

**BASIC AND PRACTICAL SURGICAL
CRANIAL NEUROANATOMY
BASIC AND PRACTICAL SURGICAL
BRAIN FUNCTION**

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BASIC NEUROSURGICAL CEREBRAL ANATOMY

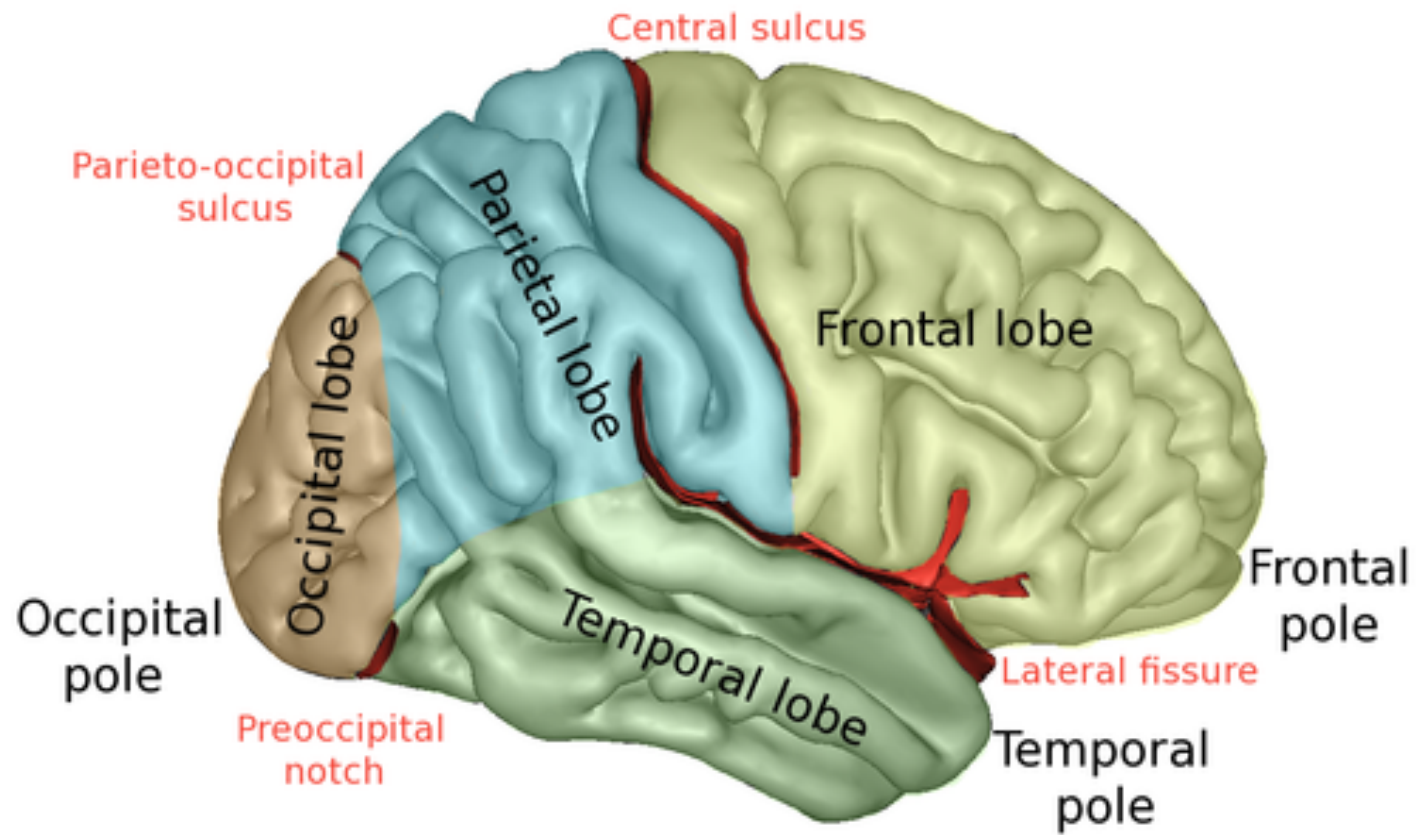
- **SUPRATENTORIAL**

- FRONTAL LOBE
- PARIETAL LOBE
- OCCIPITAL LOBE
- TEMPORAL LOBE

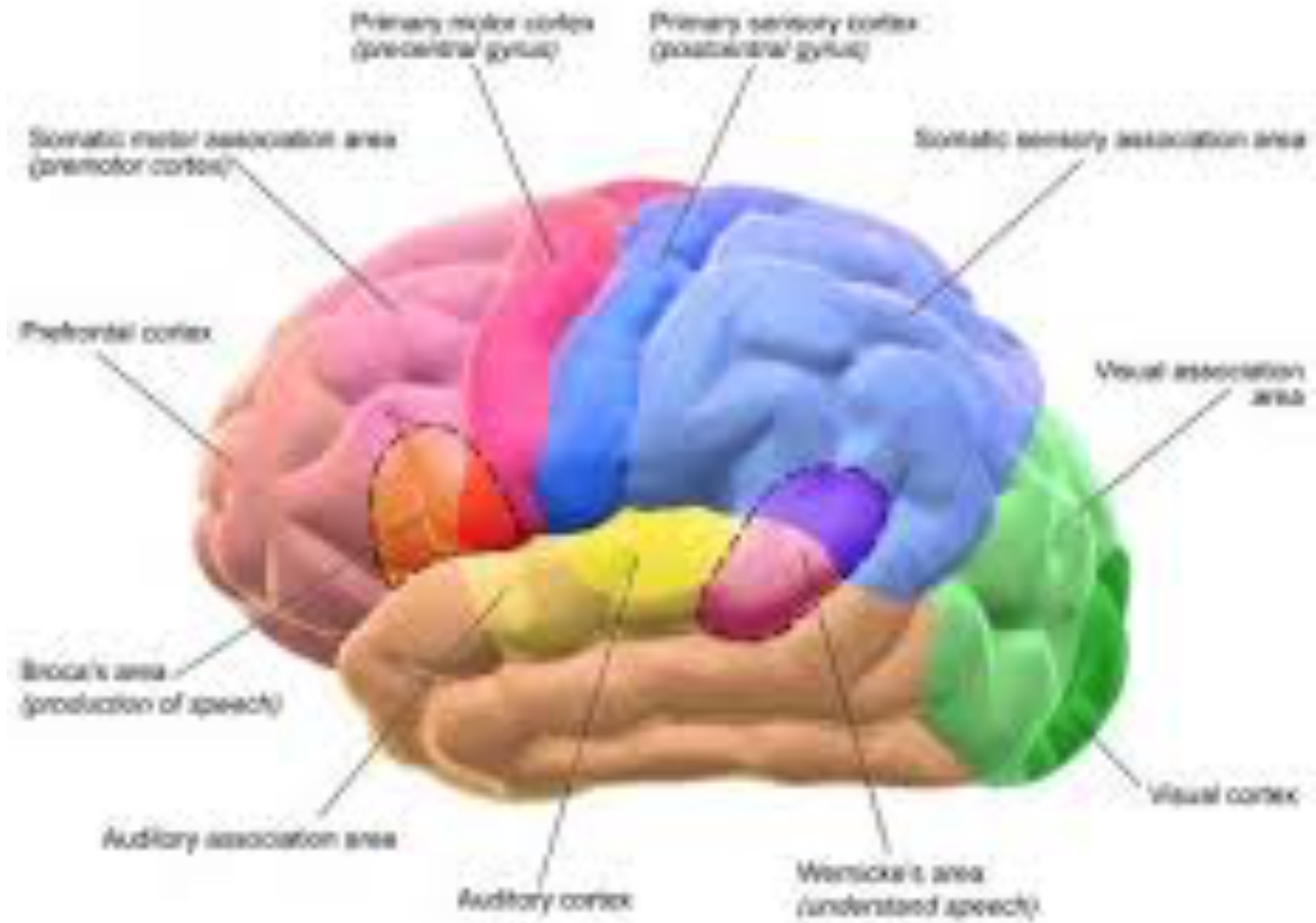
- **INFRATENTORIAL**

- CEREBELLUM
- MIDBRAIN
- PONS
- MEDULLA

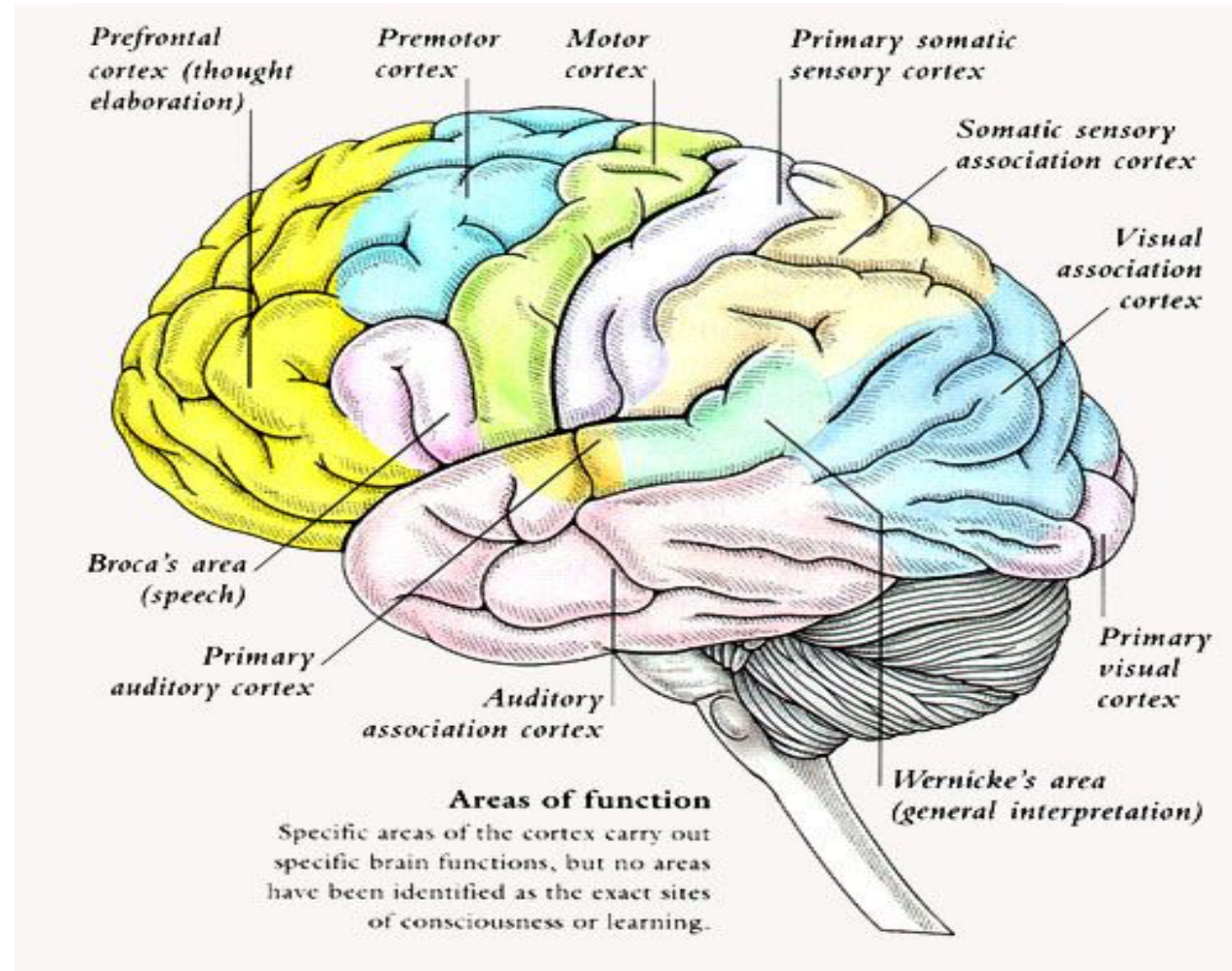
LOBES



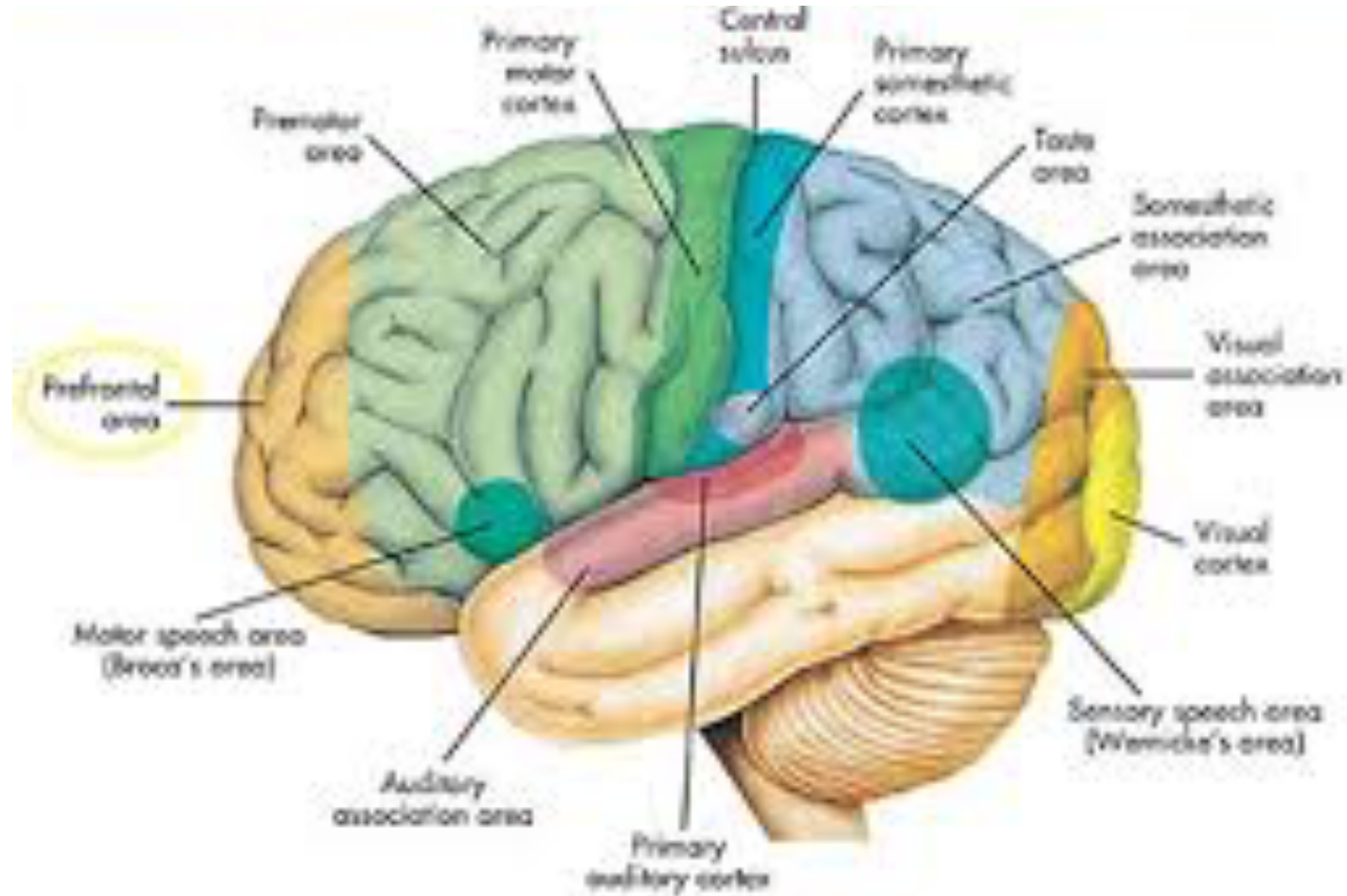
LOBE FUNCTION



LOBE FUNCTIONS



LOBE FUNCTION

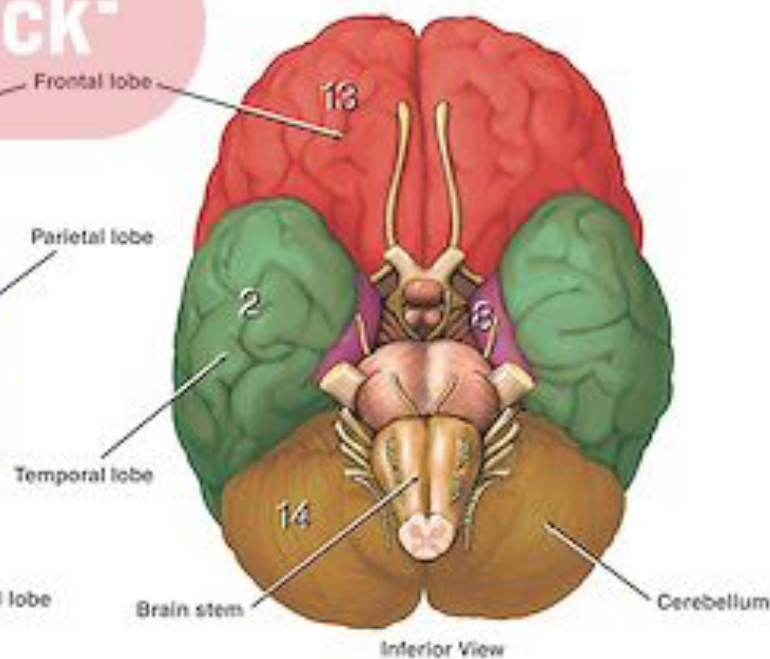
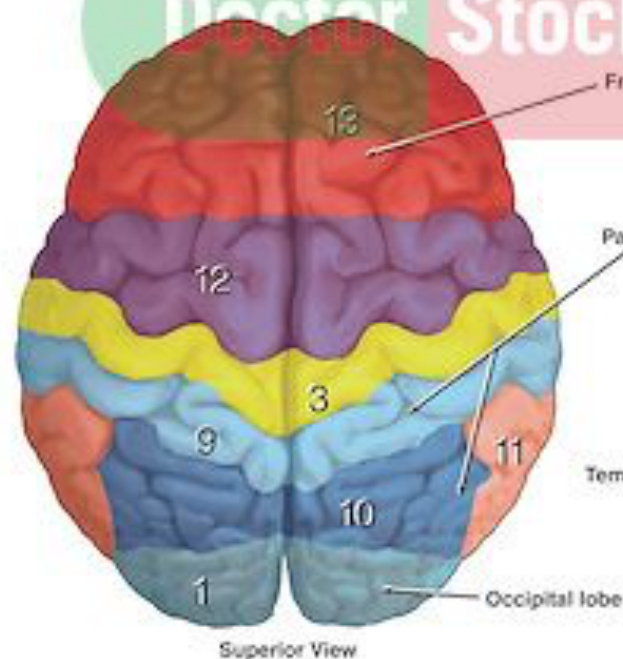
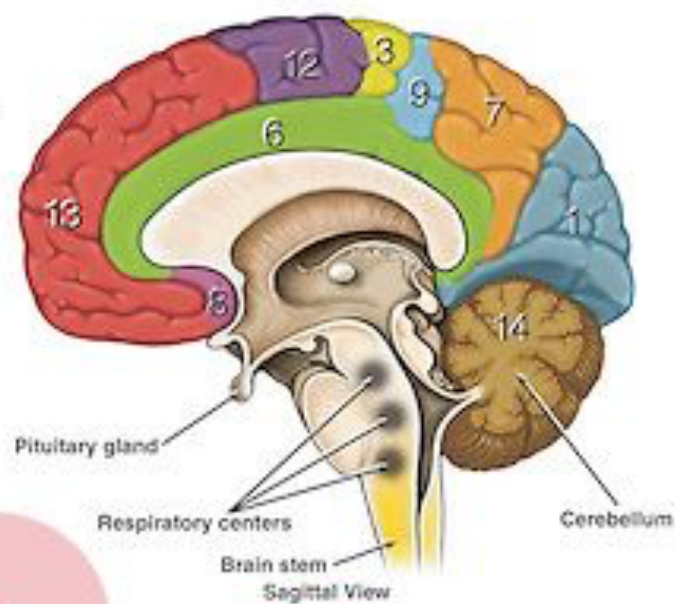
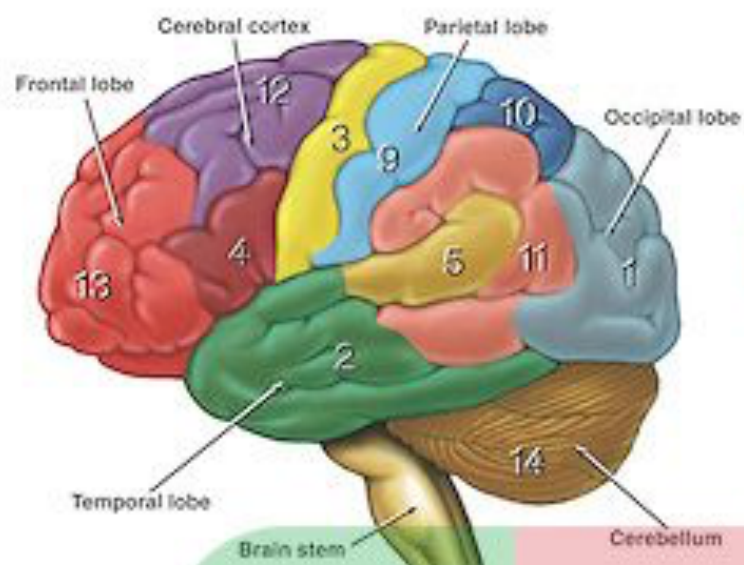


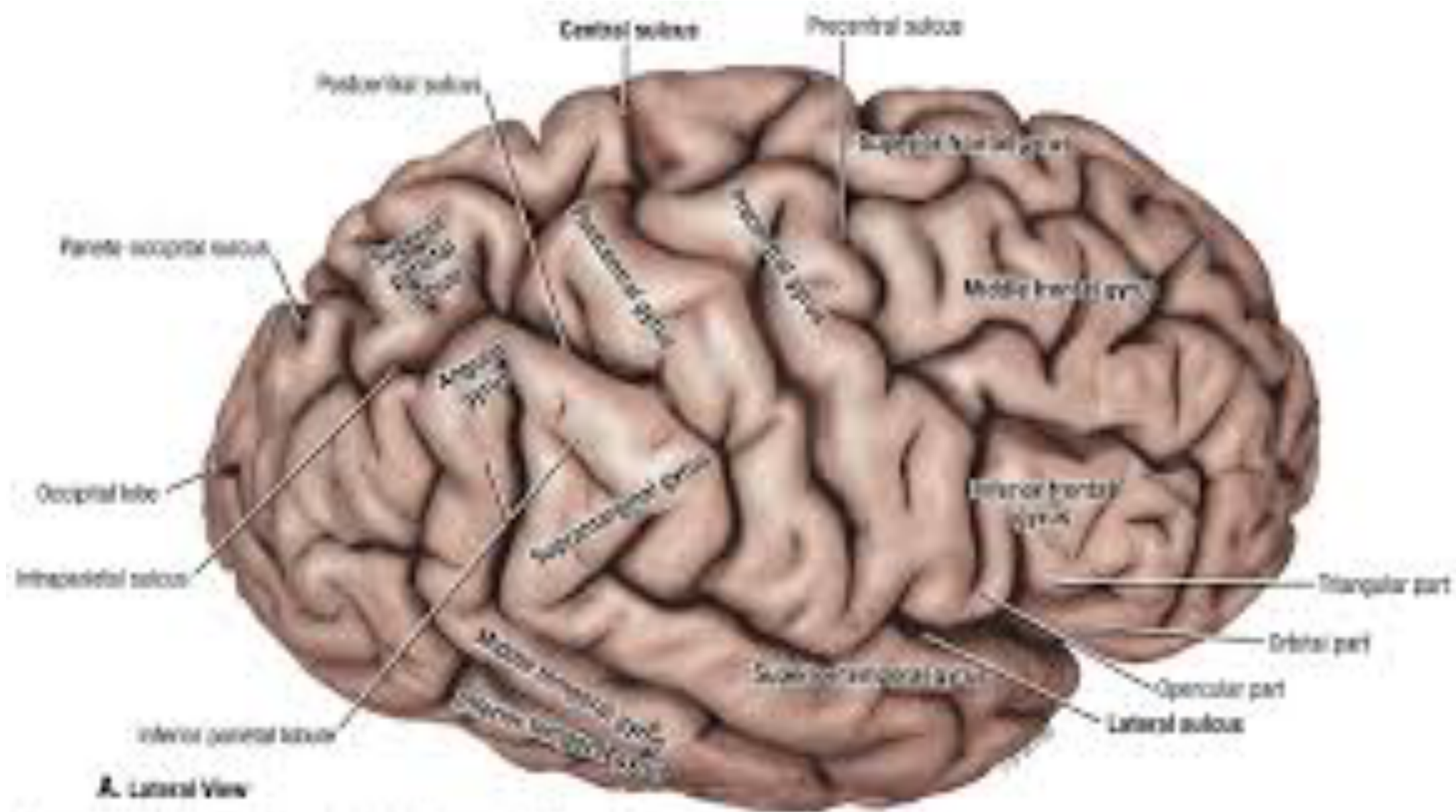
Functional Areas of the Cerebral Cortex

- 1 **Visual Area:**
Sight
Image recognition
Image perception
- 2 **Association Area**
Short-term memory
Equilibrium
Emotion
- 3 **Motor Function Area**
Initiation of voluntary muscles
- 4 **Broca's Area**
Muscles of speech
