PSYCH 260

Neuroanatomy II

Rick O. Gilmore

2021-09-07 07:18:28

Prelude (1:22)

https://www.youtube.com/embed/snO68aJTOpM

Today's topics

- Quiz 1 on Thursday
- Warm-up
- More neuroanatomy

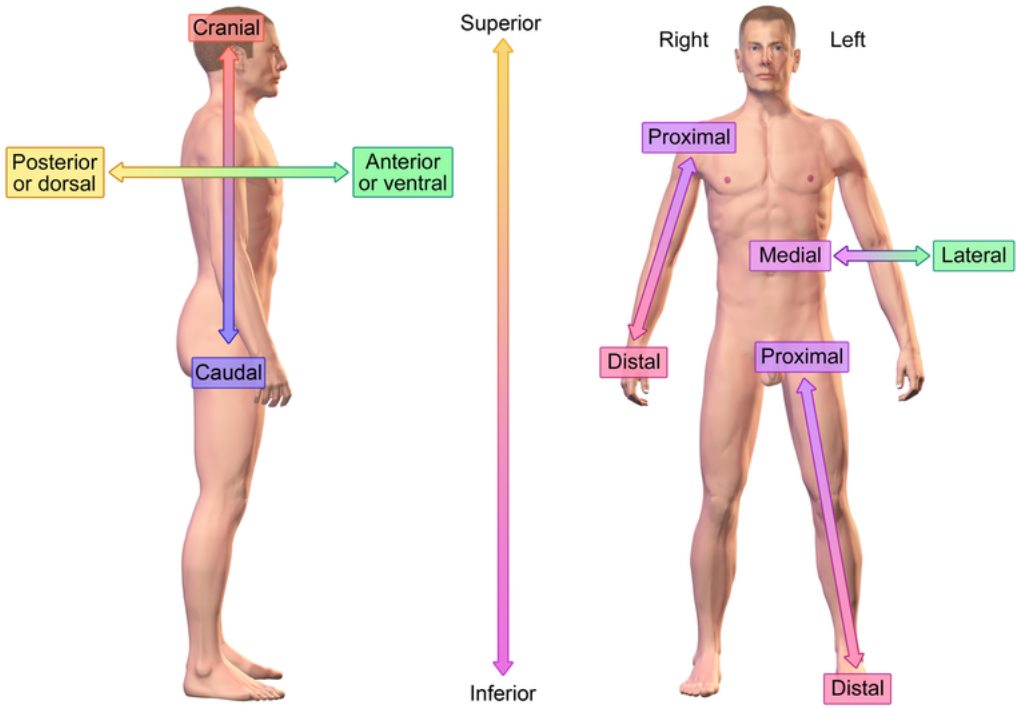
Warm-up

Neural structures that are “belly-ward” from the spinal cord are also called…

- A. Dorsal
- B. Ventral
- C. Medial
- D. Rostral

Neural structures that are “belly-ward” from the spinal cord are also called…

- A. ~~Dorsal~~
- B. Ventral
- C. ~~Medial~~
- D. ~~Rostral~~



Lateral view

Anterior view

Directional References

The blood/brain barrier is especially thin in which hindbrain area?

- A. Pons
- B. 4th ventricle
- C. Cerebellum
- D. Medulla oblongata (medulla)

The blood/brain barrier is especially thin in which hindbrain area?

- A. ~~Pons~~
- B. ~~4th ventricle~~
- C. ~~Cerebellum~~
- D. Medulla oblongata (medulla)

Which of the cerebral ventricles is most caudal (closest to the spinal cord)?

- Cerebral aqueduct
- Lateral ventricles
- 3rd ventricle
- 4th ventricle

Which of the cerebral ventricles is most caudal (closest to the spinal cord)?

- ~~Cerebral aqueduct~~
- ~~Lateral ventricles~~
- ~~3rd ventricle~~
- 4th ventricle

More neuroanatomy

Organization of the brain

Major division	Ventricular Landmark	Embryonic Division	Structure
Forebrain	Lateral	Telencephalon	Cerebral cortex
			Basal ganglia
			Hippocampus, amygdala
	Third	Diencephalon	Thalamus
			Hypothalamus
Midbrain	Cerebral Aqueduct	Mesencephalon	Tectum, tegmentum

Organization of the brain

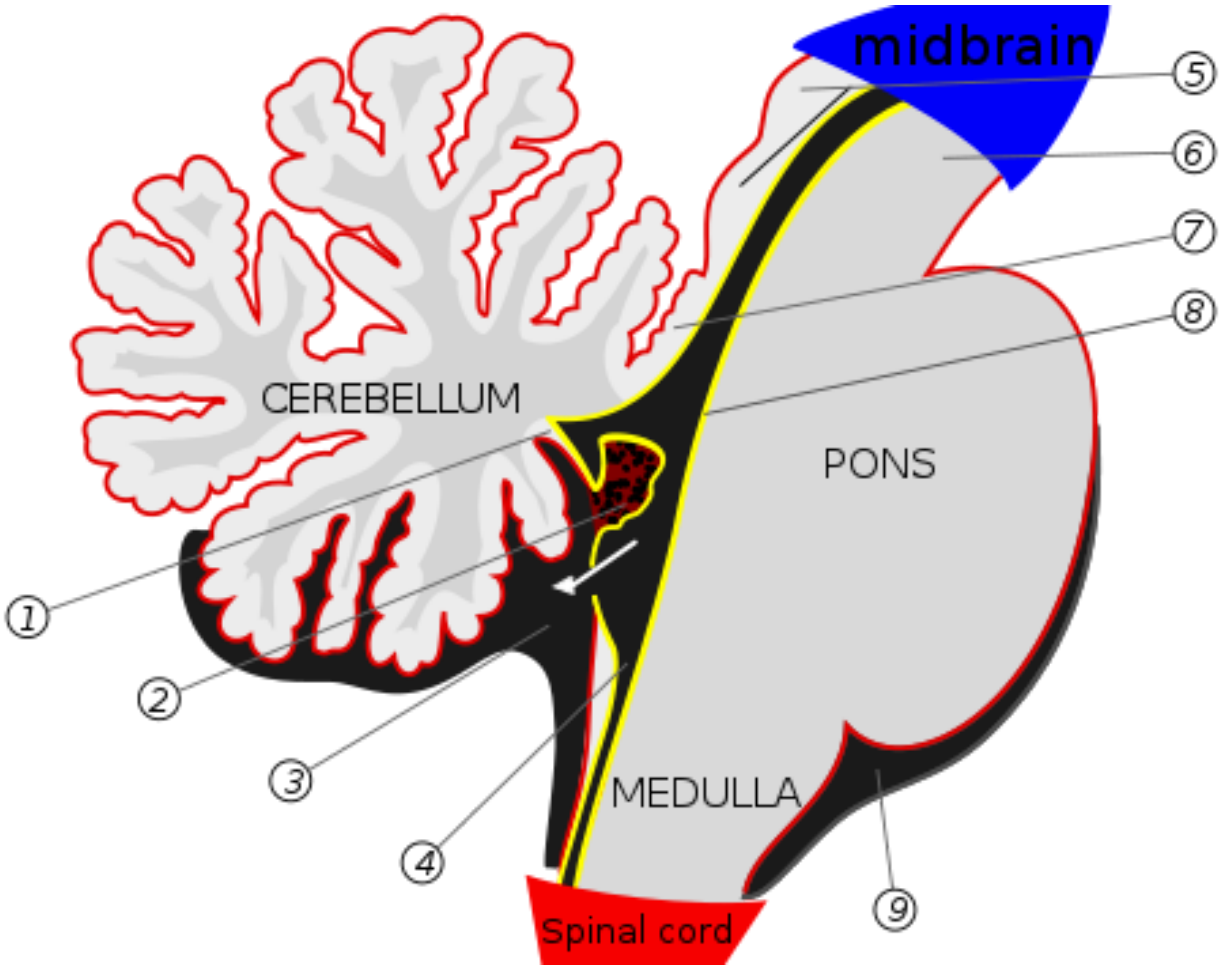
Major division	Ventricular Landmark	Embryonic Division	Structure
Hindbrain	4th	Metencephalon	Cerebellum, pons
	–	Mylencephalon	Medulla oblongata

Hindbrain

Structures adjacent to 4th ventricle

- Medulla oblongata
- Cerebellum
- Pons

Hindbrain



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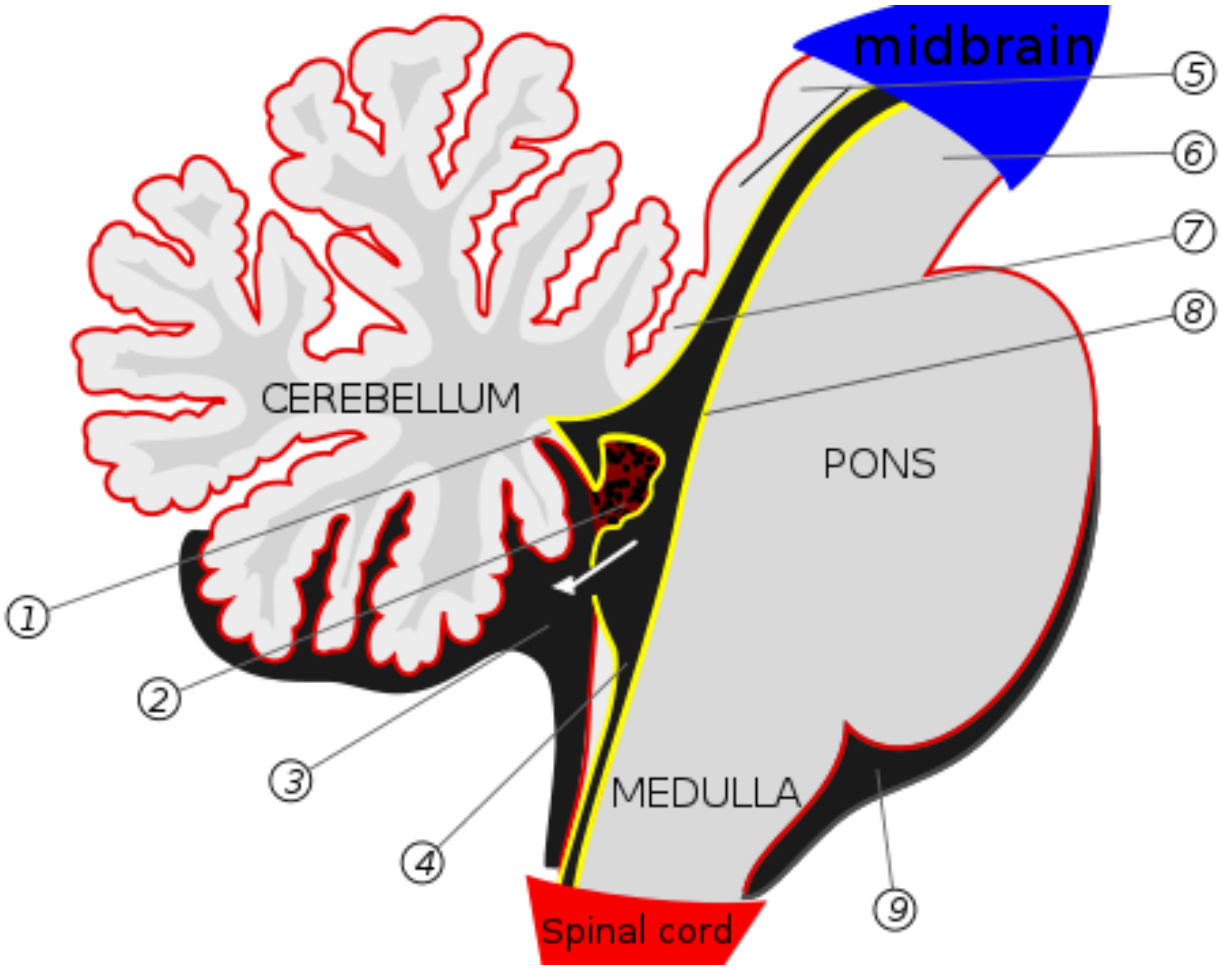
Medulla oblongata

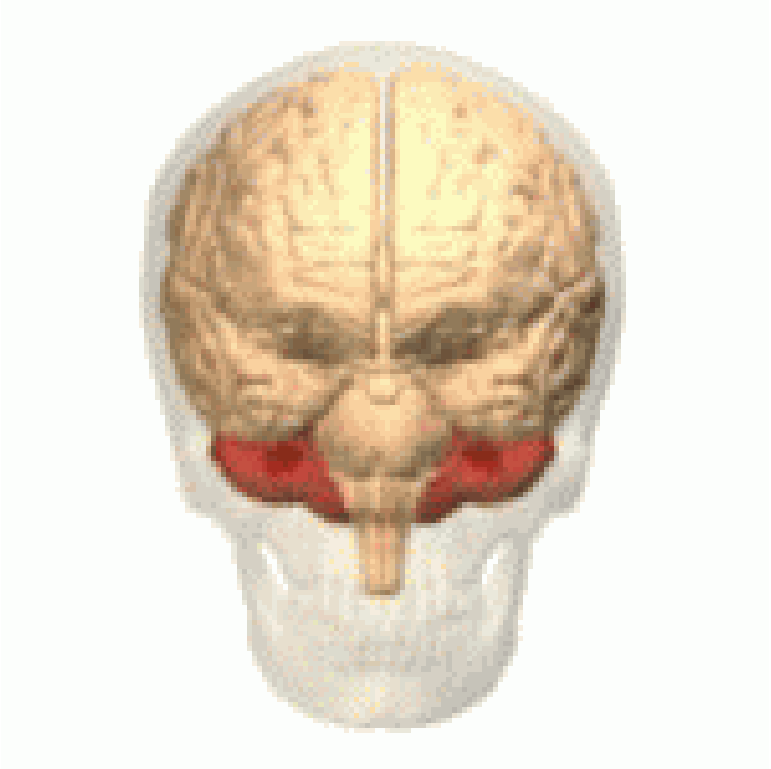


https://upload.wikimedia.org/wikipedia/commons/thumb/b/b9/Gray708.svg/500px-Gray708.svg.png

- Fibers of passage (to/from spinal cord)
- Cranial nerves VI-XII
- Cardiovascular regulation
- Muscle tone

Cerebellum

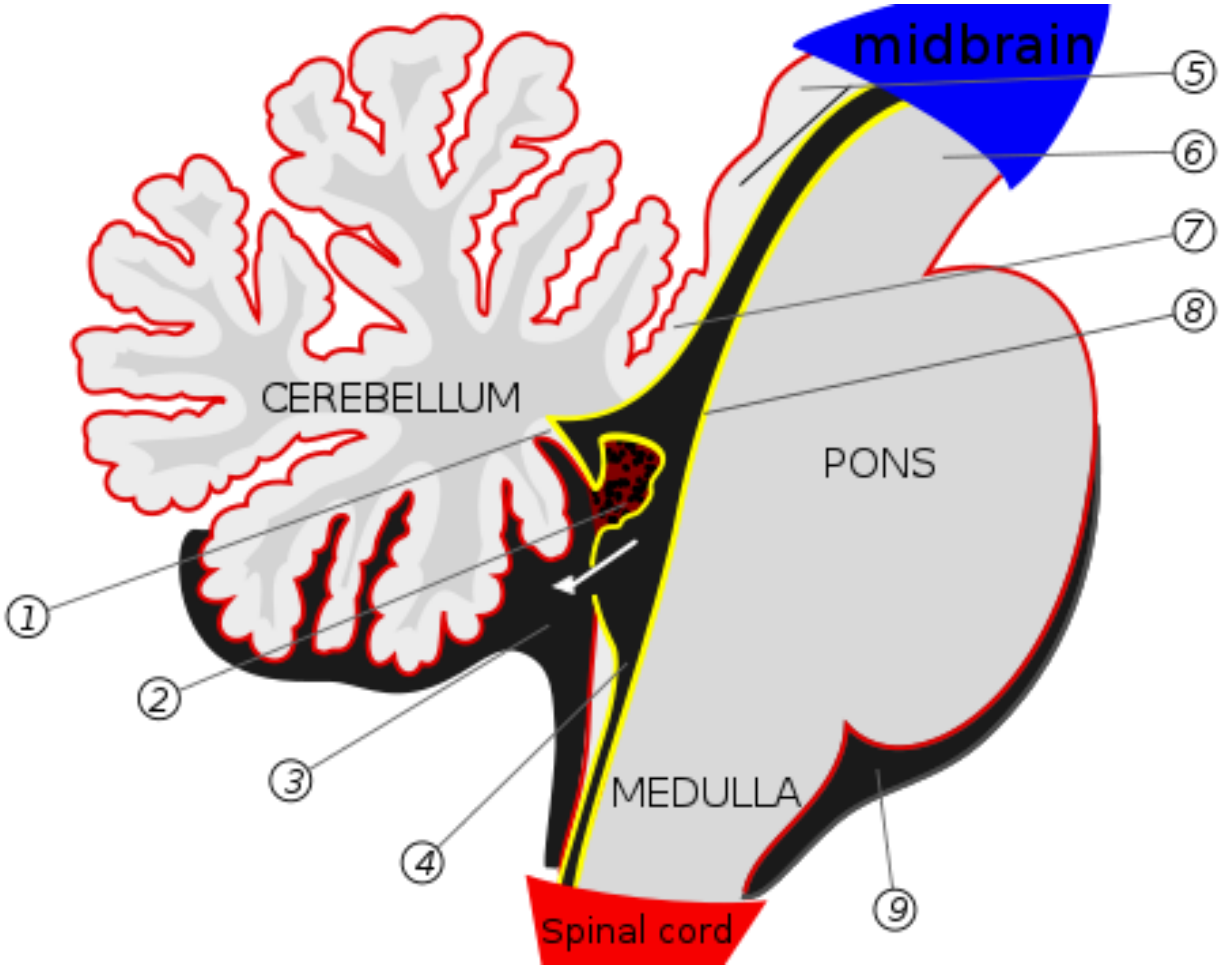
- “Little brain”
- Dorsal to pons
- Movement coordination, classical conditioning (associative learning), + ???



