

# Neocortex

Organisation, Function, Lateralization

# Neocortex

## Organisation:

- Histology
- Brodmann Areas

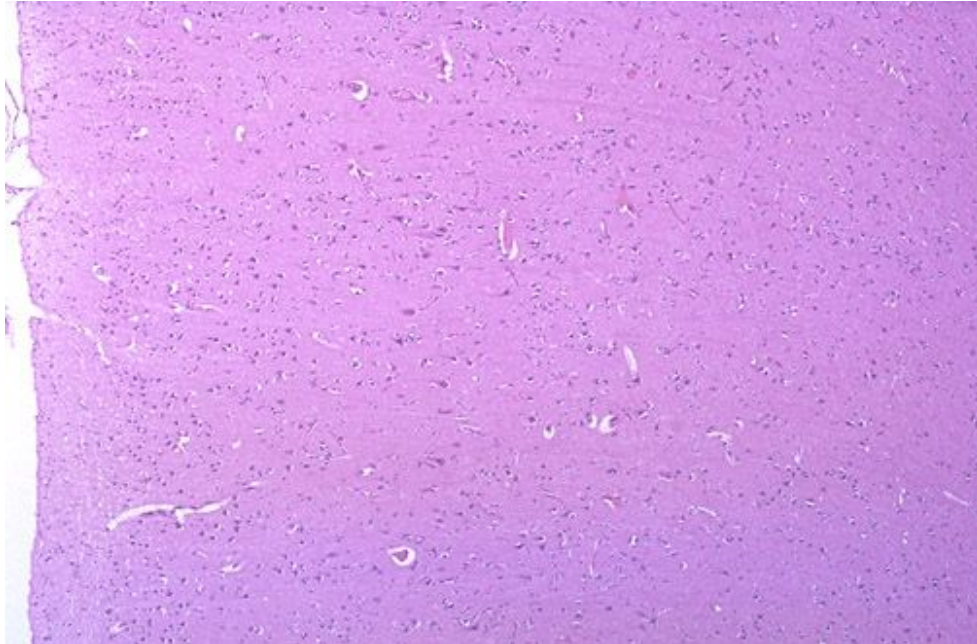
## Function:

- Lobes
- Examples

## Lateralization:

- Language
- Sensory Processing
- Clinical significance

# Organization: Histology



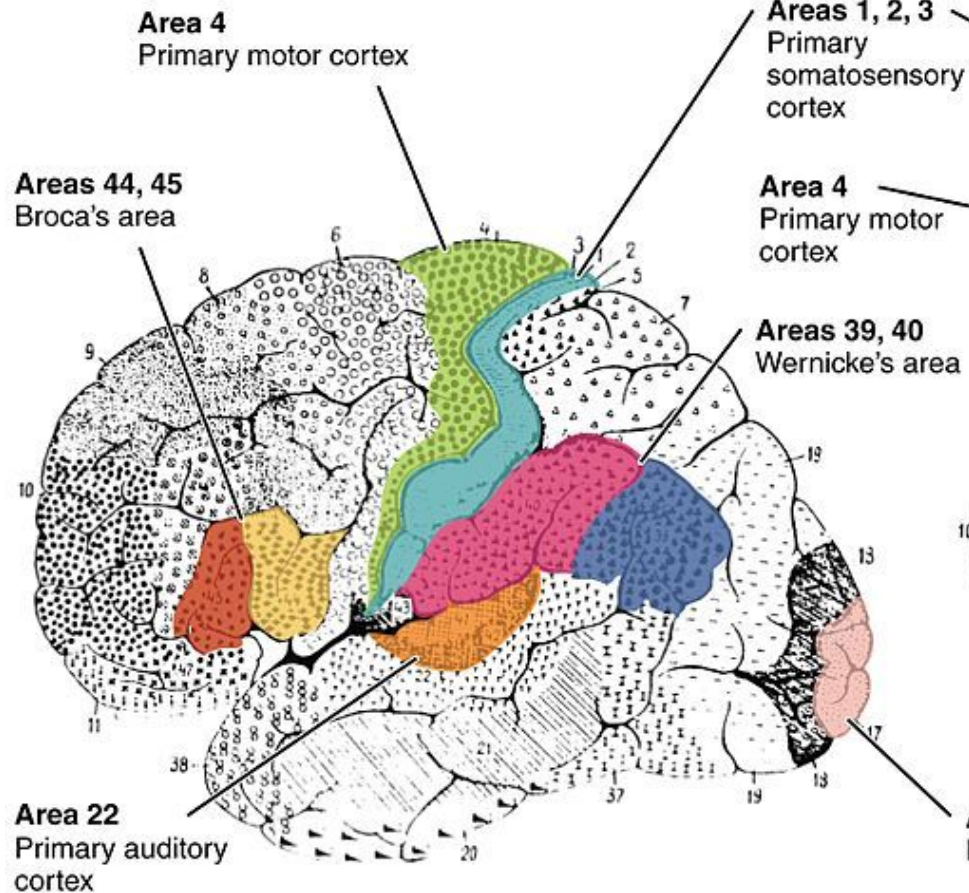
(left → right)

