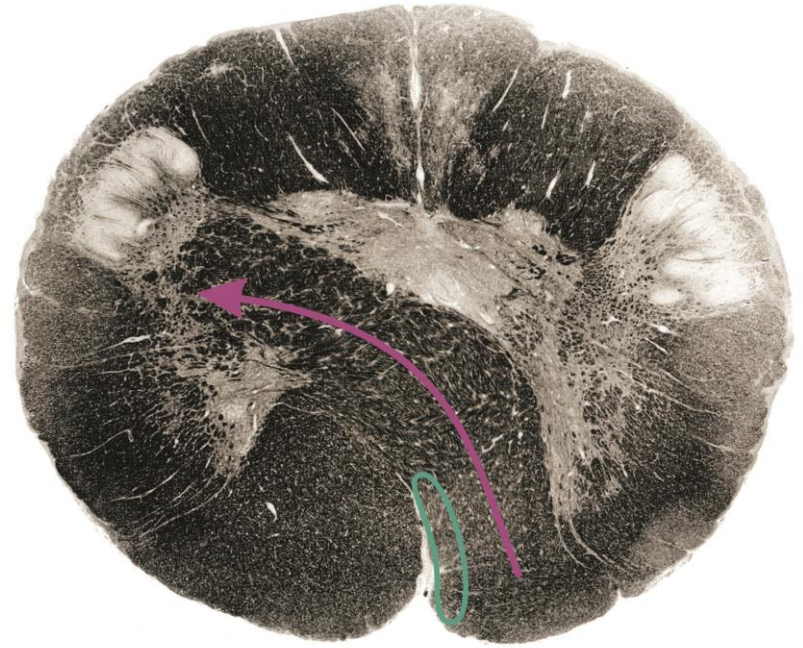
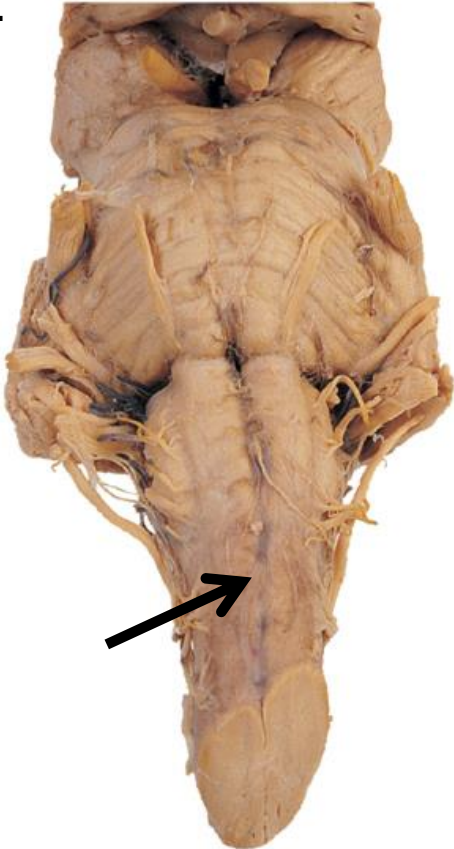
- Pyramids are axons carrying motor information descending from cortex.



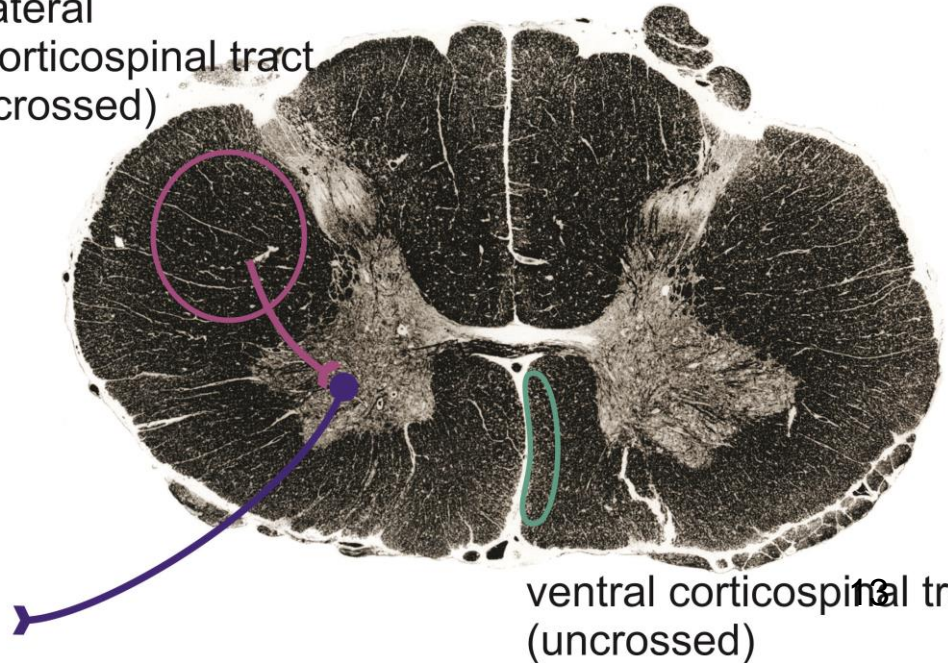
## Lower Medulla

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- 90% of the axons in the pyramids cross in lower medulla forming the lateral corticospinal tract.
- 10% remain as the anterior corticospinal tract.



lateral  
corticospinal tract  
(crossed)



ventral corticospinal tract  
(uncrossed)

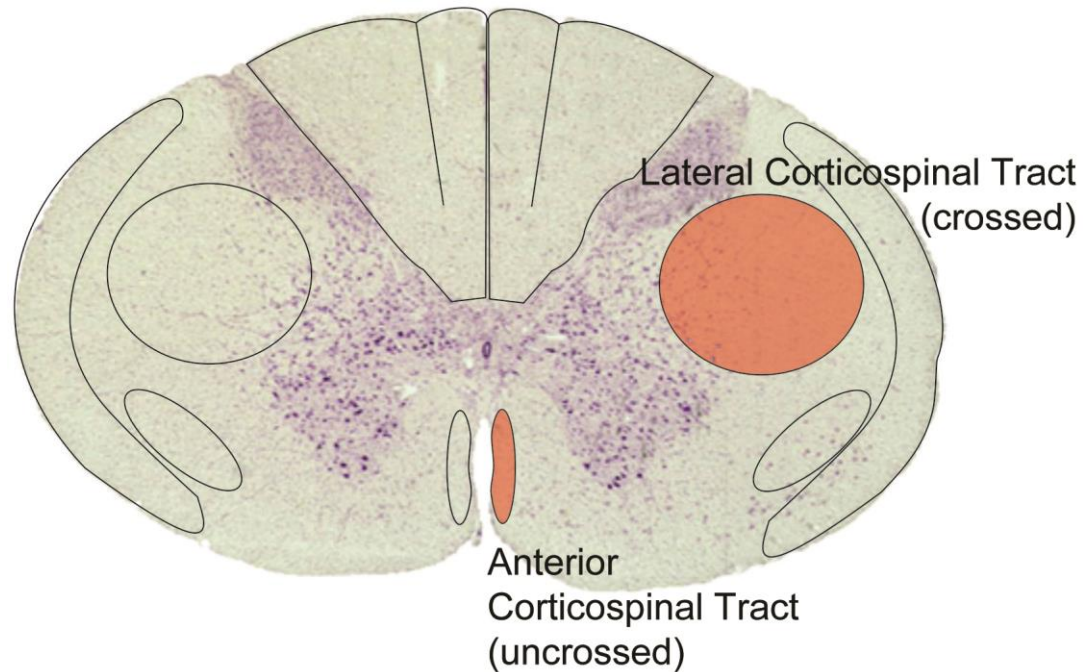


# Spinal Cord Review

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Tracts of descending axons carrying motor information from cortex:

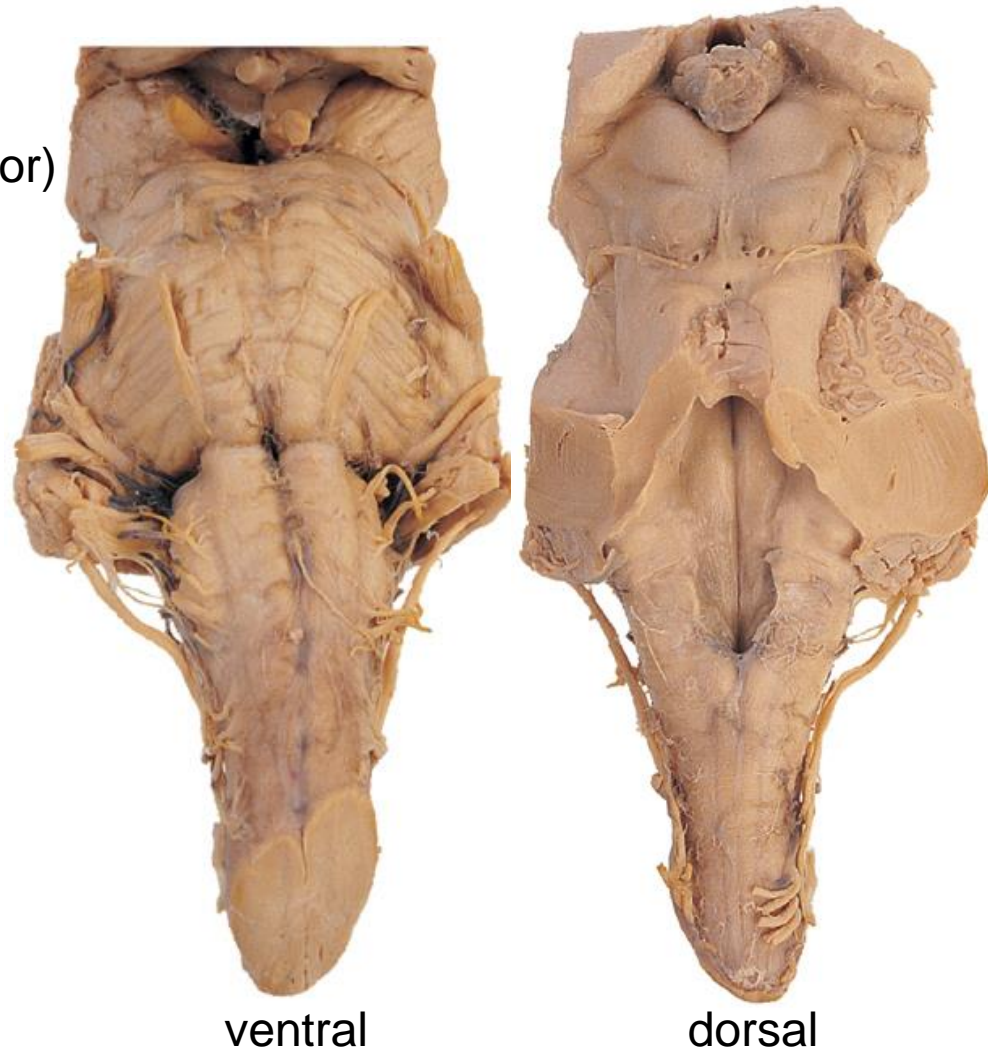
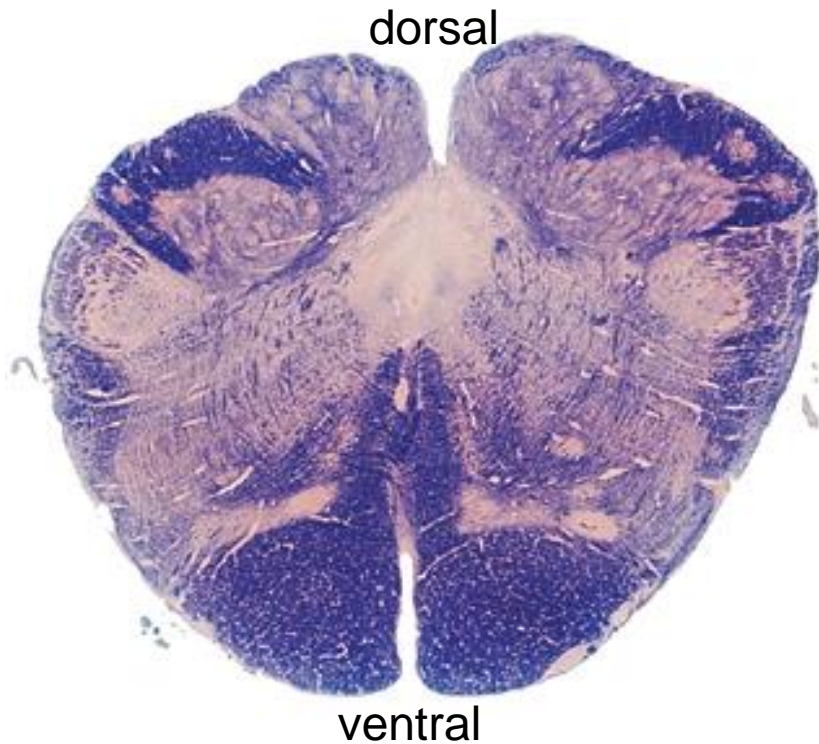
- Lateral corticospinal tract (crossed)
- Anterior corticospinal tract (uncrossed)



## Lower Medulla

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- Cranial nerves III – XII are attached to the brainstem .
- All have nuclei (sensory and/or motor) in the brainstem.

