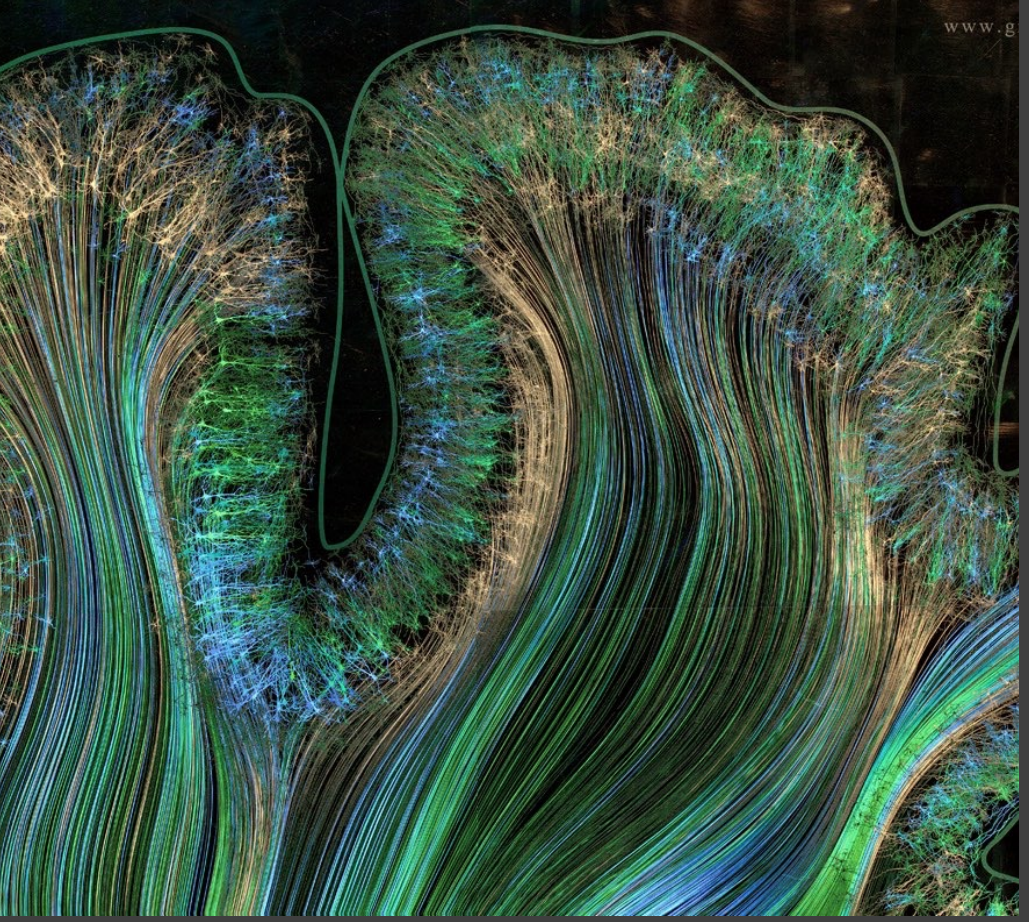
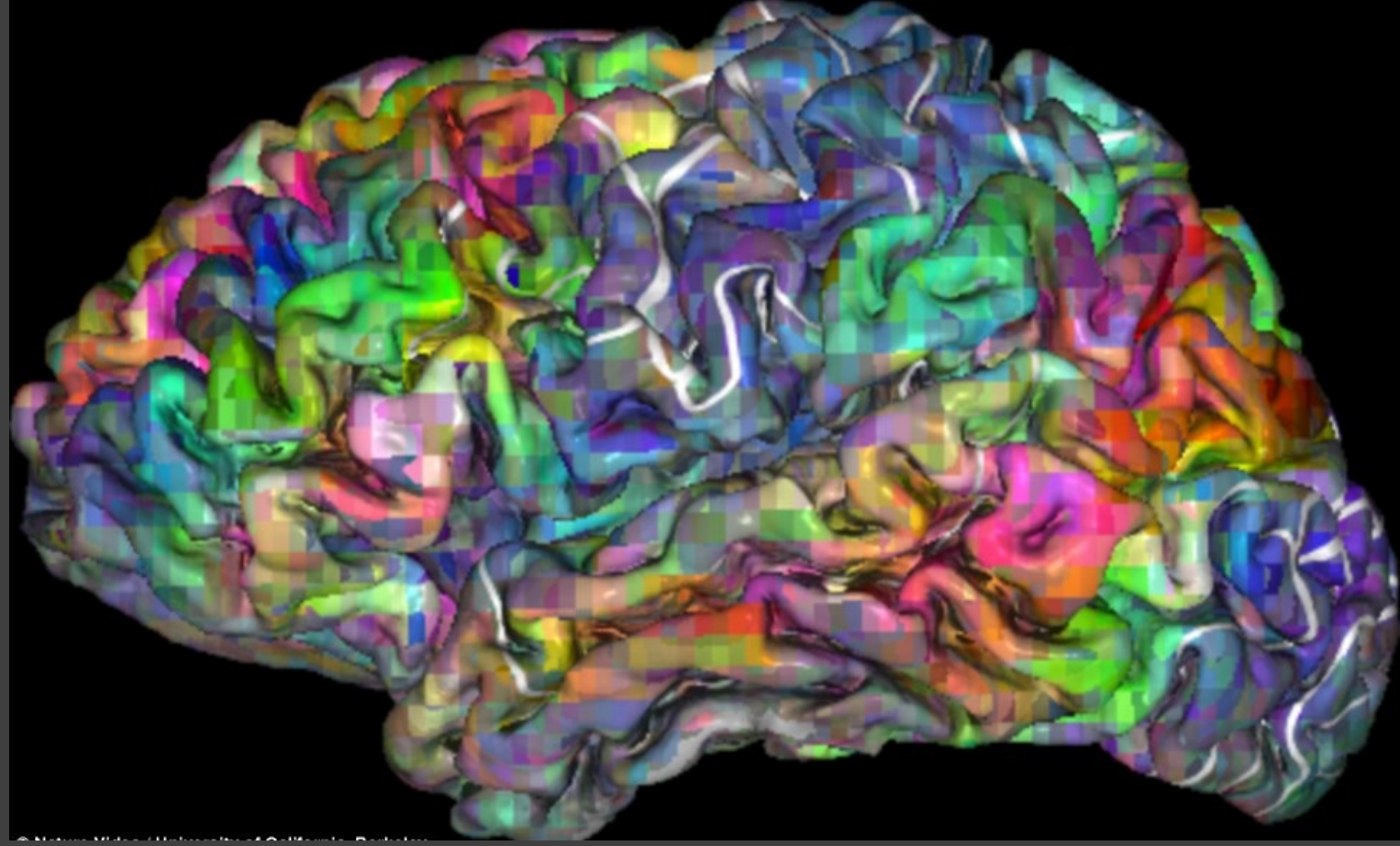
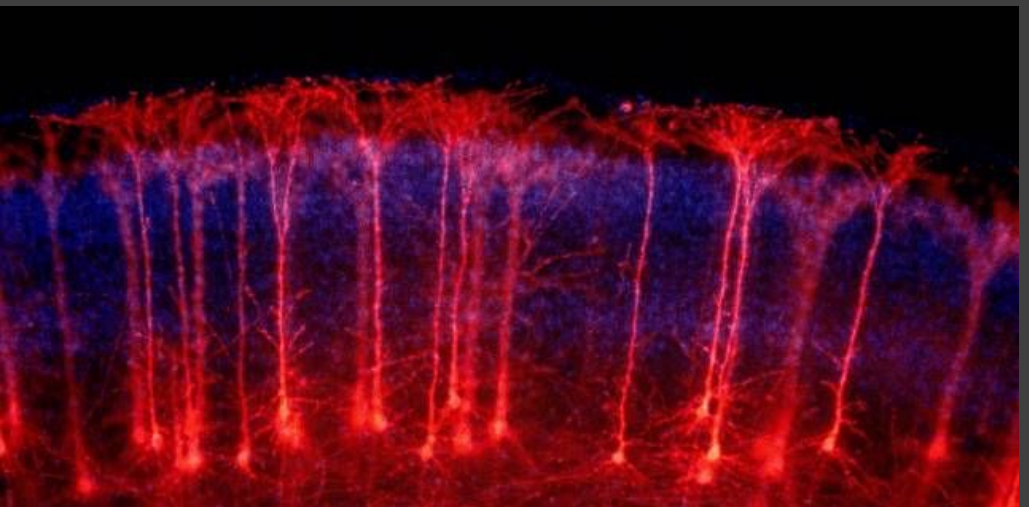




