

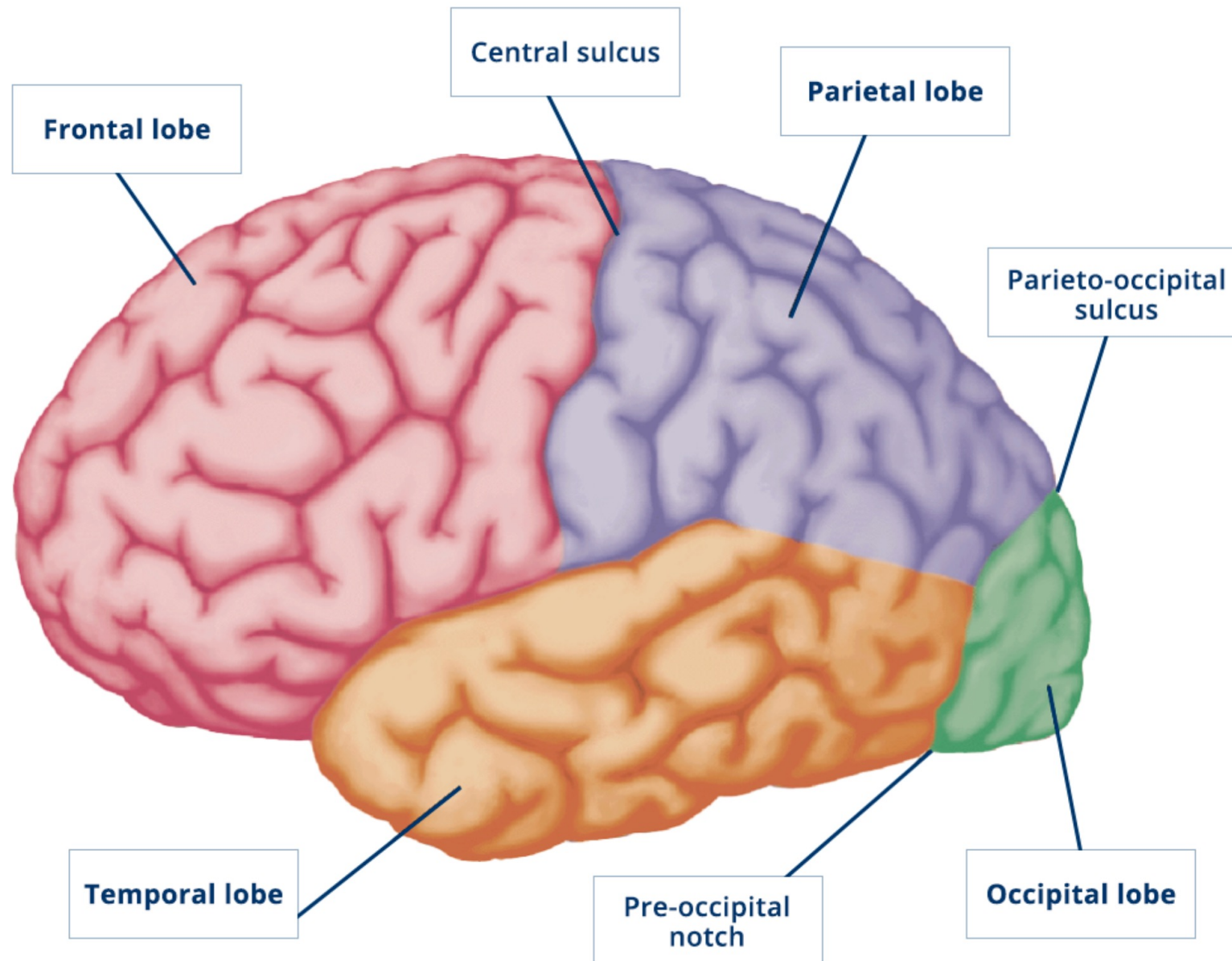
Functional Divisions of the Brain



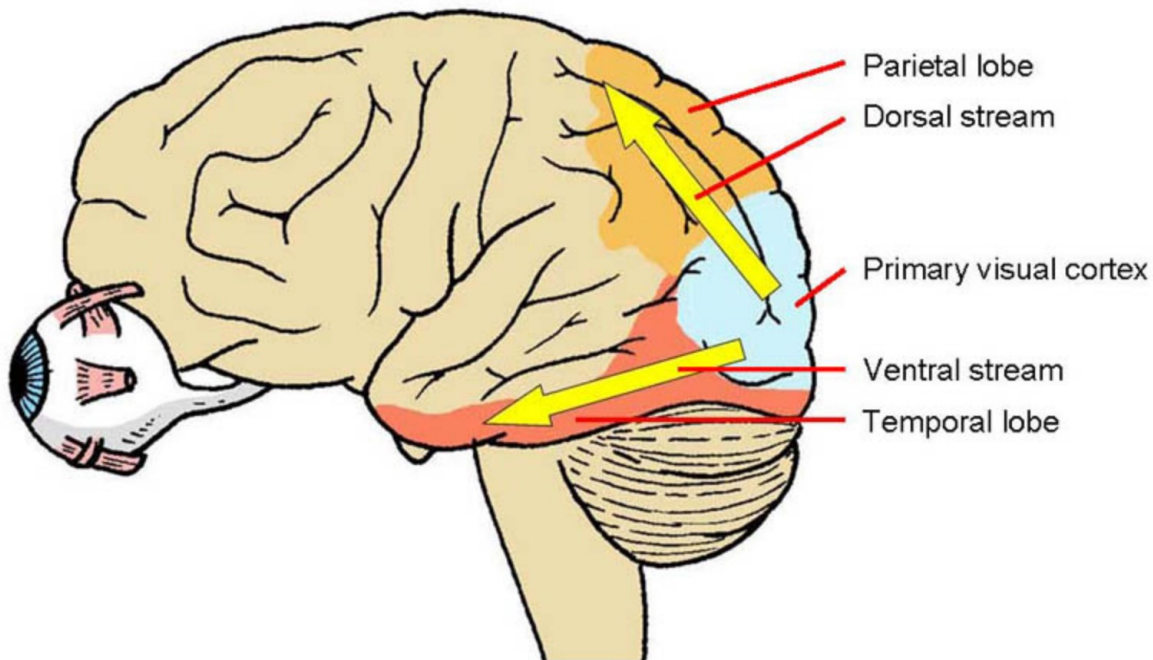
Learning Objectives

- Understand the key functional divisions of the cortex
 - Lobes of the cerebral cortex
 - Primary visual & auditory cortex
 - Primary somatosensory cortex
 - primary motor cortex
- Introduce the simple motor action
