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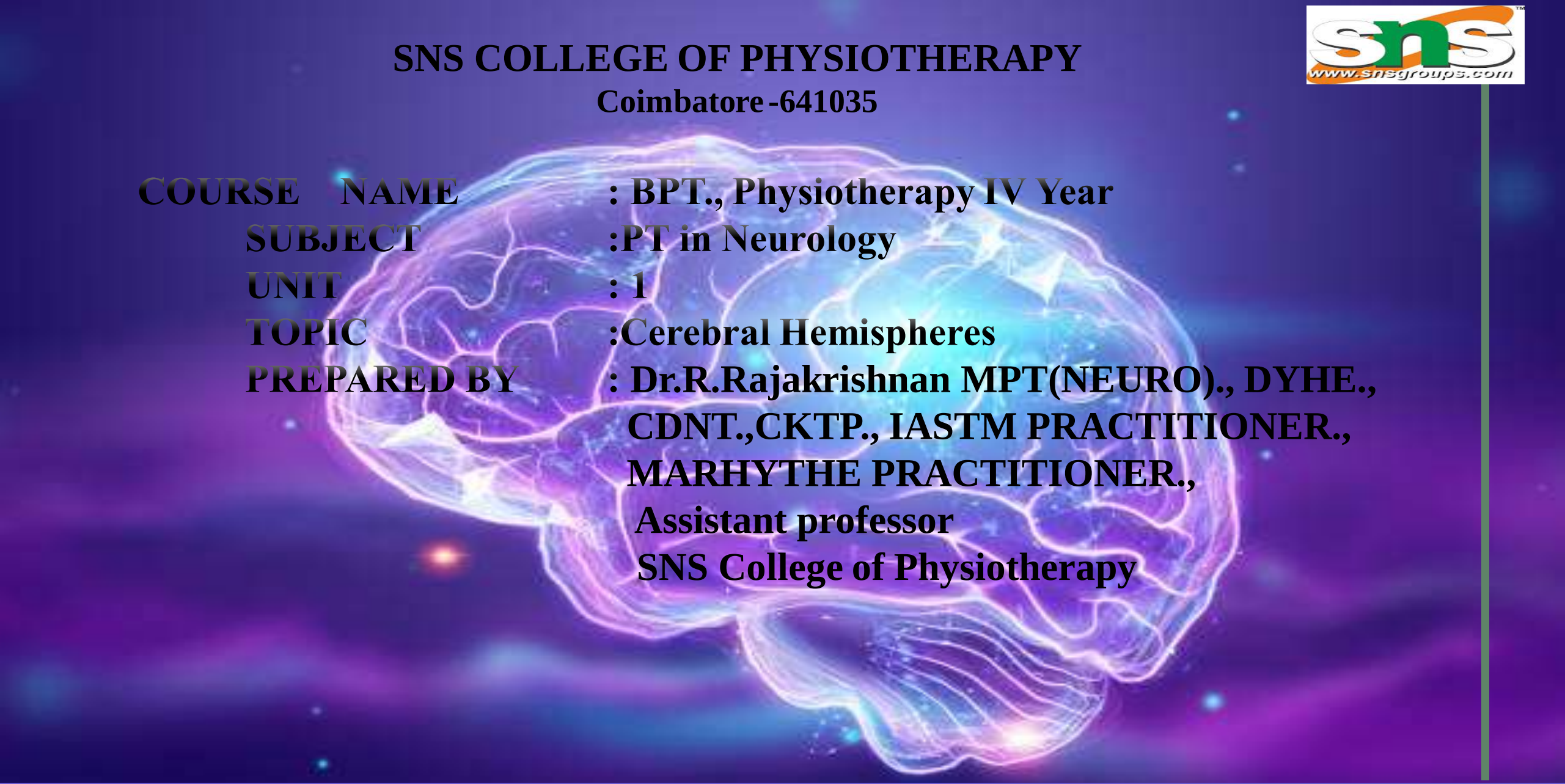

