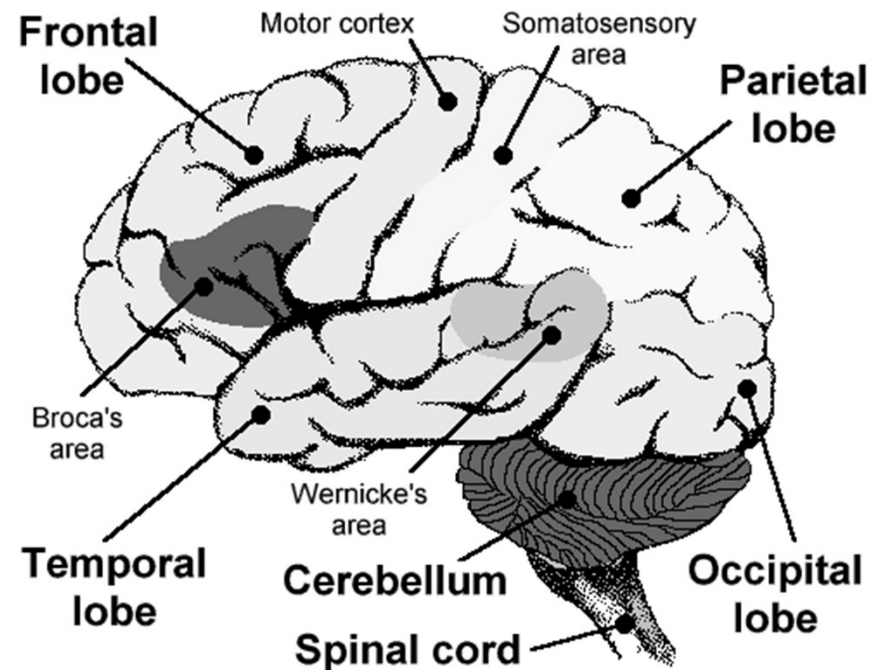


Cerebral cortex

- The cerebral cortex is the outer layer of grey matter of the cerebrum.
- The surface of the cerebral cortex folds to create gyri (ridges) and sulci (furrows) which increase the surface area.
- The cerebral cortex is generally classified into four lobes: the frontal, parietal, temporal and occipital.

Cerebral lobes



Cerebral white matter

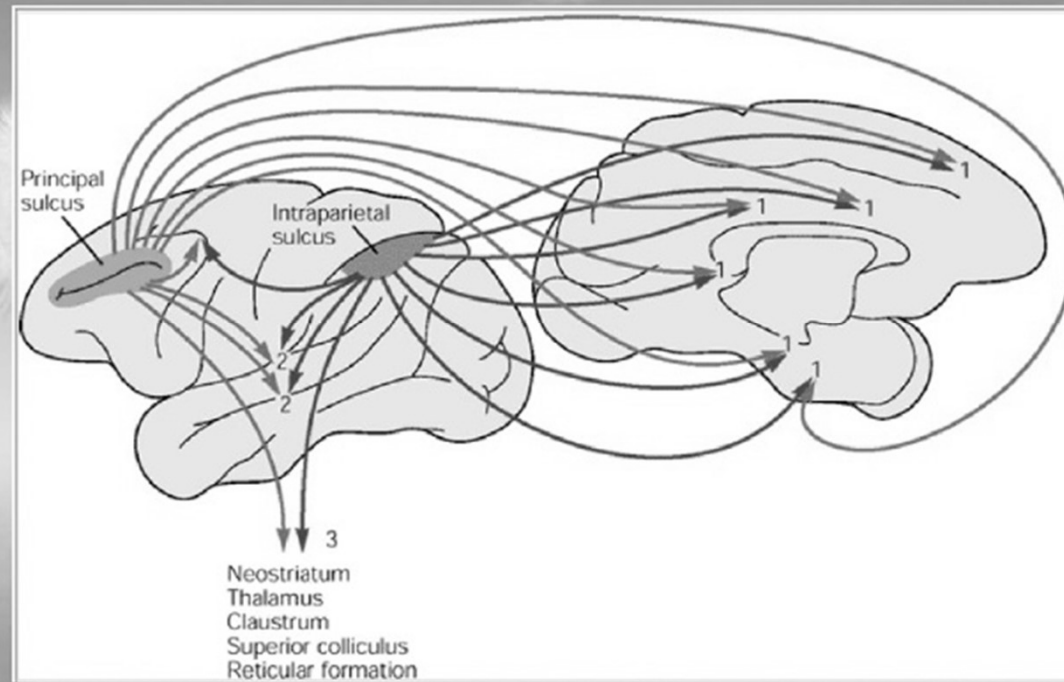
- Projection fibers
- Efferent
- Afferent
- Association fibers
- Commissural fibers – corpus callosum

Brain cortex

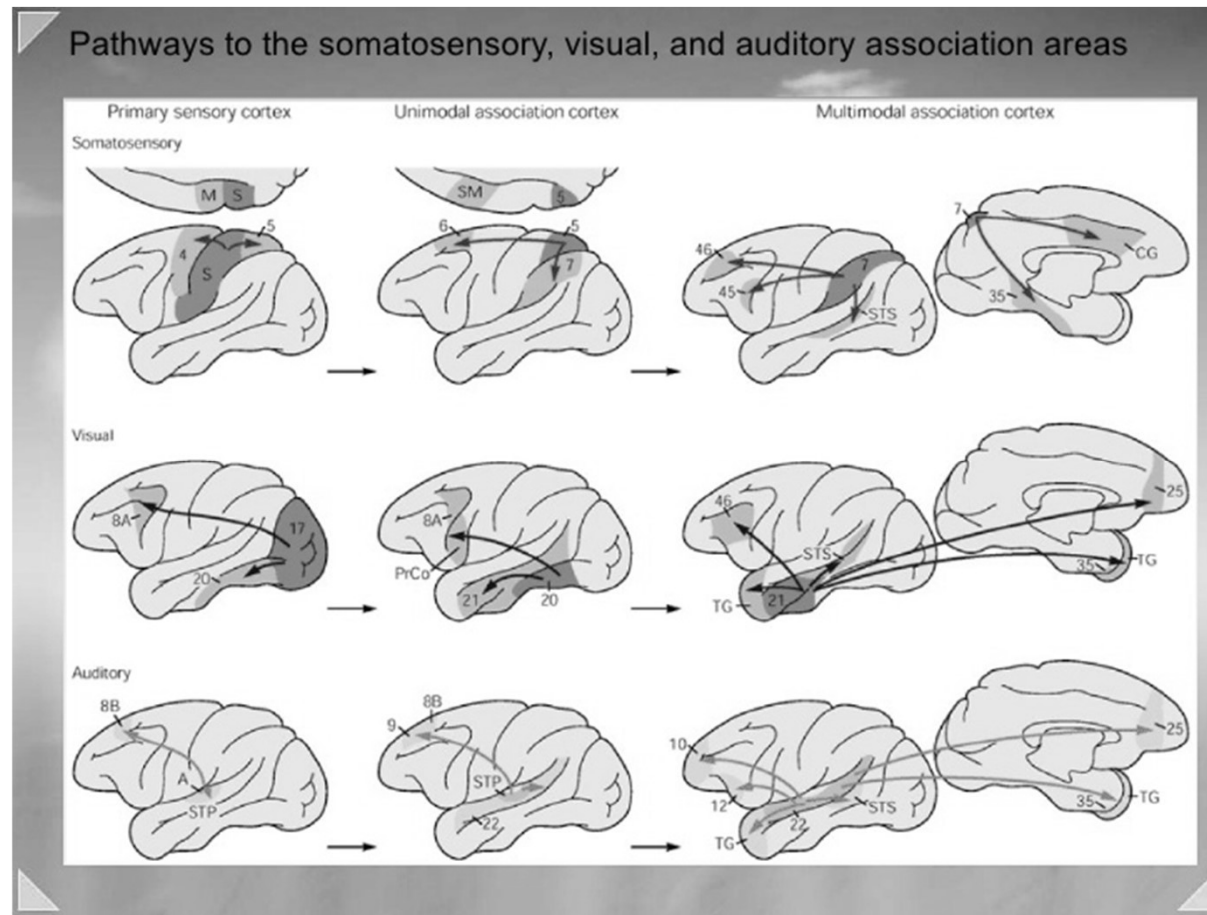
- From the functional point of view, cortex is divided to:
- Primary cortical fields
- Unimodal Association areas
- Multimodal Association areas