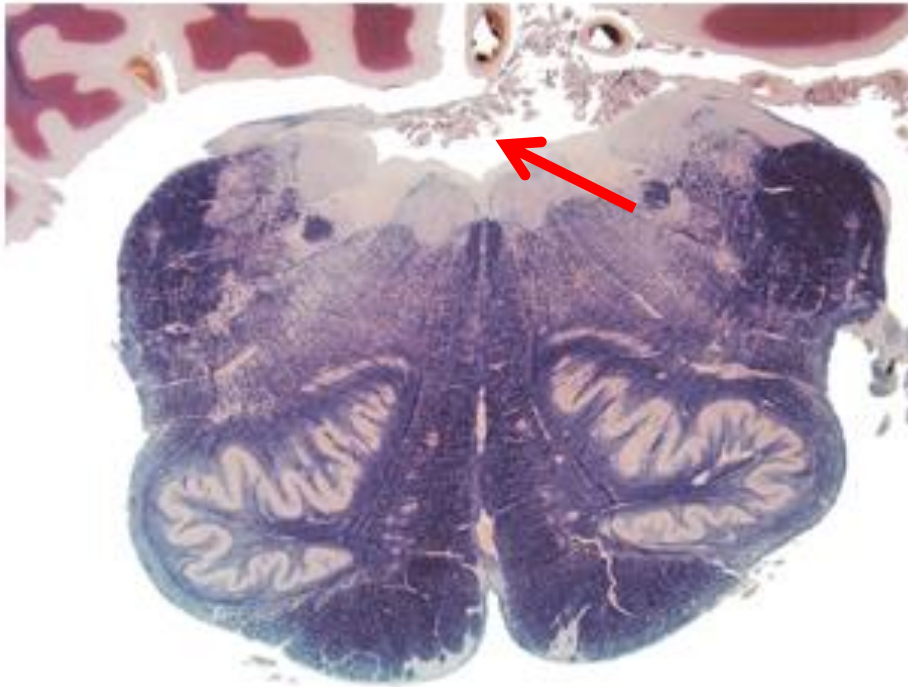


# Upper Medulla

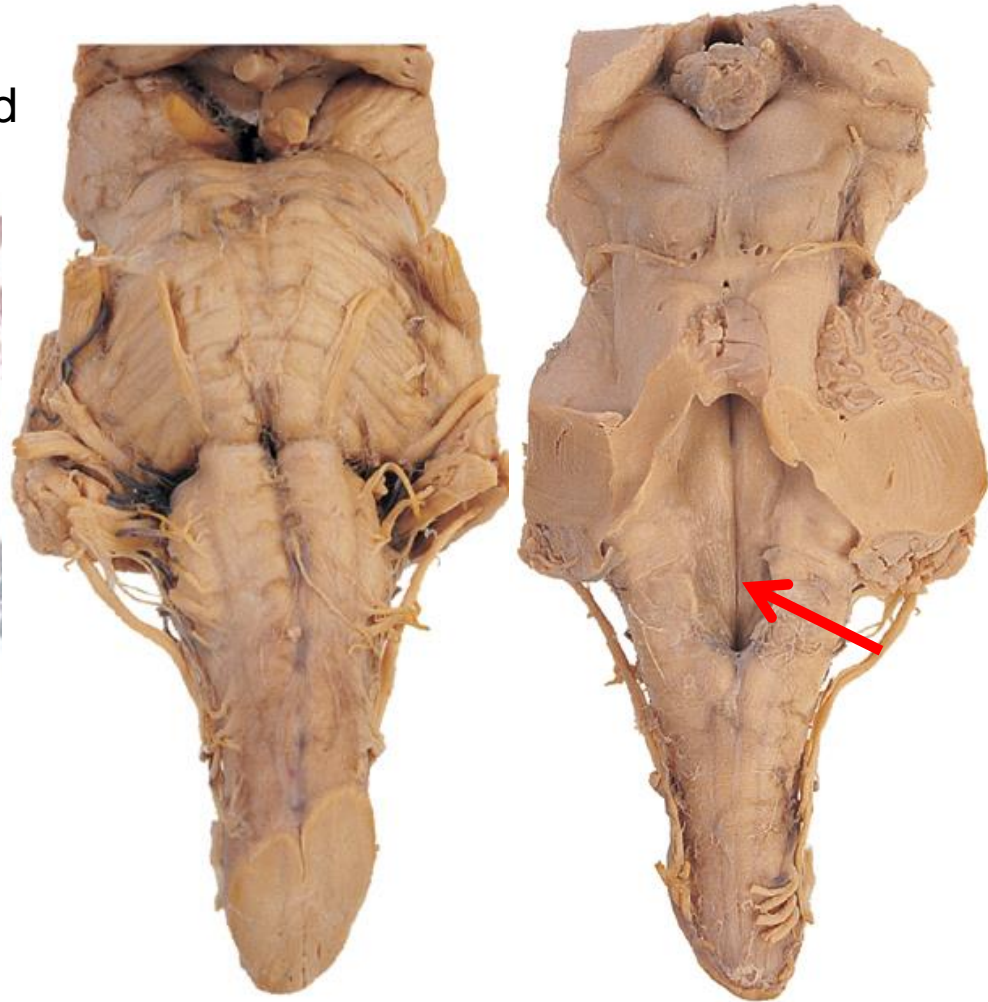
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- IV ventricle (covered by cerebellum)
  - choroid plexus
  - openings into the subarchnoid space

dorsal



ventral



ventral

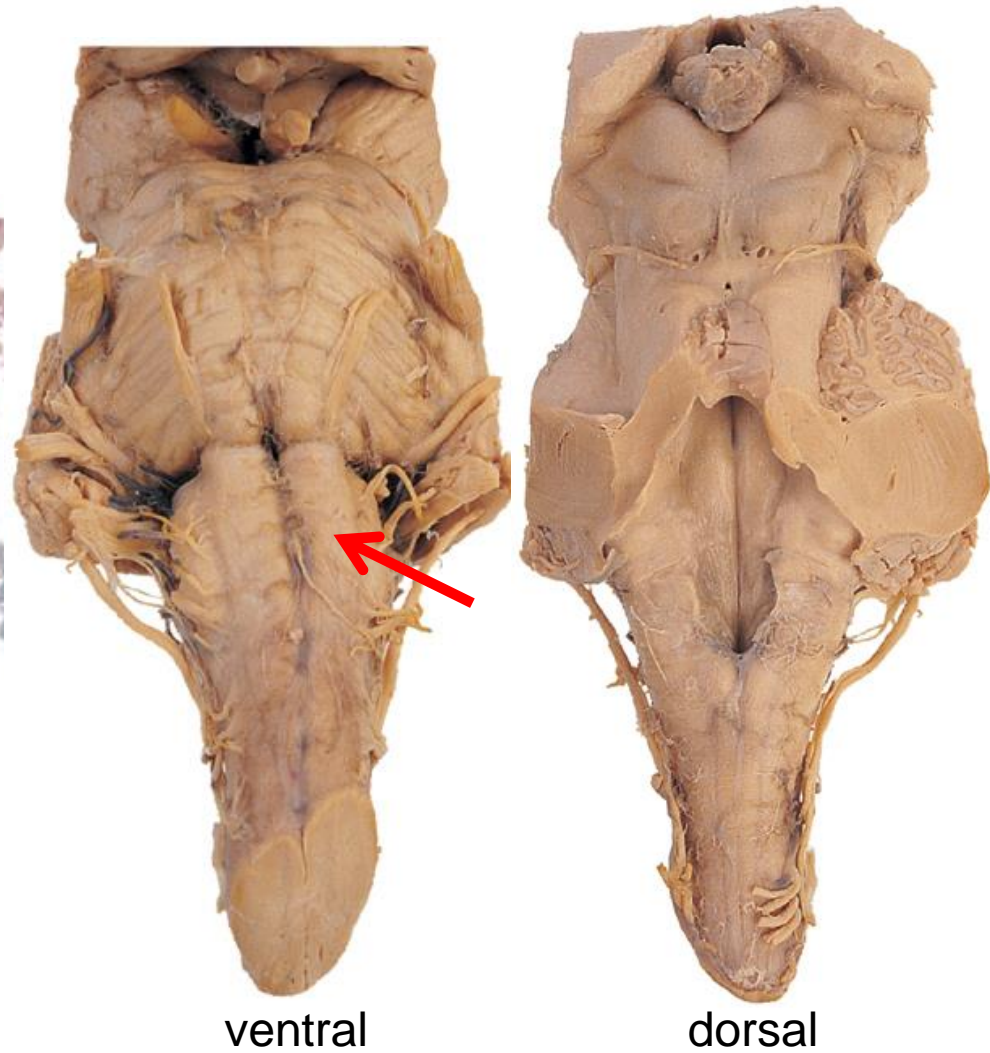
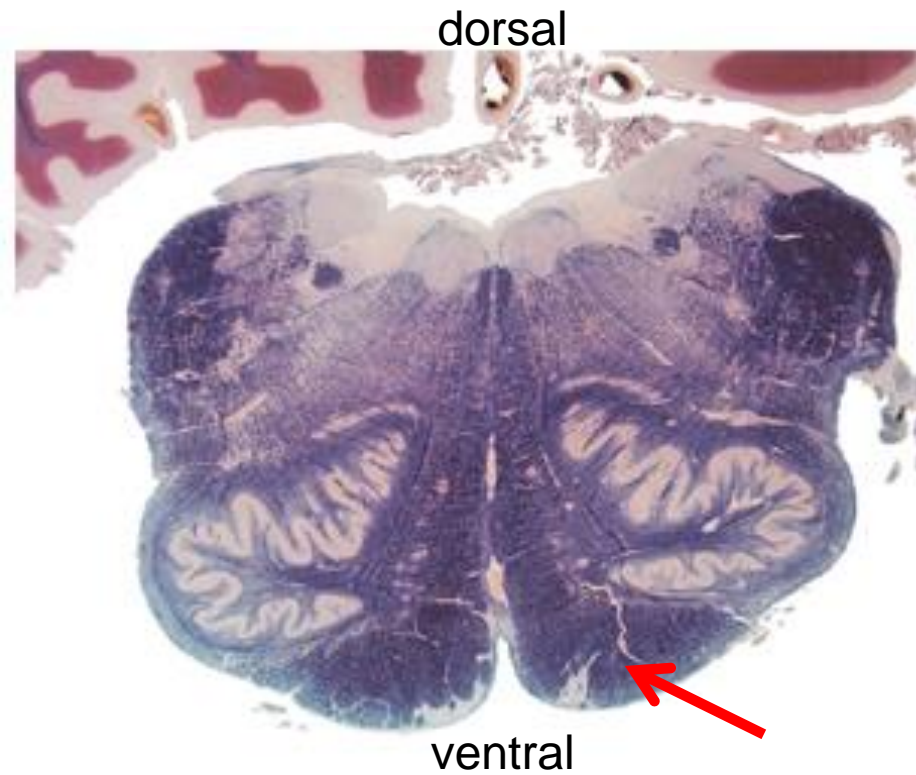
dorsal



