

Gross Divisions of CNS

Principles and Practices of Osteopathic Medicine I

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Do.
Make.
Heal.
Innovate.
Reinvent the Future.

Session Objectives

- Describe major **organizations** of the human nervous system
- Understand the major **functions** of each subdivision.

Nolte's Essentials of the Human Brain, 2nd edition

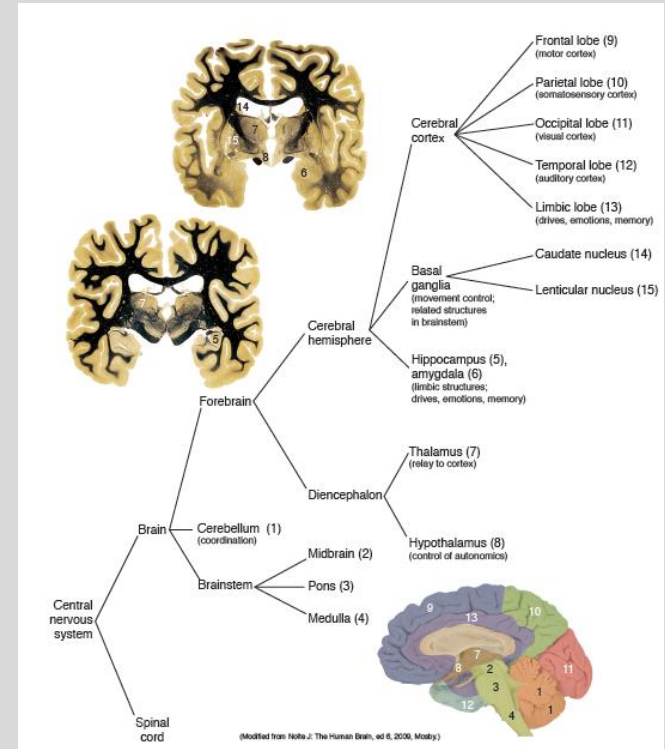
Chapter 3. "Gross Anatomy and General Organization of the Central Nervous System"

Available at ClinicalKey:

<https://www.clinicalkey.com/#!/content/book/3-s2.0-B9780323529310000080?indexOverride=GLOBAL>

Please see the **detailed session objectives** in the CPG

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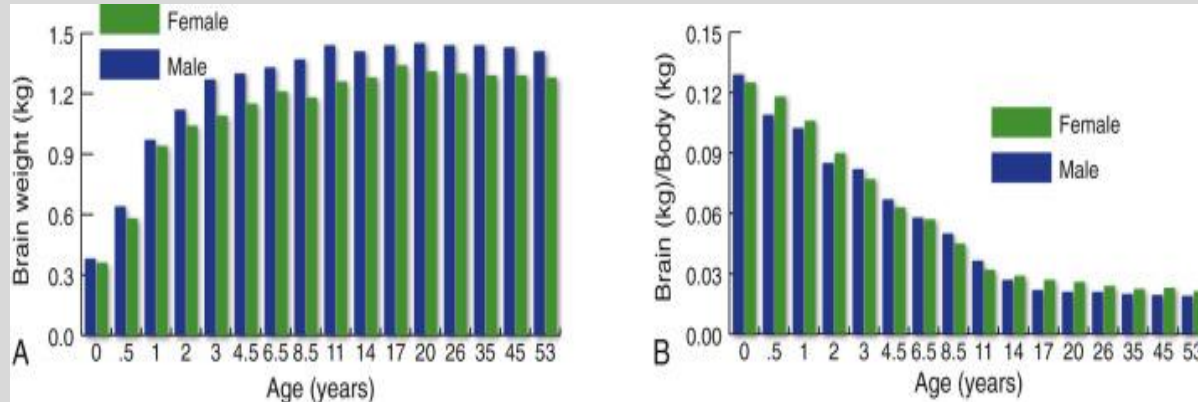


Brain Fun Facts!

- Bilaterally symmetric
- Soft, gelatinous (gray and white matter)
- Surrounded by meninges and cranium
- Gender and age differences

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Anatomical Organization of the Nervous System

- Central Nervous System (CNS)

- Brain

- Forebrain
 - Cerebellum
 - Brainstem

- Spinal cord

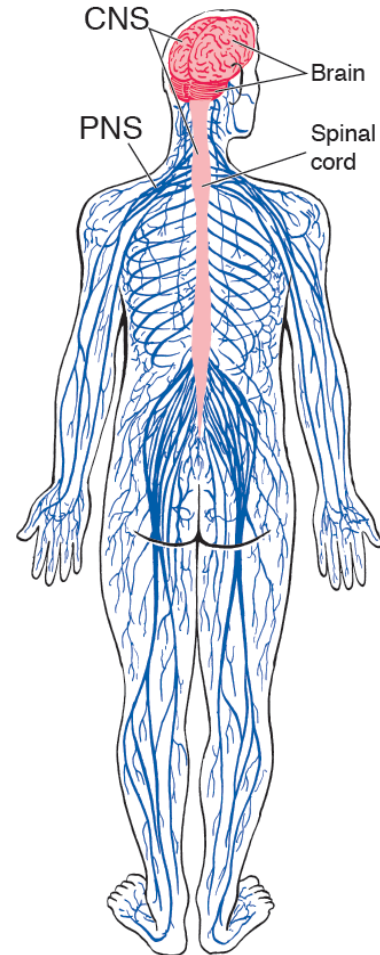
- Peripheral Nervous System (PNS)

- Nerves

- Cranial nerves
 - Spinal nerves

- Ganglia (exception: Basal ganglia)

- Sensory/motor neurons
 - Autonomic neurons
 - *Enteric nervous system
- } Parts are in the CNS



(Redrawn from Krstic RV: General histology of the mammal, Berlin, 1985, Springer-Verlag.)

Anatomical Organization of the CNS

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Gray Matter

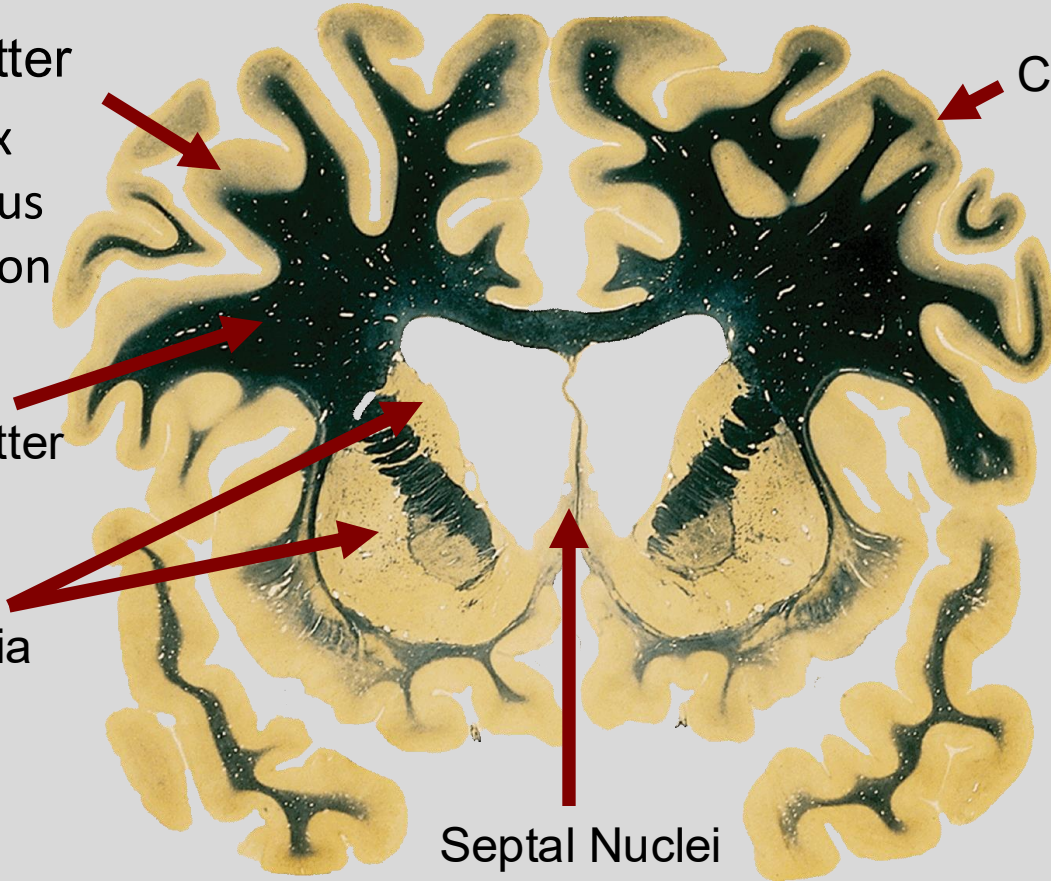
- Cortex
- Nucleus
- Ganglion

Cortex

White Matter

Basal
Ganglia

Septal Nuclei



Anatomical Organization of the CNS

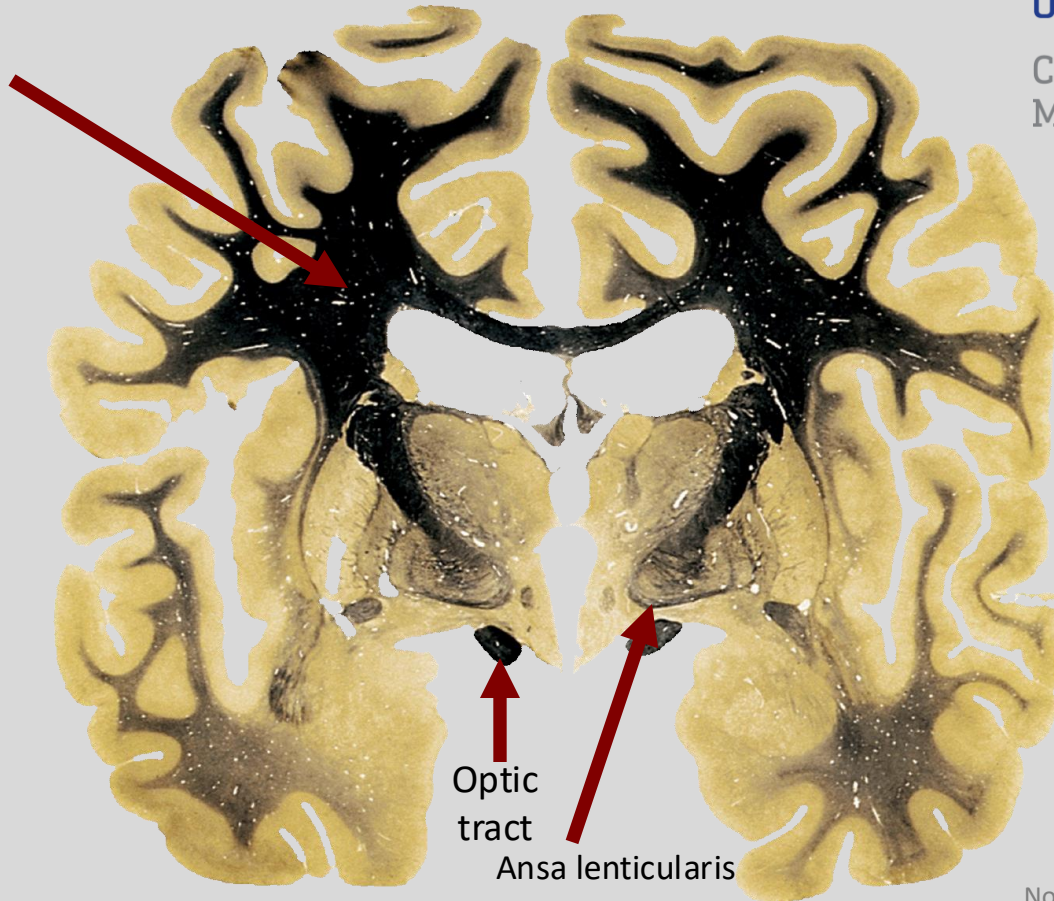
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White Matter