Brain cortex

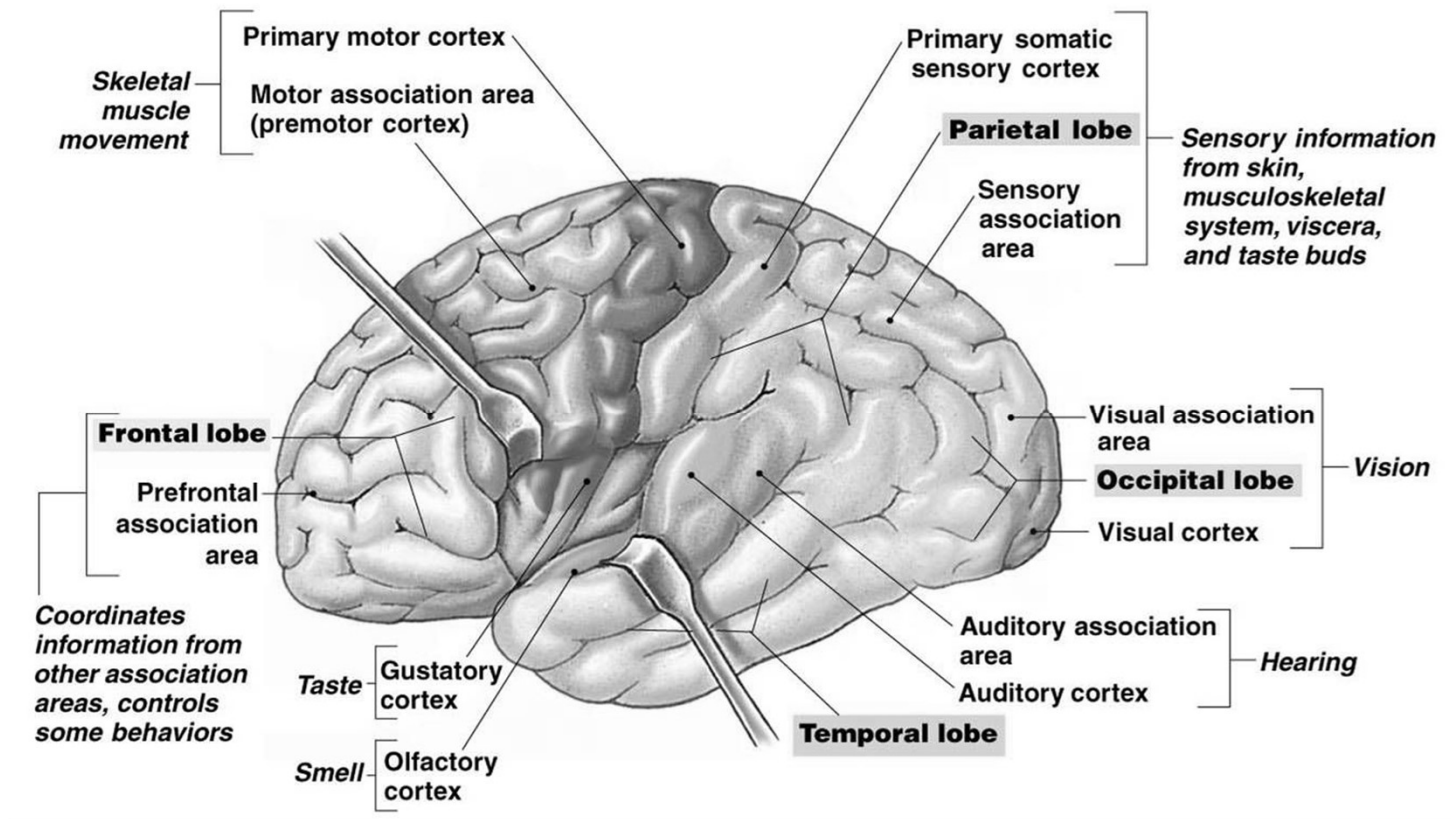
Interaction Among Association Areas Leads to Comprehension, Cognition, and Consciousness



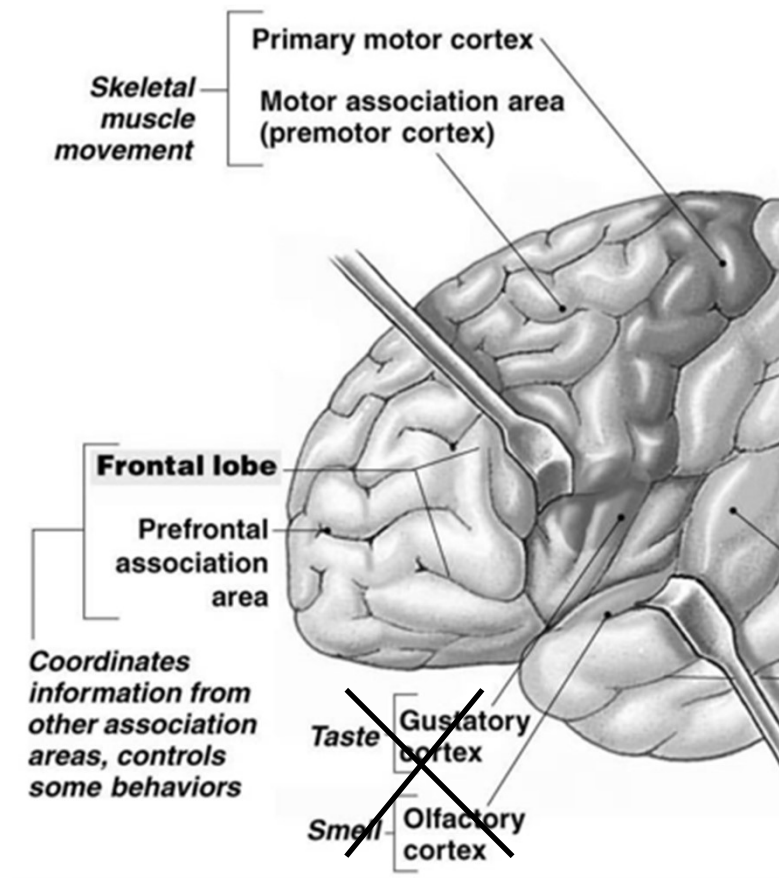
Brain cortex



Cerebral lobes

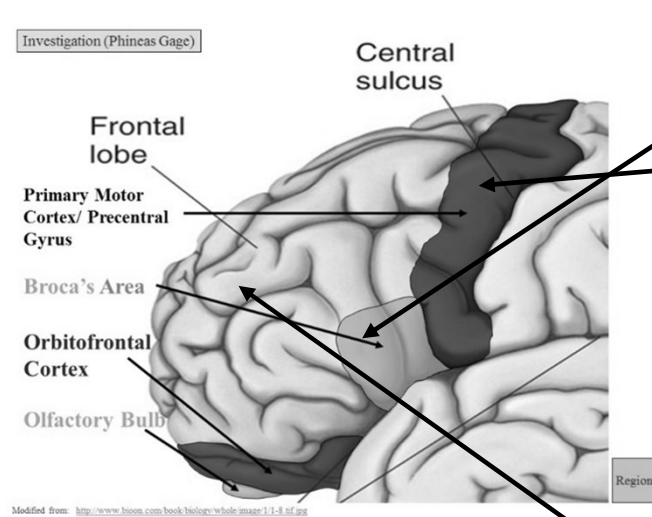


Frontal lobe



- **Speech and language production** - Broca's speech center in the dominant hemisphere (inferior frontal gyrus – Brodmann area 44 and 45)
- **Primary motor cortex** – realization of voluntary movements on contralateral side
- **Center for conjugate gaze**
- Planning complex movements - (dressing, making tea, etc.)
- Attention, concentration
- Working memory – processing of just acquired information
- **Planning, decision making**
- **Emotion and mood management**
- Impulse control
- Social behaviour control

Frontal lobe



- Speech and language production - Broca's speech center in the dominant hemisphere

- Primary motor cortex – realization of voluntary movements on contralateral side

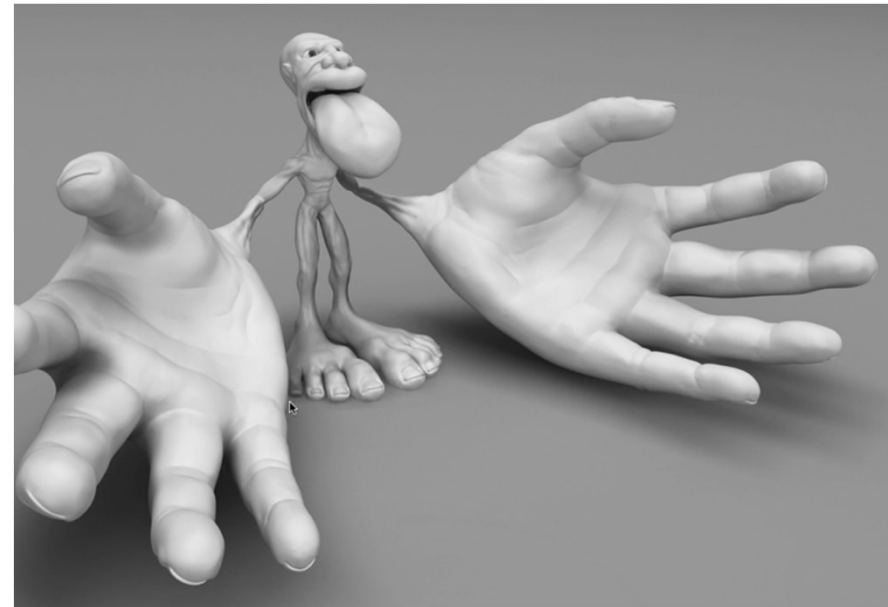
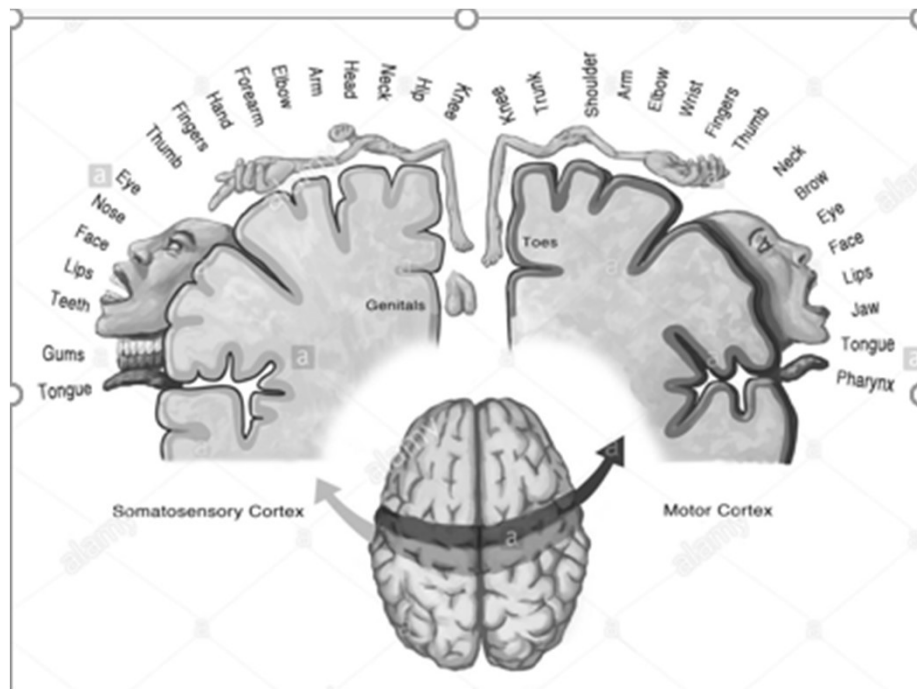
- Planning complex movements - (dressing, making tea, etc.)
- Attention, concentration
- Working memory – processing of just acquired information
- Planning, decision making
- Emotion and mood managementspracovanie práve nadobudnutých informácií
- Impulse control
- Social behaviour control