https://en.wikipedia.org/wiki/Cerebellum

Pons

- Bulge on brain stem
- Neuromodulatory nuclei
- Relay to cerebellum
- Cranial nerve V



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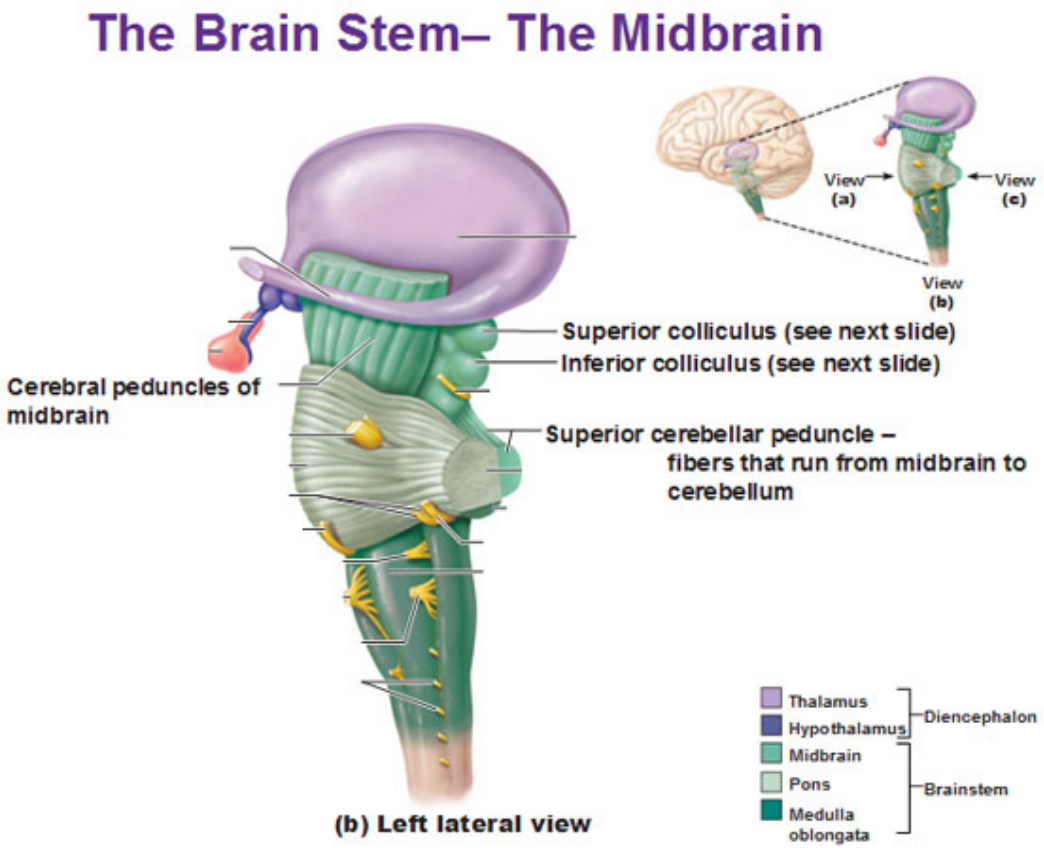
Midbrain



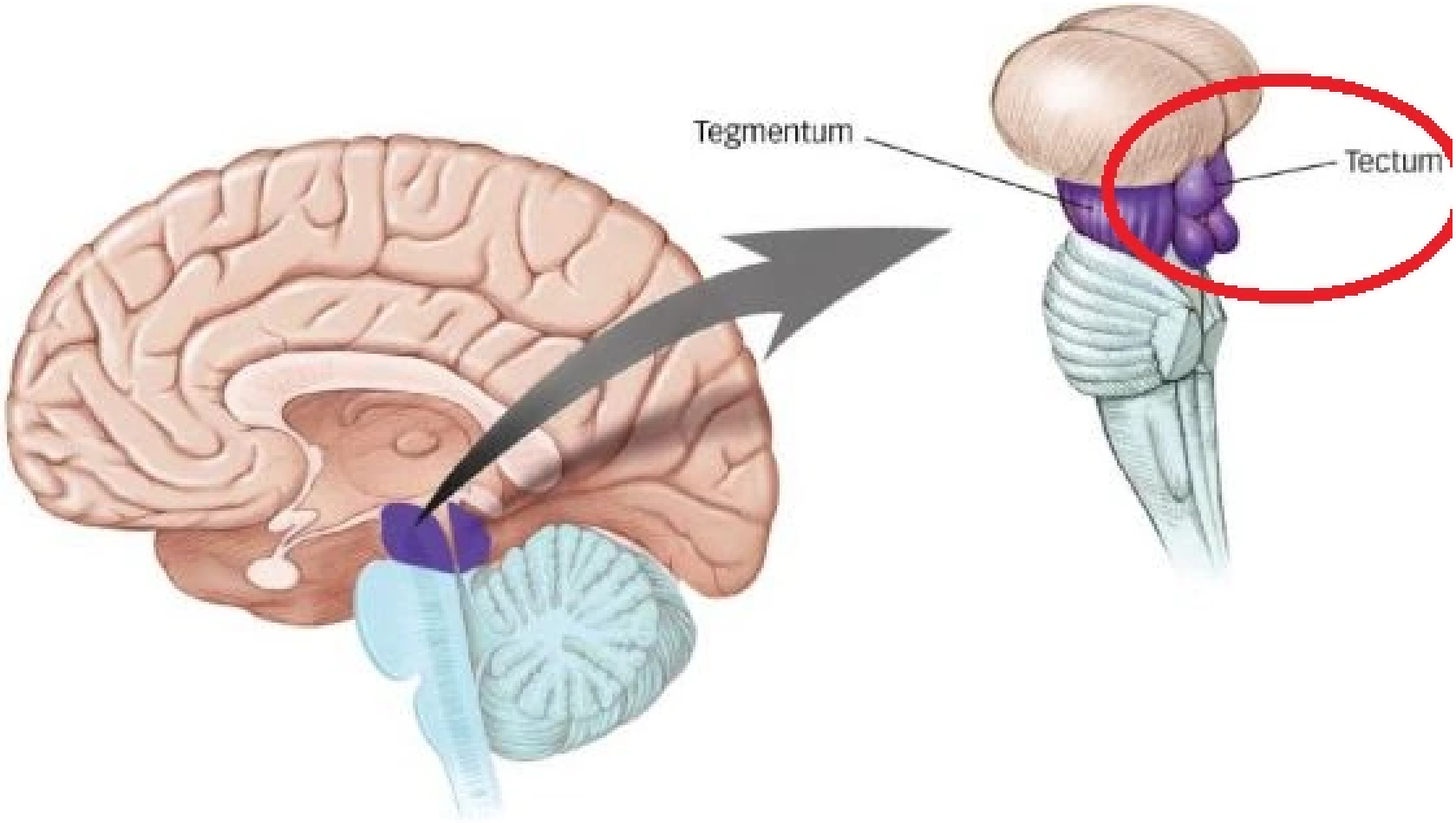
http://antranik.org/wp-content/uploads/2011/11/the-brain-stem-mid-brain-left-lateral-view-superior-colliculus-inferior-cerebellar-peduncle.jpg

Midbrain components

Tectum

Tegmentum

Midbrain



https://vignette.wikia.nocookie.net/brain-for-ai/images/b/bd/Tectum.png/revision/latest?cb=20170613125935

Tectum

- Tectum -> “roof”
- *Superior colliculus* (reflexive orienting of eyes, head, ears)
- *Inferior colliculus* (sound/auditory processing)

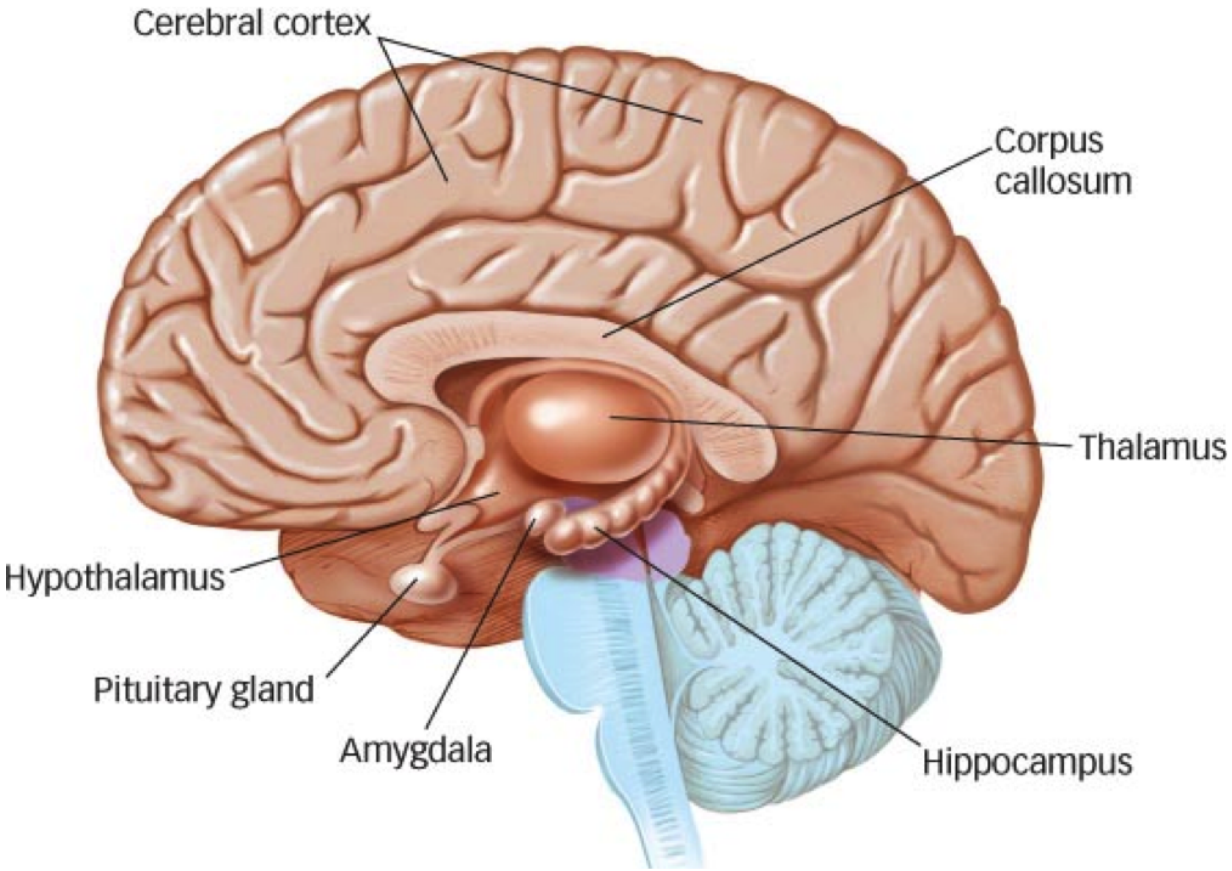
Tegmentum

- Tegmentum -> “floor”
- Species-typical movement sequences (e.g., cat: hissing, pouncing)
- Cranial nerves III, IV

Tegmentum

- *Nuclei* that release modulatory neurotransmitters ("neuromodulators")
  - *Dopamine (DA)*
  - *Norepinephrine (NE)*
  - *Serotonin (5-HT)*

Forebrain



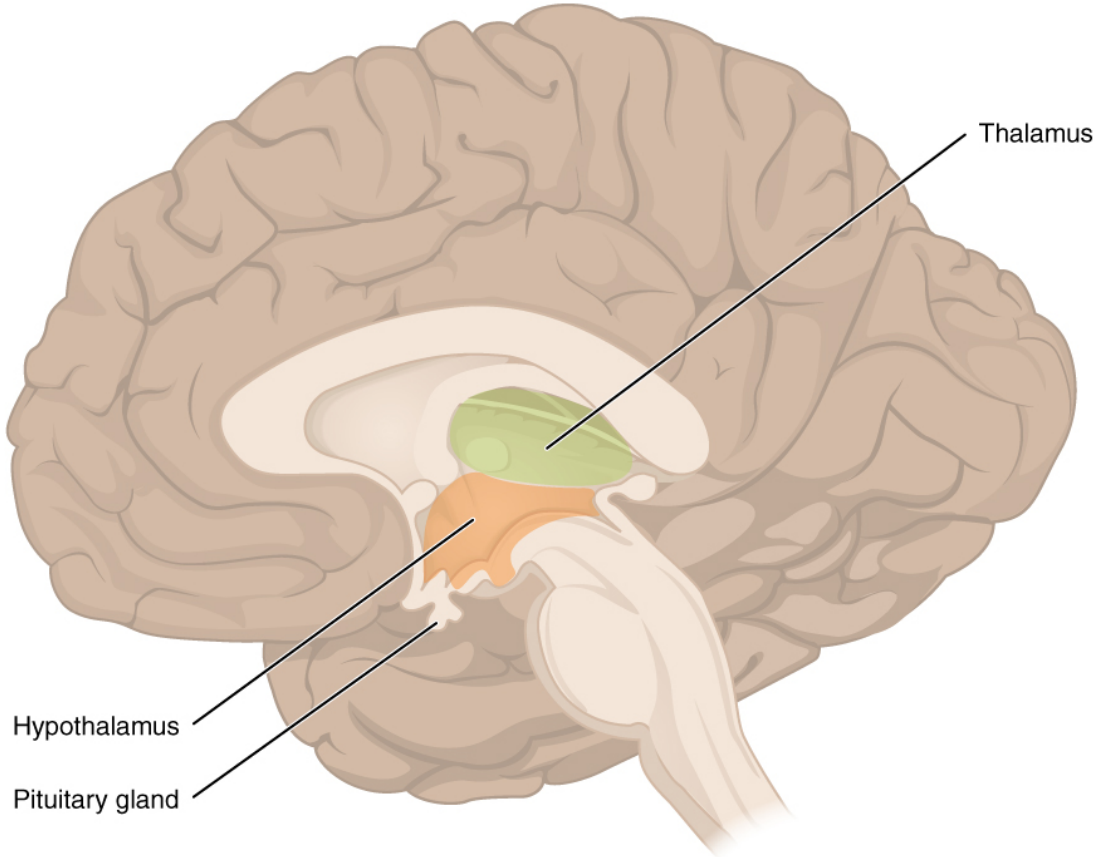
http://classconnection.s3.amazonaws.com/252/flashcards/1048252/png/forebrain1328987872235.png

Forebrain Components

Diencephalon (“between” brain)

