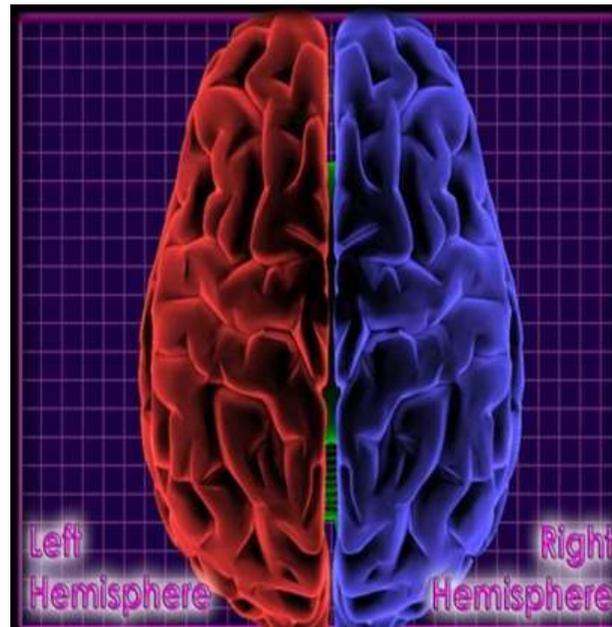


## CEREBRAL CORTEX

- External features.
- Cortical functional areas.
- Phylogenetical division of cerebral cortex.
- Histological structure.
- Areas , connections, functions & applied aspects.



### Poles

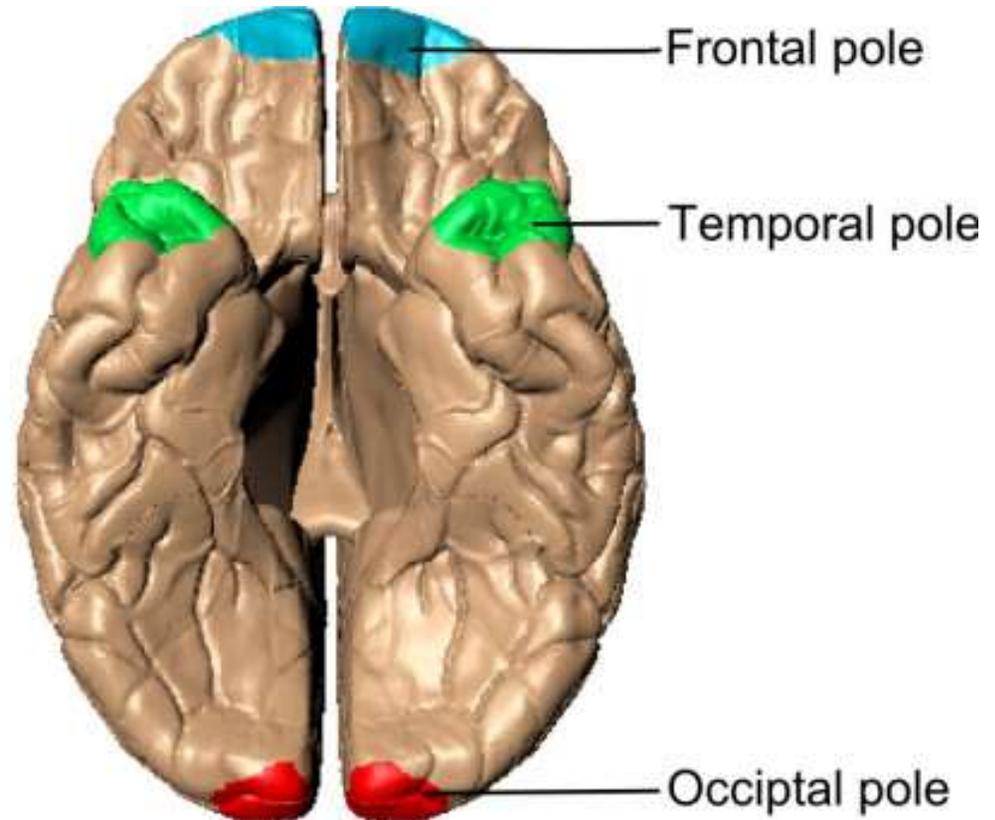
- Frontal
- Occipital
- Temporal.

### Surfaces

- Superolateral
- Medial
- Inferior.

### Borders

- Superomedial
- Inferolateral
- Medial.



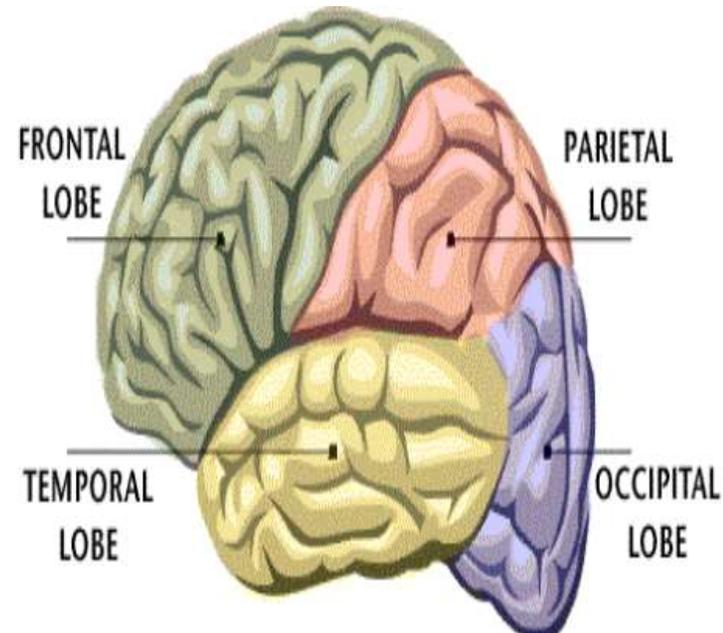
- Sulci & Gyri
- Surface area of cortex–2200cm<sup>2</sup>
- Lobes of cerebral hemispheres

Frontal – Motor.

Parietal – Sensory.

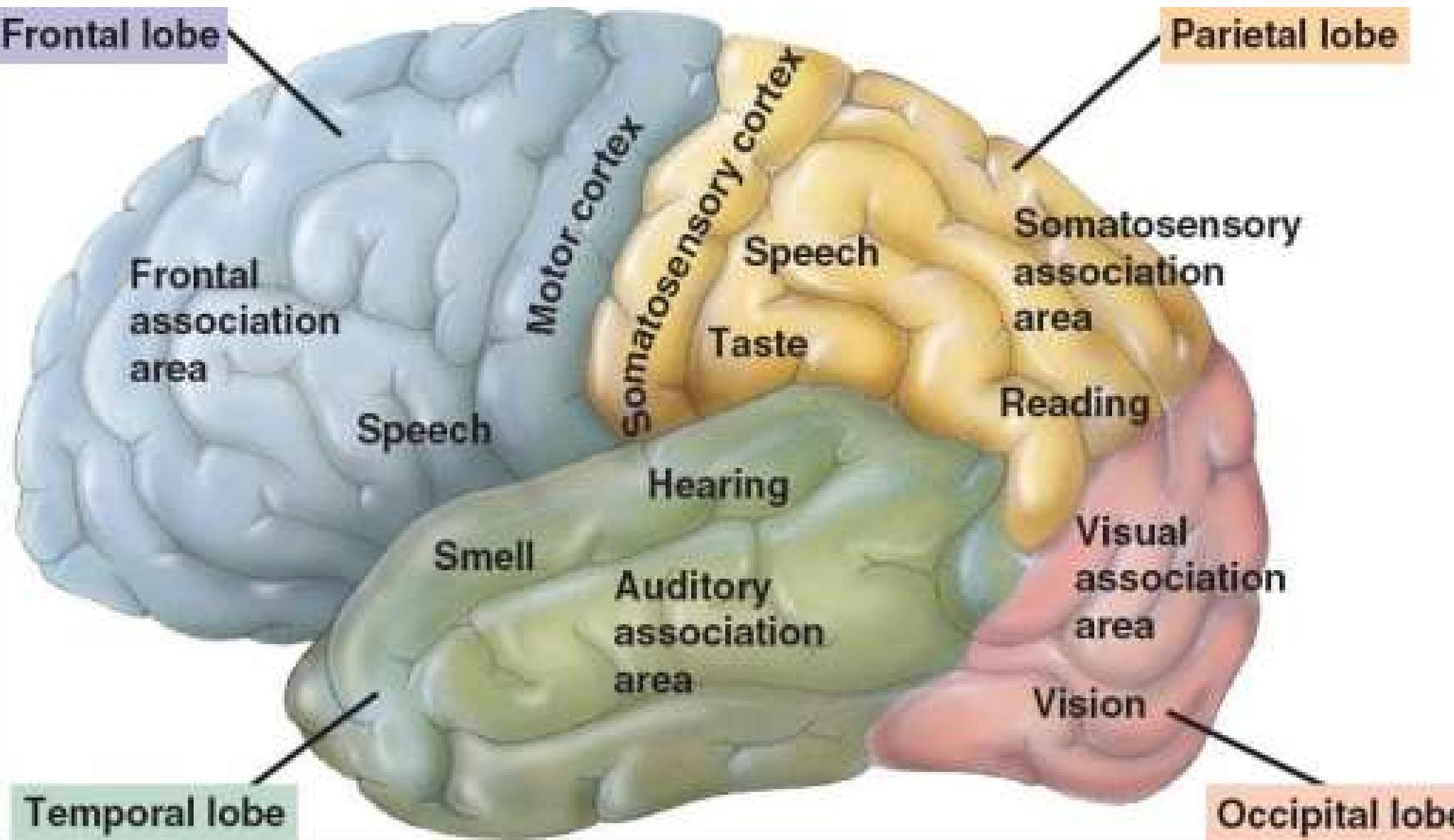
Temporal – Auditory.

Occipital – Vision.