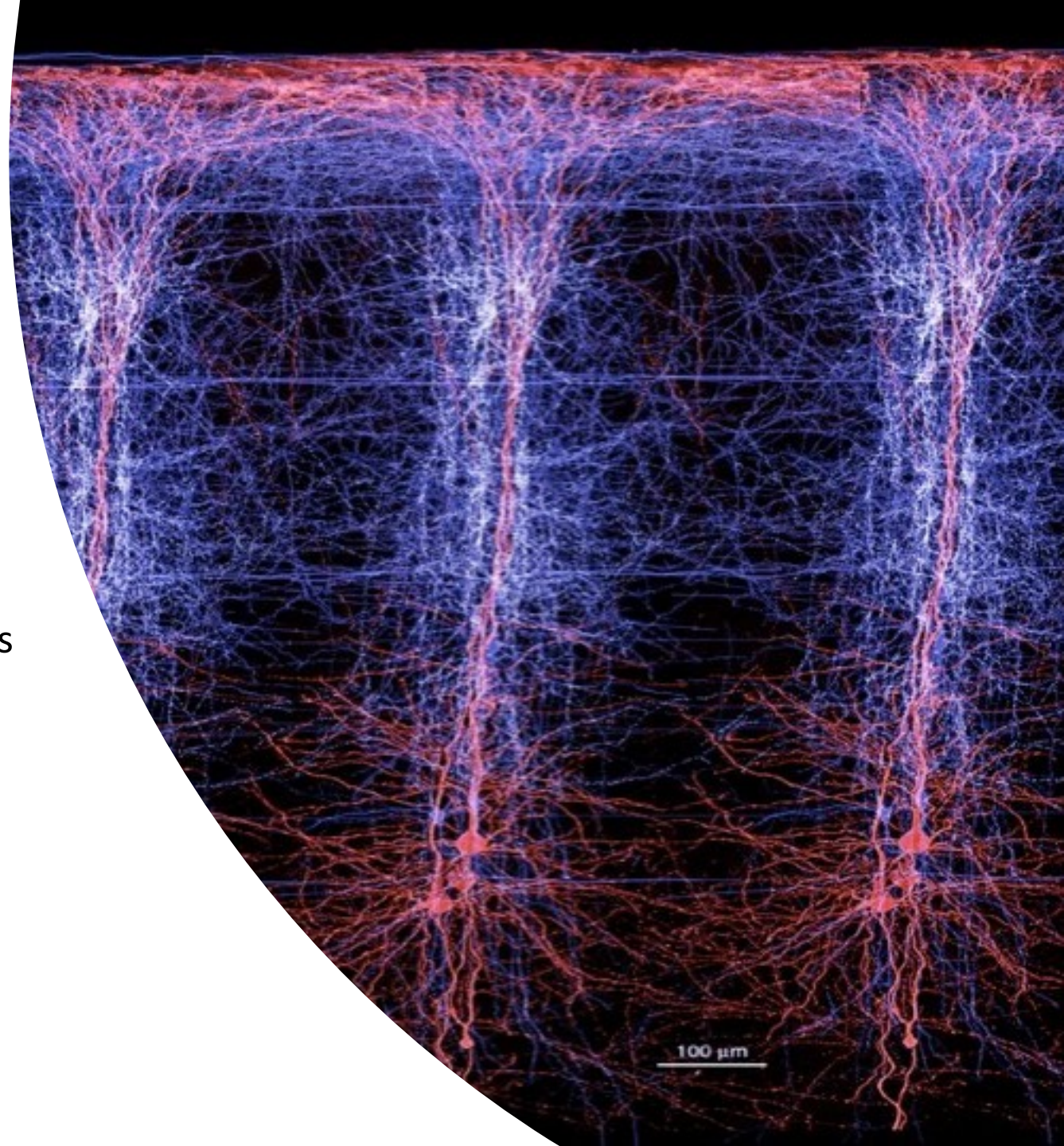


The cerebral cortex

Åsa Fex Svenningsen 2020

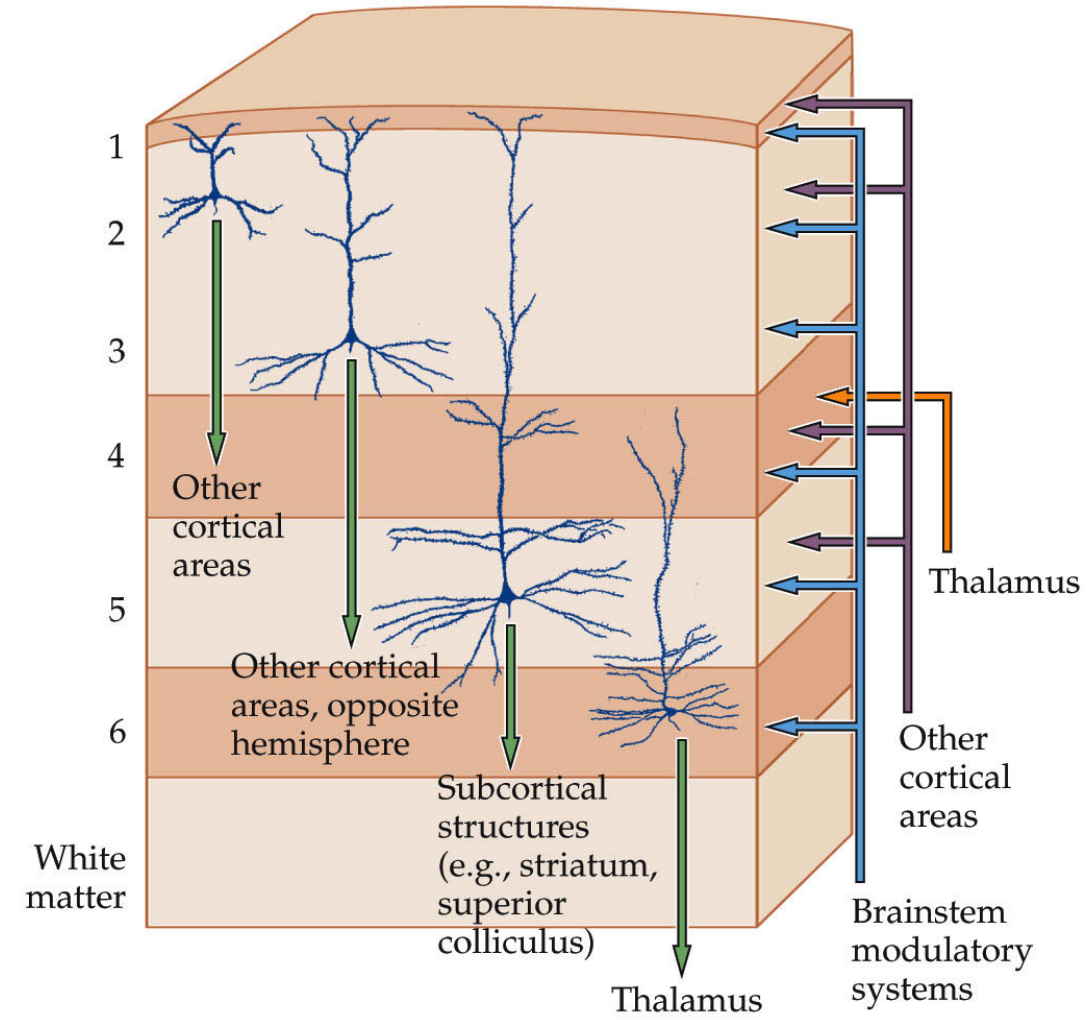
Cortex

- 5 mm of grey substance!
- Most of the cerebral cortex is neocortex, which means it has **six layers! Named I to IV.**
- The different layers laminae gets different types of information from the rest of the brain and body.
- The place where all information that the brain receives is analyzed, plans are decided on and responses formulated.
- Cortex is where cognition happens
- What makes us human!



Input and output to cortex

- Each cortical layer has a primary source of inputs and a primary output target.
- The cortex get information from most other pats of the brain and also sends information to most parts.
- One of the structures that carry information to the cortex is the thalamus



NCE, Fourth Edition, Figure 26.3

Thalamus

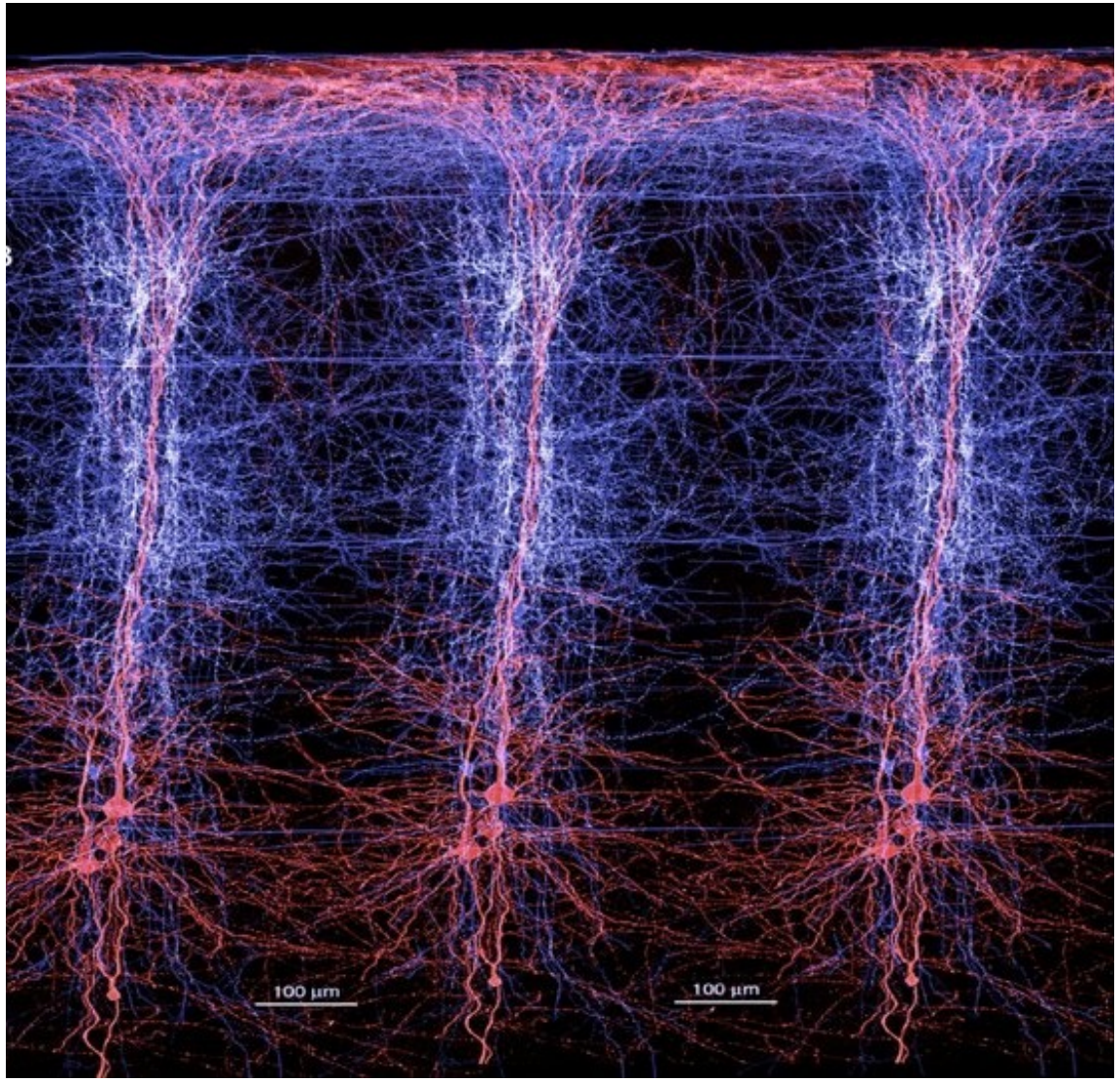
- Is a paired structure in the middle of the brain
- It relays sensory and motor information to the cerebral cortex.
- Every sensory system (except for the olfactory system) includes a thalamic nucleus that receives sensory signals and then sends them to the associated cortical area.
- The thalamus also plays an important role in regulating states of sleep and wakefulness
- Thalamus is also involved functions as fx memory, speech and decision making.