Telencephalon

Diencephalon

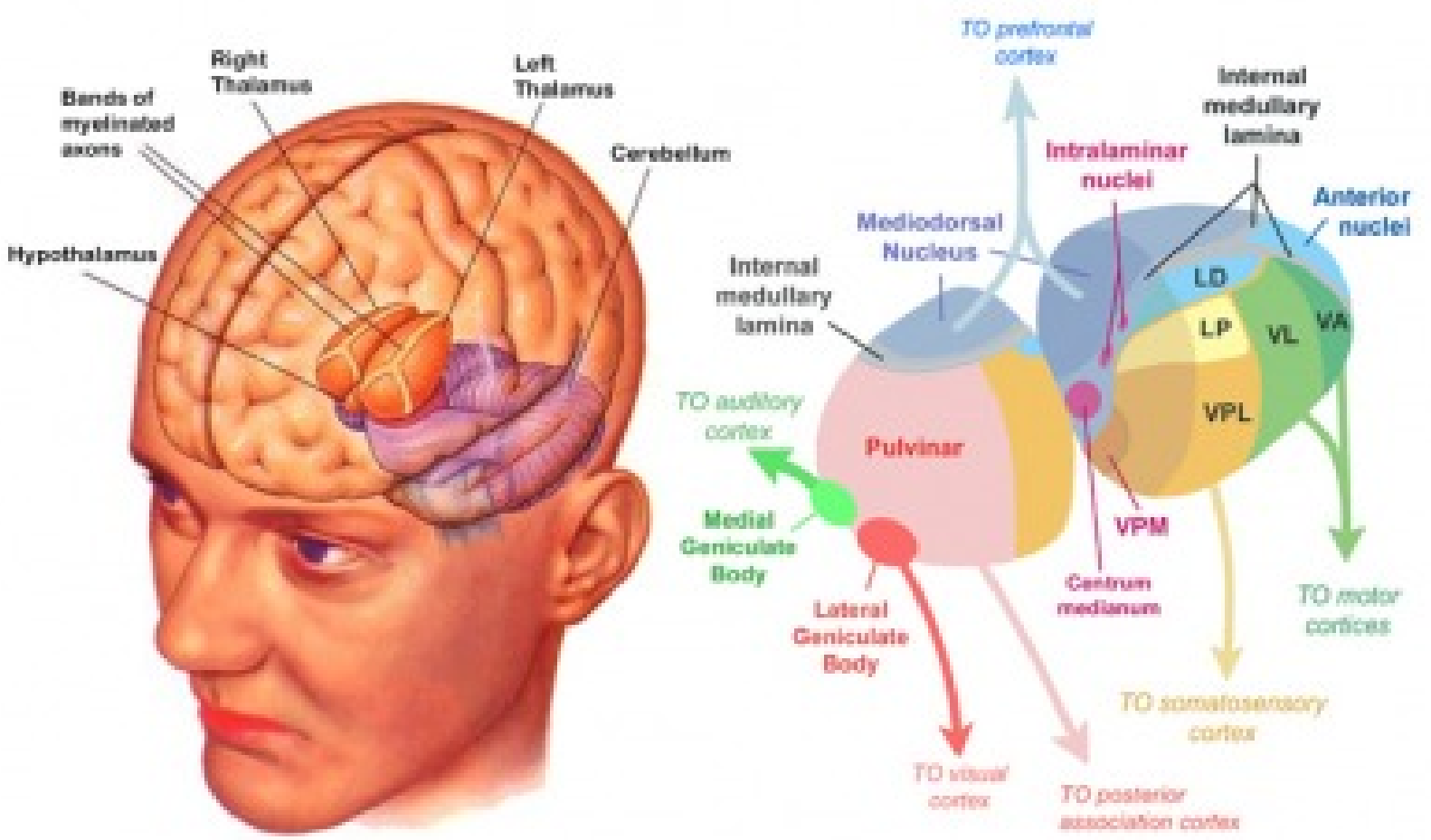


https://upload.wikimedia.org/wikipedia/commons/a/a0/1310_Diencephalon.jpg

Diencephalon Components

- *Thalamus*
- *Hypothalamus*

Thalamus



http://neurobiologychapter3.weebly.com/uploads/1/4/1/8/1418733/5118342.jpg?401x231

Thalamus functions

- Input to cortex
- Functionally distinct nuclei (collection of neurons)
  - *Lateral geniculate nucleus (LGN)*, vision
  - *Medial geniculate nucleus (MGN)*, audition

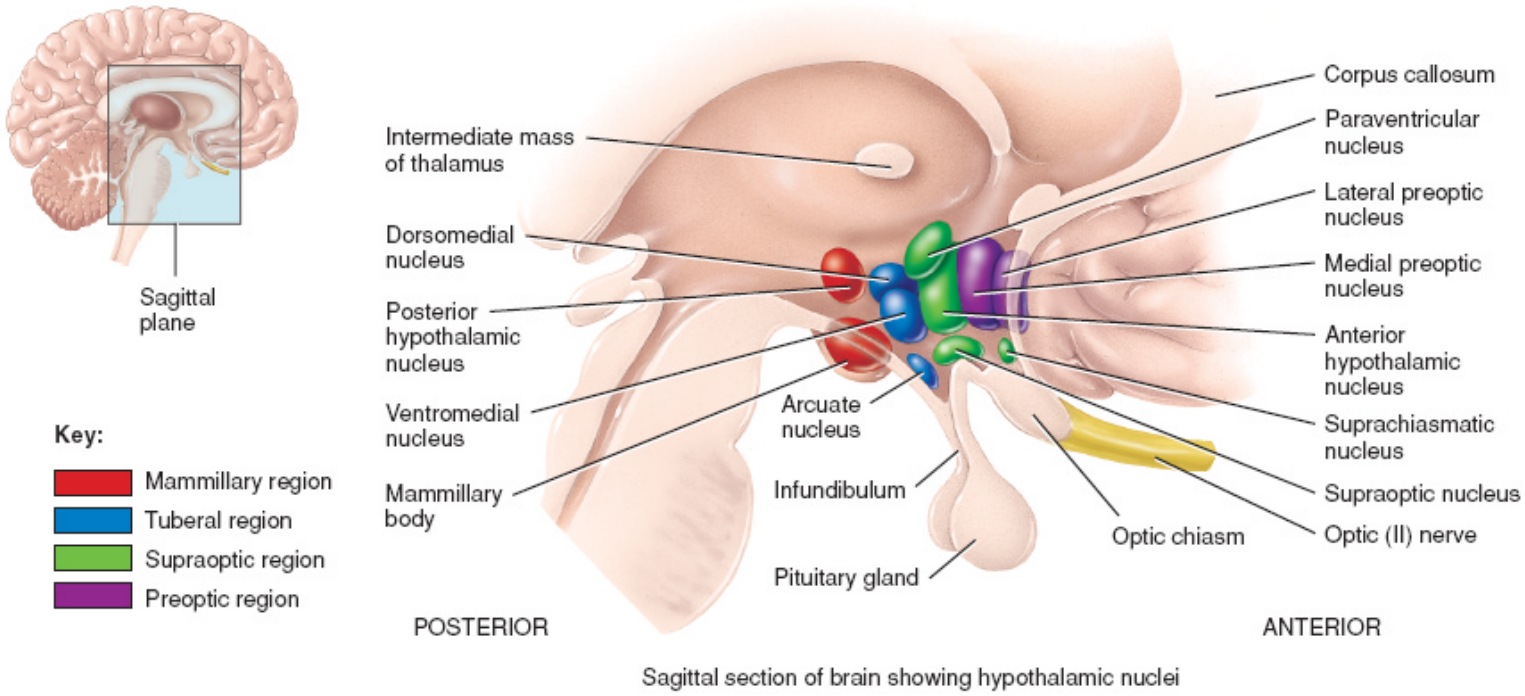
Hypothalamus

- Five Fs: fighting, fleeing/freezing, feeding, and reproduction
- Controls *Autonomic Nervous System (ANS)*
  - Sympathetic branch
  - Parasympathetic branch

Hypothalamus

- Controls *endocrine system* via *pituitary gland* (“master” gland)
  - *Anterior pituitary* (indirect release of hormones)
  - *Posterior* (direct release of hormones)
    - *Oxytocin*
    - *Vasopressin*

Hypothalamus



Sagittal section of brain showing hypothalamic nuclei

http://higheredbcs.wiley.com/legacy/college/tortora/0470565101/hearthis_ill/pap13e_ch14_illustr_audio_mp3_ar

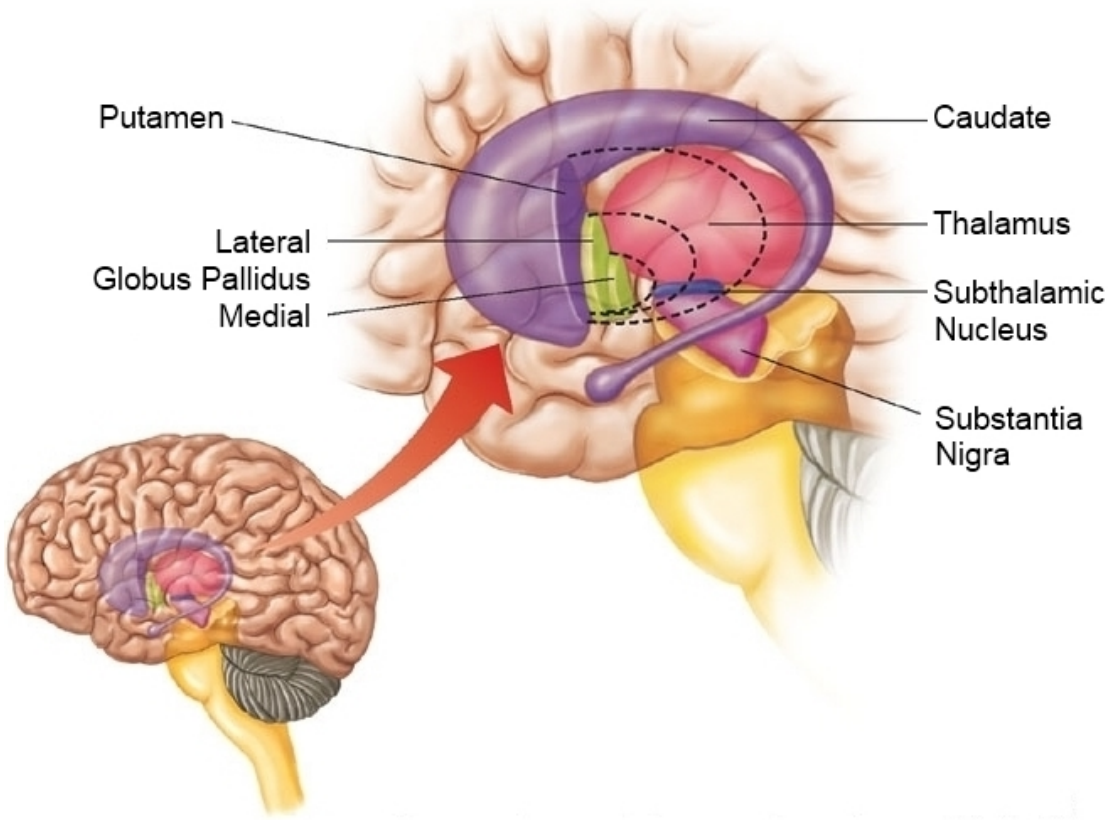
Telencephalon components

- Basal (not basil) ganglia
- Hippocampus
- Amygdala
- Cerebral cortex

Basal ganglia

- Skill and habit learning
- Sequencing of movement
- Example: Parkinson’s Disease

Basal ganglia



http://humanphysiology.academy/Neurosciences%202015/Images/5/basalganglia%20sehati_org.jpeg

Basal ganglia

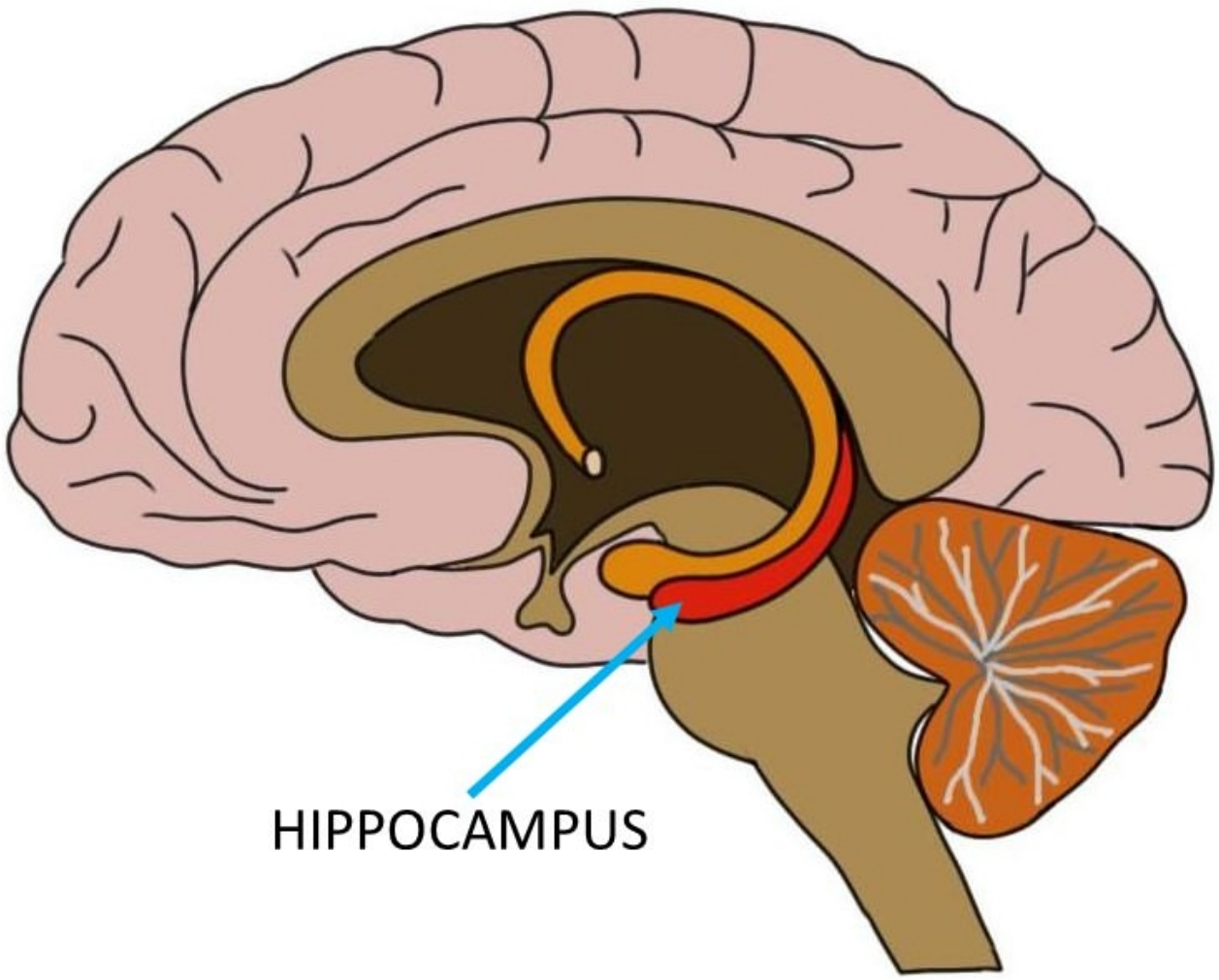
- Striatum
  - Dorsal
    - Caudate nucleus
    - Putamen
  - Ventral
    - Nucleus accumbens (NAcc)

Basal ganglia

- Globus pallidus
- Subthalamic nucleus
- Substantia nigra (in tegmentum)

Hippocampus

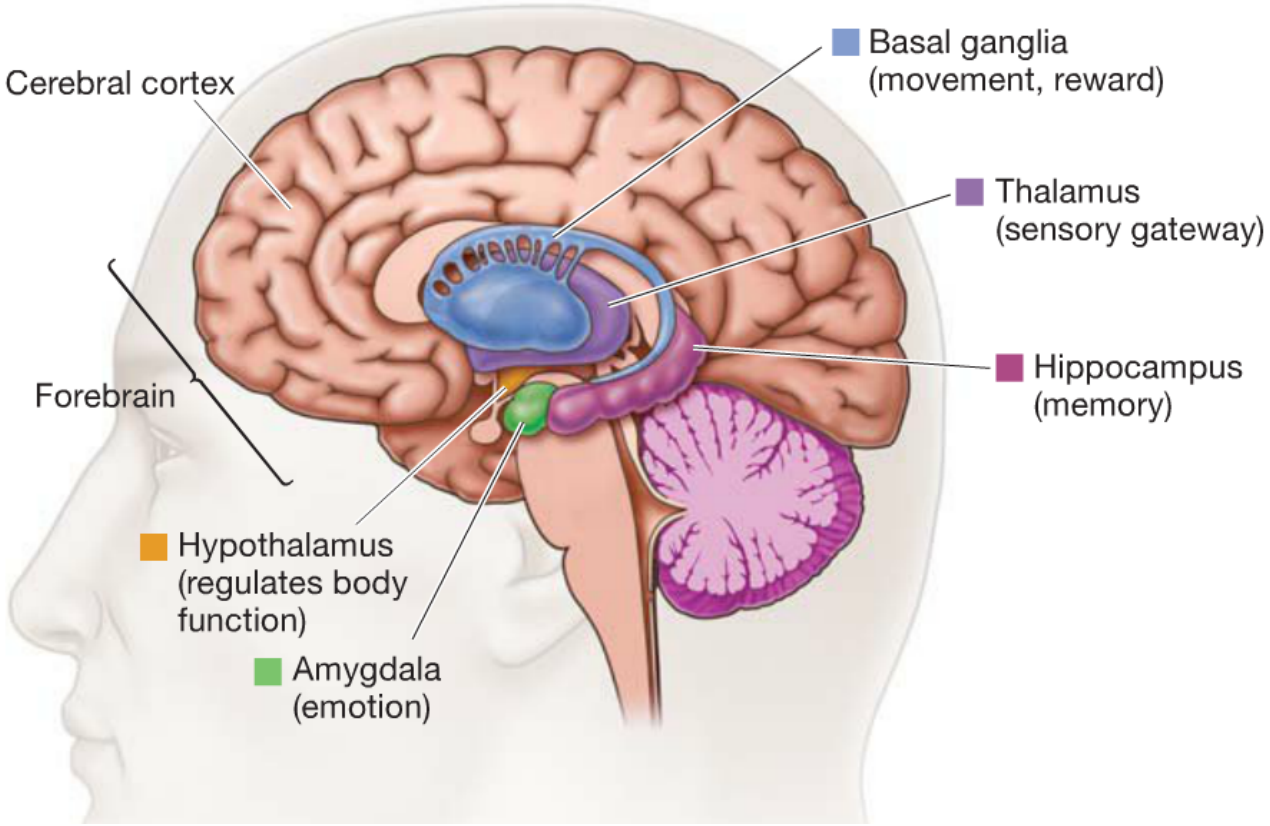
- From Greek for “sea horse”
- Immediately lateral to (inferior) lateral ventricles
- Memories of specific facts or events, spatial locations
- Implicated in Alzheimer’s Disease
- Fornix projects to hypothalamus
- Mammillary bodies


HIPPOCAMPUS

Amygdala

- “almond”
- Physiological state, behavioral readiness, affect
- NOT the fear center! (LeDoux, 2015).