Frontal lobe

Parietal lobe



Frontal association area

Speech

Motor cortex

Somatosensory cortex

Speech

Taste

Somatosensory association area

Reading

Hearing

Smell

Auditory association area

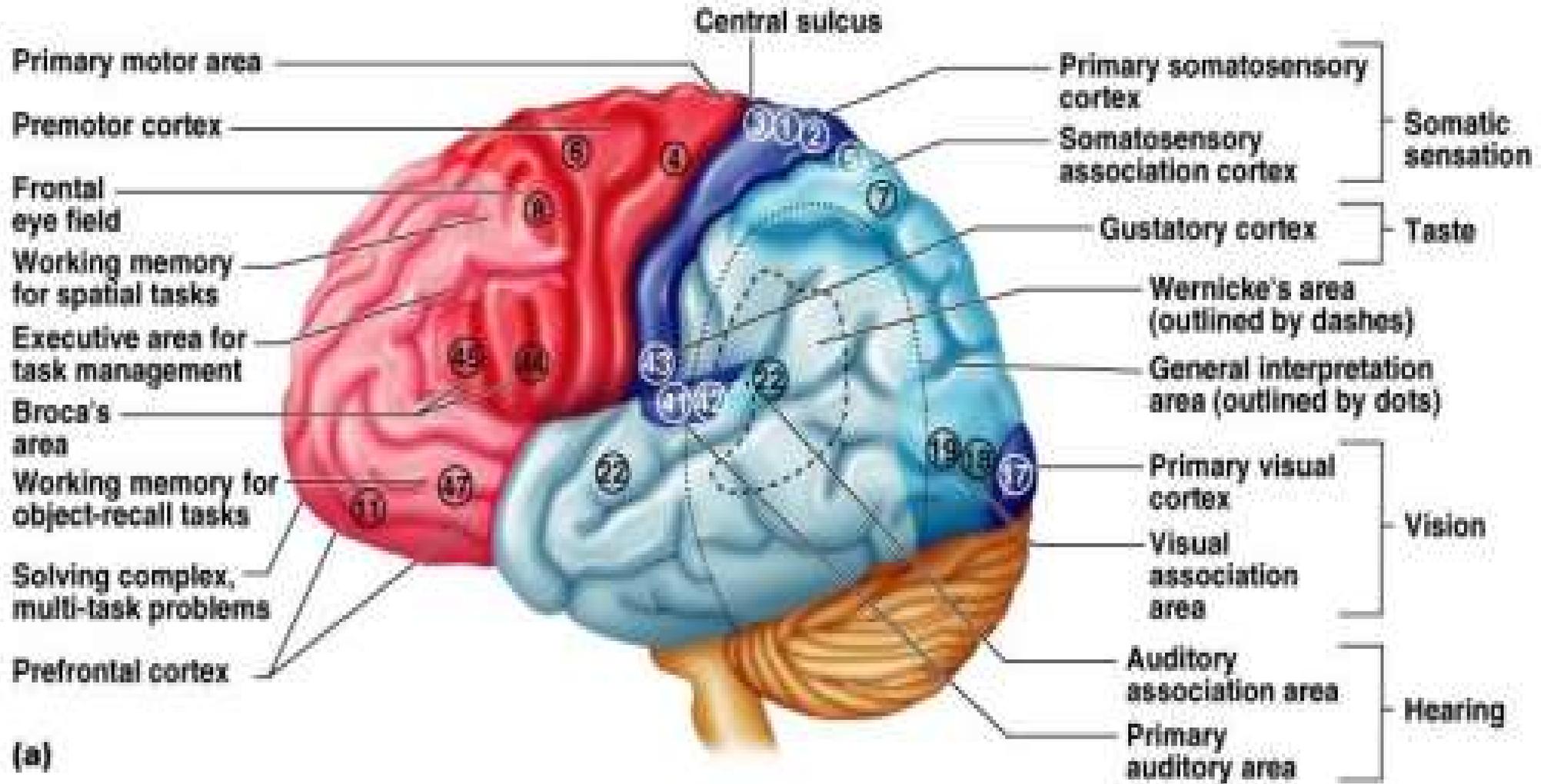
Visual association area

Vision

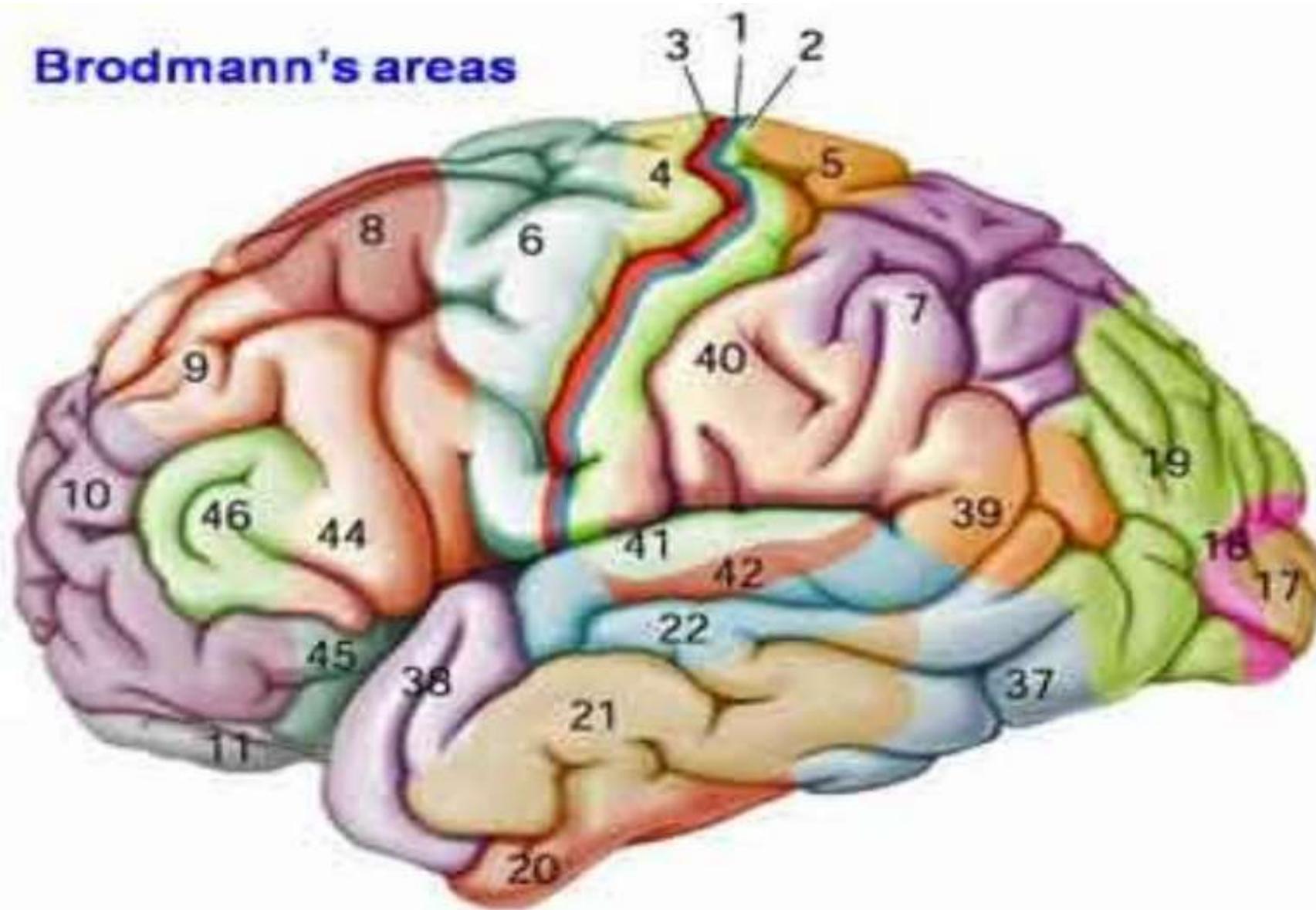
Temporal lobe

Occipital lobe

## Brodmann areas—47)



## Brodmann's areas



### Motor area

- Primary motor area. (4)
- Premotor area. (6)
- Frontal eye field. (8)
- Supplementary motor area.

### Sensory area

- Primary somesthetic areas. (3,1,2)
- Secondary somesthetic areas.
- Somesthetic association areas. (5,7 & 40)

### Speech area

- Motor speech.
- Anterior area (44,45)
- Superior area.
- Sensory speech.
- Reading centre.(39)
- Area 40.
- Wernicke's area. (22)

### Smell & Gustatory area.

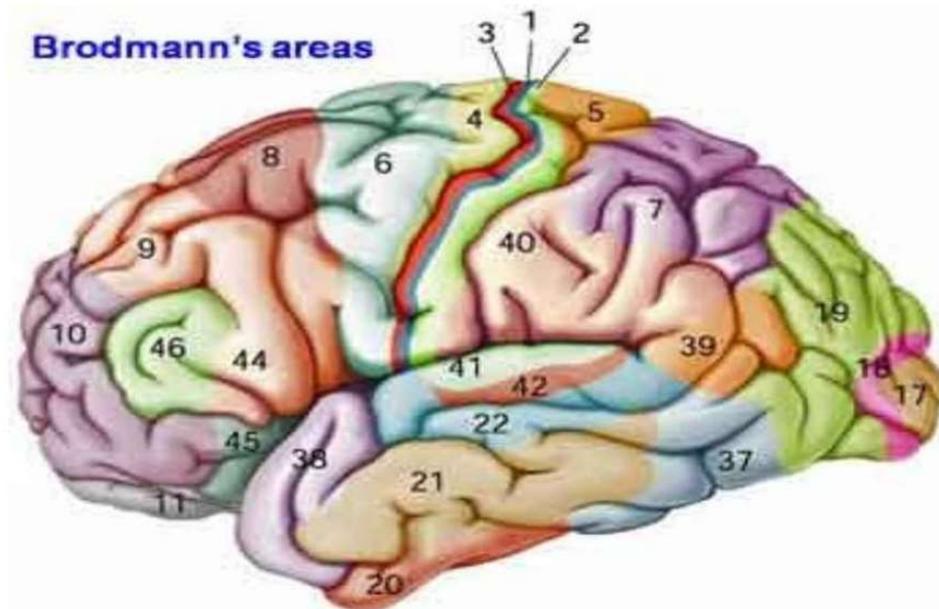
- Area 28.
- Area 43.

