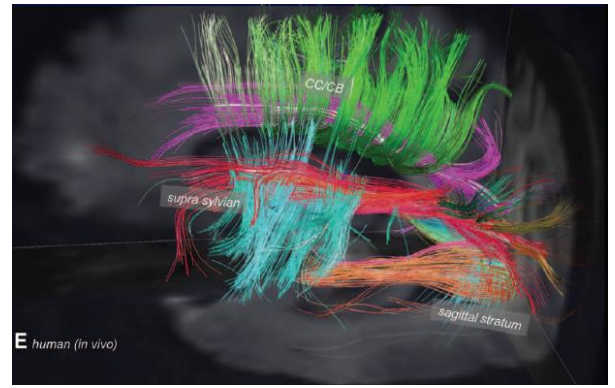
# Cerebral Functions:

## Grey Matter & White Matter –

### 3-D Architecture of Brain's Neural System

**The Geometric Structure of the Brain Fiber Pathways**
Van J. Wedeen *et al.*
*Science* **335**, 1628 (2012);
DOI: 10.1126/science.1215280

## White Matter: Connecting Fibres of Brain:




### In 3-Axes:

### Right-Left ( X-axis)

### Back-Front ( Y-axis)

### Up-Down ( Z-axis)

**Patterning of corpus callosum integrity in glioma observed by MRI: Effect of 2D bi-axial lamellar brain architecture**

Journal of Neuro-Oncology
https://doi.org/10.1007/s11060-019-03217-9

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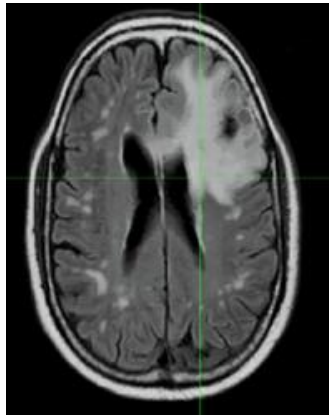
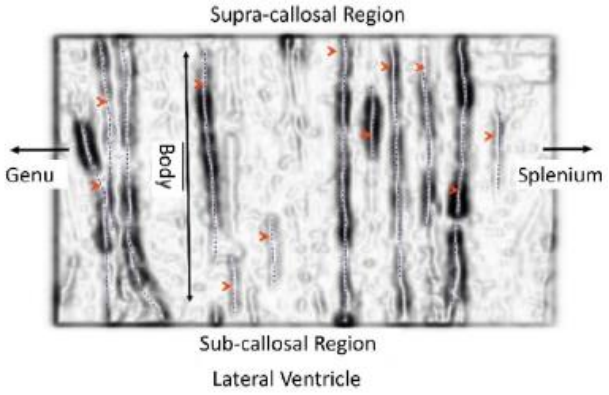




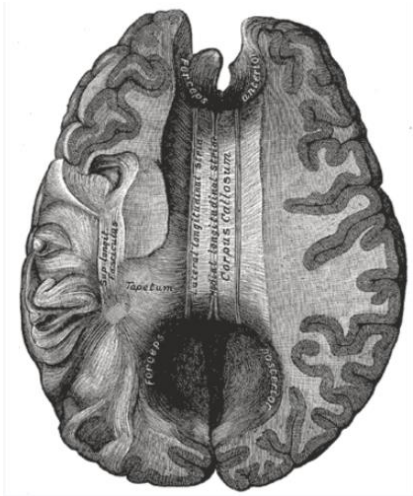
# Nerve Fibres across Horizontal Direction

# (X-axis)

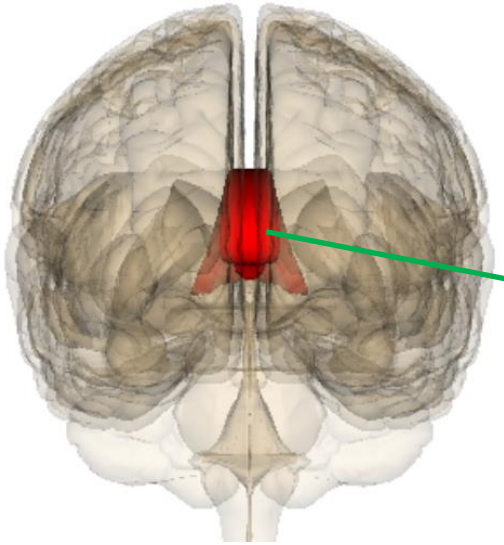
# Corpus Callosum, CC: Body of Connector