- Discuss the higher order function of the frontal lobes

Lobes of the cerebral cortex



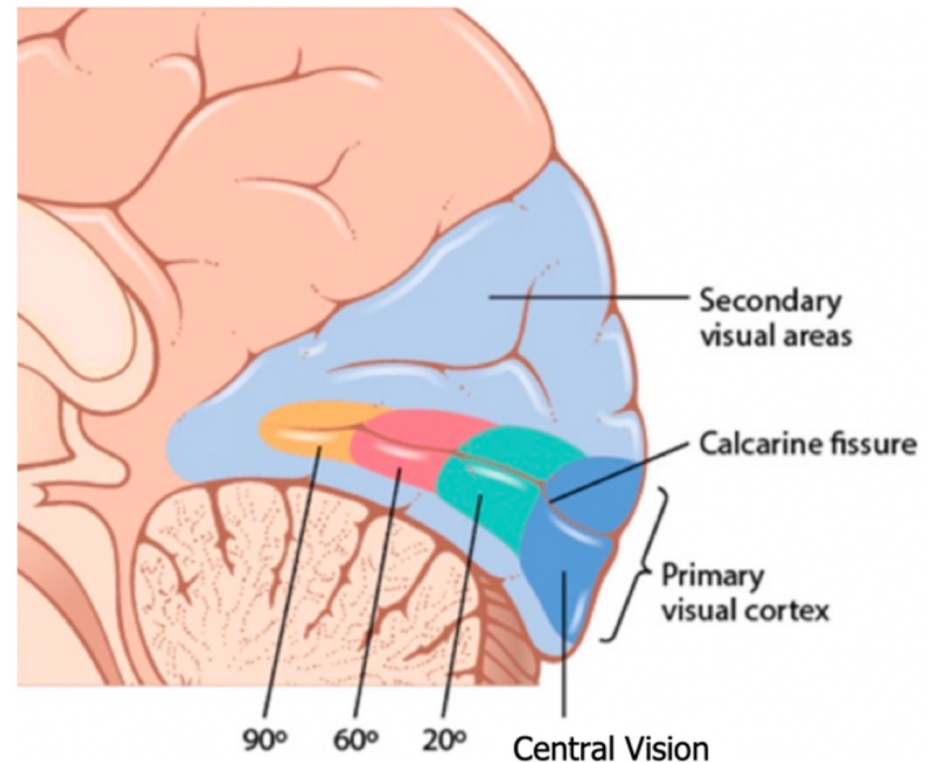
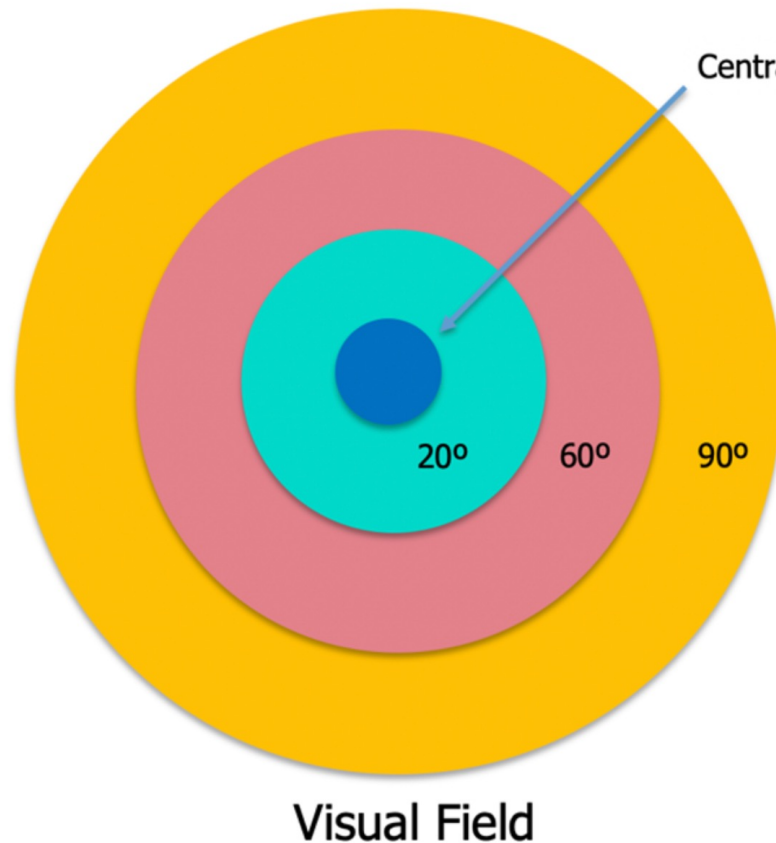
Primary visual cortex



- Occupies medial and lateral parts of the **occipital cortex/lobe** at the back/posterior of the brain.
- Receives sensory information from **retina**.