Frontal lobe

Homunculus

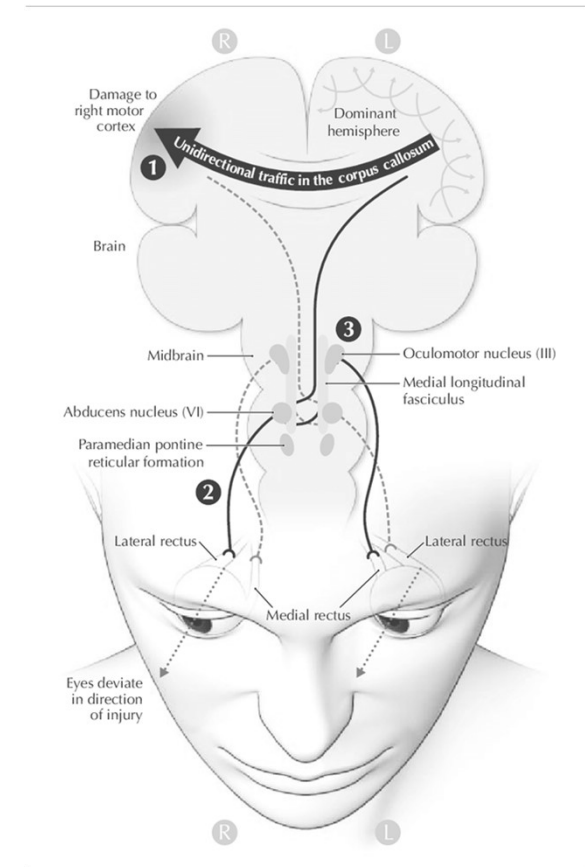
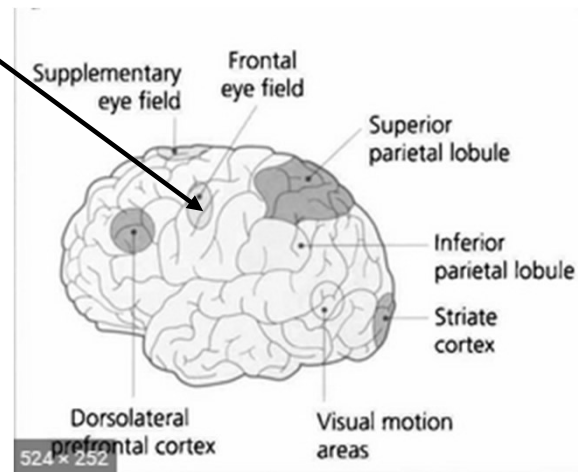
shows the representation of the body parts in precentral (Frontal lobe) and postcentral (Parietal lobe) gyri

shows the relative weighting given to different parts of the body on the primary motor and somatosensory cortex



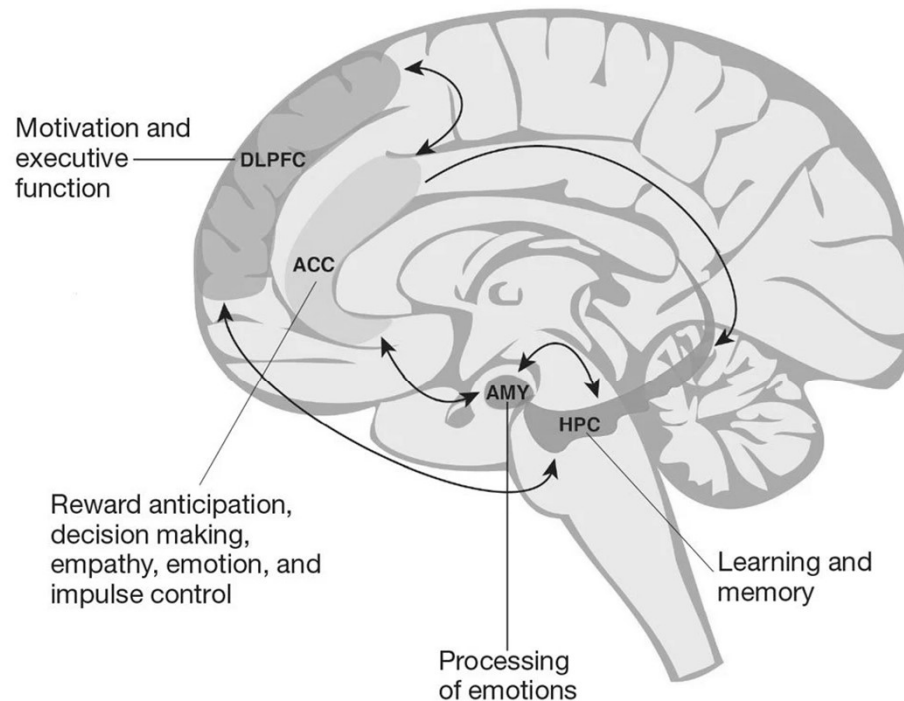
Center for conjugate gaze

- Conjugate gaze is the ability of the eyes to work together or in unison.
- It refers to the motion of both eyes in the same direction at the same time.
- Center in the frontal lobe – Brodman area 8 – responsible for voluntary movements



Frontal lobe

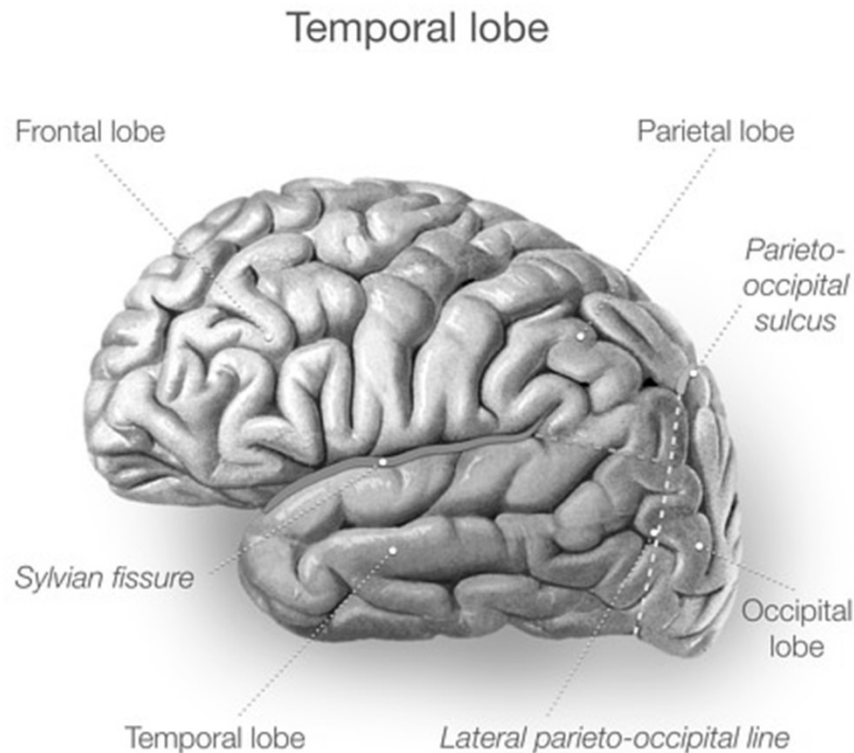
Figure 1. Corticolimbic system



DLPFC, dorsolateral prefrontal cortex; ACC, anterior cingulate cortex; AMY, amygdala; HPC, hippocampus.