Two general types of neurons in the cortex

Pyramidal neurons /association neurons :

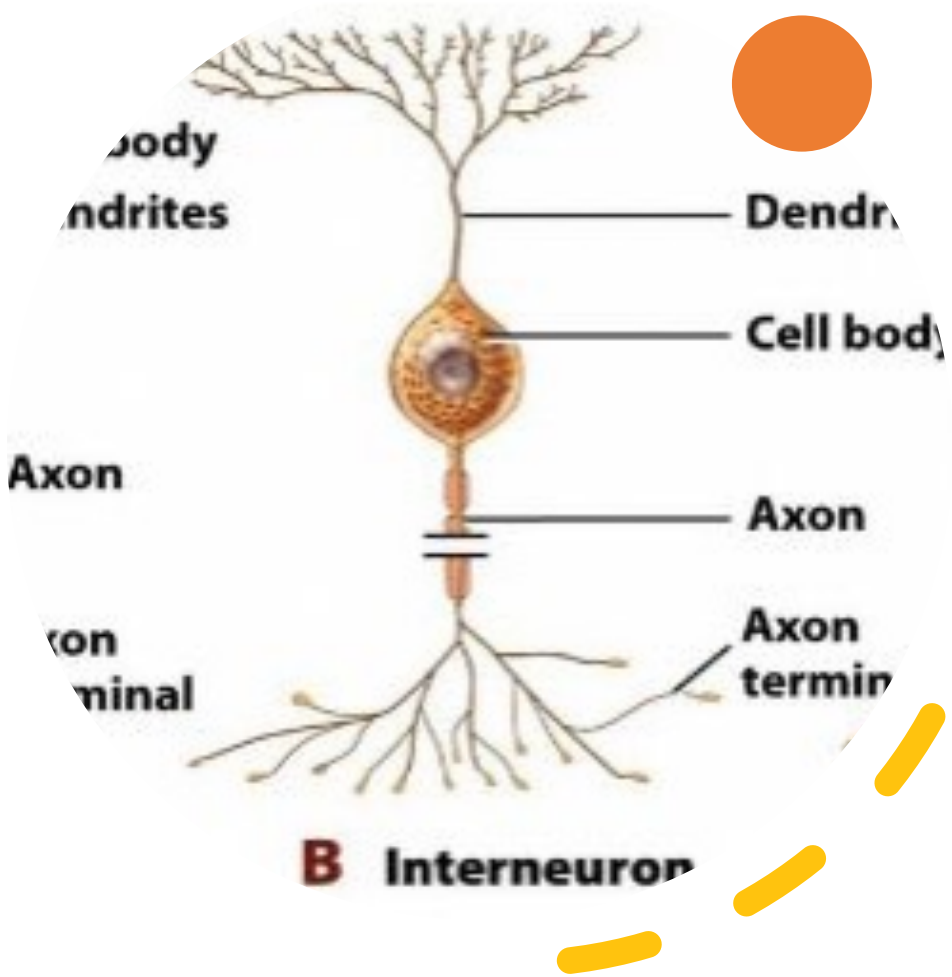
- 80% of all cortical neurons
- have long dendrites ascending towards the cortical surface, and long axons.
- Connect different parts of the brain and different parts of the different hemispheres.
- Important in cognition
- Are excitatory- use glutamate as neurotransmitter

(They are named pyramidal because their cell body looks like a little pyramid)



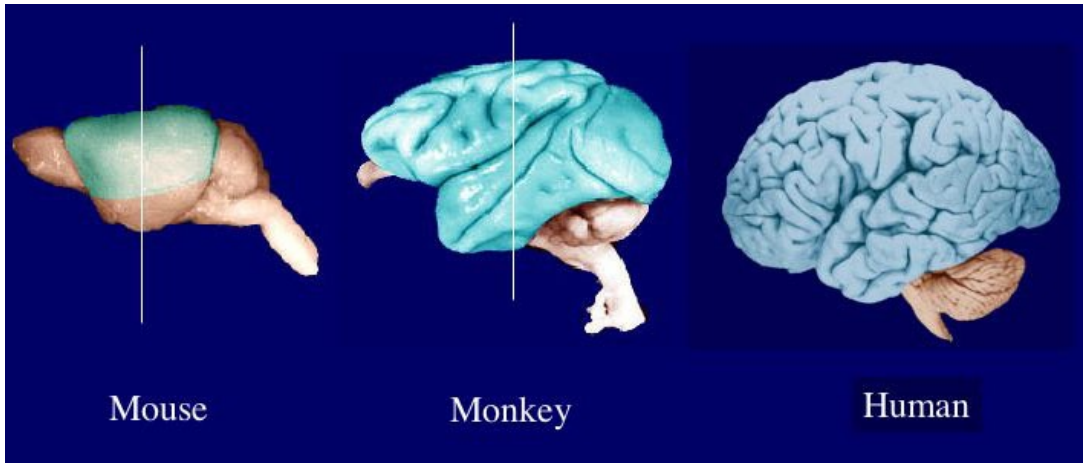
Two general types of neurons in the cortex

- Non-pyramidal cells are cortical interneurons and form circuits with nearby neurons to analyze small pieces of information or connect circuits of neurons in one region of the brain with those in other regions.
- The interaction between interneurons allow the brain to perform complex functions such as learning, and decision-making.
- Make up 20 % of all cortex neurons Inhibitory-use GABA as their neurotransmitter.



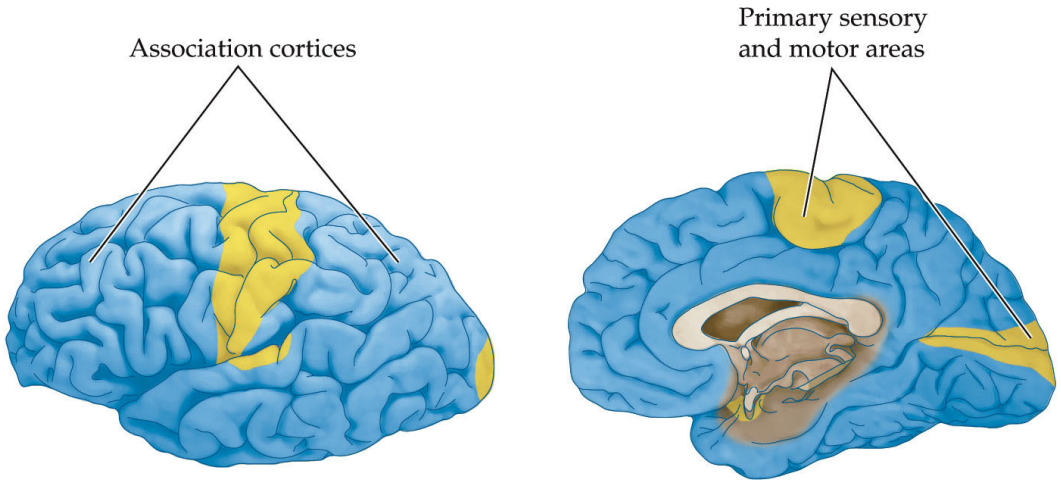
Cortex is particularly big in primates

- Most of the cortex that cover the cerebral hemispheres, is defined as the neo-cortex, that has six cellular layers or laminae.
- In mouse brain the neocortical surface is smooth and covers only the top part of the brain. In the monkey and human brains, neocortex has many sulci or wrinkles and covers almost the entire brain.
- The primate cortex is wrinkled to make the area bigger!



Association cortex

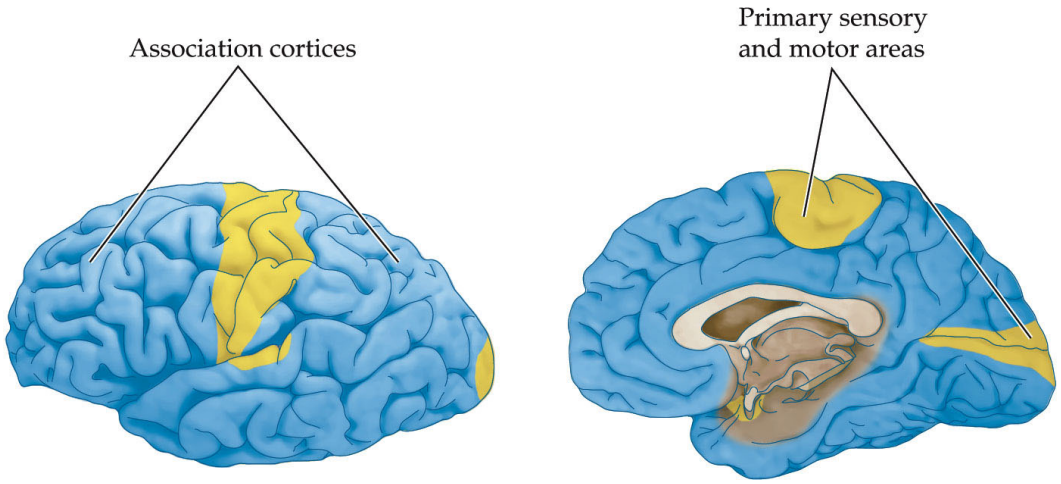
- Sensory and motor cortices and the cortex used by the senses only take up 1/5 of the whole cerebral cortex.
- The rest is concerned with attending to complex stimuli, identifying relevant features of such stimuli, recognizing the related objects, and planning appropriate responses- *cognition*.
- *The association cortex (especially the temporal and frontal lobes) makes cognition possible.*



***NEUROSCIENCE, Fourth Edition,* Figure 26.1**

Association cortex receives ”old” information

The signals coming into the association cortices via the thalamus *is sensory and motor information that has already been processed in the primary sensory, motor and senses areas* of the cerebral cortex and then fed back to the association regions.