# Upper Medulla

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- Pyramids

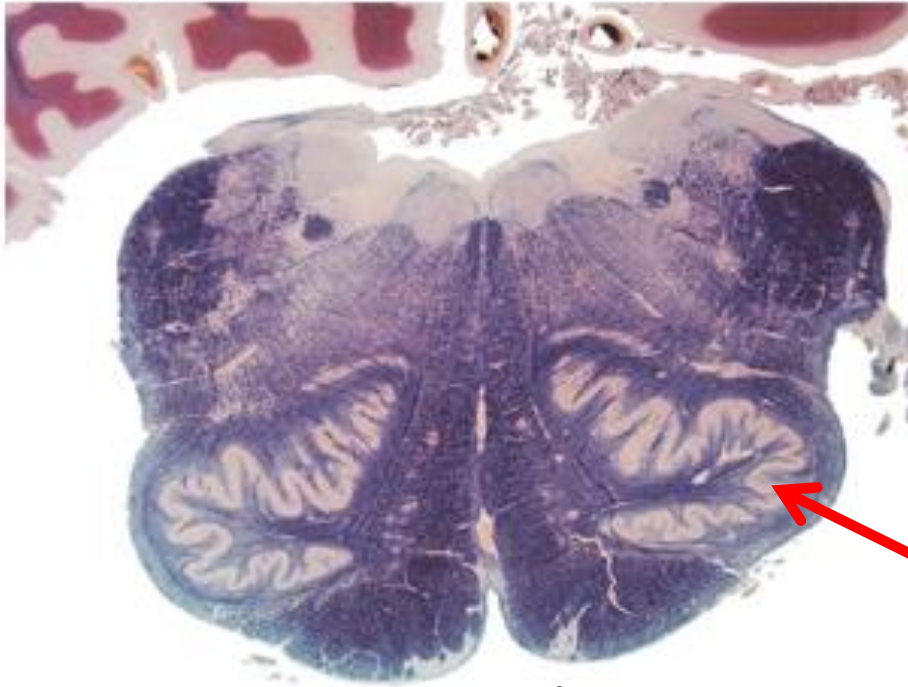


# Upper Medulla

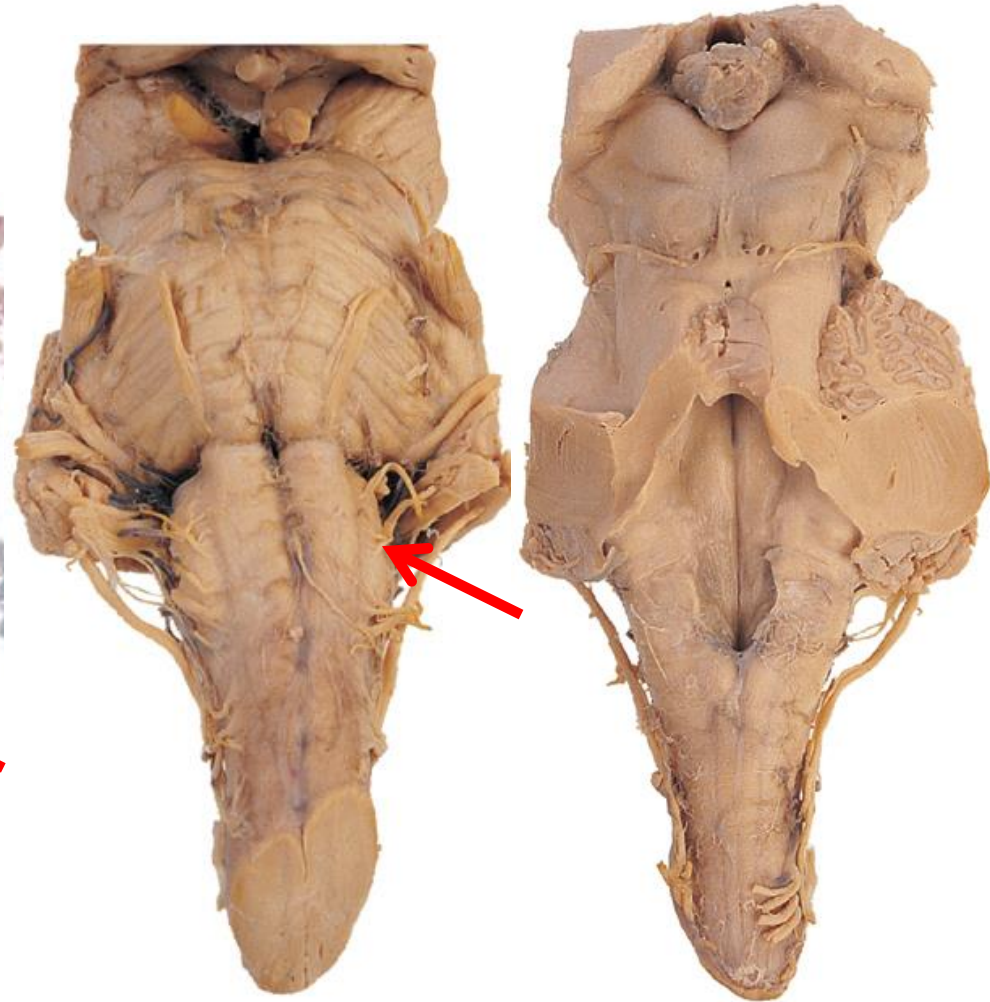
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- Olive (external) and inferior olivary nucleus (internal)

dorsal



ventral



ventral

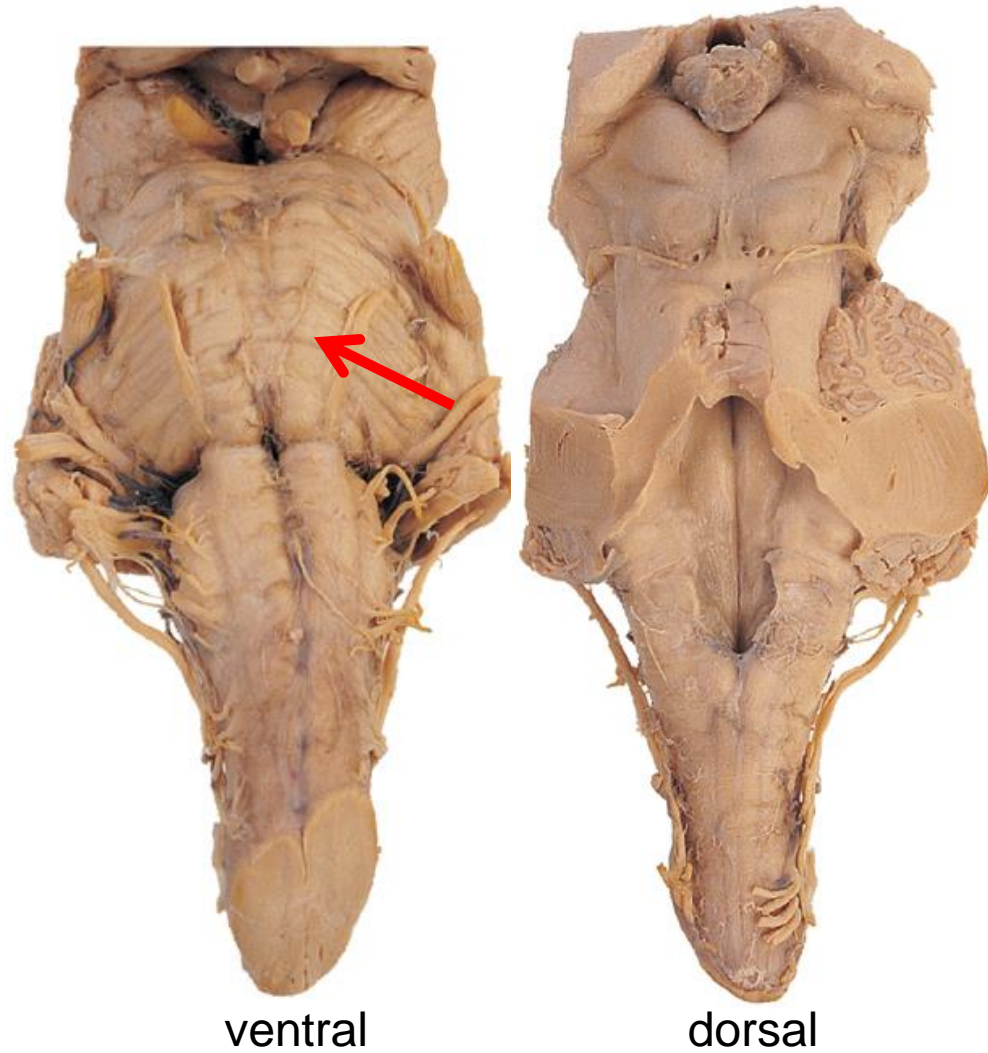
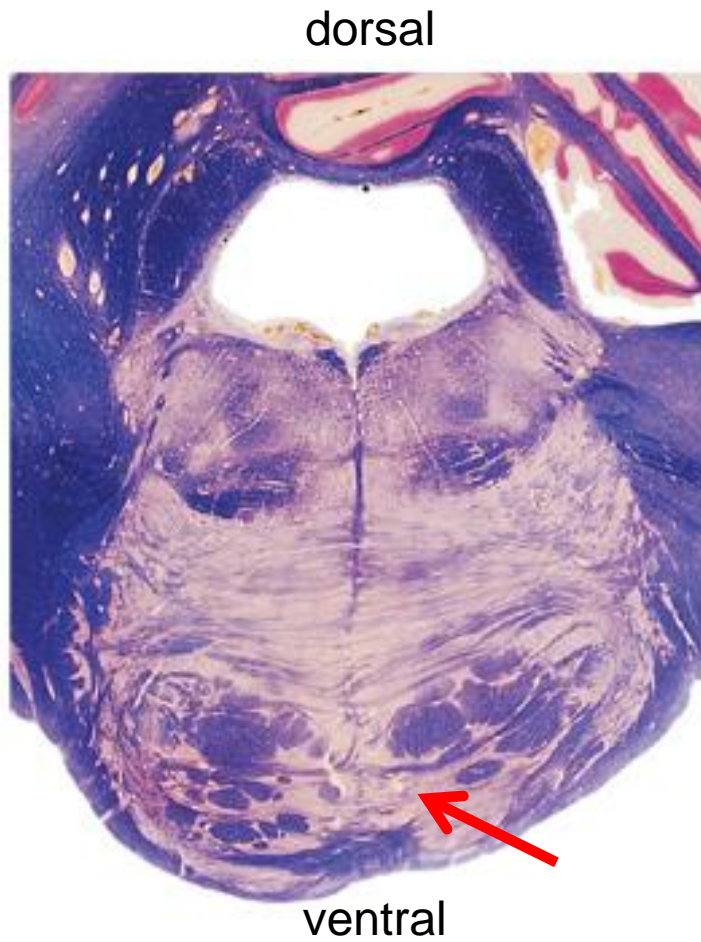
dorsal