- Tract
- Lenticularis
- Fasciculus
- Lemniscus
- Peduncle

All means
“small bundle”



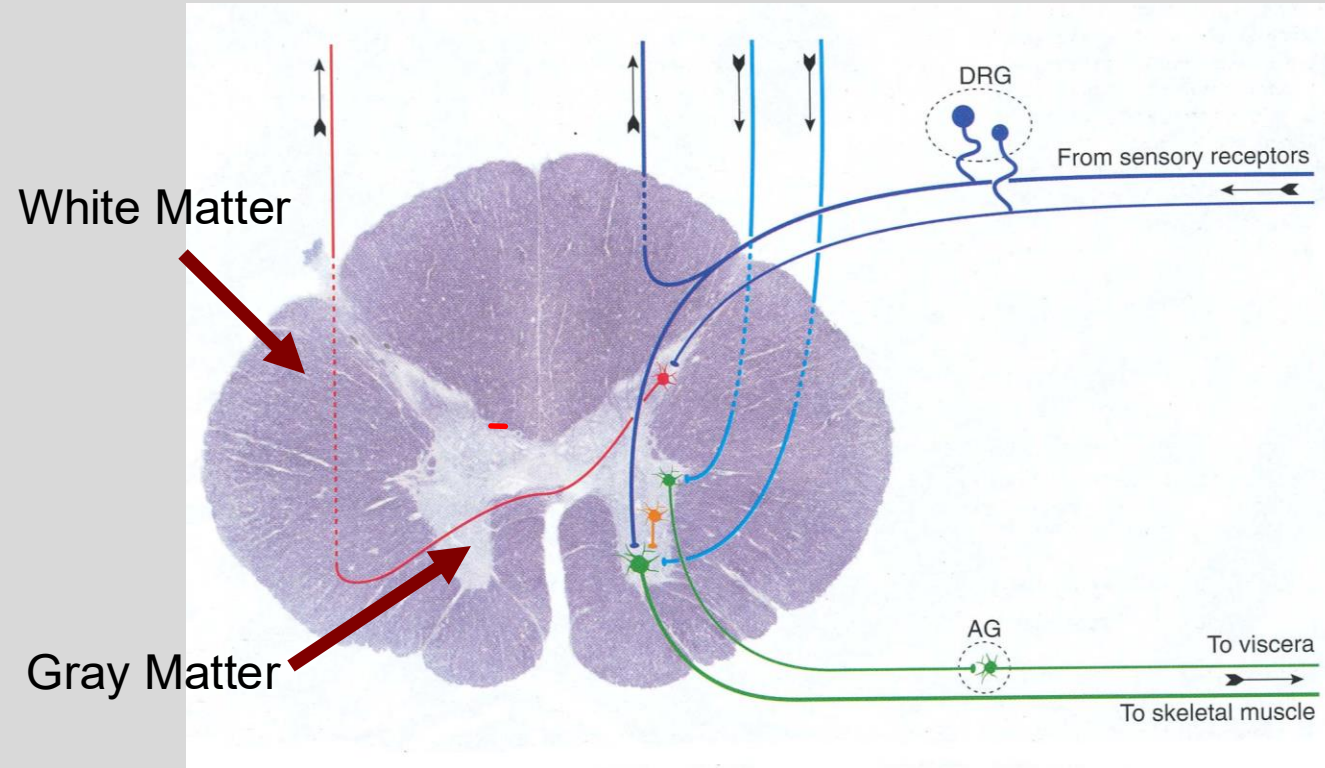
Optic
tract

Ansa lenticularis

Anatomical Organization of the CNS

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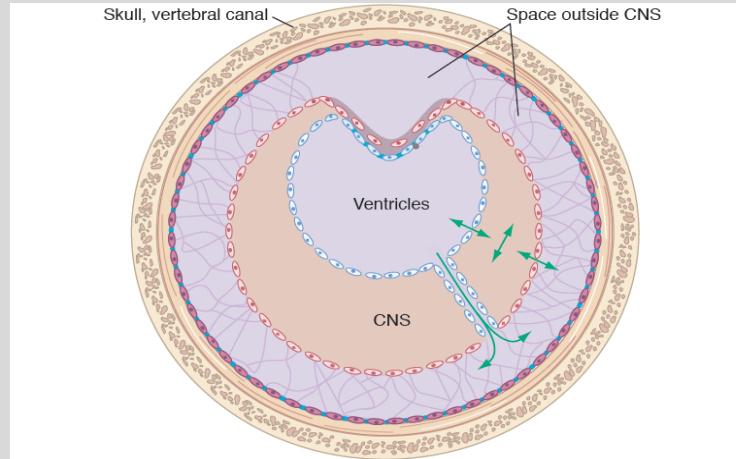


Anatomical Organization of the CNS

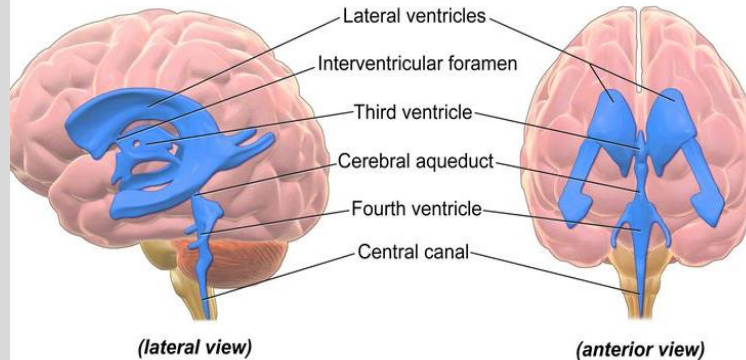
Spaces

- ventricles
- aqueduct
- sulcus (fissures)
- cisterns

Filled with
cerebrospinal fluids
(CSF)



(Adapted from Nolte J. Elsevier's Integrated Neuroscience, 2007, Elsevier.)



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Anatomical Organization of the CNS

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Spaces

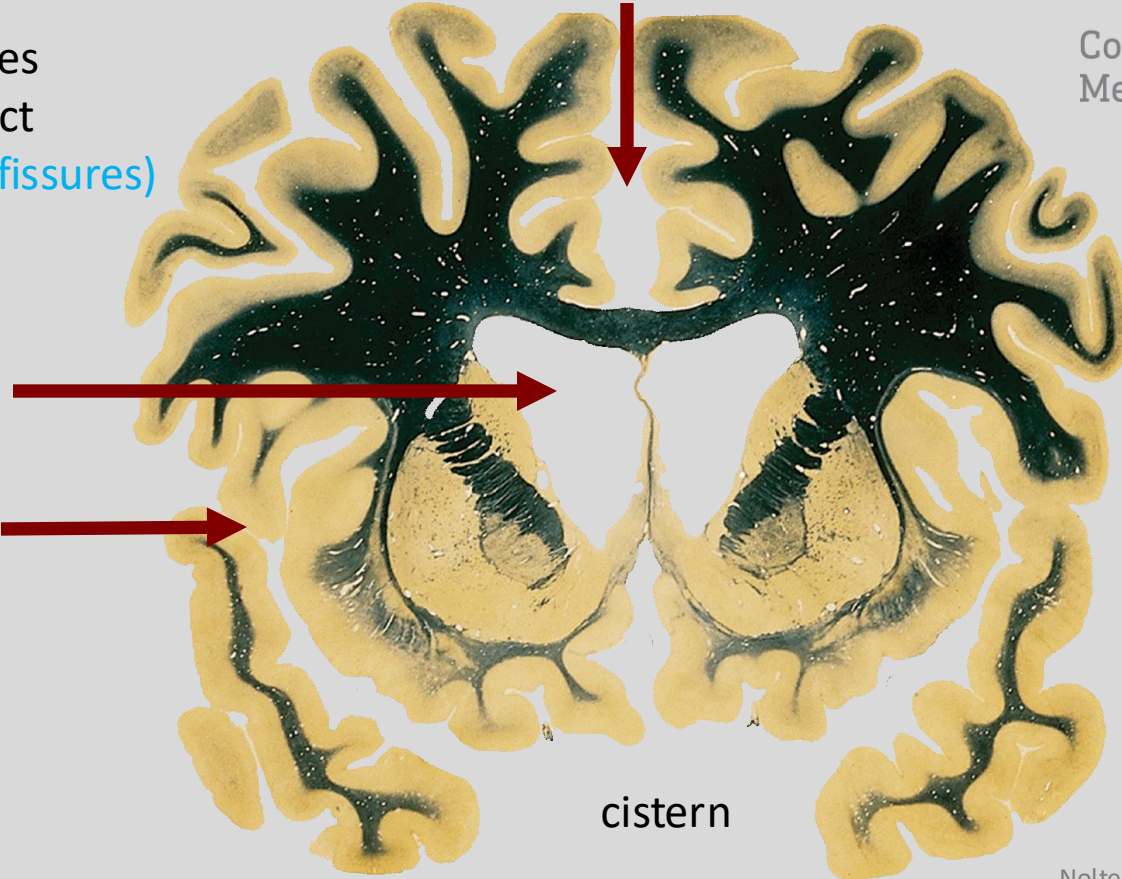
- ventricles
- aqueduct
- sulcus (fissures)
- cisterns