COURSE NAME : BPT., Physiotherapy IV Year

SUBJECT :PT in Neurology

UNIT : 1

TOPIC :Cerebral Hemispheres

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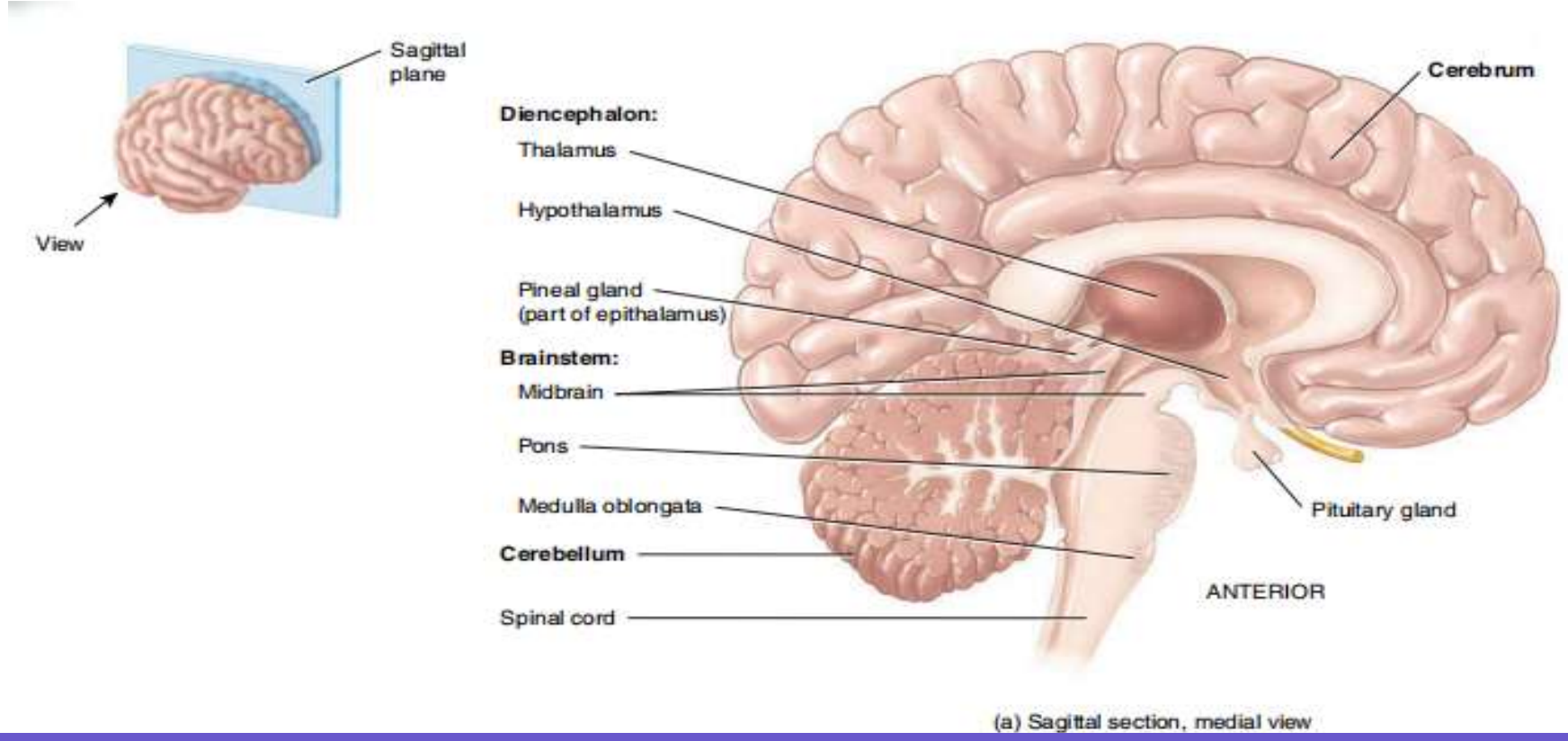
Introduction

The cerebrum is the largest part of the brain, consisting of two cerebral hemispheres. It represents the highest degree of evolutionary development in humans. Functions include: Conscious perception of sensory perceptions, conscious motor activity, and cognition (memory, learning, intelligence.

Clinical Relevance: Essential for understanding UMN lesions and stroke.



(a) Sagittal section, medial view

Gross Anatomy & Hemispheric Structure

Two hemispheres separated by longitudinal fissure.

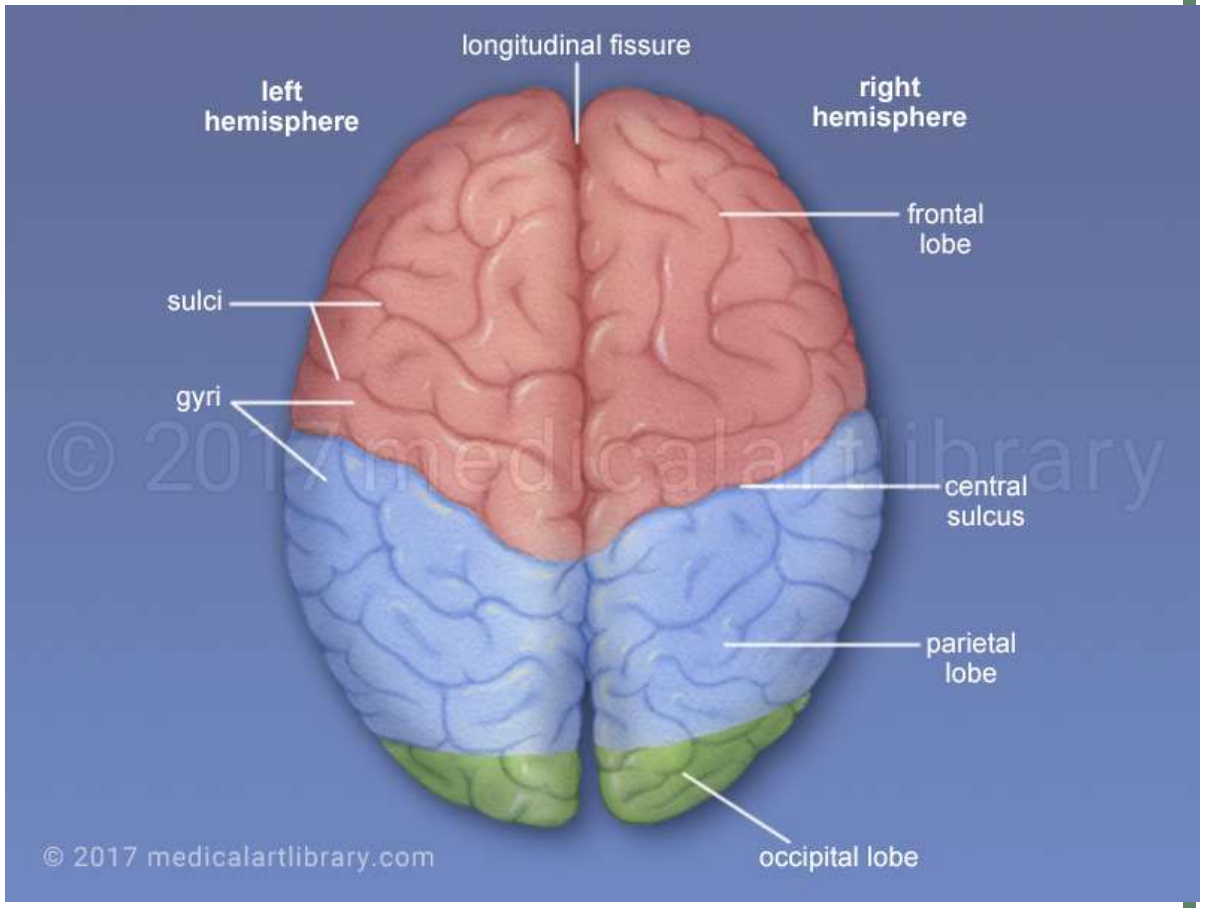
Separation of the Two Hemispheres:

The right and left cerebral hemispheres are separated by a deep groove called the median longitudinal fissure.

This fissure almost completely divides the brain into two halves,

except where they connect via the corpus callosum (a major fiber bundle).

- Components:
- - Cerebral Cortex (grey matter)
- - White Matter
- - Basal Nuclei
- Controls opposite side of body.



External Features & Lobes

The cerebral hemispheres are divided into four major lobes, separated by key sulci that help identify functional regions of the brain.

Frontal Lobe: Motor control, planning, judgment, personality.

Parietal Lobe: Somatosensory processing, spatial perception, body orientation.

Temporal Lobe: Hearing, language comprehension (Wernicke's area), memory.

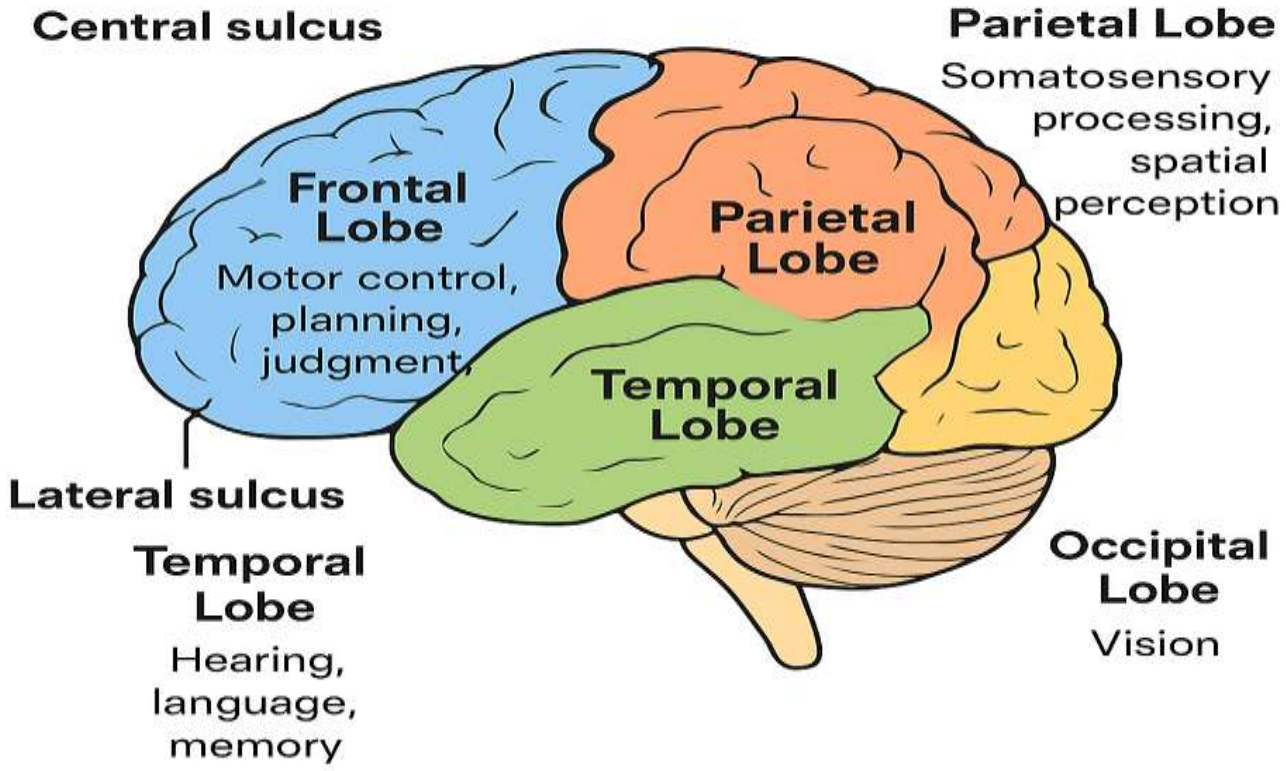
Occipital Lobe: Vision processing (Primary Visual Cortex).