***NEUROSCIENCE, Fourth Edition,* Figure 26.1**

Questions 1

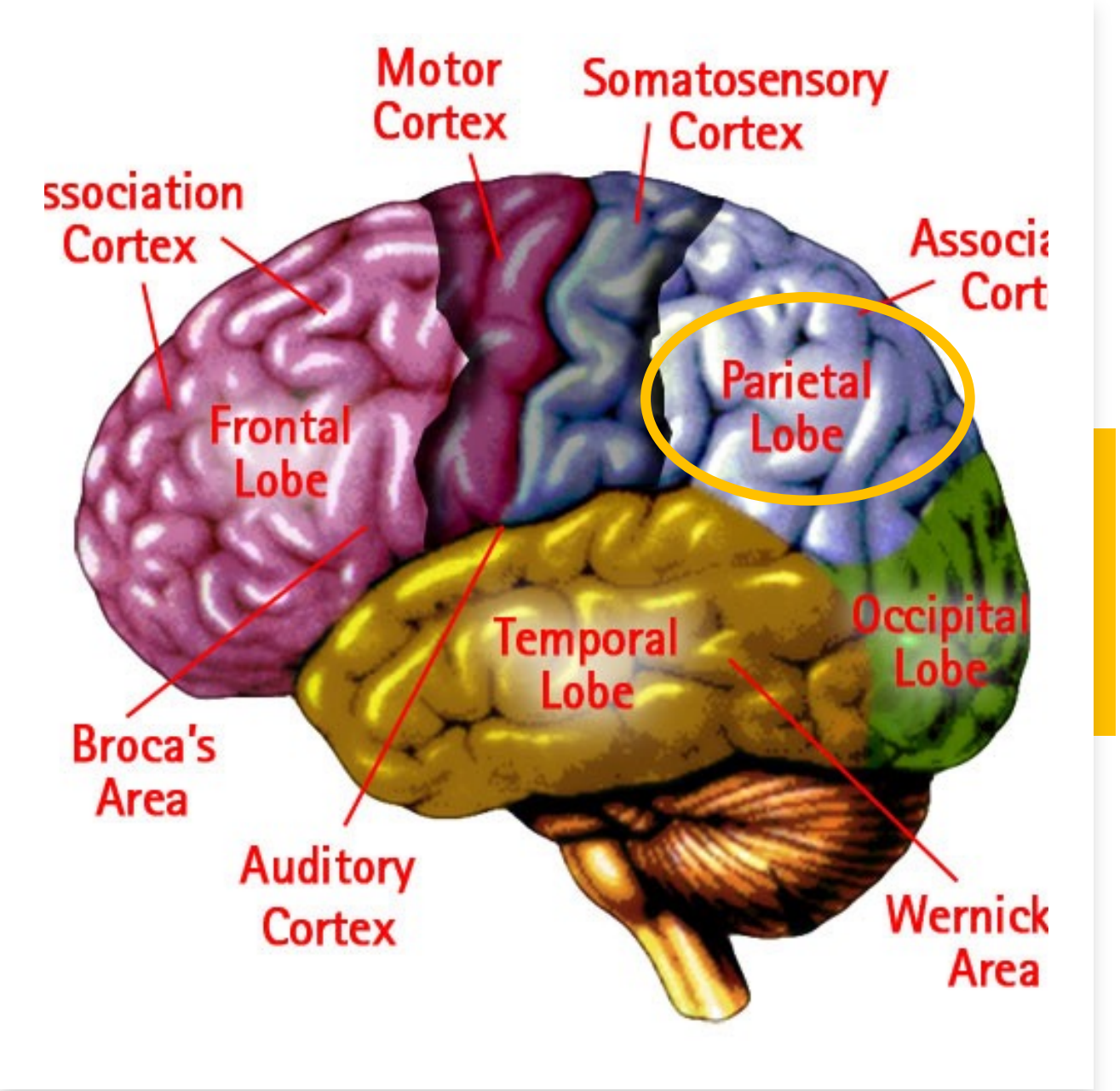
- Name the thickness and the number of layers in the cortex.
- Describe where Thalamus is situated in the brain, its function and what brain areas it is in contact with.
- Name and describe the two major types of neurons in the cortex
- What parts of the cortex are not part of the association cortex and why is that?

The lobes of the association cortex

Temporal lobe: Auditory processing (auditory cortex), speech and verbal memory, hippocampus (on the inside), episodic/declarative memory (long term)

The parietal lobe plays important roles in integrating sensory information from various parts of the body. Portions of the parietal lobe are involved with visual-spatial processing

Frontal lobe: ability to recognize future consequences resulting from current actions, to choose between good and bad actions (or better and best), override and suppress unacceptable social responses, and determine similarities and differences between things or events. Executive functions.

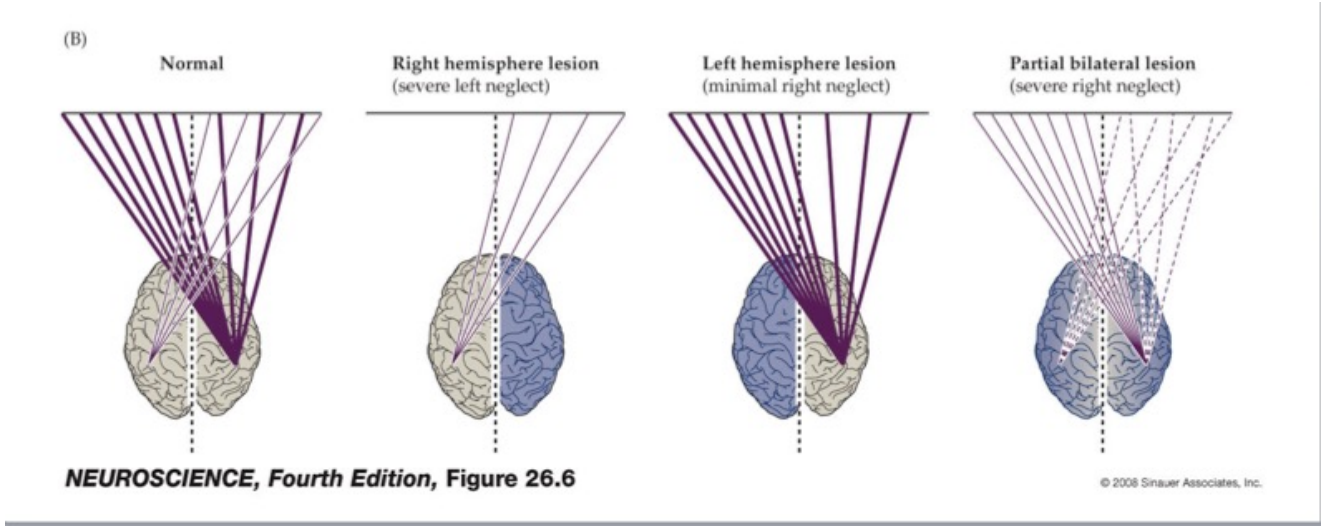


What does the different areas of association cortex do?

The parietal lobe

Damage to the Parietal Cortex- Neglect syndrome

- Damage to one parietal lobe : deficit in attention …
- Inability to attend to objects or one's own body in a proportion of space, despite the fact the visual acuity, somatic sensation and motor ability remain intact.
- Affected individuals fail to report, respond to, or even orient to stimuli presented to the side of the body (or visual space) opposite the lesion
- Film: https://www.youtube.com/watch?v=WbC0LojzAIg

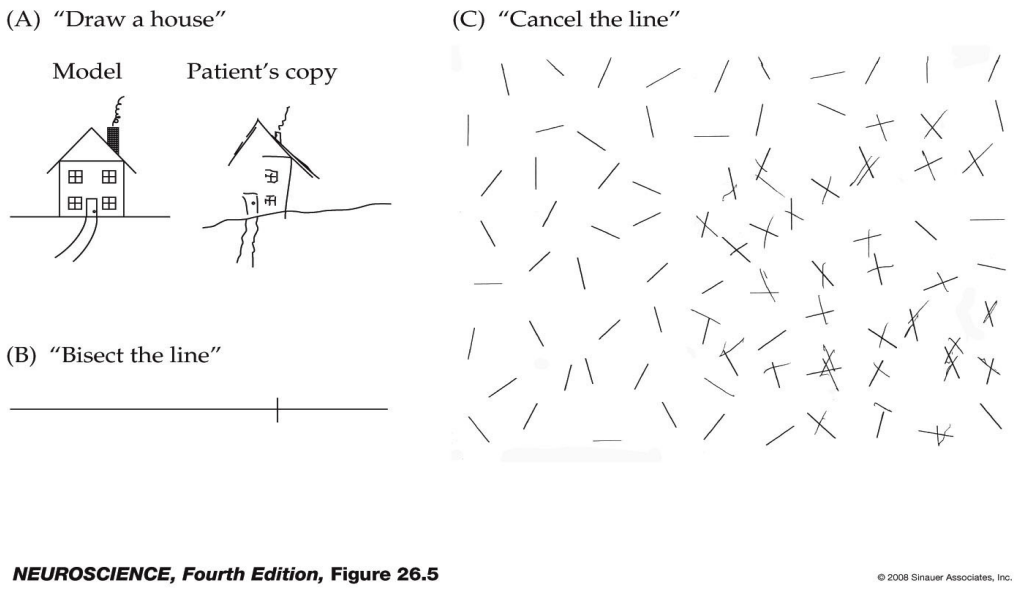


More neglect

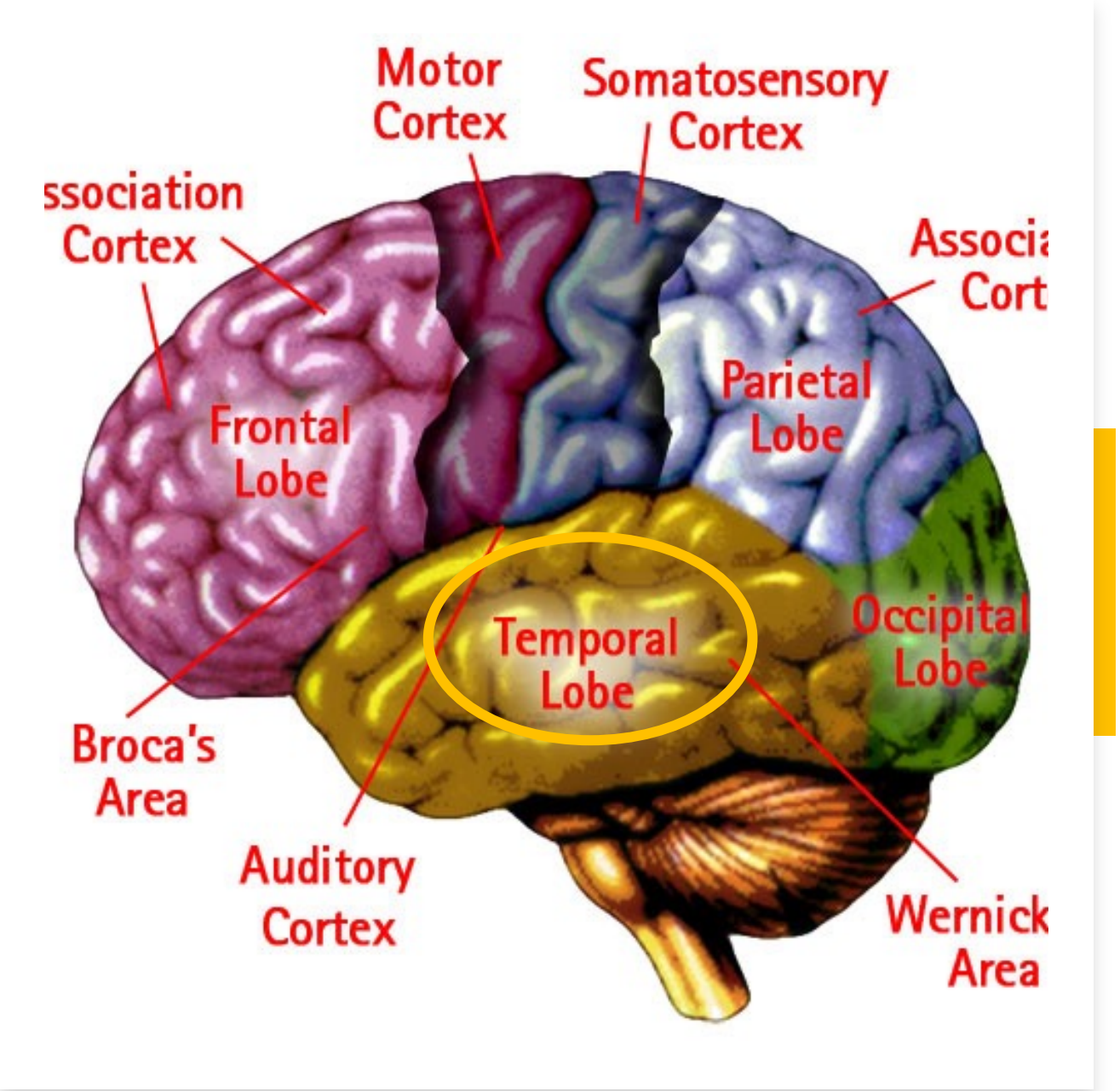
- See also:
- https://www.youtube.com/watch?v=d4FhZs-m7hA

