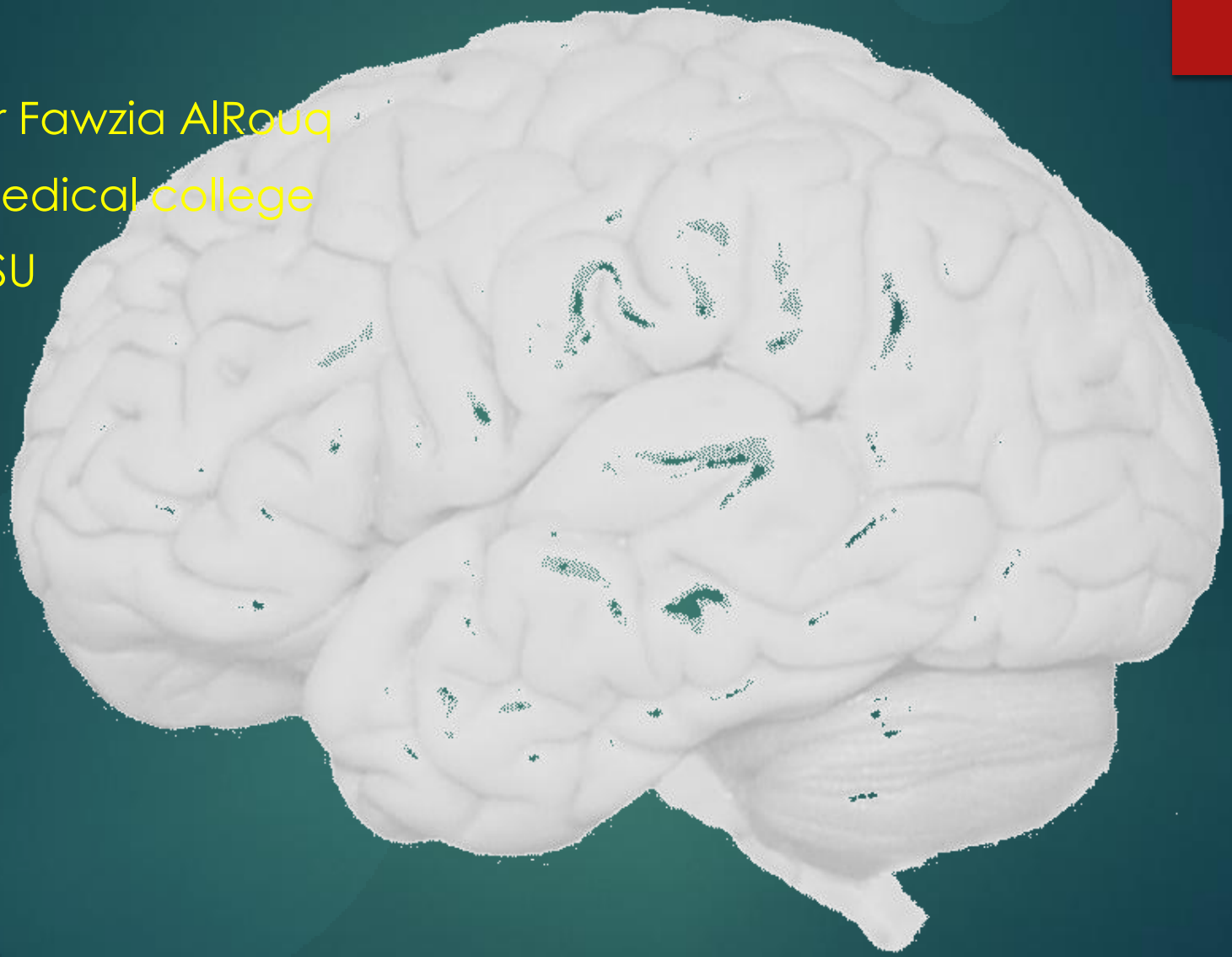
- Functions of The Cerebral Hemisphere

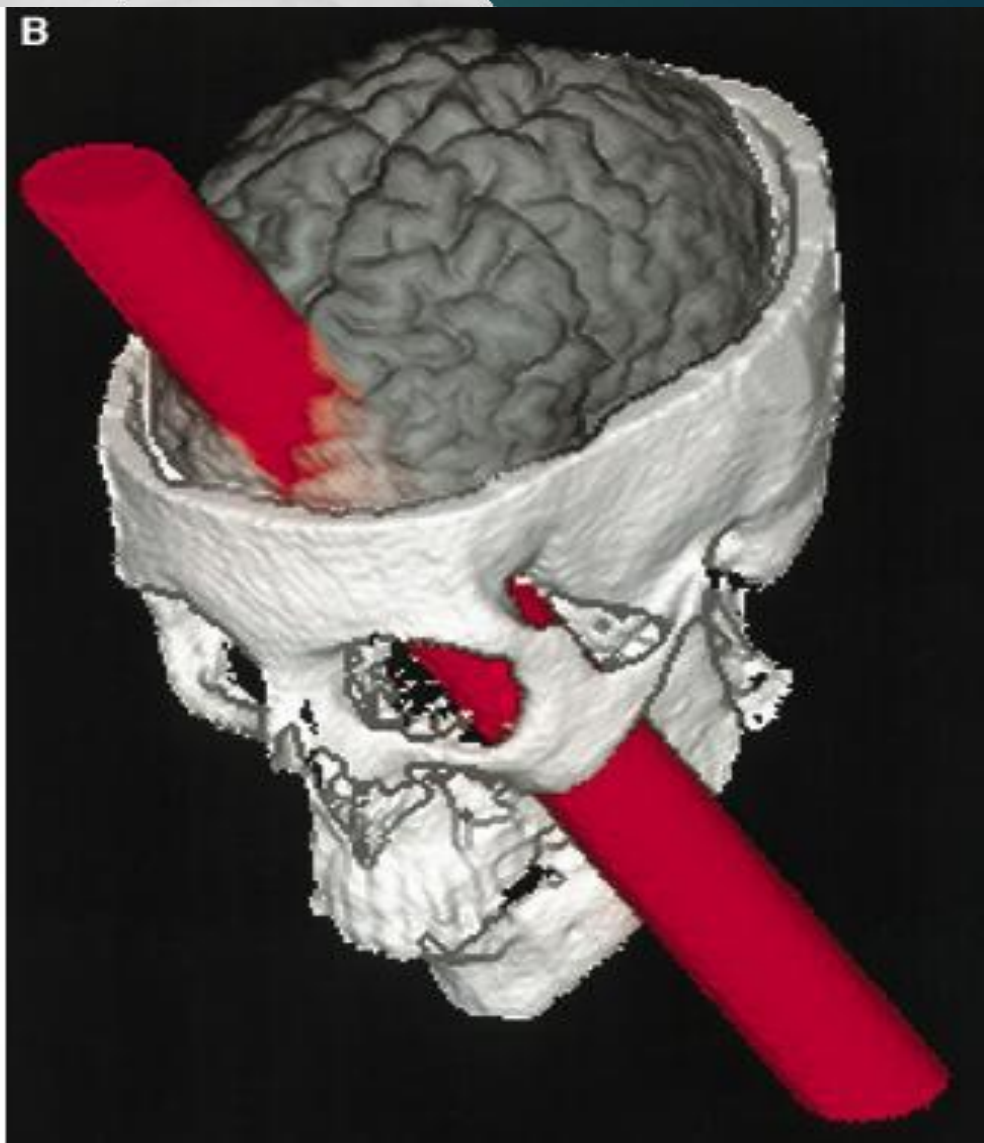
- Dr Fawzia AlRouq
- Medical college
- KSU