- 5 **Auditory Area**
Hearing
- 6 **Emotional Area**
Pain
Hunger
"Fight or flight" response
- 7 **Sensory Association Area**
- 8 **Olfactory Area**
Smelling
- 9 **Sensory Area**
Sensation from muscles and skin
- 10 **Somatosensory Association Area**
Evaluation of weight, texture, temperature, etc. for object recognition
- 11 **Wernicke's Area**
Written and spoken language comprehension
- 12 **Motor Function Area**
Eye movement and orientation
- 13 **Higher Mental Functions**
Concentration
Planning
Judgment
Emotional expression
Creativity
Inhibition

Functional Areas of the Cerebellum

- 14 **Motor Functions**
Coordination of movement
Balance and equilibrium
Posture





FRONTAL LOBE

- **SUPERIOR FRONTAL GYRUS (SFG)**
 - PREFRONTAL CORTEX
 - SUPPLEMENTAL MOTOR CORTEX (PREMOTOR CORTEX)
- **MIDDLE FRONTAL GYRUS (MFG)**
 - PREFRONTAL CORTEX
 - SUPPLEMENTAL MOTOR CORTEX (PREMOTOR CORTEX)
 - FRONTAL EYE FIELDS
- **INFERIOR FRONTAL GYRUS (IFG)**
 - BROCA'S AREA (DOMINANT HEMISPHERE)
- **ORBITOFRONTAL GYRUS**
- **PRECENTRAL GYRUS**