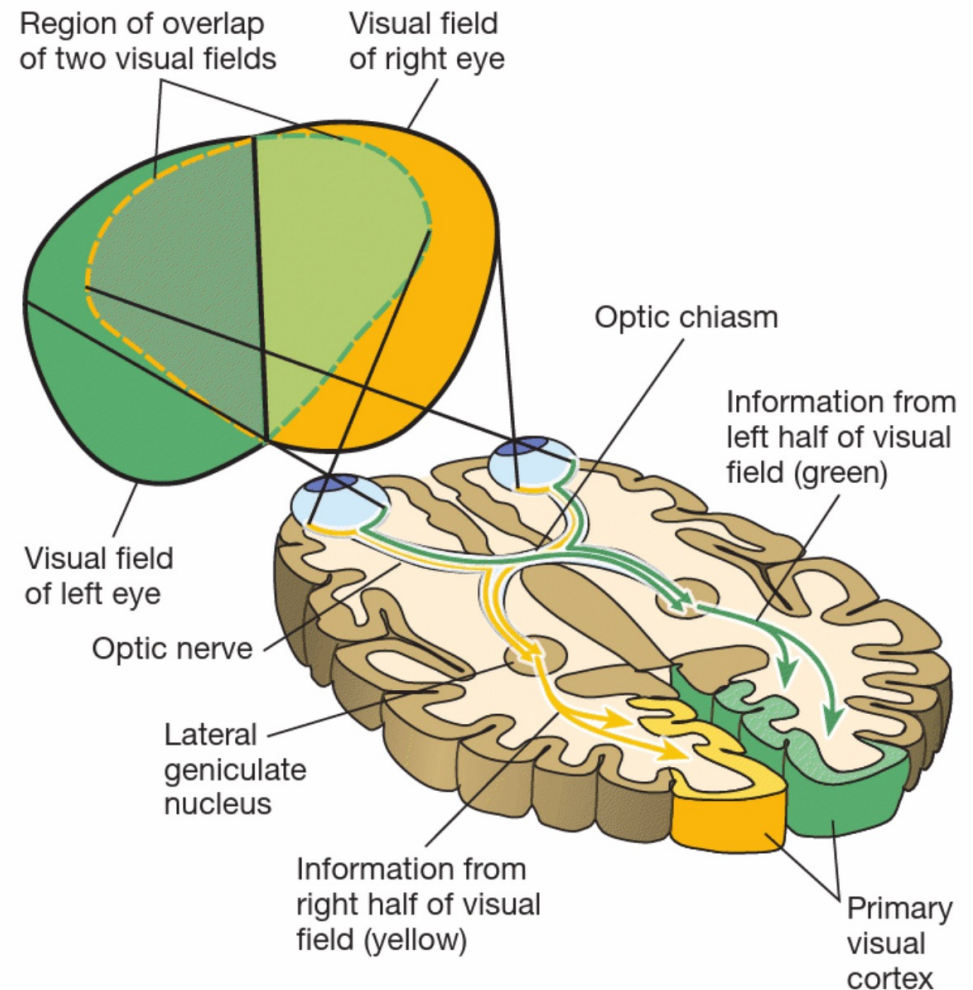
Primary visual cortex



- Different regions of the retina are represented by different areas within the primary visual cortex.
- areas further out in peripheral vision are processed by areas of the visual cortex that extend into the calcarine fissure