بسم الله الرحمن الرحيم

The Human Brain

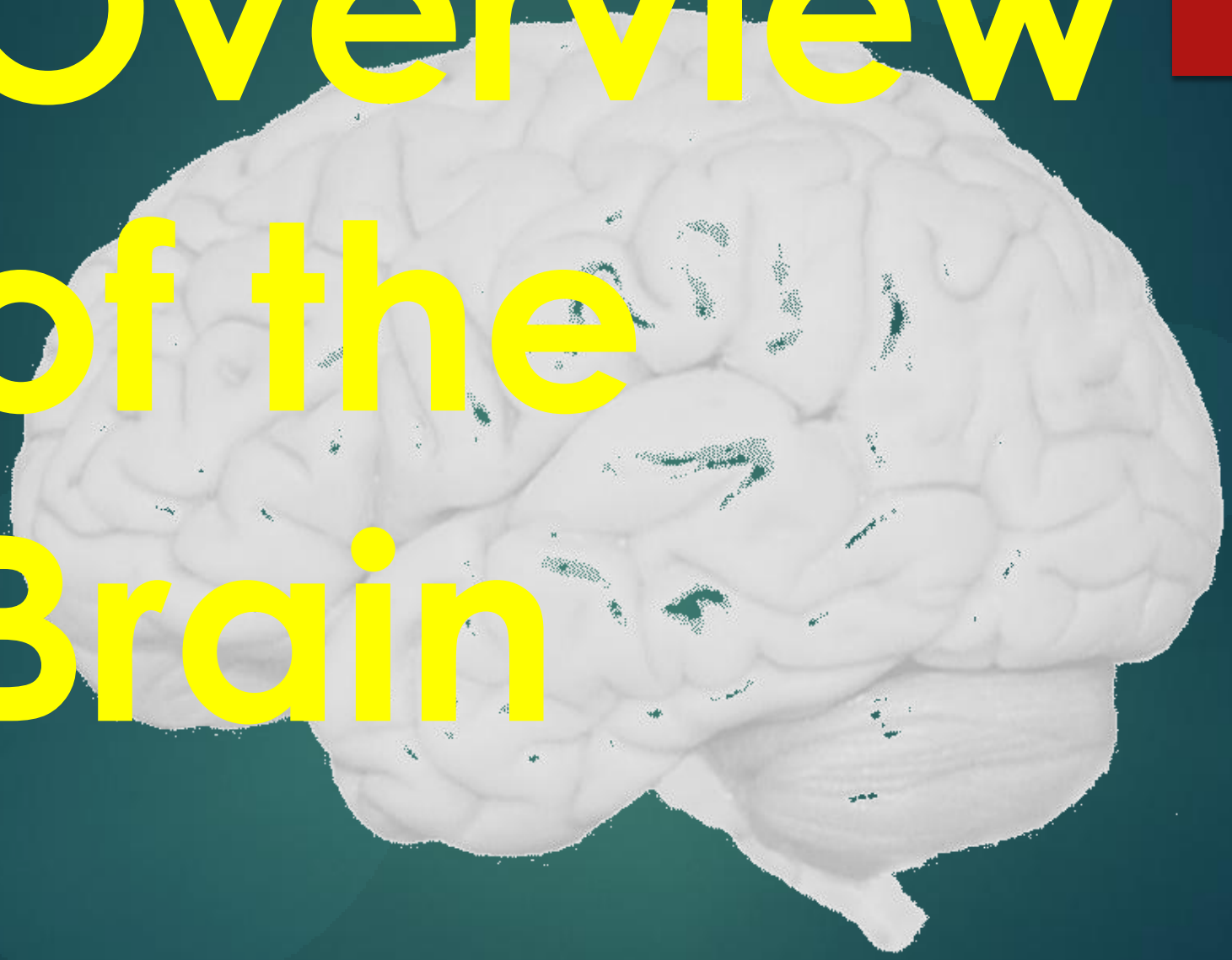
Phineas Gage



Phineas Gage

- In 1848 in Vermont, had a 3.5-foot-long, 13 lb. metal rod blown into his skull, through his brain, and out of the top of his head. Gage survived. In fact, he never even lost consciousness.
- Friends reported a complete change in his personality after the incident. He lost all impulse control.

Overview of the Brain



Components of The Brain

- **A/ Telencephalon →**

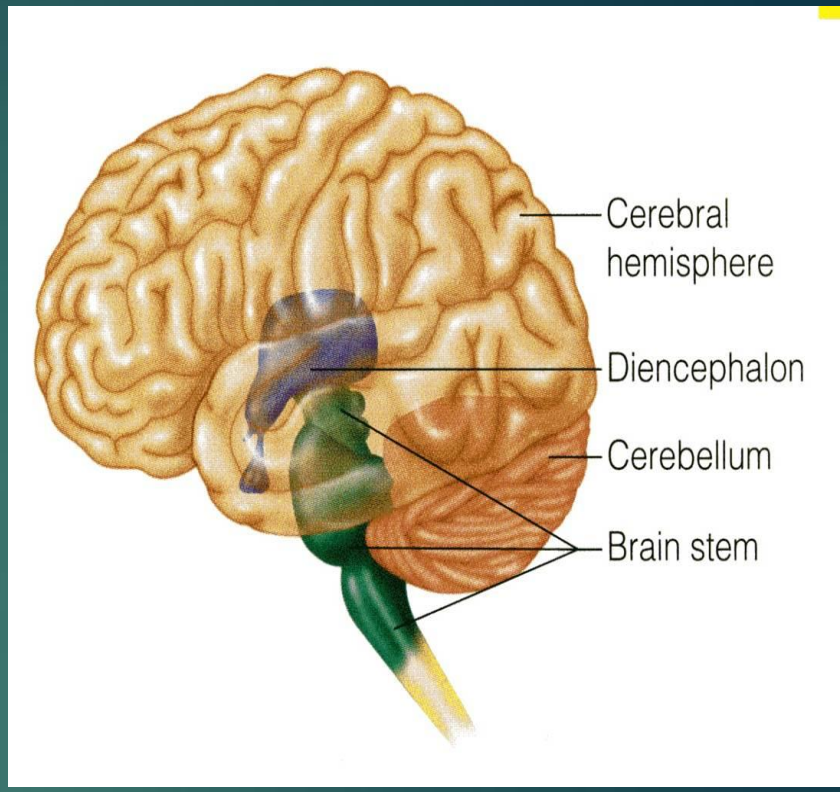
(1) Cerebrum and

(2) Basal Ganglia (collection of grey matter situated inside the cerebral hemispheres)

- **B/ Diencephalon →**
- Mainly :

(1) Thalamus (mainly a relay station for sensory pathways in their way to the cerebral cortex)

(2) Hypothalamus (contains cesnter for autonomic and endocrine control)



- **C/ Brainstem →**

(1) Midbrain

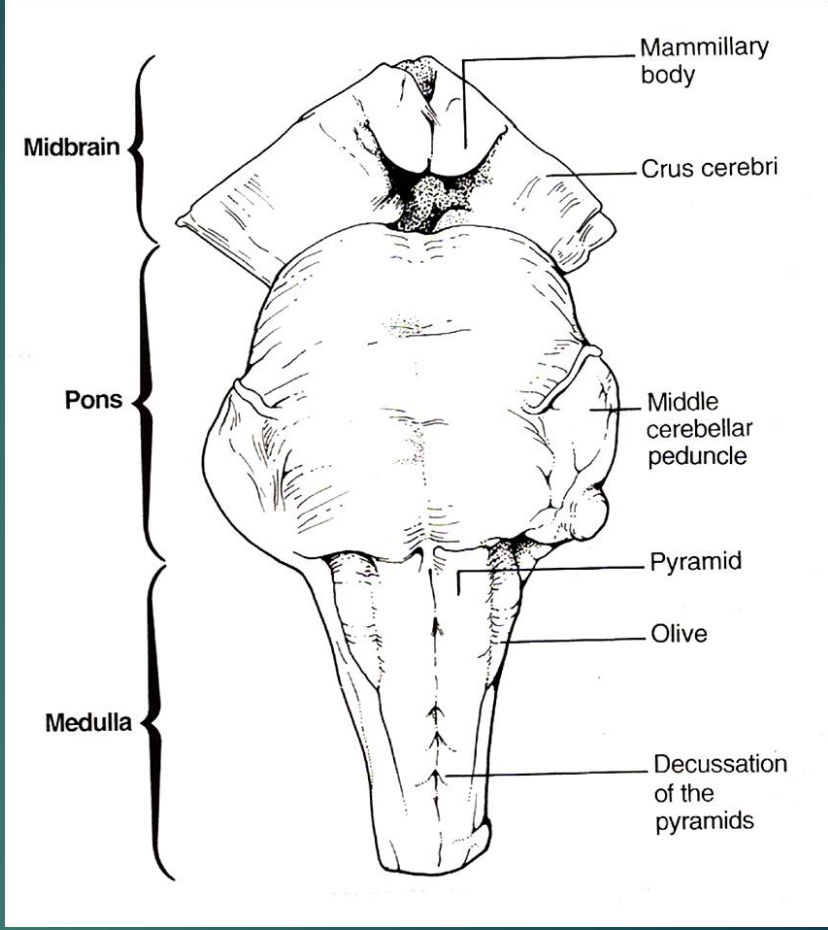
(2) Pons

(3) Medulla

- **E/ Cerebellum**

The Brainstem

- The term " brainstem " is actually an anatomic rather than physiologic term , because it is easier , in terms of anatomy , to group <u>" all CNS structures that hang between the cerebrum and spinal cord " together .</u>
- However , in terms of Physiology , the situation is more complicated , because brainstem structures are involved in many diverse & different bodily functions .



- These functions include
- (1) regulation of Consciousness , Wakefulness & Sleep ,
- (2) Respiratory , Cardiovascular and Gastrintestinal control ,
- (3) Balance (Vestibular nuclei) .
- (4) Moreover , it contain several Cranial Nerve nuclei .

,

- Most people (about 90 %) have the left cerebral hemisphere dominant , and are therefore right-handed .
- The remaining (around 10 %) of the population usually have their right hemisphere dominant , and are therefore left-handed .
- The frontal lobe of the dominant hemisphere contains Broca's area (the area for production of speech) .
- Therefore, if a right-handed person gets a stroke

  involving his left cerebral hemisphere , he is likely to have right-sided hemiplegia (paralysis) and aphasia (loss of the power of speech).

The Cerebrum

Lobes, the Cerebral Cortex, and Cortical Regions of the Brain

Objectives:

- Students will be able to describe the general structure of the Cerebrum and Cerebral Cortex.