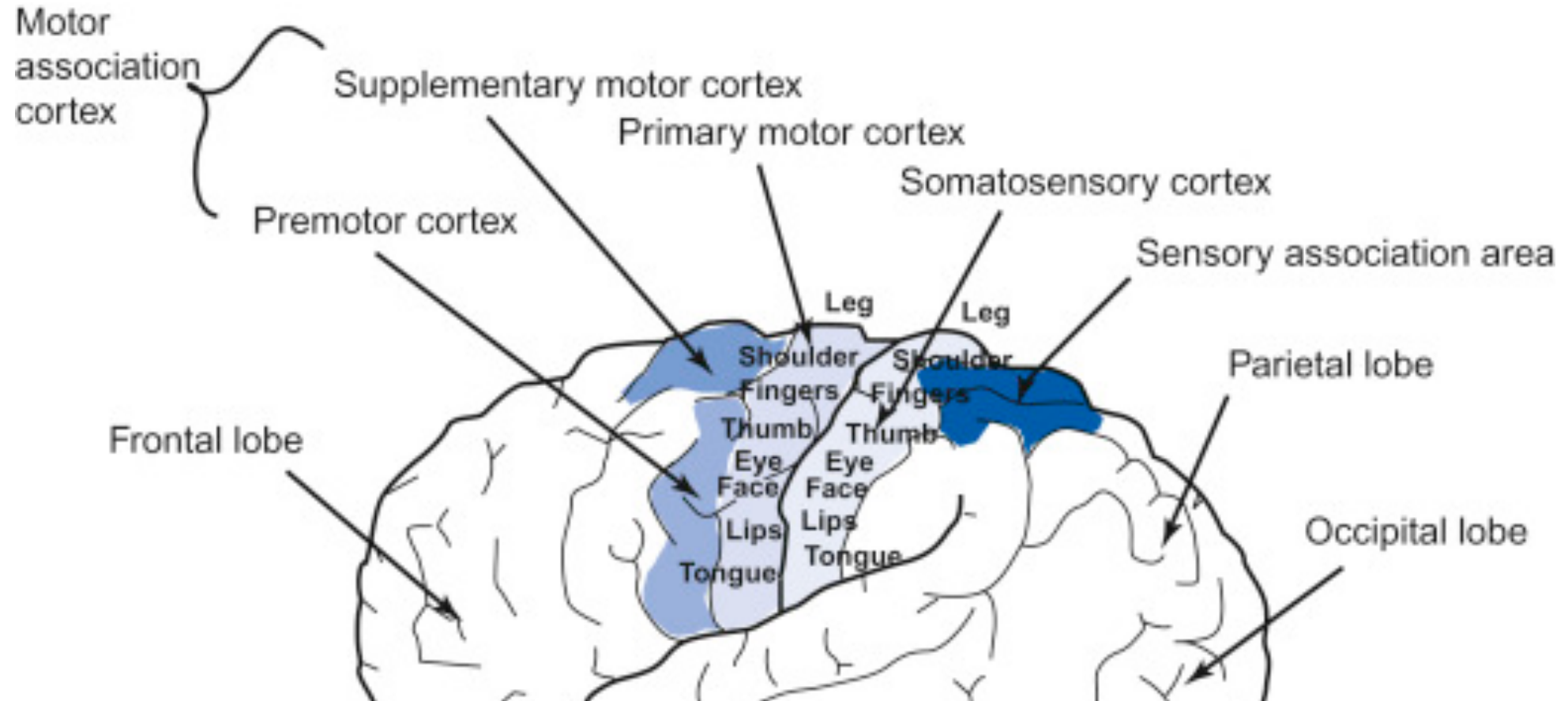
ACTIVITIES

- **PREFRONTAL CORTEX**
 - PLANNING COMPLEX COGNITIVE BEHAVIOR
 - PERSONALITY EXPRESSION
 - DECISION MAKING
 - MODERATING SOCIAL BEHAVIOUR
- **ORBITOFRONTAL CORTEX**
 - DECODING AND REPRESENTING TASTE AND TOUCH
 - CONTROLLING AND CORRECTING REWARD-RELATED AND PUNISHMENT-RELATED BEHAVIOR, EMOTION.
- **PREMOTOR CORTEX**
 - INVOLVED IN THE SELECTION OF APPROPRIATE MOTOR PLANS FOR VOLUNTARY MOVEMENTS (PRAXIAS)
 - CONTAINS BROCA'S AREA
- **MOTOR CORTEX**
 - INVOLVED IN THE EXECUTION OF VOLUNTARY MOVEMENTS.

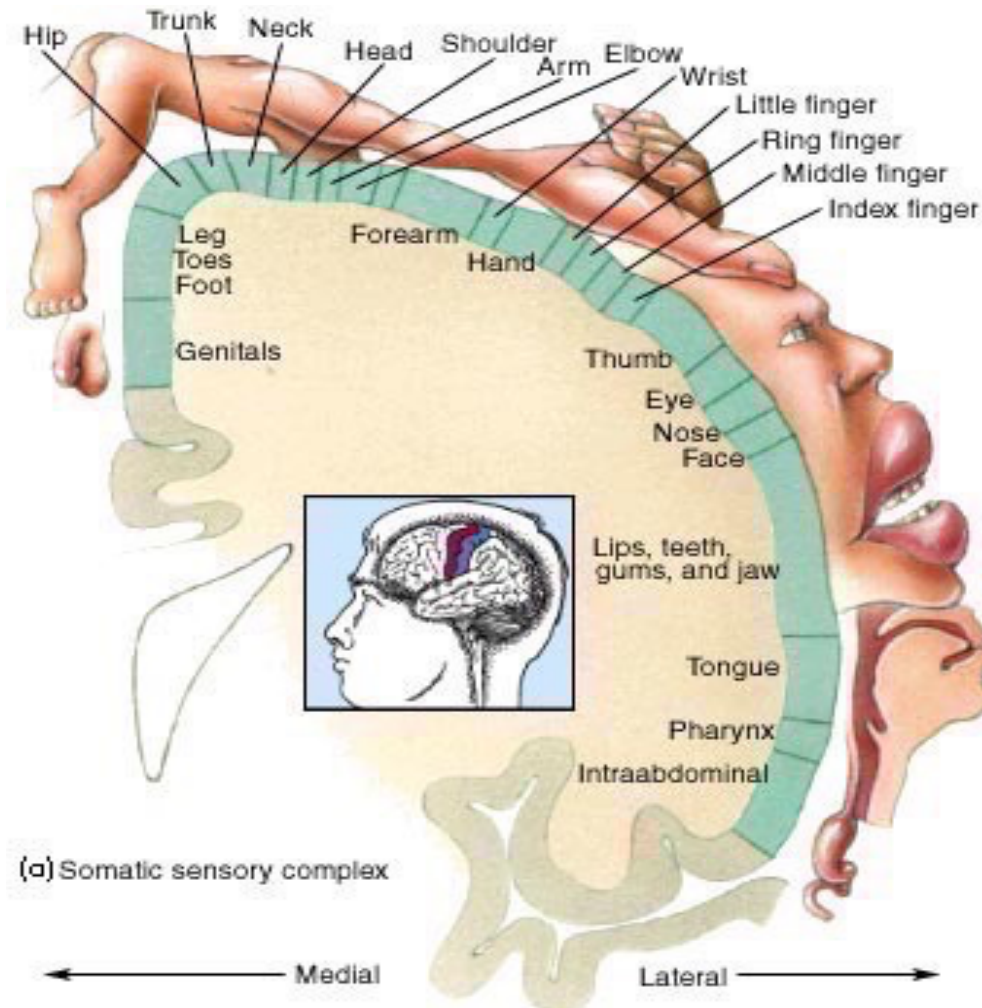
PARIETAL LOBE

- POSTCENTRAL GYRUS (SENSORY STRIP)
- SUPRAMARGINAL GYRUS
 - WERNICKE'S AREA (DOMINANT LOBE)
- ANGULAR GYRUS
 - WERNICKE'S AREA (DOMINANT LOBE)
- SUPERIOR PARIETAL LOBULE
- INFERIOR PARIETAL LOBULE

FRONTAL (MOTOR) AND PARIETAL(SENSORY) HUMUNCULI



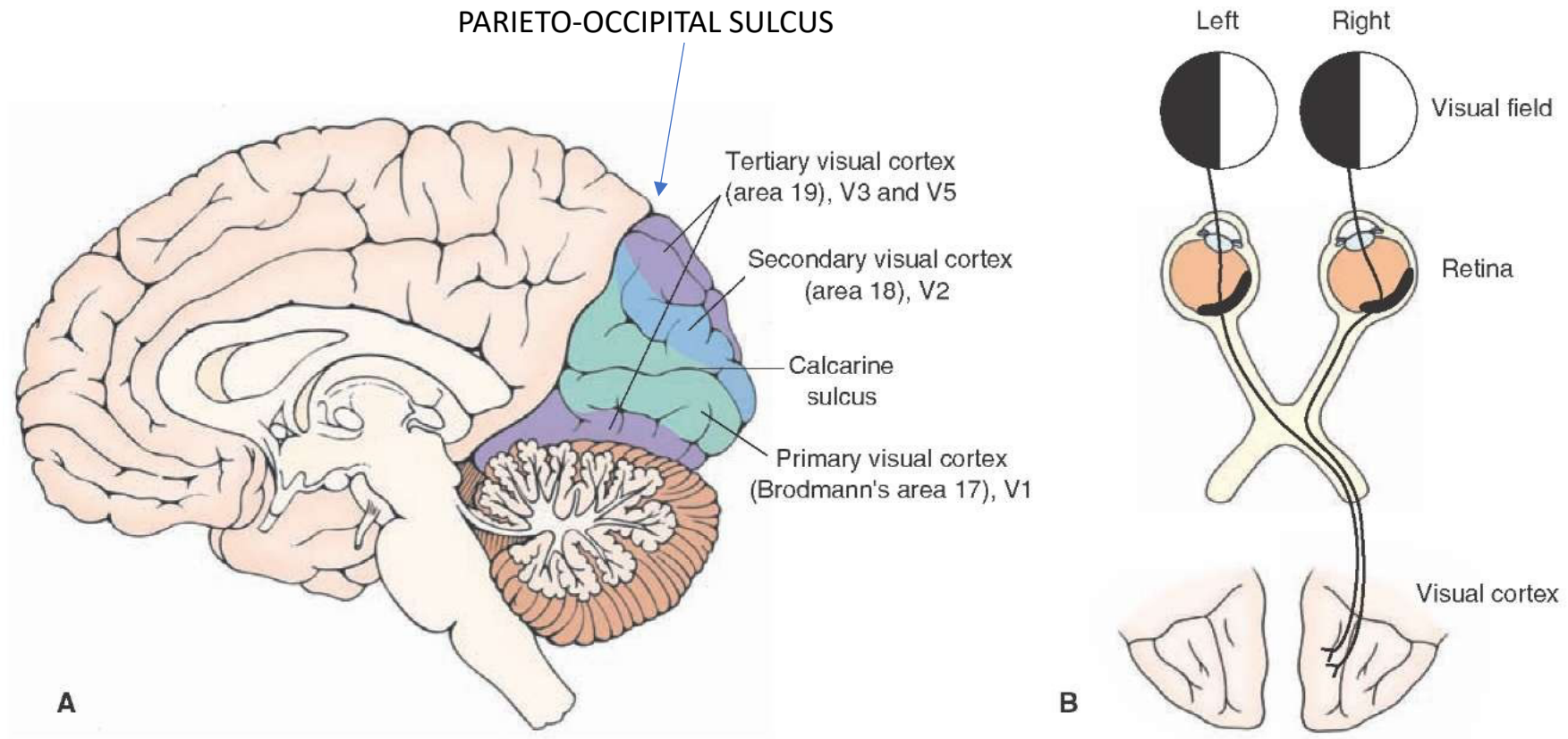
FRONTAL (MOTOR) AND (PARIETAL) HUMUNCULI



OCCIPITAL LOBE

- LOCATED POSTERIOR TO PARIETO-OCCIPITAL SULCUS
- PRIMARY VISUAL CORTEX

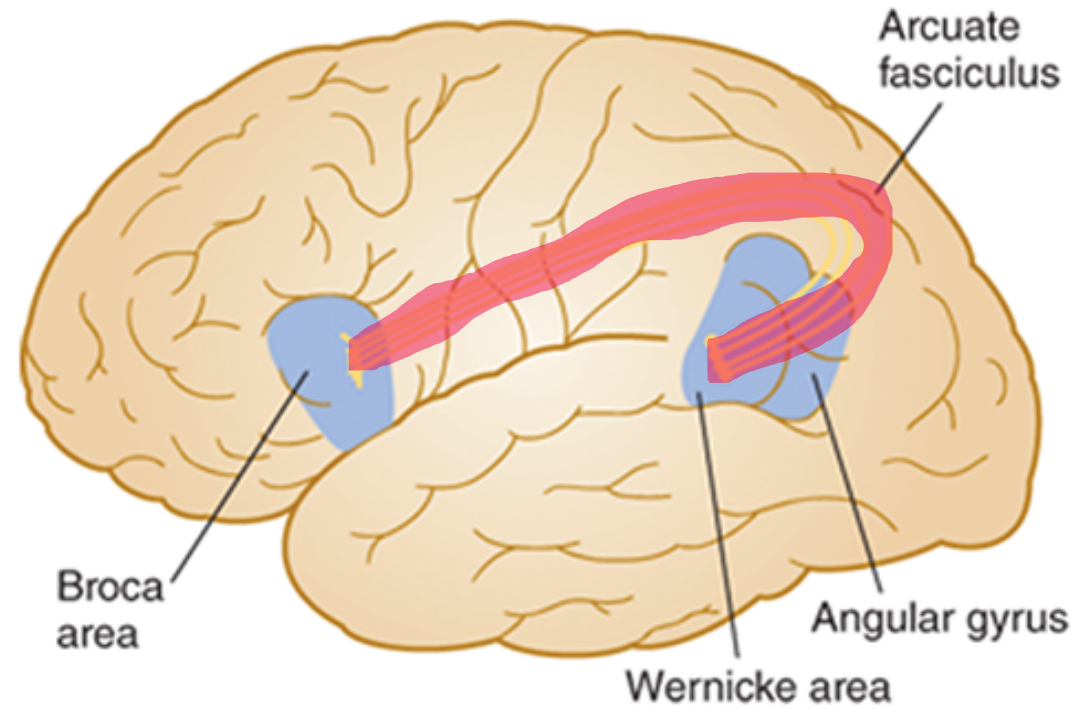
OCCIPITAL LOBE



TEMPORAL LOBE

- SUPERIOR TEMPORAL GYRUS
 - PRIMARY AUDITORY AREA (TRANSVERSE GYRUS OF HESCHL)
- MIDDLE TEMPORAL GYRUS
- INFERIOR TEMPORAL GYRUS

TEMPORAL AND FRONTAL LOBE INTERACTION



ROLE IN NEOPLASM SPREAD

Source: Arash Salardini, José Biller: *The Hospital Neurology Book*
www.neurology.mhmedical.com
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MESIAL TEMPORAL LOBE

- **MESIAL (MEDIAL) TEMPORAL LOBE**

- **AMYGDALA**

- EMOTION PERCEPTION (ANGER, FEAR, SADNESS, AGGRESSION CONTROL)
 - HELPS STORE MEMORIES OF EVENTS AND EMOTIONS

- **HIPPOCAMPUS**

- FORMATION OF NEW MEMORIES, LEARNING. SPATIAL CODING .