- I. Plexiform layer
- II. Outer granular layer
- III. Outer pyramidal layer
- IV. Inner granular layer
- V. Inner pyramidal layer
- VI. Polymorphous layer

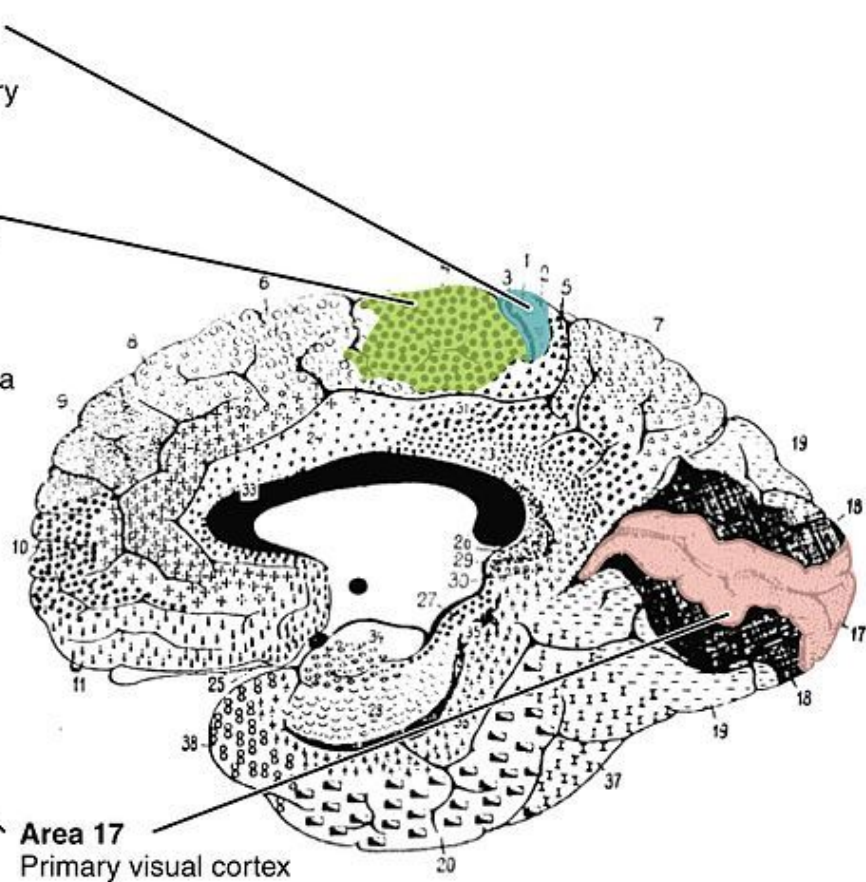
<https://webpath.med.utah.edu/HISTHTML/NORMAL/NORM180.html>

# Organization: Brodmann Areas [https://en.wikipedia.org/wiki/Brodmann\\_area](https://en.wikipedia.org/wiki/Brodmann_area)