Amygdala



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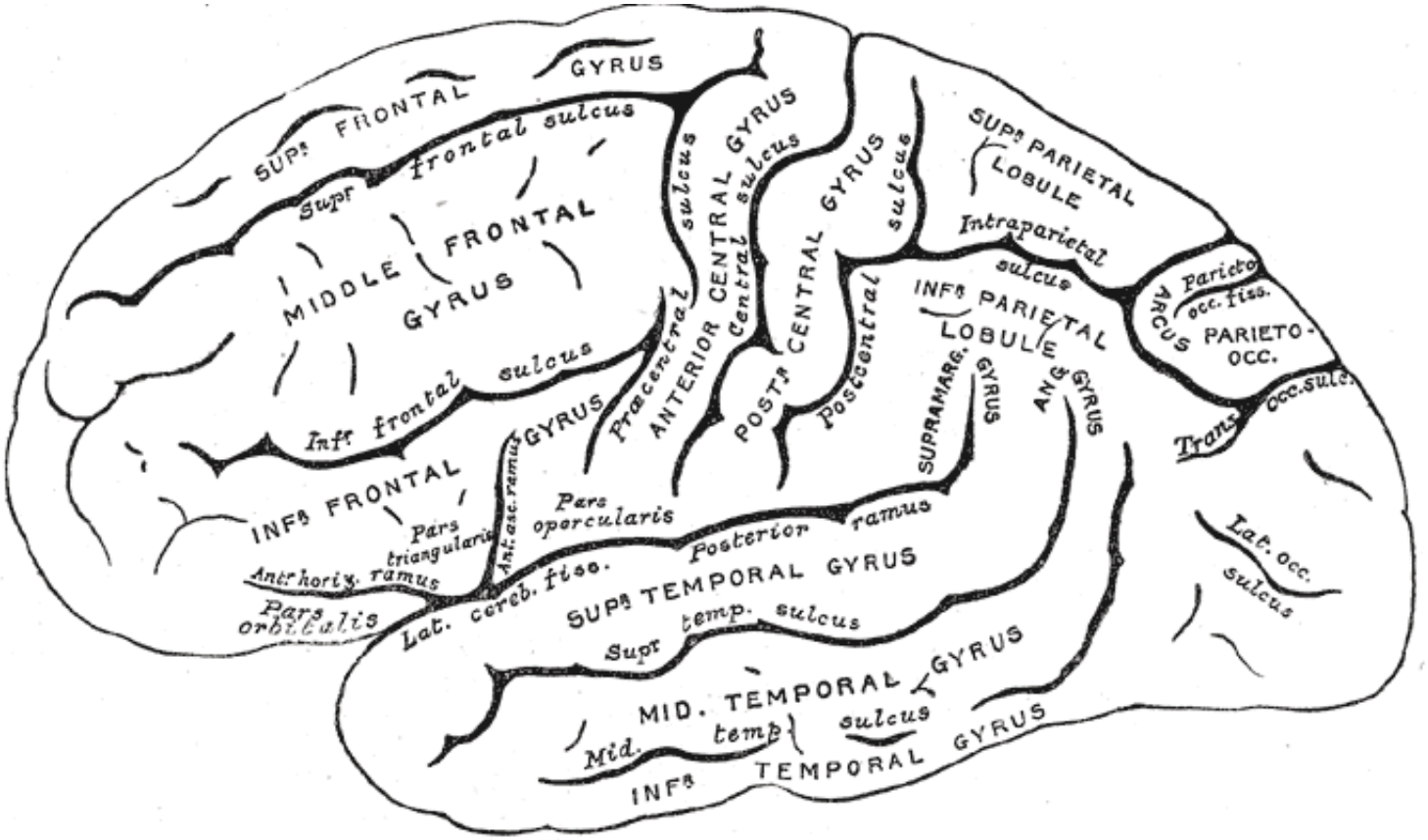
Cerebral Cortex

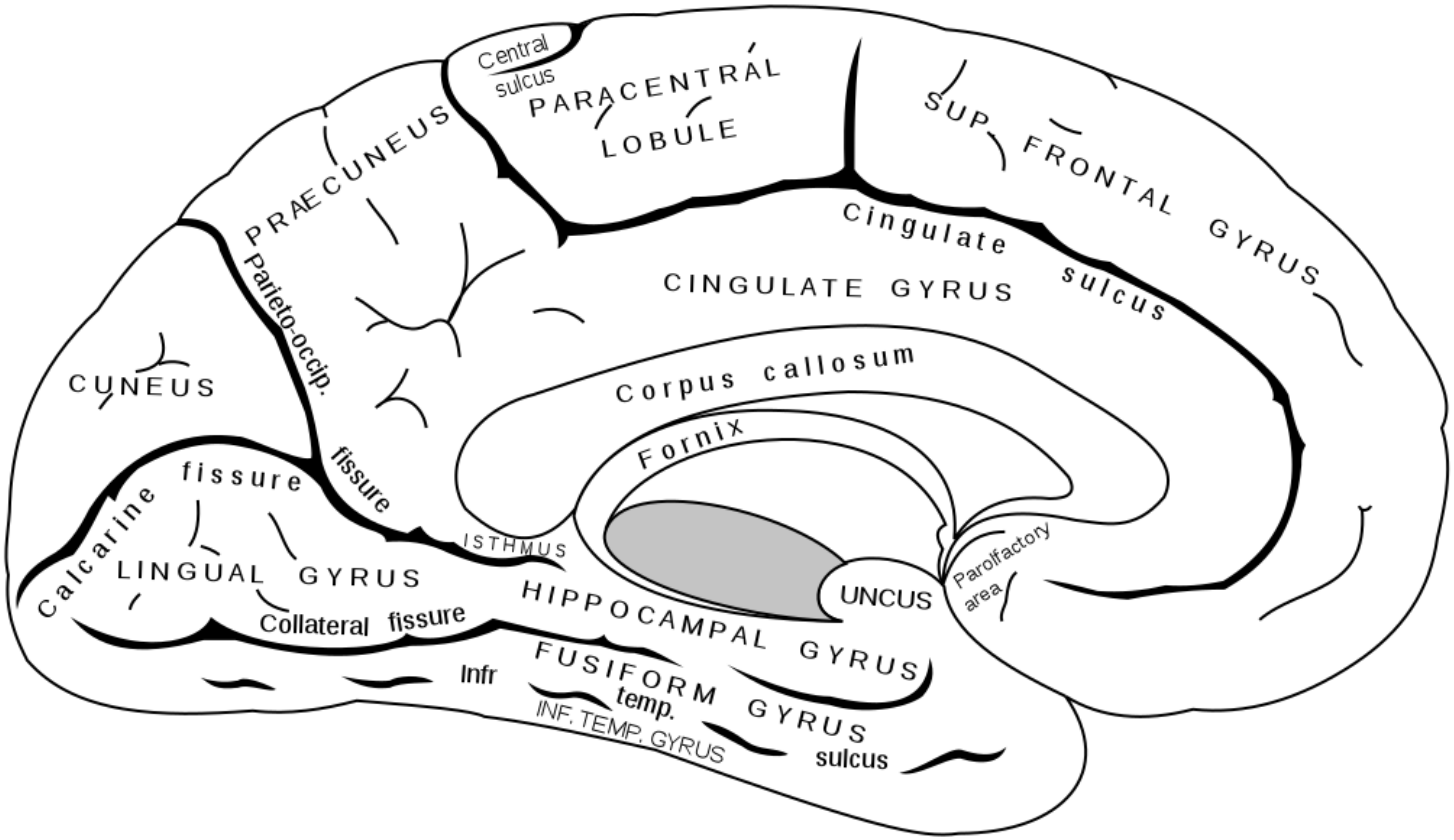
- Cerebral hemispheres
- Groove (sulcus or sulci)
- Bumps (gyrus or gyri)
- Grey vs. white matter
- Lobes

Cortical Gyri – Lateral



https://upload.wikimedia.org/wikipedia/commons/3/35/Gray726.png

Cortical Gyri – Medial



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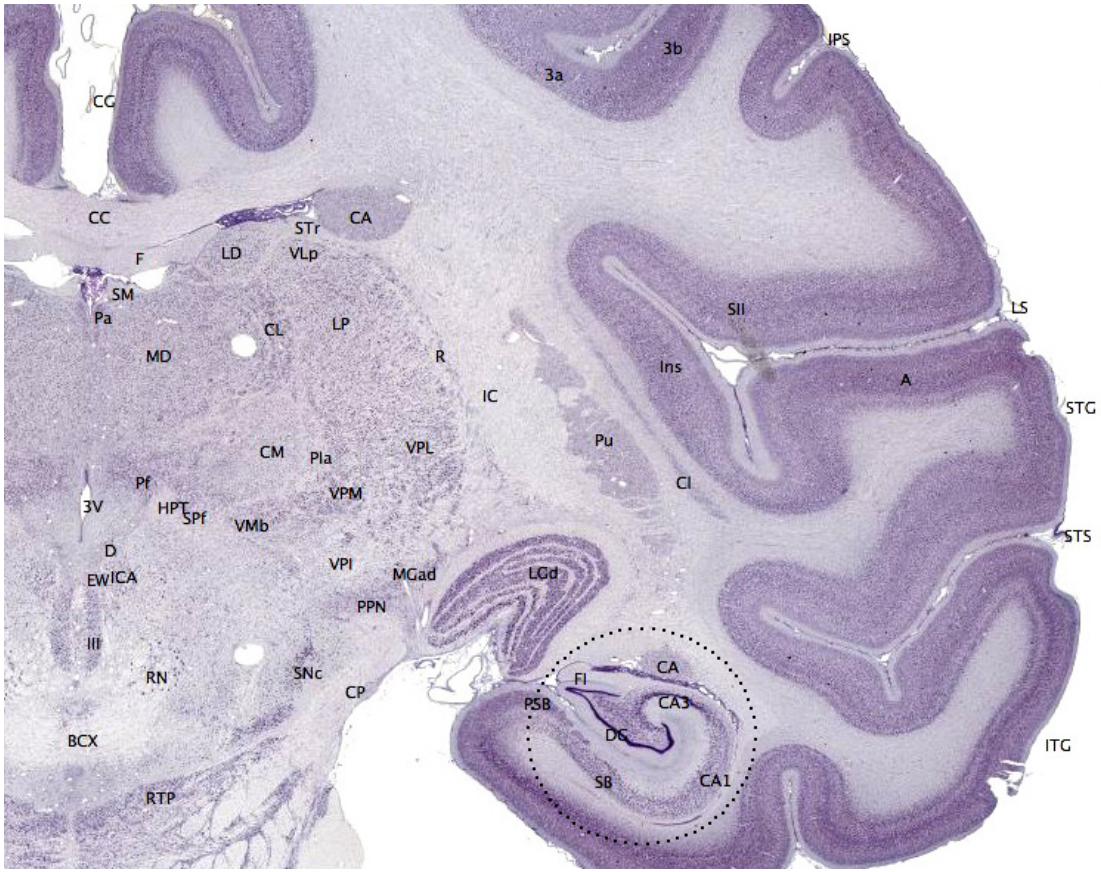
Grey vs. White Matter

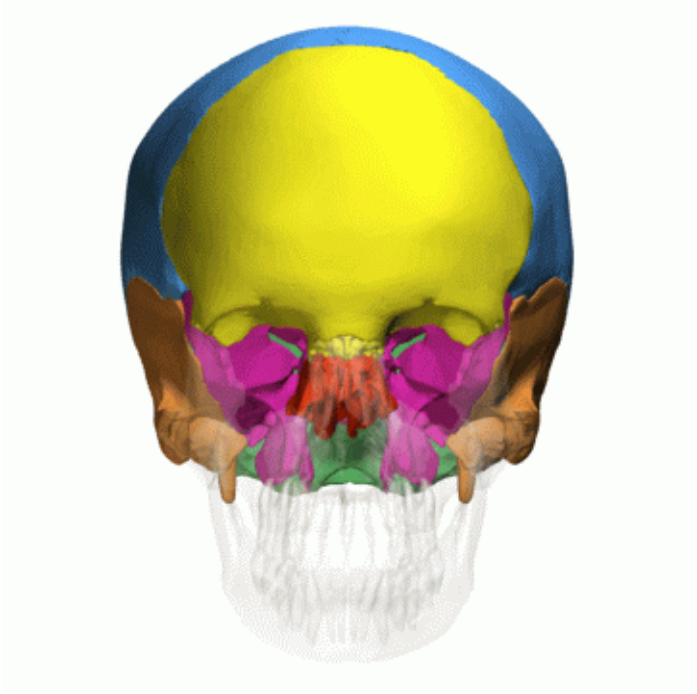
- Grey matter
  - Cell bodies, dendrites, axons, glia, vessels
- White matter
  - Mostly axons (covered in myelin)



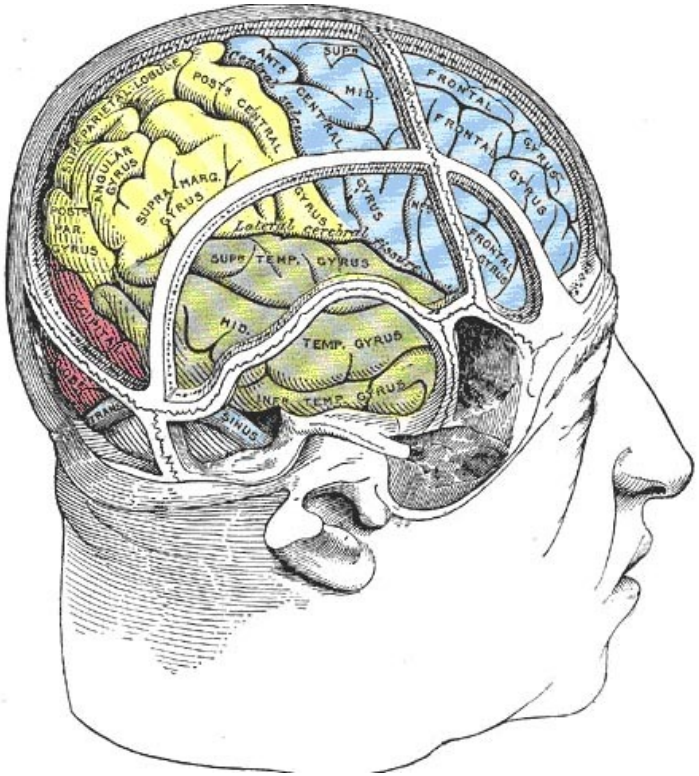
https://upload.wikimedia.org/wikipedia/commons/9/9a/Bra
macaque-hippocampus.jpg