Major Sulci:

Central Sulcus: Separates frontal (motor) from parietal (sensory) lobes.

Lateral Sulcus (Sylvian Fissure): Separates temporal from frontal & parietal lobes.

LOBES & MAJOR SULCI



Cerebral Cortex Structure

SIX LAYERS OF THE NEOCORTEX (SIMPLIFIED)

- The neocortex contains six layers, each specialized for sensory input, processing, and motor output.

I — Molecular Layer
Mostly dendrites & fibers.

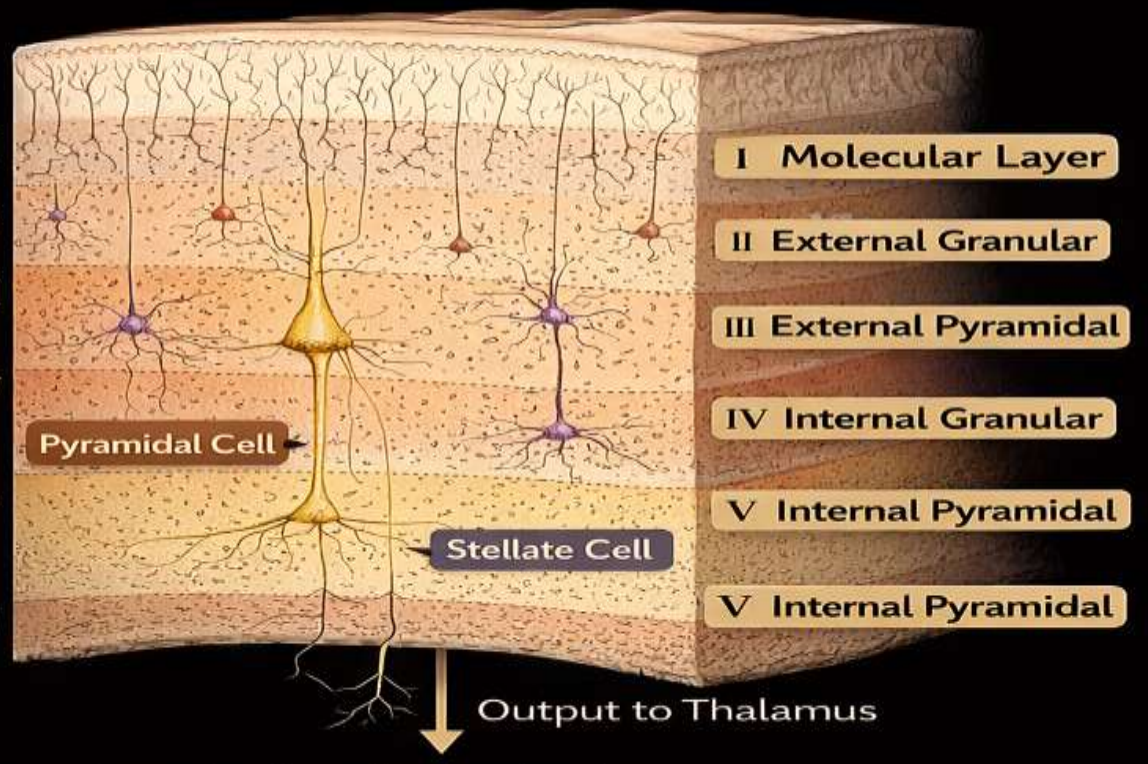
II — External Granular
Small stellate cells (local circuits).

III — External Pyramidal
Cortico-cortical connections.

IV — Internal Granular
Major sensory input layer; rich in stellate cells.

V — Internal Pyramidal
Large pyramidal cells; motor output (corticospinal).

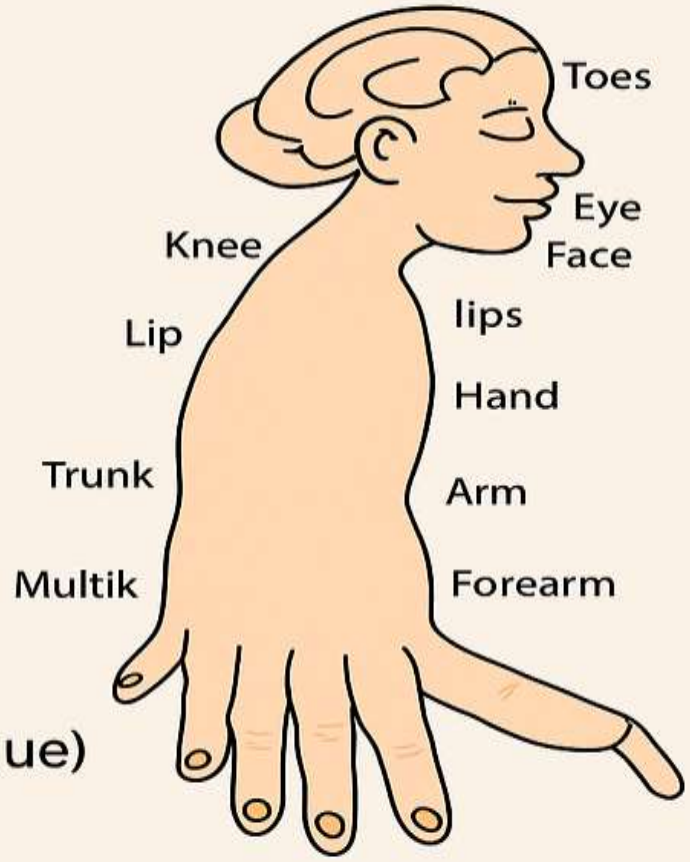
VI — Multiform
Output to thalamus.