## (between Left & Right Cerebral Hemispheres)

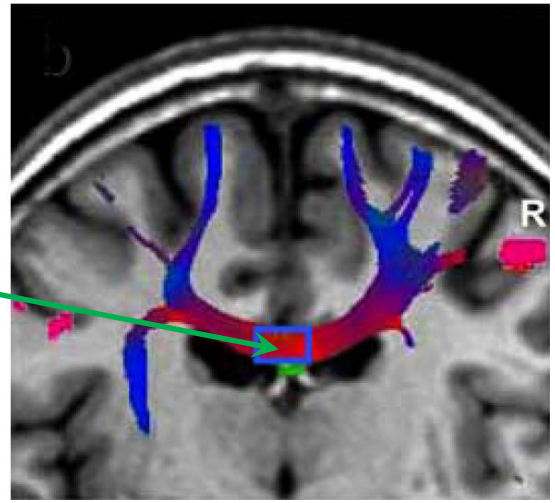
**Axial View**

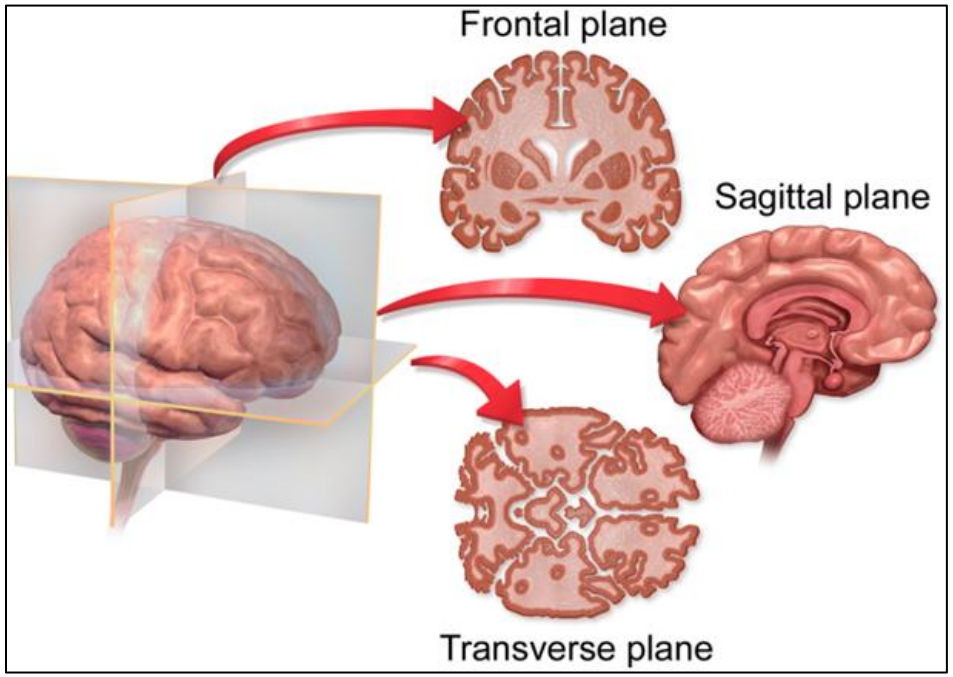



**Frontal View**

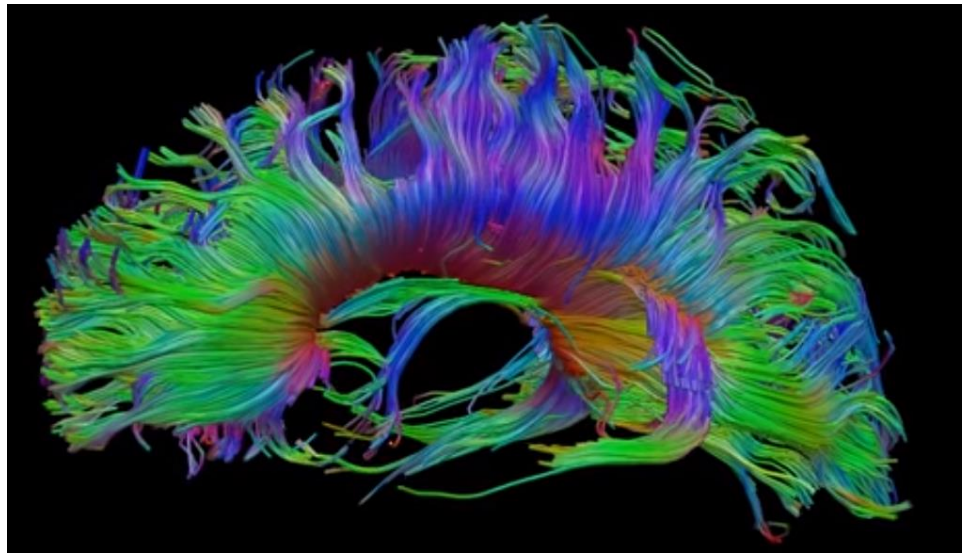


**MRI Tractography of CC**



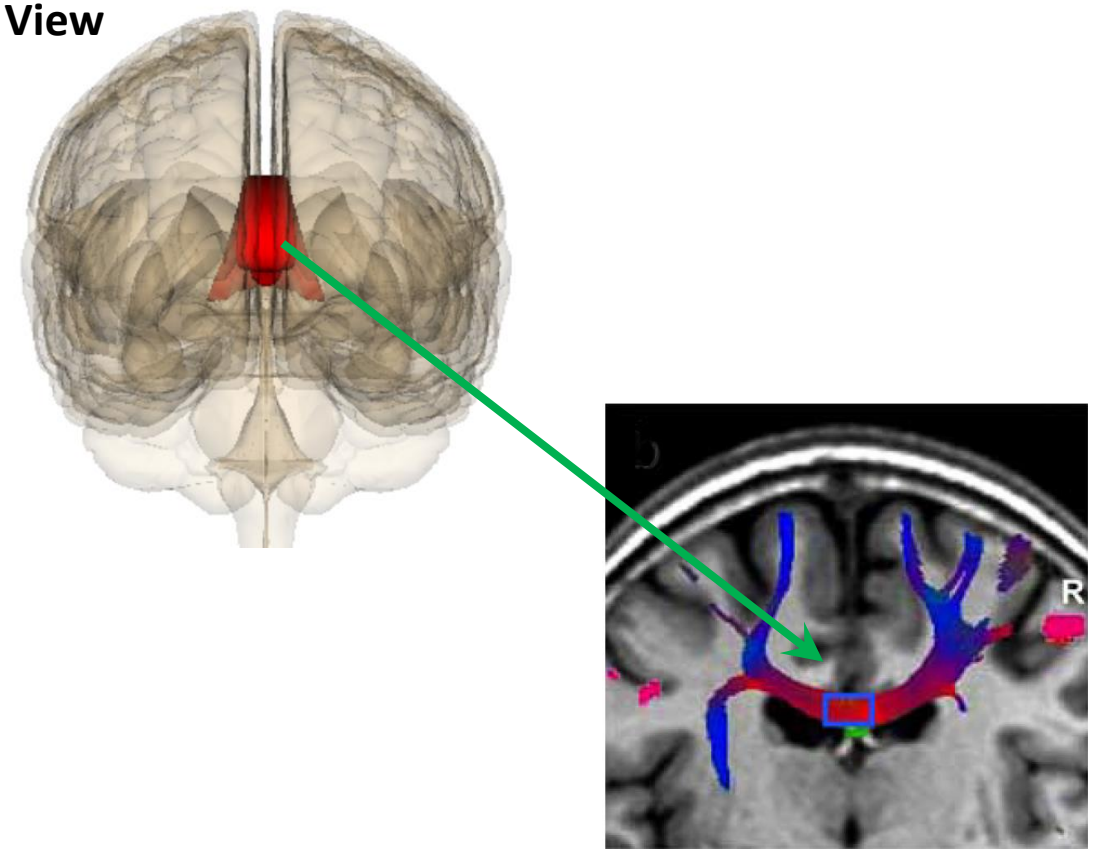

**MRI: Sagittal Tract View of CC**



# Commissure Fibres (Left-Right Cerebral Links)

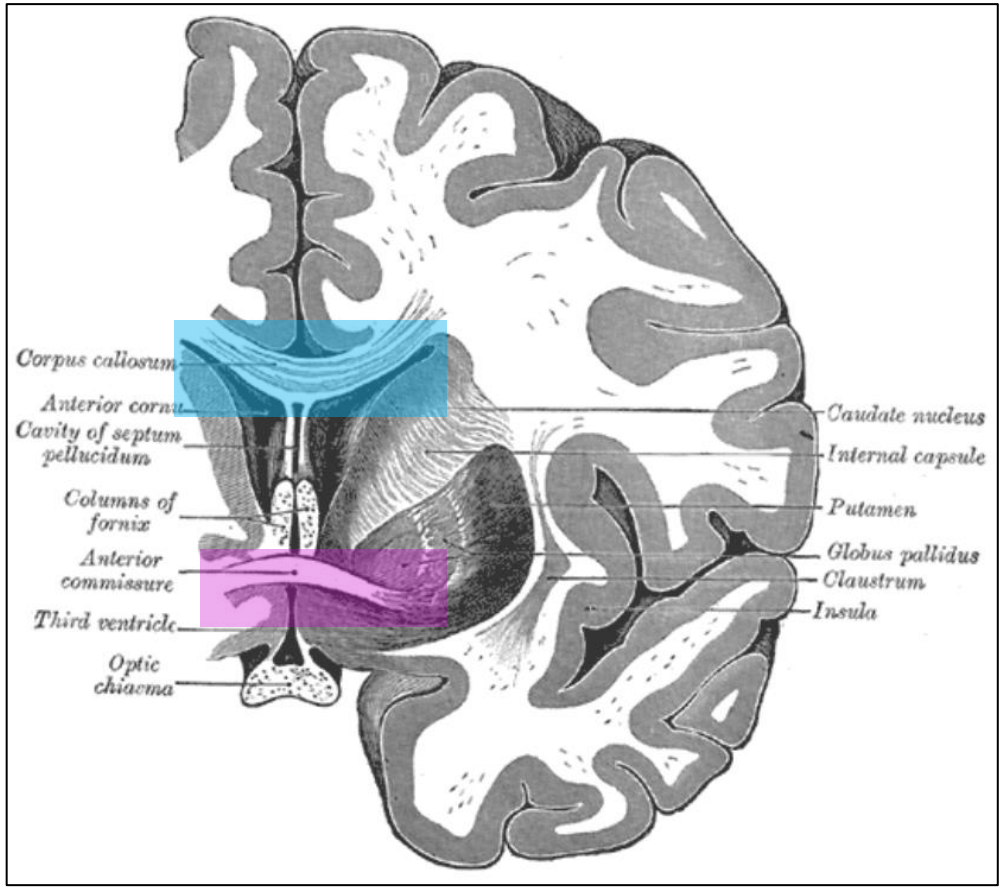
## (i) Corpus Callosum:  Body of Connector