- **UNCUS**

- OLFACTORY ROLE

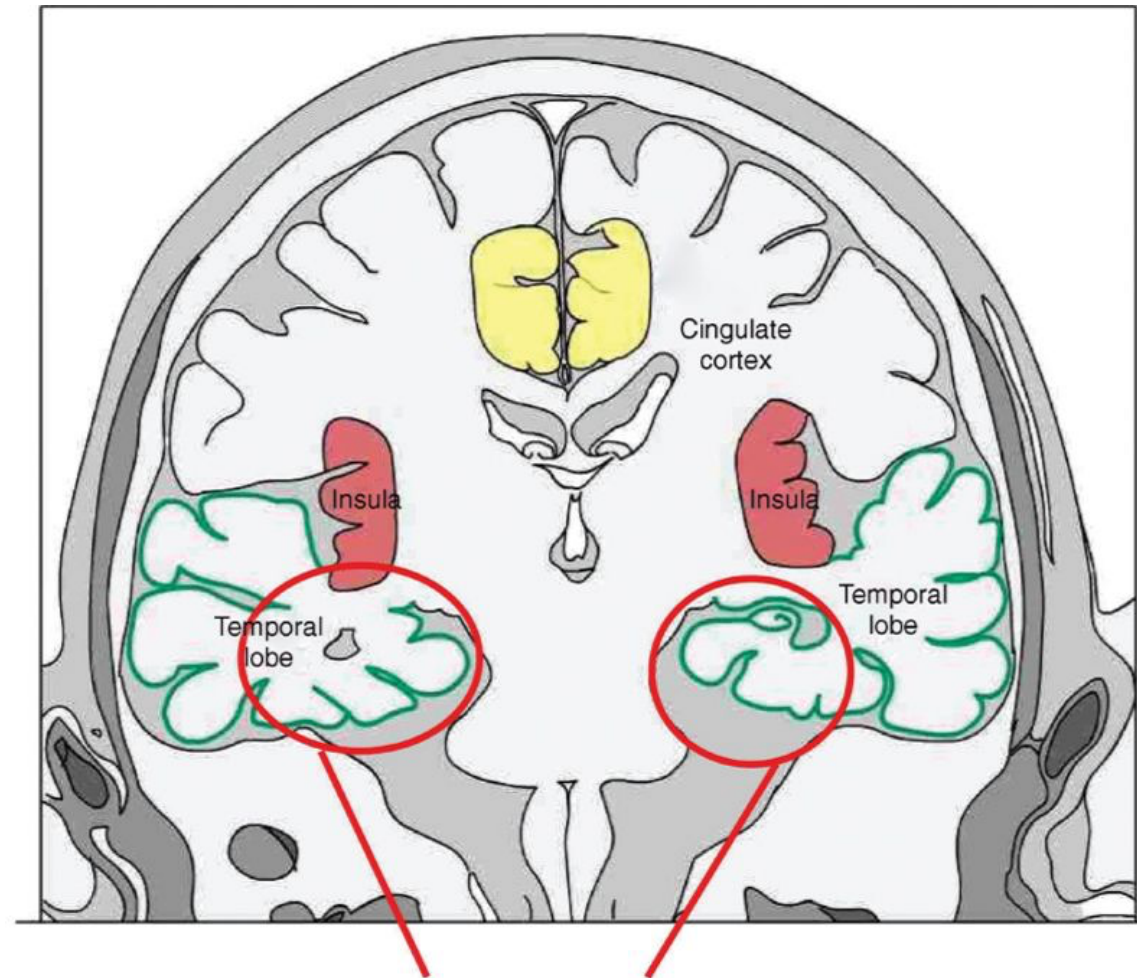
- **DENTATE GYRUS**

- INPUT REGION FOR HIPPOCAMPUS

- **PARAHIPPOCAMPAL GYRUS**

- MEMORY ENCODING AND RETRIEVAL

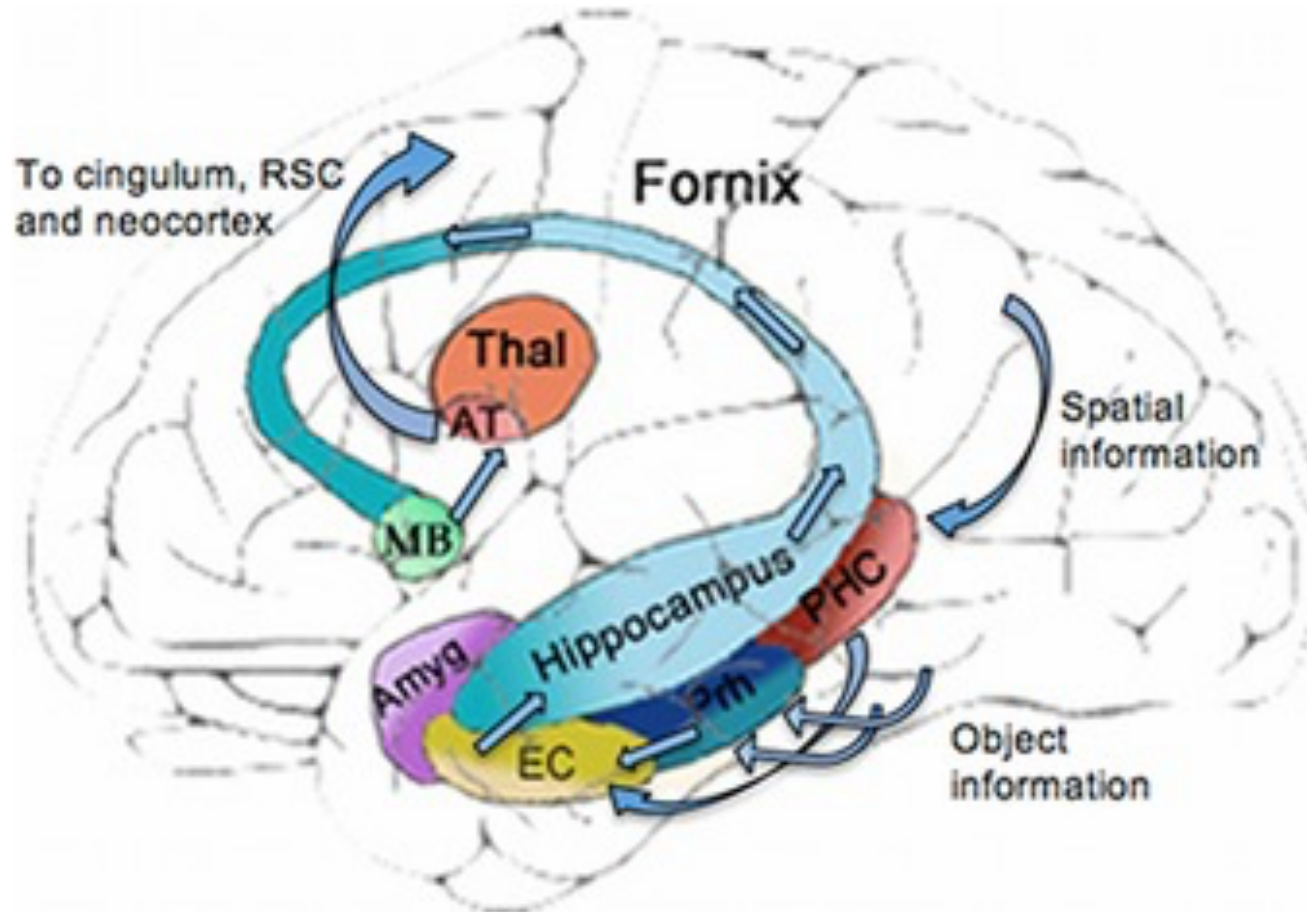
MESIAL TEMPORAL LOBE



Medial temporal lobes

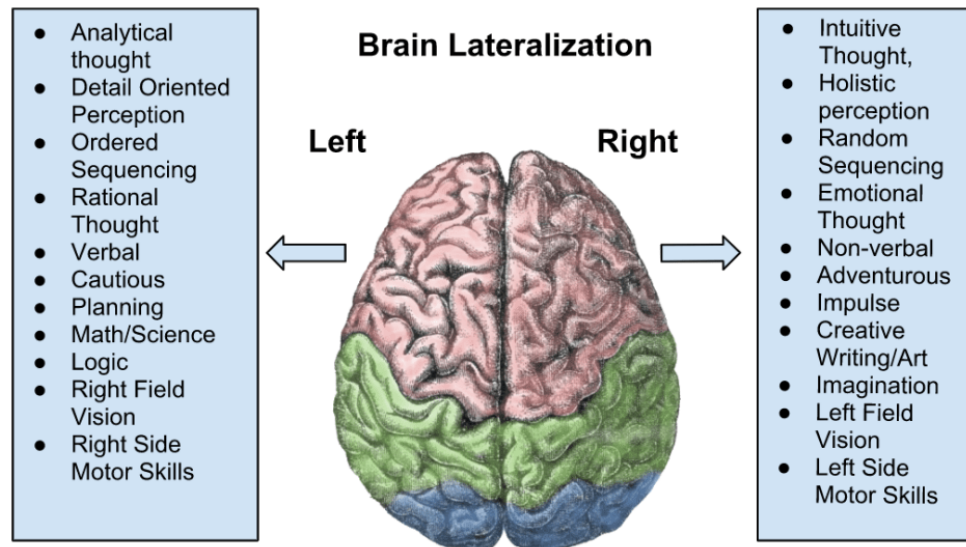
Source: Drawn by Shawn Fu.

MESIAL TEMPORAL LOBE



DOMINANT VS NON-DOMINANT LOBAR FINDINGS

- 95% of individuals are left brain dominant
- 95% of right handers are left brain dominant for language
- 70% of left handers process language in left hemisphere



KEY SUPRATENTORIAL NEUROSURGICAL SULCI AND FISSURES AND RELEVANT ANATOMY

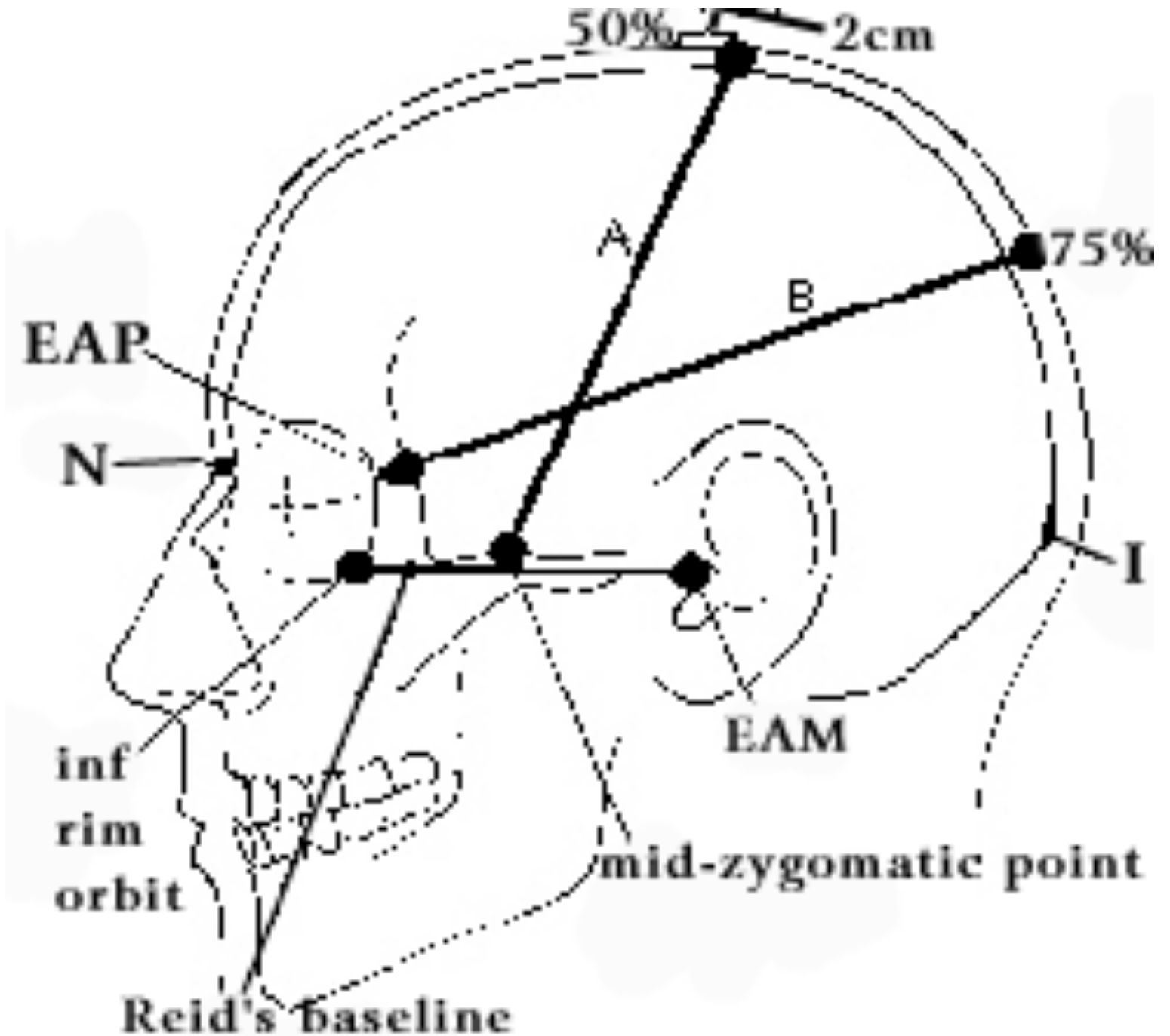
- **SYLVIAN FISSURE (LATERAL SULCUS)**
 - JUST INFERIOR TO DISTAL SF IS THE PRIMARY AUDITORY AREA
 - SF ENDS IN SUPRAMARGINAL GYRUS WITH SMG ABOVE AND BELOW
- **SUPERIOR TEMPORAL SULCUS**
 - SEPARATES STG FROM MTG
 - ENDS IN ANGULAR GYRUS WITH AG ABOVE AND BELOW
- **ROLANDIC FISSURE (CENTRAL SULCUS)**
 - SEPARATES MOTOR STRIP FROM SENSORY STRIP
- **PARIETO-OCCIPITAL SULCUS**
 - SEPARATES PARIETAL LOBE FROM OCCIPITAL LOBE