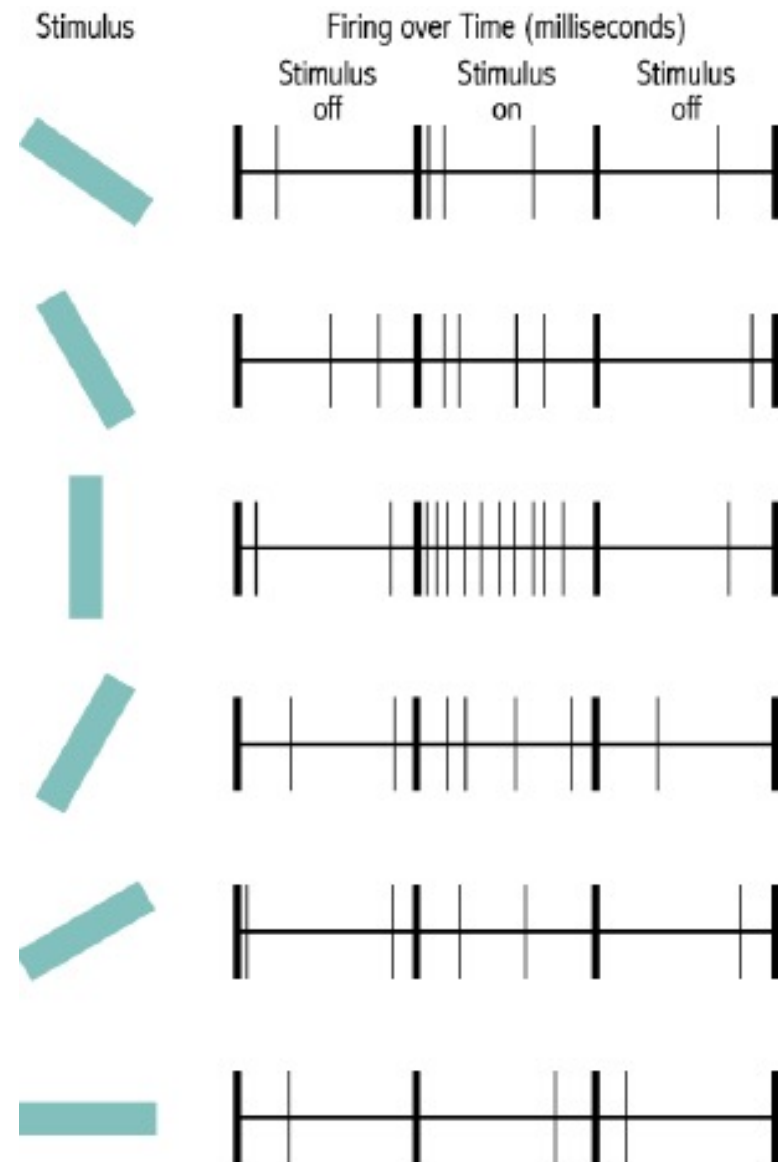
Primary visual cortex

- The left and right visual field are each projected to the contralateral hemisphere.
- Light stimulus from the external environment from both visual fields stimulate the corresponding area of the retina within each eye.
- From the retina sensory data is transmitted to the LGN through the optic nerve to the primary visual cortex



Primary visual cortex

- Within the primary visual cortex neurons show **“orientation selectivity”**
- Hubel and Wiesel won the Nobel prize in 1981 for this work.



Parietal Lobe / Parietal Cortex



- Involved in attention and spatial awareness.
- sits on the dorsal surface of the cortex and is referred to as part of the dorsal stream and the “where” pathway – named for its role in spatial localisation