- **Key Neurons:**
  - **Pyramidal Cells:** Excitatory, long-axon neurons → motor & cortical outputs.
  - **Stellate Cells:** Interneurons → sensory processing (layer IV).

Primary Motor Cortex – Location & Functio

- **Location:**
  Situated in the precentral gyrus of the frontal lobe
- **Primary Function:**
  Controls voluntary skilled movements of the body
- **Motor Homunculus:**
  Body parts are represented somatotopically
  Larger areas → body parts requiring fine control (hands, face, tongue)



- **Lesions:**
  Cause contralateral paralysis or weakness (upper motor neuron type)
  May also lead to loss of fine motor skills

Secondary Motor Areas

Premotor Area (PMA):

- Located anterior to the primary motor cortex.
- Programs and plans movements before execution.
- Important for posture adjustment and movement preparation.

Supplementary Motor Area (SMA):

- Located on the medial surface of the hemisphere.
- Controls complex, bilateral and sequential movements (e.g., playing piano).
- Helps initiate internally driven movements.

Frontal Eye Field (FEF):

- Located in the middle frontal gyrus.
- Controls voluntary eye movements, especially saccades (rapid eye shifts).

Lesions:

- Cause apraxia → inability to perform purposeful, learned movements despite normal strength.
- FEF lesions may cause deviation of eyes toward the lesion side.

Primary Sensory Area

Location:

Situated in the postcentral gyrus and posterior part of the paracentral lobule.

Input Source:

Receives third-order sensory neurons from VPL (body) and VPM (face) nuclei of the thalamus.

Functional Map:

Organized as a sensory homunculus (inverted).

Larger representation for highly sensitive areas like lips, face, hand.

Function:

Processes fine touch, pain, temperature, vibration, and proprioception from the opposite side of the body.

Lesions:

Loss of fine touch

Loss of proprioception

Difficulty in tactile discrimination (e.g., astereognosis).

Special Sensory Areas

Primary Visual Area (Area 17):

Located in the occipital lobe around the calcarine sulcus.

Processes visual information (form, color, movement).

Primary Auditory Area (Areas 41 & 42):

Located in the superior temporal gyrus of the temporal lobe.

Responsible for perception of sound (pitch, rhythm, loudness).

Vestibular Cortical Area:

Located near the postcentral gyrus & insular region.

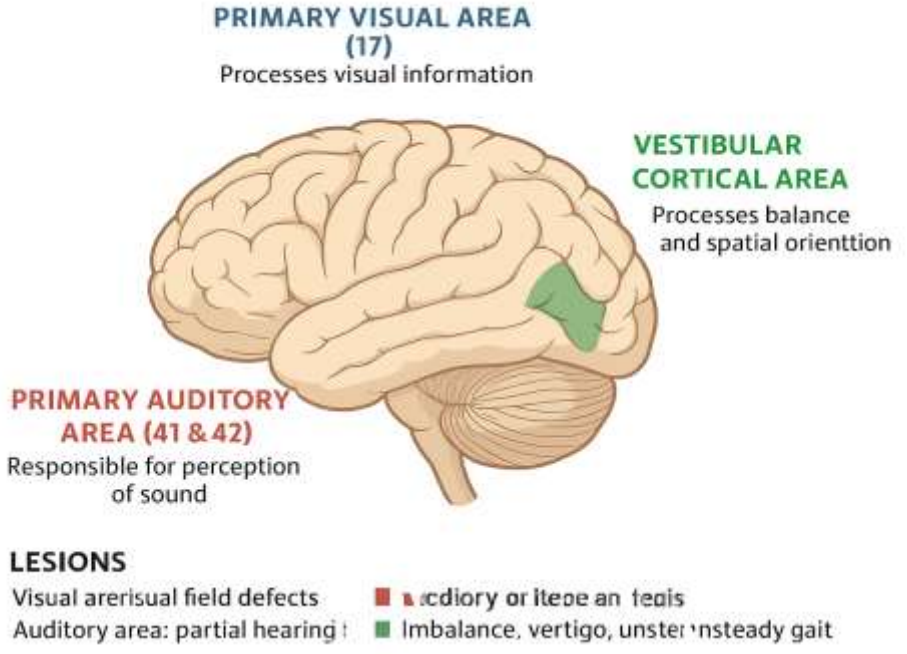
Integrates balance and spatial orientation.

Lesions:

Visual area: Causes visual field defects (e.g., hemianopia).

Auditory area: Partial hearing deficits (due to bilateral projections).

Vestibular area: Leads to imbalance, vertigo, unsteady gait.