Lateral
Ventricle

Lateral
Sulcus

Longitudinal Fissure

cistern



Anatomical Organization of the CNS

Spaces

- ventricles
- aqueduct
- sulcus (fissures)
- cisterns

Third
Ventricle

Aqueduct

Cistern



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Directions in the CNS

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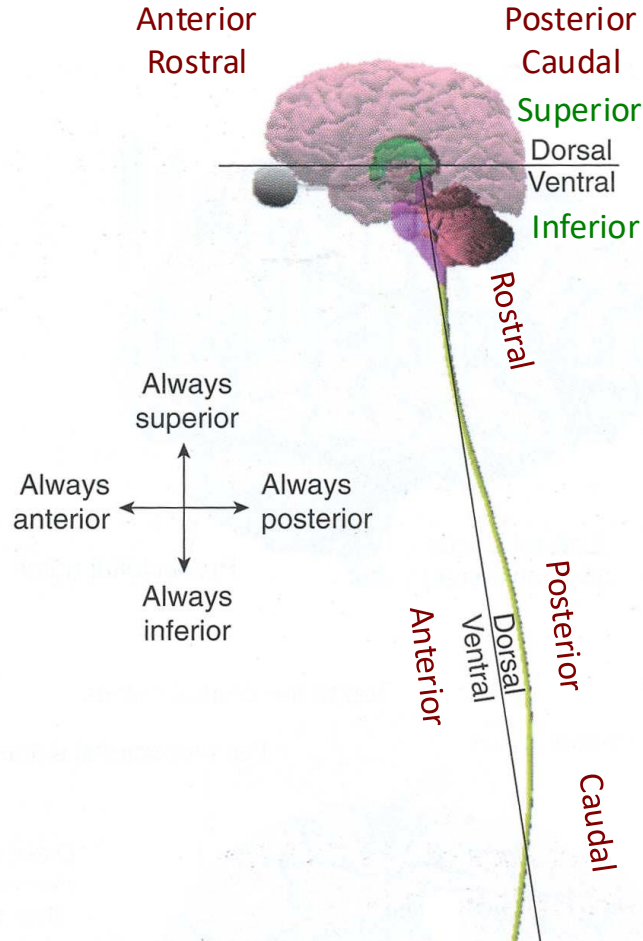
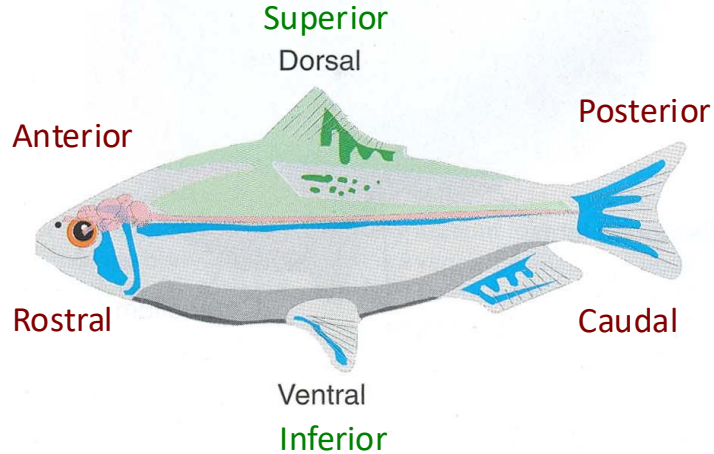
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Brain:

Dorsal = Superior

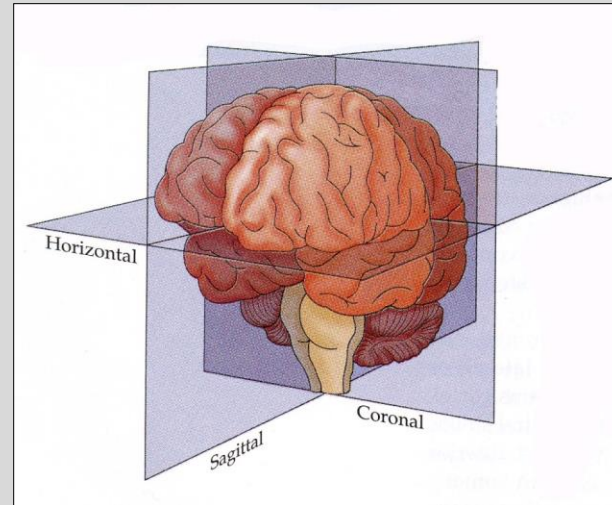
Brainstem and Spinal Cord:

Dorsal = Posterior



Orientation: Planes of Section

- **Sagittal:**
 - Midsagittal: divides structures along longitudinal axis (separates the hemispheres)
 - Parasagittal: sections that run parallel to midsagittal
- **Horizontal:** parallel to the longitudinal axis; “axial” for brainstem/spinal cord
- **Coronal:** frontal sections; perpendicular to the longitudinal axis; “transverse” or “cross” sections for brainstem/spinal cord



Major Structures of the CNS

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Forebrain

- 2 cerebral hemispheres (cerebrum)
- diencephalon

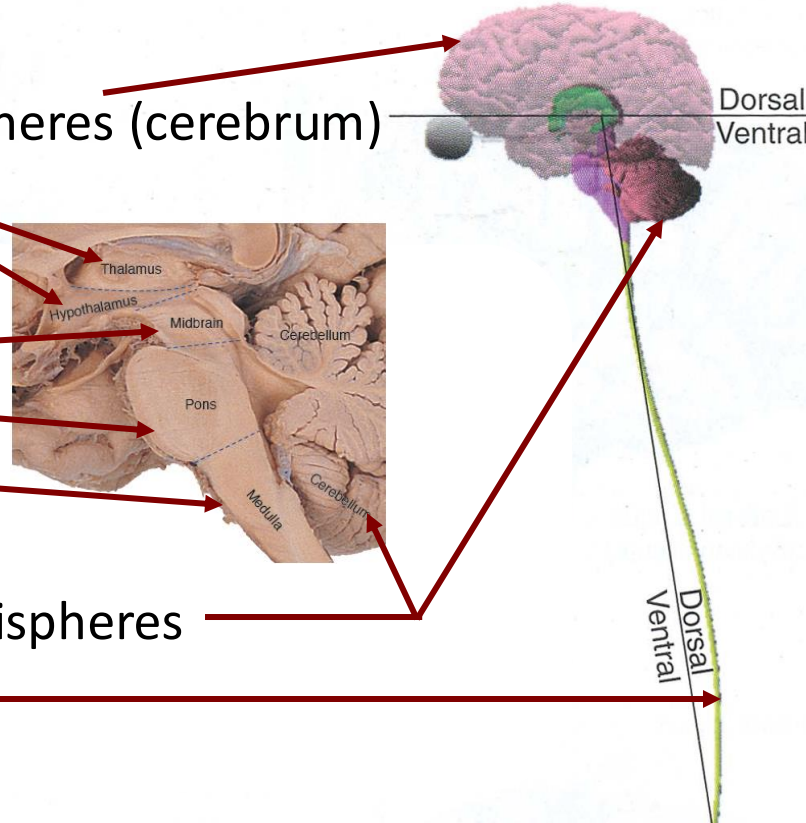
Brainstem

- midbrain
- pons
- medulla

Cerebellum

- 2 cerebellar hemispheres

Spinal Cord



Major Structures of the CNS using Imaging



Forebrain

Brainstem

Cerebellum

Spinal Cord



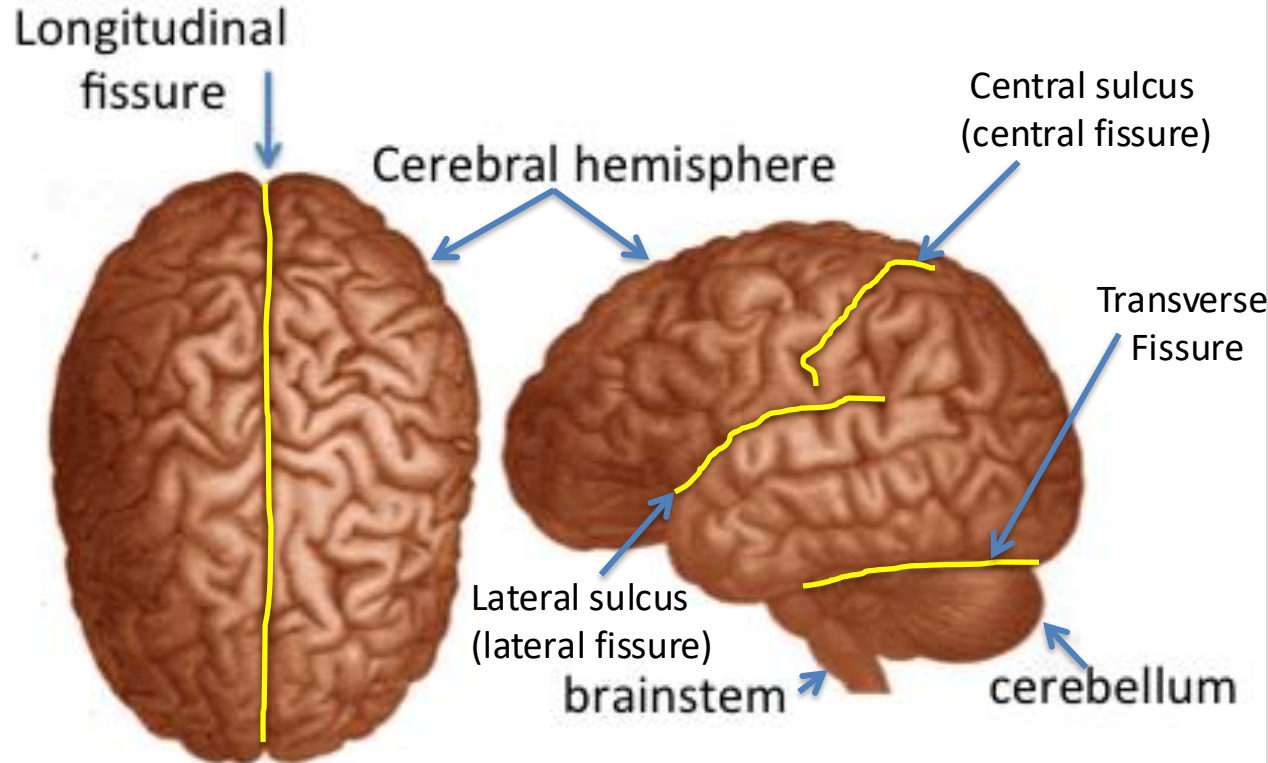
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Major Structures of the CNS