**Coronal View**




## (ii) Anterior Commissure

**Coronal View**

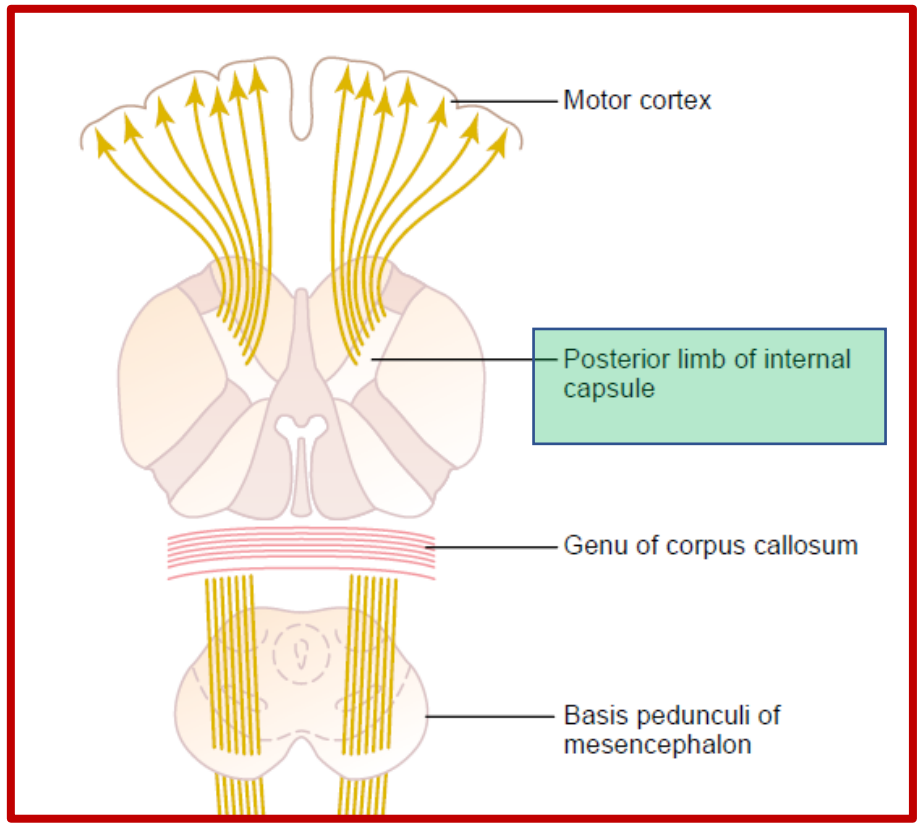


# Nerve Fibres across Vertical Direction

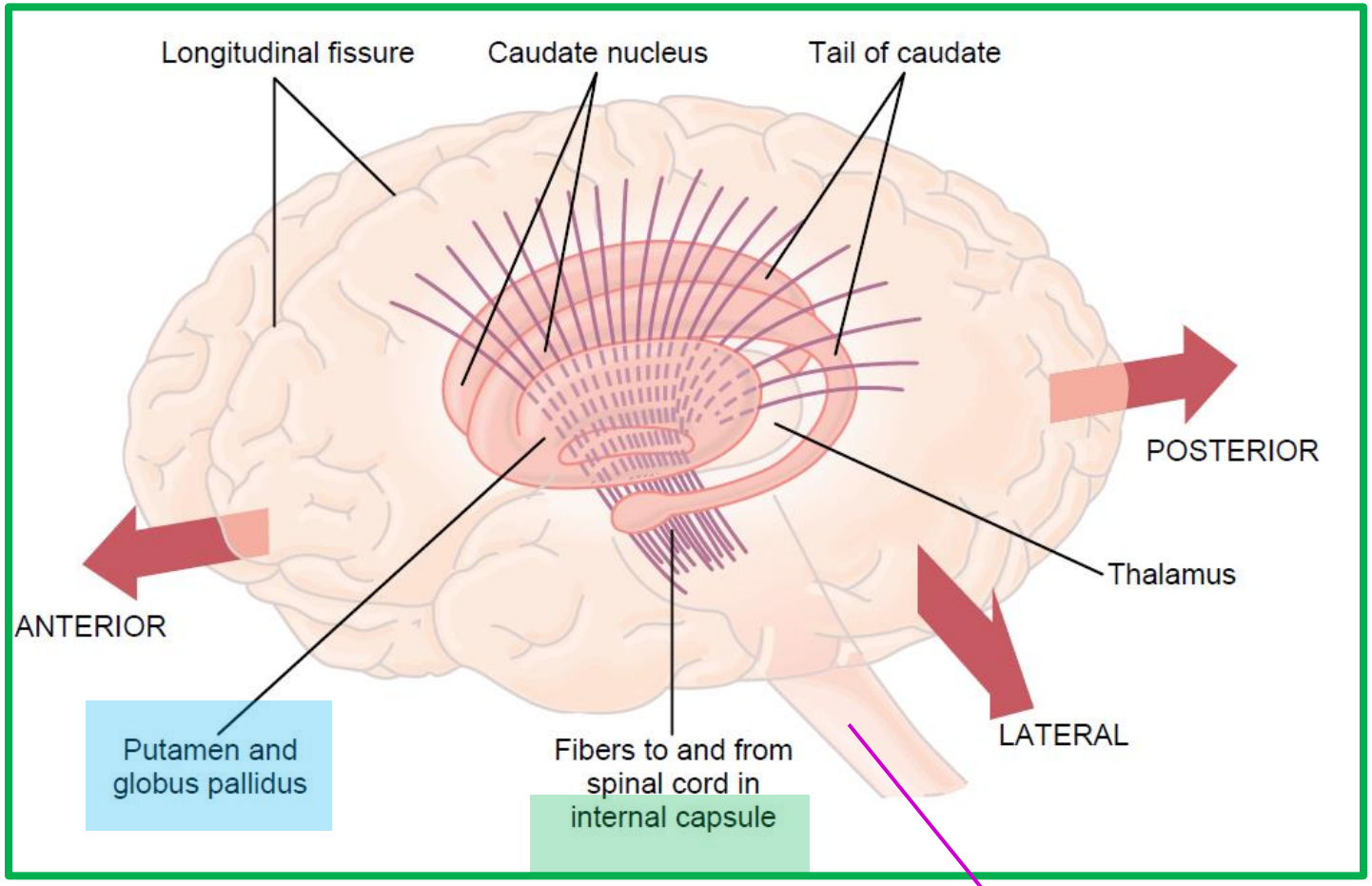
# (Z-axis)