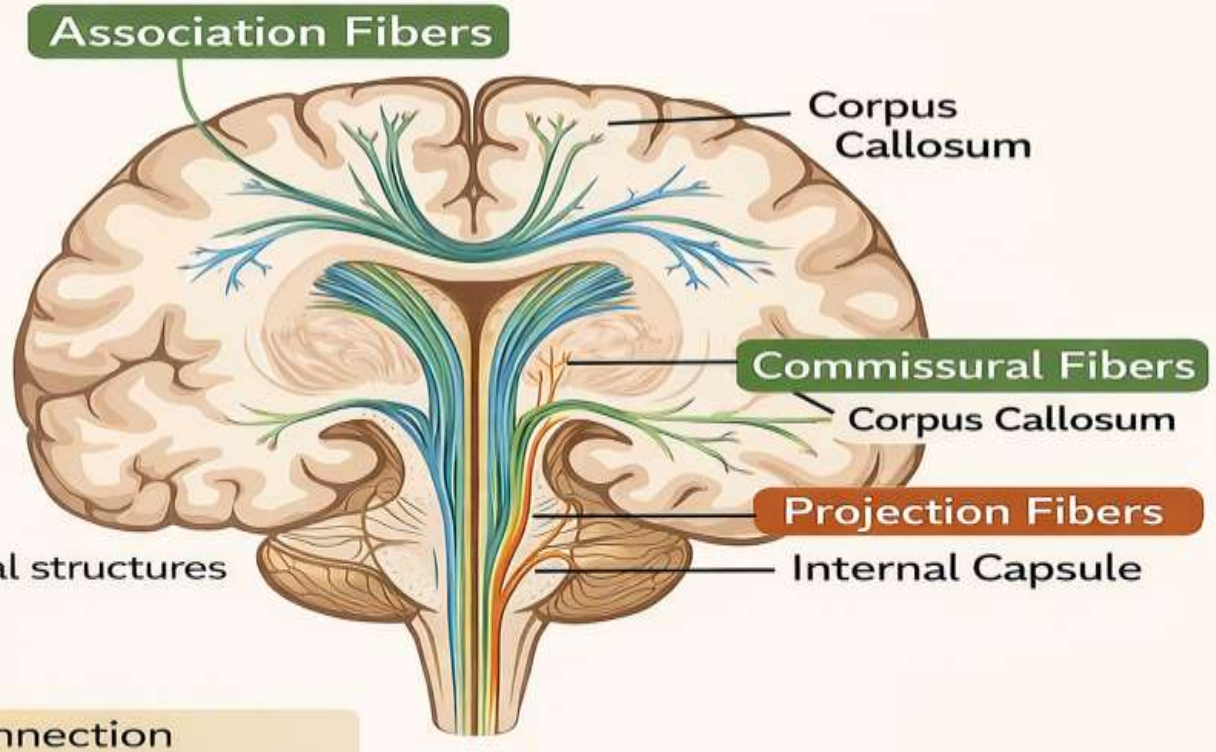


WHITE MATTER CONNECTIONS

- White matter consists of myelinated fibers enabling communication within the brain and with lower centers

Types of White Matter Fibers

- **Association Fibers**
  Connect cortical areas within same hemisphere
- **Commissural Fibers**
  Connect corresponding areas of both hemispheres
  Example: Corpus callosum
  Important for bilateral coordination
- **Projection Fibers**
  Connect cerebral cortex to subcortical structures
  Example: Internal capsule
  Carry motor and sensory pathways



Clinical Note – Lesions → Disconnection syndromes Seen in stroke, trauma, demyelinarders

Basal Nuclei

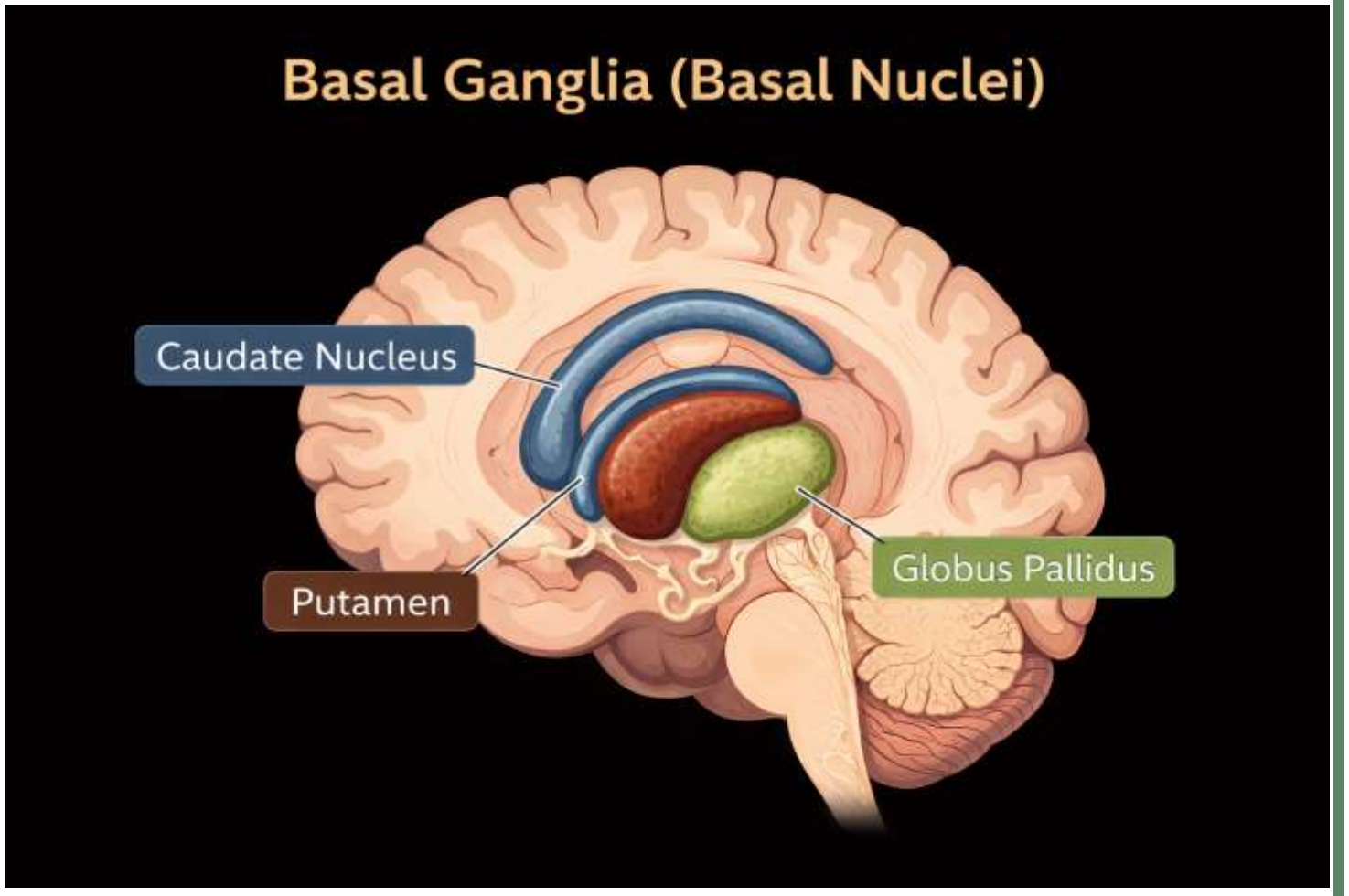
Includes caudate, putamen, globus pallidus.