MR/CT IMAGING OF NEUROSURGICALLY PERTINENT LOBES, GYRI AND SULCI/FISSURES

- ROLANDIC FISSURE (CENTRAL SULCUS)
- MOTOR STRIP
- SENSORY STRIP
- INFERIOR FRONTAL GYRUS (BROCA'S)
- SYLVIAN FISSURE (LATERAL SULCUS)
- SUPRAMARGINAL AND ANGULAR GYRUS (WERNICKE'S)
- PARIETO-OCCIPITAL SULCUS
- PRIMARY VISUAL CORTEX

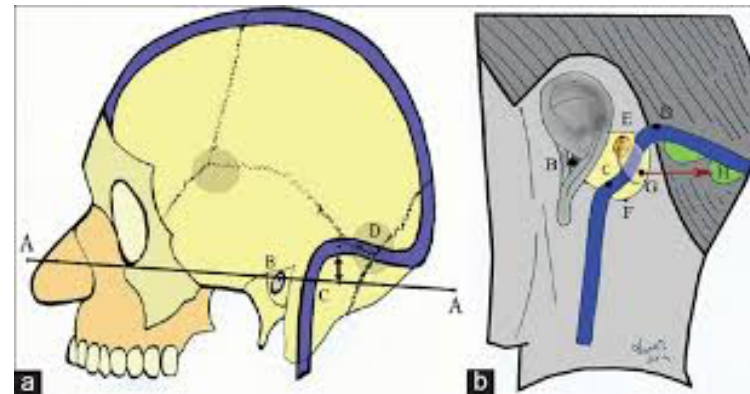
KEY NEUROSURGICAL SURFACE MEASUREMENTS FOR VISUALIZING UNDERLYING SURFACE ANATOMY AND LOCATING KEY STRUCTURES

- MEASURE DISTANCE FROM NASION TO INION
- DIVIDE NASION TO INION DISTANCE INTO 4 EQUAL DISTANCES

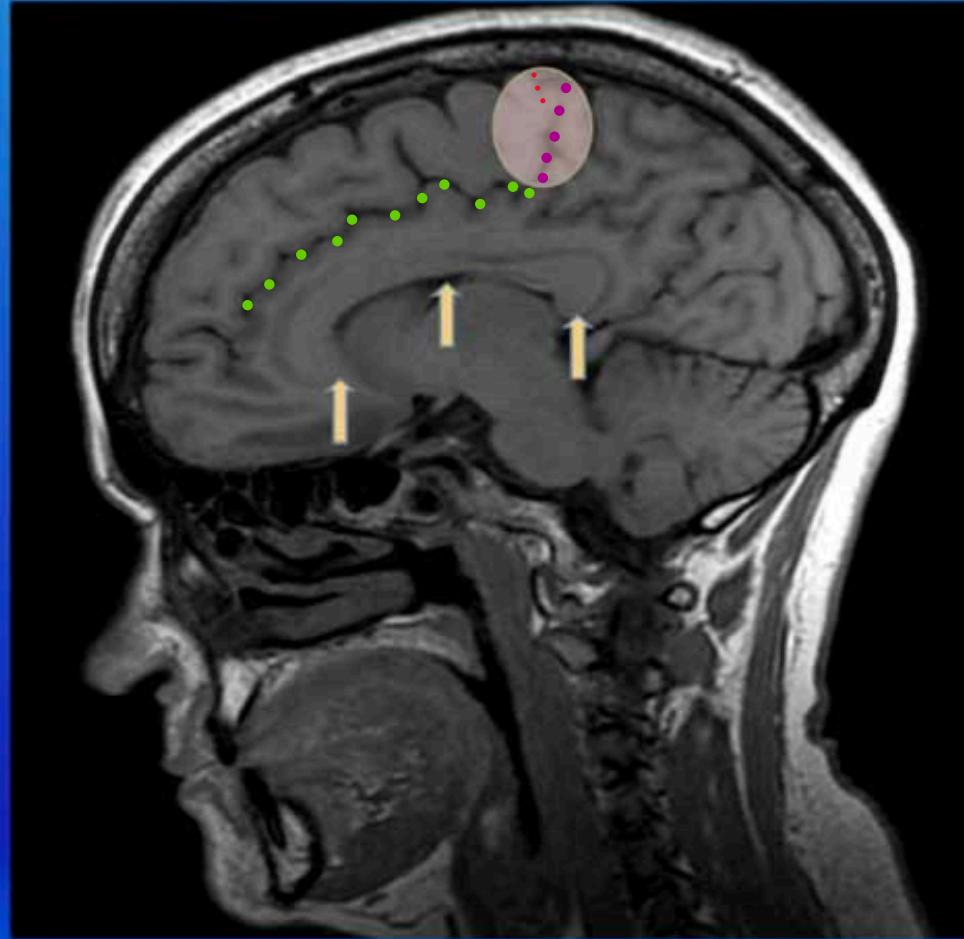


KEY NEUROSURGICAL SURFACE MEASUREMENTS FOR VISUALIZING UNDERLYING SURFACE ANATOMY AND LOCATING KEY STRUCTURES

- DRAW A LINE FROM THE INION TO A POINT 1-2 CM BELOW THE TOP OF THE EAR
- THIS IS THE TRANSVERSE SINUS
- DRAW A LINE VERTICALLY UPWARD ALONG THE MASTOID
- THIS LINE REPRESENTS THE SIGMOID SINUS



How to localize the central sulcus on sagittal images medially



1. Find the close to midline sagittal slices.
2. Identify the **corpus callosum**.
3. Identify the **cingulate gyrus and sulcus**.
4. Follow the cingulate sulcus posteriorly and superiorly. This is the **marginal branch – (bracket sign)**.
5. This lies in the **paracentral lobule**.
6. First sulcus in front of marginal branch is the **central sulcus**.

Animation slide. Please wait

LOCATING CENTRAL SULCUS ON MRI

FIND TOP AXIAL IMAGE ON T2 WEIGHTED MRI

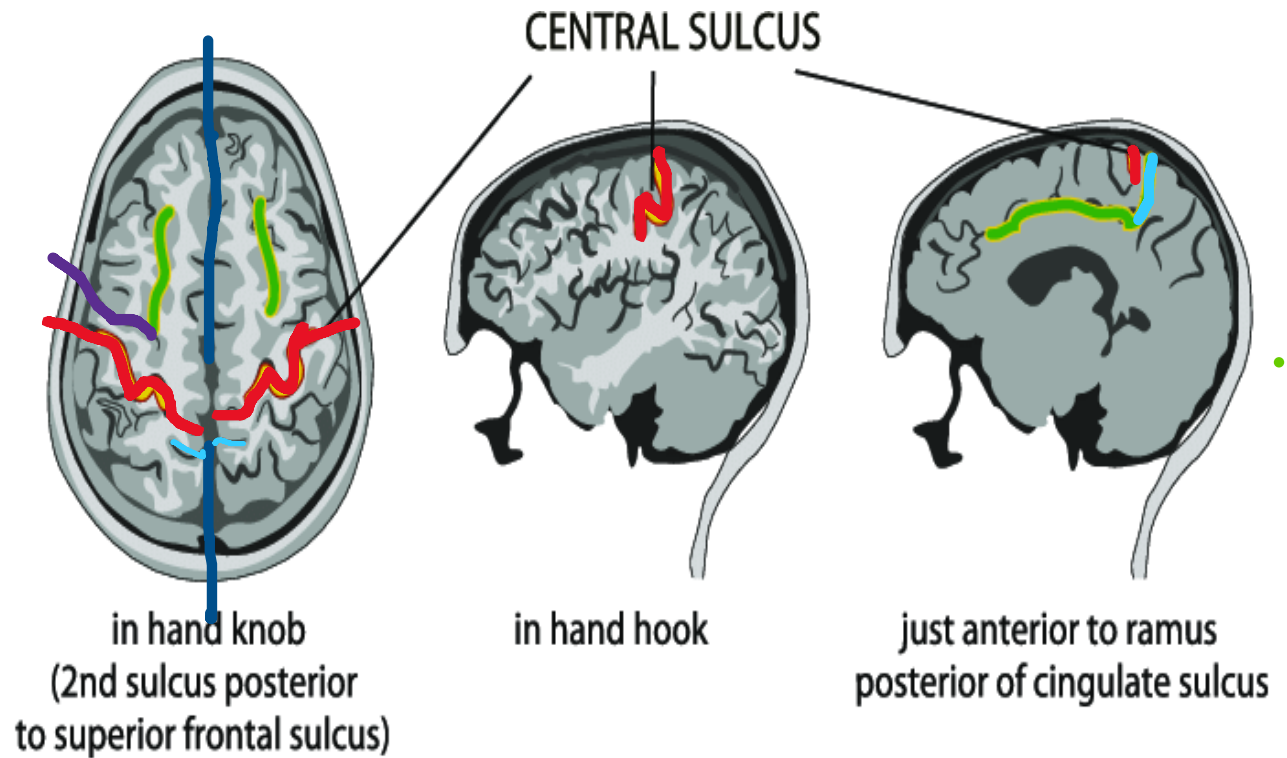
IDENTIFY INTERHEMISPHERIC FISSURE (BLUE)

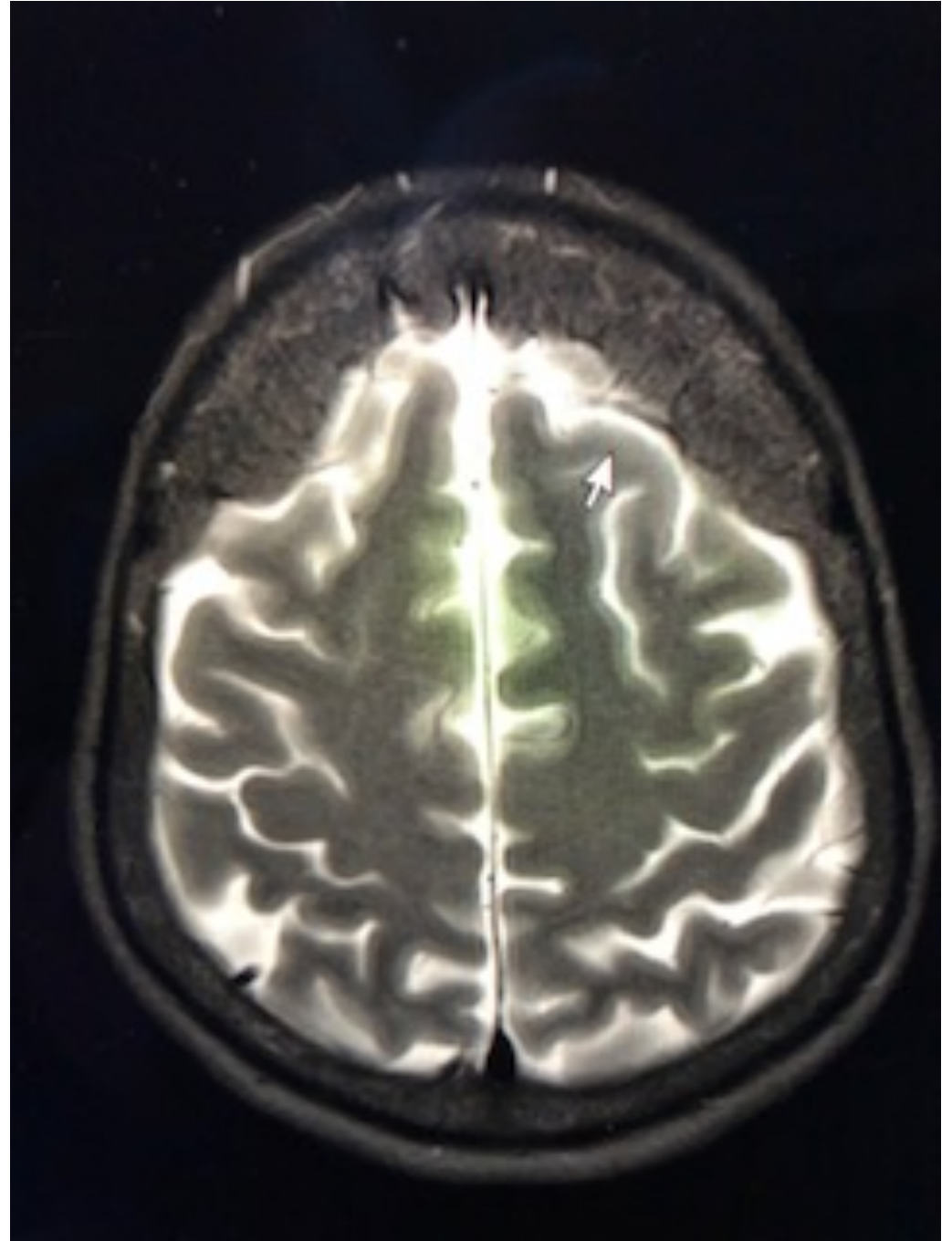
IDENTIFY FIRST PROMINENT SULCUS RUNNING PARALLEL TO INTERHEMISPHERIC FISSURE (SUPERIOR FRONTAL SULCUS) (GREEN)