### Auditory area

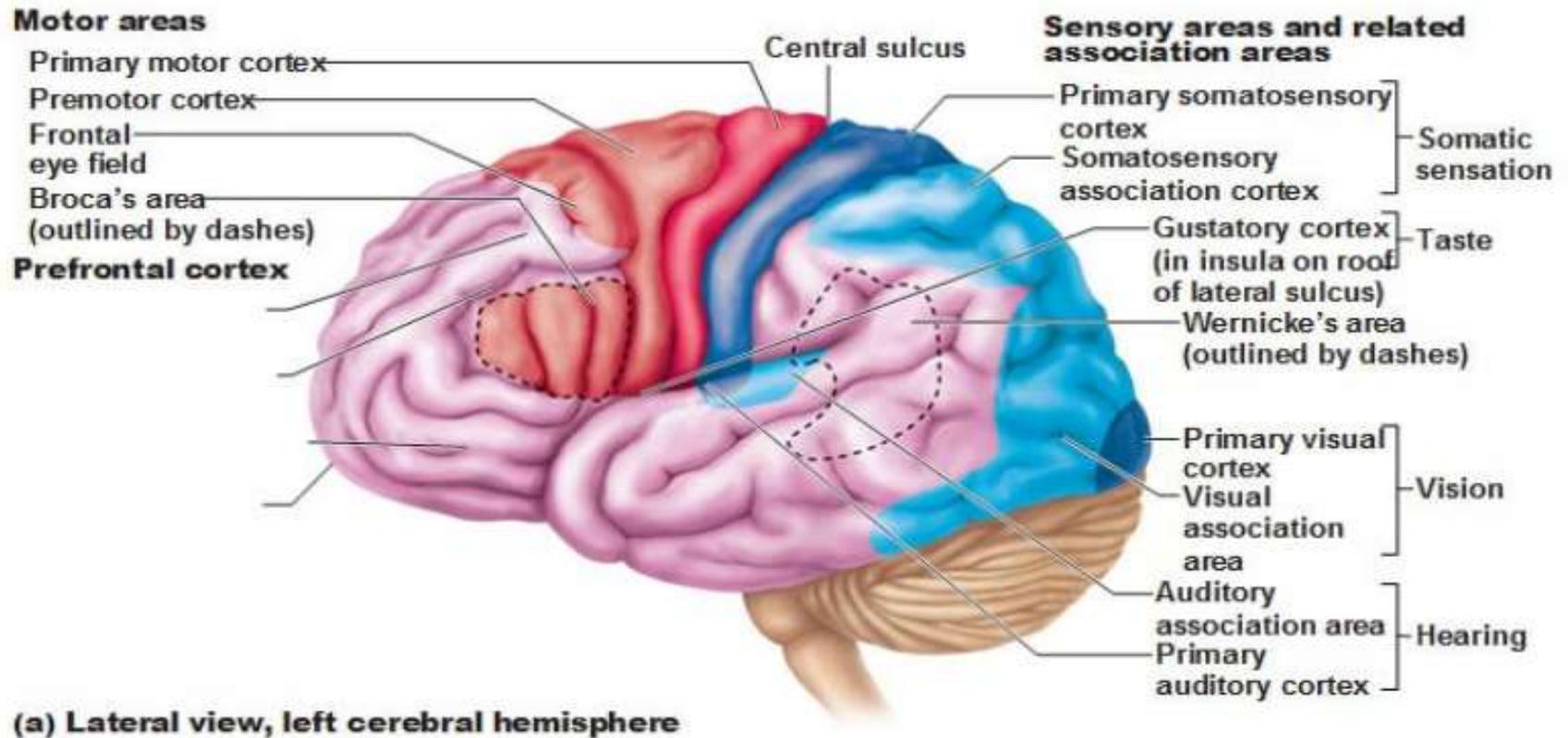
- Primary auditory area. (41)
- Auditory association area.(42).
- Higher auditory association area. (22)

### Visual area.

- Primary visual area. Or Visuostriate area.(17)
- Visual association area. Or Peristriate area.(18)
- Visual association area. Or Perastriate area.(19)



# Functional Areas of the Cerebral Cortex



- |   |   |
|---|---|
| <span style="color: red;">■</span> Primary motor cortex           | <span style="color: orange;">■</span> Motor association cortex      |
| <span style="color: blue;">■</span> Primary sensory cortex        | <span style="color: lightblue;">■</span> Sensory association cortex |
| <span style="color: pink;">■</span> Multimodal association cortex |   |

**Supplementary motor area**  
(on inner surface—not visible;  
programming of complex movements)

**Premotor cortex** (coordination  
of complex movements)

**Prefrontal association cortex**  
(planning for voluntary  
activity; decision making;  
personality traits)

**Frontal lobe**

**Broca's area**  
(speech formation)

**Primary auditory cortex**  
surrounded by higher-order  
auditory cortex (hearing)

**Limbic association cortex**  
(mostly on inner and bottom  
surface of temporal lobe;  
motivation and emotion; memory)

**Temporal lobe**

Brain stem

**Primary motor cortex**  
(voluntary movement)

Central  
sulcus

**Somatosensory cortex**  
(somesthetic sensation  
and proprioception)

**Posterior parietal cortex**  
(integration of somato-  
sensory and visual input;  
important for complex  
movements)

**Wernicke's area**  
(speech understanding)

**Parietal lobe**

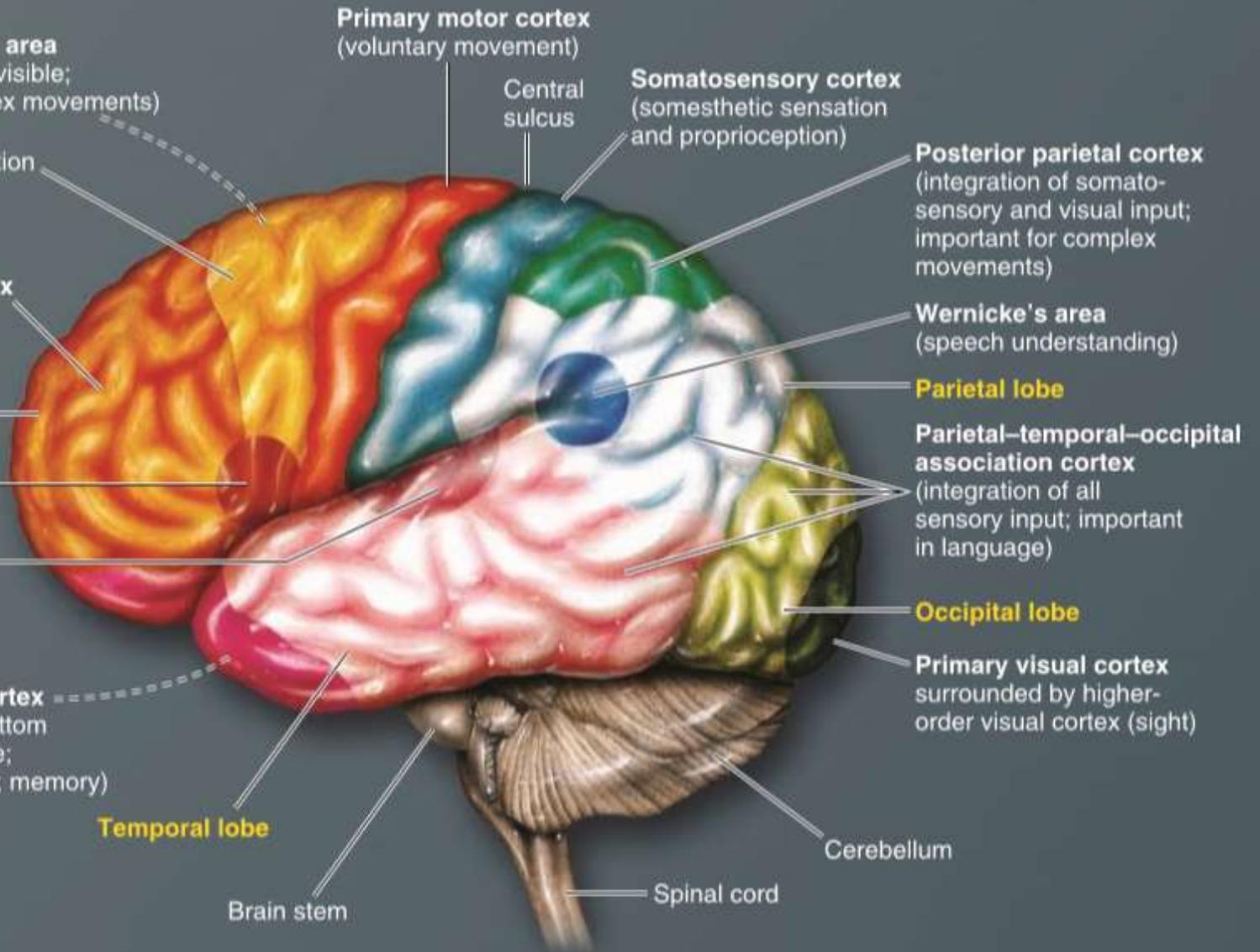
**Parietal-temporal-occipital  
association cortex**  
(integration of all  
sensory input; important  
in language)