- connection to the limbic system
- Planning complex movements - (dressing, making tea, etc.)
- Attention, concentration
- Working memory – processing of just acquired information
- Planning, decision making
- Emotion and mood management
- Impulse control
- Social behaviour control

Temporal lobe



Adapted from illustration from "Sobotta's Textbook and Atlas of Human Anatomy" 1908, now in the public domain.

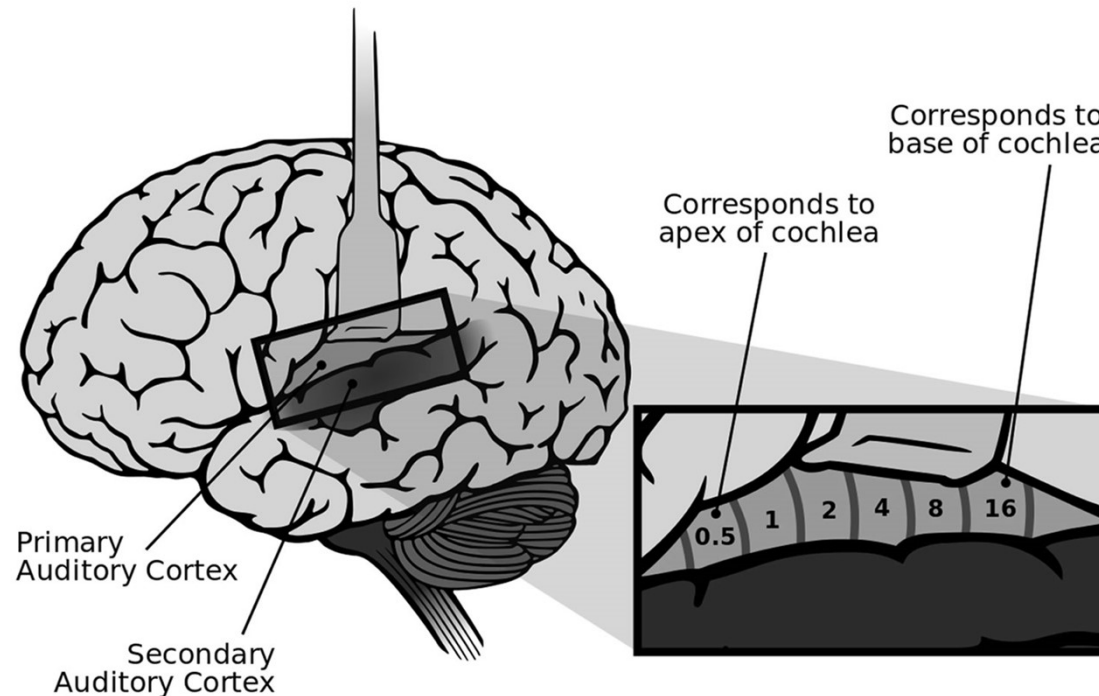


- **Functions:** centers around auditory stimuli, memory, and emotion
- **The primary auditory complex** - responsible for interpreting information in the form of sounds from the ears
- **Wernicke's speech center** – responsible for processing and giving meaning to speech and the written word.
- Plays a role in **understanding** and giving **meaning** to language
- **There is visual aspect** to the temporal lobe as well - helps establish object recognition, including complex objects
- Participates in the **recognition of objects** (in depth there is an optic radiation (stimuli from the opposite visual field))
- **The part of the limbic system** which is involved with motivation, emotion, learning, and memory.

Temporal lobe

The primary auditory complex

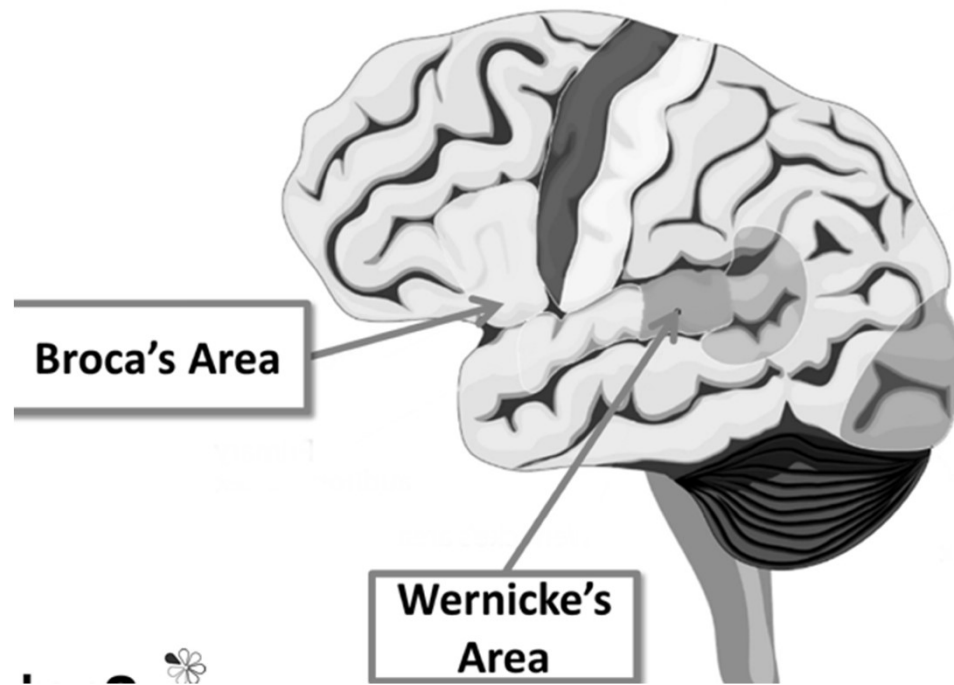
- housed within Heschl gyrus - a region that is positioned posteriorly in the superior temporal lobe within the supratemporal plane
- responsible for interpreting information in the form of sounds from the ears



Temporal lobe

Wernicke's area

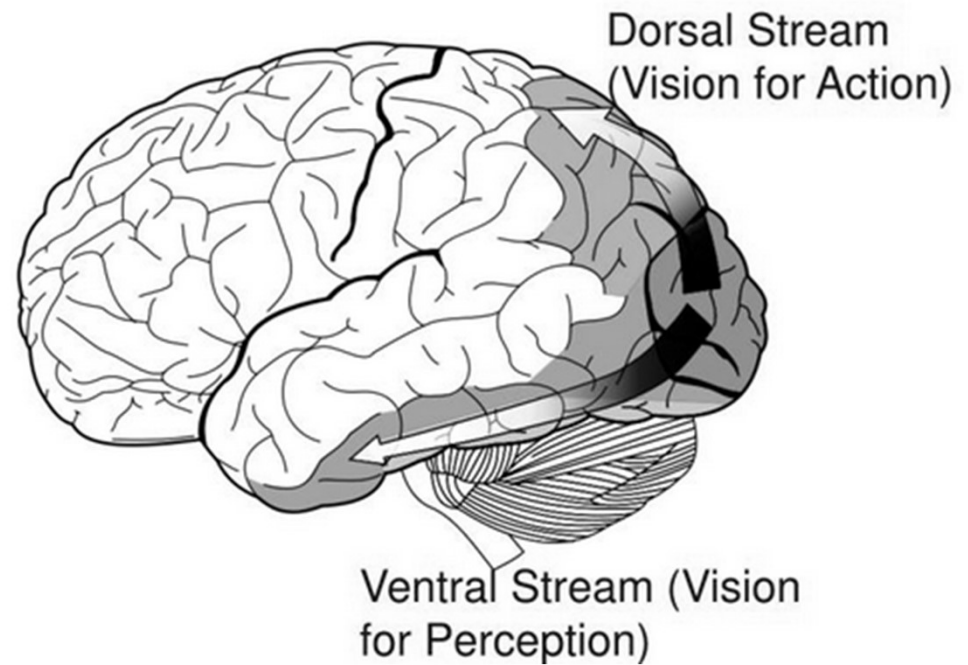
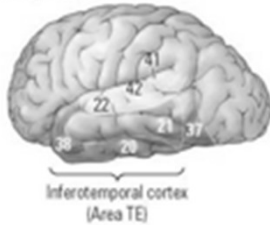
Brodman area 22 - in the superior temporal gyrus in the dominant cerebral hemisphere,