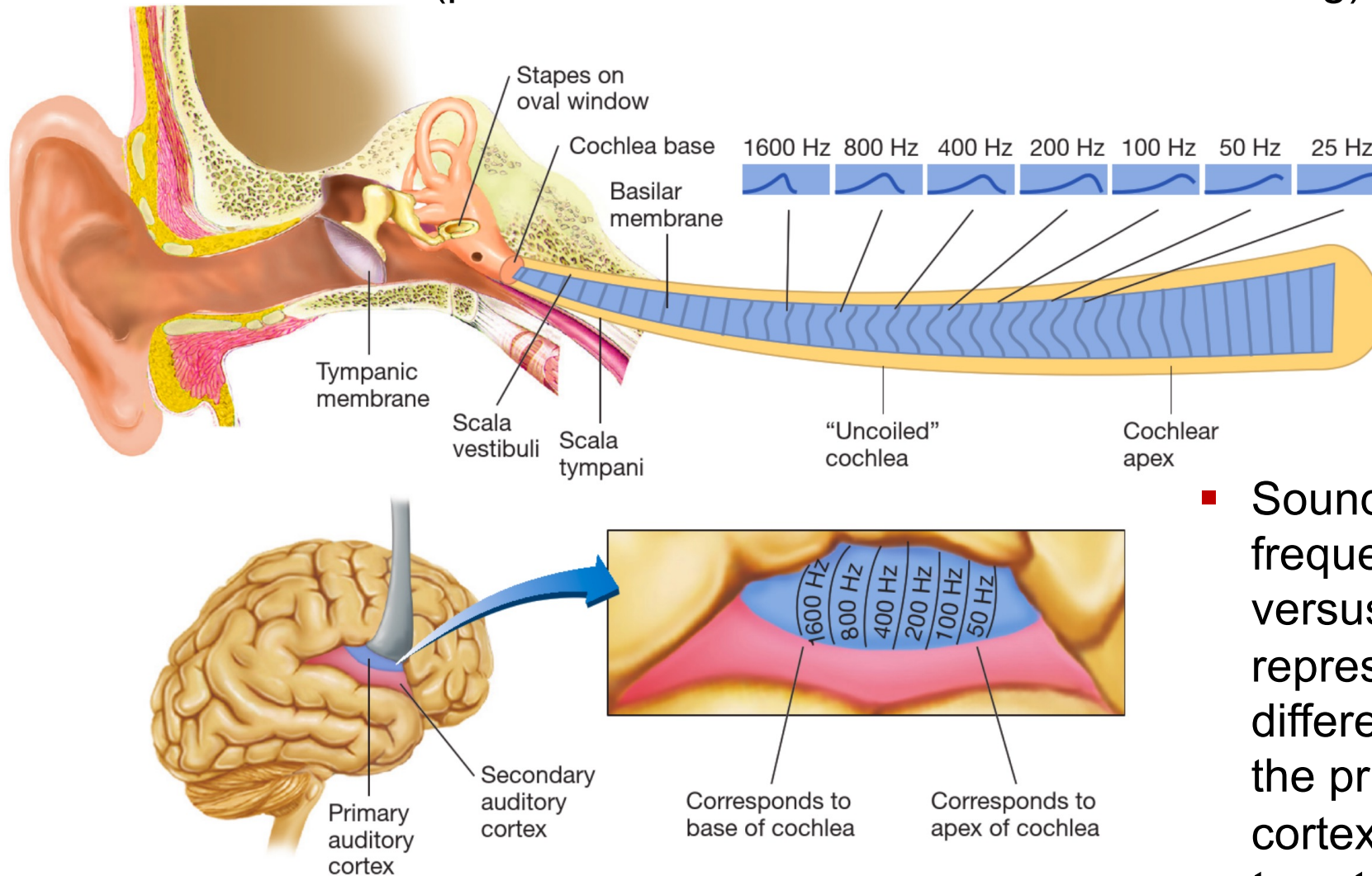
Temporal Lobe / Temporal Cortex



- Important in auditory processing.
- Also involved in more complex visual processing (faces & complex object recognition).
- sits on the ventral surface of the cortex and is part of the ventral stream and the “what” pathway – named for its role in complex object recognition.

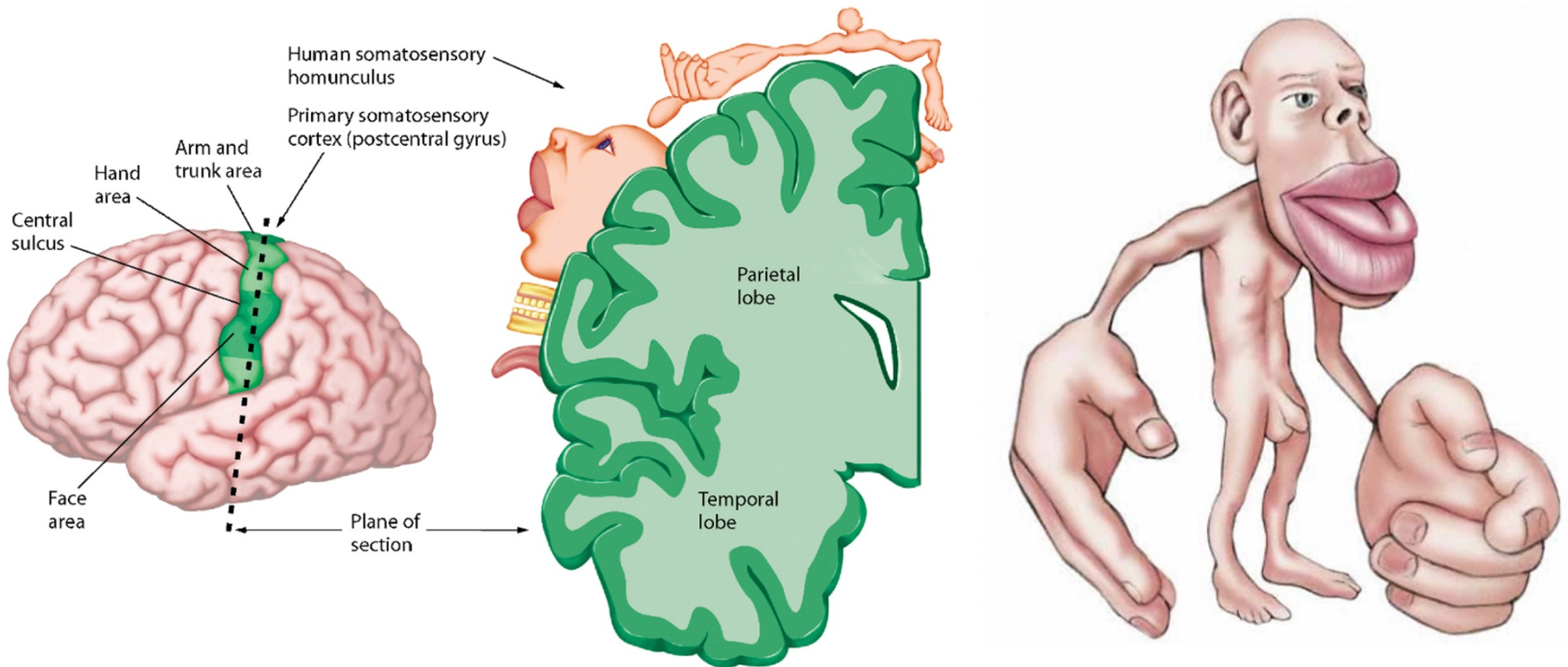
Primary auditory cortex

- Occupies superior part of the **temporal cortex**, as well as a patch of cortex that is buried within the **Sylvian fissure**. It receives auditory sensory information from the **cochlea** (part of the inner ear concerned with hearing).



- Sounds of different frequencies (e.g., low versus high tones) are represented by different areas within the primary auditory cortex, forming a **tonotopic map**.