- Defined by histological structure and organization of cells (Nissl staining)
- Not identical in all individuals
- 52 Areas:
  - 1, 2 & 3: 1° Somatosensory cortex
  - 4: 1° Motor cortex
  - 17: 1° Visual cortex
  - 41 & 42: 1° Auditory cortex
  - 43: 1° Gustatory complex
  - 44 & 45: Broca's Area



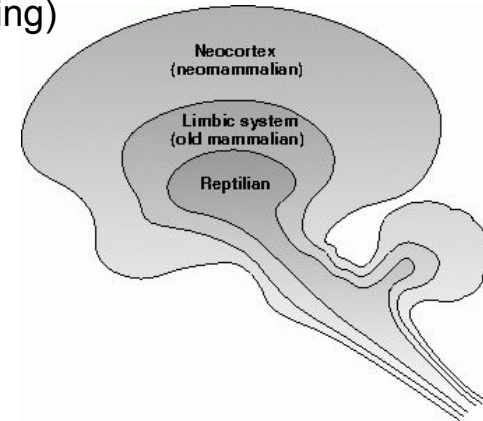
**Brodman's cytoarchitectonic map (1909):**  
Lateral surface



**Brodman's cytoarchitectonic map (1909):**  
Medial surface

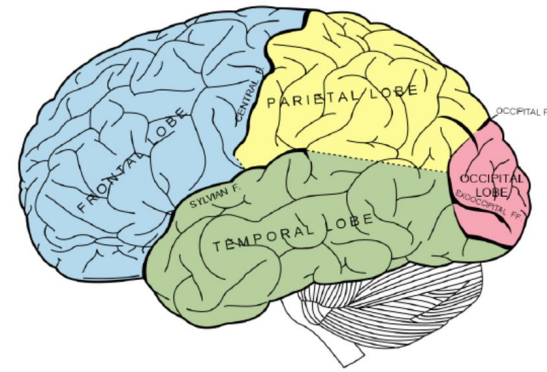
# Function of the neocortex

- Consists of **grey matter** surrounding the white matter of the cerebrum
  - 76% of grey matter
- High precision in planning complex behaviour & sensory processing
- Rodents & small animals have a smooth neocortex, birds & reptiles don't have a neocortex
- Higher cognitive functioning responsible for:
  - attention, thought, perception & episodic memory
- Sleep: neocortex stays active in the slow wave period of sleep
  - Critical for memory consolidation (sleep dependent memory processing)
  - Neurons move btw rest & depolarization during sleep
- Neurons:
  - 80% = excitatory
  - 20% = inhibitory



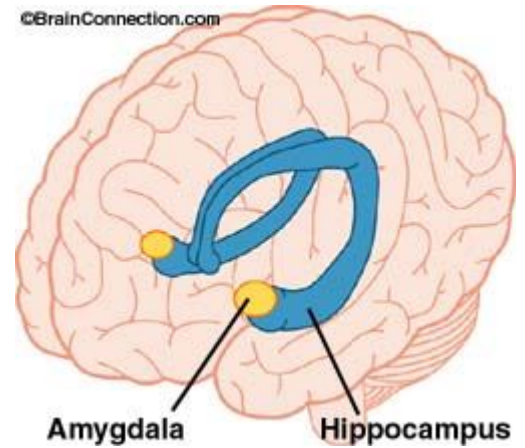
# Function: Frontal Lobe

- Selection & coordination of goal-directed behavior
- Task switching
- Reinforcement
- Learning
- Decision-making
- Disorders:
  - Dementia
  - Parkinson's disease
  - Alzheimer's disease



# Function: Temporal Lobe

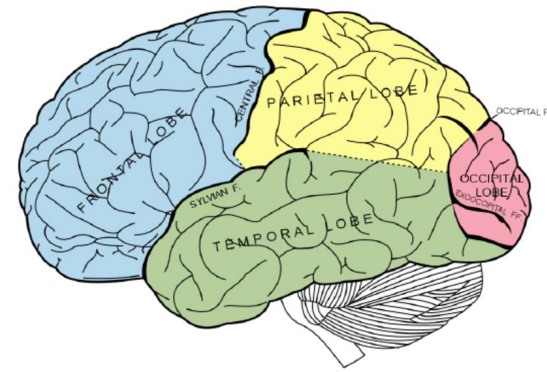
- houses Hippocampus & Amygdala
- Processing of sensory information
- Language
- Emotions
- Meaningful memories
- Declarative memory
  - Semantic memory (what)
  - Episodic memory (when & where)