Temporal lobe

object recognition, including complex objects

(B) Auditory and visual areas



Temporal lobe

The part of limbic system

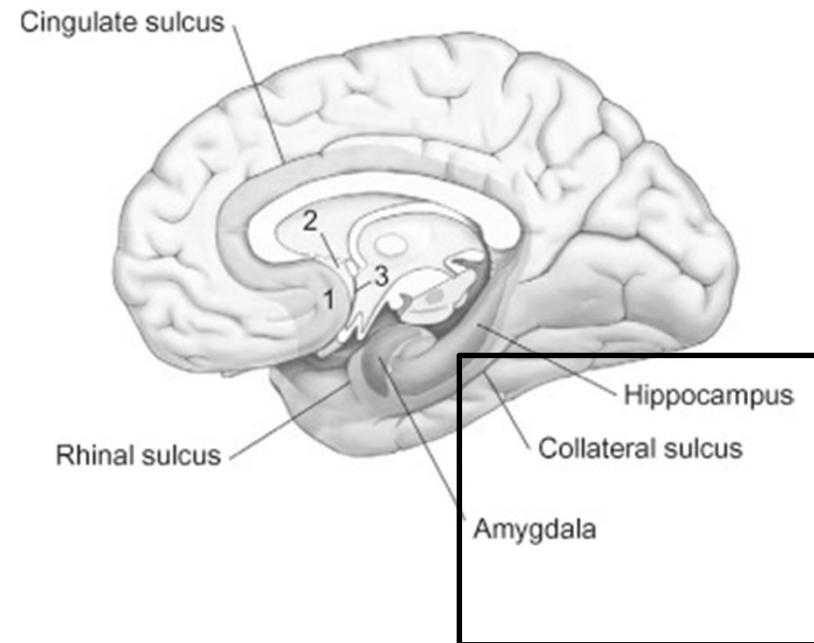
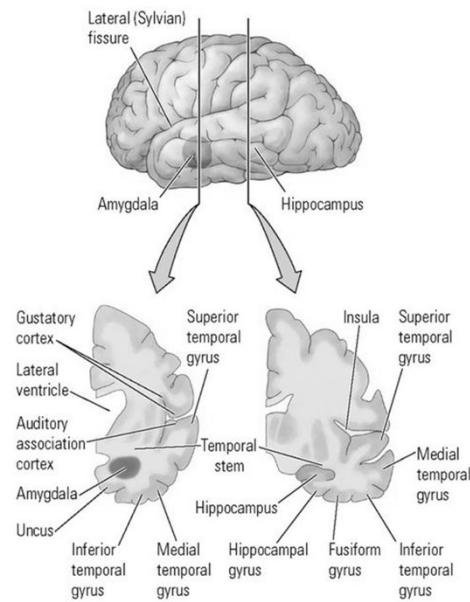
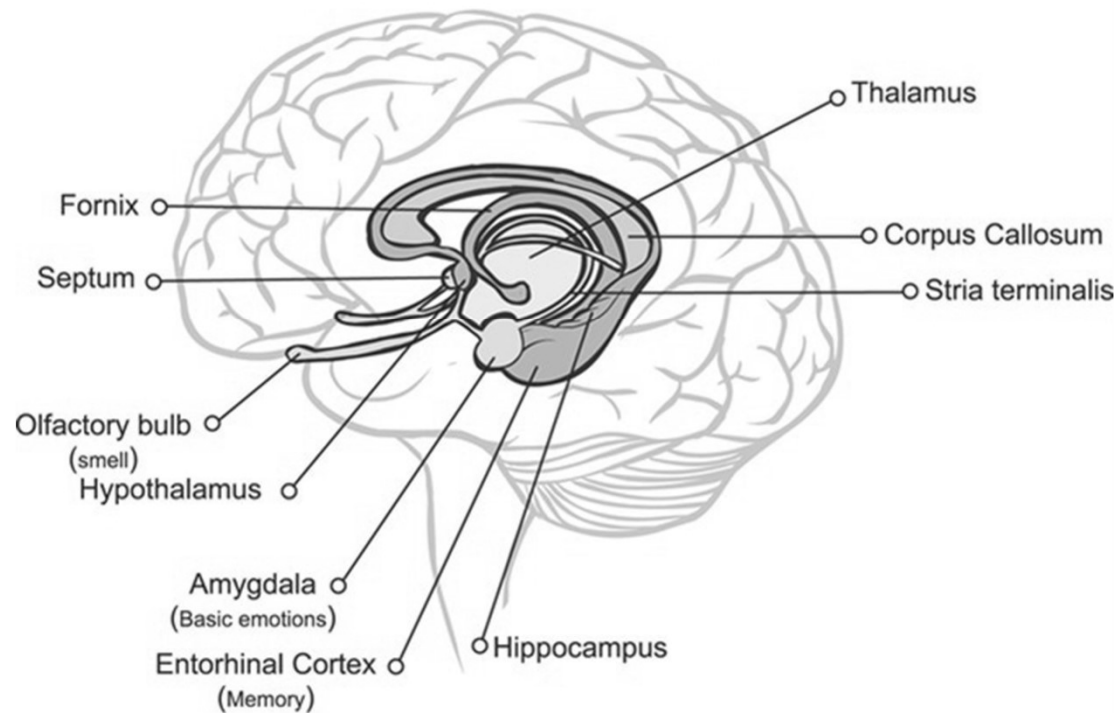


Figure 15.2 Internal Structure of the Temporal Lobe
Kolb/Whishaw: Fundamentals of Human Neuropsychology
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Temporal lobe

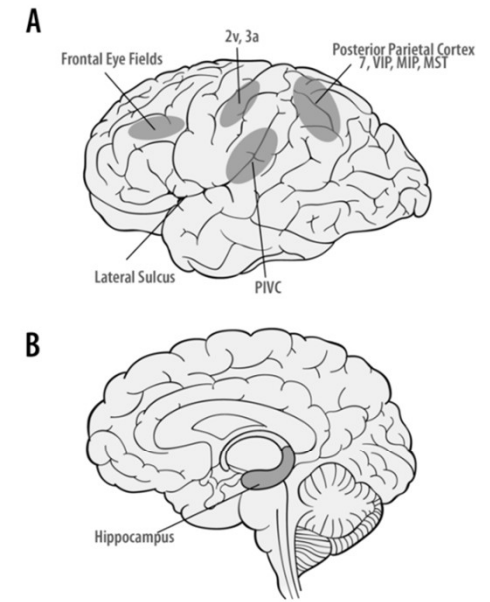
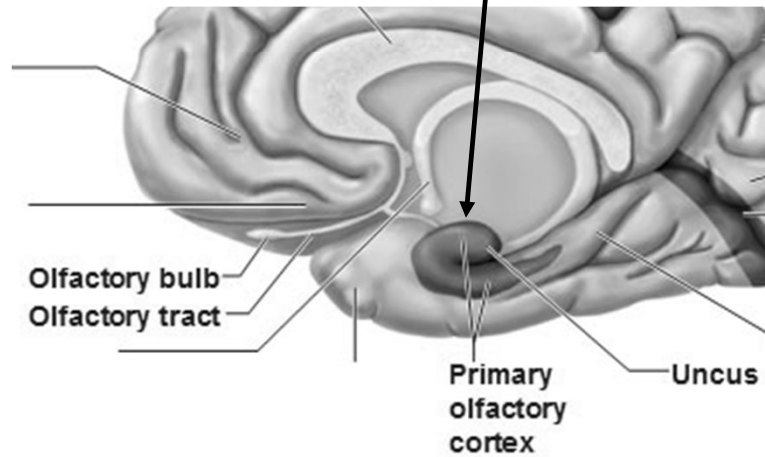
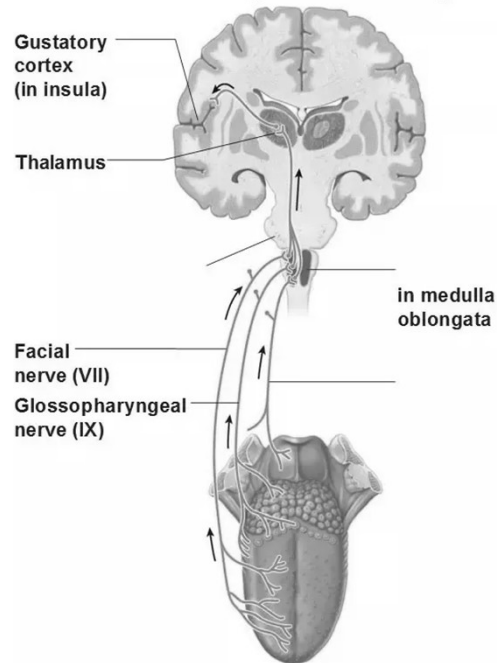
The part of limbic system