# Pons

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- Basal pons with pontine nuclei

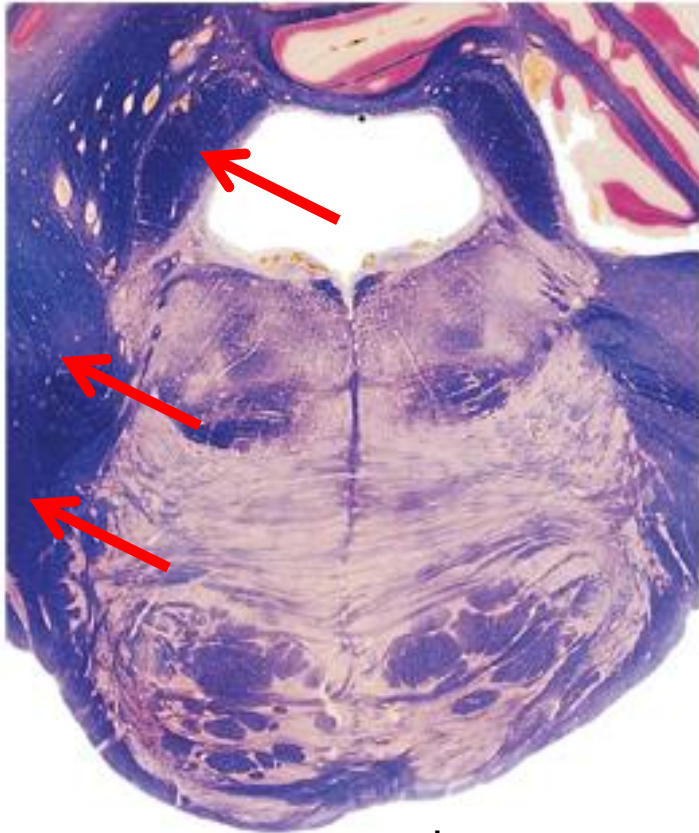


# Pons

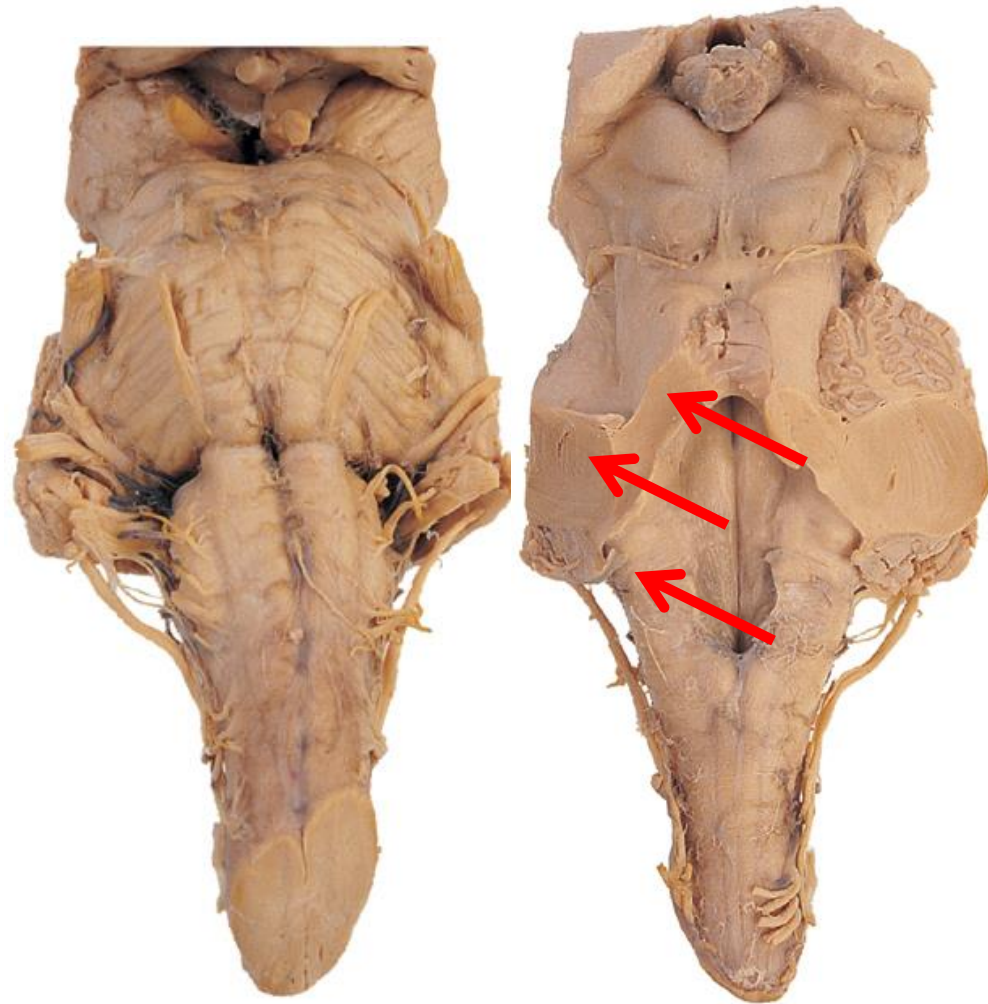
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- Superior, middle and inferior cerebellar peduncles

dorsal



ventral



ventral

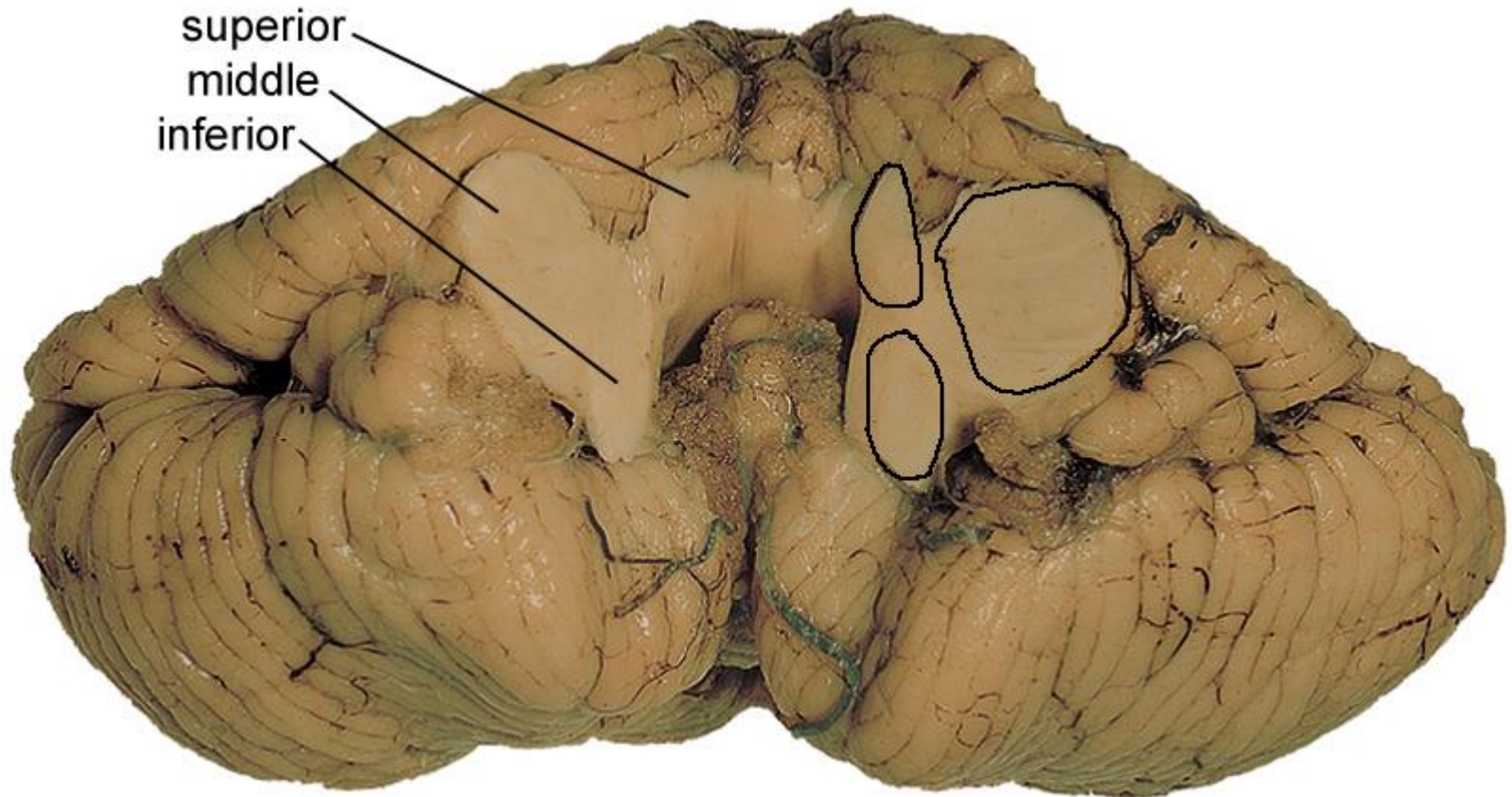
dorsal



# Pons

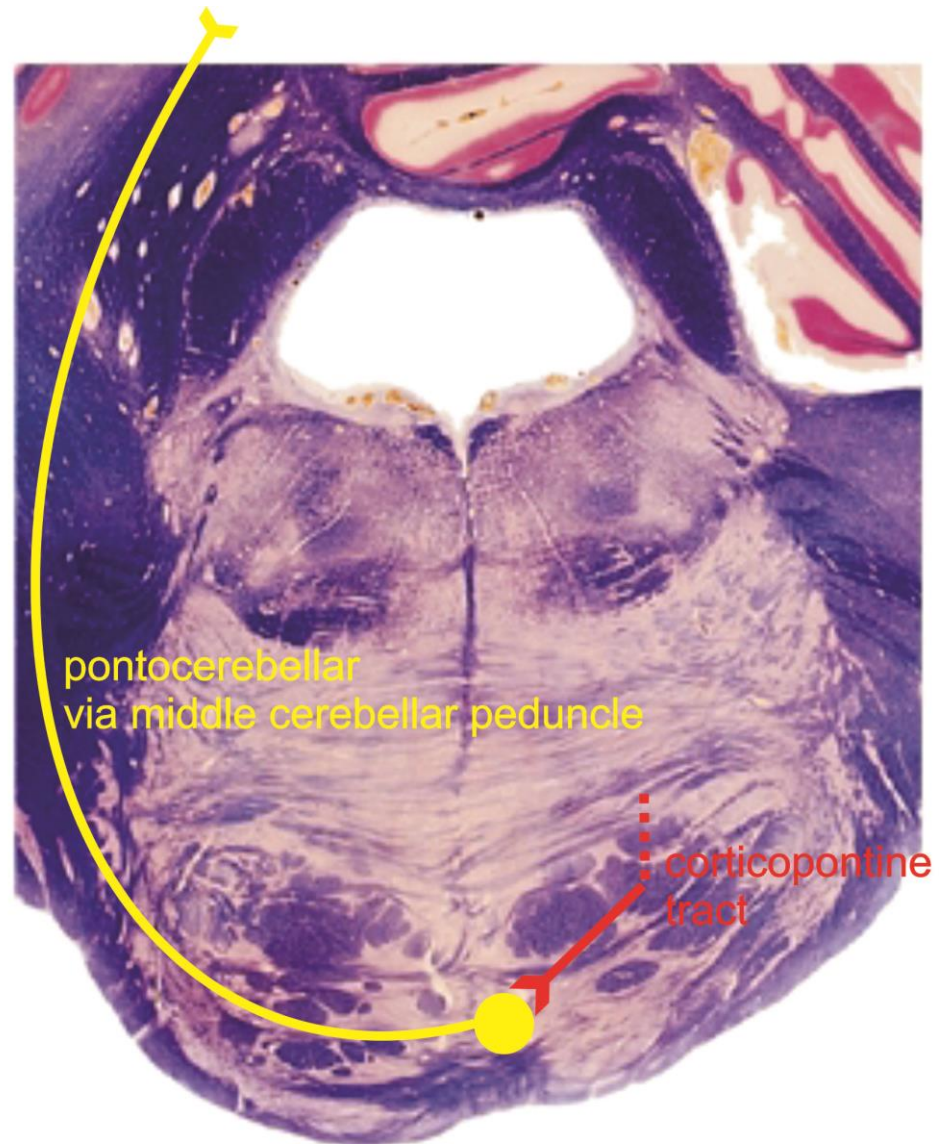
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- Superior, middle and inferior cerebellar peduncles