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"The Soul of Man" Paul Carus, Open Court Publishing ,1905

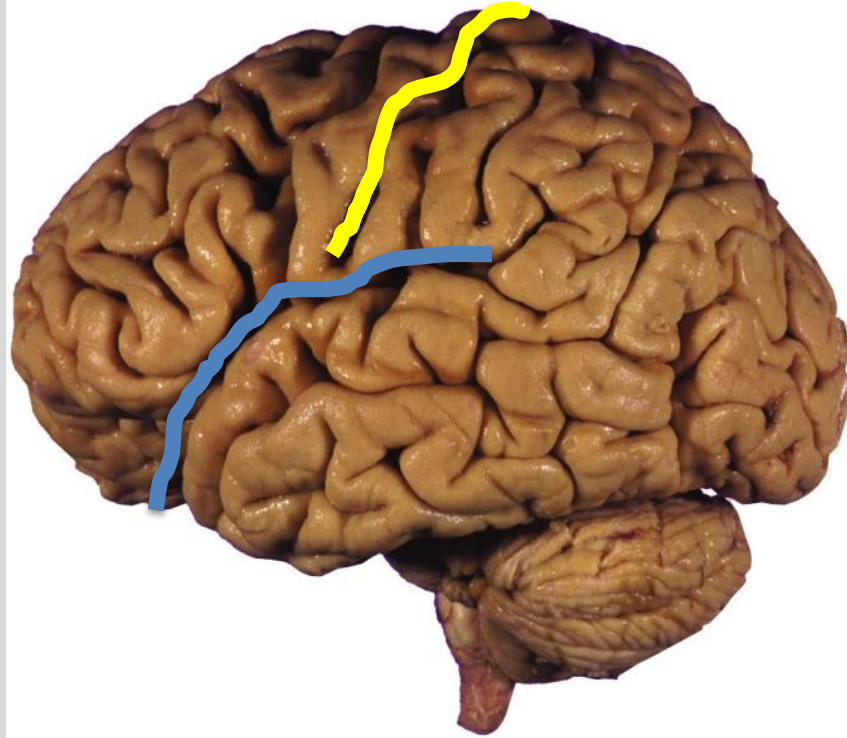
What's Where in the Cerebral Hemispheres

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Sulci & Gyri

- **central sulcus**
(aka Rolando fissure or central fissure)
- **lateral sulcus**
(aka Sylvian fissure or lateral fissure)



What's Where in the Cerebral Hemispheres

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Lobes:

Frontal Lobe

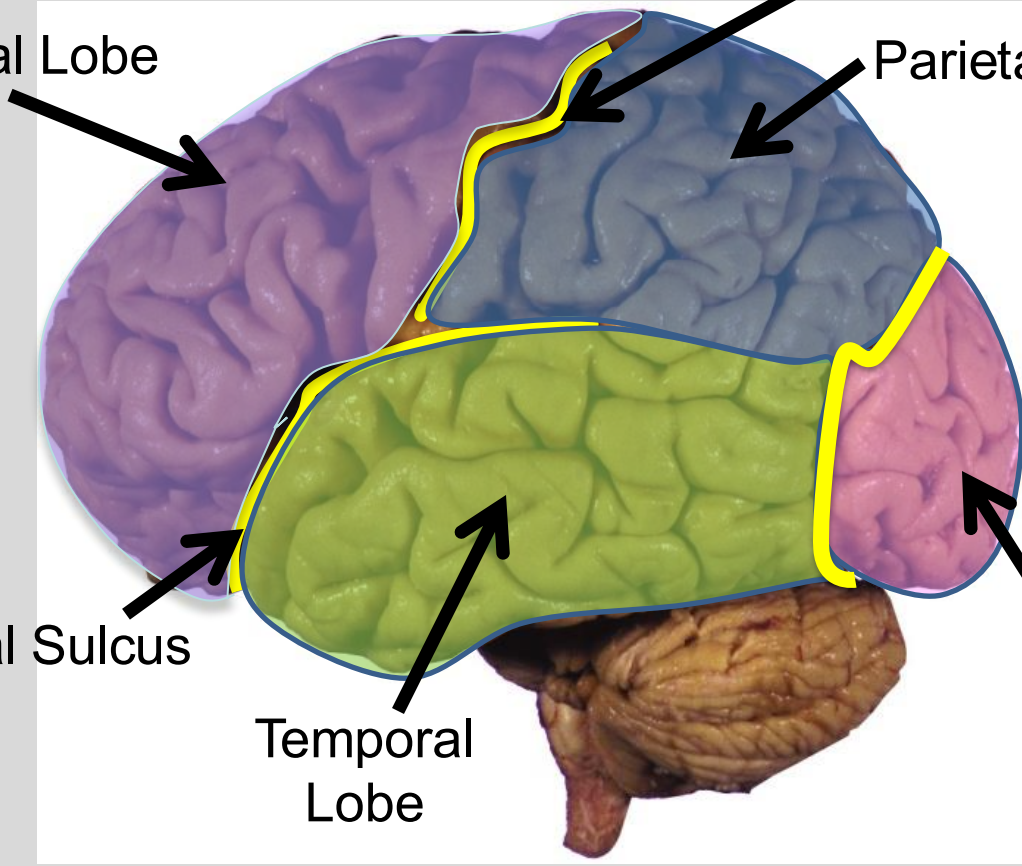
Central Sulcus

Parietal Lobe

Lateral Sulcus

Temporal
Lobe

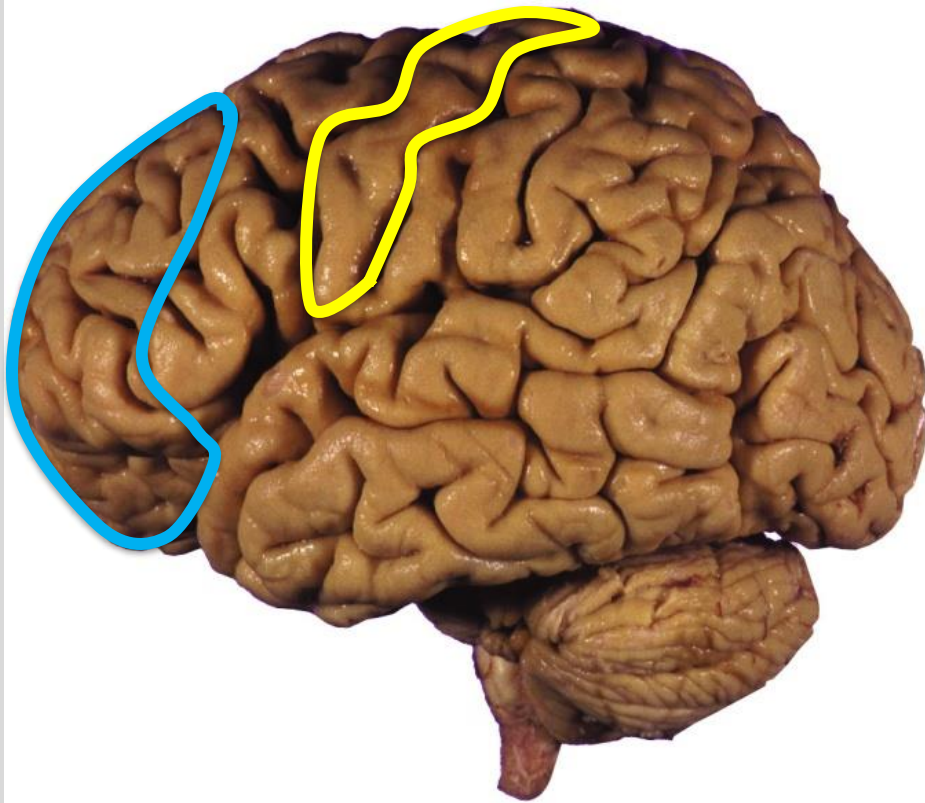
Occipital
Lobe



Major Functions of the Cerebral Hemispheres

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Frontal Lobe

- Planning, executive function
 - Primary motor cortex:
Precentral gyrus
 - Prefrontal cortex
 - Personality
 - Inhibition
- (Mr. Phineas Gage)

Major Functions of the Cerebral Hemispheres

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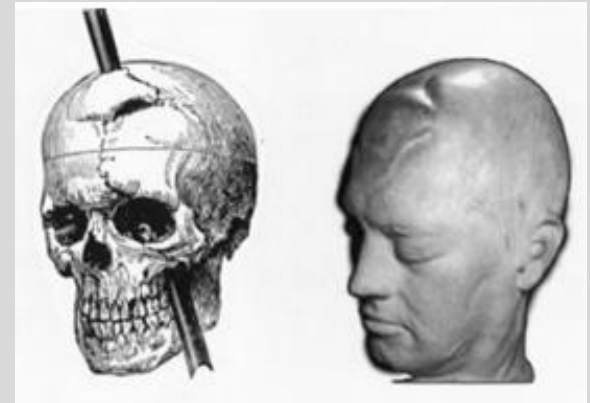
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Frontal Lobe

- Personality
- (Mr. Phineas Gage)



Harvard's Countway Library of Medicine

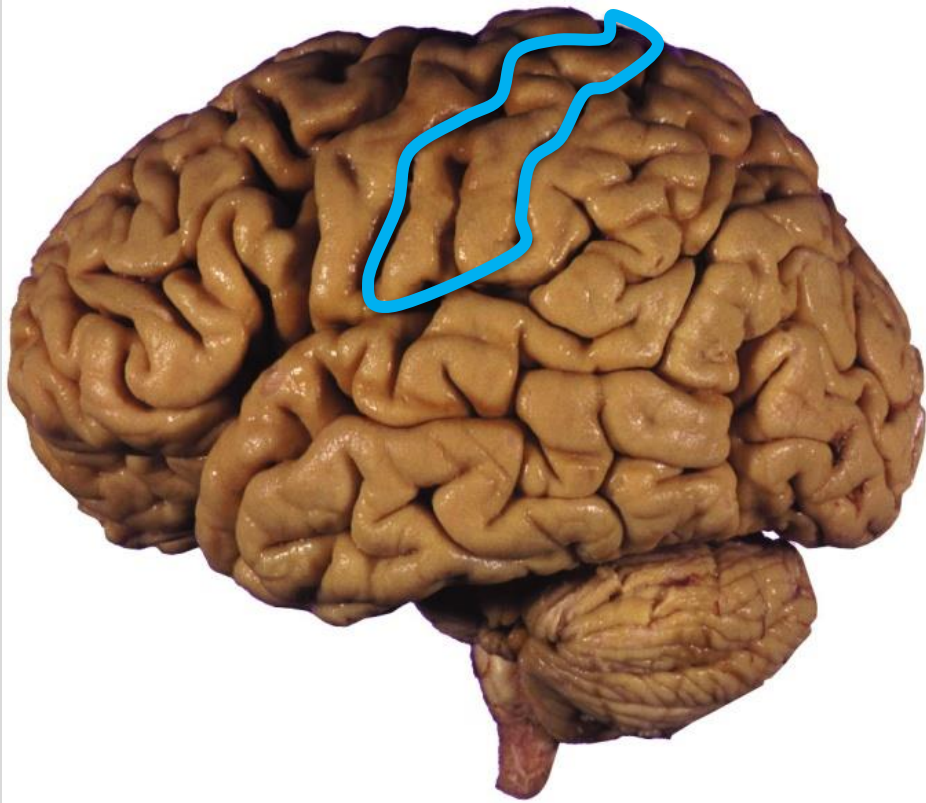


Lena, M.L. and M. Macmillan (2010). *"Picturing Phineas Gage" (invited comment)*. *Smithsonian*. March 2010.