The Limbic System

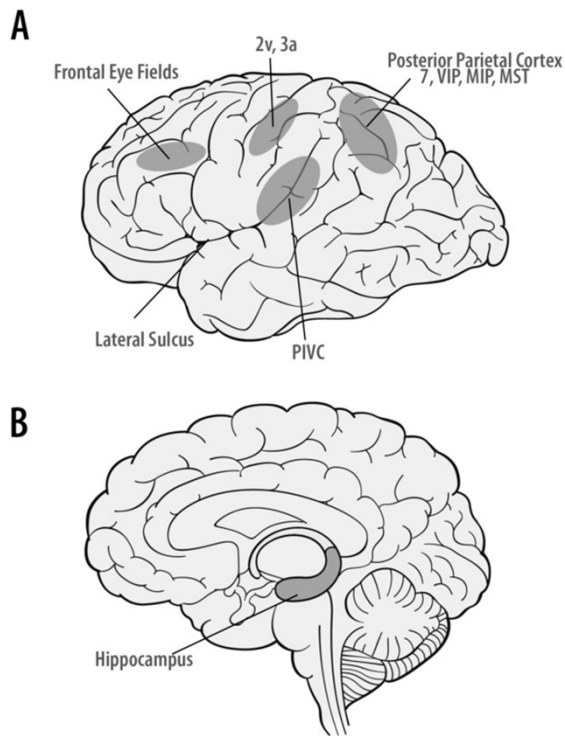


Primary centers for taste, smell, and vestibular

Gustatory Pathway



Cortical regions of the brain known to be involved with vestibular processing

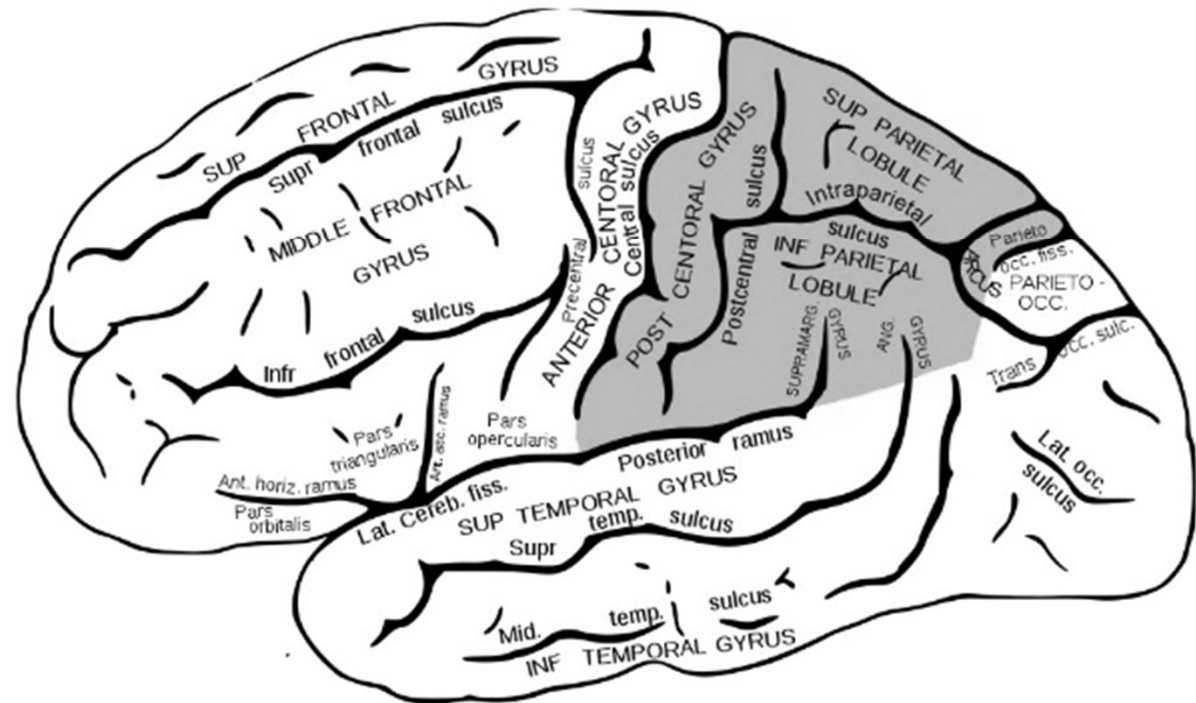
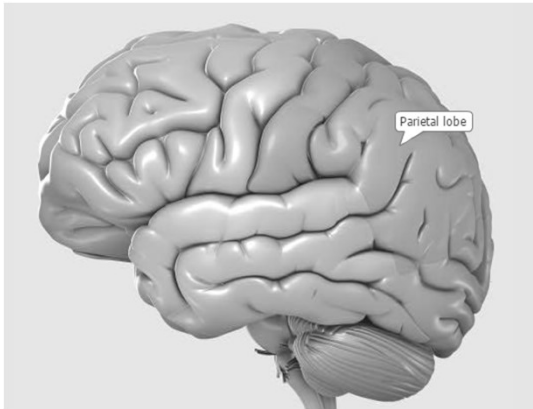


- A) The frontal eye fields control eye movements and receive vestibular motion information.
- Areas 2v and 3a are somatosensory areas that map body location and movement signals.
- Area PIVC (parieto-insular vestibular cortex) responds to body and head motion information.
- The posterior parietal cortex is involved with motion perception and responds to both visual and vestibular motion cues.
- B) The hippocampus and parahippocampal regions are involved with spatial orientation and navigation functions.

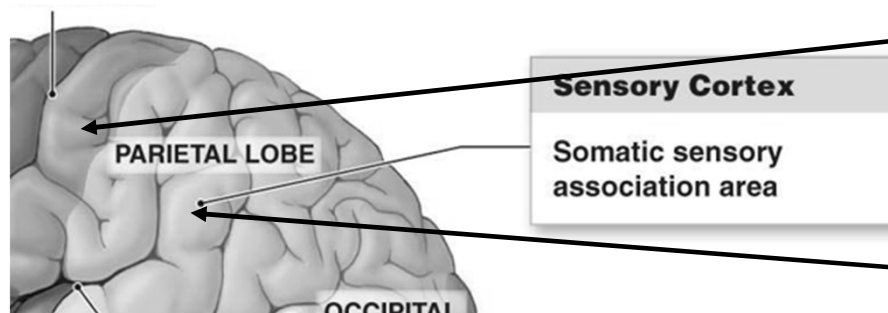
All receive vestibular signals regarding body and head motion.

Parietal lobe

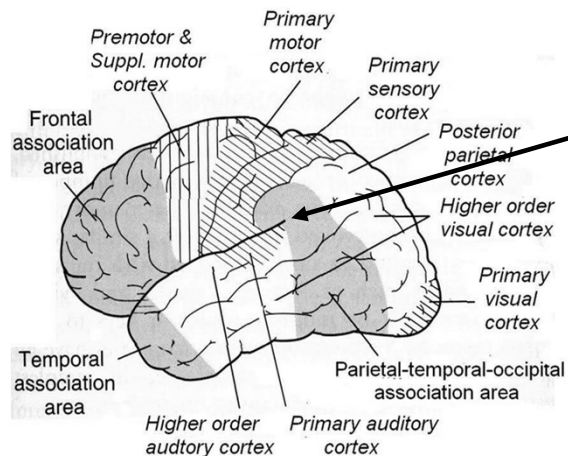
BOUNDARIES OF THE PARIETAL LOBE



Parietal lobe



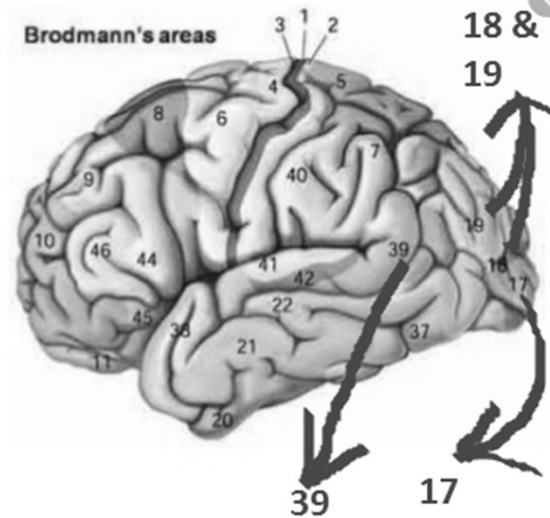
- **Primary sensoric area** – impulses from the skin, such as warmth, cold, pain, and touch, are interpreted
- Essential element of **spatial information**, which gives us the ability to judge size, distance, and shapes.



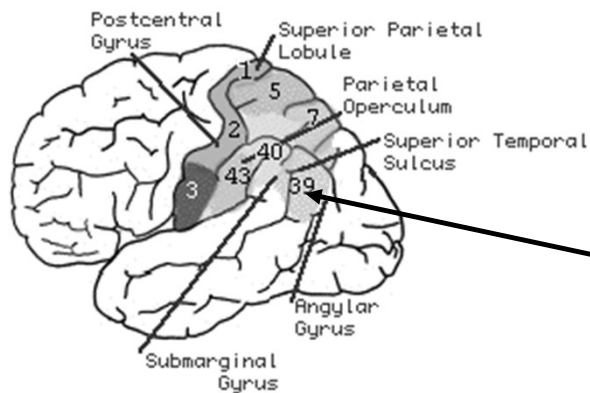
- The **parietal association cortex** gives us the ability to understand written language and solve mathematical problems
- Left hemisphere - for handling the symbolism of letters and numbers, right hemisphere - helps with the interpretation of images and spatial distances within them

Occipital lobe

1. Primary visual area (area 17)
2. Visual association area (area 18 & 19)
3. Higher visual association area (area 39)



- In general, the occipital lobe deals with aspects of vision, including:
- distance
- depth perception
- color determination
- object recognition
- movement
- face recognition
- memory information