Lobes of the cerebral cortex

- Frontal
- Temporal
- Parietal
- Occipital
- Related to cranial bones of the skull



https://en.wikipedia.org/wiki/Neurocranium

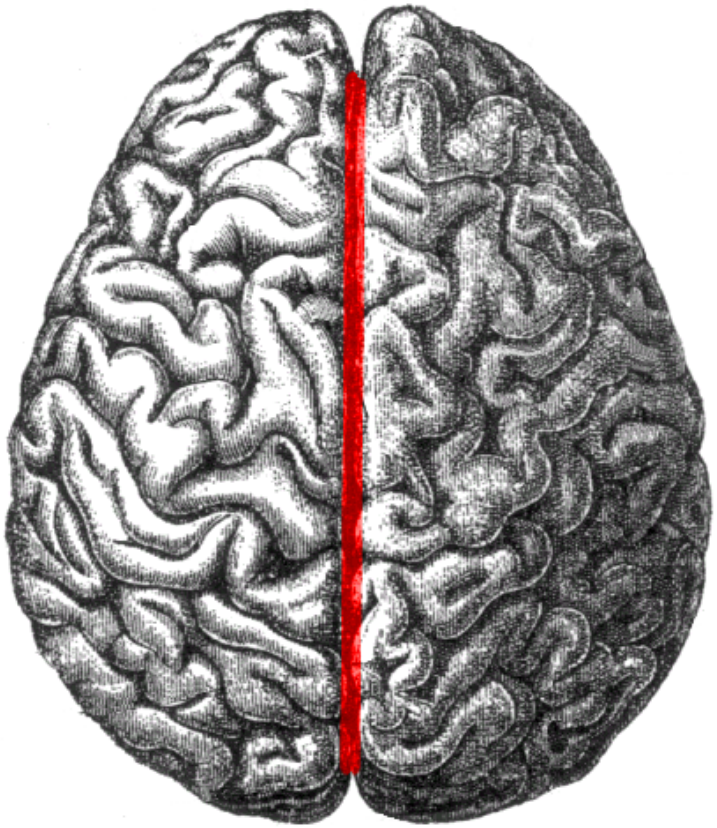


http://40.media.tumblr.com/tumblr_m1kpkr7Wsq1rn6pqk

Landmarks of the cerebral cortex

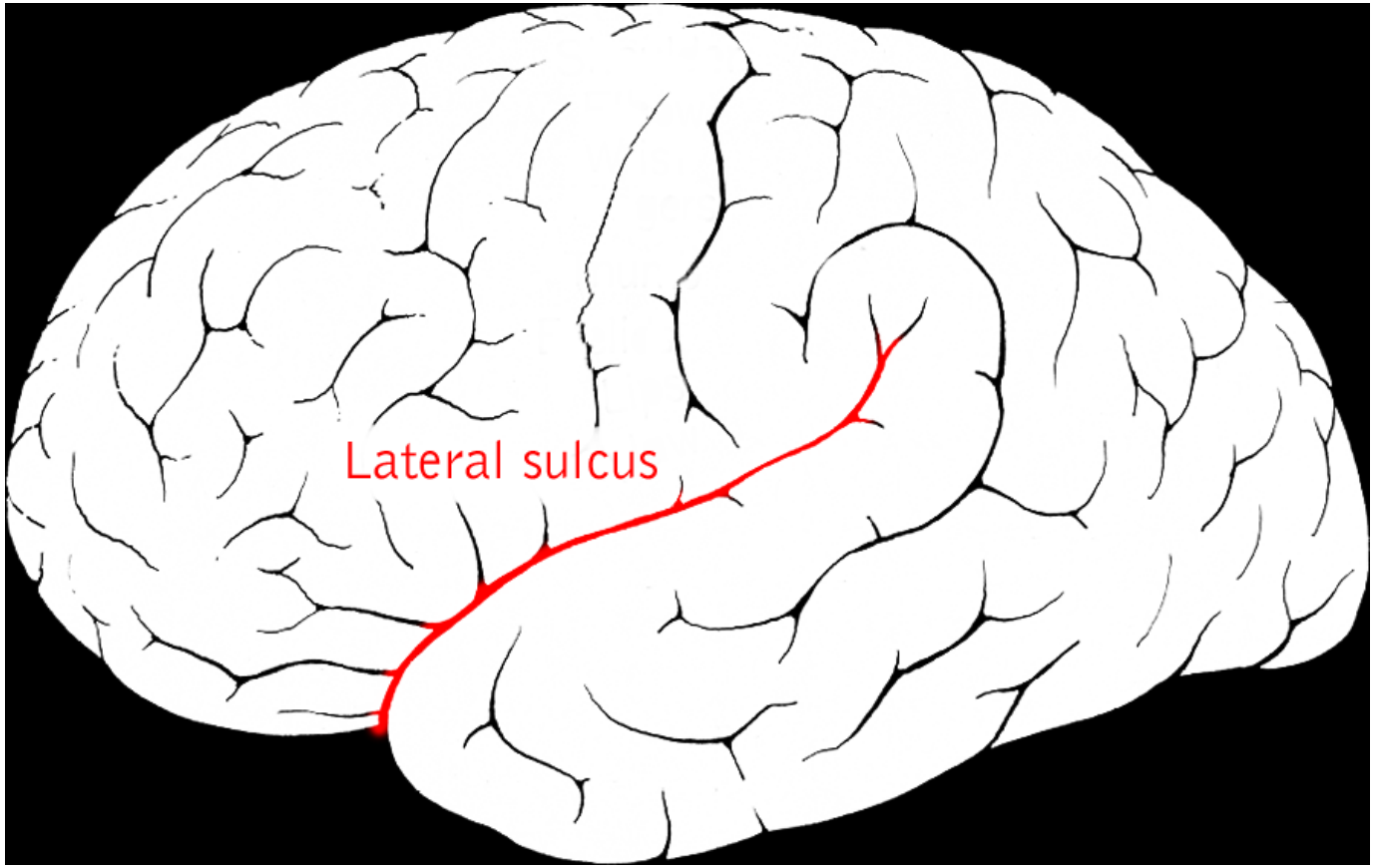
Landmark	Identifies/separates
Medial longitudinal fissure (longitudinal fissure)	Divides hemispheres
Lateral sulcus/fissure	Divides temporal lobe from frontal & parietal
Central sulcus	Divides frontal from parietal lobe

Medial longitudinal fissure (longitudinal fissure)



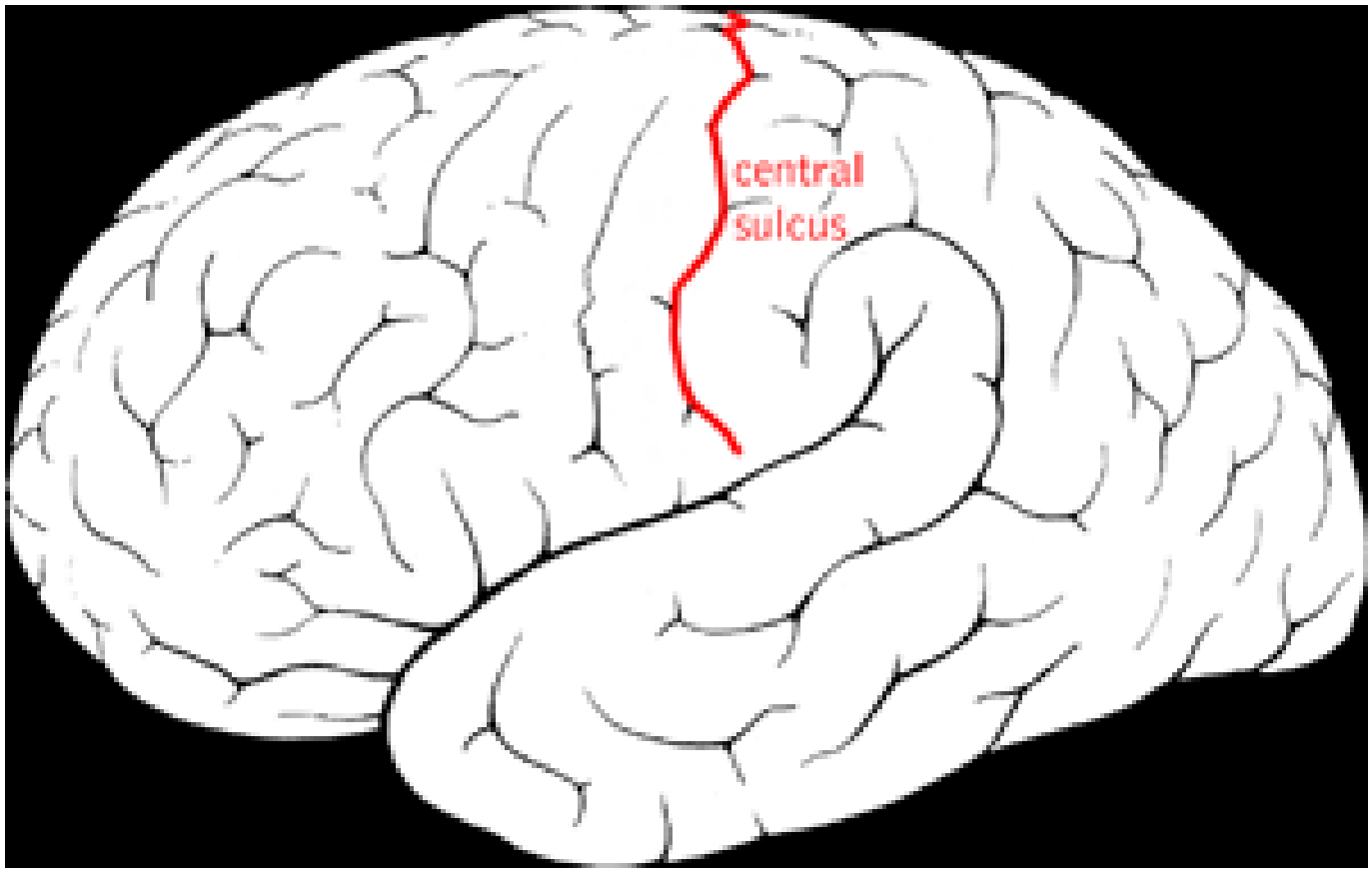
https://upload.wikimedia.org/wikipedia/commons/0/04/Human_brain_longitudinal_fissure.png

Lateral sulcus/fissure



https://upload.wikimedia.org/wikipedia/commons/4/41/Lateral_sulcus2.png

Central sulcus

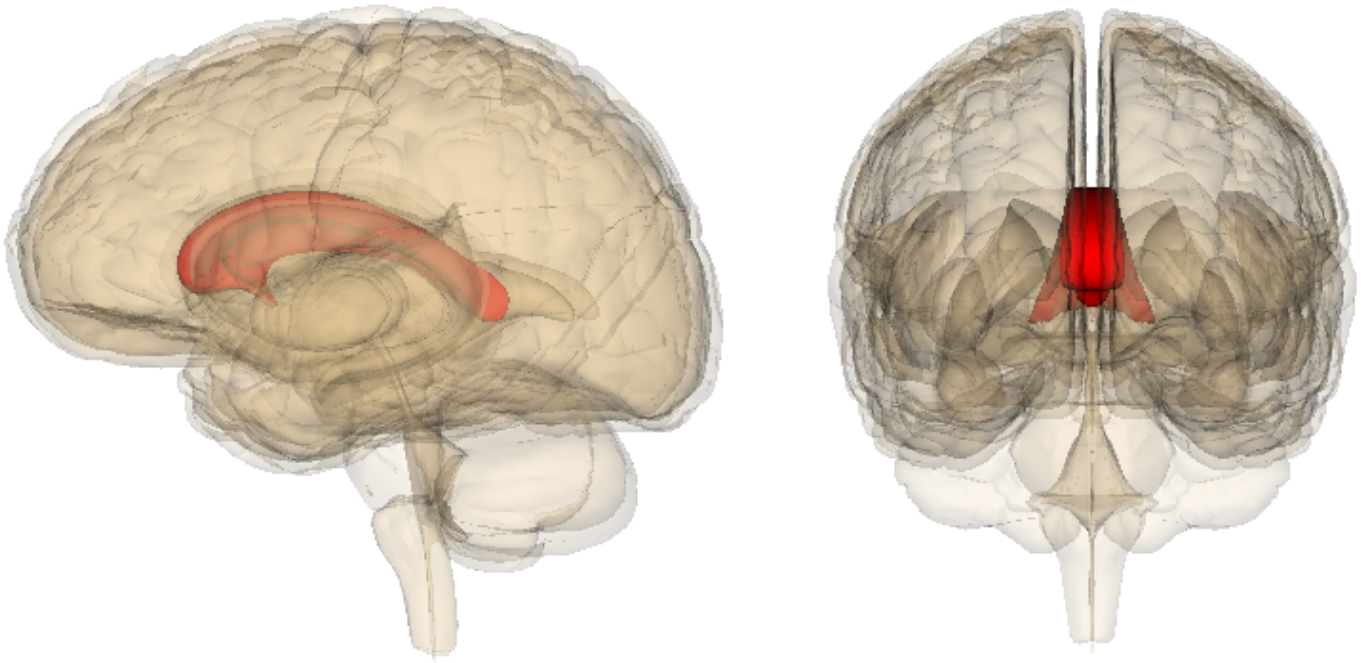


https://upload.wikimedia.org/wikipedia/commons/8/88/Central_sulcus_diagram.png

Representative interhemispheric fiber tracts in the cortex

- Connect left and right hemispheres
- Corpus callosum
- Anterior, Posterior Commissures

Corpus callosum



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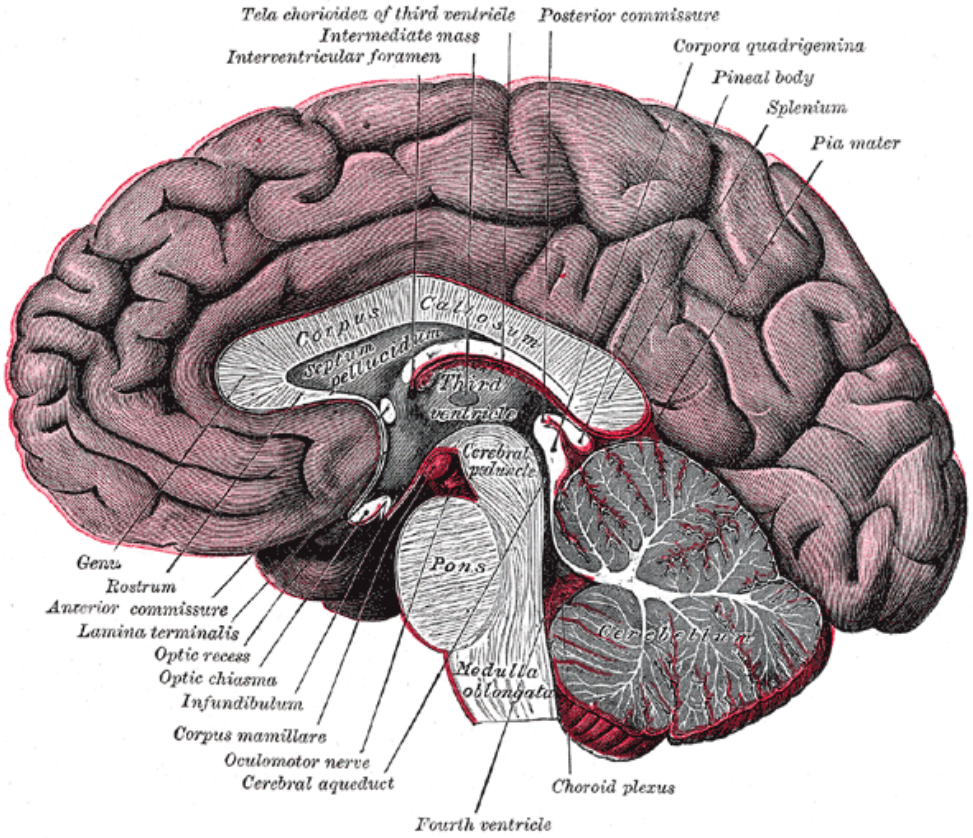
Anterior, Posterior Commissures