# Function: Parietal Lobe

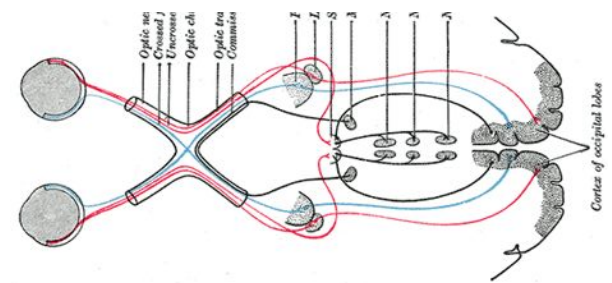
- 'association cortex'
- Decision-making
- Numerical cognition
- Processing of sensory information
- Spatial awareness



# Function: Occipital Lobe

- Visual perception

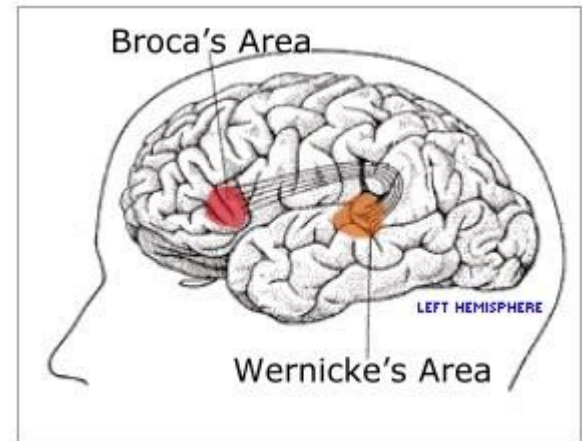
# Lateralization: Sensory processing



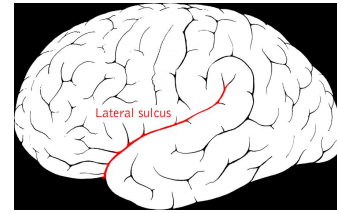
- Vision:
  - Half of the N.s of Optic N from each eye cross to the opposite hemisphere, the other half do not change hemisphere
  - **Left** side of visual field is processed largely by visual cortex of the **right** hemisphere ( & vice versa)
- Hearing:
  - 90% of Auditory N. from one ear cross to project to the auditory cortex of the opposite hemisphere
- Touch:
  - most N. from skin cross to the somatosensory cortex of the opposite hemisphere
- Value systems of hemispheres:
  - **Left hemisphere:** tends to reduce complex matters (ex.: ethics) to rules & measures
  - **Right hemisphere:** is responsible for holistic & metaphorical matters

# Lateralization: Language (**Left**)

- Grammar, vocabulary & literal meaning -- lateralized to the **Left** hemisphere
- **Left** lateralization in 90% of R-Handers, **bilateral** in 50% of L-Handers
- 2 Language areas:
  - Broca's Area:
    - Location: left inferior frontal hemisphere
    - speech production
  - Wernicke's Area:
    - Location: left hemisphere, above the Lateral sulcus
    - speech comprehension



# Clinical significance



- Depression: linked with hyperactive **Right** hemisphere
- Damage Left:
  - impaired language production & perception
- Damage Right:
  - reduced ability to:
    - understanding discourse
    - generate judgment
    - comprehend & produce main concepts
    - manage alternative meanings
- Broca's aphasia:
  - expressive & non-fluent aphasia (partial loss of ability to produce language)
  - Patient understands you, can not formulate thoughts themselves
  - Broca's area is critical for language pronunciation & production
  - The area controls some motor aspects of speech production & articulation of thoughts --> words
- Wernicke's aphasia:
  - Fluent aphasia, ability to speak fluently with normal melodic intonation
    - Healthy people don't understand, nonsensical chatter
  - deficit in language comprehension, can often not understand healthy person's speech