**Occipital lobe**

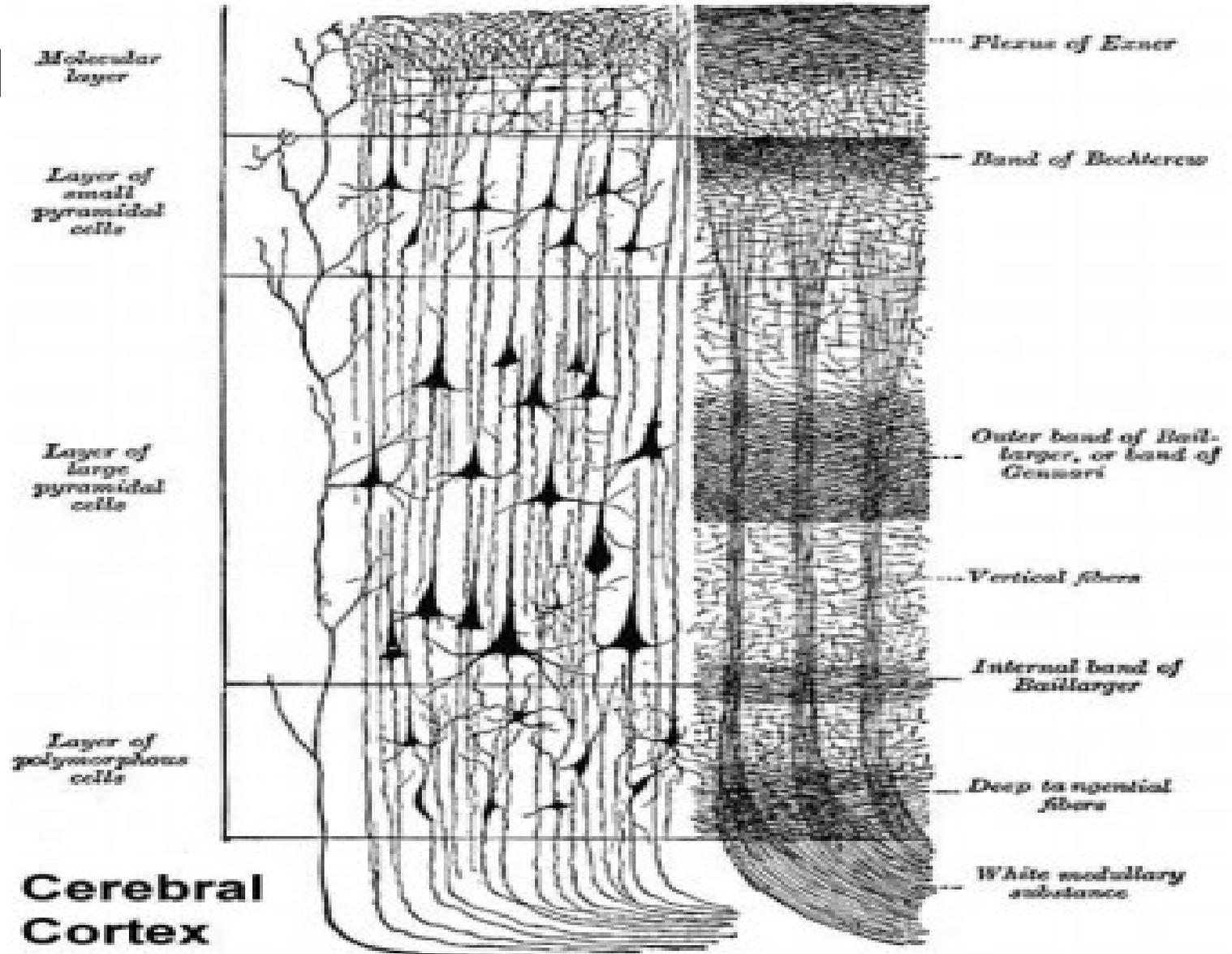
**Primary visual cortex**  
surrounded by higher-  
order visual cortex (sight)

Cerebellum

Spinal cord

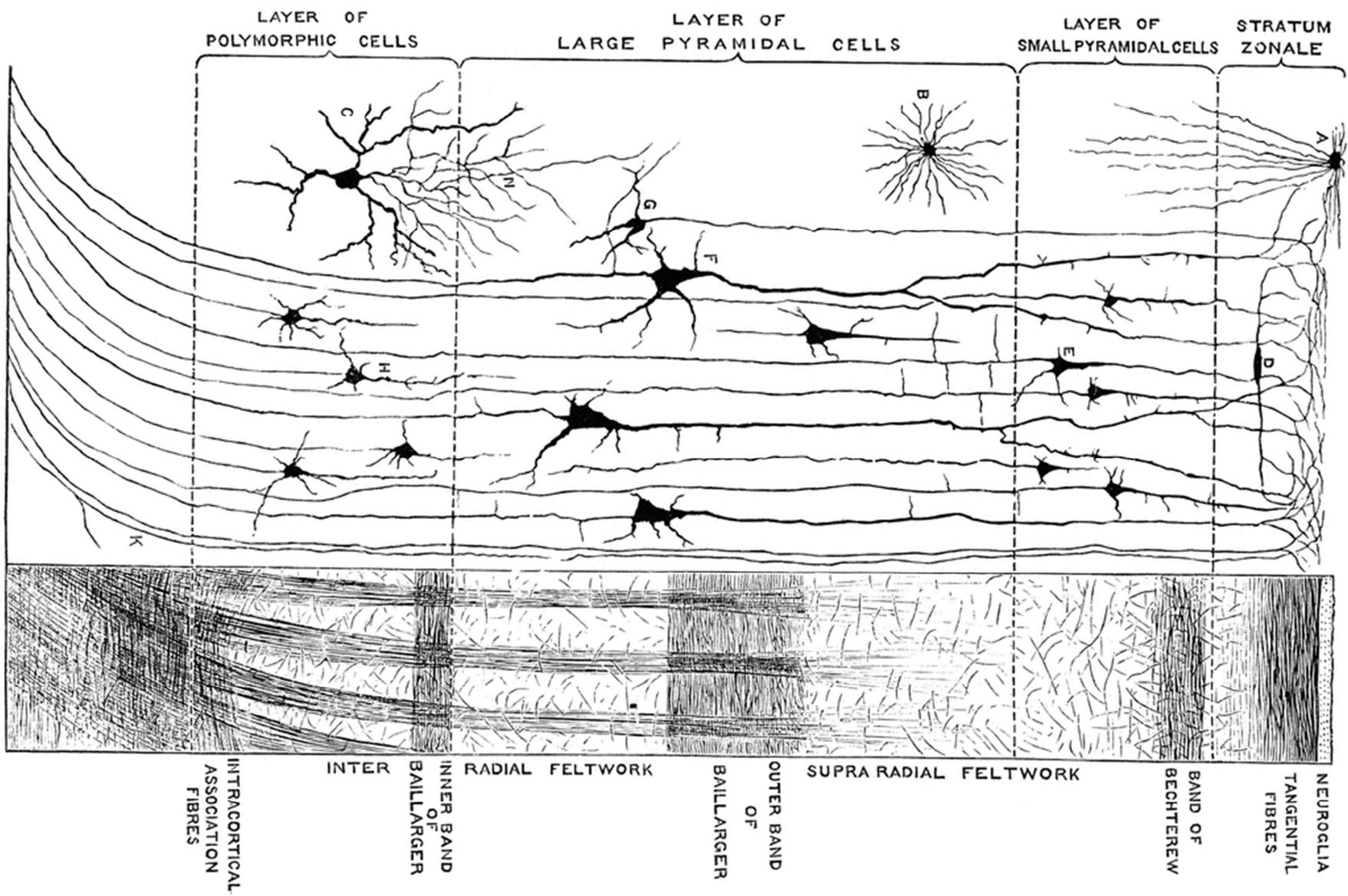


Histological structure.



BOTTOM

TOP



## Laminae.

### 1. Molecular / plexiform layer.

- Transverse nerve fibre –apical dendrite of pyramidal cells
- Horizontal cells. – CAJAL

### 2. External granular layer.

- Granule cells & Pyramidal cells

Dendrite – to Molecular layer

Axons – to deeper layer.

### 3. Outer pyramidal layer.

Mainly pyramidal cells, stellate cells & basket cells.

### 4. Inner granular layer.

Densely packed stellate cells.

Inner zone prominent transverse fibres.”

### **External Band of Baillarger.**

### 5. Inner pyramidal layer. (Ganglionic)

Large pyramidal cells.

Developed in motor cortex.

### **Inner Band of Baillarger.**

### 6. Polymorphous or multiform layer.

Modified pyramidal cells.

Many fusiform cells.

# Frontal lobe.

## Precentral cortex.

- Also called Excitomotor area of cortex.
- Stimulation causes activity in discrete skeletal muscles
- Sensorimotor cortex.— sensory & motor cortex.

## Prefrontal cortex.

- Also called prefrontal lobe or Orbitofrontal cortex.
- Ant to area 8 & 44.

# Precentral cortex.

Areas.

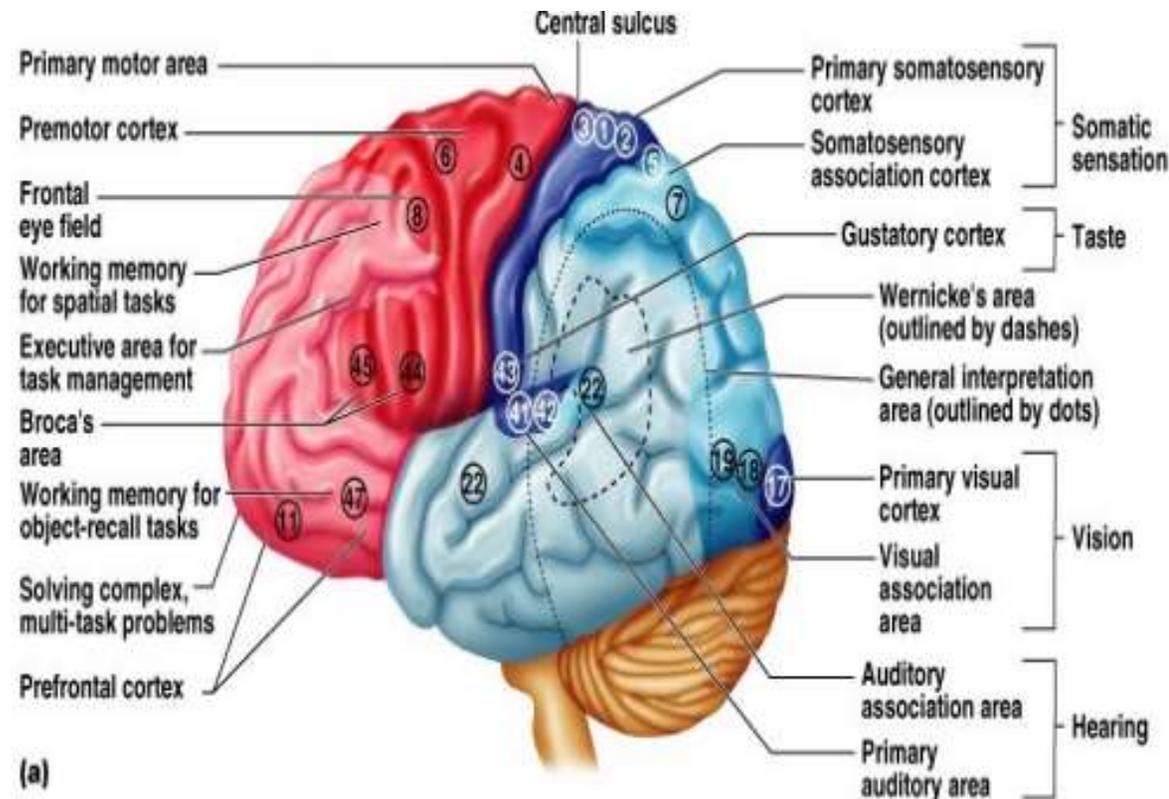
## Primary motor area.