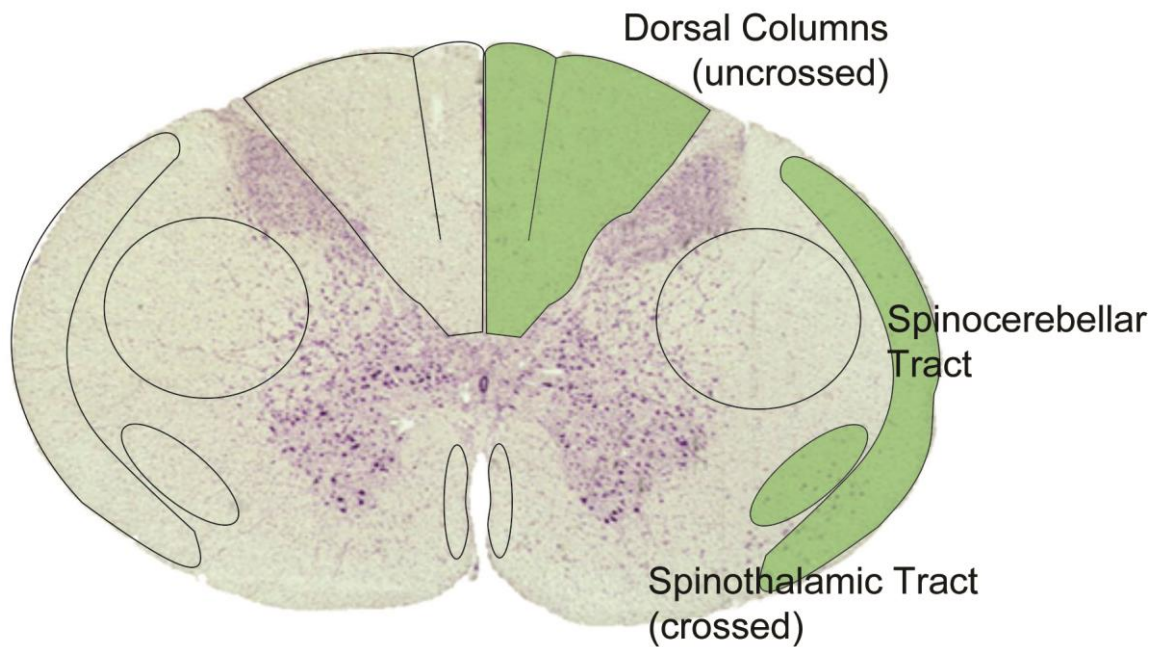
# Pons

- Corticopontine axons synapse in pontine nuclei
- Neurons in pontine nuclei send their axons to the cerebellum via the middle cerebellar peduncle



# Spinocerebellar Pathway

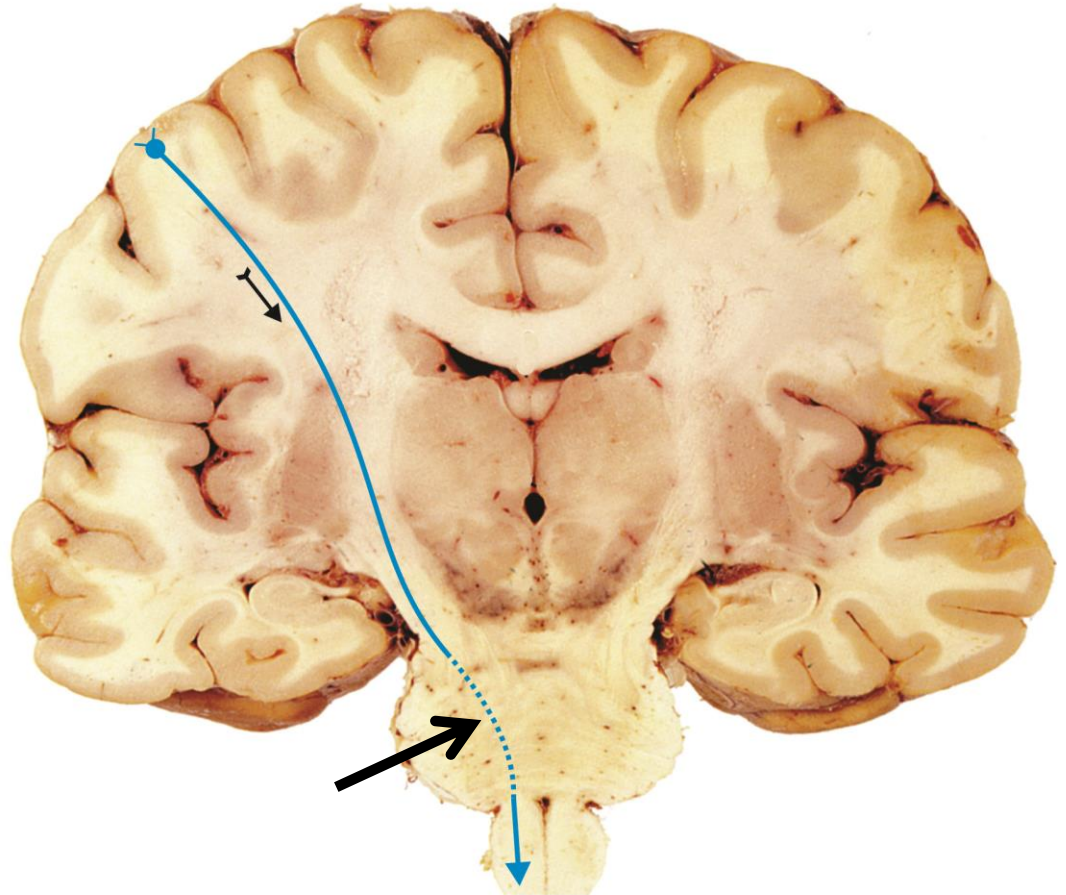
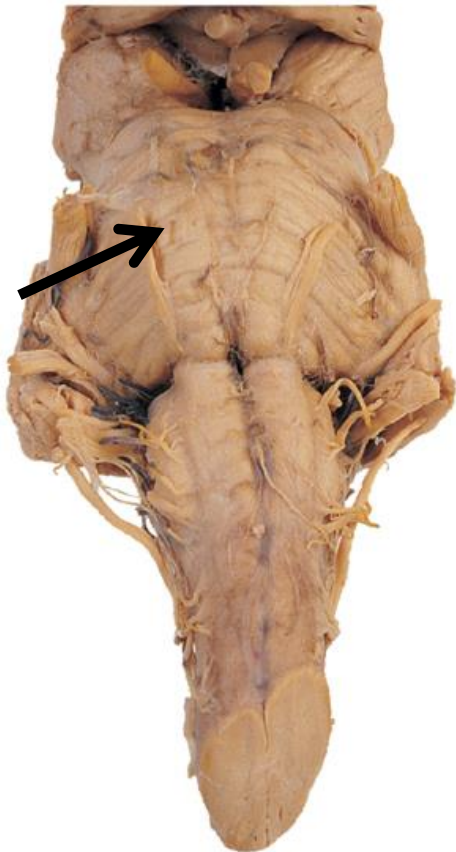
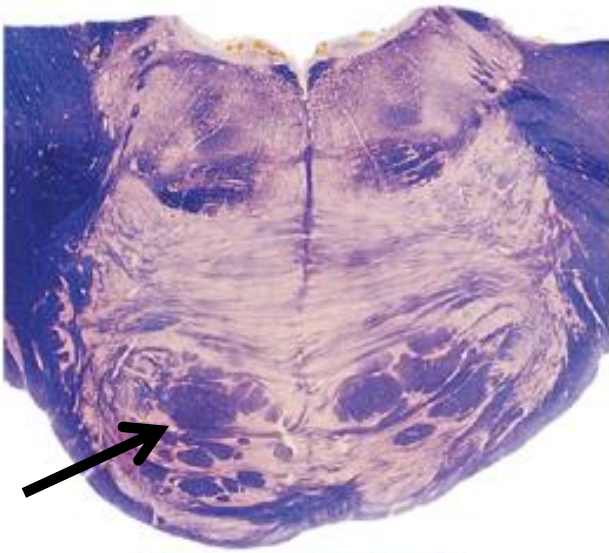
- Spinocerebellar tracts enter cerebellum via inferior and superior cerebellar peduncles.





## Pons

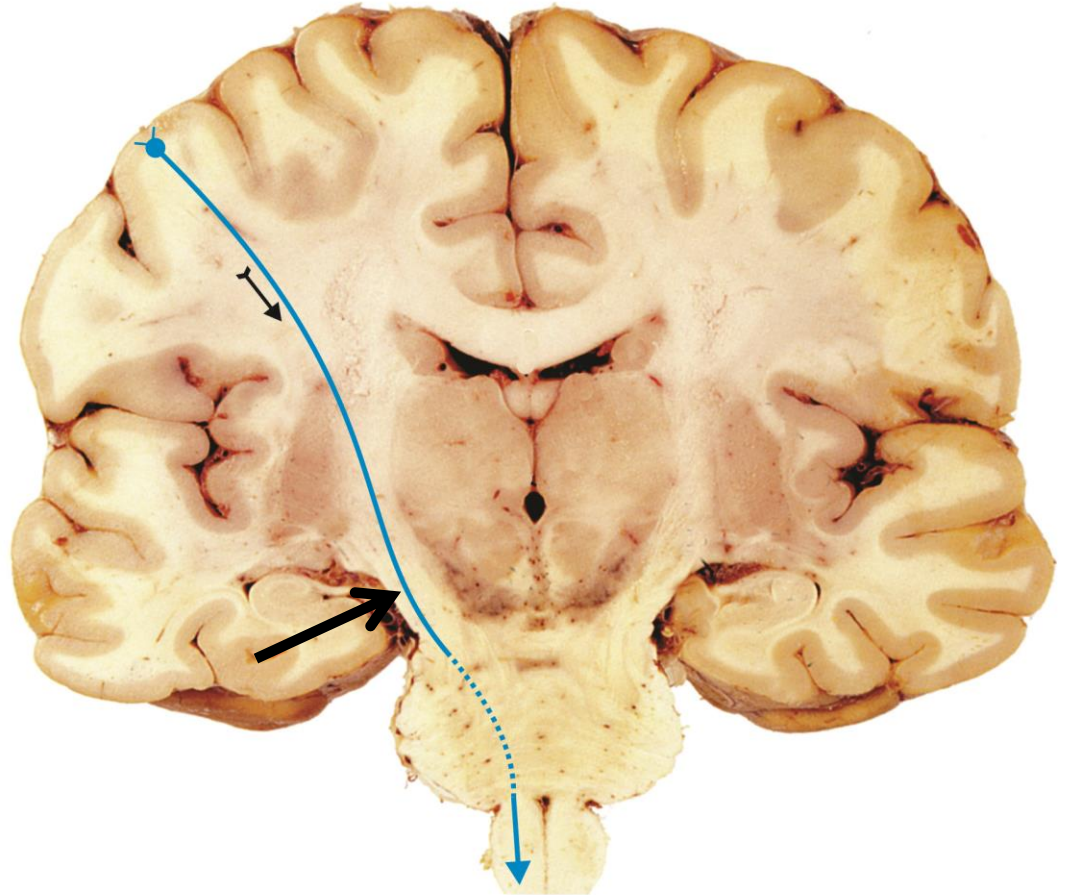
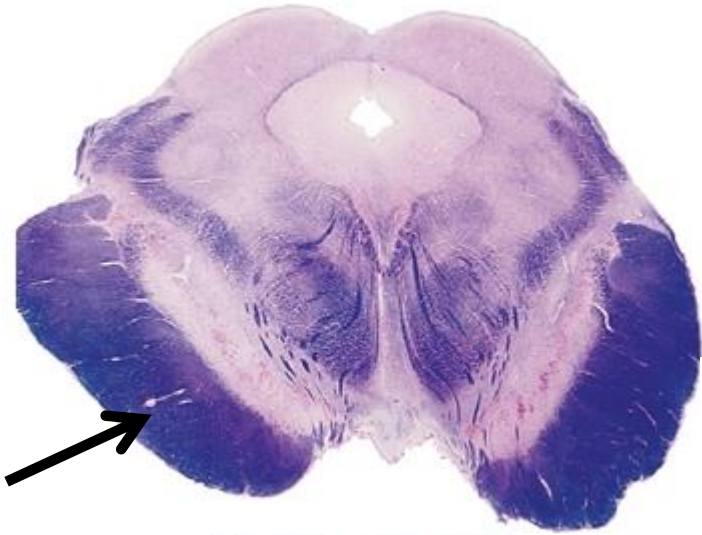
- Corticospinal, corticopontine and corticobulbar tracts (motor) pass through pontine nuclei.