Primary somatosensory cortex

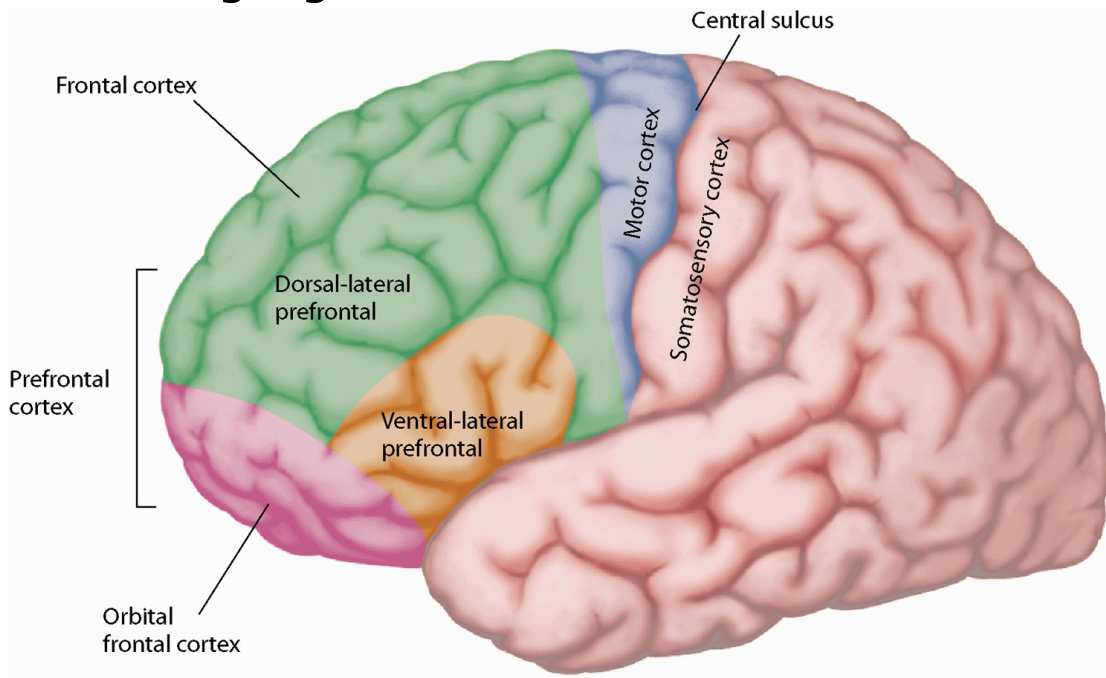
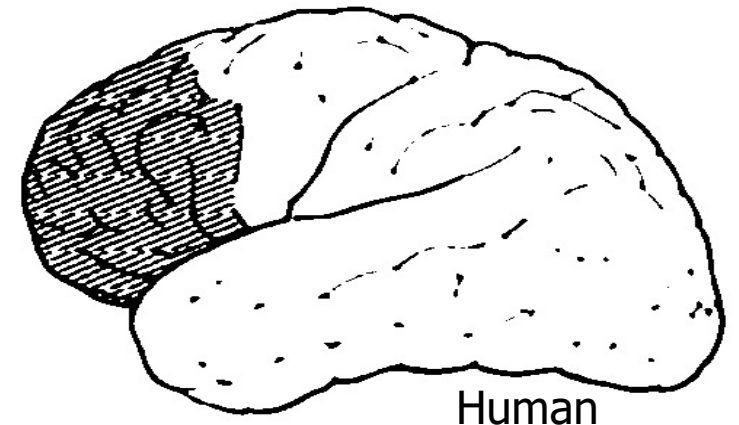
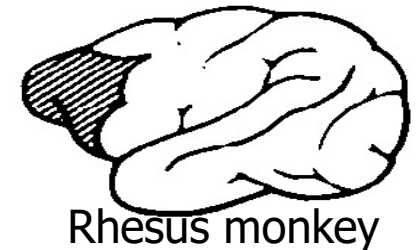


- Located immediately posterior to the central sulcus (large groove between the frontal & parietal lobe)
- Receives sensory information from the skin (temperature, touch & pain).
- Different regions of skin surface represented by different areas along the strip of cortex, forming a **somatotopic map** (face & hands overrepresented).

Frontal Lobe

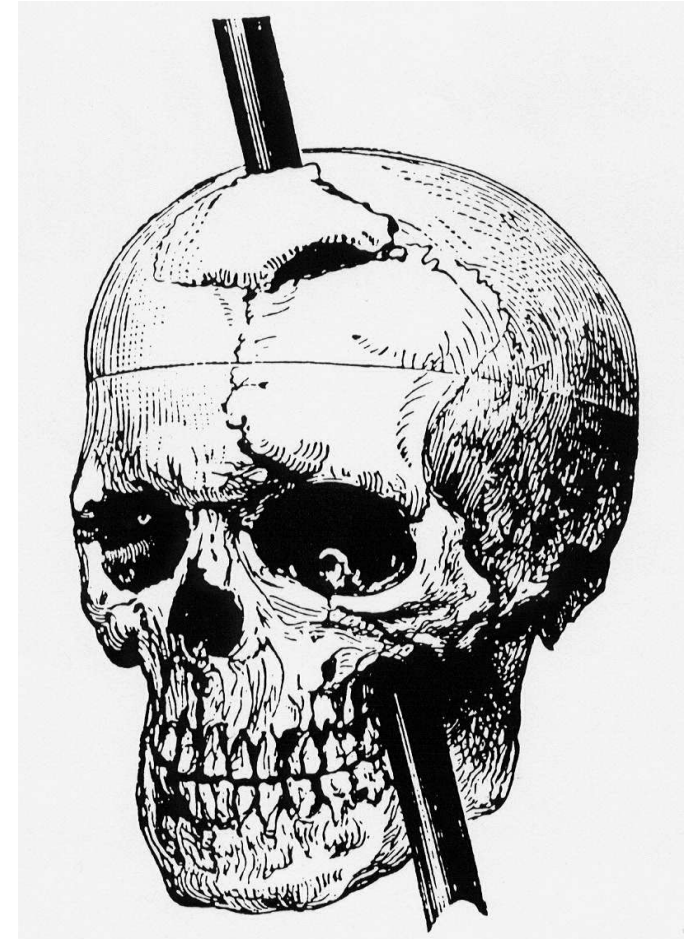
- Human frontal cortex is different from other animals
 - relatively larger than non primates
 - a higher level of connectivity with rest of the brain (compared to other apes)
- “higher order” functions of the frontal lobes
 - Voluntary, controlled behaviour
 - Impulse control & emotional regulation
 - Abstract reasoning & planning
 - Social cognition
 - Language