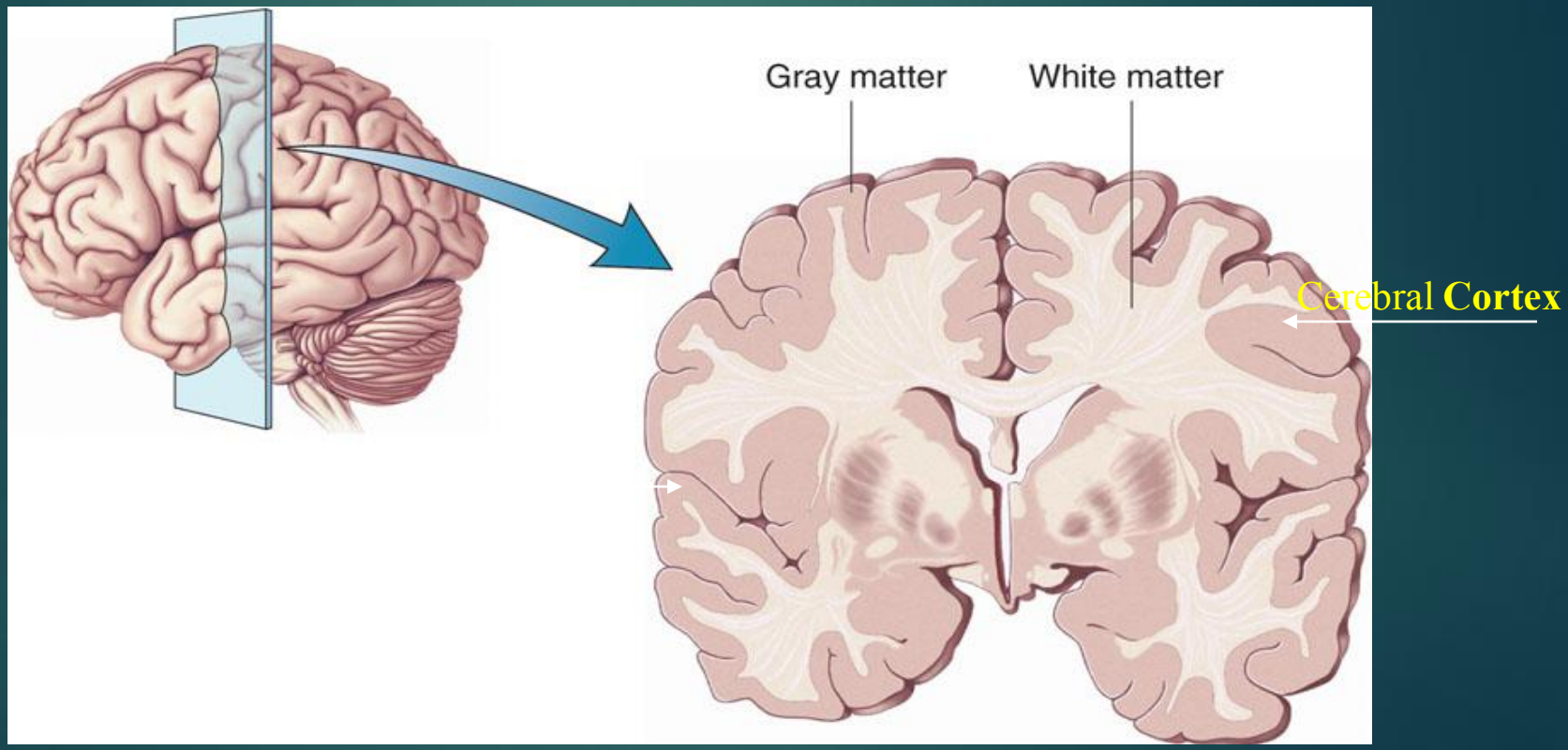
- Students will be able to identify the Cerebrum, the Lobes of the Brain, the Cerebral Cortex, and its major regions/divisions.

- Students will be able to describe the primary functions of the Lobes and the Cortical Regions of the Brain.

Cerebrum -The largest division of the brain. It is divided into two hemispheres, each of which is divided into four lobes

http://williamcalvin.com/BrainForAllSeasons/img/bonoboLH-humanLH-viaTWD.gif

Cerebral Cortex - The outermost layer of gray matter making up the superficial aspect of the cerebrum.



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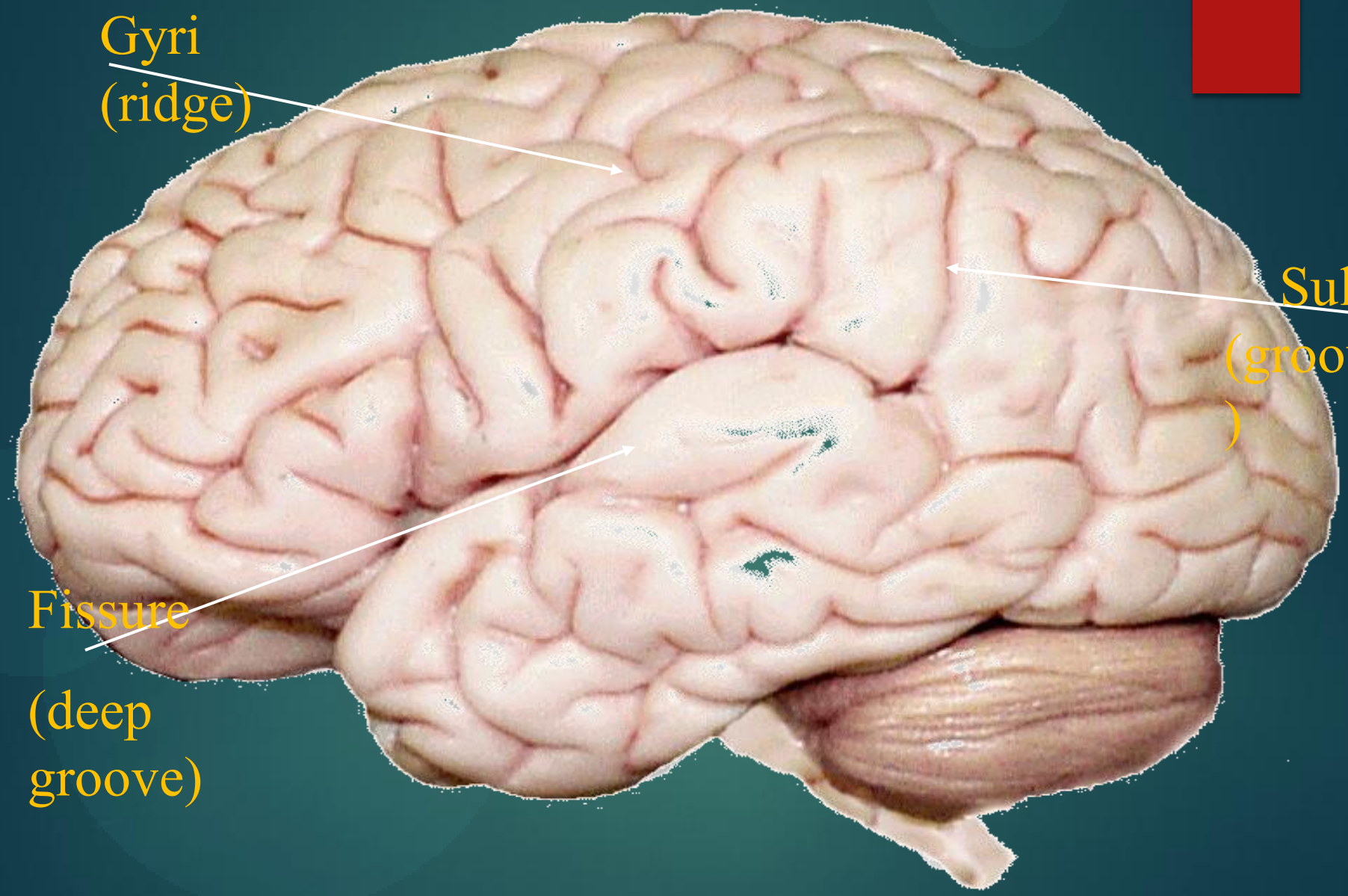
Cerebral Features:

- **Gyri** – Elevated ridges "winding" around the brain.
- **Sulci – Small grooves dividing the gyri**
  - **Central Sulcus – Divides the Frontal Lobe from the Parietal Lobe**
- **Fissures** – Deep grooves, generally dividing large regions/lobes of the brain
  - **Longitudinal Fissure** – Divides the two Cerebral Hemispheres
  - **Transverse Fissure** – Separates the Cerebrum from the Cerebellum
  - **Sylvian/Lateral Fissure** – Divides the Temporal Lobe from the Frontal and Parietal Lobes