FOLLOW SUPERIOR FRONTAL SULCUS TO NEXT NEAR PERPENDICULAR SULCUS (PRECENTRAL SULCUS)(PURPLE)

SULCUS POSTERIOR TO AND PARALLEL TO PRECENTRAL SULCUS IS THE CENTRAL SULCUS (RED)

FIND THE TWO SULCI THAT MEET ON EACH SIDE OF THE INTERHEMISPHERIC SULCUS. THESE ARE THE POST CENTRAL SULCI (LIGHT BLUE)

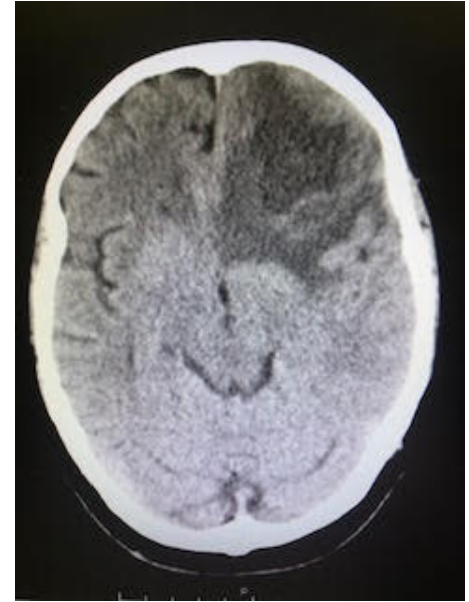
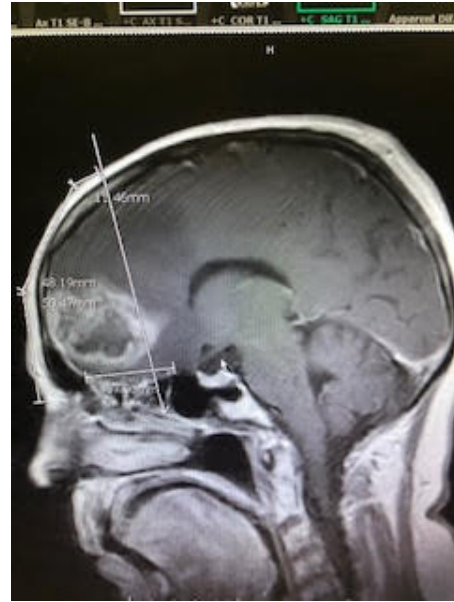
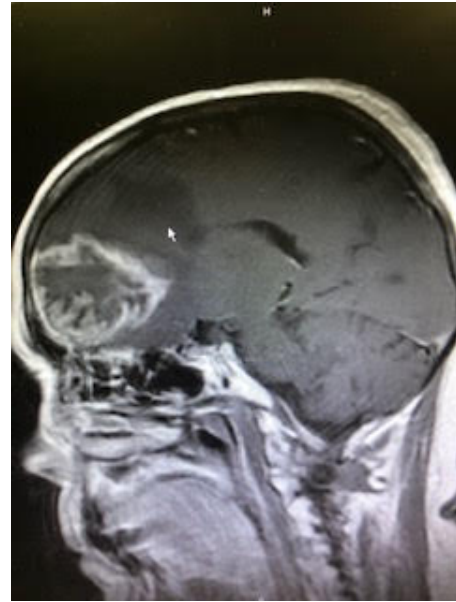
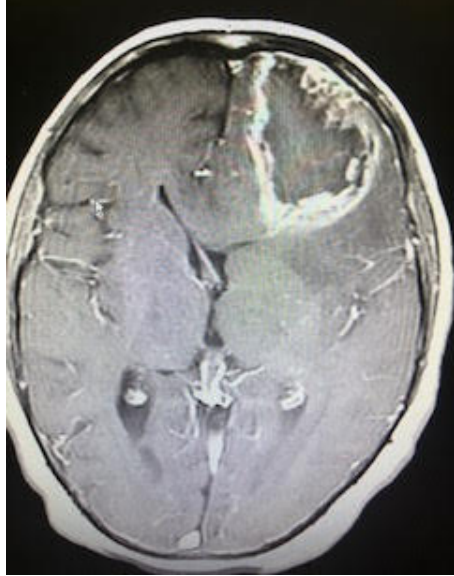




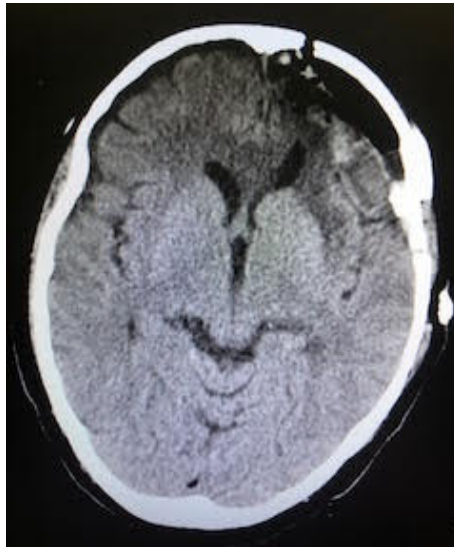
MOTOR
SENSORY

MEASUREMENTS USED TO PLAN LEFT FRONTAL GBM RESECTION ON 1/5/2020

PRE-OP

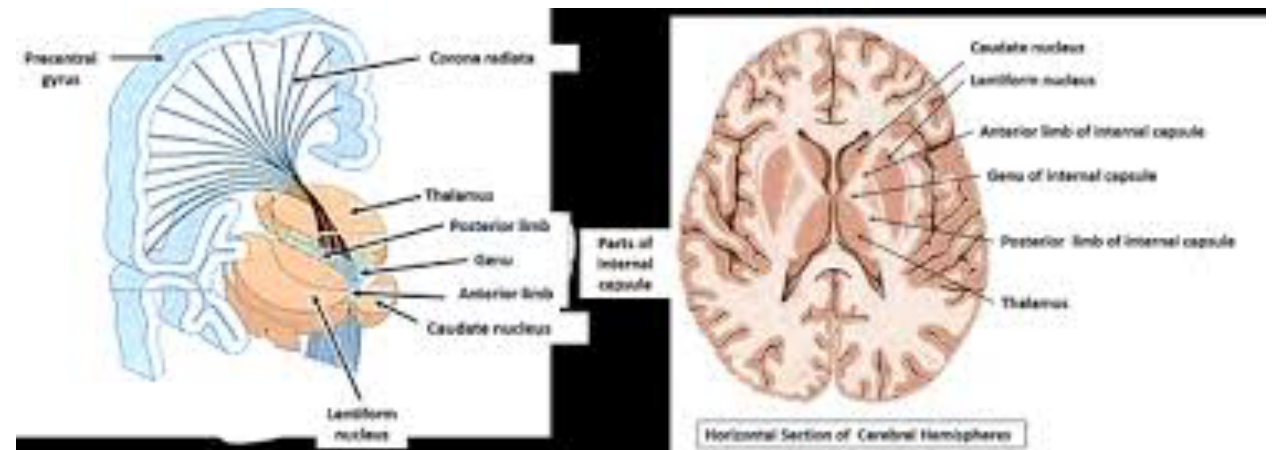
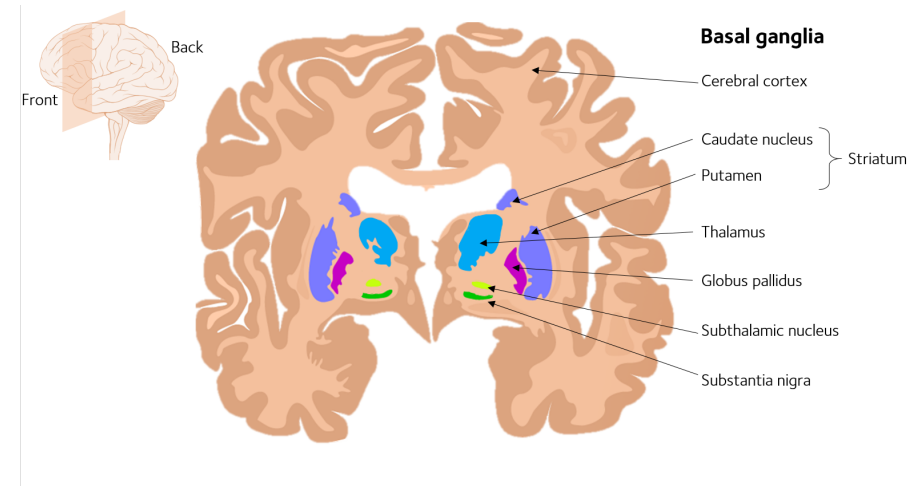


POST-OP

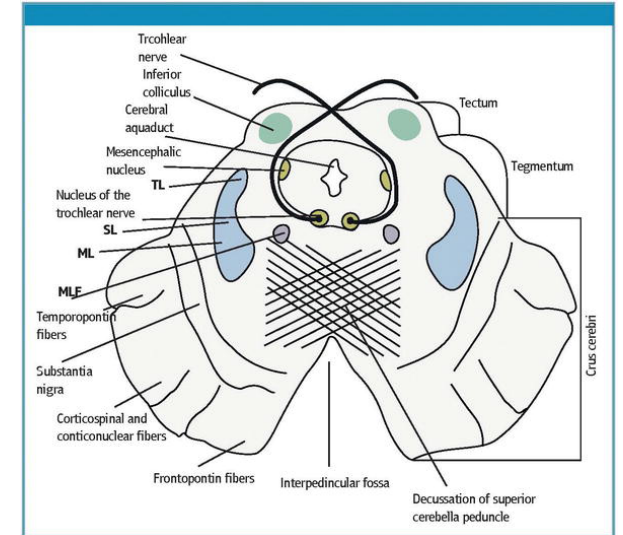
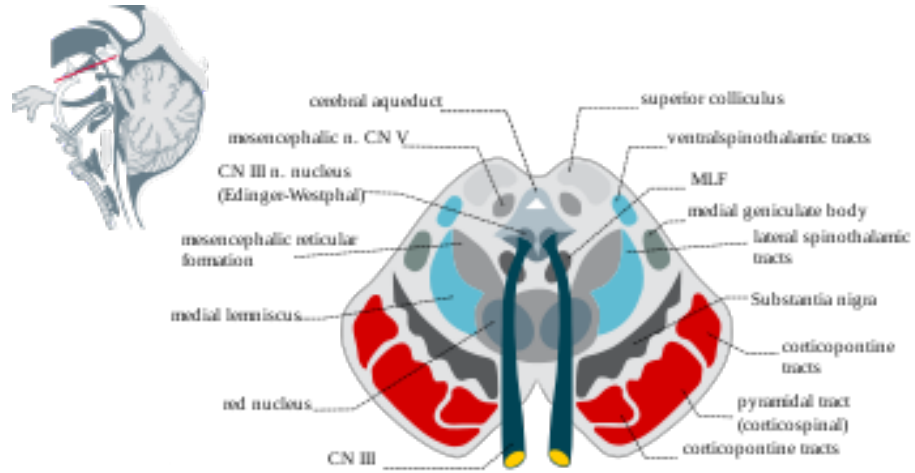
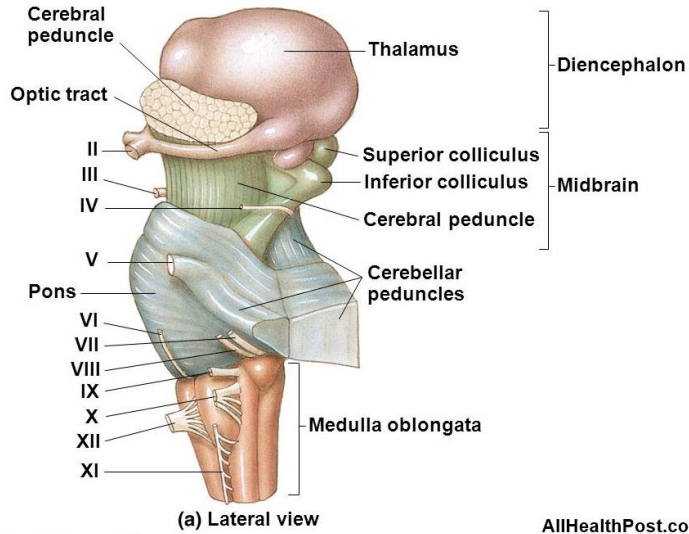