Comparative frontal lobe size

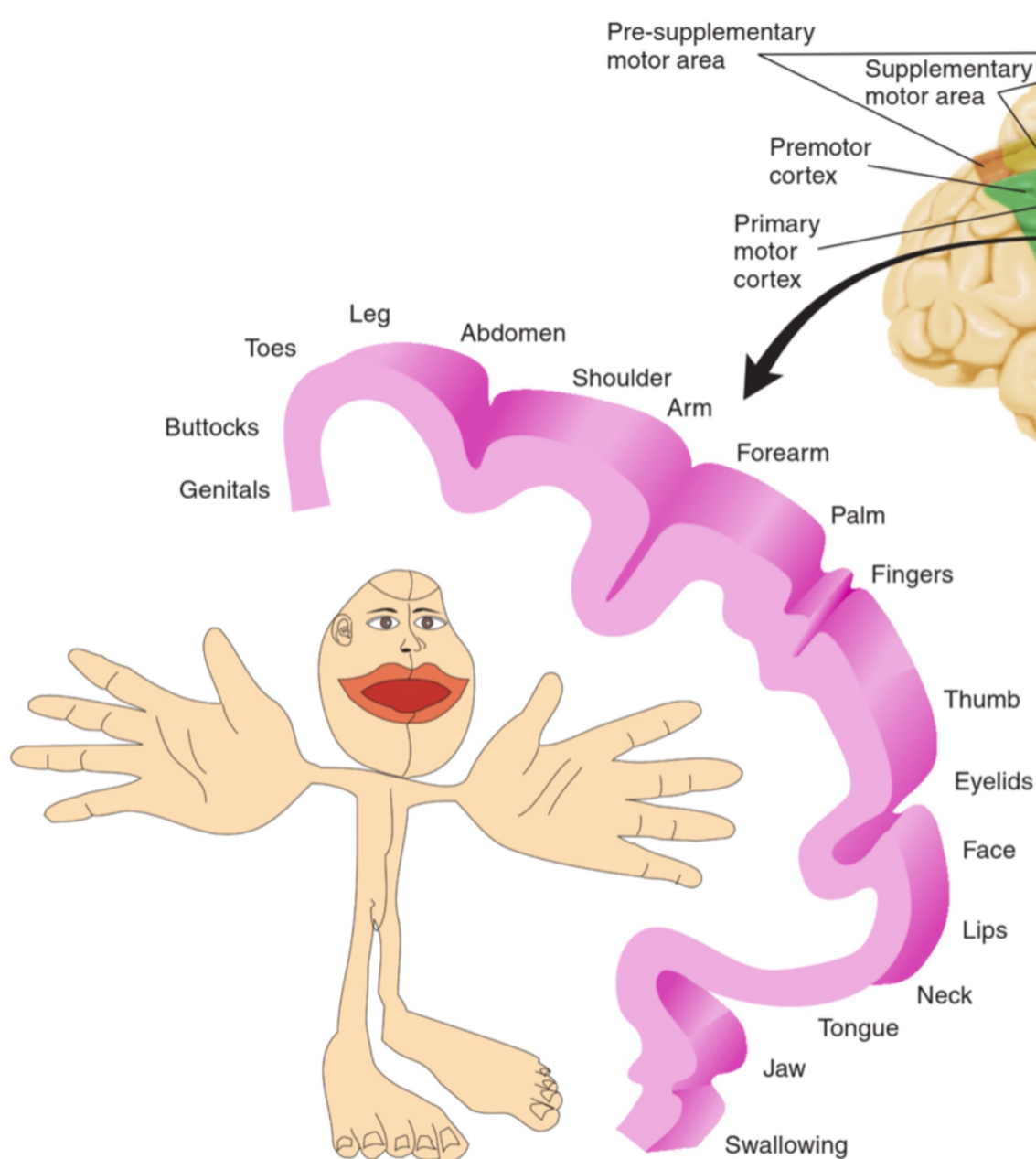


Frontal Lobe

- Phineas Gage – Classic case of altered “executive functioning” with frontal lobe damage
- railway foreman in Cavendish, Virginia
accident involving ‘tamping iron’ (1848)
- survived profound damage to frontal lobe
behavioural changes (*'no longer Gage'*)
 - personality changed profoundly
 - angry, impatient, obstinate, capricious
 - unable to plan for the future.
 - not employable in old job, (only held jobs where he did not make decisions)