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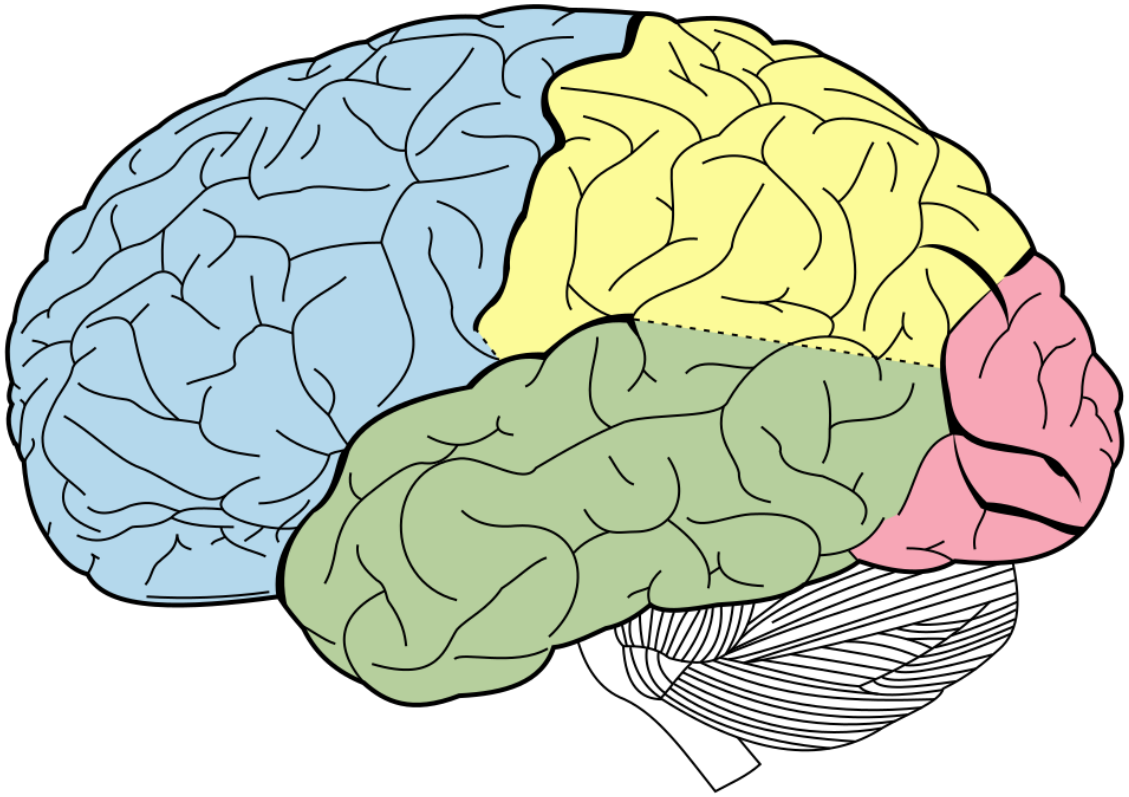
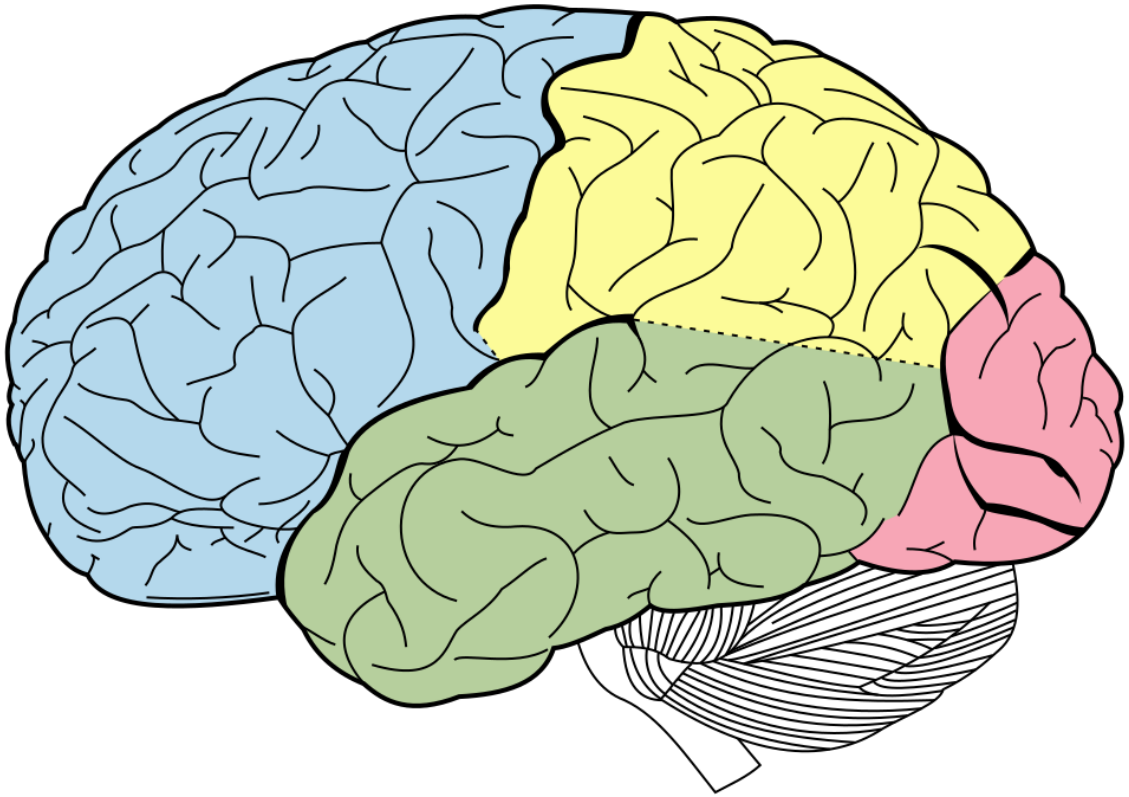
Lobes of the Cerebral Cortex



https://upload.wikimedia.org/wikipedia/commons/thumb/0/0e/Lobes_of_the_brain_NL.svg/1024px-Lobes_of_the_brain_NL.svg.png

Frontal lobe

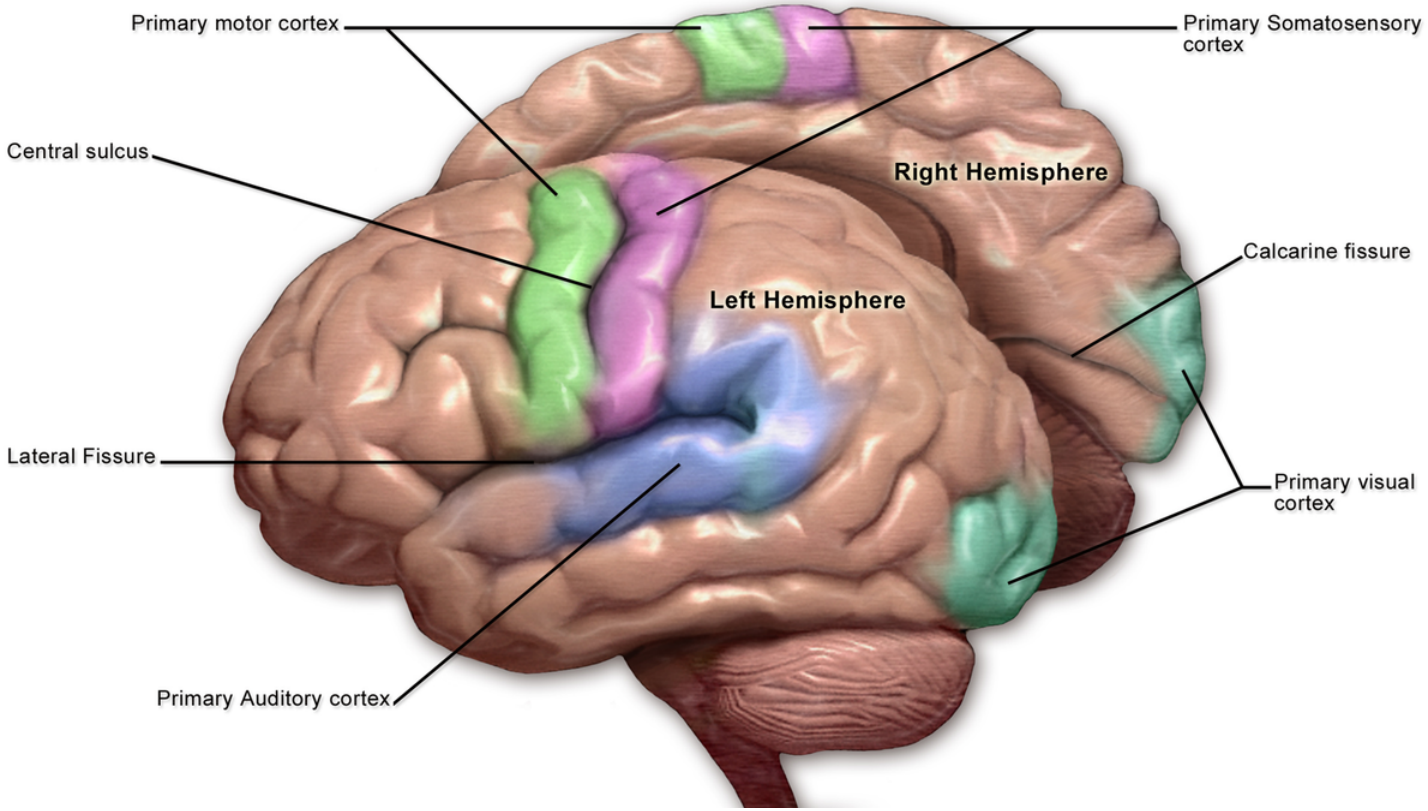
- Where is it?
  - Anterior to central sulcus
  - Superior to lateral fissure
  - Dorsal to temporal lobe



https://upload.wikimedia.org/wikipedia/commons/thumb/0
Lobes_of_the_brain_NL.svg.png

Frontal lobe

- What does it do/contain?
  - Primary motor cortex (M1)
  - Pre-central gyrus (pre/anterior to central sulcus)



https://upload.wikimedia.org/wikipedia/commons/thumb/c
Blausen_0103_Brain_Sensory%26Motor.png

Frontal lobe

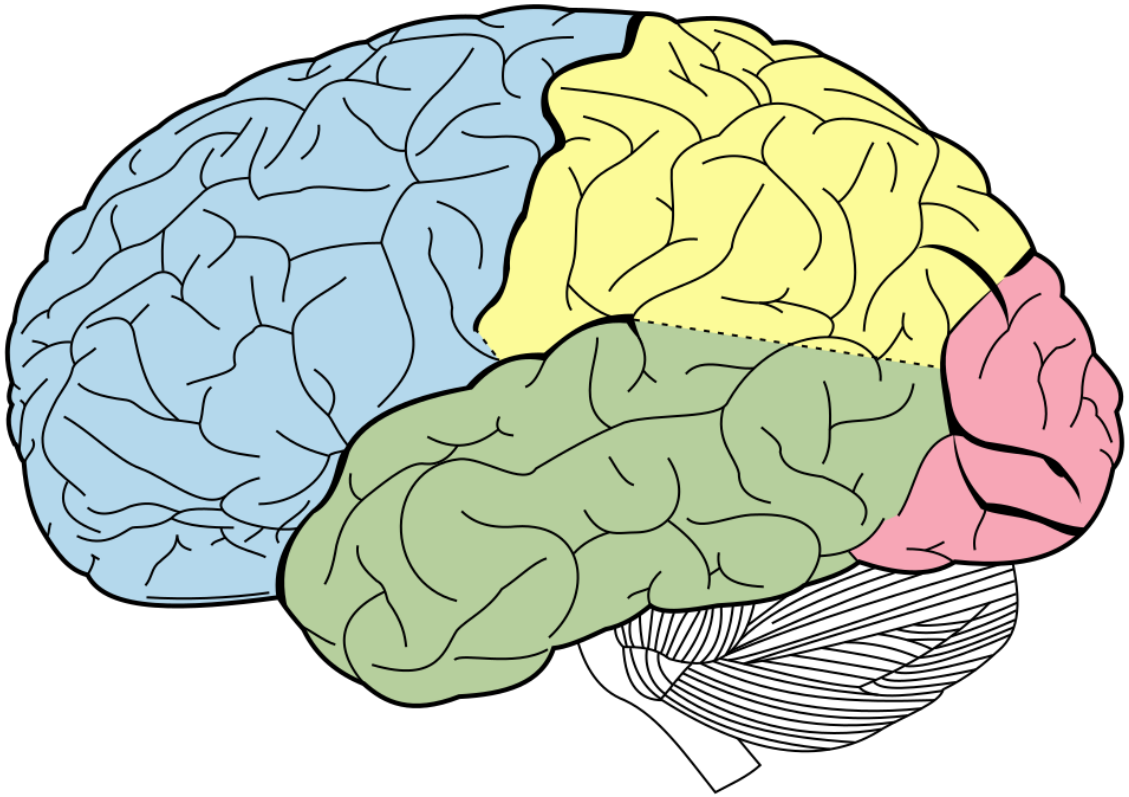
- What does it do/contain?
  - Prefrontal cortex
    - Planning, problem solving, working memory…?
  - Anterior cingulate cortex (ACC)
  - Primary olfactory cortex
  - Gustatory cortex

Cingulate Gyrus

http://cis.jhu.edu/data.sets/cortical_segmentation_validation/photos/cinggyrus75.jpg

Temporal lobe

- Where is it?
  - Ventral to frontal, parietal lobes
  - Inferior to lateral fissure



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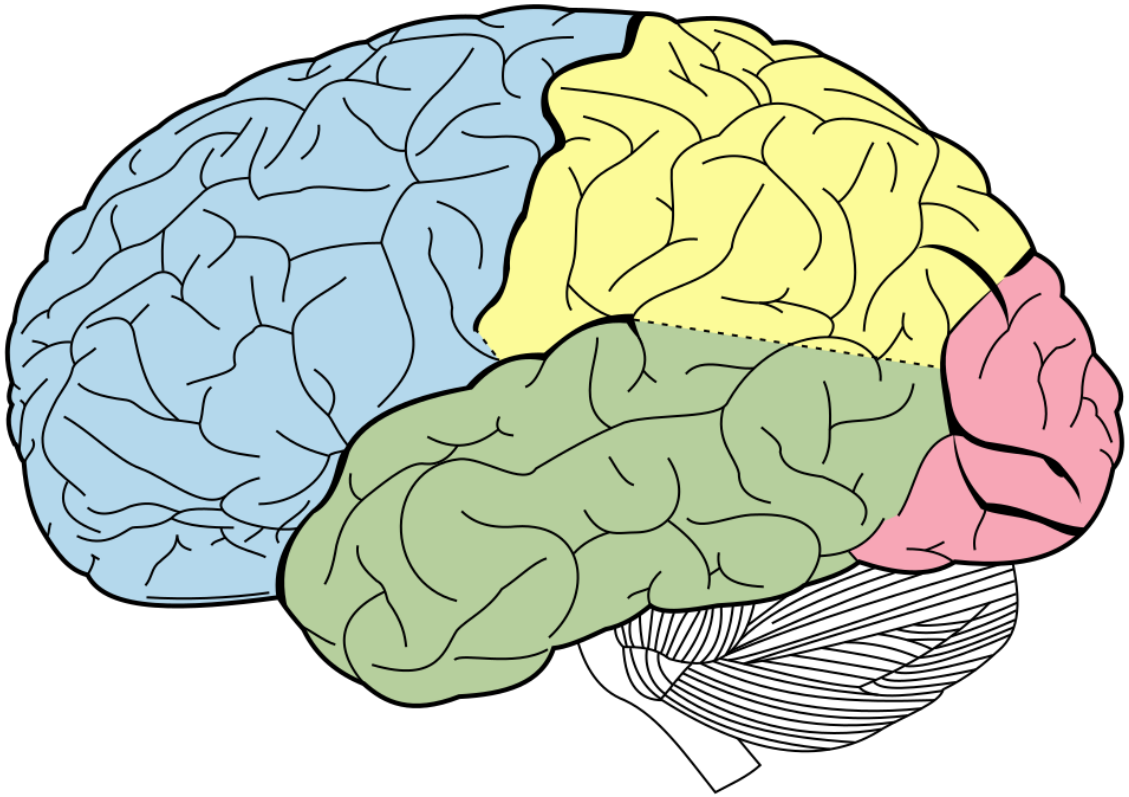
Lobes_of_the_brain_NL.svg.png

Temporal lobe

- What does it do/contain?
  - Primary auditory cortex (A1)
  - Object, face recognition
  - Amygdala, hippocampus
  - Storage of memories about events, objects
  - Olfactory cortex

Parietal lobe

- Where is it?
  - Caudal to frontal lobe
  - Dorsal to temporal lobe
  - Posterior to central sulcus



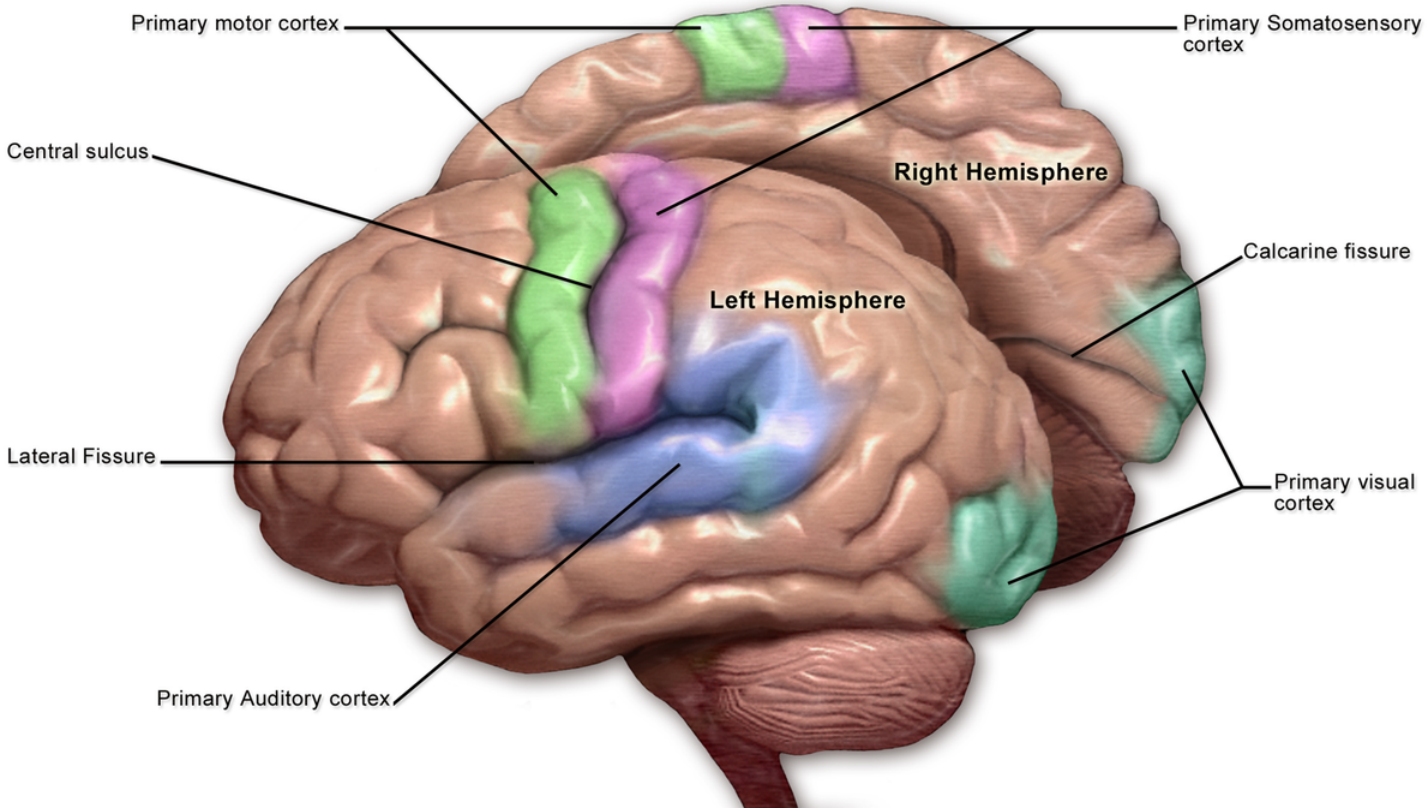
https://upload.wikimedia.org/wikipedia/commons/thumb/0
Lobes_of_the_brain_NL.svg.png