## Midbrain

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- Cerebral peduncles  
(corticospinal, corticopontine,  
corticobubar tracts - motor)

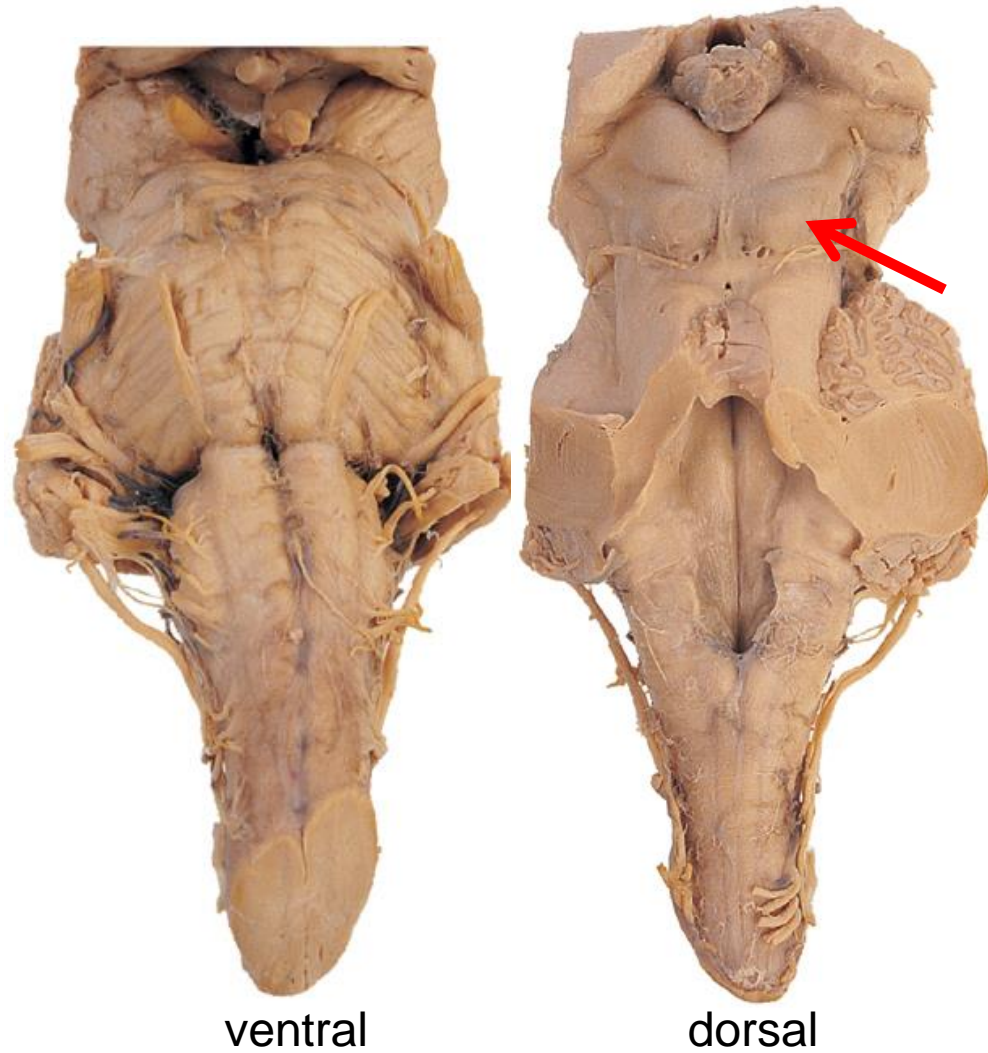
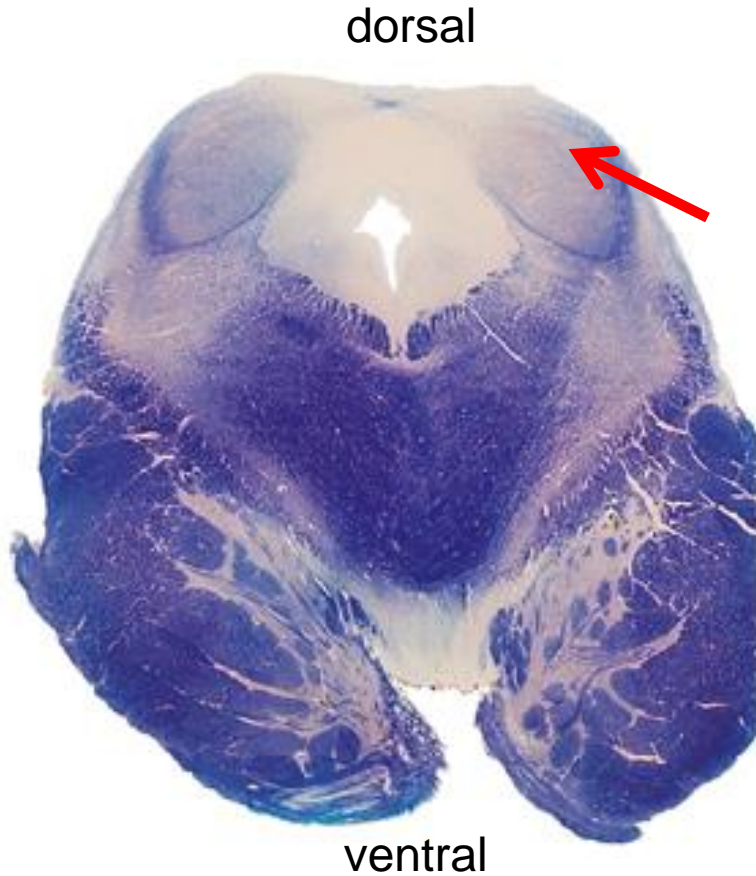




## Midbrain (lower)

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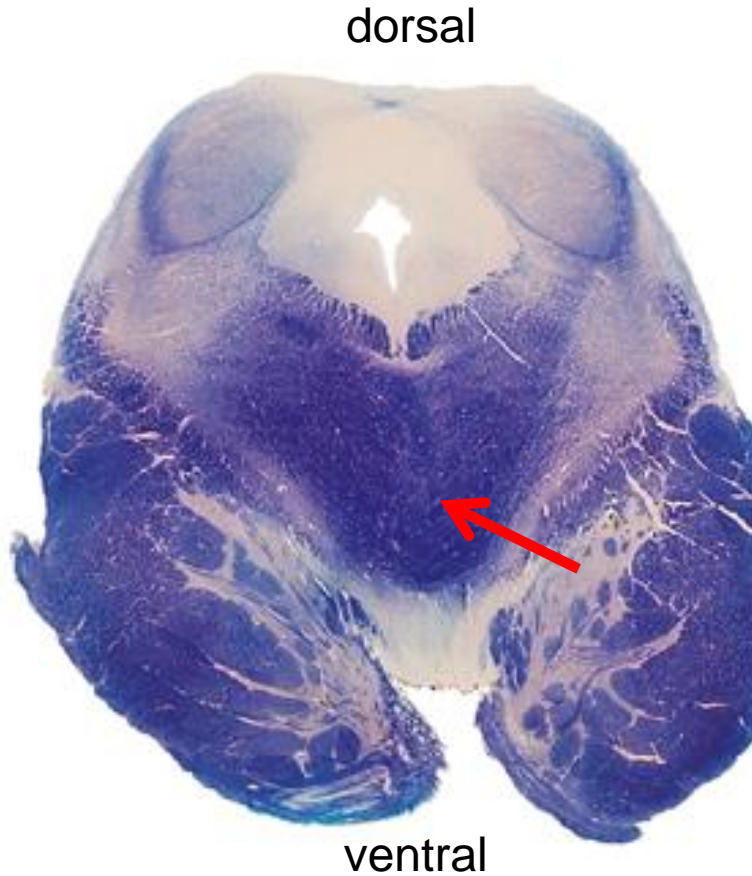
- Inferior colliculus (auditory)