DEEP SUBCORTICAL STRUCTURES

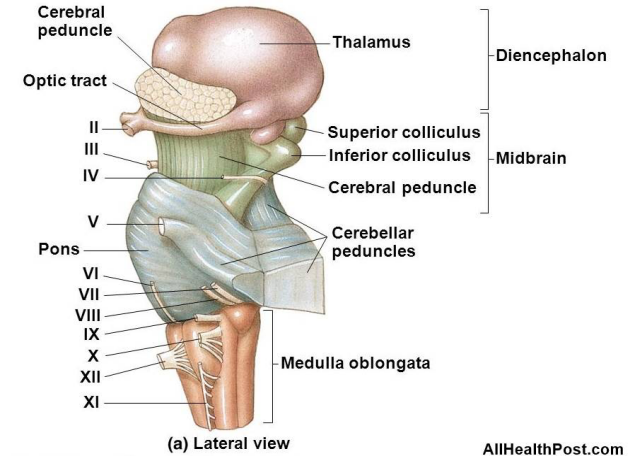
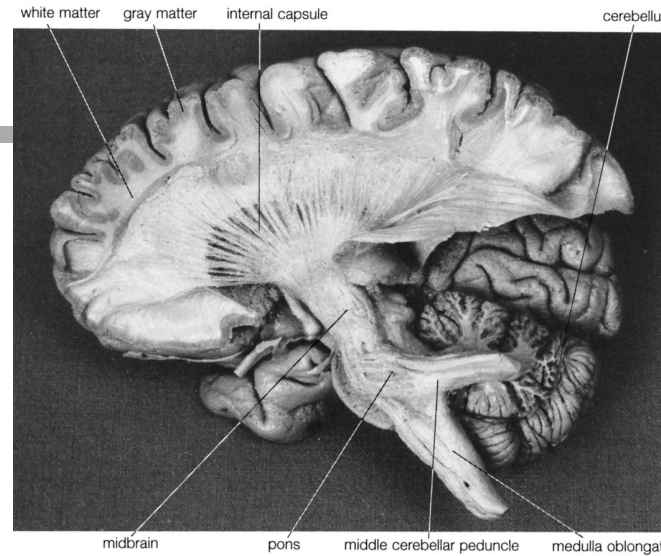
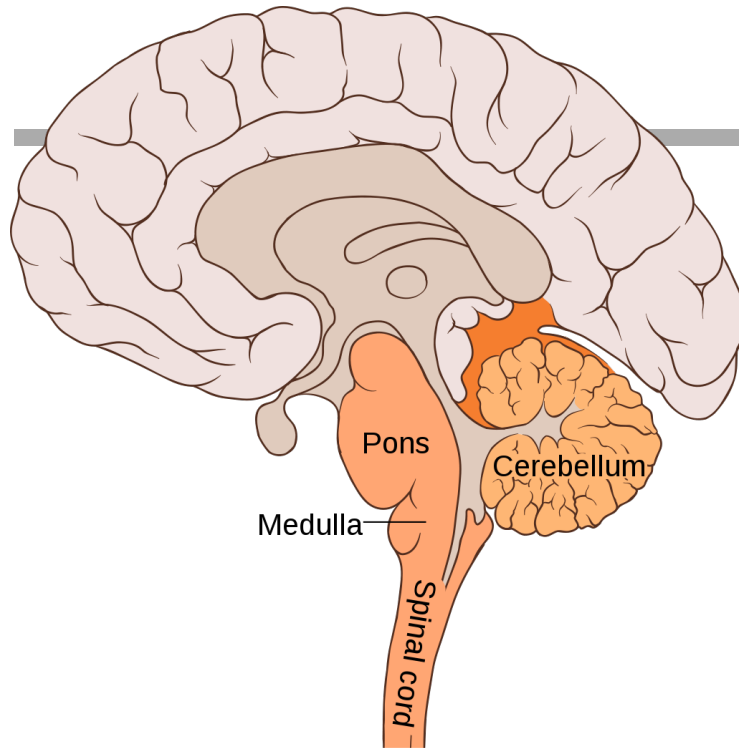
- THALAMUS (LIMBIC)
 - REGULATES ALERTNESS
 - NUCLEI RELAYS M/S INFO TO CTX
- HYPOTHALAMUS (LIMBIC)
 - HORMONE RELEASING FACTORS
 - REGULATES THIRST, TEMP, HUNGER, SLEEP, URINE OUTPUT, BP
 - BEHAVIORAL INPUTS (SEXUAL)
 - EMOTION
 - ACTIVATION OF SYMPATHETIC SYSTEM
- CAUDATE
 - ASSISTS WITH LEARNING IN TERMS OF USING MEMORIES TO INFLUENCE ACTIONS
- AMYGDALA (LIMBIC)
 - PROCESSING OF EMOTIONS
- HIPPOCAMPUS (LIMBIC)
 - LEARNING AND MEMORIES
- BASAL GANGLIA
 - (CAUDATE, PUTAMEN, GLOBUS PALLIDUS, SUBSTANTIA NIGRA, SUBTHALAMIC NUC)
 - MOTOR CONTROL
 - MOTOR LEARNING
 - EMOTIONS
- PITUITARY GLAND
 - HORMONE RELEASE
- INTERNAL CAPSULE (POSTERIOR LIMB: H-A-L)



MIDBRAIN



PONS AND MEDULLA



AllHealthPost.com

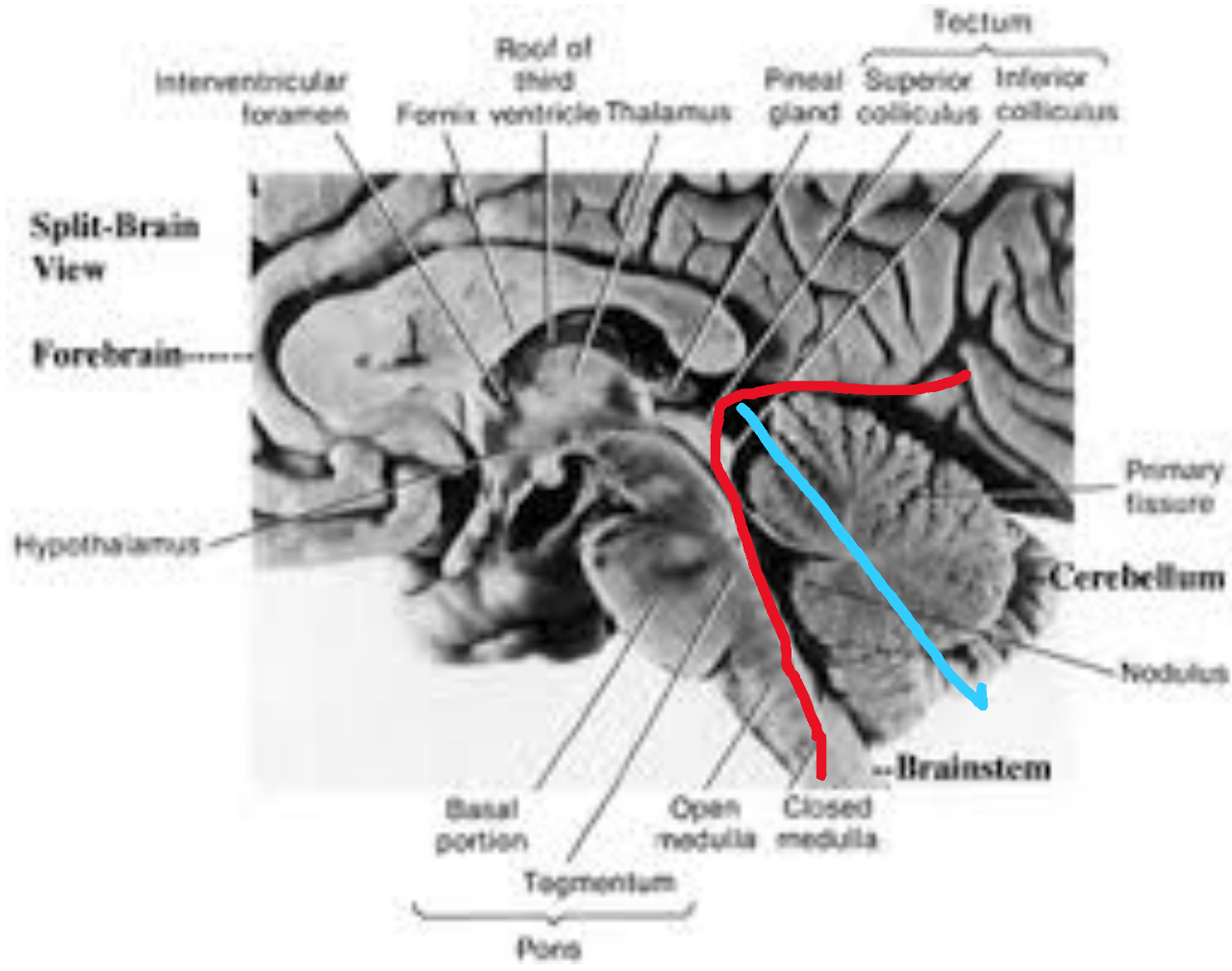
PONS

nuclei that relay signals from the forebrain to the cerebellum
 nuclei that regulate sleep, respiration, swallowing, bladder control,
 hearing, equilibrium, taste, eye movement, facial expressions,
 facial sensation, and posture

MEDULLA

helps regulate breathing, heart and blood vessel function, **digestion**, sneezing, and swallowing. This part of the brain is a center for respiration and circulation.
 Sensory and motor neurons (nerve cells) from the forebrain and midbrain travel through the medulla.

CEREBELLUM



COMMON SIGNS BY LOCATION (MOST CLEARLY IDENTIFIED WITH STROKES, TUMORS, TRAUMA)

- **CN 3 PALSY**
 - UNCAL HERNIATION AT TENTORIUM
- **6 NERVE PALSY**
 - INCREASED ICP
- **EXPRESSIVE APHASIA (CANNOT SPEAK APPROPRIATELY OR PERHAPS WRITE APPROPRIATELY)**
 - BROCA'S INJURY (MCA, TRAUMA, TUMOR)
- **RECEPTIVE APHASIA (CANNOT UNDERSTAND SPEECH OR PERHAPS WRITING)**
 - WERNICKE'S INJURY (MCA, TRAUMA, TUMOR)
- **CONDUCTION APHASIA (CAN UNDERSTAND AND CAN SPEAK CLEARLY BUT CANNOT REPEAT)**
 - ARCUATE FASCICULUS INJURY (MCA, TUMOR, DEMYELINATION)
- **HEMIPLEGIA**
 - MOTOR STRIP INJURY (STROKE, TUMOR, TRAUMA)
 - INTERNAL CAPSULE INJURY (LENTICULOSTRIATE LACUNAR STROKE- PURE MOTOR)
 - CEREBRAL PEDUNCLE INJURY (ANTERIOR CHOROIDAL ARTERY STROKE)
- **PURE SENSORY LOSS**
 - THALAMIC INJURY (LENTICULOSTRIATE LACUNAR STROKE)
- **LEFT INFERIOR PARIETAL LOBE SYNDROME (GERSTMANN'S SYND (AGRAPHIA, ACALCULIA, FINGER AGNOSIA, RIGHT/LEFT CONFUSION) + RECEPTIVE APHASIA)**
 - TUMOR, MCA STROKE, TRAUMA
- **RIGHT PARIETAL LOBE SYNDROME (DEFICITS IN SPATIAL ORIENTATION, CALCULATION, CONSTRUCTION APRAXIA, DENIAL OF DEFICITS)**
 - STROKE, TUMOR, TRAUMA
- **NON-DOMINANT BROCA AND WERNICKE REGIONS AFFECT SPEECH AND AUDITORY PROSODY, FACIAL EXPRESSION, GESTICULATION (NON-VERBAL ASPECTS OF COMMUNICATION)**
- **DECORTICATE POSTURING**
 - UPPER MIDBRAIN DAMAGE
- **DECEREBRATE POSTURING**
 - UPPER PONTINE DAMAGE

HOW DO WE USE GROSS ANATOMIC LOCALIZATION ON A DAILY BASIS IN THE OR?