Major Functions of the Cerebral Hemispheres

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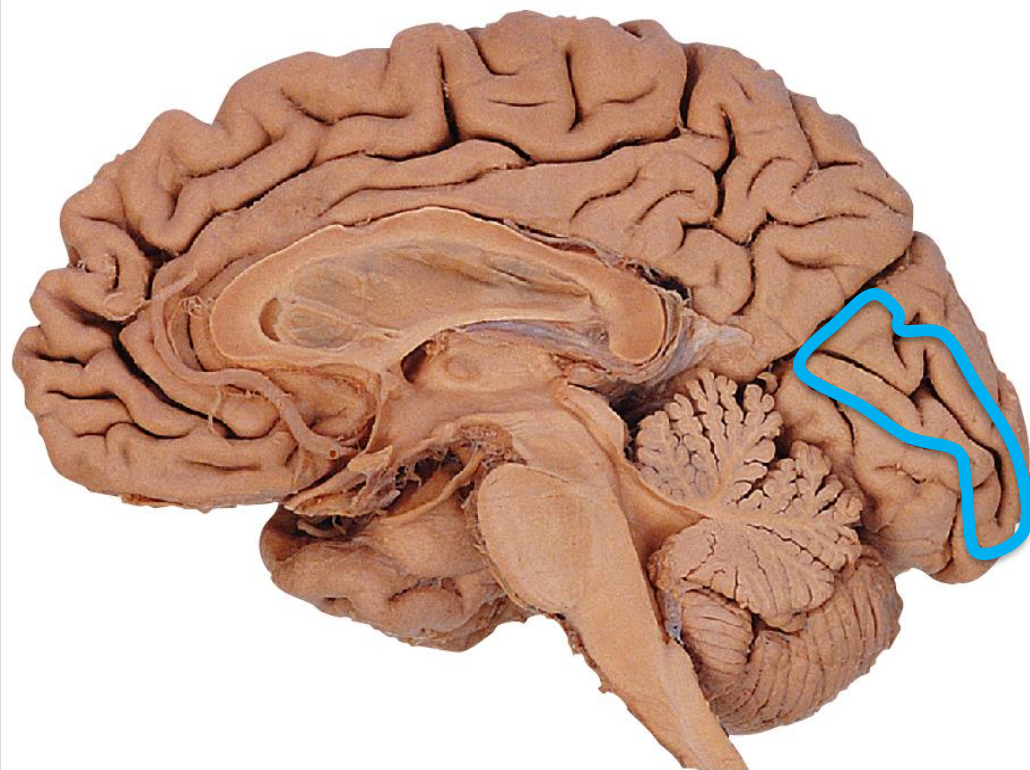
Parietal Lobe

- Primary somatosensory cortex: postcentral gyrus
- Spatial awareness

Major Functions of the Cerebral Hemispheres

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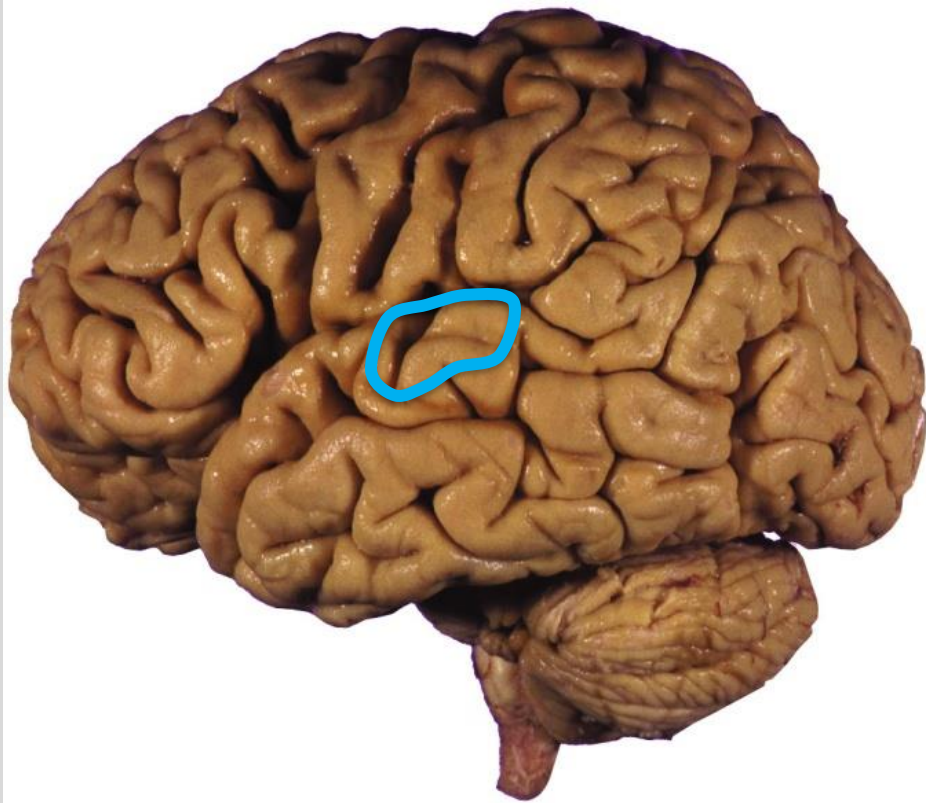
Occipital Lobe

- Primary visual cortex

Major Functions of the Cerebral Hemispheres

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Temporal Lobe

- Primary auditory cortex

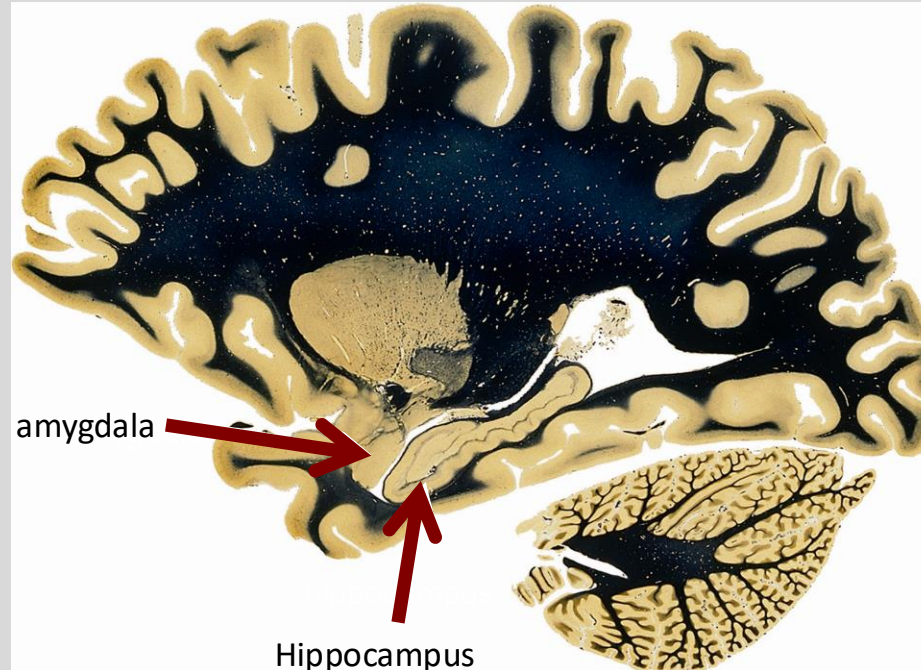
Major Functions of the Cerebral Hemispheres

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Temporal Lobe

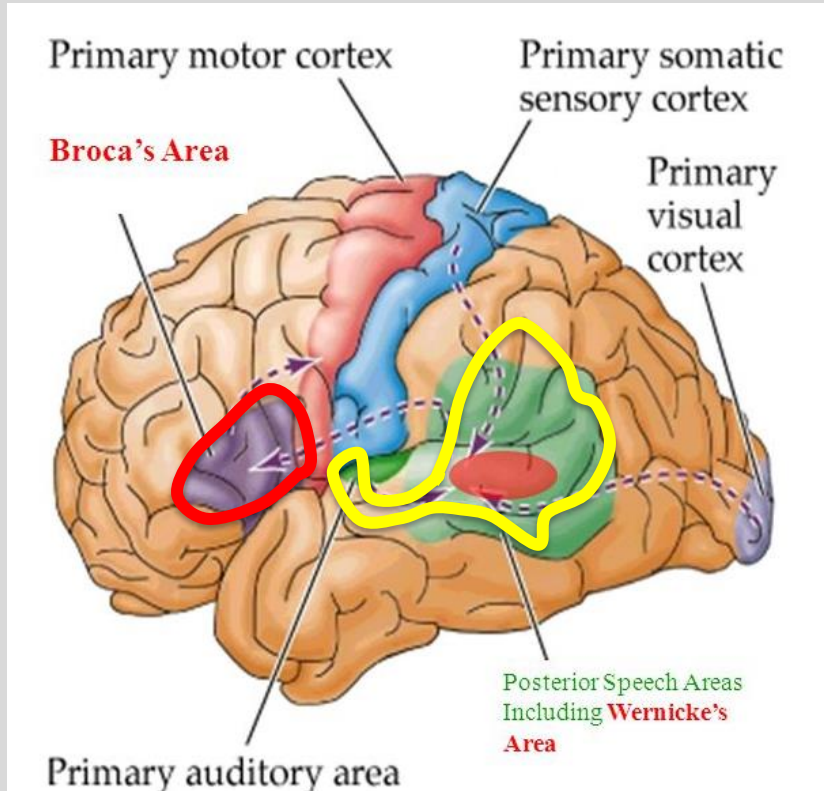
- auditory cortex
- hippocampus
 - Learning and memory
- amygdala
 - Emotions (fear, anger, etc.)