## Midbrain (lower)

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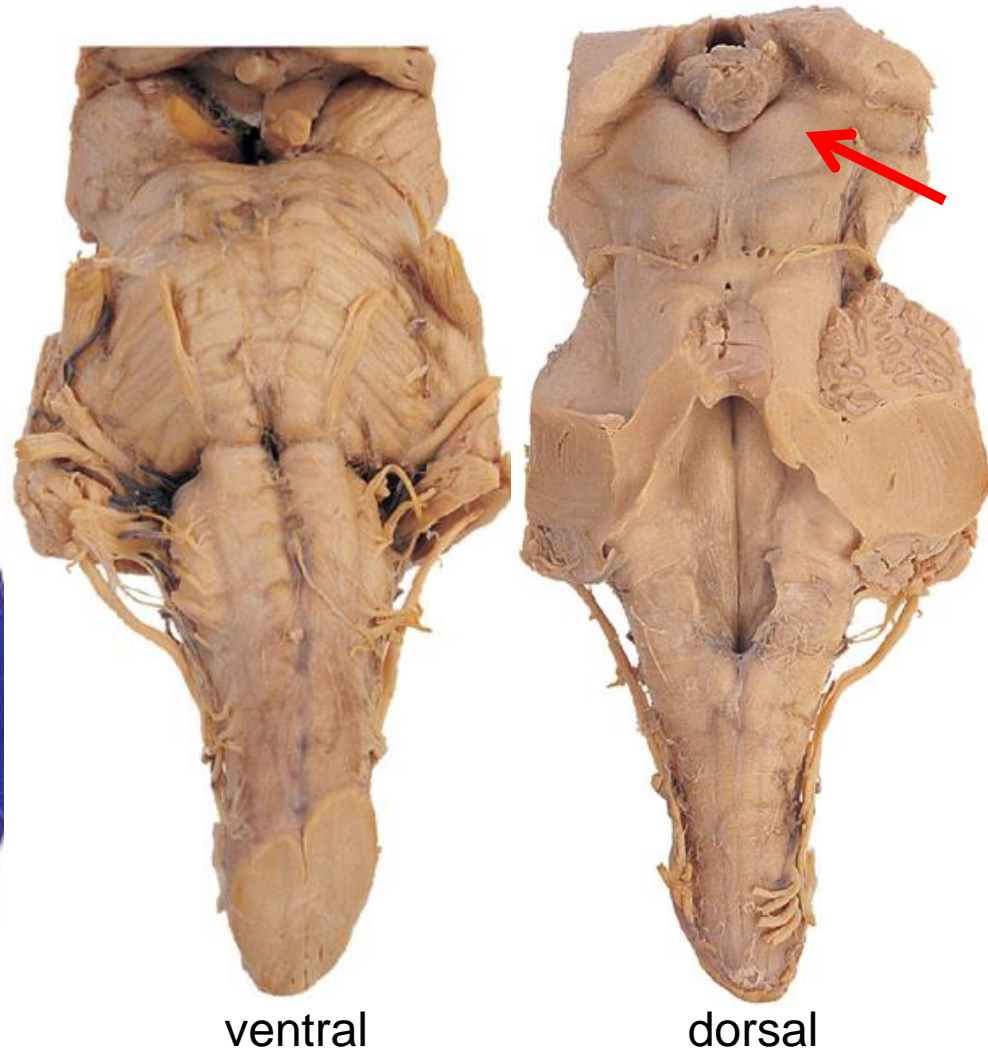
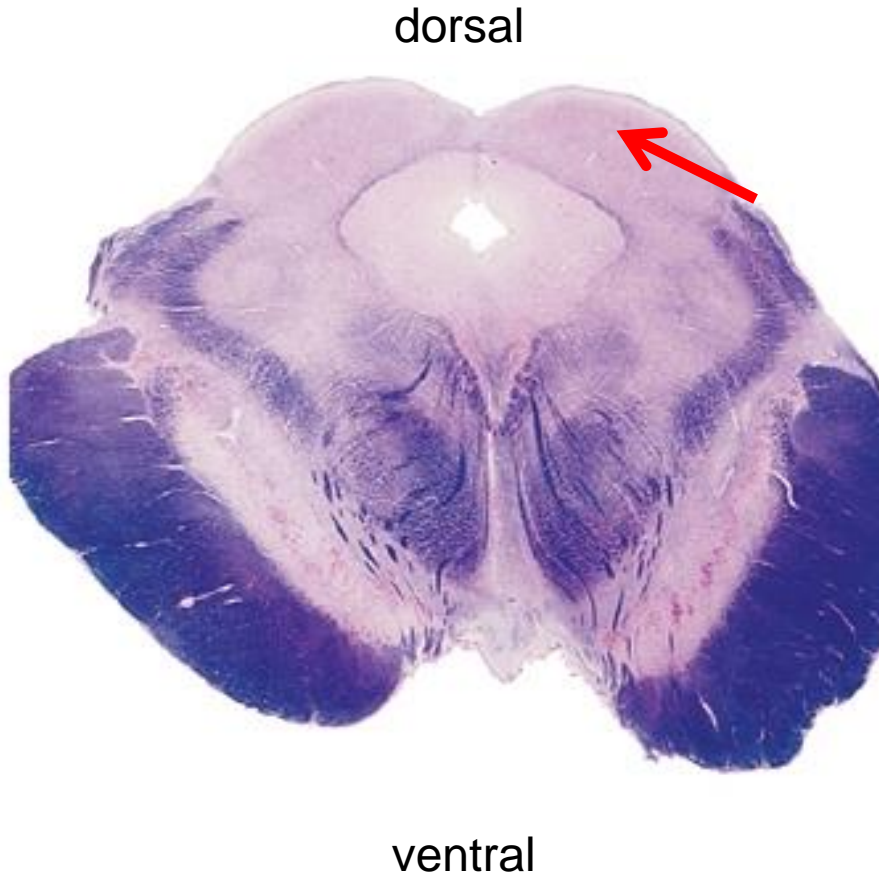
- Decussation of the superior cerebellar peduncles



## Midbrain (upper)

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- Superior colliculus (vision)





## Midbrain (upper)

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- Red nucleus – related to the cerebellum and the motor system

dorsal



ventral

## Midbrain (upper)

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- Substantia nigra – sends axons to the basal ganglia; neurotransmitter is dopamine; degenerates in Parkinson's disease

dorsal

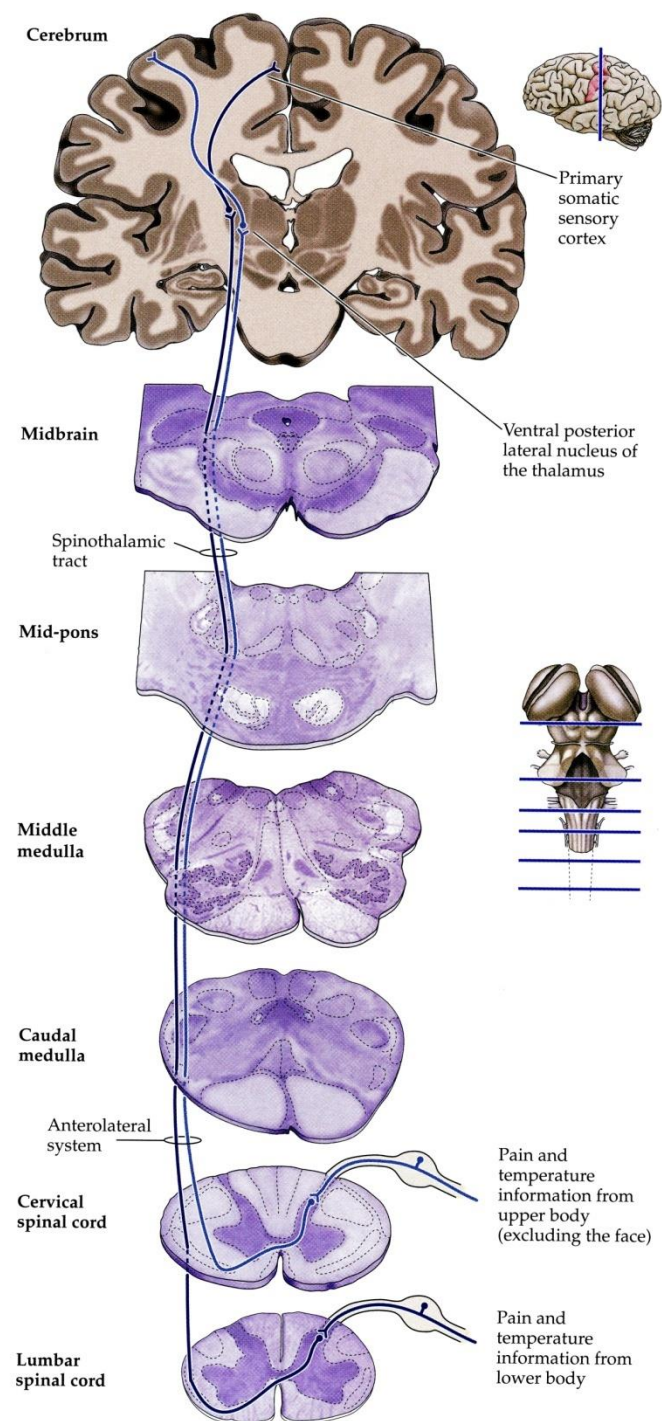


ventral

# Somatosensory Projection to Cortex

Spinothalamic projection:

- Primary sensory axons for pain, temperature and light touch synapse on neurons in the dorsal horn.
- Axons of these dorsal horn neurons cross the spinal cord and ascend in the spinothalamic tract.
- They synapse in the ventral posterolateral nucleus (VPL) of the thalamus.
- Axons from the VPL neurons project to somatosensory cortex.