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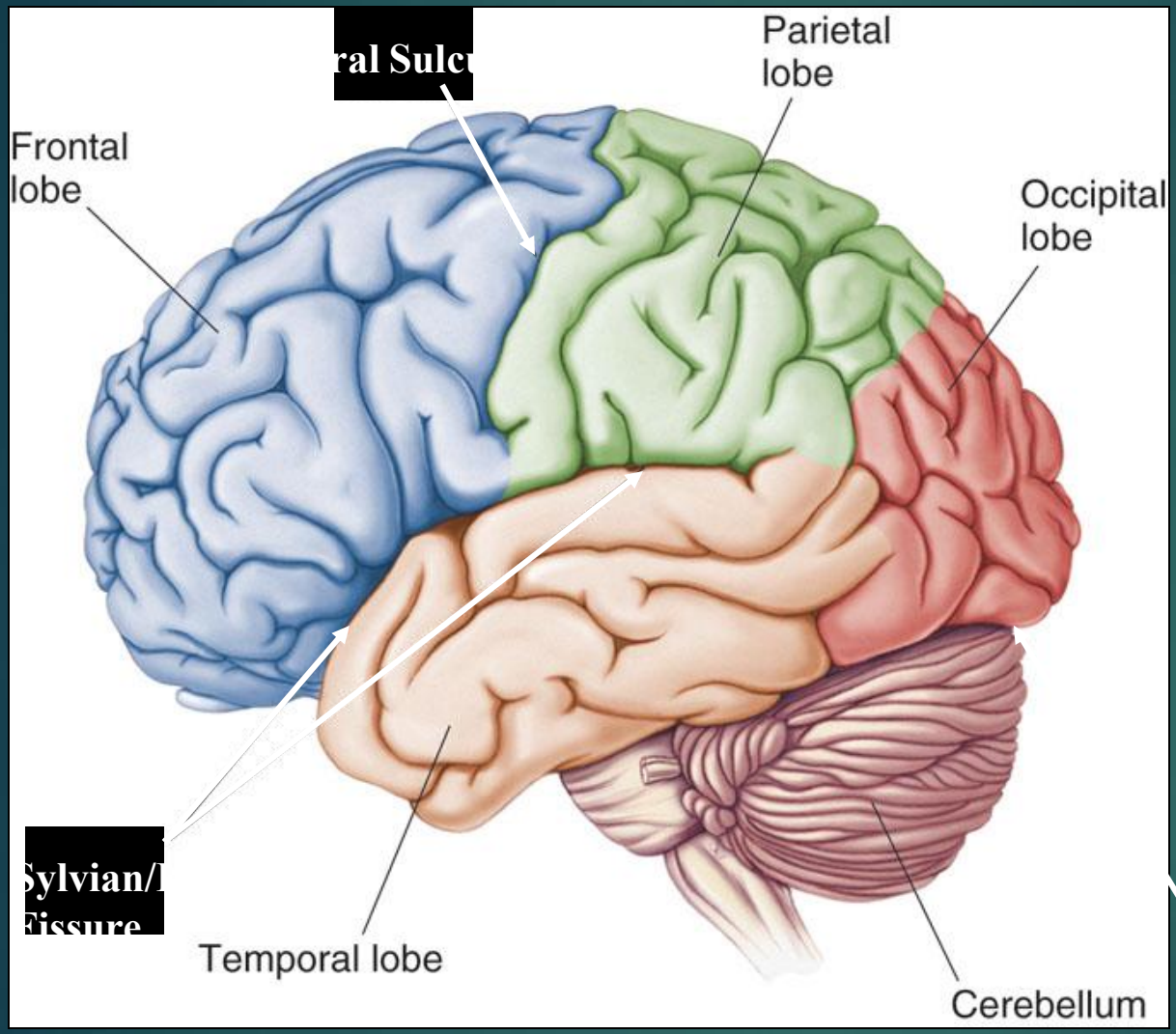
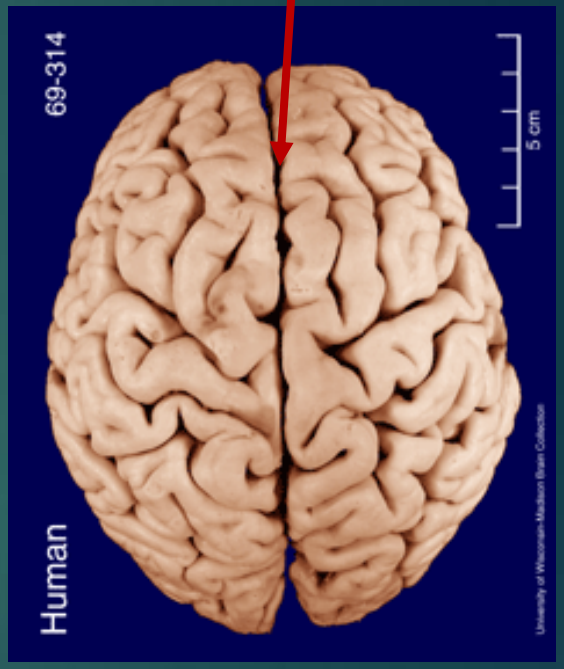
Specific Sulci/Fissures:



Longitudinal Fissure



Transverse Fissure

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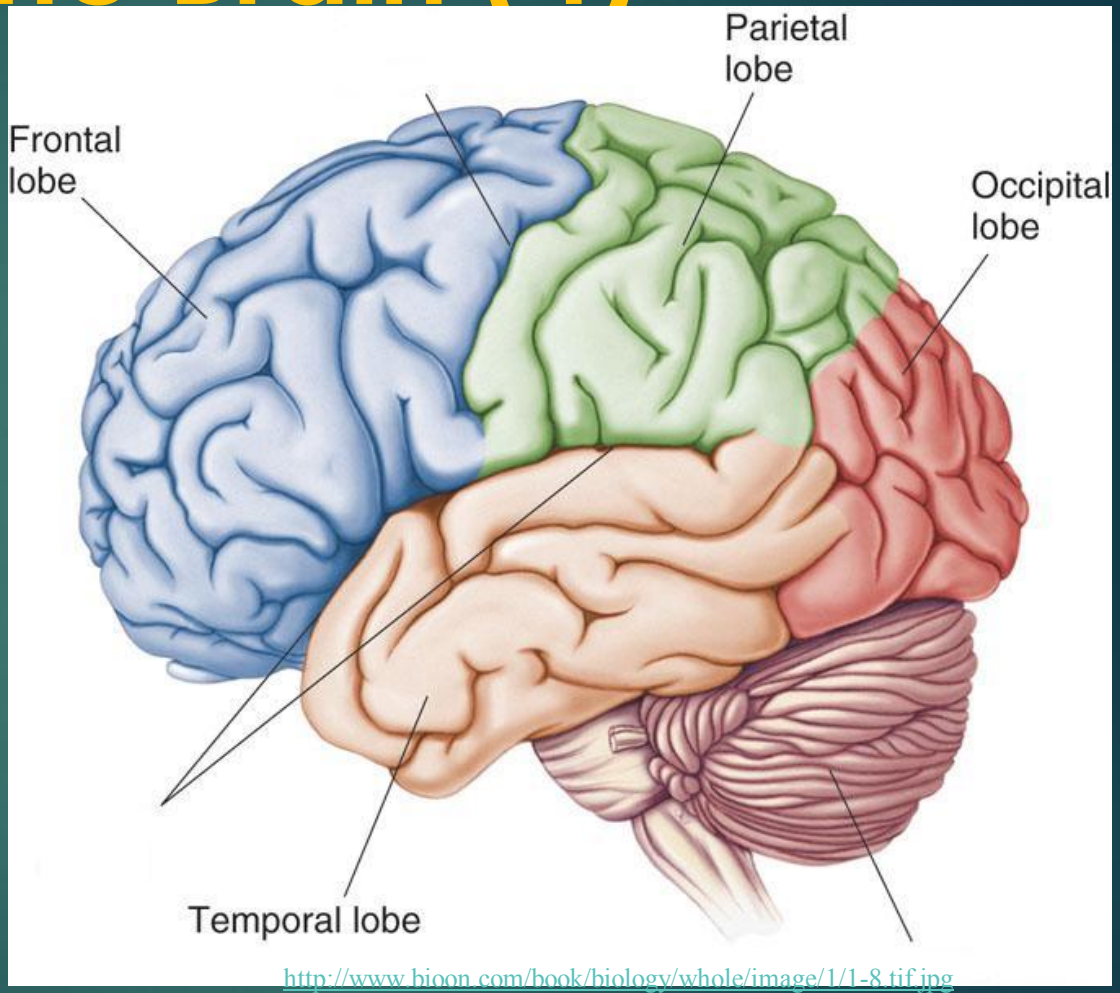
Lobes of the Brain (4)

- Frontal
- Parietal
- Occipital
- Temporal



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* Note: Occasionally, the Insula is considered the fifth lobe. It is located deep to the Temporal Lobe.

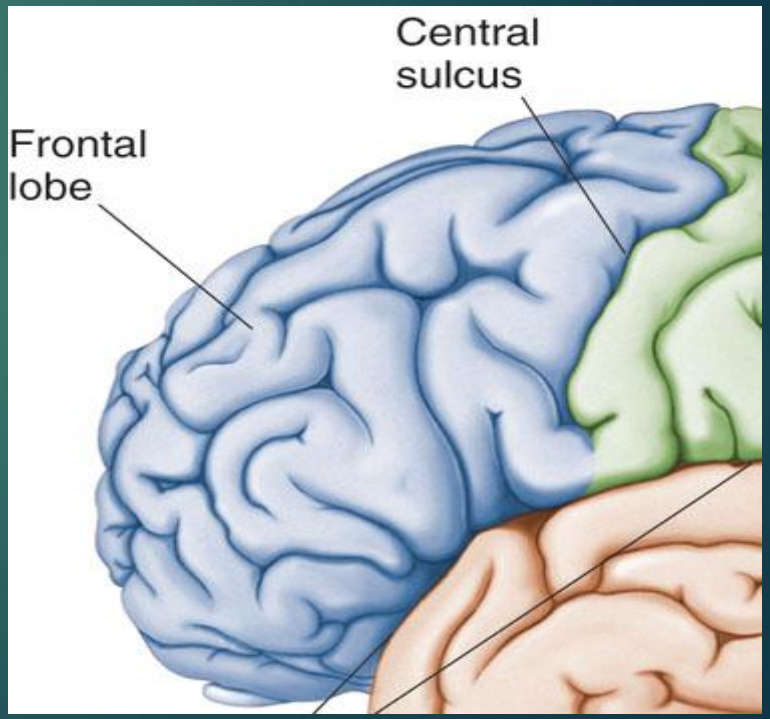
Lobes of the Brain - Frontal

- The Frontal Lobe of the brain is located deep to the Frontal Bone of the skull.

- It plays an integral role in the following functions/actions:

  - Memory Formation
  - Emotions
  - Decision Making/Reasoning
  - Personality

(Investigation: Phineas Gage)



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Frontal Lobe

- Responsible for initiation and execution of voluntary movement .
- Also contains Broca's area of speech in the dominnat hemisphere (i.e., in the left hemisphere in most people) .
- Lesion can cause →

(1) paralysis on opposite side of the body ,

(2) aphasia (loss of ability to speak) if lesion involves Broca's area in the dominant hemisphere) .

Frontal Lobe - Cortical Regions

- **Primary Motor Cortex (Precentral Gyrus) – Cortical site involved with controlling movements of the body.**

- **Broca's Area – Controls facial neurons, speech, and language comprehension. Located on *Left* Frontal Lobe.**

– **Broca's Aphasia** – Results in the ability to comprehend speech, but the decreased motor ability (or inability) to speak and form words.