Damage to the Parietal Cortex- Neglect syndrome

Associated with damage to the *right parietal lobe*, because the right parietal lobe mediates attention to both the left and the right halves of the body and extra personal space, whereas the left hemisphere mediates attention primarily to the right



***NEUROSCIENCE, Fourth Edition*, Figure 26.5**



What does the different areas of association cortex do?

The temporal lobe

Lesions in the temporal association cortex

- *Normally*: Recognition and identification of stimuli that are attended to, particularly complex stimuli.
- *Agnosia*: Difficulty recognizing, identifying and naming different categories of objects as persons, sounds, shapes, or smells while the specific sense is not defective nor is there any significant memory loss
- This may not only happen after an injury. Some people are born with this (genetically inherited)
- Generally lesions to the *right temporal* lobe lead to agnosia called for faces (prosopagnosia) and objects while lesions to the *left temporal* lobe lead to difficulties with language-related problems.

Agnosia

Visual agnosia:

- https://www.youtube.com/watch?v=ze8VVtBgK7A
- https://www.youtube.com/watch?v=edrWWjvhrgY

Prosopagnosia:

- https://www.youtube.com/watch?v=XLGXAiSpN00
- https://www.youtube.com/watch?v=vwCrxomPbtY

Visual Agnosia

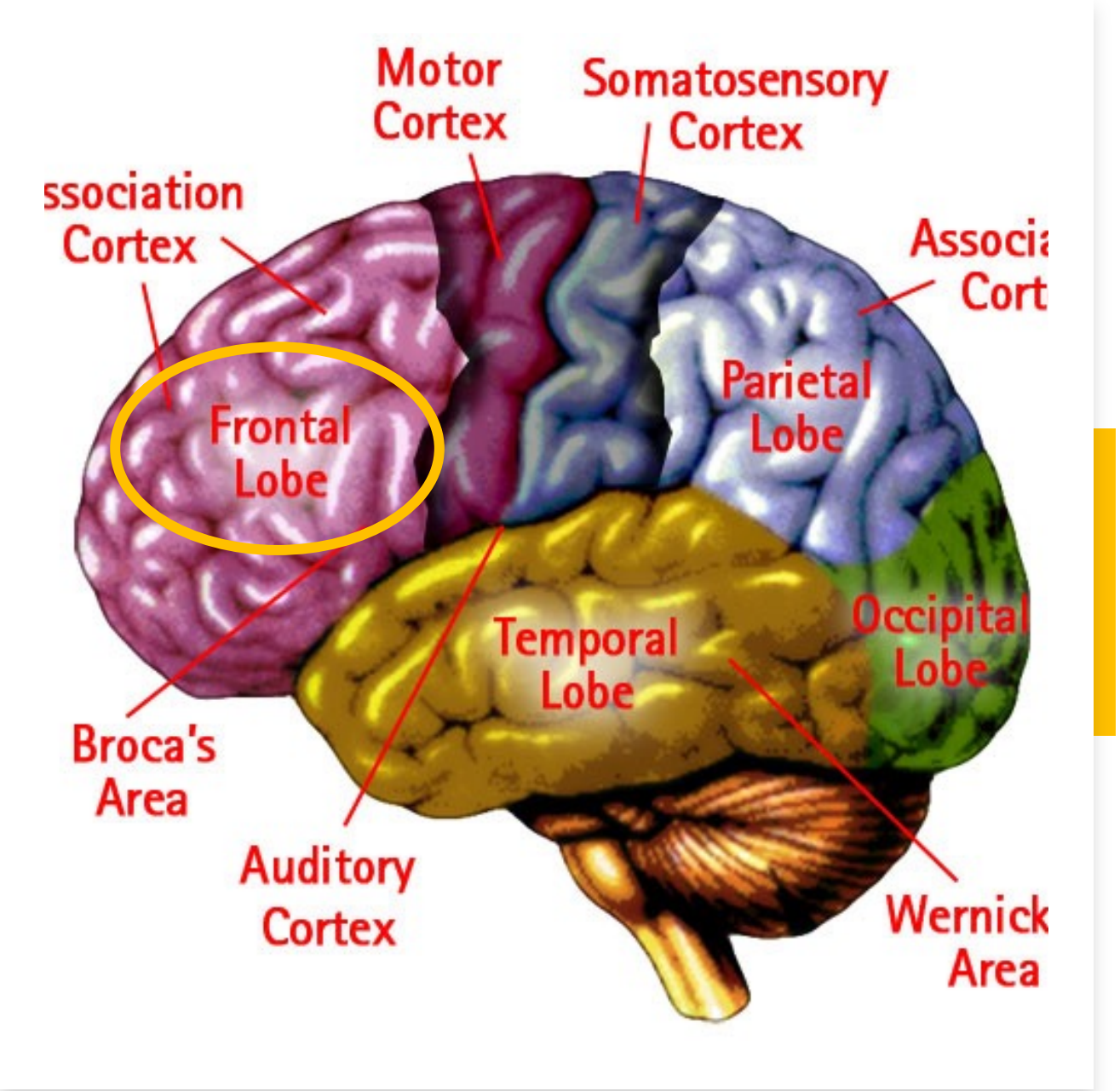
https://www.youtube.com/watch?v=ze8VVtBgK7A&t=5s

Prosopagnosia

https://www.youtube.com/watch?v=-vQGPcYfIAo&t=352s
https://www.youtube.com/watch?v=vwCrxomPbtY

Questions

1. Describe the normal function of the temporal lobe and what happens when you have and injury in this area (the right temporal lobe)
2. Describe the normal function of the parietal lobe and what happens when you have an injury to the right parietal lobe?
3. Why is damage to the left parietal lobe not giving such big problems?



What does the different areas of association cortex do?