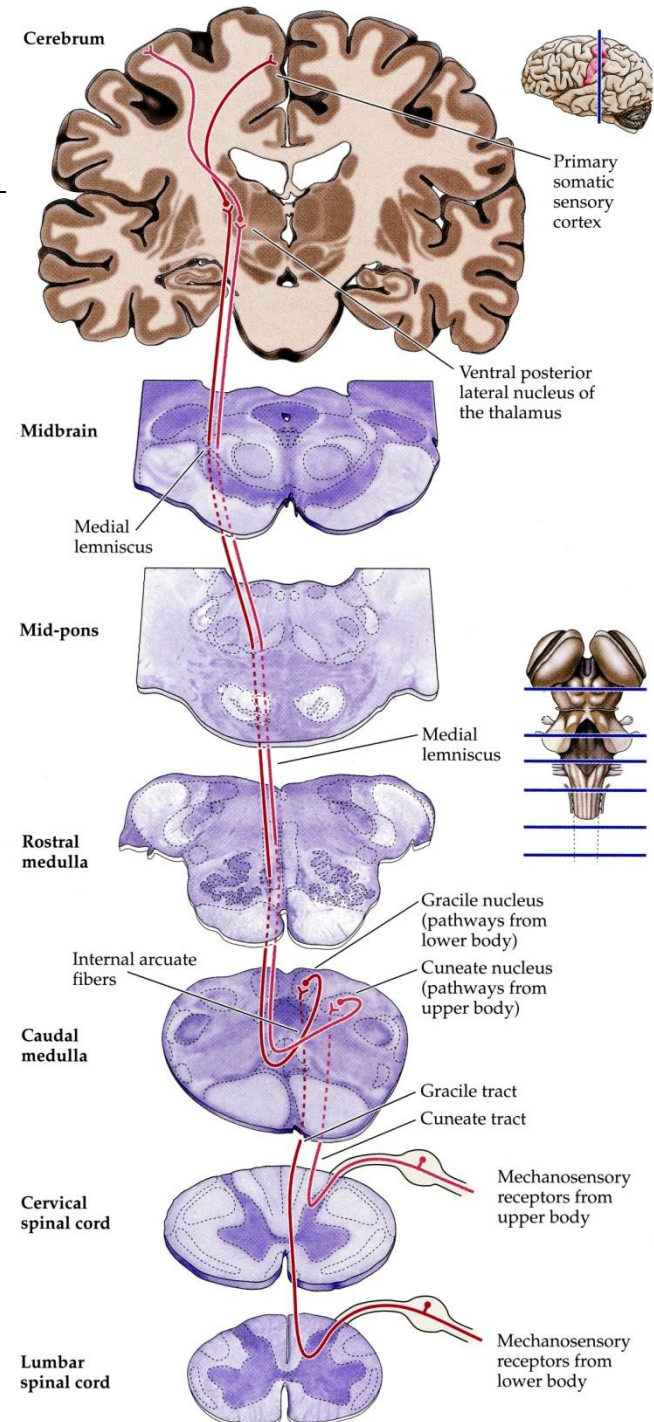




# Somatosensory Projection to Cortex

## Dorsal column projection:

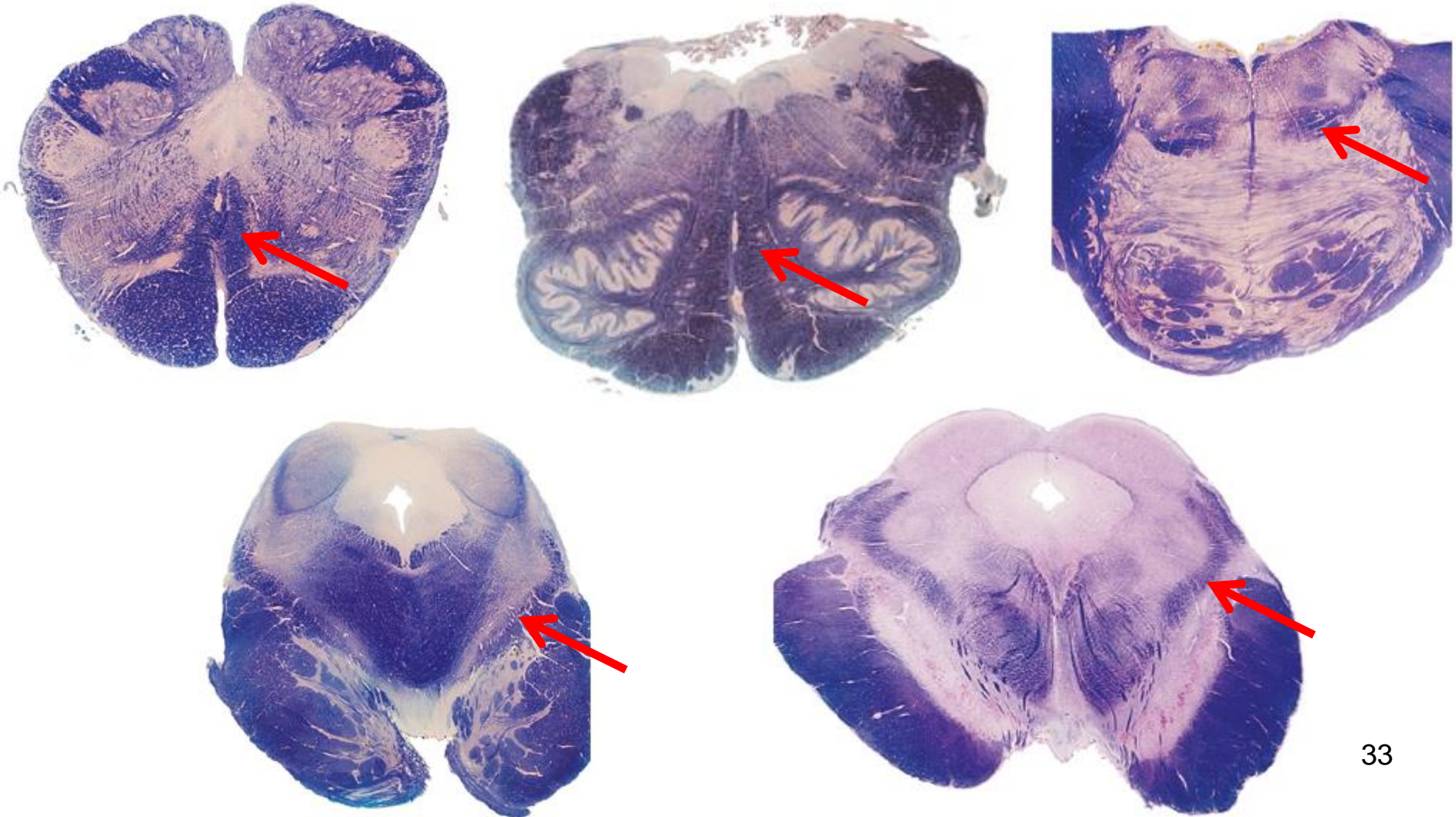
- Primary sensory axons for proprioception and touch enter the dorsal horn and ascend in the dorsal columns.
- These axons synapse in nucleus gracilis (from lower body) and nucleus cuneatus (from upper body) in the medulla.
- Axons from these nuclei cross the medulla and ascend to thalamus.
- They synapse in the ventral posterolateral nucleus (VPL) of the thalamus.
- Axons from the VPL neurons project to somatosensory cortex.



## Somatosensory Pathway: Dorsal Columns for Proprioception and Touch

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- Medial lemniscus ascends through the brainstem to thalamus.

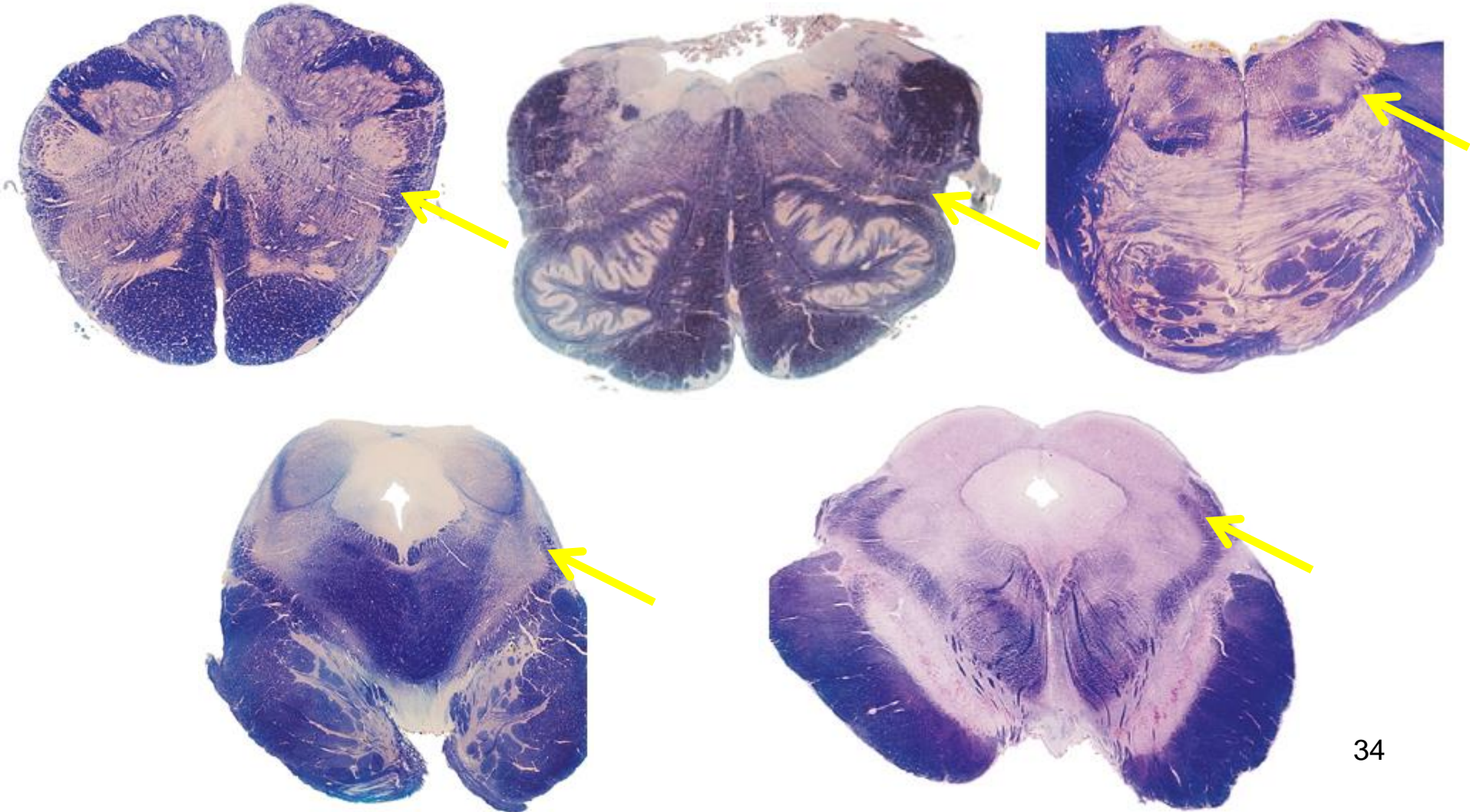




## Somatosensory Pathway: Spinothalamic Tract for Pain, Temperature & Touch

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- Spinothalamic tract ascends through the brainstem to thalamus.

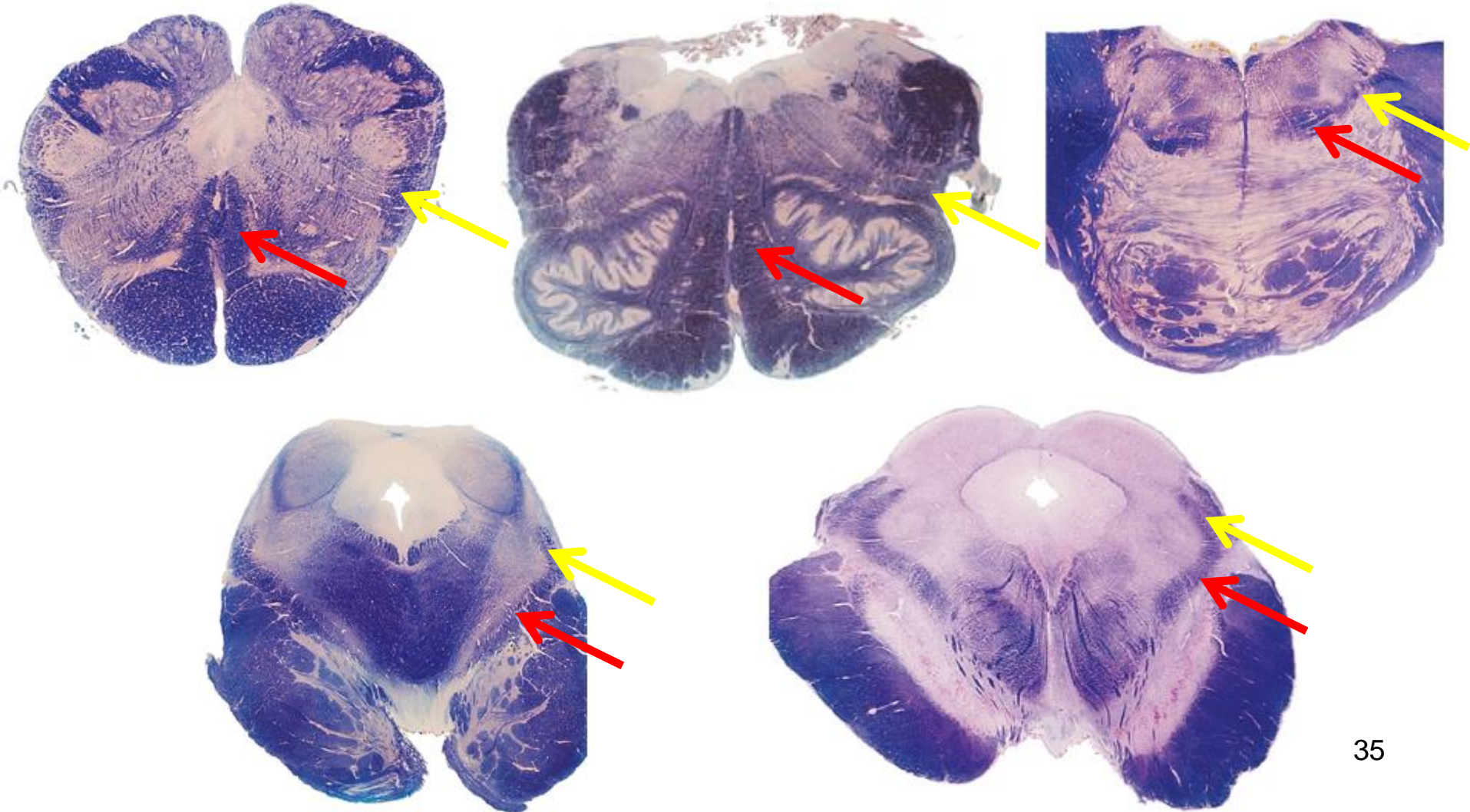




# Somatosensory Pathway

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- Medial lemniscus (red) and spinothalamic (yellow)



## Motor System

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- Axons of upper motor neurons descend from cortex.