- **Orbitofrontal Cortex – Site of Frontal Lobotomies**

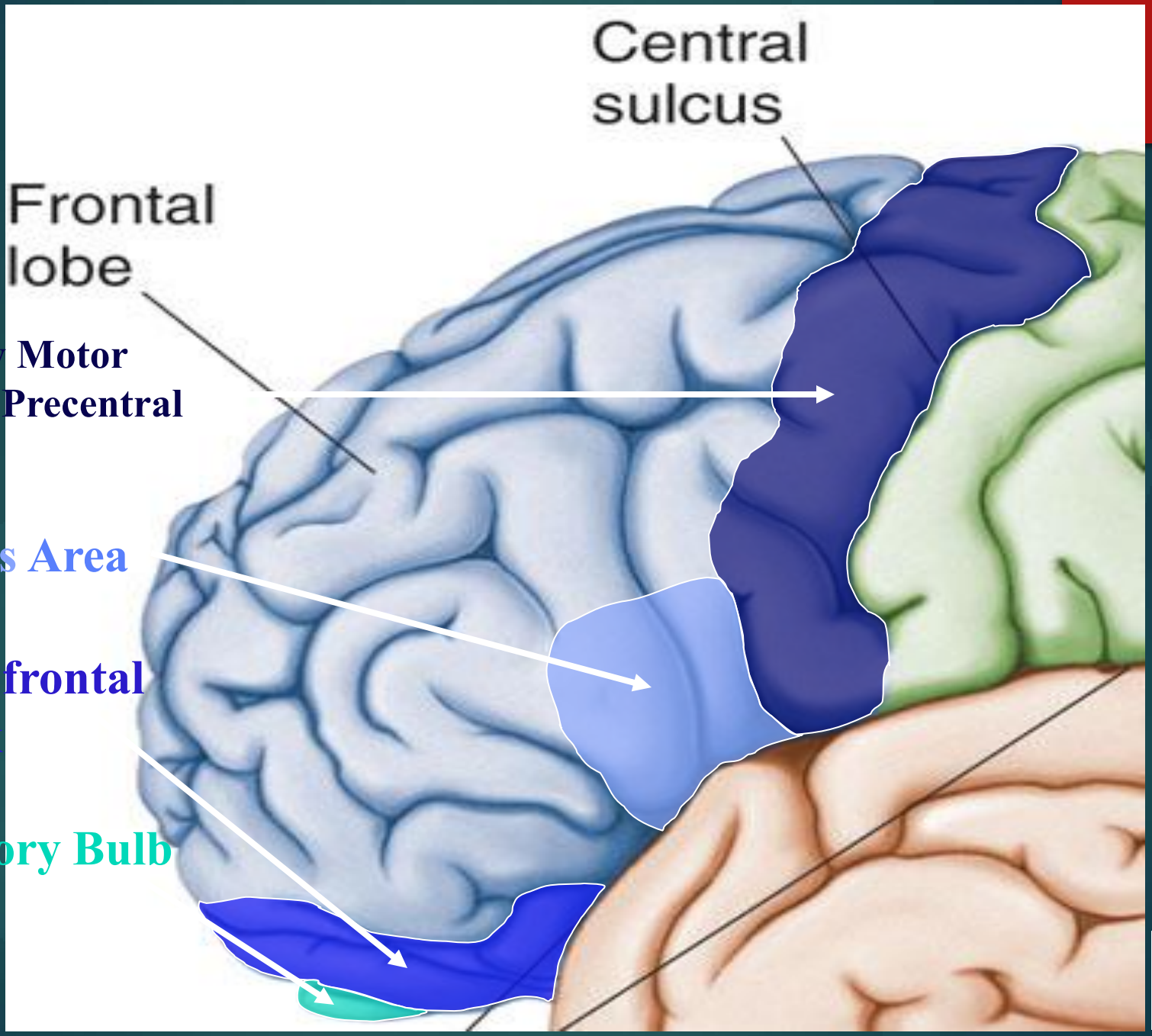
* **Desired Effects:**

- **Diminished Rage**
- **Decreased Aggression**
- **Poor Emotional Responses**

* **Possible Side Effects:**

- Epilepsy
- Poor Emotional Responses
- Perseveration (Uncontrolled, repetitive actions, gestures, or words)

- **Olfactory Bulb** - Cranial Nerve I, Responsible for sensation of Smell



Primary Motor Cortex/ Precentral Gyrus

Broca's Area

Orbitofrontal Cortex

Olfactory Bulb

Regions

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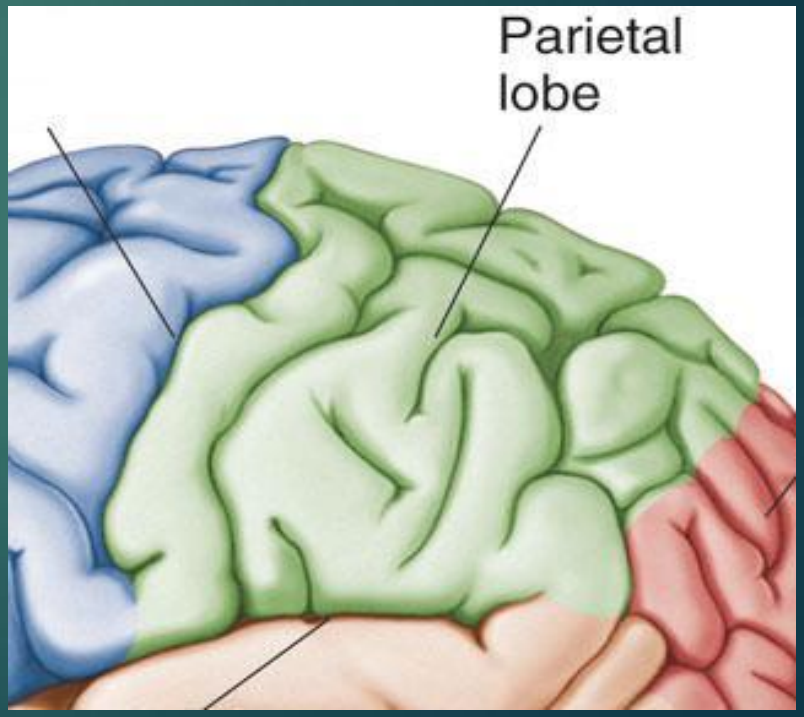
Lobes of the Brain - Parietal Lobe

- The Parietal Lobe of the brain is located deep to the Parietal Bone of the skull.

- It plays a major role in the following functions/actions:
  - Senses and integrates sensation(s)
  - Spatial awareness and perception
    (Proprioception - Awareness of body/ body parts in space and in relation to each other)



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Parietal Lobe - Cortical Regions

- **Primary Somatosensory Cortex (Postcentral Gyrus)** – Site involved with processing of tactile and proprioceptive information.

- **Somatosensory Association Cortex - Assists with the integration and interpretation of sensations relative to body position and orientation in space. May assist with visuo-motor coordination.**

- **Primary Gustatory Cortex – Primary site involved with the interpretation of the sensation of Taste.**

Parietal Lobe

Contains →

- (1) Primary Somatosensory in the post-central gyrus → to receive general sensations from opposite

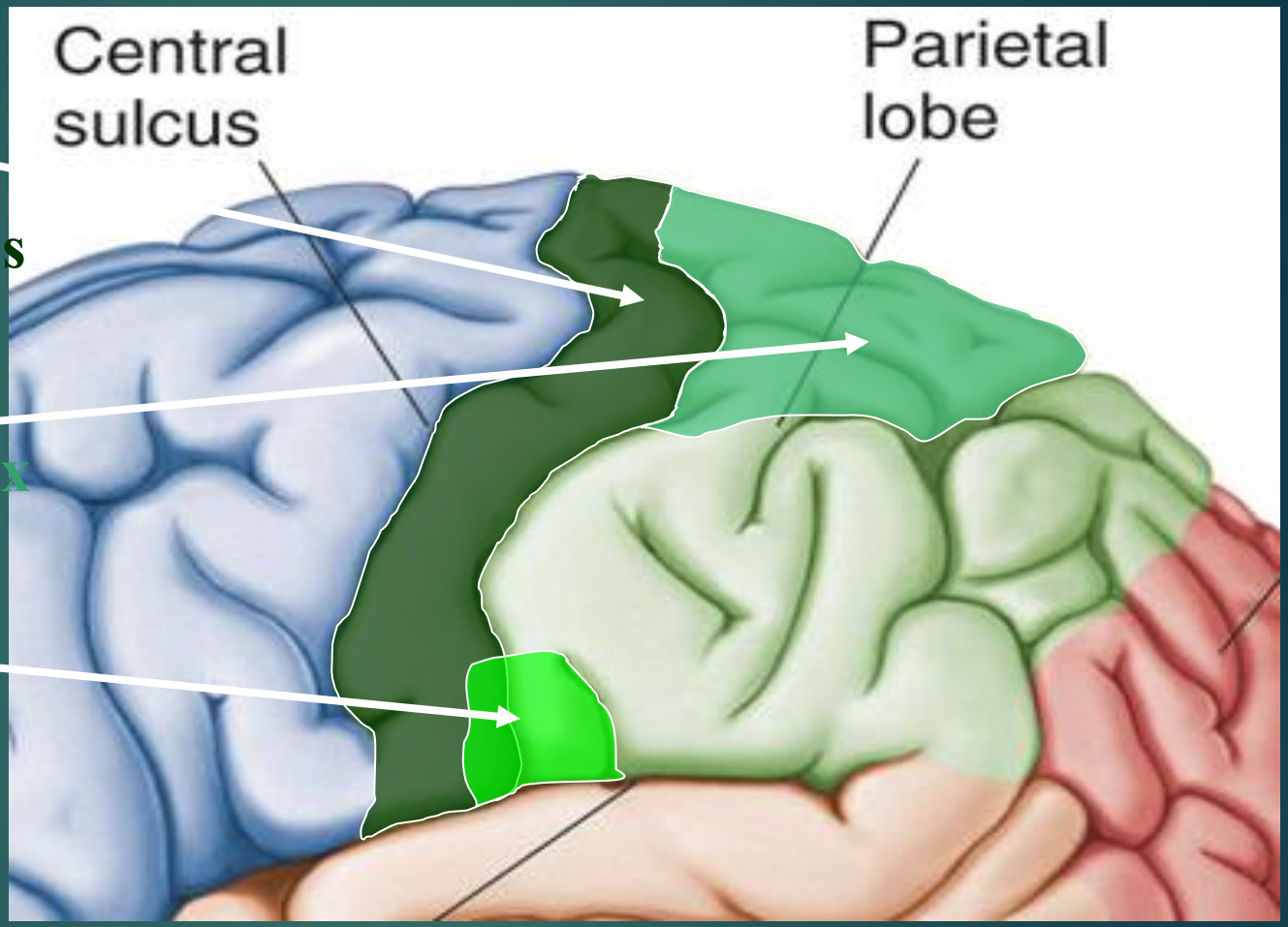
  (contralateral) half of the body
- (2) Sensory Association Cortex