- Area 4 ,
- Area 45

## Premotor area.

- Area 6
- ? Area 8
- ? Area 44 & 45 or
- Broca's motor speech area.

## Supplementary motor area.



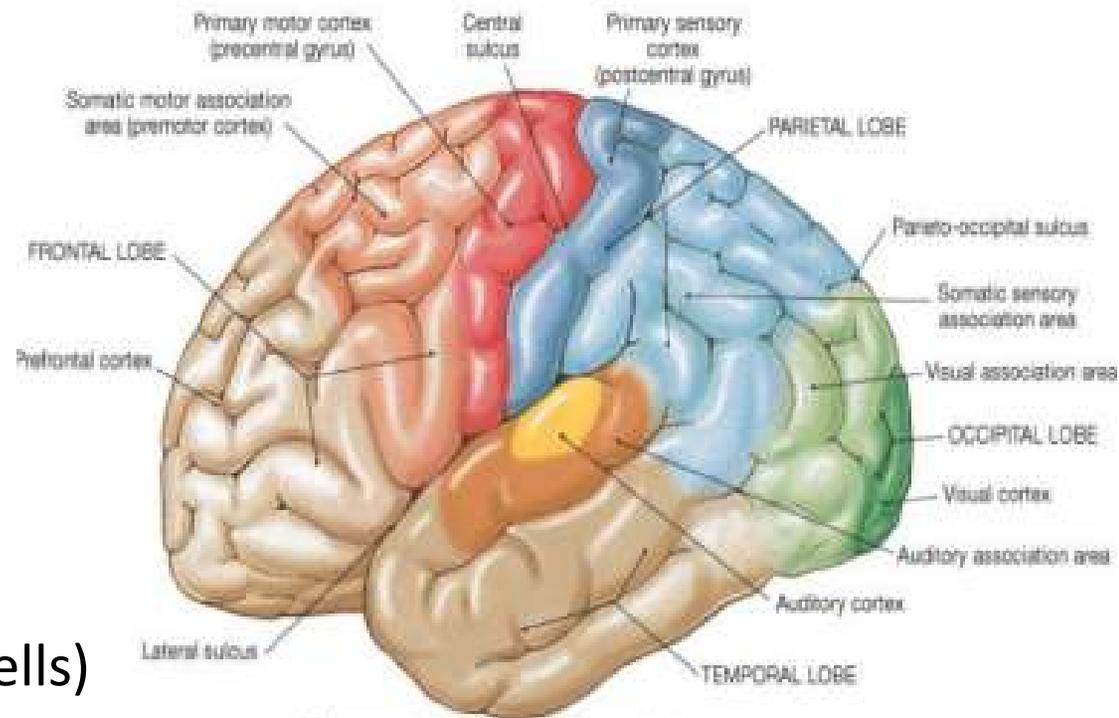
# Primary Motor Area (4)

## Extent

- from Precentral gyrus to Paracentral lobule on medial surface.

## Characteristics –

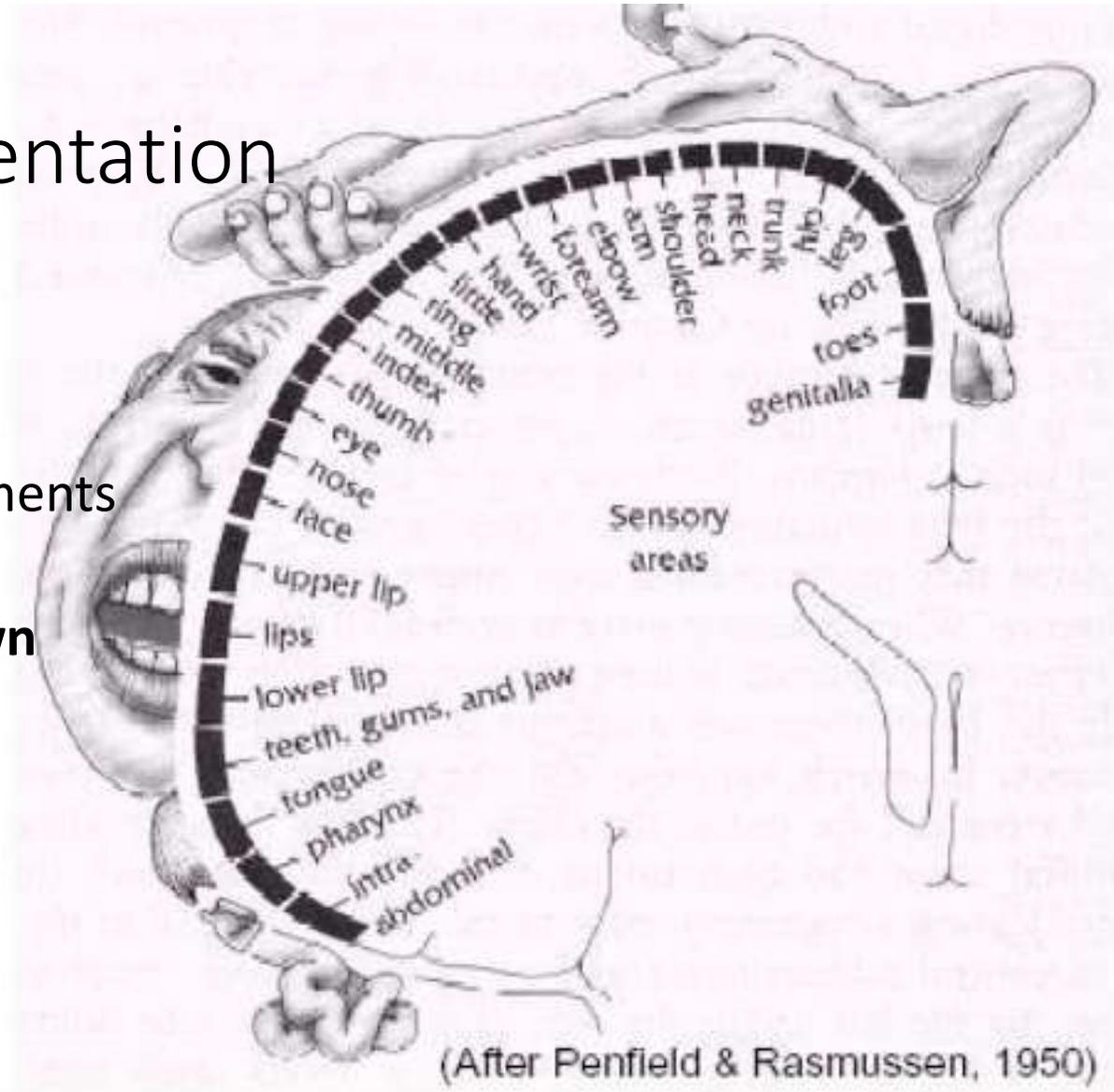
- [?] 6 layers of cortex.
- [?] Giant pyramidal cells (Betz cells)