Major Functions of the Cerebral Hemispheres

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Language areas

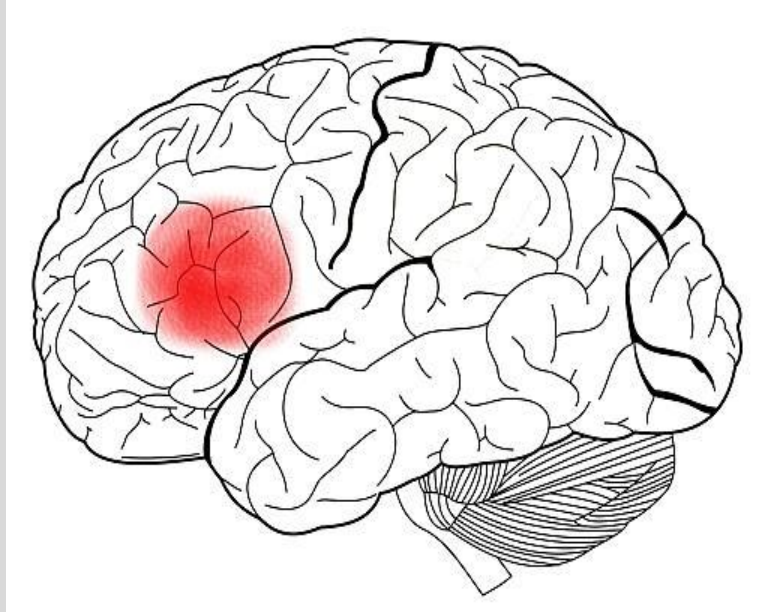
- bordering **lateral sulcus**
 - Broca's area
 - Wernicke's area

Clinical Correlation: Broca's Aphasia

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- Broca's Aphasia
- Lesion in Broca's area
 - Causes difficulty with **production** of spoken language
 - Can understand but cannot speak!
 - Knows what they want to say but cannot form words
- “Expressive Aphasia”



<https://www.youtube.com/watch?v=6zNKz7YoUao>

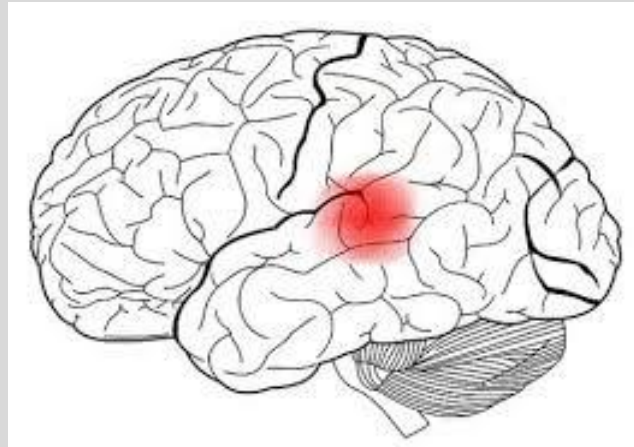
<https://www.lifepersona.com/broca-s-area-functions-anatomy-and-diseases>

Clinical Correlation: Wernicke's Aphasia

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- Wernicke's Aphasia
- Lesion in Wernicke's area
 - Causes inability to comprehend spoken language
 - Can speak but cannot understand!
 - Uninhibited speech, yet nonsensical
- “Receptive Aphasia”



<https://www.youtube.com/watch?v=aVhYN7NTIKU>

<https://exploringyourmind.com/wernickes-area-and-language-comprehension/>

Online videos for aphasia

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Broca's Aphasia



<https://www.youtube.com/watch?v=6zNKz7YoUao>

Wernicke's Aphasia



<https://www.youtube.com/watch?v=aVhYN7NTIKU>

What's Where in the Cerebral Hemispheres

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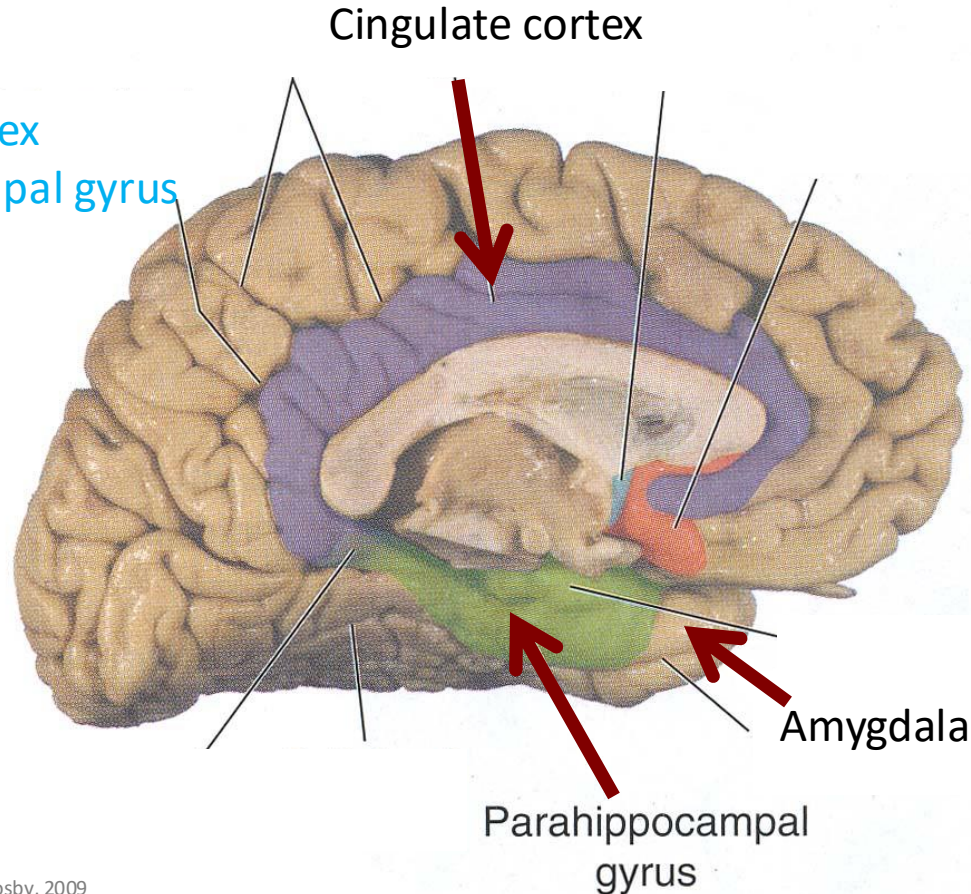
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Limbic Lobe

- Cingulate cortex
- Parahippocampal gyrus
- Amygdala

■ Five F's:

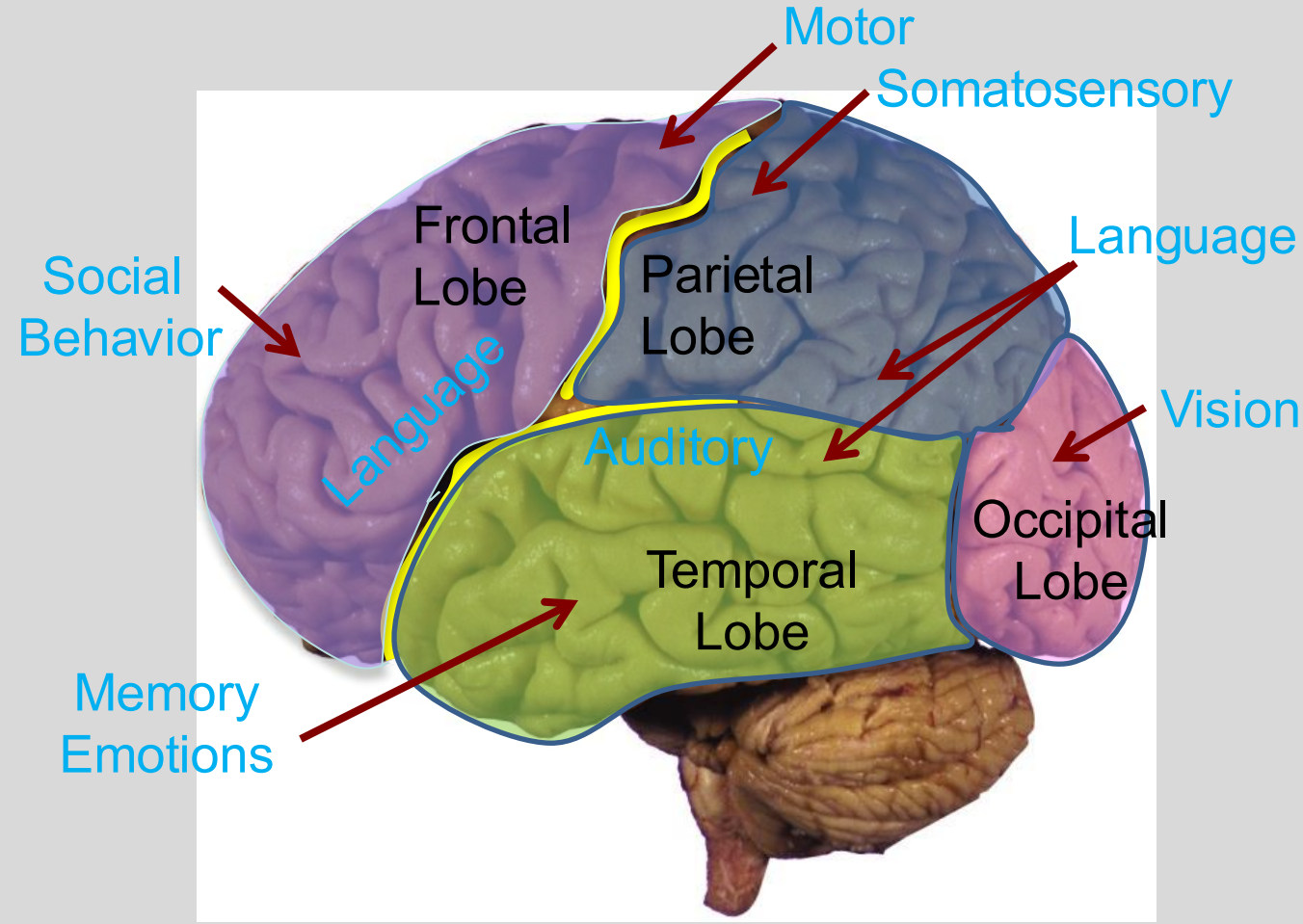
- Feeling
- Feeding
- Fleeing
- Fighting
- "Sex"