  (for integration & association of sensory information)
- Parietal lobe is essential for our feeling of touch, warmth/heat , cold, pain , body position and appreciation of shapes of palpated objects .
- When damaged , the person loses the ability to recognize shapes of complex objects by palpation (palpation = examaination of objects by touch) .
- & develops Sensory Inattention on opposite side

Primary Somatosensory Cortex/ Postcentral Gyrus

Somatosensory Association Cortex

Primary Gustatory Cortex



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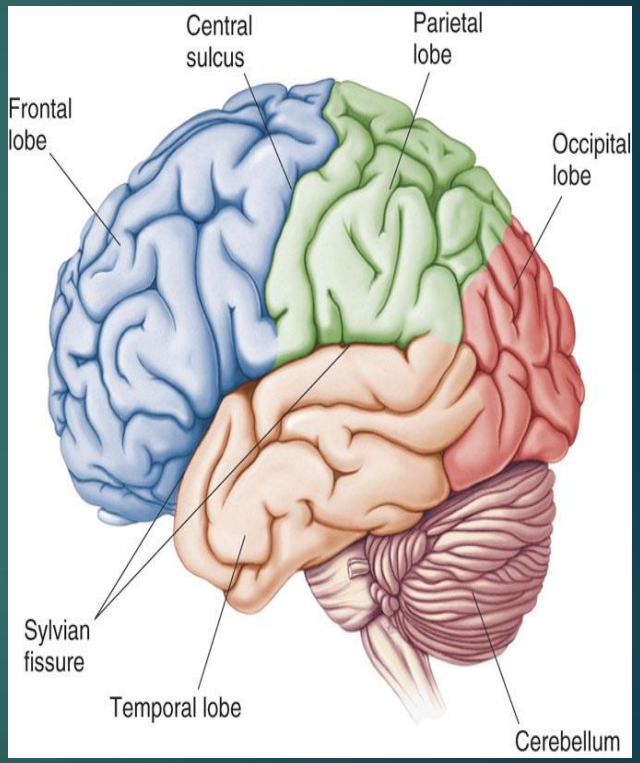
Regions

Lobes of the Brain – Occipital Lobe

- The Occipital Lobe of the Brain is located deep to the Occipital Bone of the Skull.
- Its primary function is the processing, integration, interpretation, etc. of VISION and visual stimuli.



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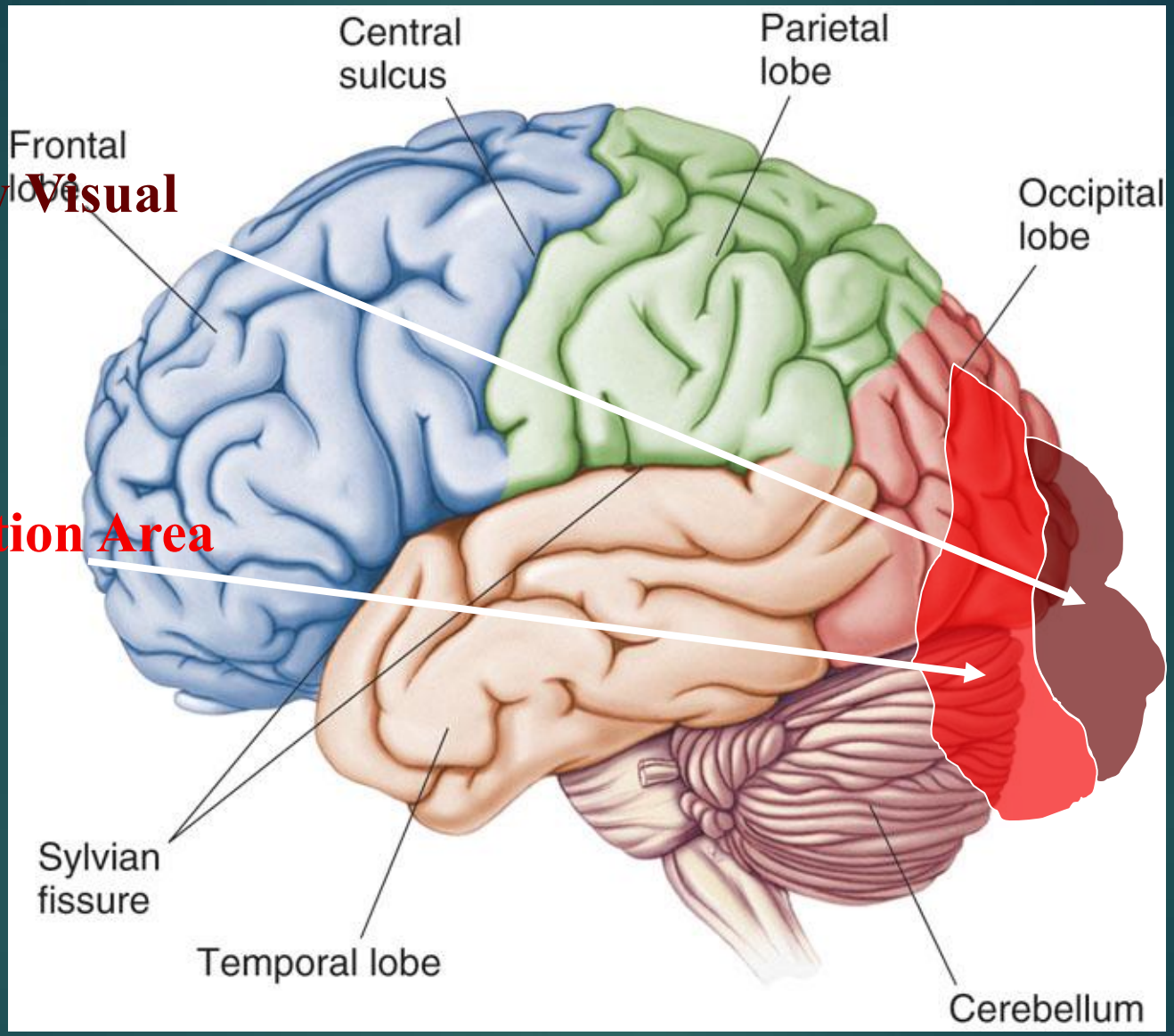
Occipital Lobe – Cortical Regions

- Primary Visual Cortex – This is the primary area of the brain responsible for sight - recognition of size, color, light, motion, dimensions, etc.

- Visual Association Area – Interprets information acquired through the primary visual cortex.

Primary Visual Cortex

Visual Association Area



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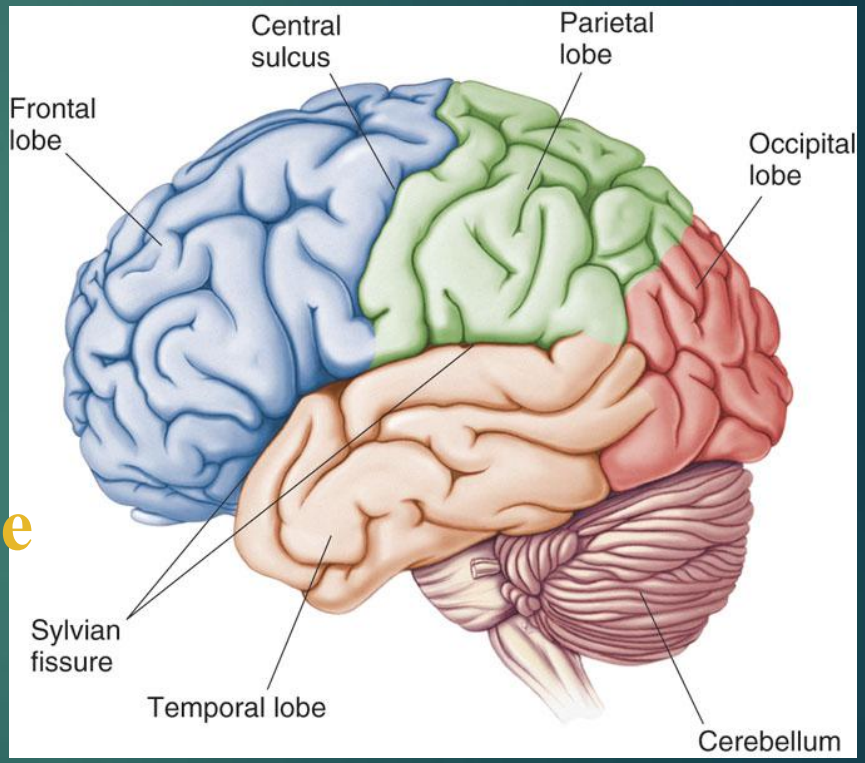
Regions

Lobes of the Brain – Temporal Lobe

- The Temporal Lobes are located on the sides of the brain, deep to the Temporal Bones of the skull.



- They play an integral role in the following functions:
  - Hearing
  - Organization/Comprehension of language
  - Information Retrieval (Memory and Memory Formation)

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Temporal Lobe – Cortical Regions

- Primary Auditory Cortex – Responsible for hearing

- Primary Olfactory Cortex – Interprets the sense of smell once it reaches the cortex via the olfactory bulbs. (Not visible on the superficial cortex)

- Wernicke's Area – Language comprehension. Located on the *Left* Temporal Lobe.