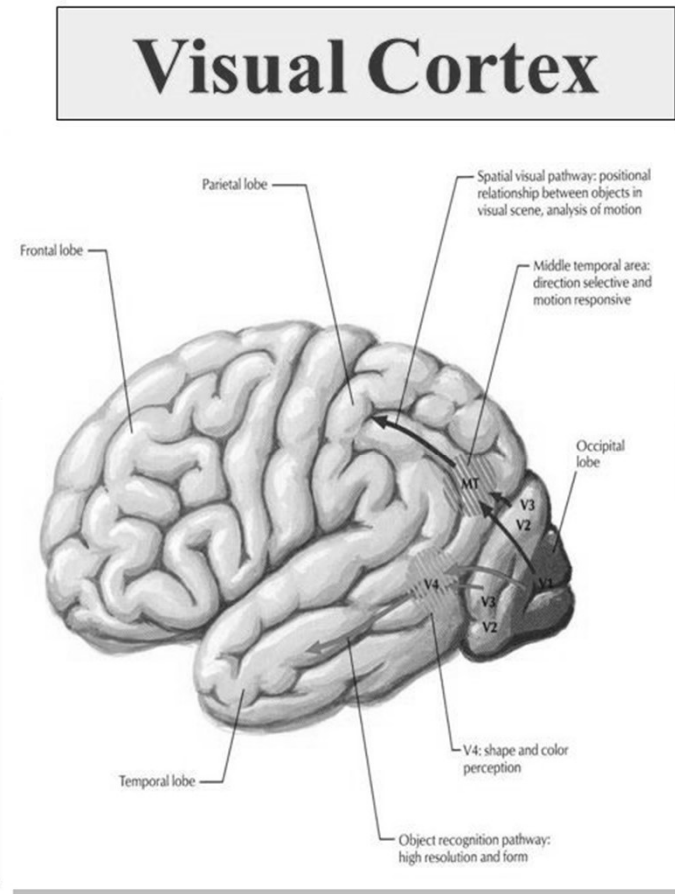


Parietal lobe

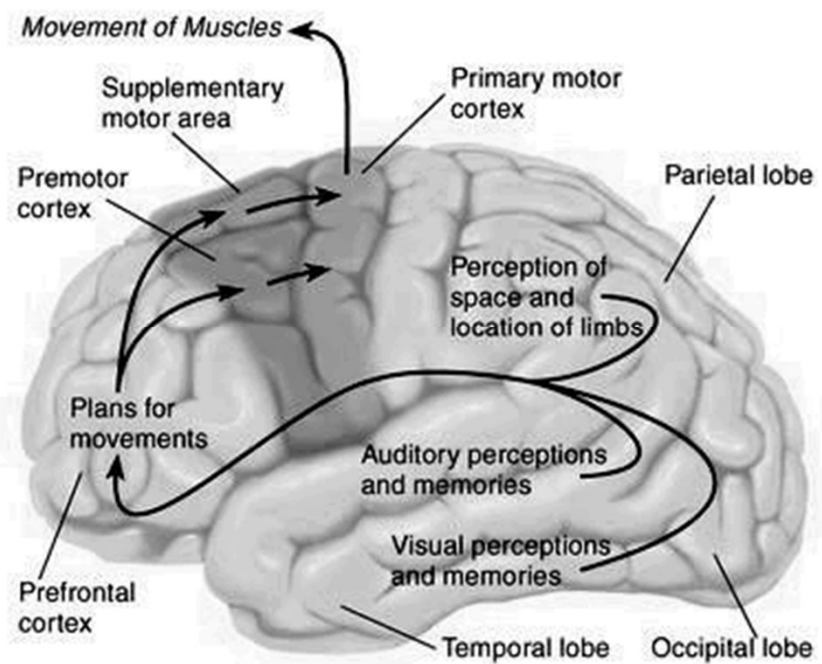
Occipital lobe

- **The primary visual cortex (area 17 of Brodmann's) occupies the upper and lower lips of the calcarine sulcus on the medial surface of the cerebral hemisphere.**

The visual association cortex is extensive, including the whole of the occipital lobe, the adjacent posterior part of the parietal lobe. This cortex is involved in interpretation and recognition of objects and perception of color, depth, motion, and other aspects of vision.



► **Cortical Control of Movement**



Cognitive functions

Cognitive functions are mental processes that allow us to carry out any task.

They allow the subject to have an active role in the processes of receiving, choosing, transforming, storing, processing and retrieval of information, allowing the subject to navigate the world around him.

- Fatic
- Gnosis
- Praxis

Language

- Language is a high-level cognitive function that develops processes of symbolization related to encoding and decoding.
- **Expression:** ability to formulate ideas in a meaningful and grammatically correct manner.
- **Comprehension:** ability to understand the meaning of words and ideas.
- **Vocabulary:** lexical knowledge.
- **Naming:** ability to name objects, people or events.
- **Fluency:** ability to produce fast and effective linguistic content.
- **Discrimination:** ability to recognize, distinguish and interpret language-related content.
- **Repetition:** ability to produce the same sounds one hears.
- **Writing:** ability to transform ideas into symbols, characters and images.
- **Reading:** ability to interpret symbols, characters and images and transform them into speech.

Gnosis

- The ability of the brain to recognize previously learned information such as objects, persons, or places collected from our senses.
- **Visual gnosis:** ability to visually recognize various elements and attribute meaning to them (objects, faces, places, colors, etc.).
- **Auditory gnosis:** ability to recognize and differentiate between various sounds.
- **Tactile gnosis:** ability to recognize various objects by touch (textures, temperatures, etc.) - **Stereognosia**
- **Olfactory gnosis:** ability to recognize, by smell, different odors.
- **Gustatory gnosis:** ability to recognize, through taste, different flavors.
- **Body schema:** ability to recognize and mentally perceive the body as a whole and its various parts, development of the movements that can be done with each, and orientation of the body in space.

Praxis

- Praxis refers to learned motor activity.
- Praxis is the generation of volitional movement for the performance of a particular action or towards achieving a goal.
- Different types of praxis include:
 - **Ideomotor praxis:** ability to intentionally make a movement or a simple gesture.
 - **Ideational praxis:** ability to manipulate objects through a sequence of actions, which implies the knowledge of the object's function, knowledge of the action and knowledge of the serial order of the acts leading to that action.
 - **Facial praxis:** ability to voluntarily make movements or gestures with different parts of the face (lips, tongue, eyes, eyebrows, cheeks, etc.).
 - **Visuoconstructive praxis:** ability to plan and make the movements necessary in order to organize a series of elements in space to form a drawing or completed 3-D figures.

Cognitive functions pathology

- Non-fluent (expressive or motor aphasia) speech output is severely reduced, while understanding of speech is preserved
- Inferior frontal gyrus (Broca's area) – dominant h.
- Non-fluency – the reduced rate of word production
- Perseveration – repeating of last words
- Amnesic aphasia – unable to recall the words
- Agrammatism - faults of speech are grammatical

Cognitive functions pathology

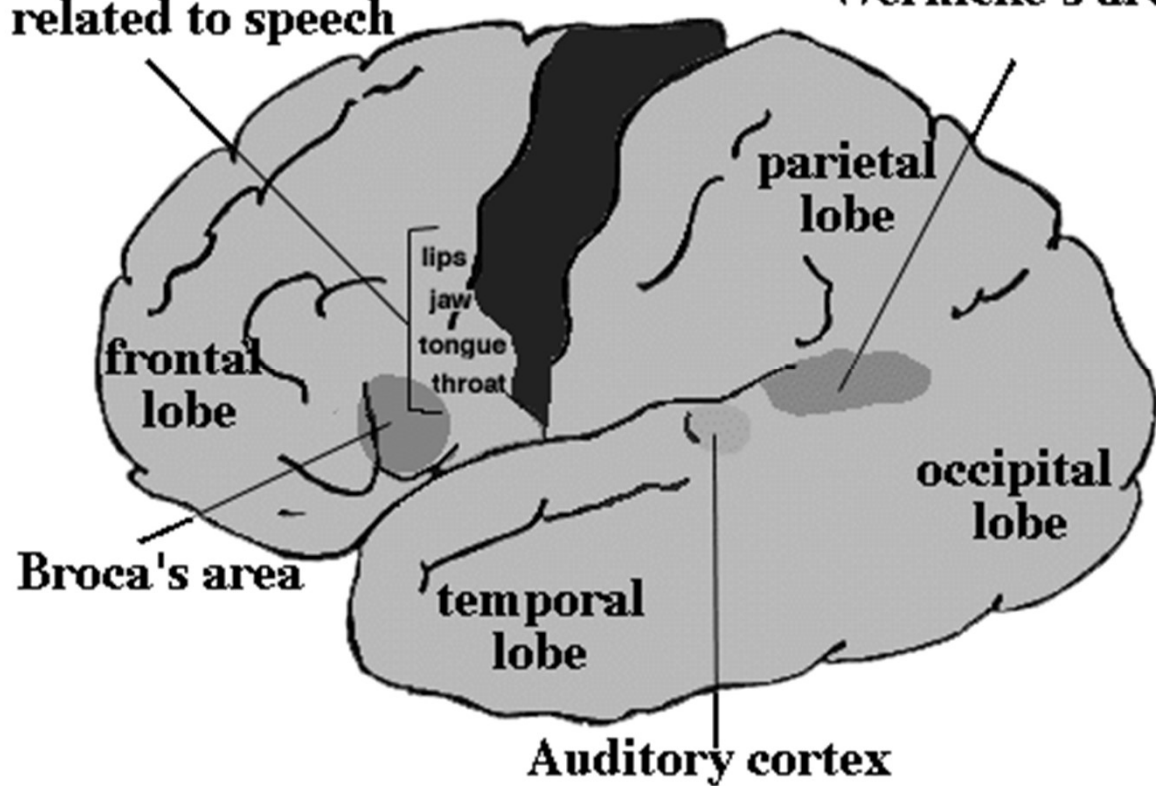
- Fluent (Sensory or receptive) aphasia
- the ability to grasp the meaning of spoken words is chiefly impaired
- inability to understand the speech,
- inability to recognize words leads to a disorder of both comprehension and expression of meaning by spoken words
- Superior temporal gyrus (Wernicke's area) – dom. h.
- Speech is fluent – patient does not know his faults, logorrhoe