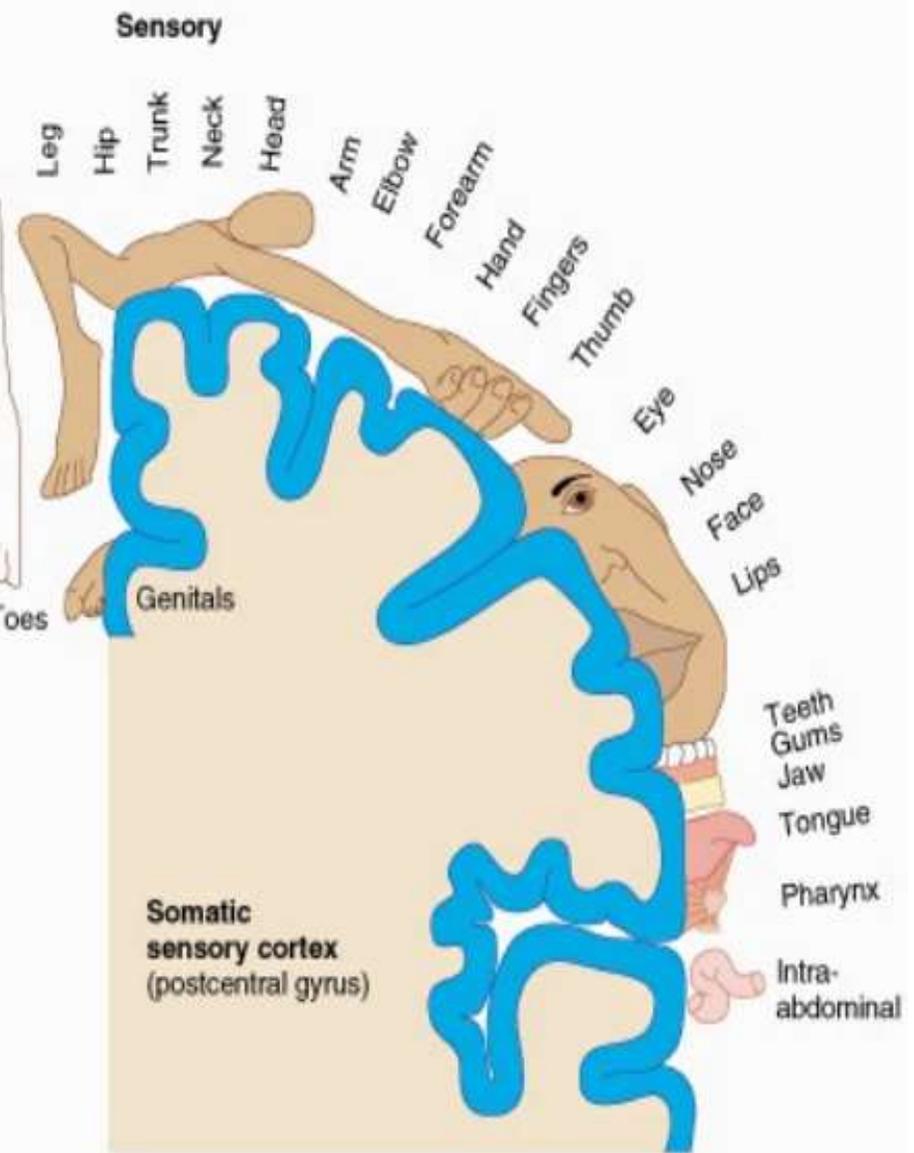
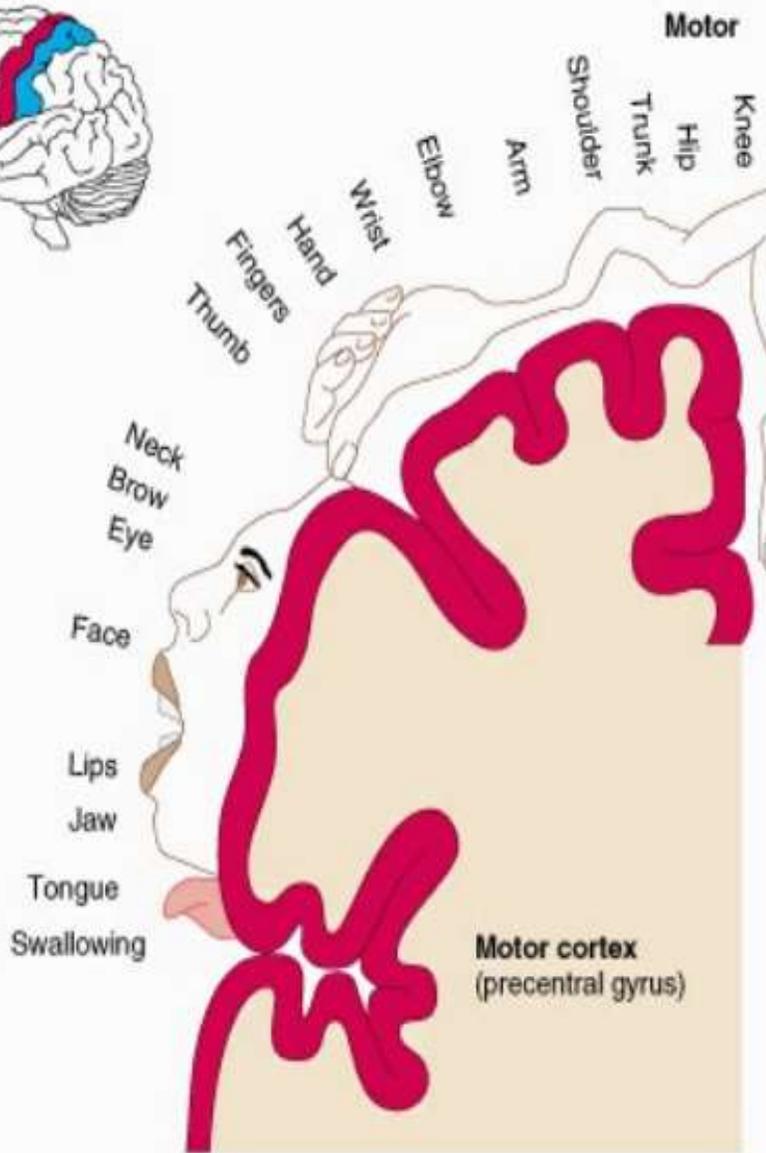


(a) Motor and sensory areas of the cerebral cortex.

# Topographic Representation

- Contra lateral half of body in inverted order.
- Part of body for skilled movements – larger area.
- Body represented **upside down**





# Primary Motor Area (4)

- Electrical stimulation.–  
Motor homunculus.
- [?] Motor cortex organized  
in terms of movements.
- Stimulation of points of face,  
pharynx & vocal cords – bilateral  
response.

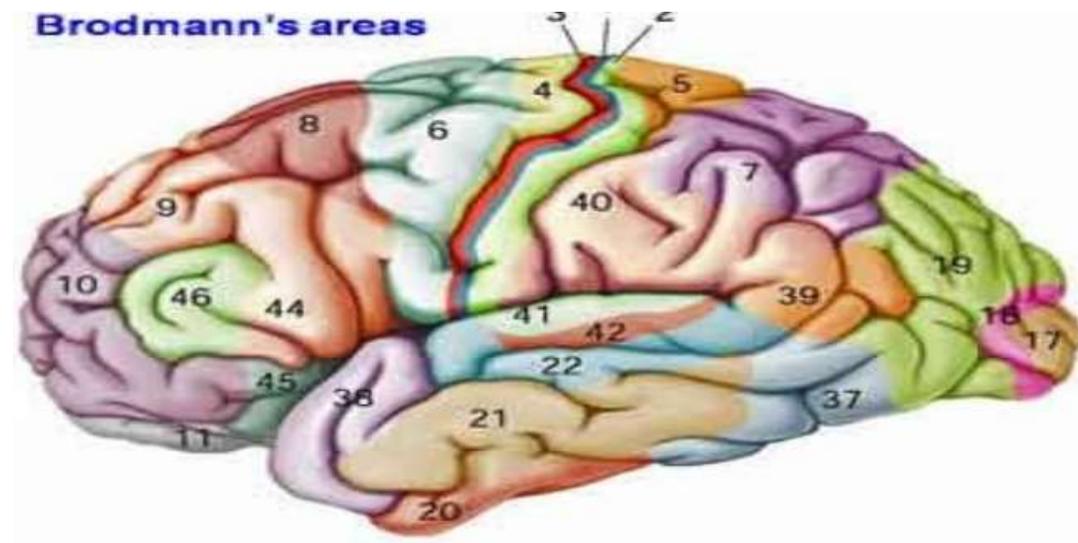
**Functions** – Centre for volition.  
i.e. initiation of movements &  
speech.  
Area 45 – suppressor area.  
Inhibits movements initiated by  
area 4

# Premotor area. (6,8,44,45) area 6

- Structurally similar except Giant Pyramidal Cells.
- 2 parts – Upper 2a, Lower 2b.
- Topographical representation – same.
- Functions – Integration of voluntary movements.

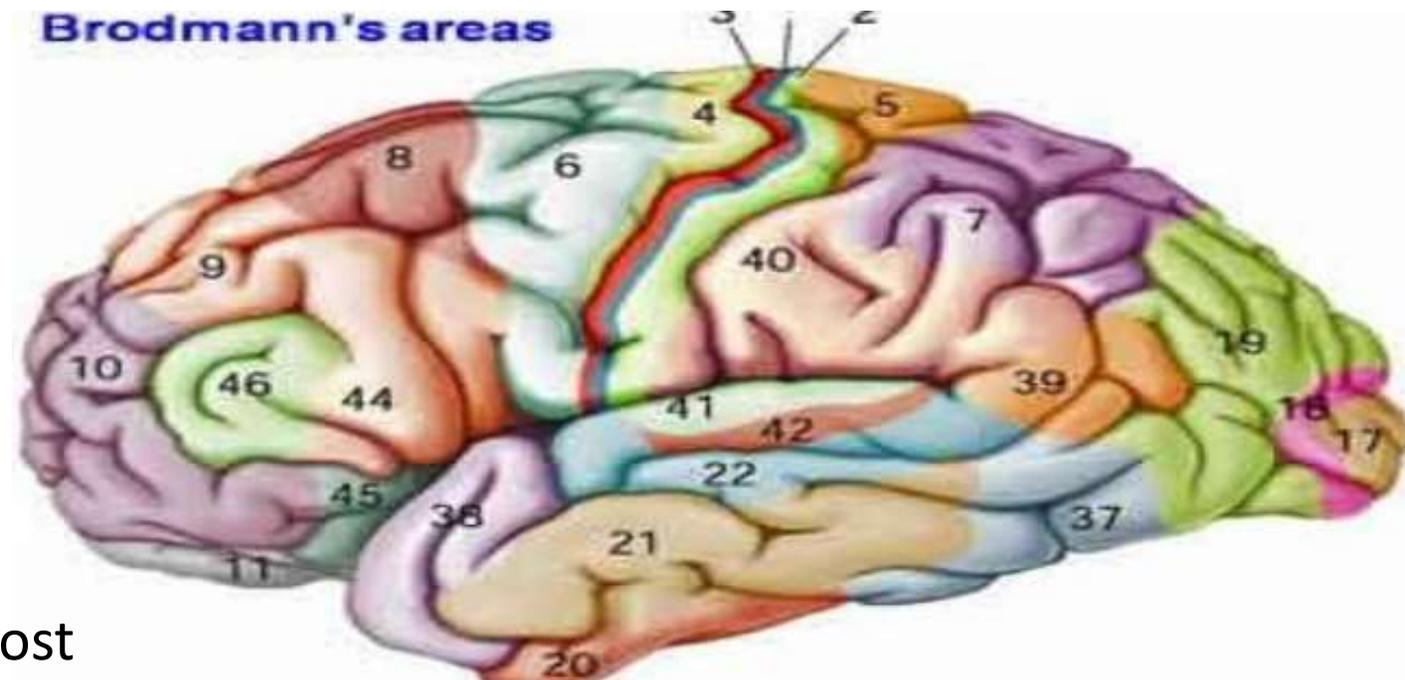
Make skilled movements accurate & smooth.

- Lesions – Hemiplegia with Spastic paralysis.