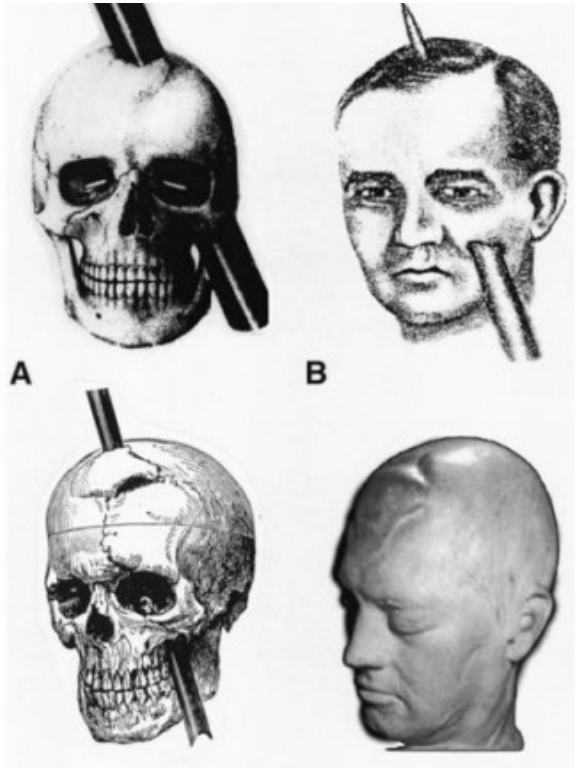
The frontal lobe

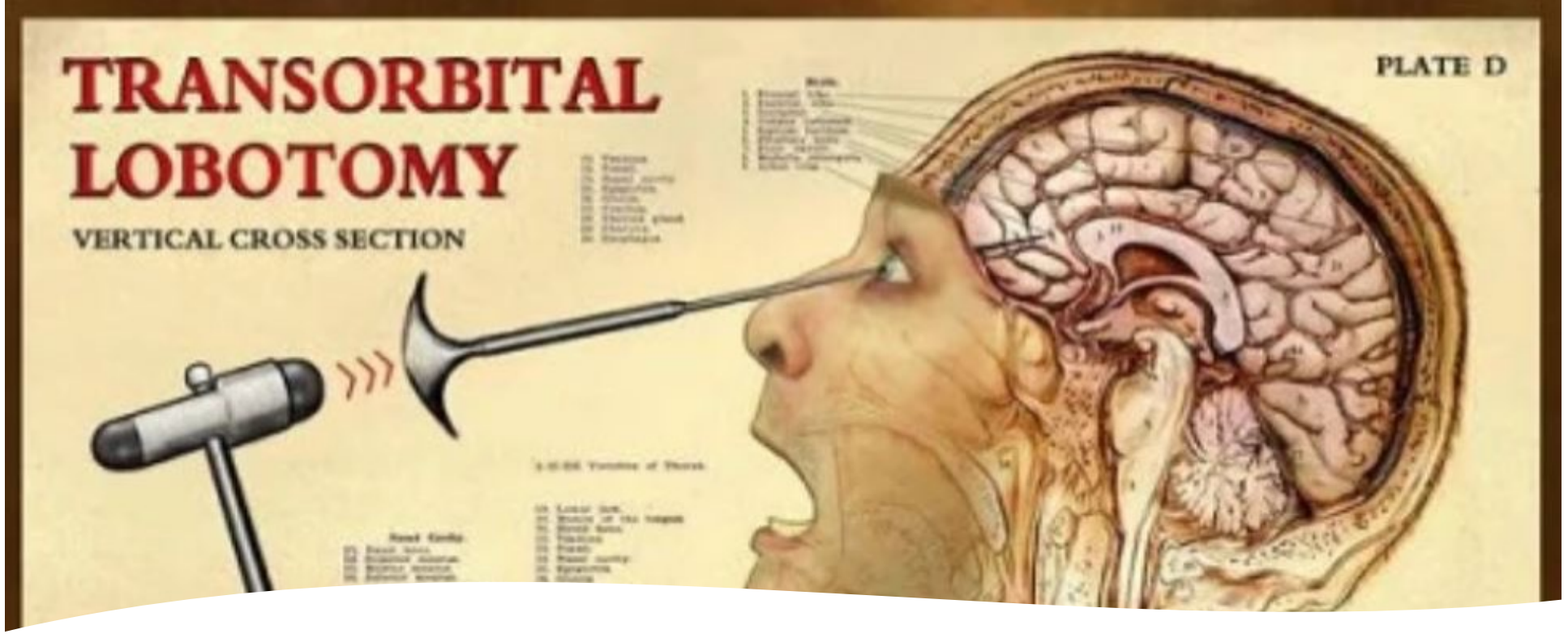
The frontal lobe

- The frontal cortex has a wider repertoire of functions than any other neocortical region – Appreciation of self in relation to the world that allows behaviors to be planned and executed normally.
- Your personality resides in the frontal lobe!
- **When damaged:** difficulty planning and executing complex behaviors that are appropriate to the circumstances, complete change in personality.

Phineas Gage

- https://www.youtube.com/watch?v=yXbAMHzYGJ0
- https://www.youtube.com/watch?v=flRamGBSoP4





Lobotomy

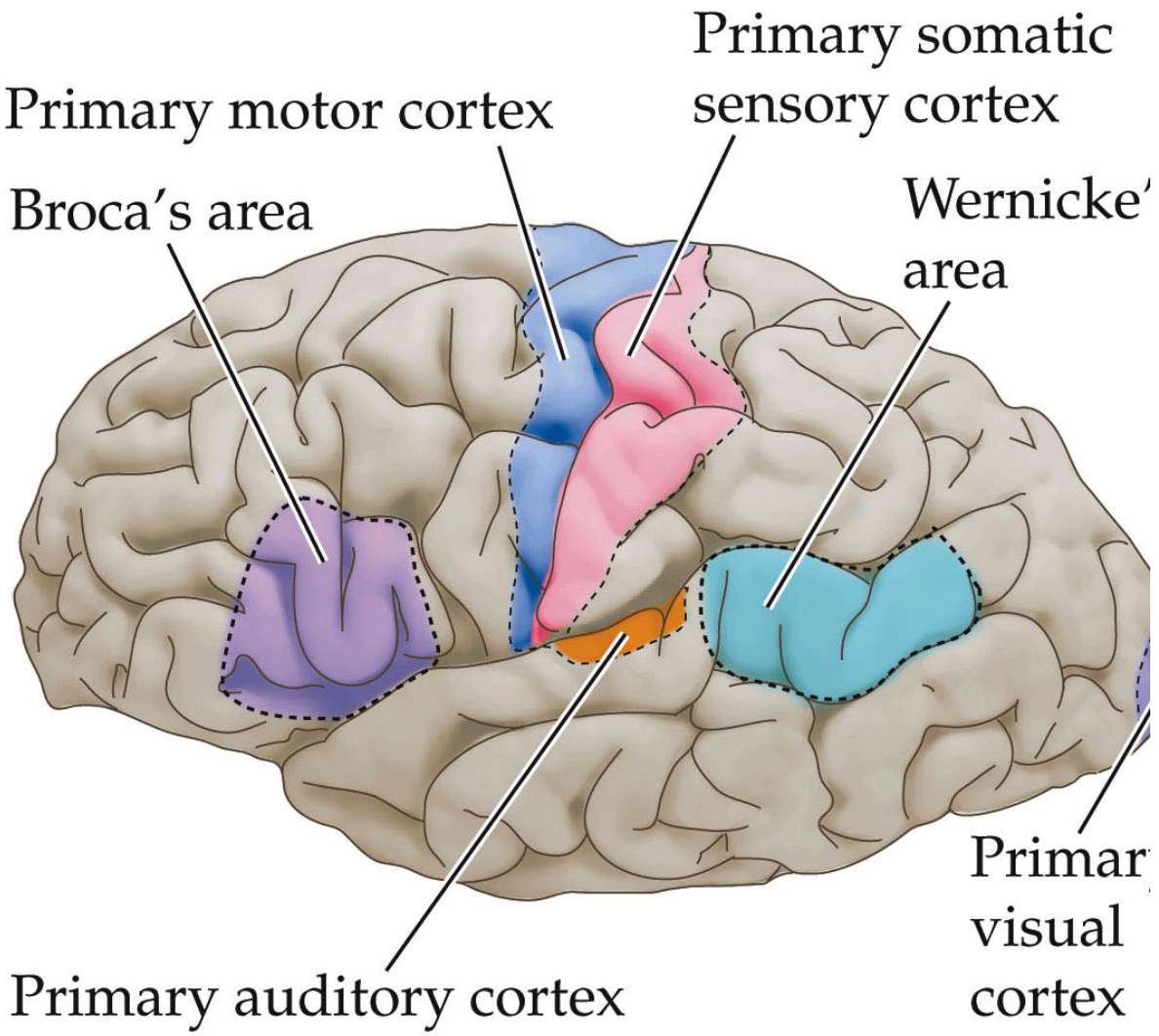
- cutting the connections to and from the prefrontal cortex.
- Lobotomies were used mainly from the 1930s to 1950s to treat a wide range of severe disorders, including schizophrenia, clinical depression and various anxiety disorders, as well as people who were considered a nuisance by demonstrating behavior characterized as, for example, "moodiness" or "youthful defiance".
- the procedure has since been characterized "as one of the most barbaric mistakes ever perpetrated by mainstream medicine".

https://www.youtube.com/watch?v=2OdPxa_qbiQ

Lobotomy

- Rosmary Kennedy: he sister of President JFK, was given a lobotomy when her father complained to doctors about the 23-year-old's moodiness. The lobotomy reduced Rosemary to an infantile mentality. Her verbal skills were reduced to unintelligible babble. Her father hid the nature of Rosemary's affliction for years and described it as the result of mental retardation.
- ”One flew over the Cuckoos’nest”.

Areas involved in comprehension and production of language.



EUROSCIENCE, Fourth Edition, Figure 27.1

Are there specific areas for language in the brain?

- Much of the language function is processed in several association areas.
- There are two identified areas that are considered vital for human communication: Wernicke's area and Broca's area.
- These areas are usually located in the dominant hemisphere (the left hemisphere in 97% of people) and are considered the most important areas for language processing.
- This is why language is considered a localized and lateralized function

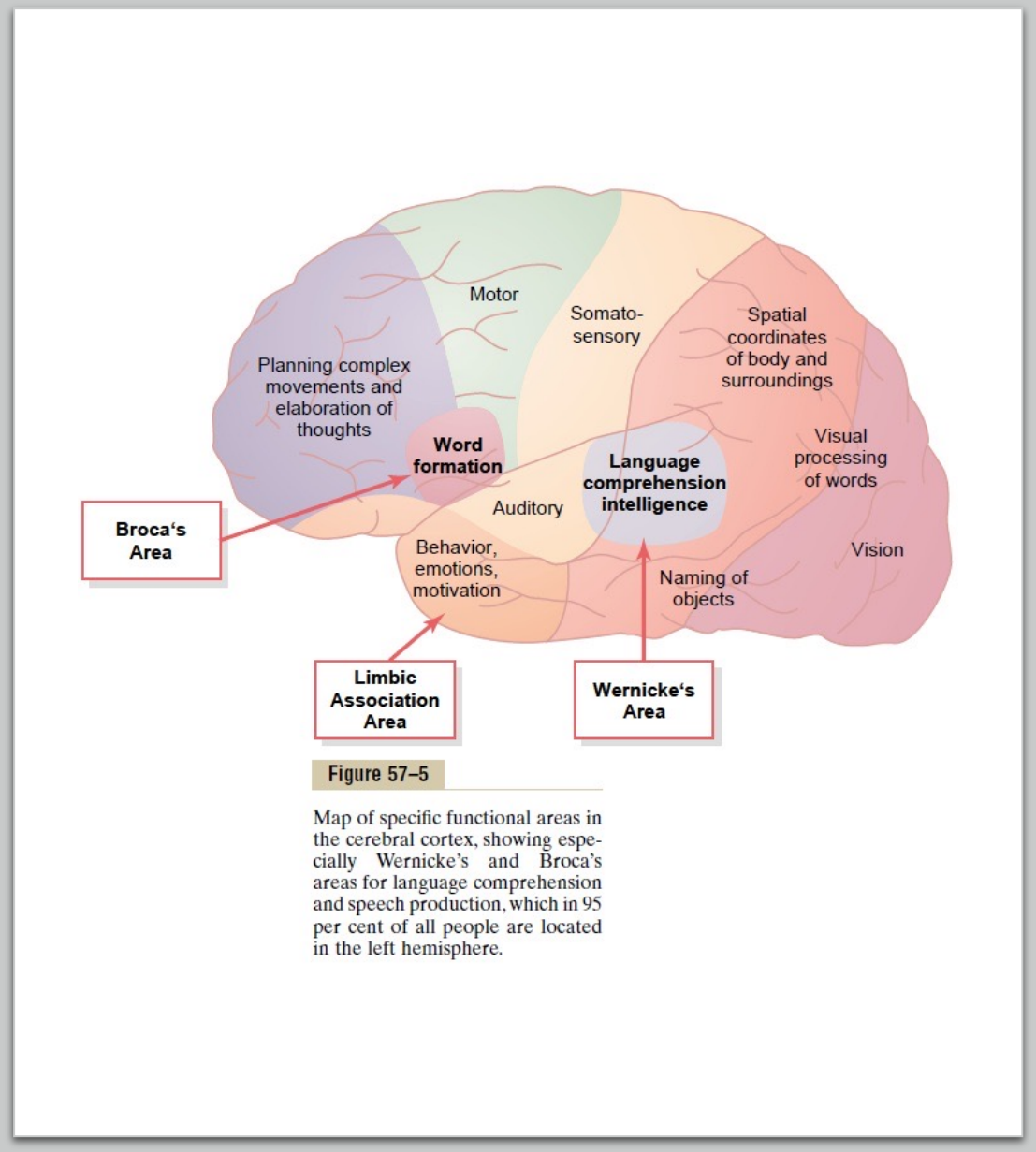


Figure 57–5

Map of specific functional areas in the cerebral cortex, showing especially Wernicke's and Broca's areas for language comprehension and speech production, which in 95 per cent of all people are located in the left hemisphere.