Controls muscle tone & automatic movements.

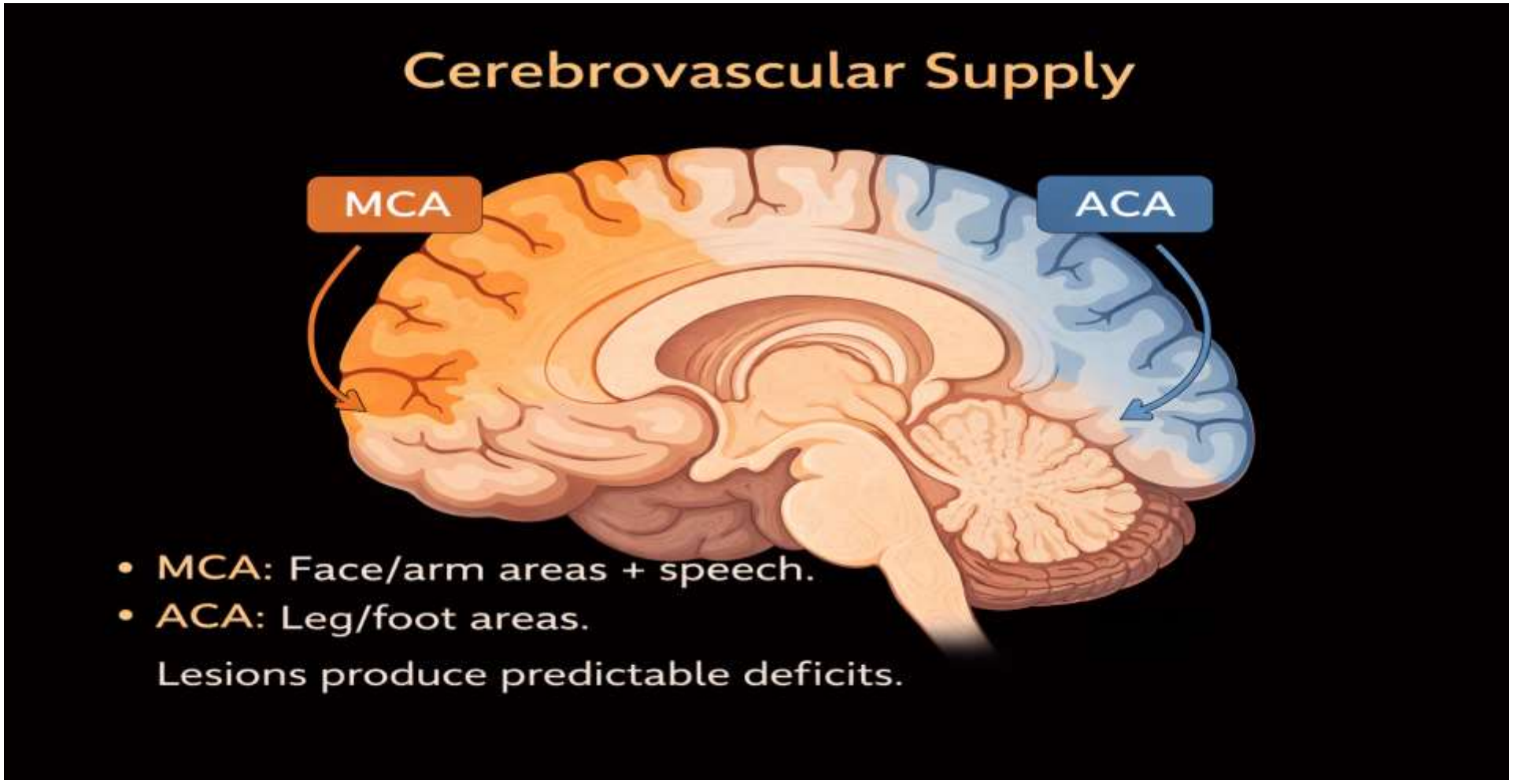
Basal Nuclei Disorders:

Parkinsonism: Dopamine loss → tremor, rigidity.