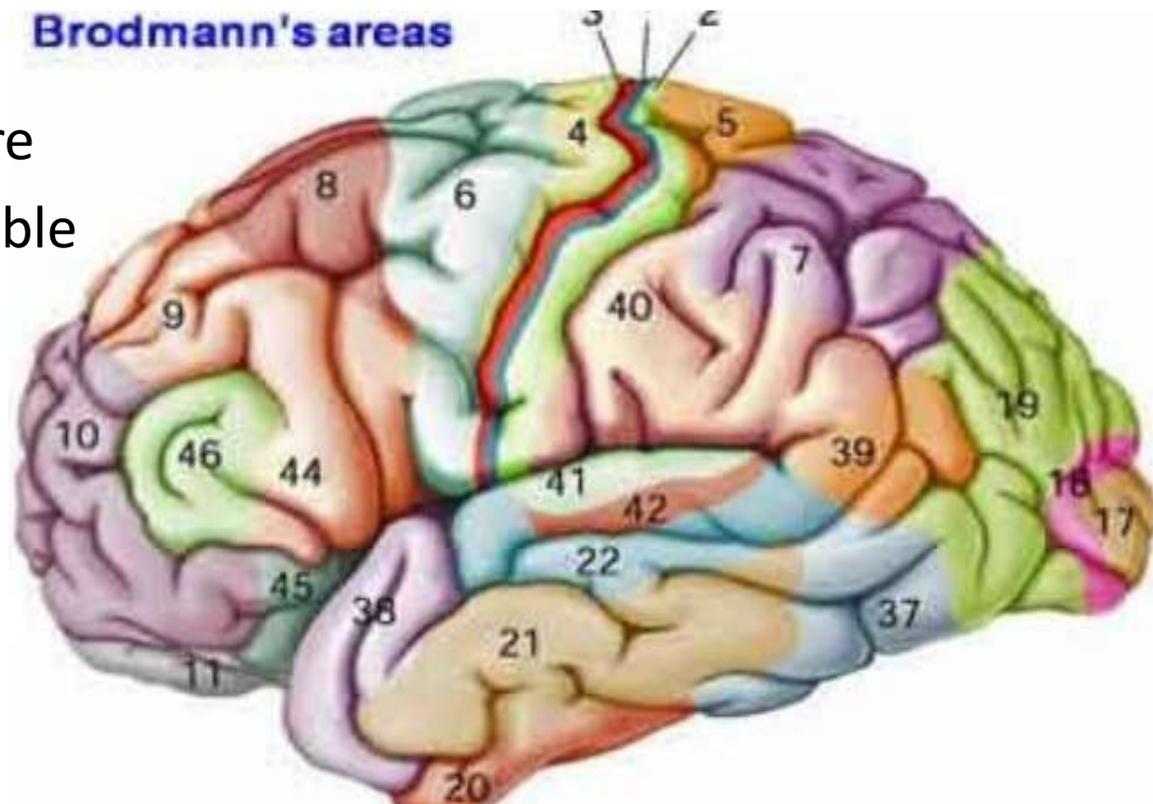
# Area 8

- Frontal Eye field.
- Location – ant to area 6.
- Function – control eye movements.
- Lesions – turn eye to opposite side.
- Conjugate movements --lost
- Afferent – occipital lobe & Dorsomedial N. of Thalamus.
- Efferents – N. of III, IV & VI Cranial nerves.



# Area 44 & 45

- Broca's motor speech area.
- Area 44 – pars Triangularis.
- Area 45 – pars Opercularis.
- **Functions** – in Dominant Hemisphere concerned with movements responsible or production of voice & articulation of speech.



# Supplementary Motor Area.

**Locations** – medial surface of frontal lobe behind primary motor area.

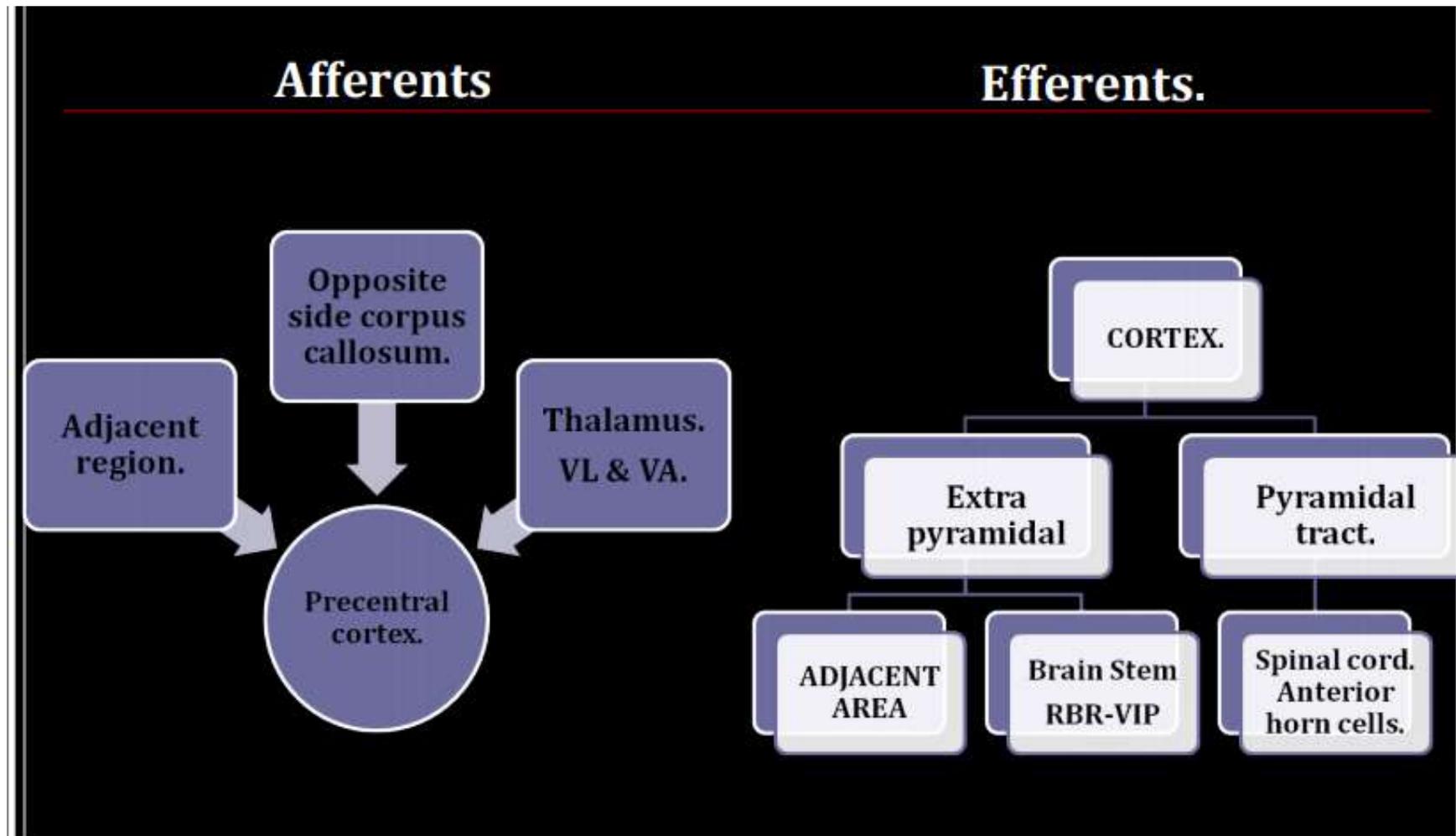
**Topographical representation.**–

upper body located dorsal to lower body.

**Functions** – with Premotor area provide

Attitudinal movements., fixational movements & positional movements of head & eye.

# Connections of pre central cortex



## Prefrontal cortex

- Major areas. (9-14, 23,24,29,32, 44-47)

### Afferents

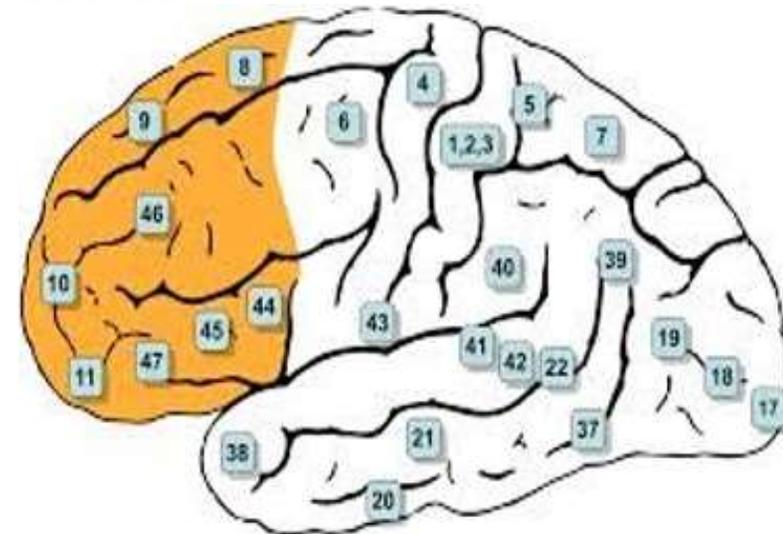
- Dorsomedial nucleus of thalamus.
- Anterior nuclei of thalamus.

**Form Papez circuit**– close circuit connection with thalamus.

Responsible for **resting EEG & genesis of Emotions**

### Efferents

- Thalamus. (V &M)
- Tegmental reticular formation.
- Pontine nuclei
- Caudate nucleus.
- Mammillary bodies.



# Functions

Centre of planned actions

Centre for higher functions.

Emotions, learning, memory & social behaviour

Causes automatic changes during emotional conditions

Seat of intelligence

Register short term memory

Called An organ of mind.

Control of intellectual activities.

# Control of Intellectual Activities.

- To prognosticate.
- Plan future.
- Concentrate – Central theme of thought.
- Delay actions in response to sensory signals.
- Consequences of motor action before it.
- Solution of complicated mathematical & philosophical problems.
- Controls one's activity according to moral laws

# Applied aspects: Frontal lobe syndrome.

- Cause – ablation of prefrontal cortex.
- **Features. (FEEL – FILL)**
- Flight of ideas
- Emotional instability
- Euphoria.
- Loss of moral & social sense.

## **Functional abnormality**

Hyperphagia.

Sphincters control loss.

Disorientation & tremors.