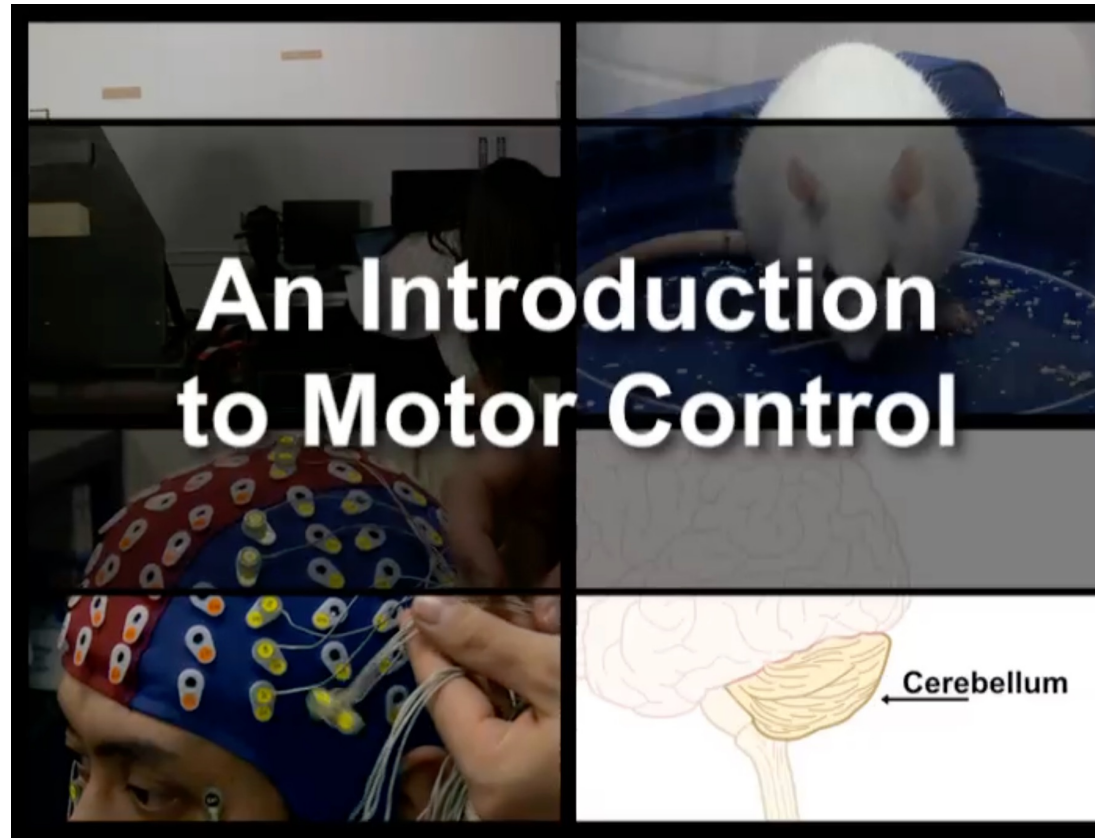


Primary motor cortex



- Located on the **precentral gyrus** immediately anterior to central sulcus.
- Different parts of primary motor cortex send signals that control different groups of voluntary muscles (e.g., hands, feet, lips).
- Like the primary sensory cortices, the primary motor cortex controls muscles on the opposite (contralateral) side of the body.

Motor Control



Very good video about motor control (1st 5min only)

<https://www.jove.com/embed/player?id=5422&access=tcm4w63yfp&t=1&s=1&fpv=1>

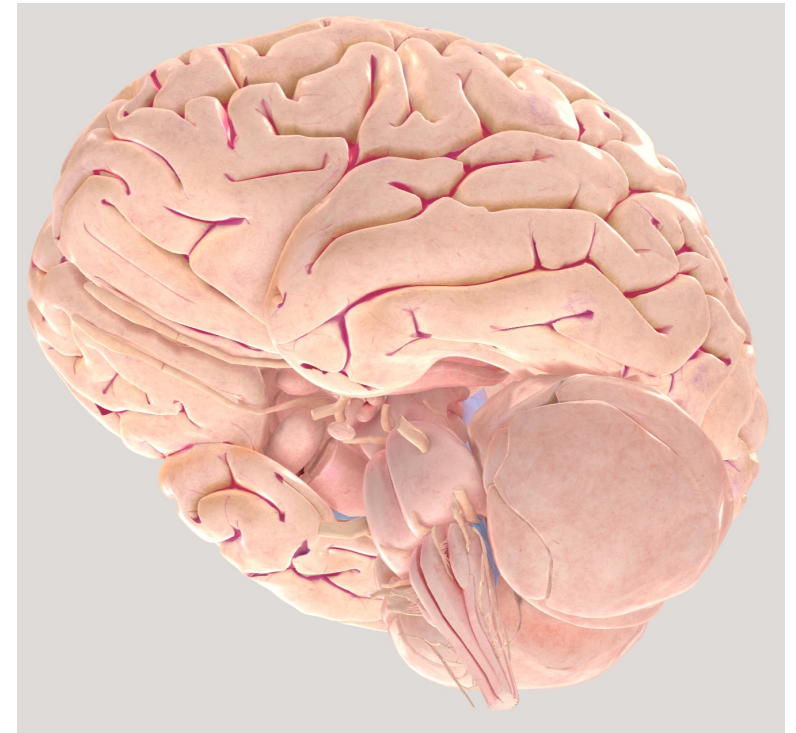
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Additional Resources

There is a lot you have learnt in this section. In your own time you may like to refer to the BrainFacts.org interactive 3D model of the brain.

BrainFacts.org

<https://www.brainfacts.org/3d-brain#intro=true>



Section Summary

- Understand the key functional divisions of the cortex
 - Lobes of the cerebral cortex
 - Primary visual & auditory cortex
 - Primary somatosensory cortex
 - primary motor cortex
- Frontal lobes support “higher order” / “executive function”
- The somatosensory and motor cortex work together to process somatosensory information and guide motor action