Parietal lobe

- What does it do/contain?
  - Primary somatosensory cortex
  - Perception of spatial relations, action planning

Post-central gyrus

- Post-central -> “posterior to” central sulcus
- Primary somatosensory cortex (S1)



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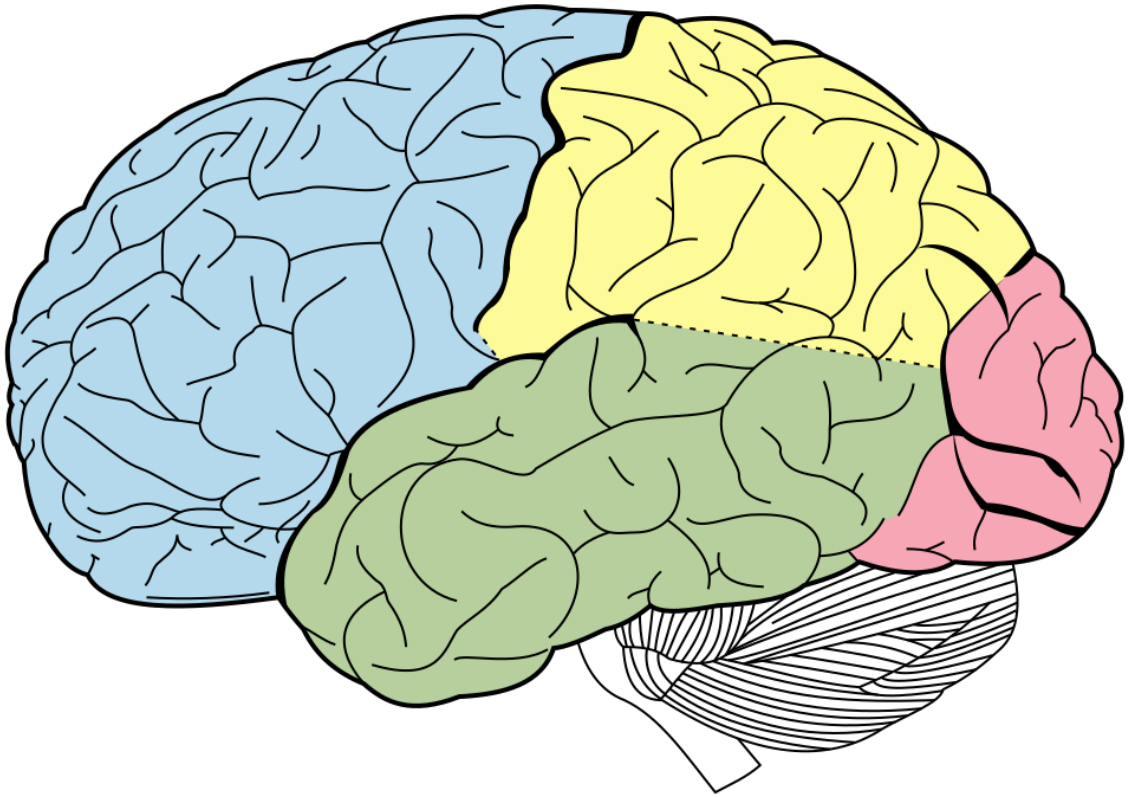
Blausen_0103_Brain_Sensory%26Motor.png

Occipital lobe

- Where is it?
  - Caudal to parietal & temporal lobes
- What does it do/contain?
  - Primary visual cortex (V1)



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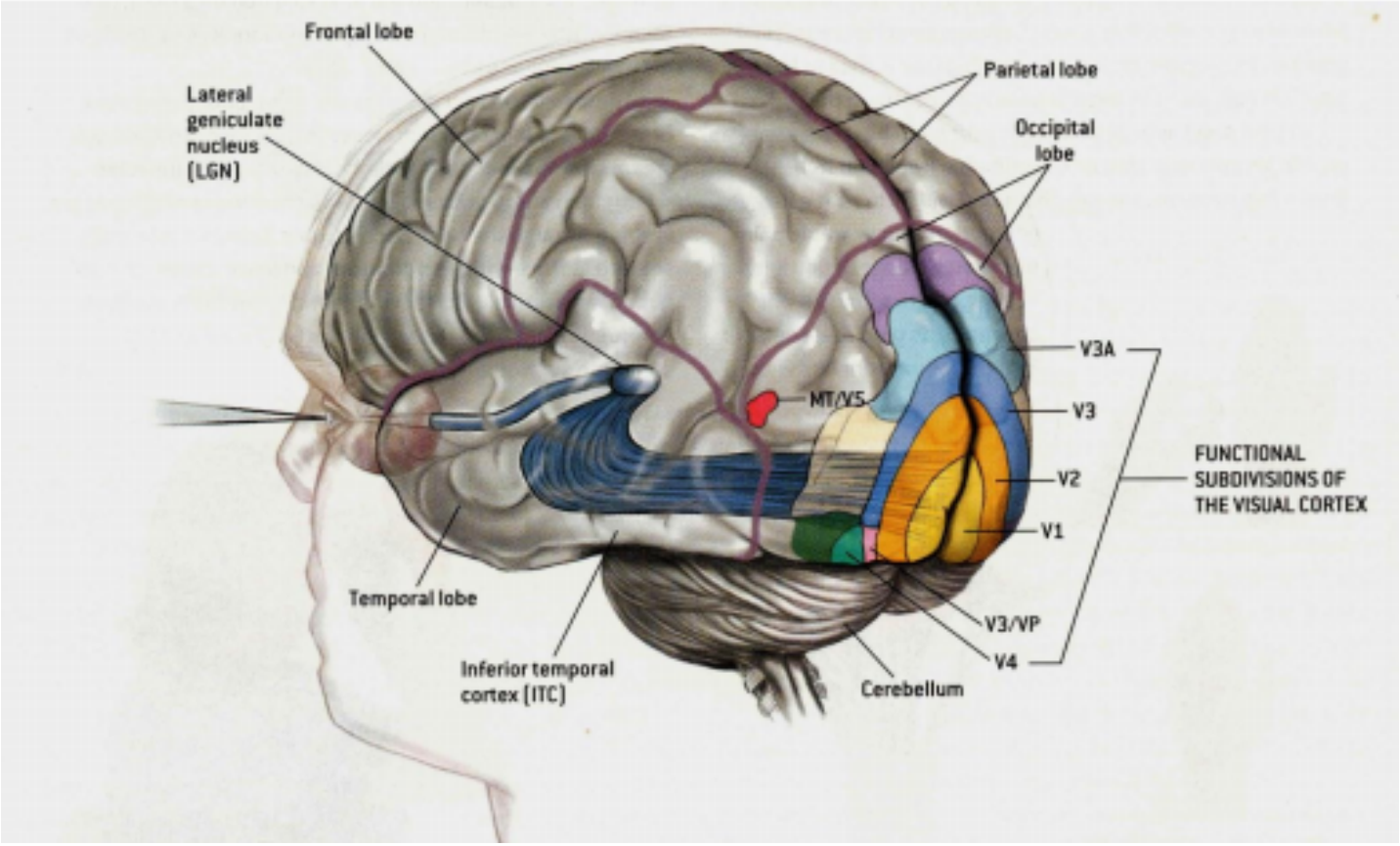
Lobes_of_the_brain_NL.svg.png

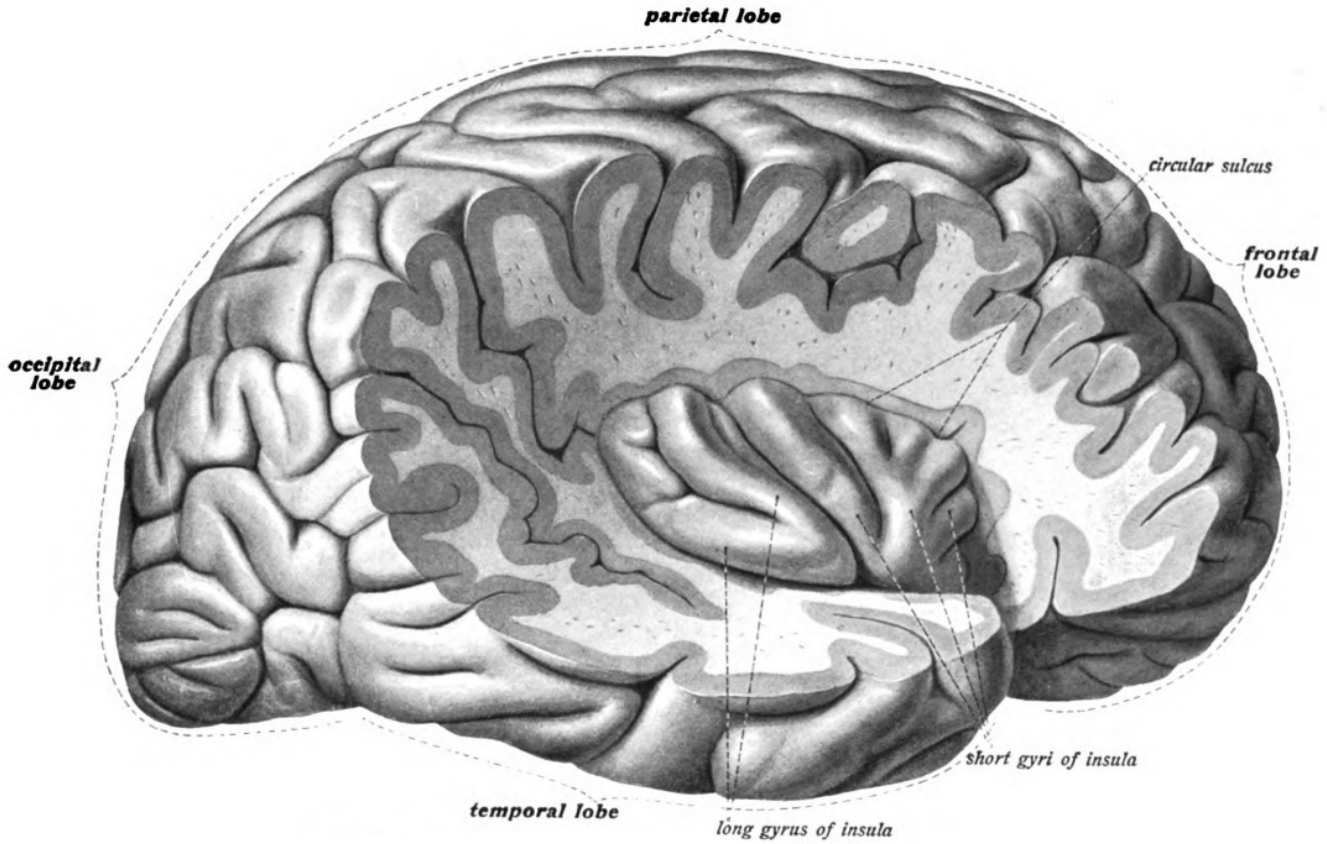
Visual Cortex



Insular cortex (insula)

- Where is it?
  - medial to temporal lobe
  - deep inside lateral fissure

Insula



https://upload.wikimedia.org/wikipedia/commons/b/b4/So

Insula

- What does it do/contain?
  - Primary gustatory cortex
  - self-awareness, interpersonal experiences, motor control

Lobes, landmarks, areas

Lobe	Sulci	Gyri	Areas
Frontal	Central sulcus	Precentral gyrus	motor cortex
	Corpus callosum	Cingulate gyrus	anterior cingulate cortex
			olfactory cortex
			gustatory cortex

Lobes, landmarks, areas

Lobe	Sulci	Gyri	Areas
Temporal	Lateral fissure		auditory cortex
			olfactory cortex
			hipppocampus
			amygdala

Lobes, landmarks, areas

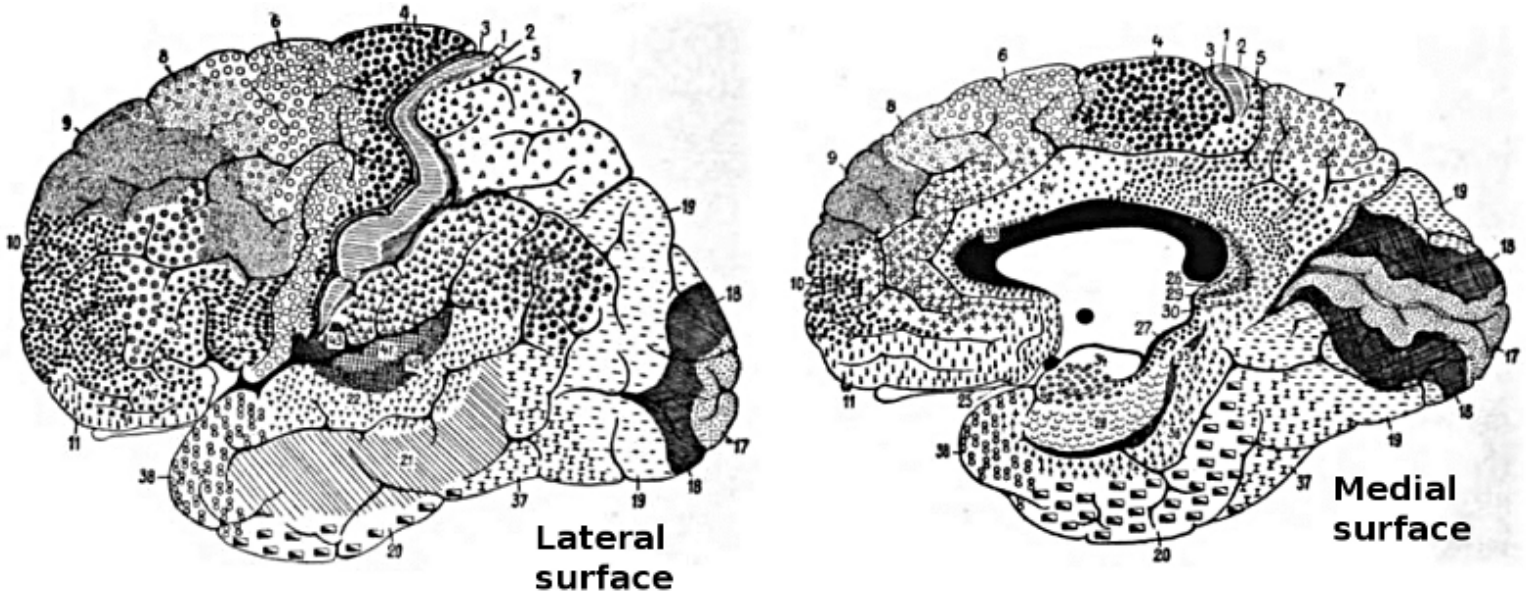
Lobe	Sulci	Gyri	Areas
Parietal	Central sulcus	Postcentral gyrus	somatosensory ctx
Occipital			visual ctx
Insula	Lateral fissure		gustatory ctx