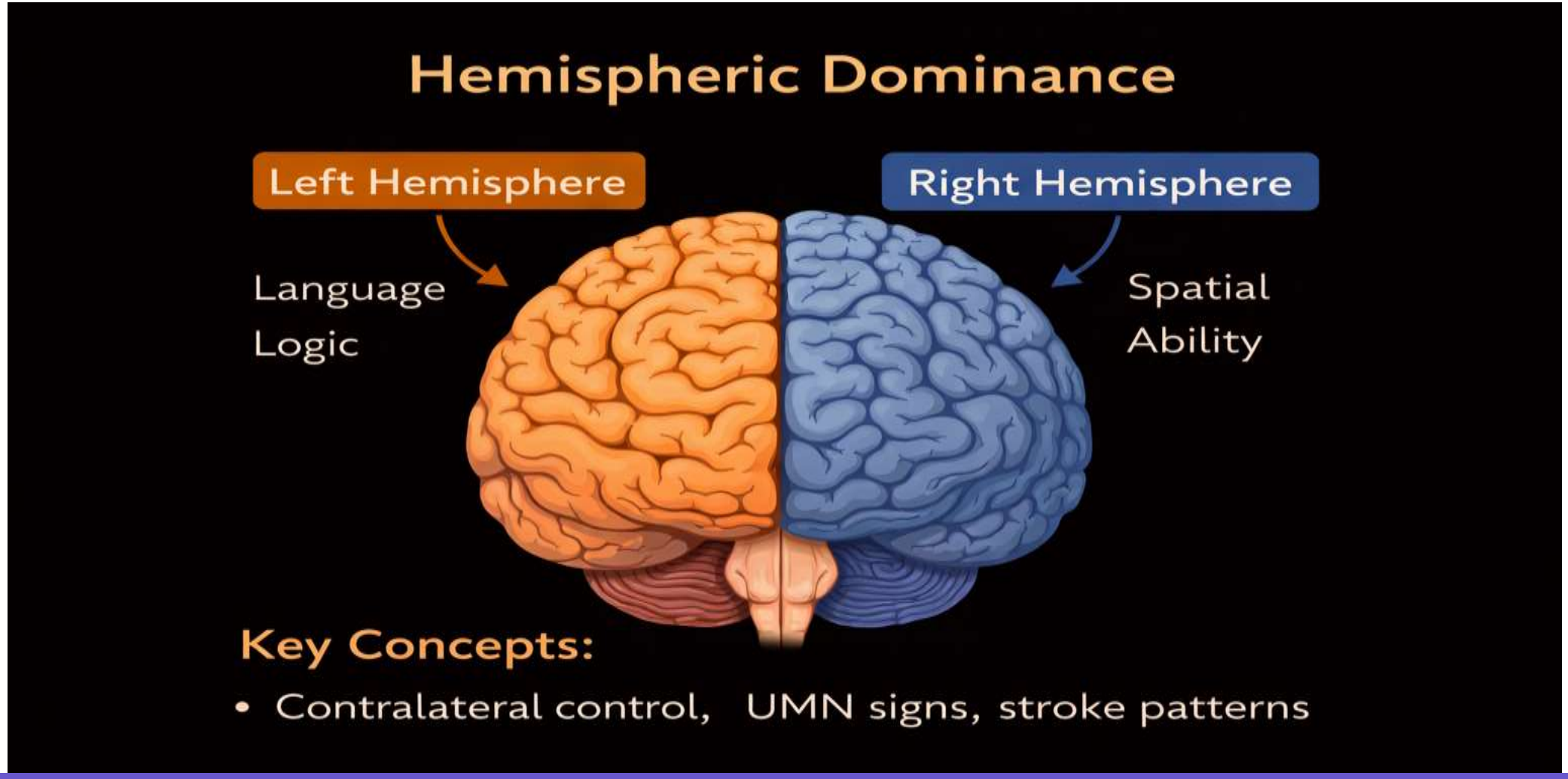
Ballism: Subthalamic lesion → violent movements.



Cerebrovascular Supply



Hemispheric Dominance



In Class Assessment

- Mr. Kumar, a 62-year-old right-handed male, was brought to the hospital with sudden onset weakness on the **right side of the body**. On examination, the following findings were noted:
- Right facial droop
- Weakness of right upper limb more than lower limb
- Difficulty in speech production
- Increased tone and exaggerated reflexes on the right side
- Sensory loss over right hand and face
- CT scan shows ischemic changes in the **left cerebral hemisphere**.

Question 1: Problem Identification

•Which **cerebral hemisphere** is affected?

•Is this the **dominant or non-dominant hemisphere**?

Question 2: Functional Analysis

•Identify **three cortical areas** likely involved based on symptoms.

•Link each symptom to the corresponding **lobe or cortical area**.

(Students must justify their reasoning — not just name the area)

Question 3: Vascular Decision Point

•Which **cerebral artery** is most likely occluded?

•Why are the **face and upper limb more affected than the lower limb**?