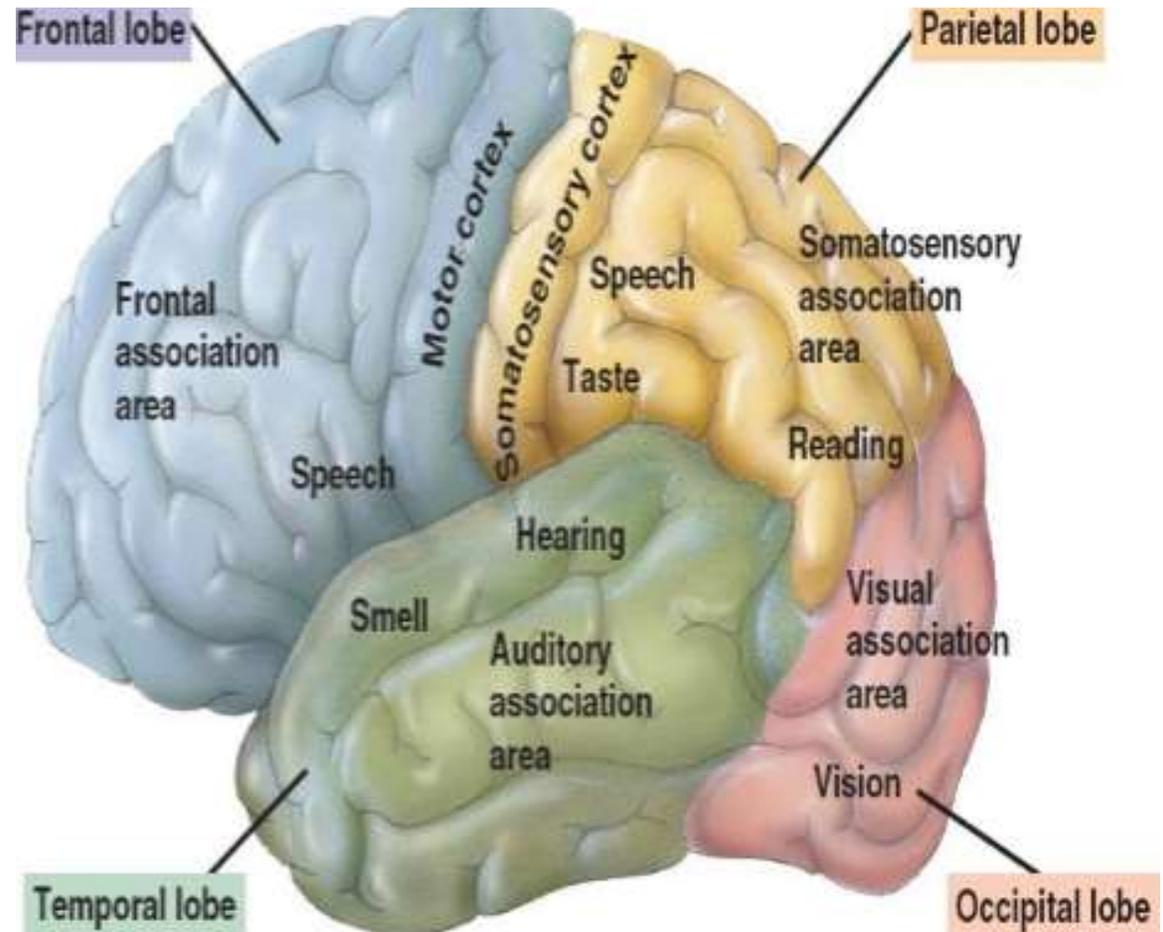
Impairment of memory.

Lack of attention & concentration.

Lack of initiative & decreased intellectual activity

# Parietal lobe

- Primary sensory area. (3,1,& 2)
- Secondary sensory area.
- Sensory association areas(5,7)

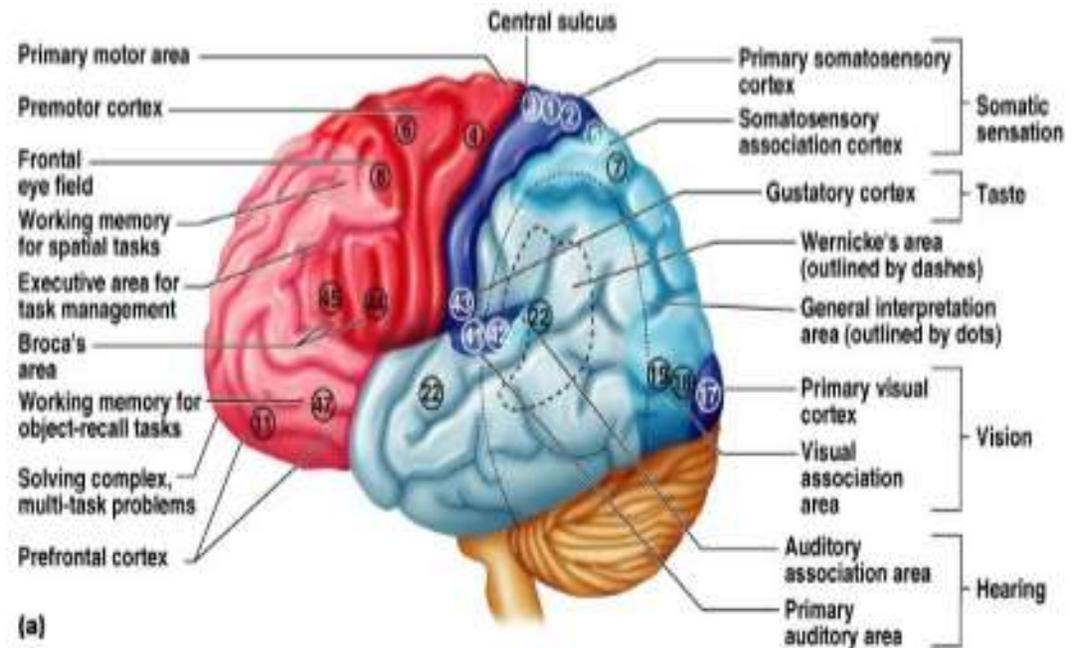


## Primary sensory area. (3,1,& 2)

- Location – Post central Gyrus & Post wall of Central sulcus.
- Histo – dense stellate cells , few pyramidal cells.
- Topographical representations. – Sensory Homunculus.
- Lesion – without thalamus only discriminative functions lost
- With thalamus – all sensation from opposite half of body

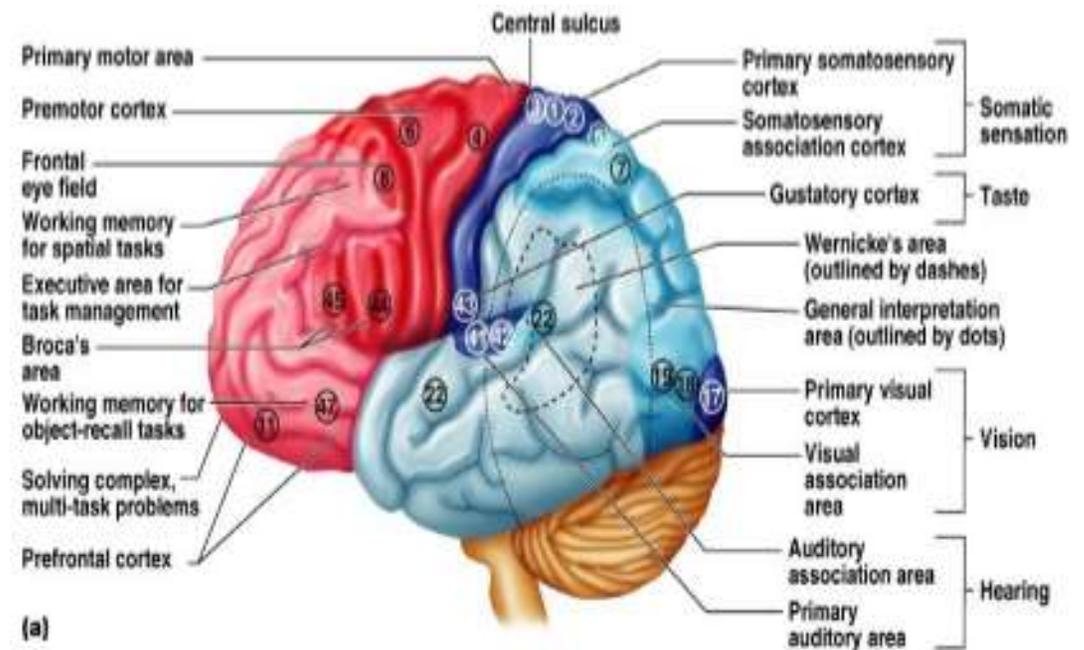
# Secondary sensory area

- Location – post central Gyrus below 1st somatic sensory area.
- Topographical representation – body represented twice in area I & area II.
- Lesion –  
discriminative power lost



## Sensory Association Areas. (5, 7)

- Post to area S1.
- Point to point representation.
- Lesion – Tactile Agnosia. (Astereognosis & tactile Aphasia)



# Connections of Parietal Lobe

## Afferents

- SI – Thalamus (VPM,VPL) Exteroceptive & Proprioceptive from opposite side & both sides of face.
- SII – from SI & thalamus
- Sensory Association area. – SI & SII

## Efferents

- Corticospinal
- Corticobulbar
- Corticonuclear tracts.

# Connections of Parietal Lobe

- Association fibres.
- To other cortical areas.
- Involve in somatic sensation.
- Commissural fibres.
- Mostly pyramidal cells connect to opposite hemisphere.
- Opposite area SI & SII

# Functions of Parietal Lobe

## **First somatic sensory area. (SI)**

- Localize, analyze & Discriminate Cutaneous & Proprioceptive senses.
- Area 3 – touch, pressure, position & vibrations.
- Area 1 – Cutaneous & joint sense.
- Area 2 – deep sense from muscles & joints.

## **Second somatic sensory area. (SII)**

- From S1 & thalamus directly.
- Perception of sensation.

## **Sensory association area. (5,7)**

- Discriminate stimuli related to intensity
- Warm, warmer, cold, colder

# Temporal lobe.

## **Primary auditory area.**

- 41, 42 Audio sensory Area.
- HEARING CENTRE.
- Middle of superior temporal gyrus.
- From – MGB, Thalamus. To – MGB, Superior colliculus.
- Perceives – loudness, pitch, source & direction of sound.

## **Auditory association area**

22,21 & 20

22- Wernicke's area, also called sensory speech area in dominant hemisphere.

Interpretation of meaning, comprehension of spoken language & formation of ideas.

21,20 – interpretation & integration of auditory