Brodmann Areas

- Korbinian Brodmann
- Cytoarchitectonic differences in cerebral cortex

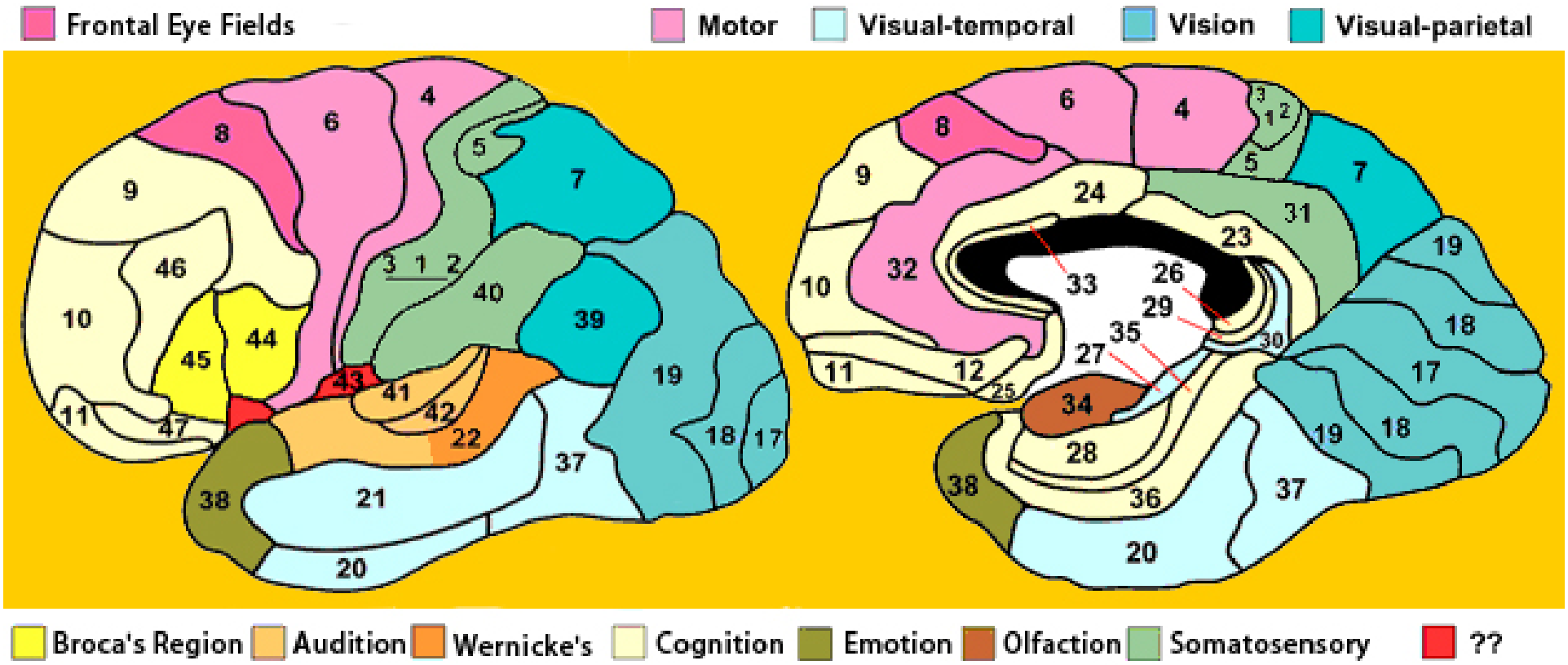
http://www.spektrum.de/lexika/images/bio/fff1209_w.jpg

Brodmann Areas



https://upload.wikimedia.org/wikipedia/commons/0/09/Brodmann-areas.png

Brodmann Areas

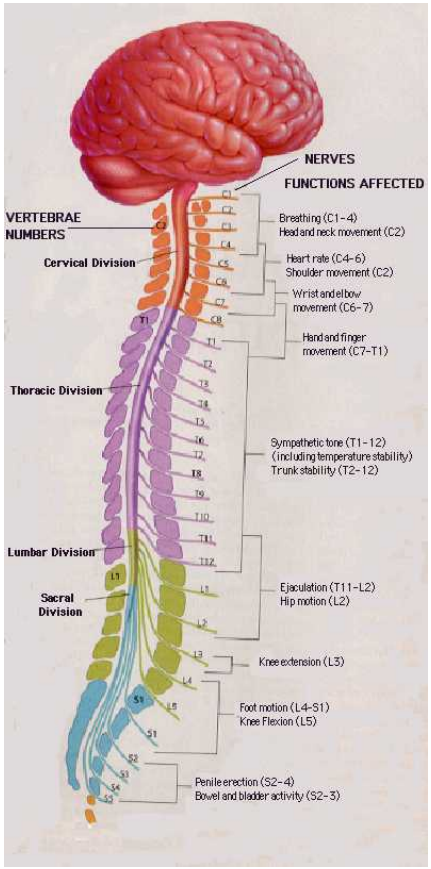


http://www.brain-maps.com/gehirn/brodmann_areale.jpg

Spinal cord

- Rostral/Caudal axis
  - Spinal column w/ vertebrae
  - Cervical (8), thoracic (12), lumbar (5), sacral (5), coccygeal (1)
  - Spinal segments & 31 nerve pairs
  - Cauda equina

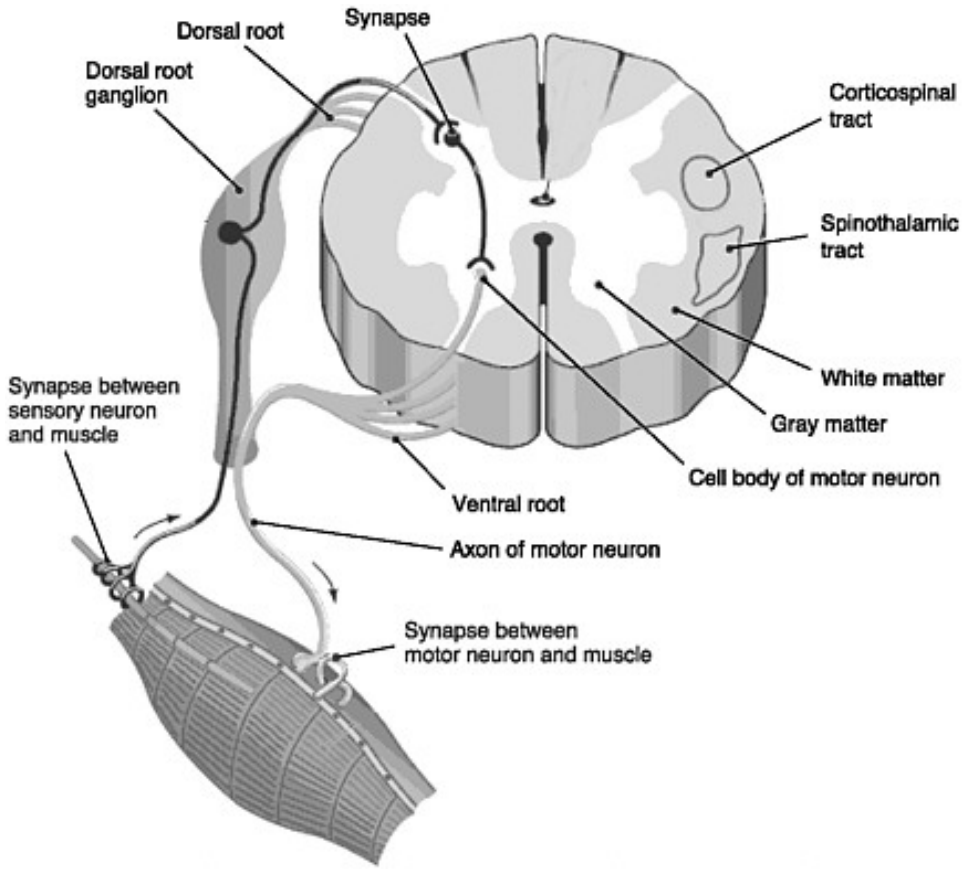
Spinal cord



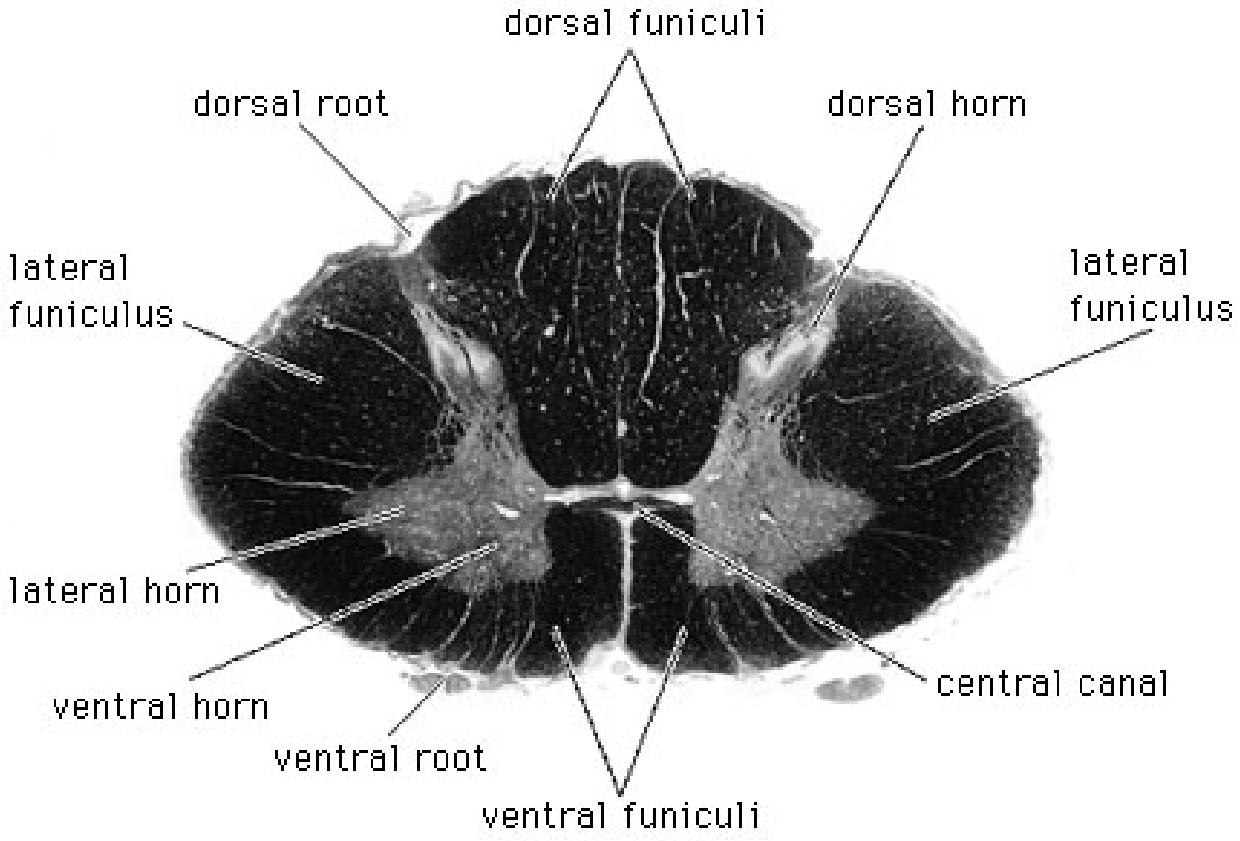
http://www.fauxpress.com/kimball/med/sensory/spinaldivisions.jpg

Spinal cord

- Organization of the spinal cord
  - Dorsal/Ventral
    - Dorsal root (sensory)
    - Ventral root (mostly motor)
  - Grey (interior) vs. white matter (exterior)



https://www.nap.edu/openbook/0309095859/xhtml/images



https://media1.britannica.com/eb-media/75/2975-004-7891D6AA.jpg

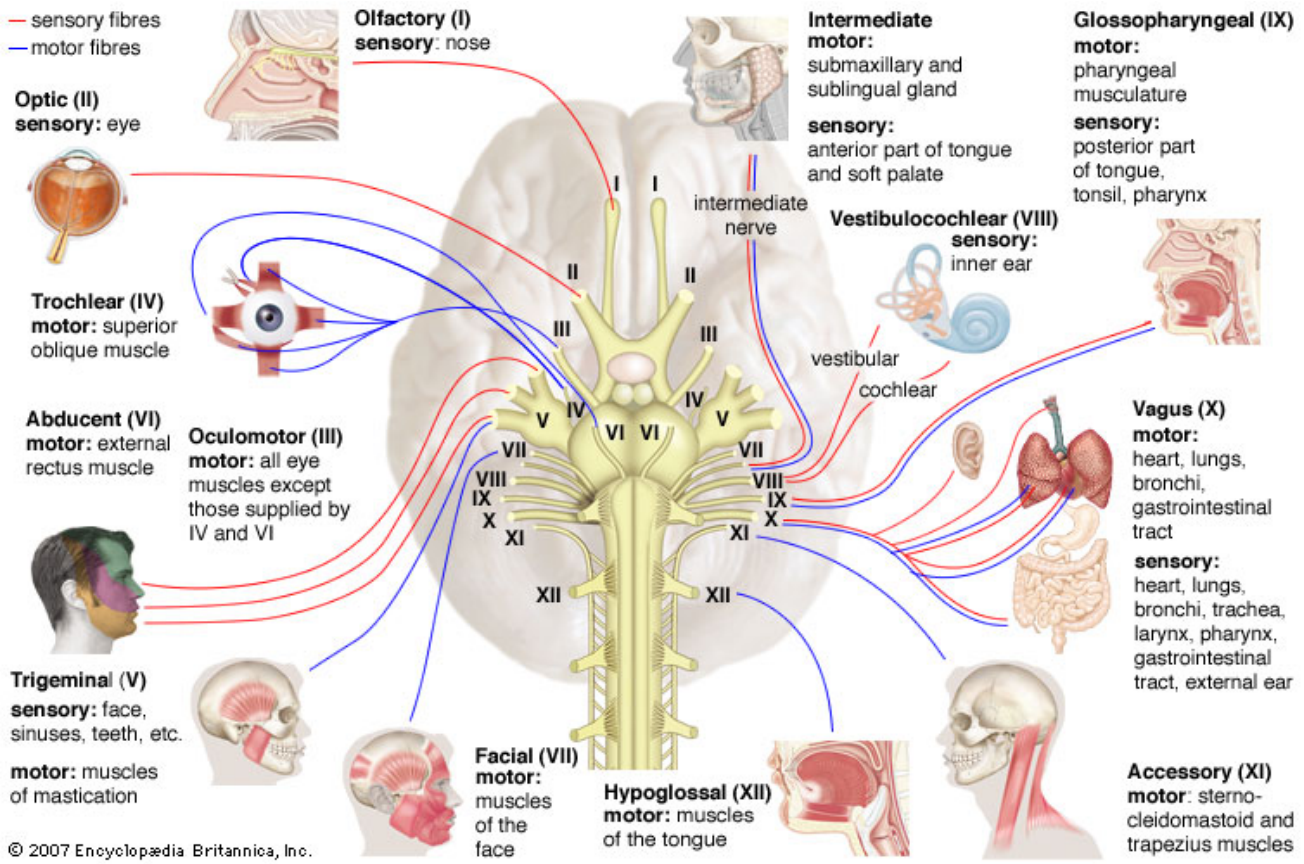
Organization of the PNS

- Somatic division
- Autonomic division
- Cranial nerves
- Spinal nerves

Cranial nerves

- Afferents (input), efferents (output), or mixed
- Innervate head and neck
- Olfactory (I), optic (II), (VIII) auditory, vagus (X), etc.
- Spinal nerves

Cranial nerves

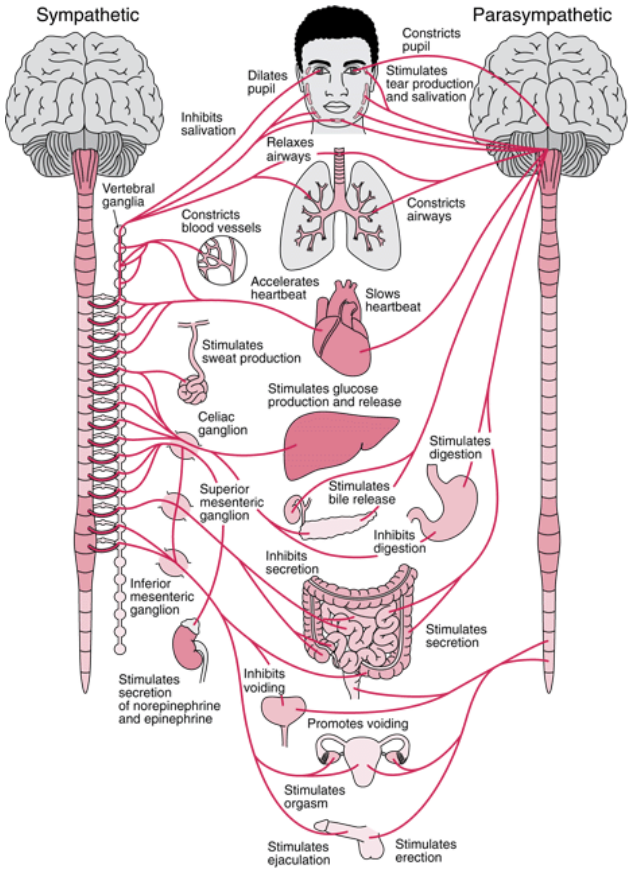


http://media-1.web.britannica.com/eb-media/44/54244-004-892C5169.jpg

Autonomic nervous system

- CNS & PNS components
- Controls “vegetative functions”"
  - Limited voluntary control
- Two divisions
  - Sympathetic
  - Parasympathetic

ANS



http://humanphysiology.academy/Neurosciences%202015/Images/2/NEU_autonomic_nervous_system%20Merc

Sympathetic division

- Prepares body for action
- “Fight or flight”"
- Spinal cord
    - ganglion chain along spinal column to End organs
- NTs
    - Preganglionic: ACh
    - Post: NE

Parasympathetic division

- Para -> “around”
- Restorative function
- “Rest & digest”
- Spinal cord -> ganglia near end organs -> end organ
    - NT: ACh

Next time…

- Quiz 1
- Neuroanatomy III

References

LeDoux, J. (2015, August 10). The Amygdala Is NOT the Brain's Fear Center. *Psychology Today*. Retrieved from https://www.psychologytoday.com/blog/i-got-mind-tell-you/201508/the-amygdala-is-not-the-brains-fear-center