# Brain's Relay Station: Basal ganglia:

## Nerve Junction between Cerebral Cortex & Spinal Cord



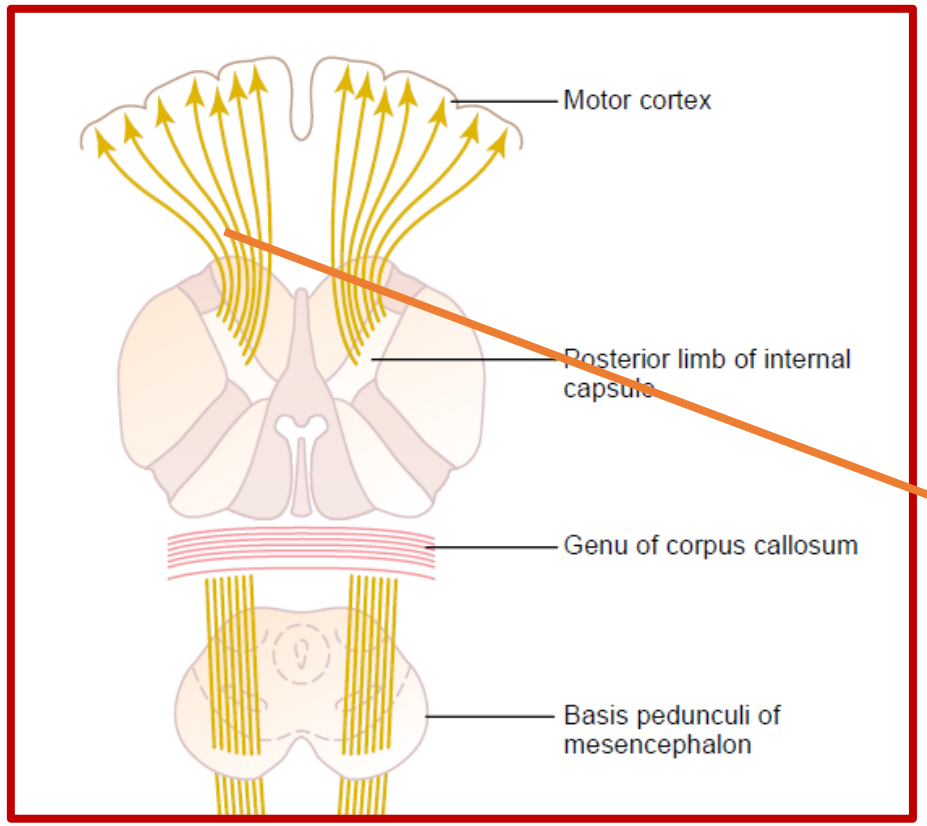

Spinal Cord



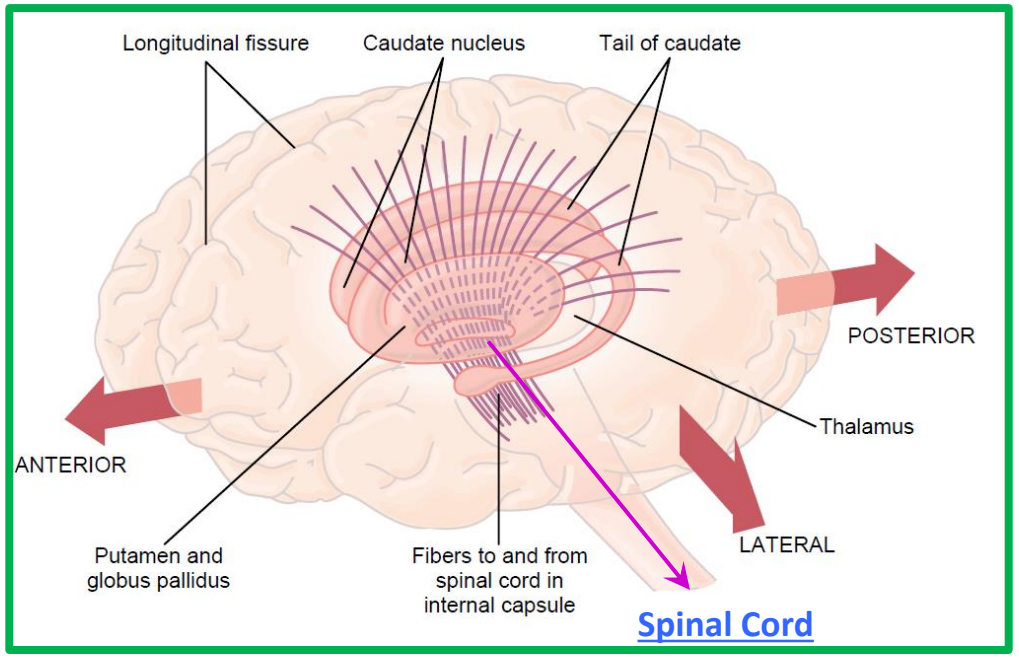

Spinal Cord

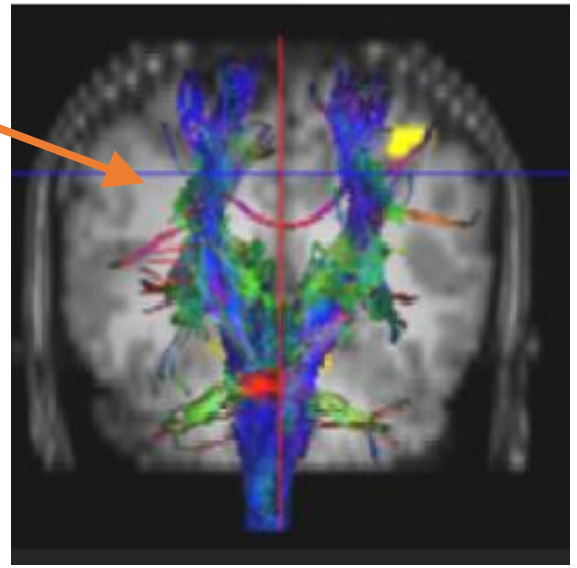
# Brain's Relay Station: Basal ganglia:

## Nerve Junction between Cortex & Spinal Cord




Spinal Cord



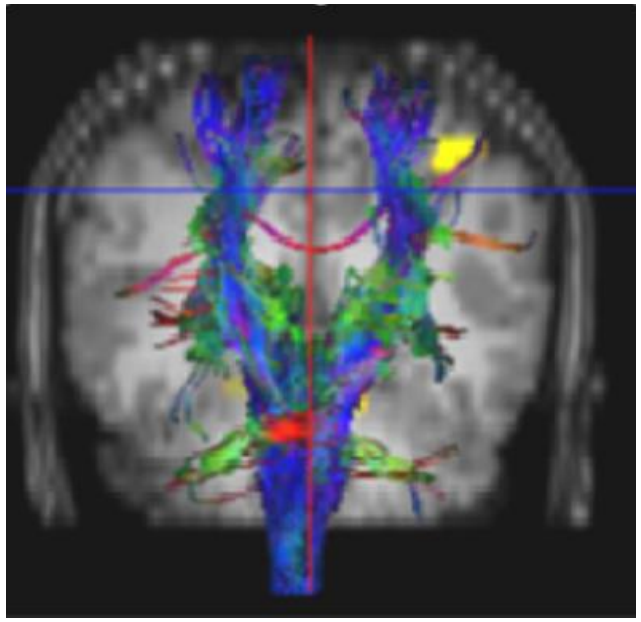



MRI: Nerve's Tractography:

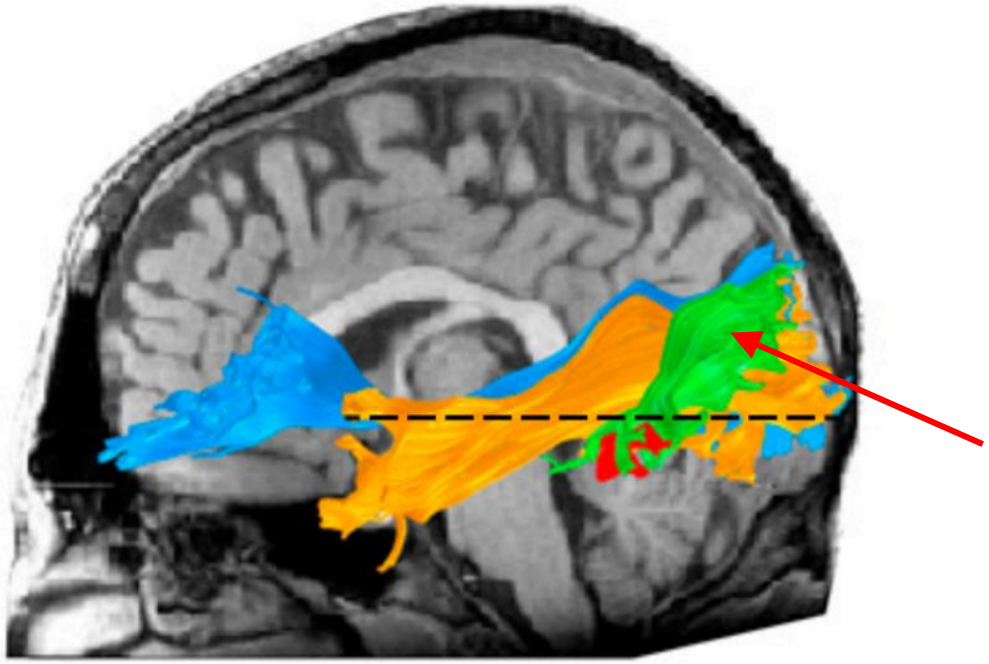
Pyramidal Tracts

# Up-Down Fibres:

## (i) Projection Bundles (Motor Or Pyramidal Tract)



## (ii) Vertical Fasciculus



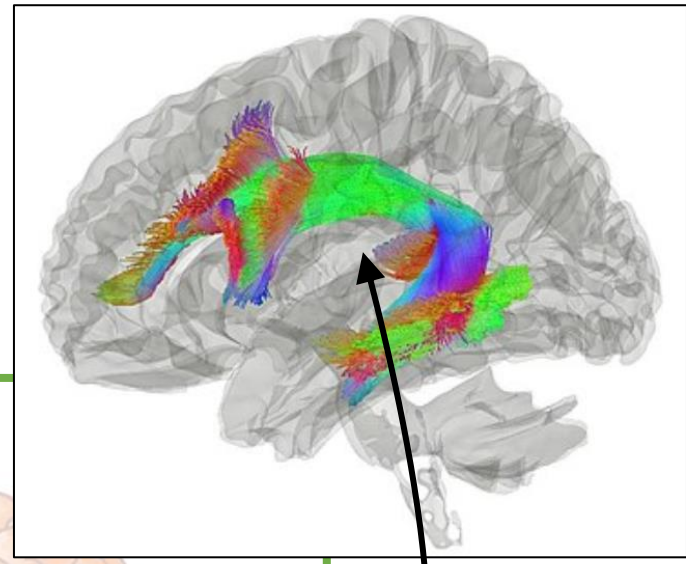
# Nerve Fibres across Front-Back Direction

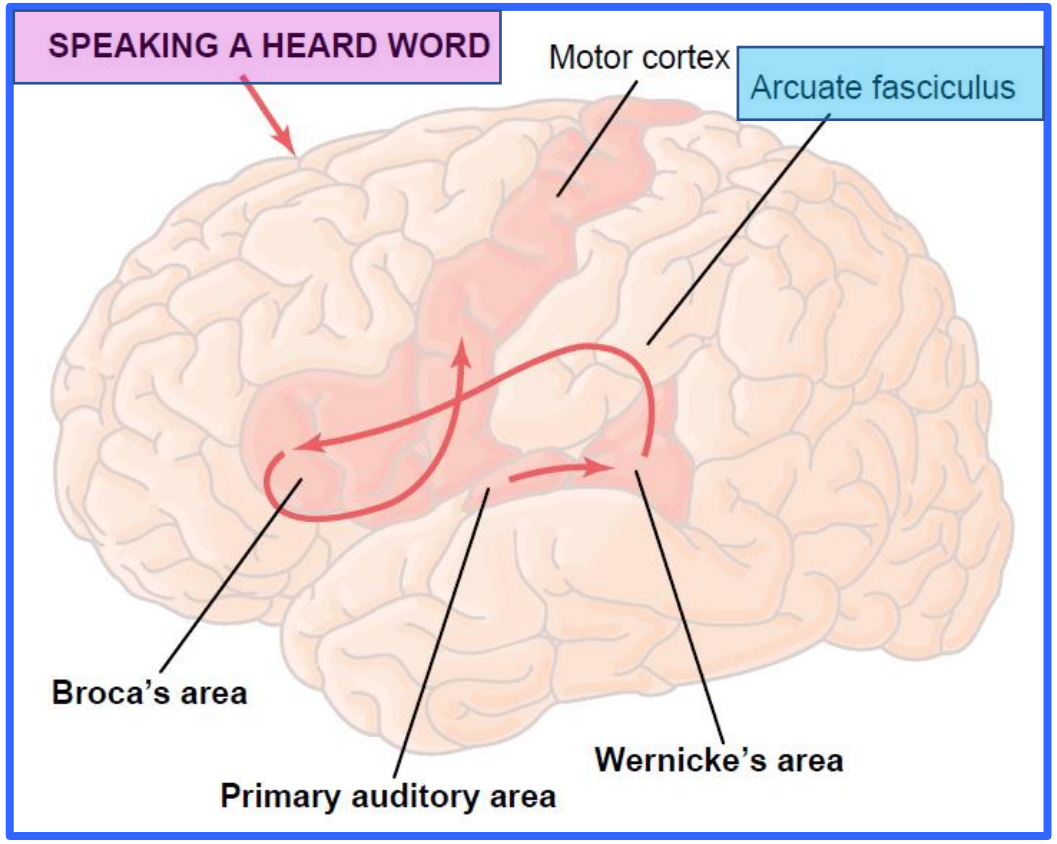
# (Y-axis)

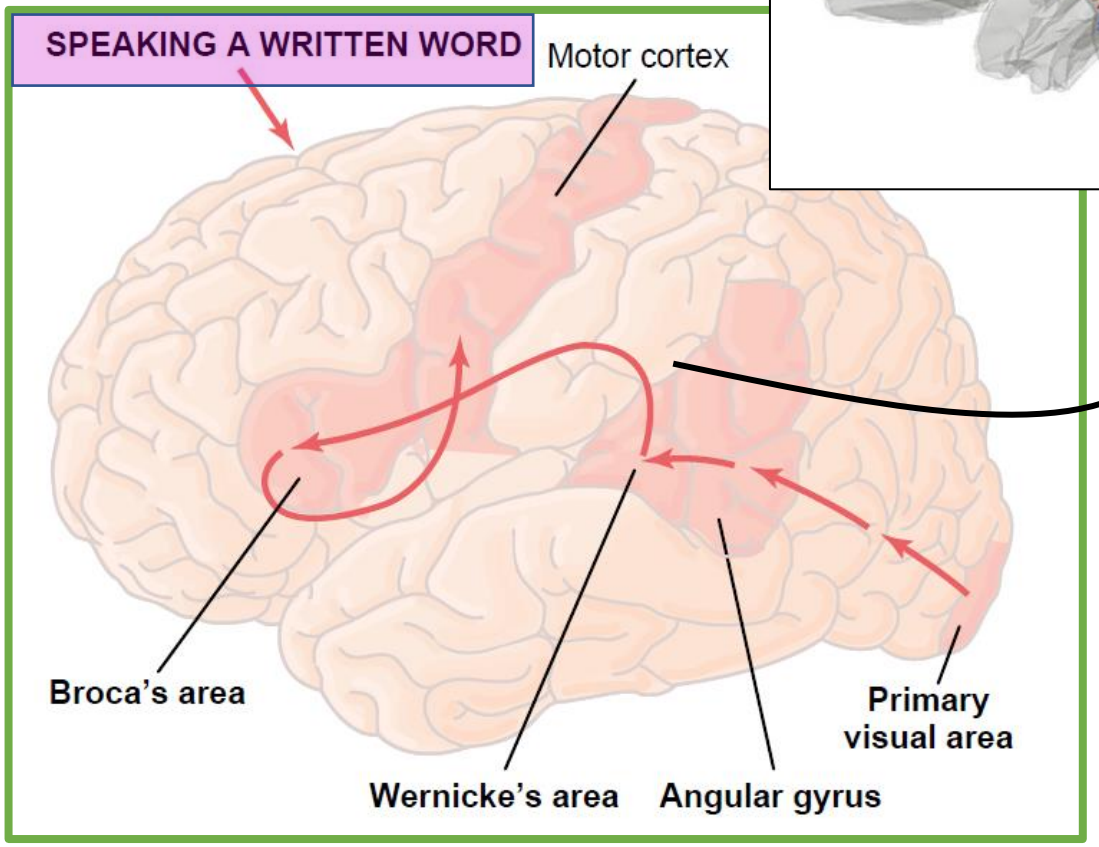
# Pathways for Hearing, Speaking & Reading:

## Literacy & Education

MRI: Tractography
View of Arcuate Bundle





# Association Bundles (Fasciculus)

## Mainly Front-Back Fibres:

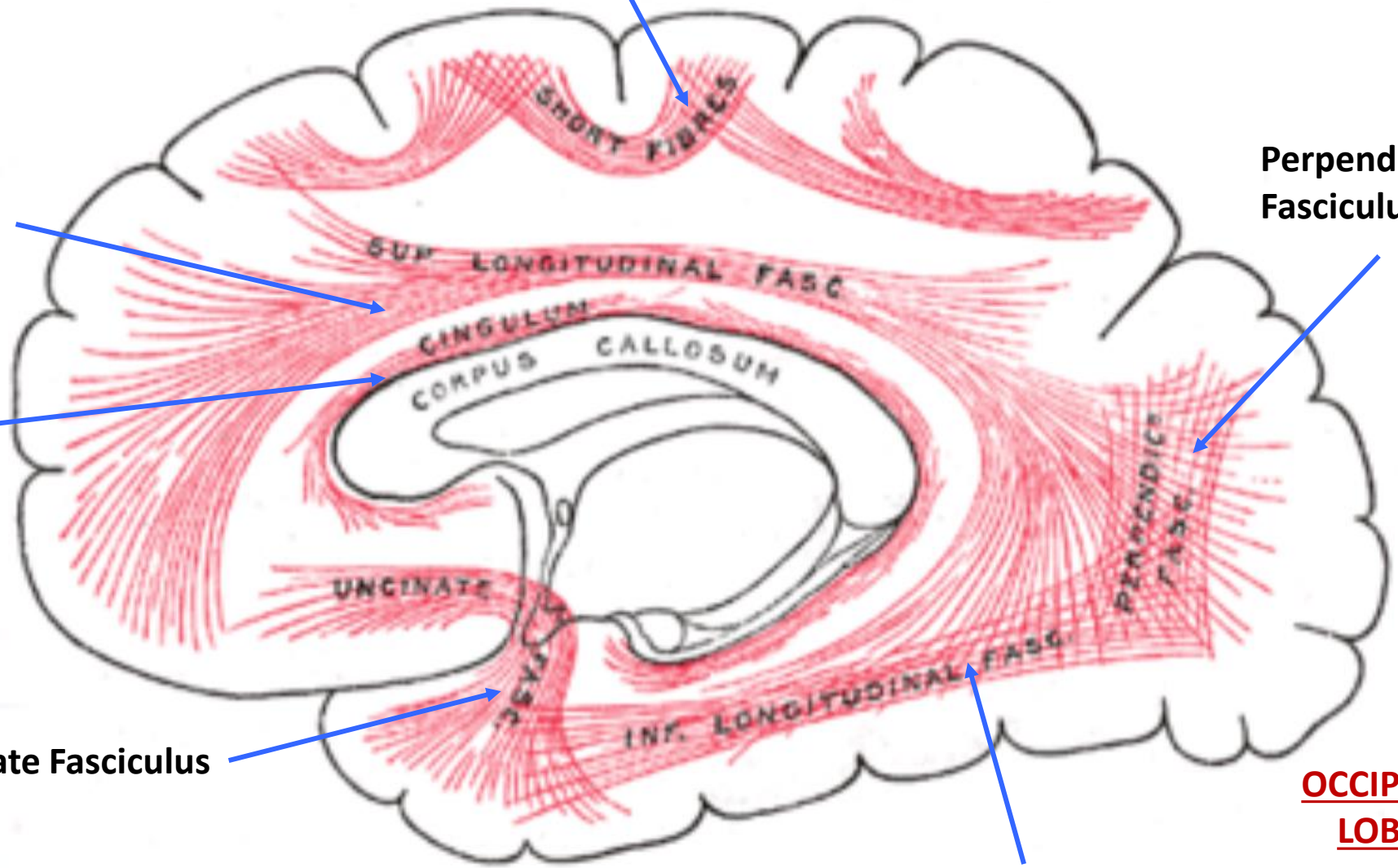
Short Fibres

Superior Longitudinal Fasciculus

Cingulum

FRONTAL LOBE

Uncinate Fasciculus



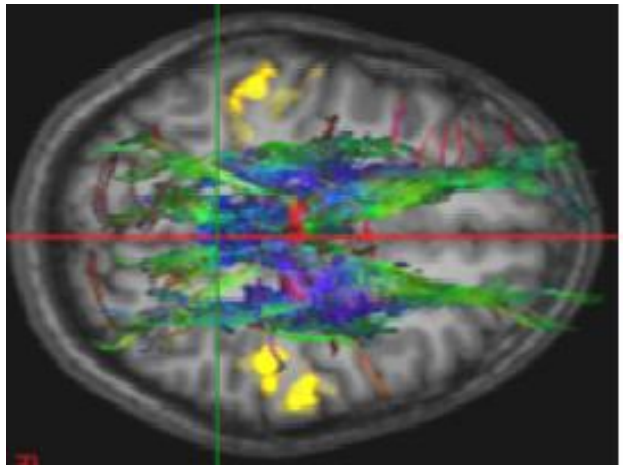

Perpendicular Fasciculus

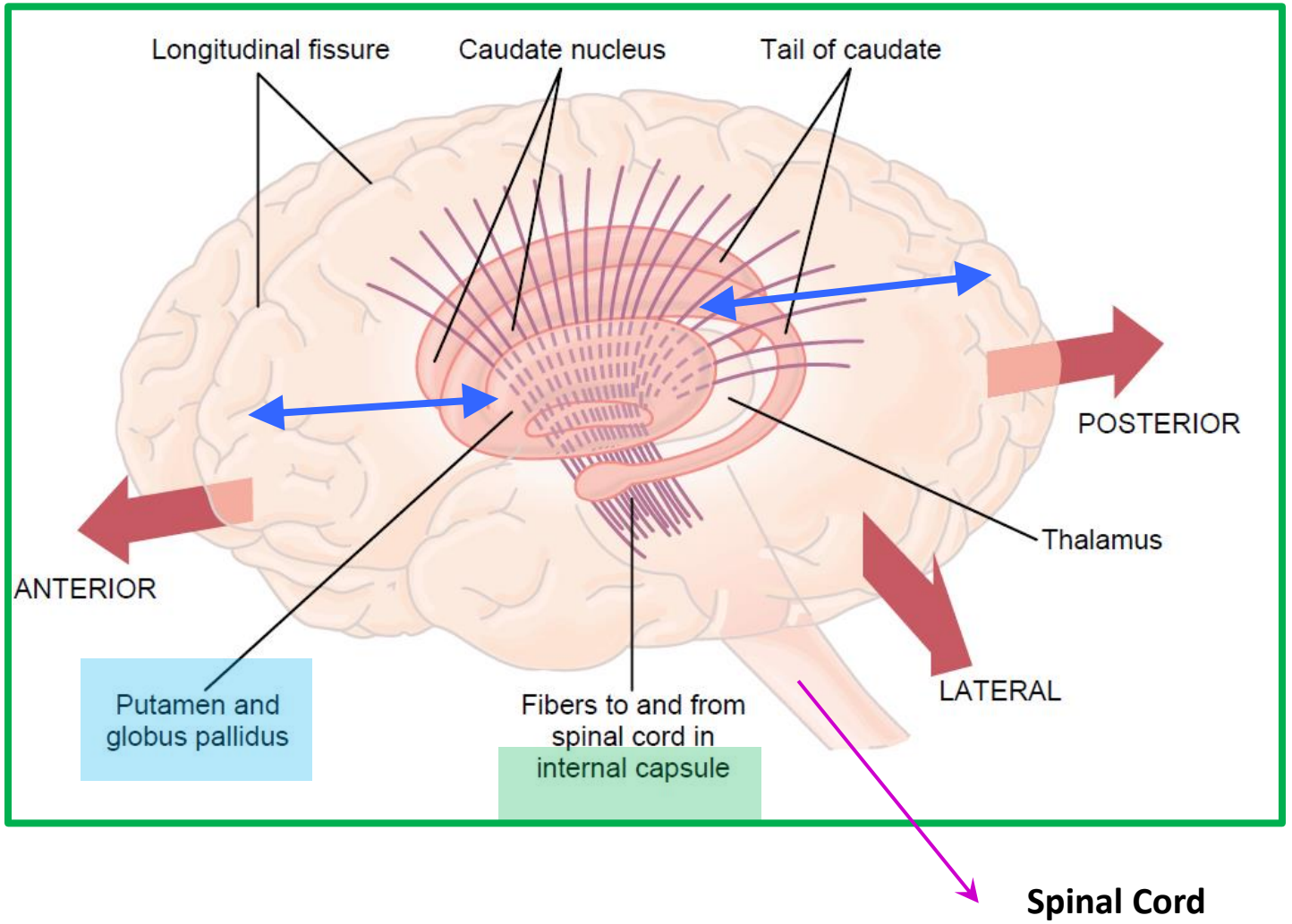
OCCIPITAL LOBE