  - Wernicke's Aphasia – Language comprehension is inhibited. Words and sentences are not clearly understood, and sentence formation may be inhibited or non-sensical.

Temporal Lobe

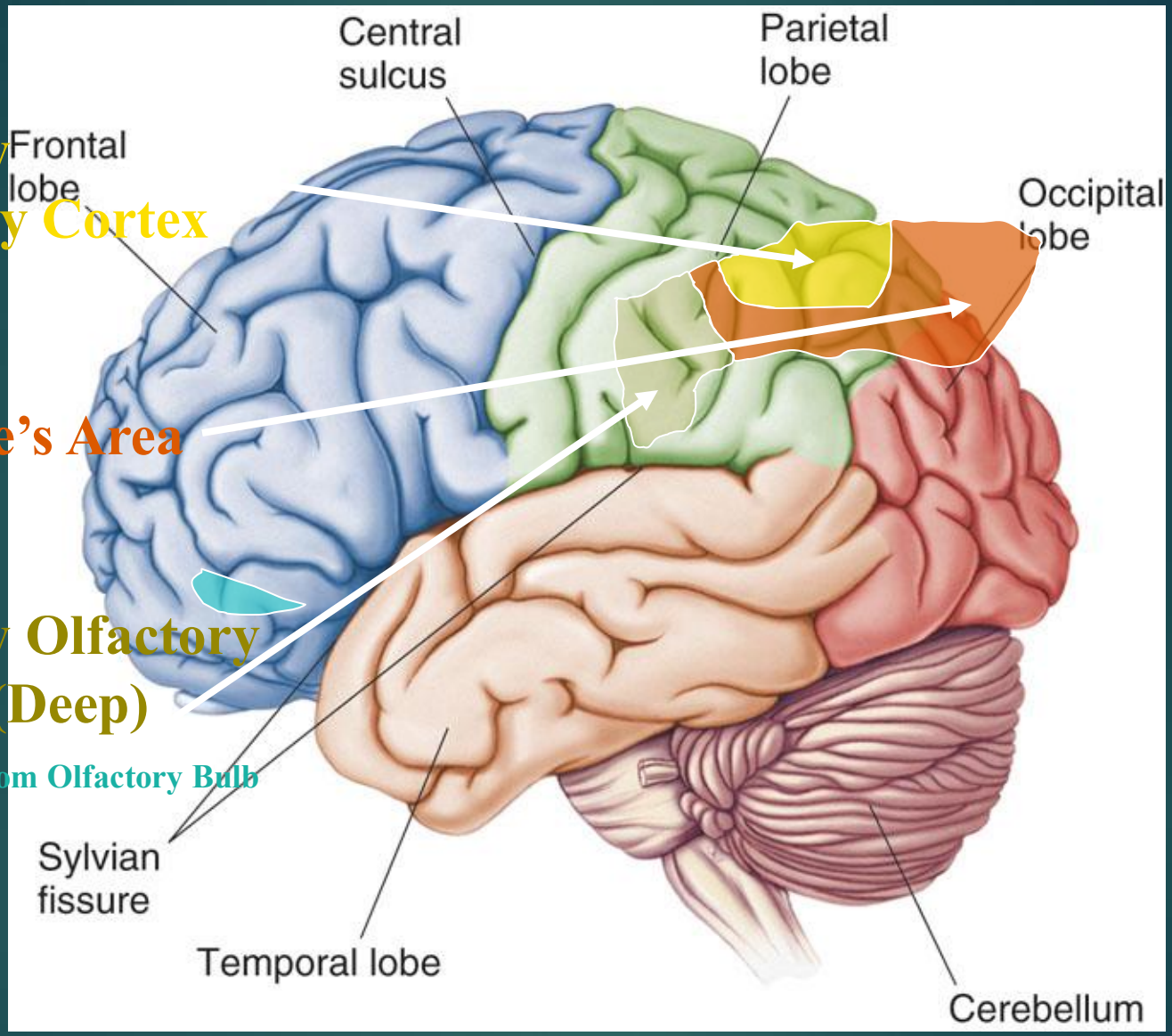
- (1) contain centers for hearing and taste ,
- (2) contribute to smell perception .
- (3) essential for memory function .
- (4) lesion → may lead to memory impairment & can be associated with temporal lobe epilepsy

Primary Auditory Cortex

Wernike's Area

Primary Olfactory Cortex (Deep)

Conducted from Olfactory Bulb



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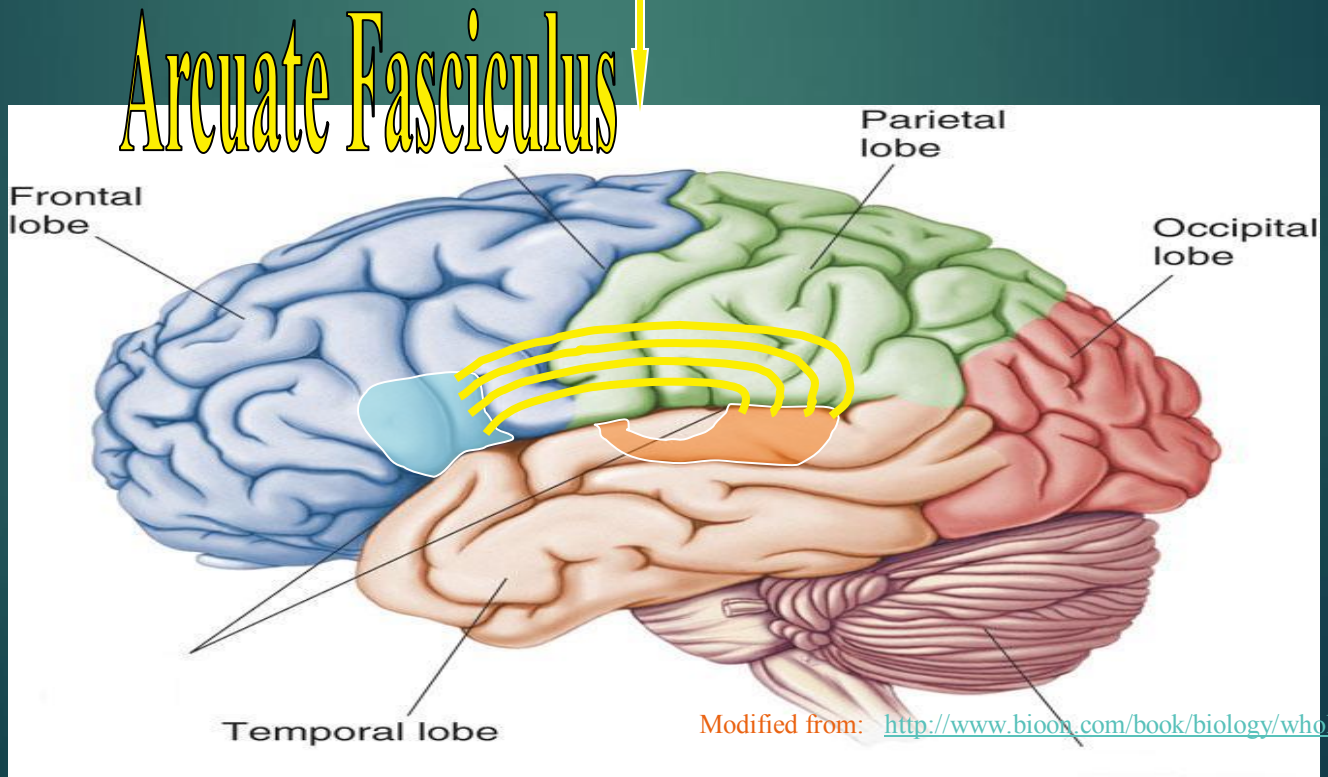
Regions

- **Arcuate Fasciculus** - A white matter tract that connects Broca's Area and Wernicke's Area through the Temporal, Parietal and Frontal Lobes. Allows for coordinated, comprehensible speech. Damage may result in:

- **Conduction Aphasia** - Where auditory comprehension and speech articulation are preserved, but people find it difficult to repeat heard speech.