- **POSTERIOR FOSSA SURGERY**

- IDENTIFYING LOCATION OF TRANSVERSE AND SIGMOID SINUS AND MASTOID TIP IS KEY TO KNOWING WHERE LATERAL CEREBELLAR EDGE IS LOCATED AND WHERE CRANIAL NERVES ARE LOCATED. THIS KNOWLEDGE PERMITS EXPOSURE OF THE SURGICAL TARGET WITH MINIMAL NEED FOR RETRACTION ON THE CEREBELLUM

- **FRONTAL VENTRICULOSTOMY PLACEMENT**

- 11 CM POSTERIOR TO NASION; 3 CM RT OF MIDLINE
- KEEPS PATH ANTERIOR TO MOTOR STRIP AND SUPPLEMENTAL MOTOR CORTEX

- **LEFT TEMPORAL LOBE RESECTION FOR DECOMPRESSION/TUMOR**

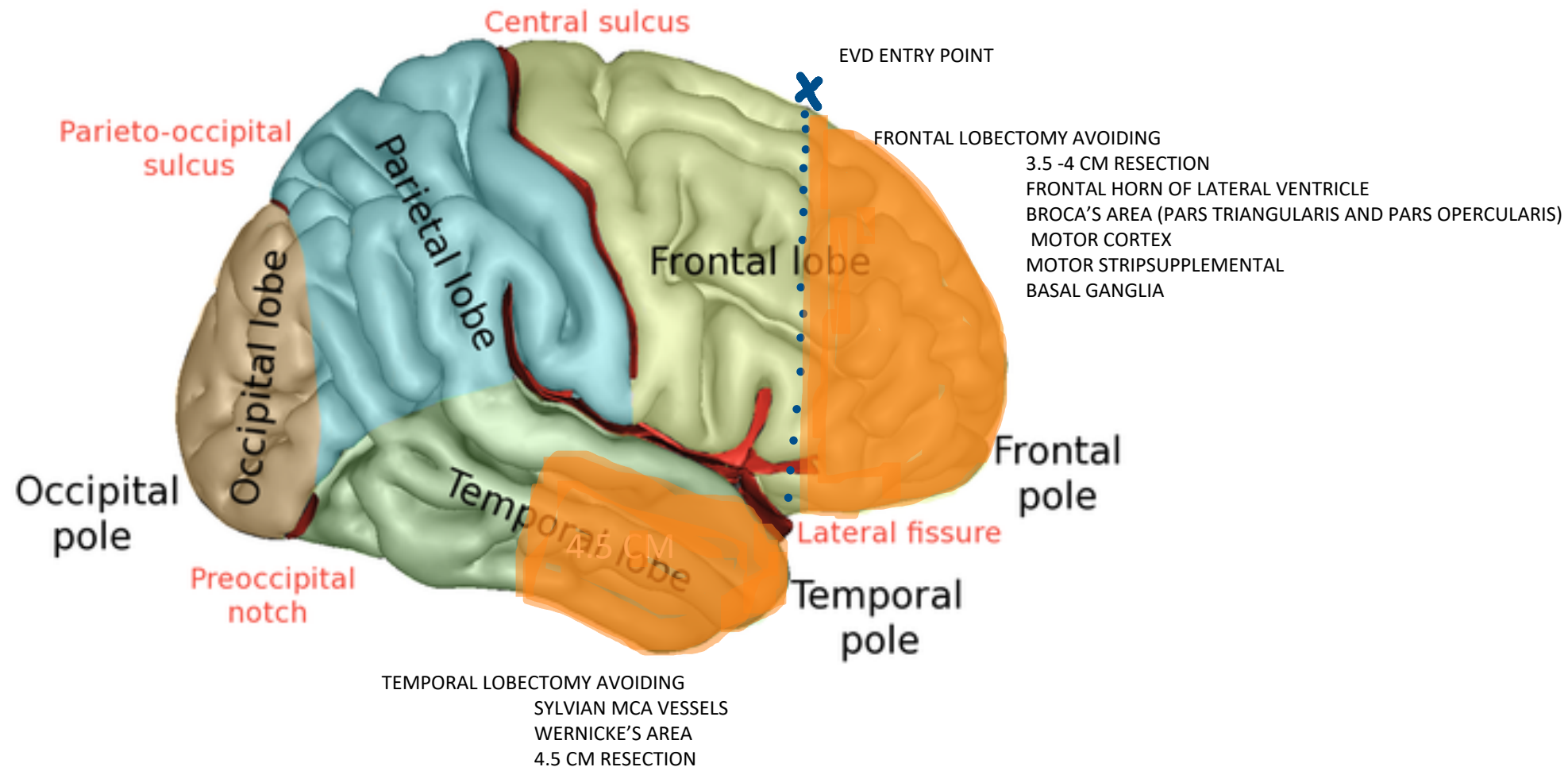
- LIMIT POSTERIOR BORDER OF RESECTION TO 4.5 CM FROM TEMPORAL TIP; LEAVE INFERIOR 50% OF STG TO AVOID ENTERING THE SUPRAMARGINAL AND ANGULAR GYRI. ALSO LIMITS EXPOSURE OF MCA

- **LEFT FRONTAL LOBECTOMY**

- LIMIT RESECTION TO THE PORTION OF THE FRONTAL LOBE THAT LIES ANTERIOR TO THE FRONT OF THE MIDDLE FOSSA. THIS WILL KEEP THE RESECTION ANTERIOR TO THE TRIANGULAR AND OPERCULAR PORTIONS OF THE INFERIOR FRONTAL GYRUS AND OUT OF BROCA'S AREA. ALSO KEEPS RESECTION ANTERIOR TO BASAL GANGLIA AND INTERNAL CAPSULE

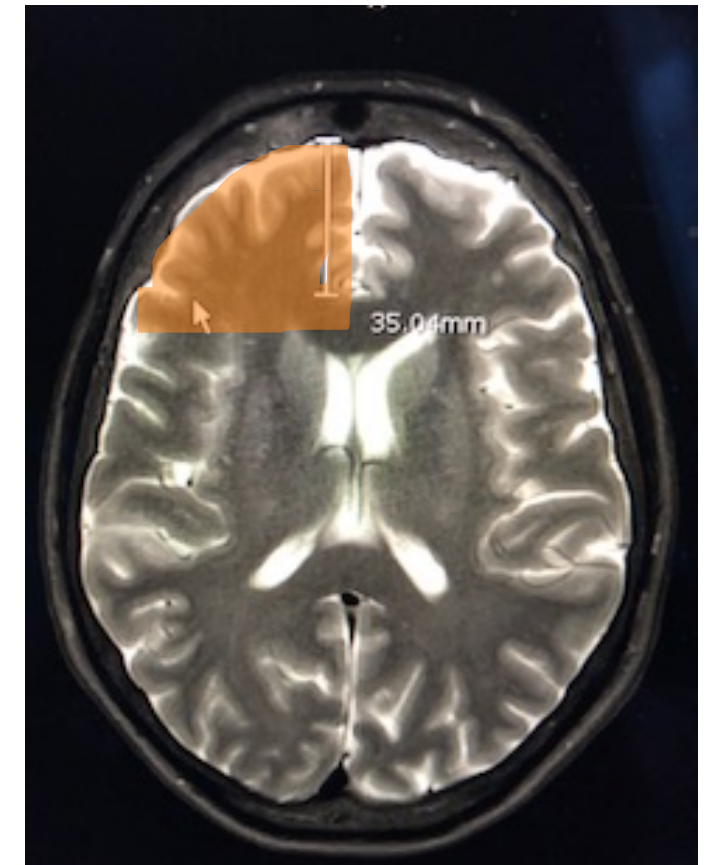
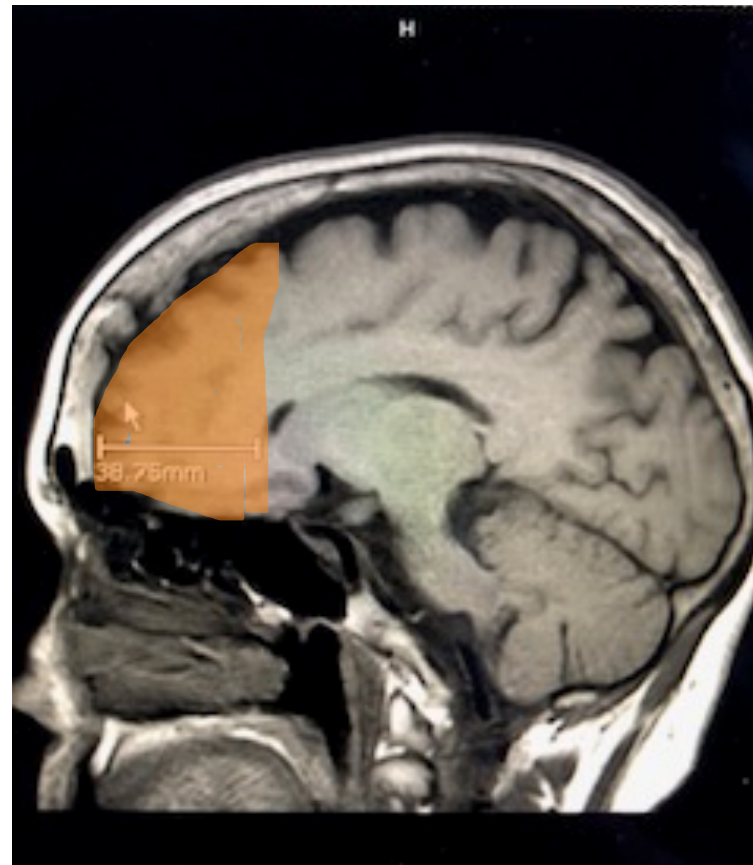
SAFE RULES FOR FRONTAL AND TEMPORAL LOBECTOMIES

21st Century Neurosurgery Provides Awake Surgical Resection, Mapping and Computer Assisted Navigation for More Sophisticated Procedures Than Routine Lobectomy for Management of Trauma Associated Mass Effect



USING LANDMARKS AND MEASUREMENTS TO SAFELY PERFORM A RIGHT FRONTAL LOBECTOMY

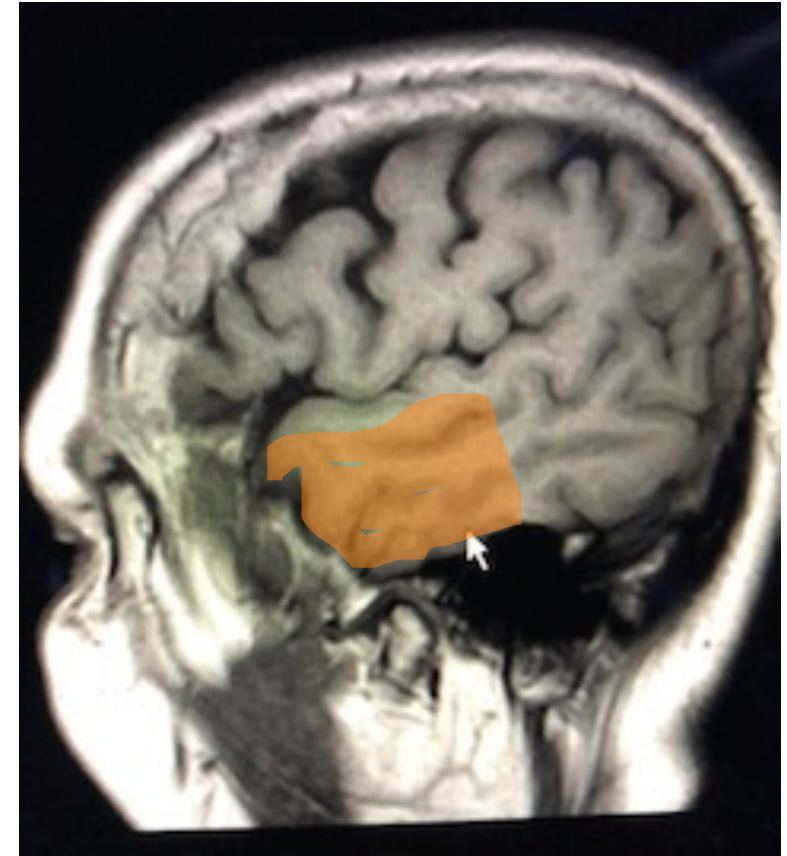
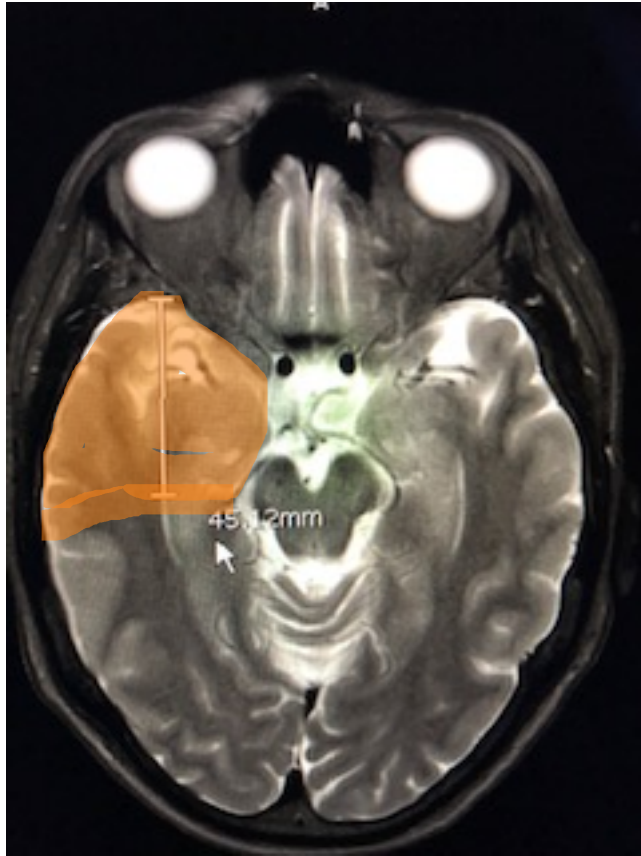
3.3-3.8 CM FROM WHERE FLOOR OF FRONTAL FOSSA MEETS FRONTAL BONE IN THE MIDLINE
11 CM POSTERIOR TO THE NASION IN THE MIDLINE ALONG SKUL CONVEXITY
DRAW LINE FROM FRONT OF MIDDLE FOSSA TO POINT 11 CM POSTERIOR TO THE NASION



USING THESE RESECTION GUIDELINES AVOIDS FRONTAL HORN OF VENTRICLE, CAUDATE, GLOBUS PALLIDUS, PUTAMEN

USING LANDMARKS AND MEASUREMENTS TO SAFELY PERFORM A RIGHT FRONTAL LOBECTOMY

4.5 CM POSTERIOR TO THE TEMPORAL TIP
LEAVE UPPER HALF OF SUPERIOR TEMPORAL GYRUS



USING THESE GUIDELINES, THERE IS NO RISK OF DAMAGING ANGULAR OR SUPRAMARGINAL GYRI, AND MINIMAL RISK OF DAMAGING THE MIDDLE CEREBRAL ARTERY. IF THE MEDIAL PIA IS RESPECTED THEN THE UNCUS CAN BE REMOVED WITHOUT THE RISK OF DAMAGING THE POSTERIOR CEREBRAL ARTERIES OF THE THIRD NERVE

ROUTINE RETROMASTOID APPROACH USING SURFACE ANATOMY