What happens?

…..Talk…..

1. Storing of words in the short-term memory
2. Process the sounds and the meaning.
3. Analyze the orders of the words.
4. Analyze correct action (if to talk back if reaction of other types are necessary)
5. Commando to the motor cortex about sound production (and perhaps other stuff).

…..Response……

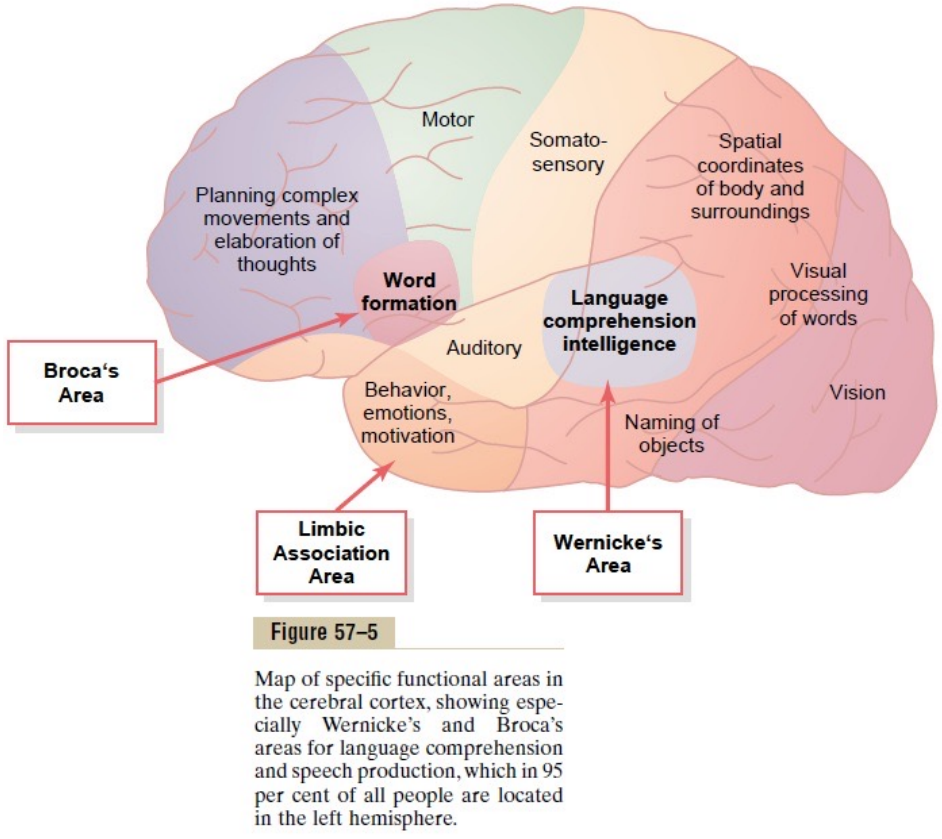
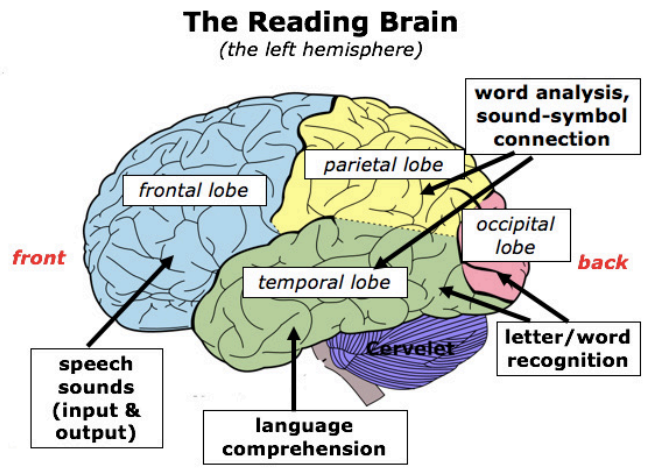


Figure 57–5

Map of specific functional areas in the cerebral cortex, showing especially Wernicke's and Broca's areas for language comprehension and speech production, which in 95 per cent of all people are located in the left hemisphere.

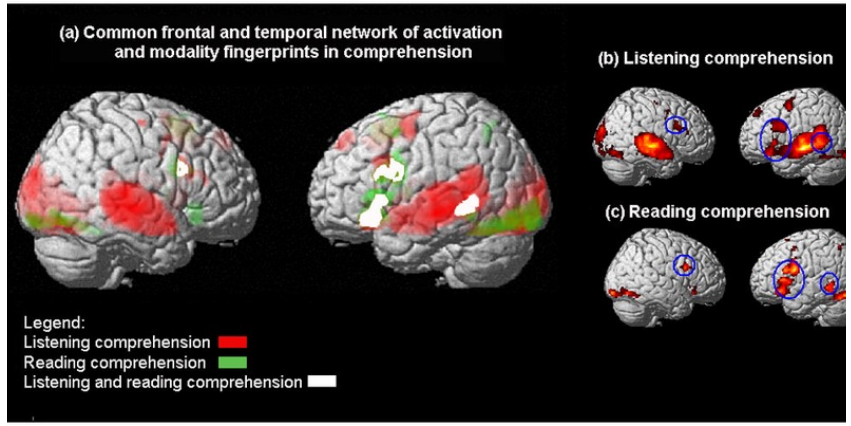
Reading

- Since reading is a cultural invention that arose after the evolution of modern humans, no single location within the brain serves as a reading center.
- Instead, brain regions that sub serve other functions, such as spoken language and object recognition, are redirected (rather than innately specified) for the purpose of reading



Reading

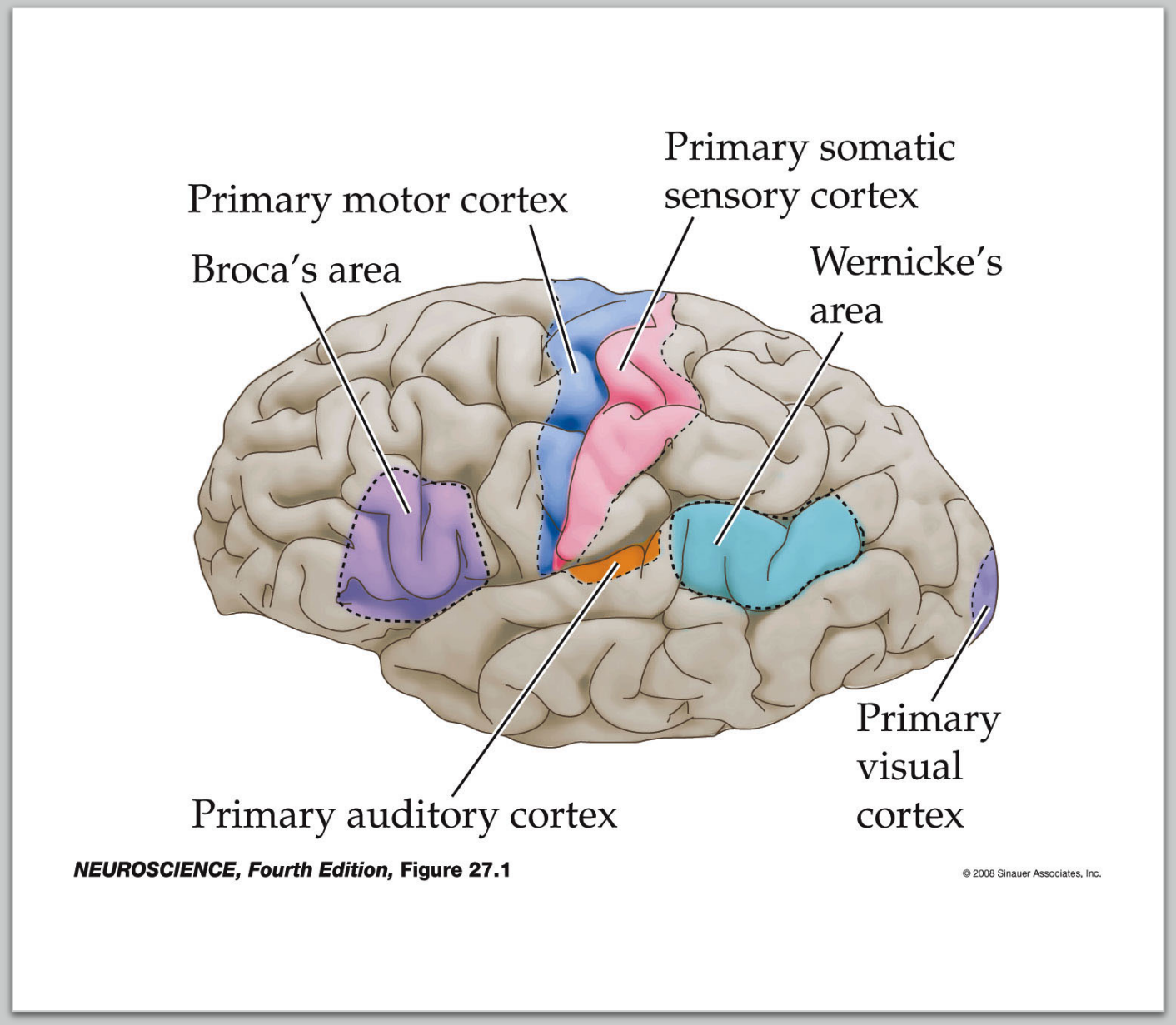
- Repetition of words = Broca's area activated
- Analysis of what a word means (semantic analysis) = engage *several areas in the temporal, prefrontal, lower parietal lobes and both Broca's and Wernicke's areas*-especially *the left side* of the brain.
- Generally, for all complex tasks many parts of the cortex (both hemispheres) are active. Different tasks also overlap in active cortex areas.