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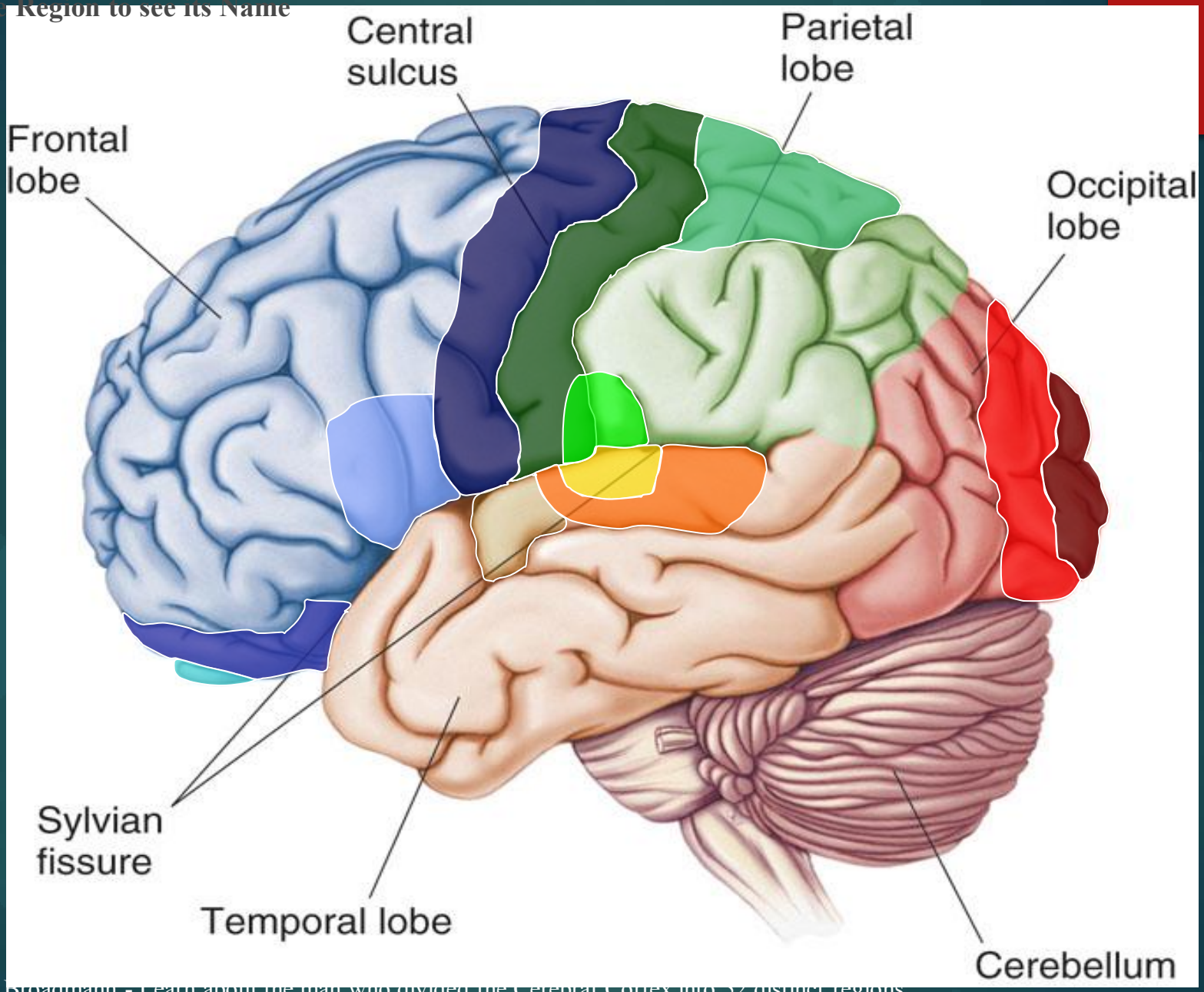
Click the Region to see its Name



Korbinian Broadmann - Learn about the man who divided the Cerebral Cortex into 52 distinct regions.
http://en.wikipedia.org/wiki/Korbinian_Brodmann

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Functional Principles of the Cerebral hemispheres

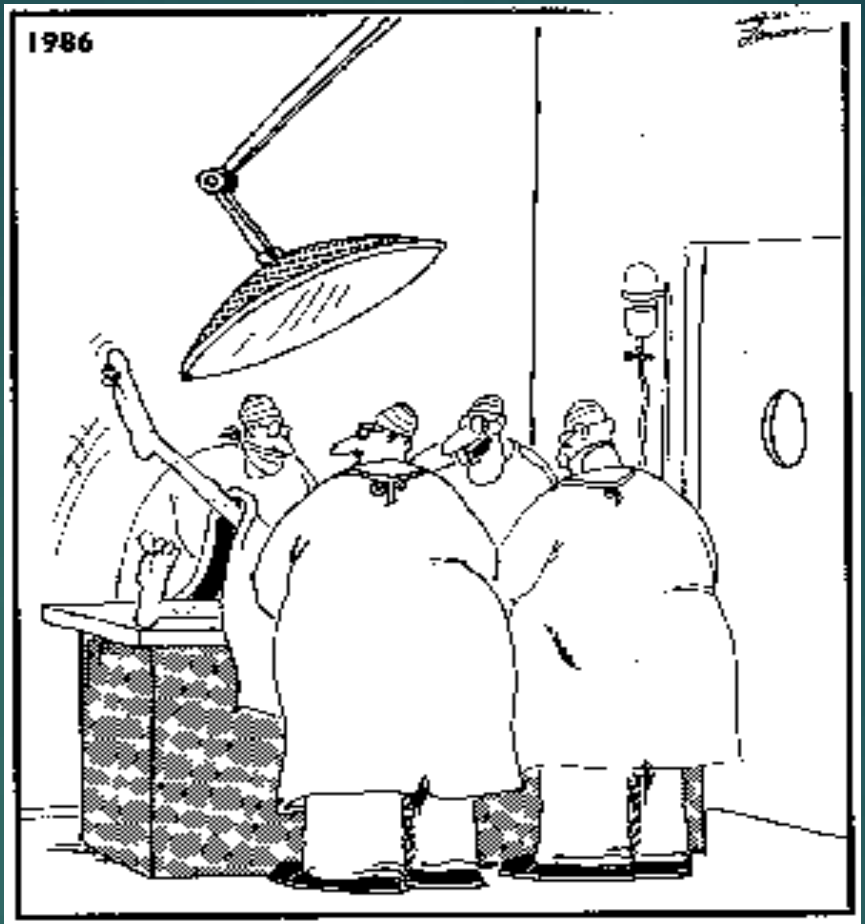
1. Each cerebral hemisphere receives sensory information from, and sends motor commands to, the <u>opposite side of body</u>
2. The 2 hemispheres have somewhat different functions although their structures are alike
3. Correspondence between a specific function and a specific region of cerebral cortex is not precise
4. No functional area acts alone; conscious behavior involves the entire cortex

Higher level: Prefrontal Cortex

- Most complicated region, coordinates info from all other association areas
- Important in intellect, planning, reasoning, mood, abstract ideas, judgement, conscience, and accuratley predicting consequences
- Phineas Gage?

Hemispheric Lateralization

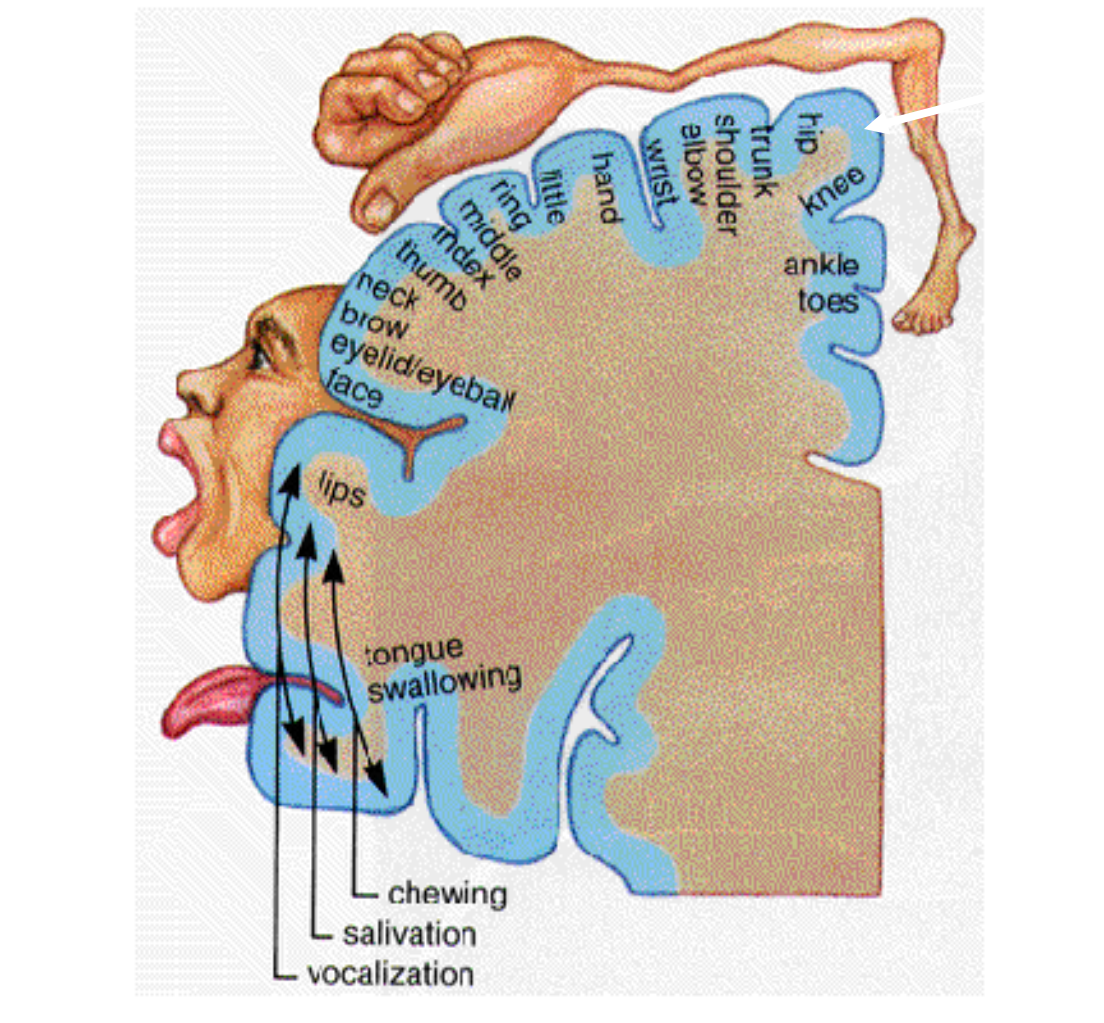
- Functional differences between left and right hemispheres
- In most people, left hemisphere (dominant hemisphere) controls:
  - reading, writing, and math, decision-making, logic, speech and language (usually)
- Right cerebral hemisphere relates to:
  - recognition (faces, voice inflections), affect, visual/spatial reasoning, emotion, artistic skills



"Whoa! *That* was a good one! Try it, Hobbs—just poke his brain right where my finger is."

Q: Assuming this comical situation was factually accurate, what Cortical Region of the brain would these doctors be stimulating?

A: Primary Motor Cortex



* This graphic representation of the regions of the Primary Motor Cortex and Primary Sensory Cortex is one example of a HOMUNCUL

Homunculus