Neuroanatomy & Physiology (review)

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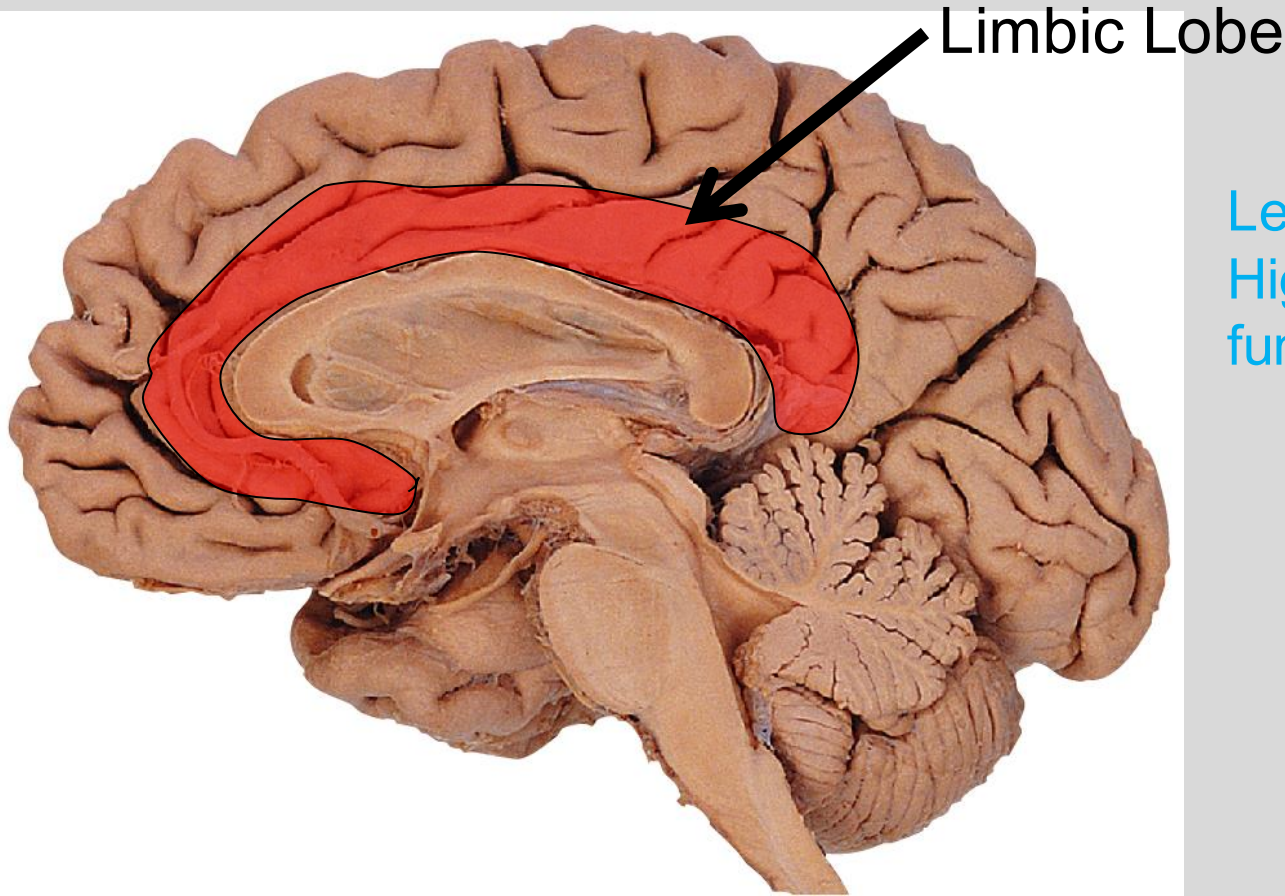
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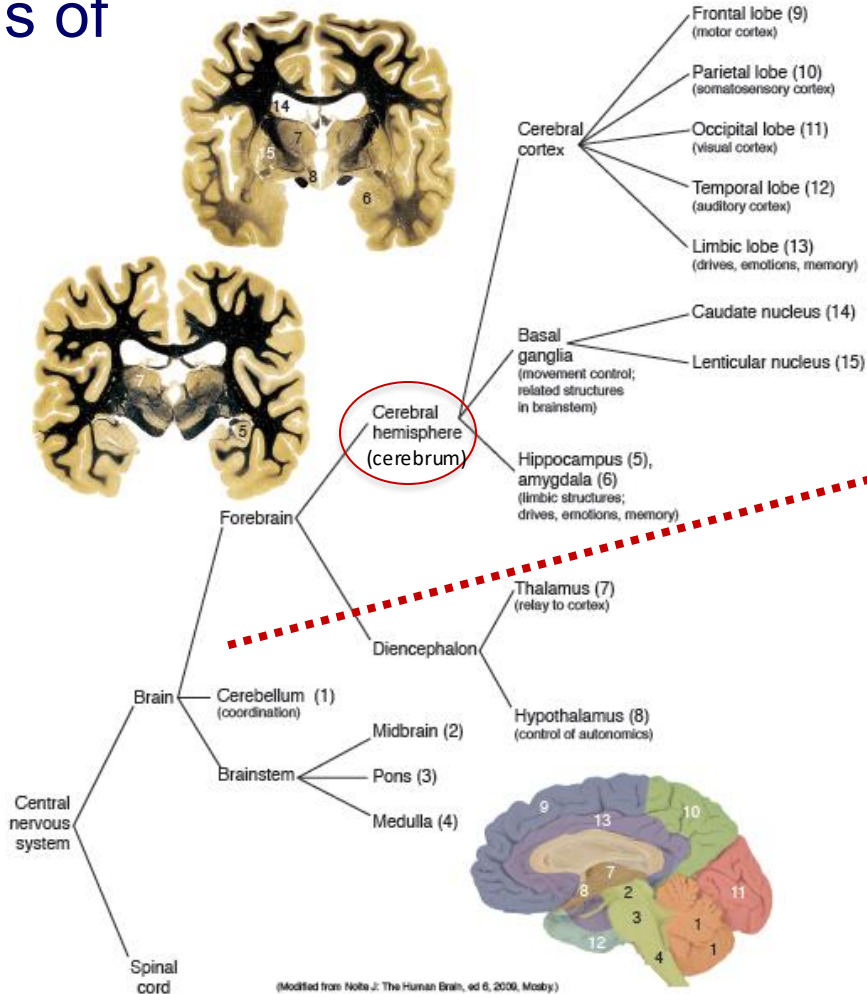
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Limbic Lobe

Learning,
Higher cognitive
function (emotions)

Gross Divisions of the CNS



(Modified from Nolte J: The Human Brain, ed 6, 2009, Mosby)

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Major Functions of the Diencephalon

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Thalamus

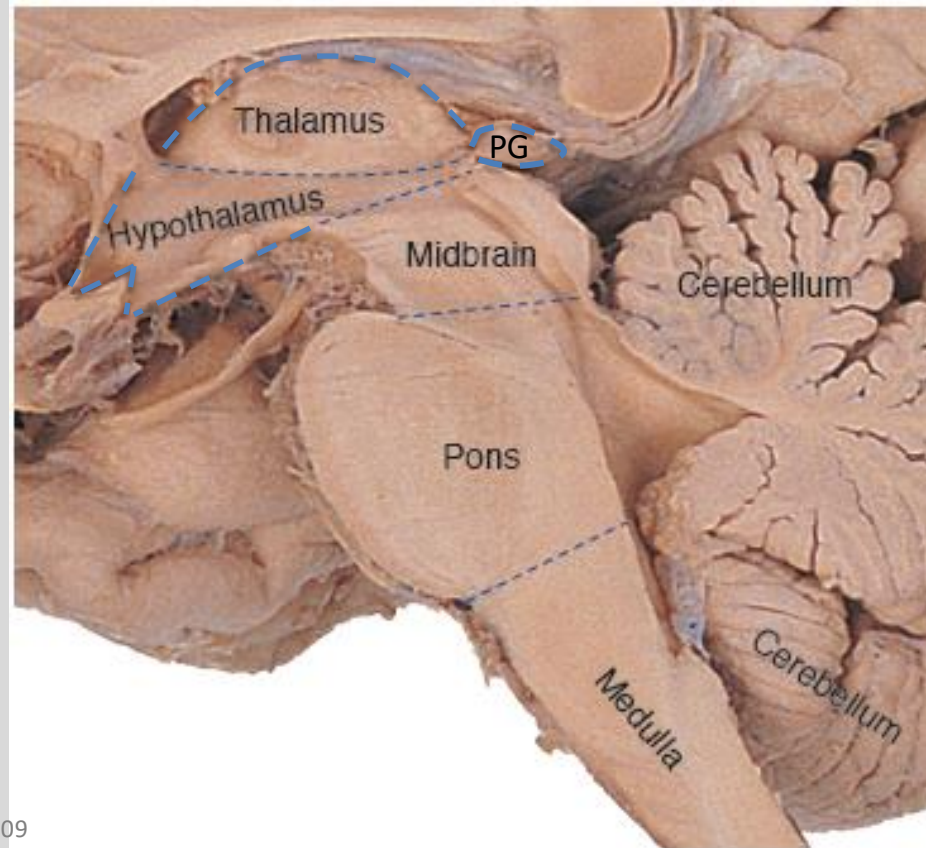
- “Relay Centers” to cortex for sensory and motor info

Hypothalamus

- maintain homeostasis
- autonomic control

Pineal Gland

- circadian rhythms



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Major Functions of the Brainstem