Cognitive functions pathology

- Patient does not understand his own speech – he is talking nonsense – jargon aphasia
- Paraphasia – patient speaks words in a different sense

**Motor projection areas
related to speech**

Wernicke's area



**frontal
lobe**

**parietal
lobe**

**occipital
lobe**

Broca's area

**temporal
lobe**

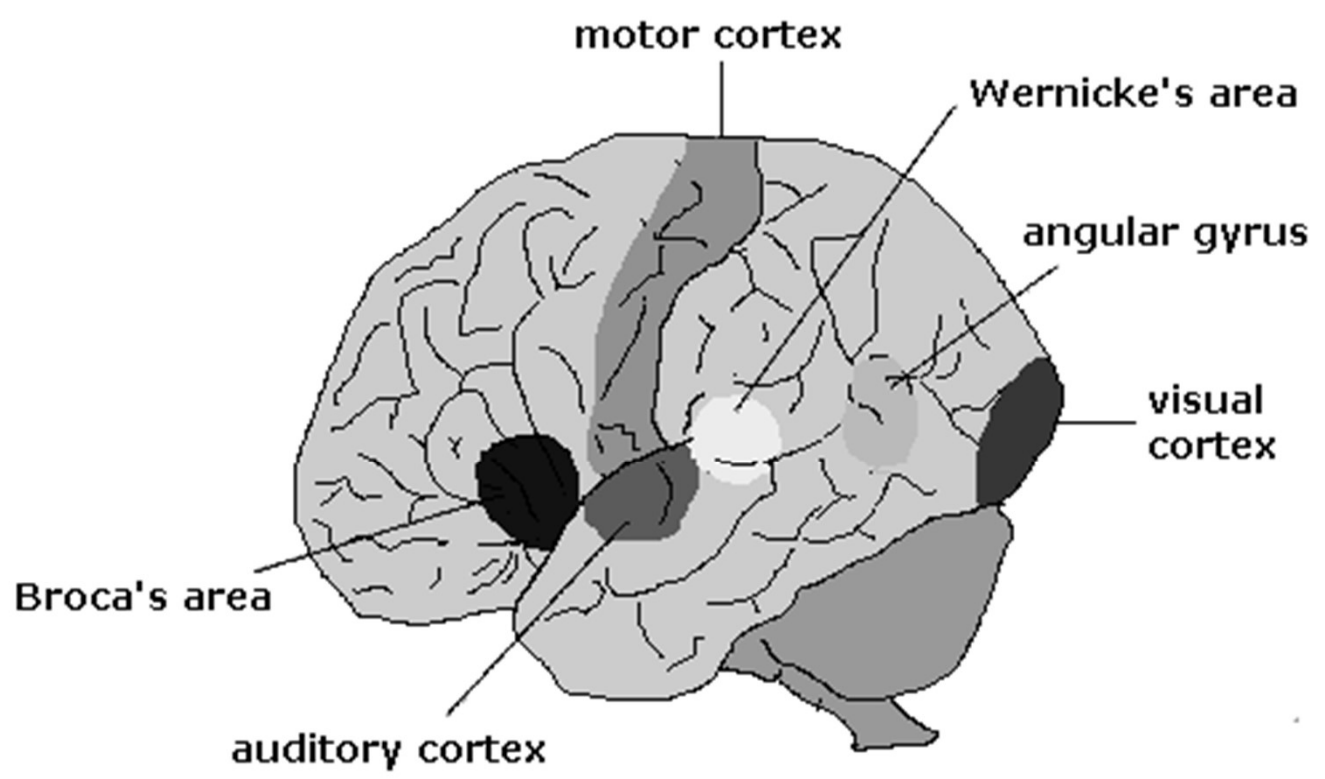
Auditory cortex

Cognitive functions pathology

- Agraphia
- total or partial inability to write, moving with write upper extremity is protected
- loss or impairment of the ability to produce written language
- Medial frontal gyrus– dom. h.
- Pure agraphia is very rare, usually is with expressive aphasia – Broca's aphasia

Cognitive functions pathology

- Alexia
- inability reading aloud, understanding the meaning of written words, or both
- inability to comprehend the *meaning* of written or printed words and sentences
- Angular gyrus dom. h. (between visual and auditory analysers)
- Splenium corporis callosi – connection with visual centres



Speech Areas

Cognitive functions pathology

- Visual agnosia – inability to visually recognize various elements and attribute meaning to them
- Parieto - occipital lobe – left hemisphere
- Subjects identify objects by touch
- Avoid obstacles, but objects does not recognize

Cognitive functions pathology

- Acalculia – lack or loss of the ability to perform simple arithmetic tasks – parietal lobe, angular gyrus – dom.h.
- Amusia – upper temporal gyrus
- Astereognosia – inability recognise objects by touch- parietal lobe – in non-dominant hemisphere
- Autotopagnosia – failure to recognize part of the body parietal lobe
- Anosognosia – the patient dose not percieve his own defect - parietal lobe – in non-dominant hemisphere

Cognitive functions pathology

- Apraxia – inability to carry out a purposive movement the nature of which patient understands
- Ideational (senzoric) apraxia: inability to manipulate objects through a sequence of actions – patient does not understand how to do something
- The patient does not know what to do with object
- Parietal lobe, supramarginal gyrus
- Ideomotor apraxia – inability to intentionally make a movement or a simple gesture.
- The patient does not know realise the movement, but he knows how he should do it
- Frontal lobe near precentral gyrus

Prefrontal syndrom

- In front of precentral gyrus
- Behaviour problems
 - decreased of spontaneity and initiation
 - apathy, sleeping, coma frontale
 - euphoria, joking
 - gatizm – loos of the social behaviour

Prefrontal syndrom

- Frontal ataxia - astazia and abazia
lesion of frontopontocerebellar pathways
Rhomebrg sign - negative
- Deliberation
grasping reflex
saccing reflex

Rolandic syndromes

- Motoric rolandic syndrom - precentral gyrus (Frontal lobe)
 - contralateral central monoplegia - crural, brachial, facial
 - diplegia spastica - parasagittal proces
 - contralateral signs of irritation - seizures of tonic – clonic convulsions - facial, brachial, crural type (Jackson motoric epilepsy)

Rolandic syndromes

- Retrorolandic syndrom - postcentral gyrus
 - irritant signs - pcontralateral aresthesias (Jackson sensitive epilepsy)
 - hypofunction - contralateral hypesthesia or anesthesia - crural, brachial type

Parietal lobe syndromes

Retrorolnadic syndrom +

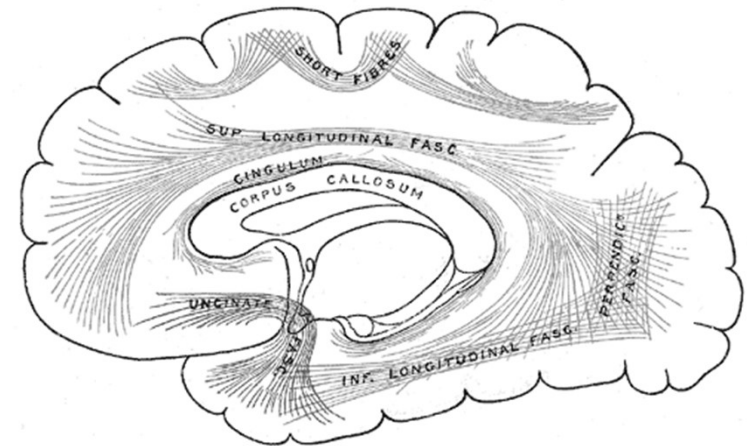
- astereognosia
- autotopagnosia
- anosognosia
- sensoric apraxia

Temporal lobe syndromes

- Sensoric aphasia, amusia
- Dreamy states, paroxysmal (defect of putting experience to the memory) – illusion de ja vu, de j'aime vu

Temporal lobe syndromes

- Uncinate crisis - smell, taste pseudohalucination – irritation of uncinus fasciculus - bi-directional pathway between the temporal lobe and frontal lobe
- Auditory disturbances – auditory pseudohalucination
- Vestibular syndrome – dizziness
- Visual disturbances quadrant contralateral hemianopia



Occipital lobe syndromes

- Irritation signs – blinking phosphens, scotoma scintilans, visual pseudohalucination
- Hypofunction
 - – scotomas – fissura calcarina
 - - homonymous hemianopia – global, quadrant
 - - Cortical blindness
- Visual agnosia

Disconnection syndromes

- Interruption of corpus callosum
- Incapacity to transfer visual or tactile information or information concerning language from one hemisphere to the other
- Patient does not give name to object which was recognized by sense with representation in right hemisphere
- Recognize object by left hand, does not know to give him name
- Sensitivity LUE – representation in right hemisphere
- Representation of speech in left hemisphere
- Subjects recognized by RUE – possible to give names