Inferior Longitudinal Fasciculus

# Brain's Relay Station: Basal ganglia:

## Nerve Junction between Cerebral Cortex & Spinal Cord

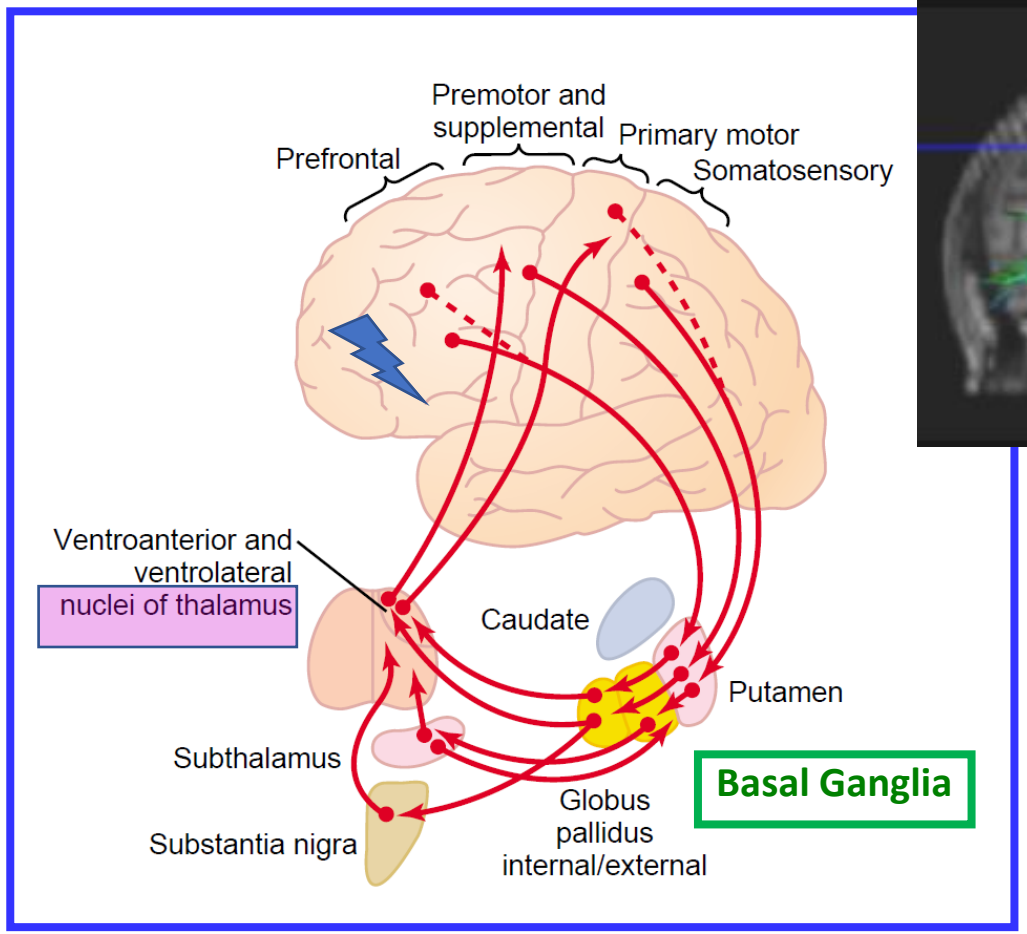


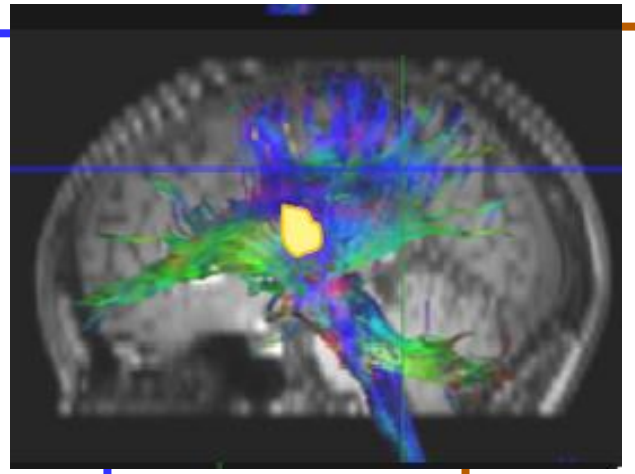


# Cortex → Basal Ganglia (B.G.) Patterning of Motor Activity of Muscles

## Riding a Bicycle

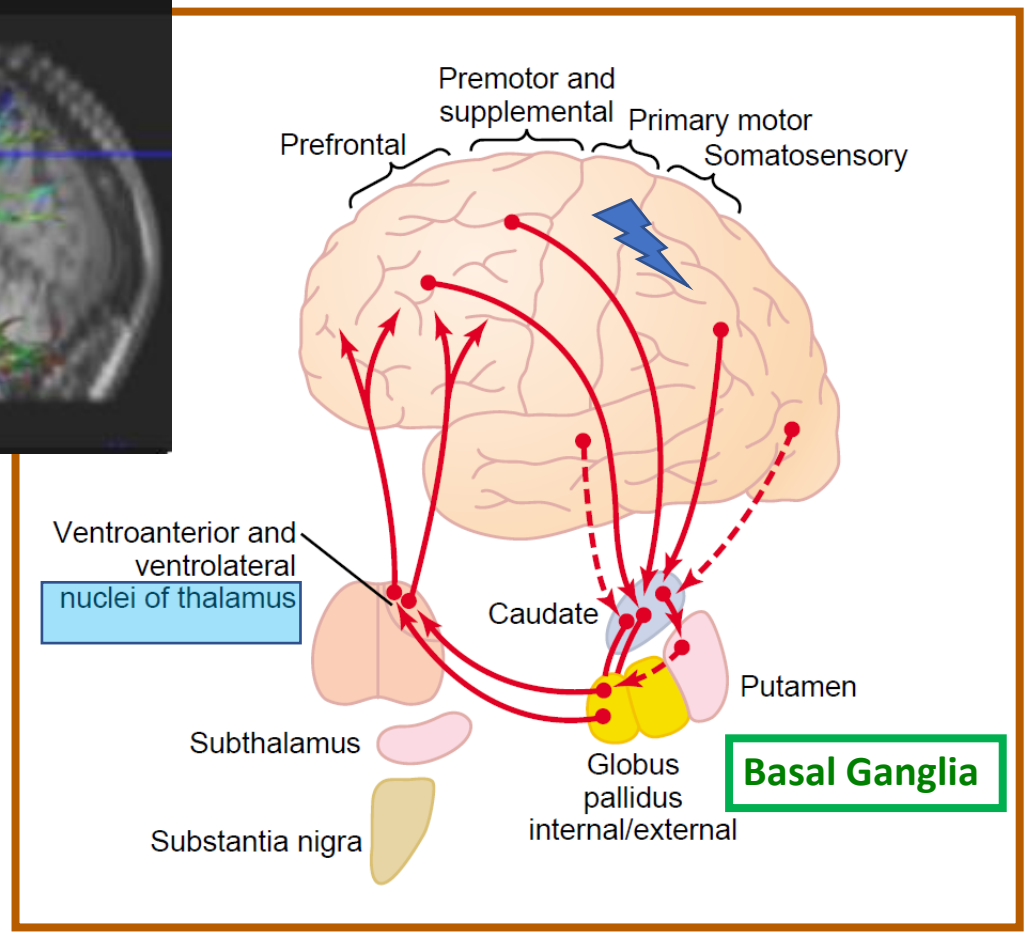
**B.G. (Putamen): Subconscious learned movement**