Reading

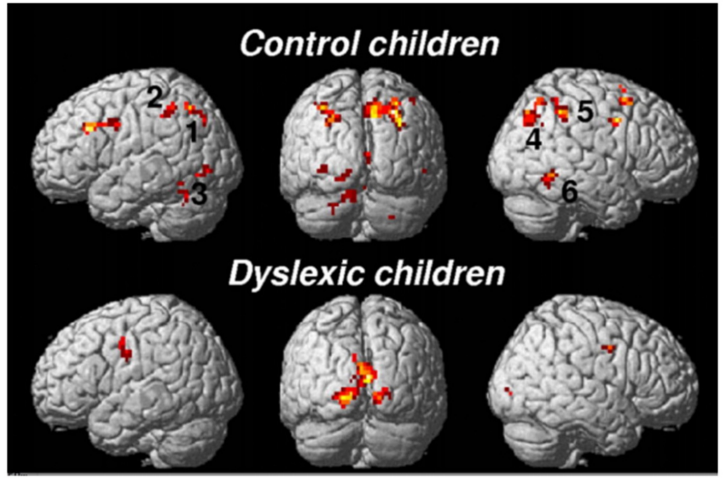
Reading is supported by a network of regions in the left hemisphere:

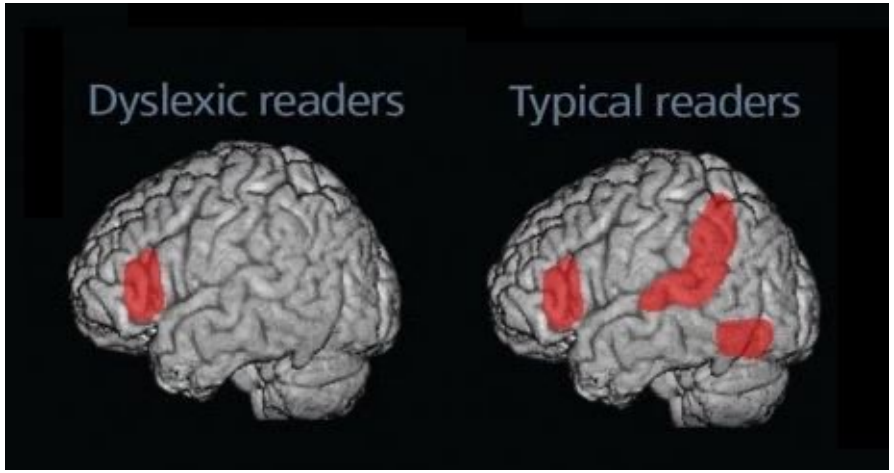
- **occipito-temporal cortex**: visual word form area
- **temporo-parietal cortex**: phonological and semantic processing of words
- **inferior frontal cortex**: : phonological and semantic processing of words. Also involved in the formation of speech sounds



Dyslexia

- Characterized by trouble with reading despite normal intelligence
- Developmental dyslexia is associated with difficulty in processing the *orthography* (the written form) and *phonology* (the sound structure) of language.
- Likely genetic
- Can be helped with special training (should be started early)



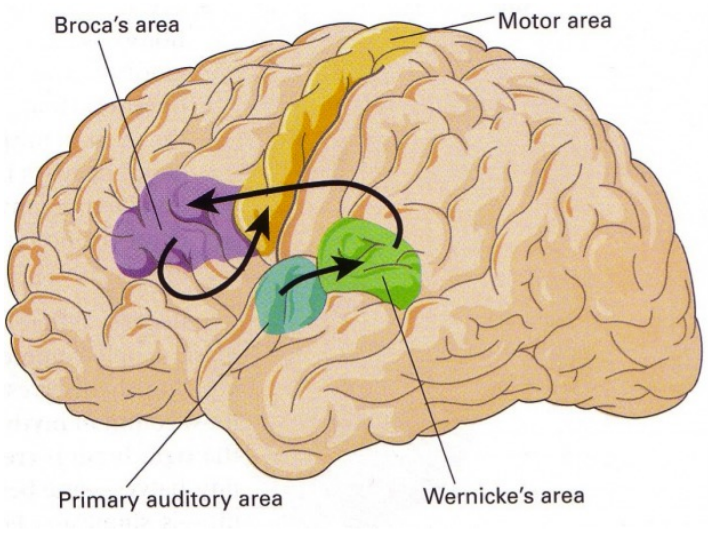


Dyslexia

https://www.youtube.com/watch?v=zafiGBrFkRM

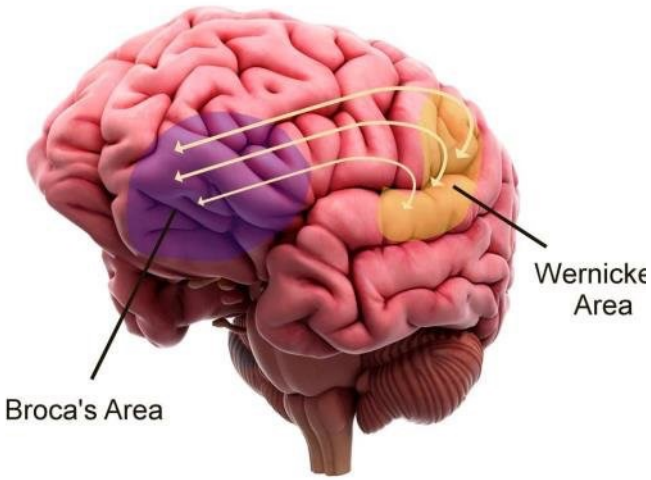
Aphasia

Brocas area



- Broca's area is in the left hemisphere. It has recently been shown that several other areas are involved in speech too.
- For a long time, it was assumed that the role of Broca's area was devoted to *language production*. Recent evidence demonstrates that Broca's area also plays a significant role in *language comprehension.*

Broca´s aphasia- non-fluent aphasia

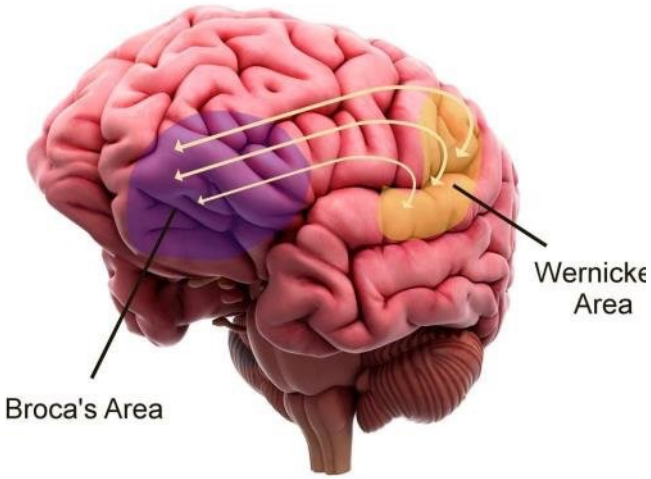


- Patients who know "what they want to say, they just cannot get it out.
- They are typically able to understand what is being said to them, but unable to speak fluently.
- Some of other symptoms may include problems with fluency, articulation, word-finding, word repetition, producing and *comprehending complex grammatical sentences,* both orally and in writing.
- Broca's aphasia also have a good ability to self-monitor their language output
- https://www.youtube.com/watch?v=JWC-cVQmEmY
- https://www.youtube.com/watch?v=NUTpel04Nkc

Broca´s Aphasia

- https://www.youtube.com/watch?v=JWC-cVQmEmY

Wernickes aphasia- fluent aphasia



- It is involved in the understanding of written and spoken language. On the left side as Broca’s area.
- Can't isolate significant sound characteristics and classify them into known meaningful systems.
- A defect in speech. A patient with Wernicke's aphasia can and may speak a great deal, but he or she confuses sound characteristics, producing “word sallad”. intelligible words that appear to be strung together randomly.
- An impairment in writing. A person who cannot discern sounds cannot be expected to write.
- https://www.youtube.com/watch?v=3oef68YabD0

Wernickes Aphasia

- https://www.youtube.com/watch?v=3oef68YabD0

Work division between the hemispheres

- Language is mostly centered to the left half of the brain. But brain scanning has shown that the right side is also involved.
- Areas on the left dealt with the core aspects of speech such as grammar and word production, while aspects such as intonation and emphasis lit up the right side.
- The hemispheres are not independent. *Commissural connections-connections between the hemispheres*-makes sure that both halves knows what is happening.

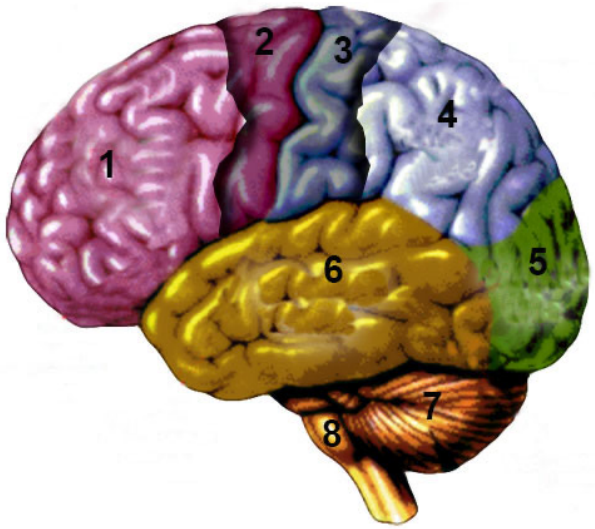
The brain is plastic

- Even though language may be a part of the left half of the brain , children with early injuries to the left hemisphere, can still learn to talk normally. The right hemisphere then takes over.
- Children’s brains can compensate, while adult brains have more difficulties with this.
- https://www.youtube.com/watch?v=VaDlLD97CLM
- https://www.youtube.com/watch?v=f2fCY_M7Vms

Severing the corpus callosum

- The corpus callosum is bridge that connects the two brain hemispheres
- The neurons that pass through are heavily myelinated to speed up conduction velocity!
- Can you live with a severed corpus callosum? In very severe cases of epilepsy the doctors may choose to sever the *corpus callosum*.
- In this case the commissural connections are cut, but both halves of the brain still functional.
- https://www.youtube.com/watch?v=lfGwsAdS9Dc

Questions



1. Name and describe the parts of the brain that are used for language (at least 4 parts).
2. Name at least 4 parts of the brain that are active when reading
3. Describe the symptoms of Broca´s and Wernickes aphasia
4. Describe corpus callosum and commissural connections
5. What makes the corpus callosum so white?
6. What happens to a person when the corpus callosum is severed?
7. Name the (8) different parts of cortex and describe their function