## Playing a Orchestrated Piano Sequence

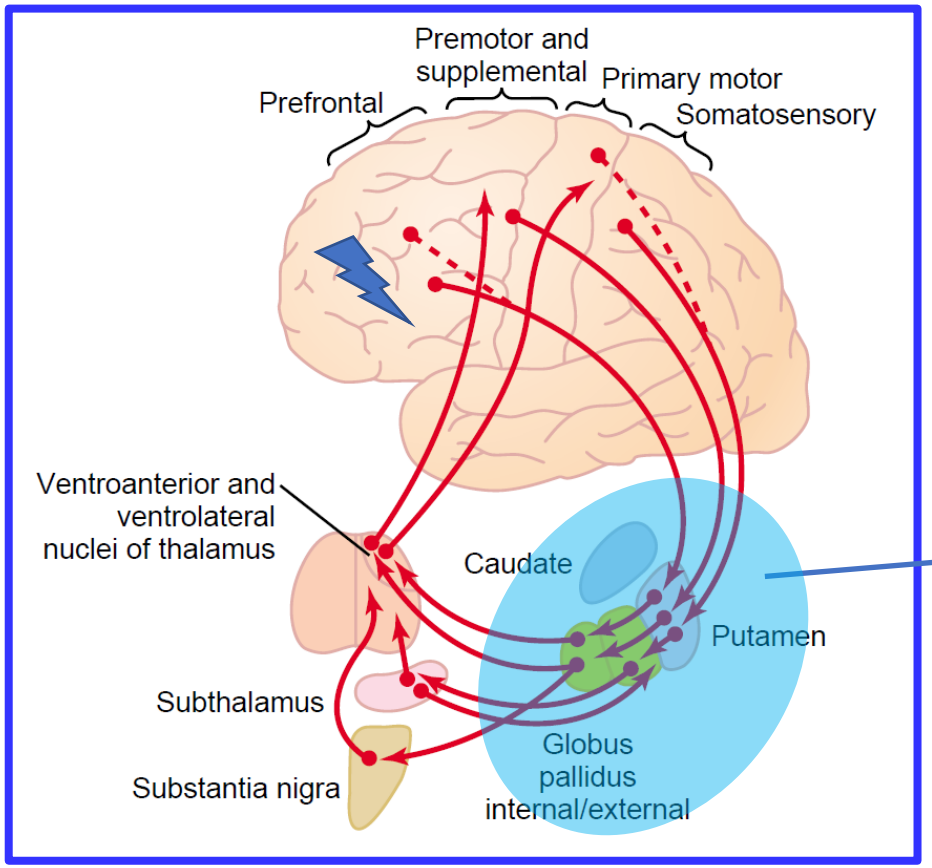
**B.G. (Caudate): Conscious Sequential Execution**

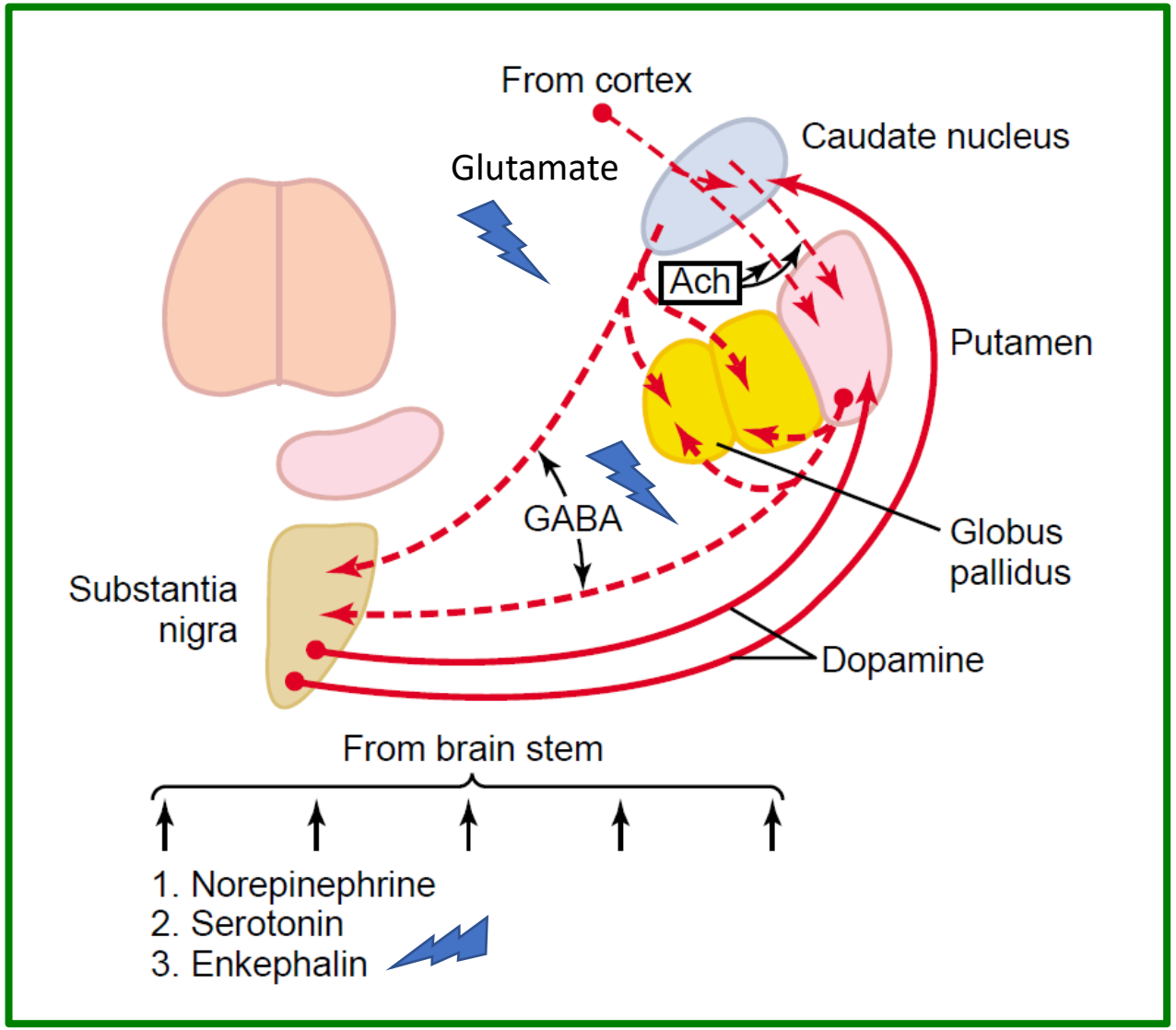


# Neurotransmitter Basis of Motor Tract via Basal Ganglia

**Neurotransmitters in Cerebrum :** Glutamate/Glutamine ↑ GABA ↓ (γ $NH_2$-butyric acid)

Encephalin



# ***Recap:*** Maintaining Long-term Tone in Brain:

**Four Neurotransmitters in**

**Spinal Cord / Brain Stem**

- **Acetylcholine,**
- **Norepinephrine,**
- **Dopamine,**
- **Serotonin**