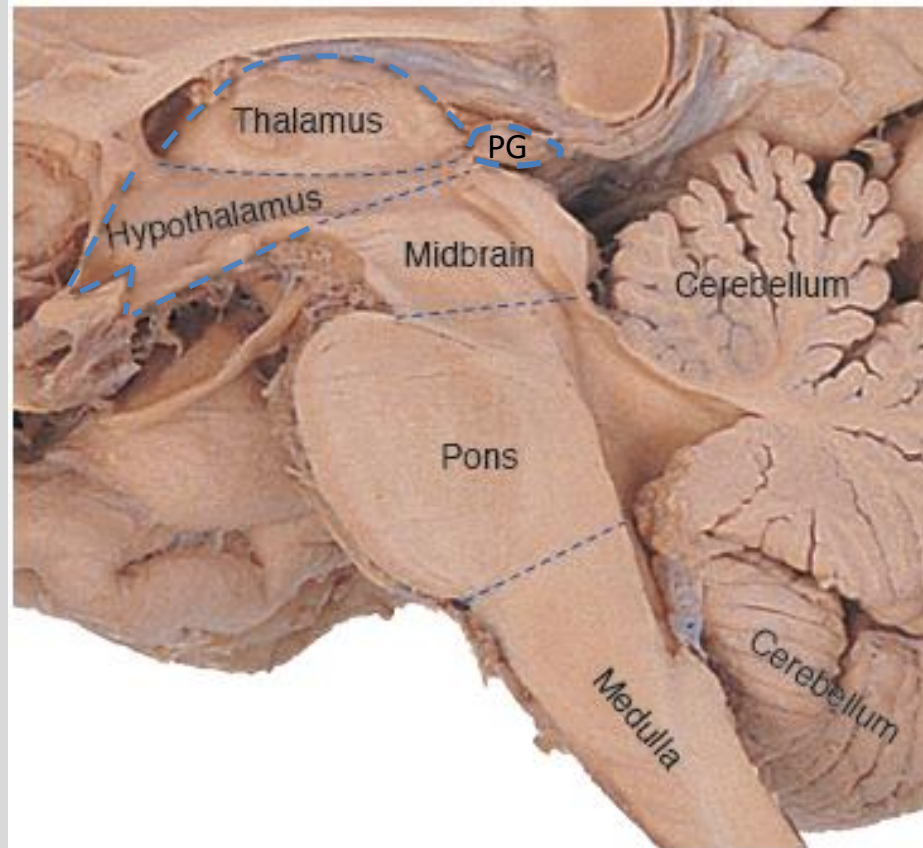
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Midbrain

Pons

Medulla

- Autonomic control
(breathing,
cardiovascular
function, etc.)
- VITAL TO LIFE



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Basal Ganglia

Cerebrum:

- caudate
- putamen
- globus pallidus
- nucleus accumbens

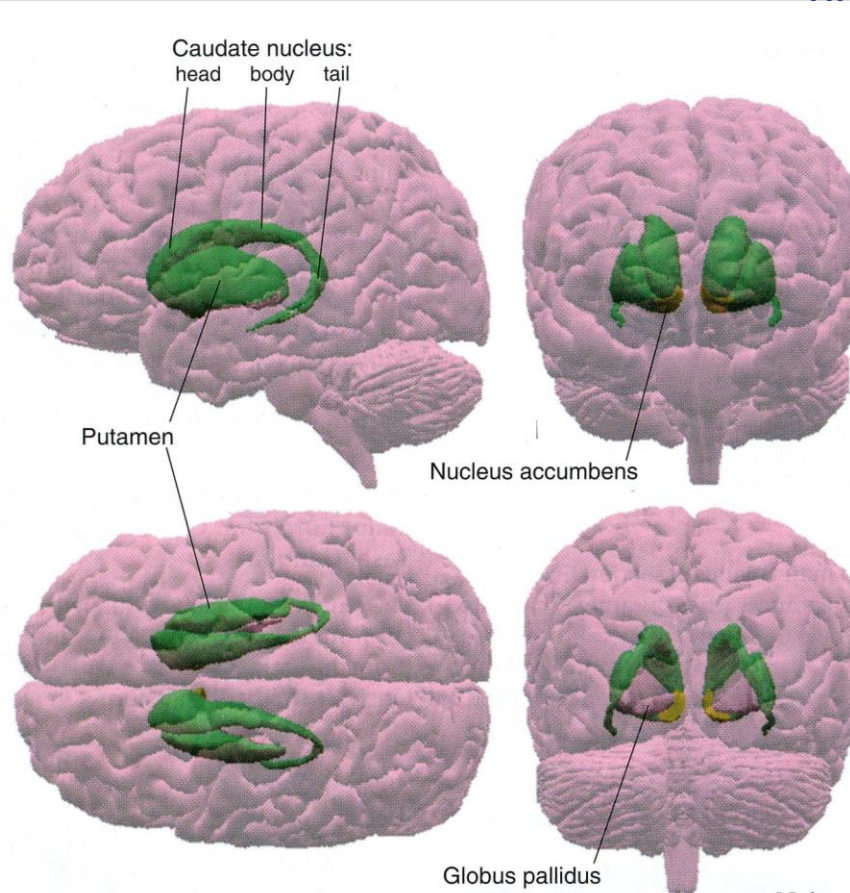
Midbrain:

- Substantia nigra

Diencephalon:

- Subthalamic nucleus

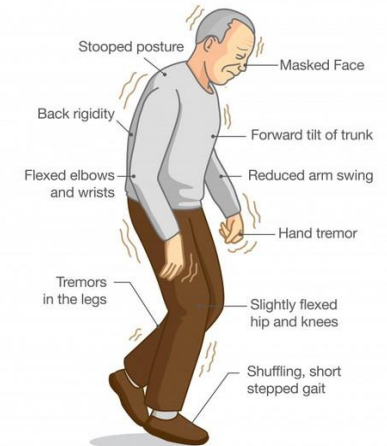
Initiation of **movement**,
thoughts, **reward** & more



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Parkinson's Disease Symptoms



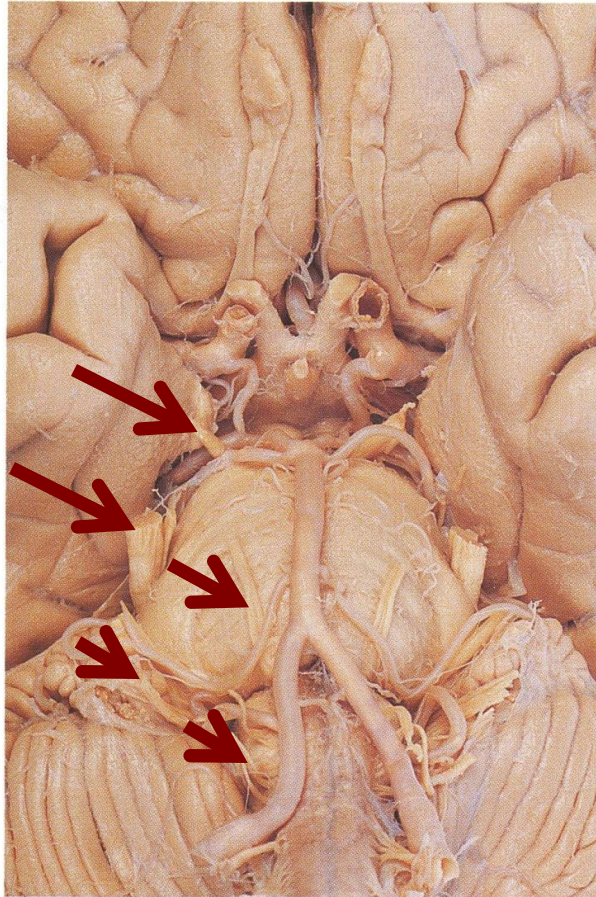
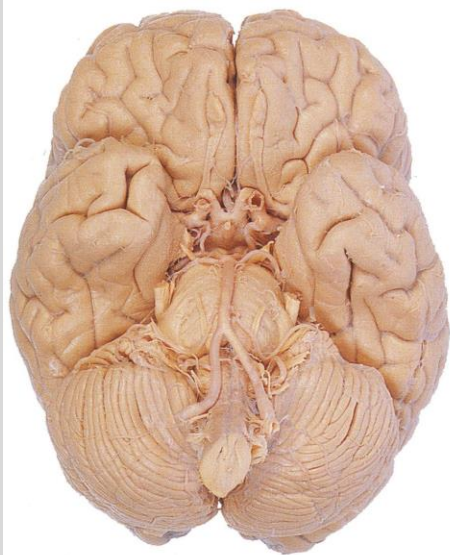
Major Functions of the Brainstem

Midbrain

Pons

Medulla

- Autonomic control
- Cranial nerves (reflexes)



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Major Functions of the Brainstem

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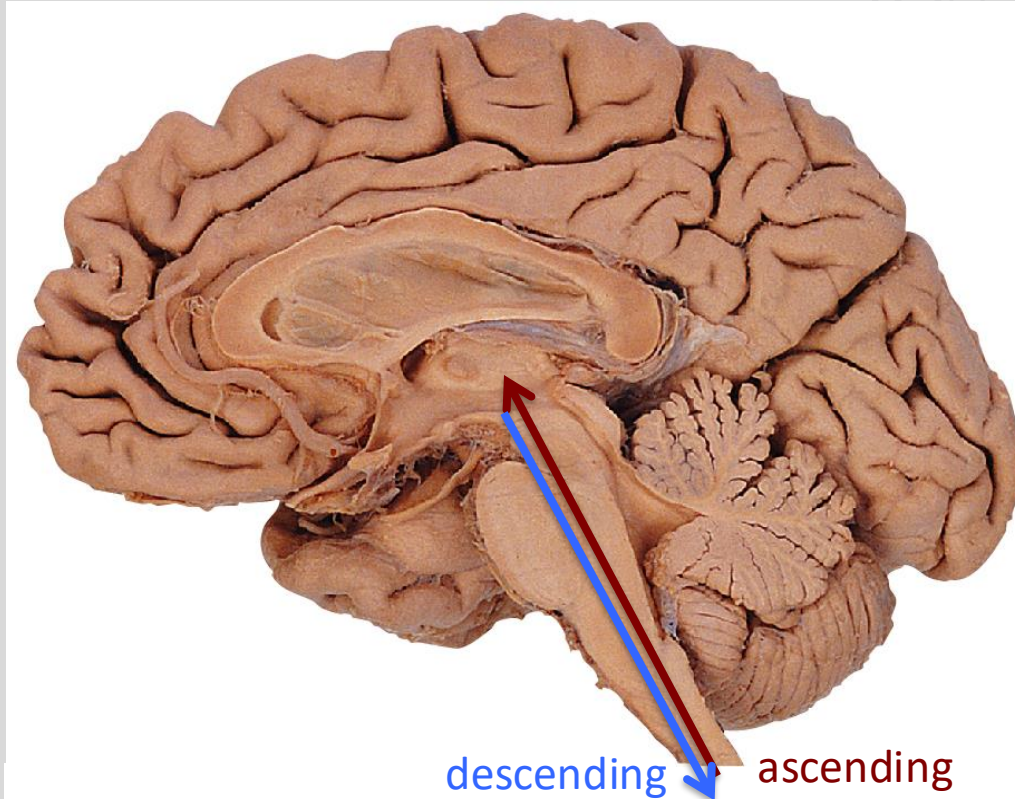
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Midbrain

Pons

Medulla

- Autonomic control
- Cranial nerves
- Long tracts



Major Functions of the Brainstem

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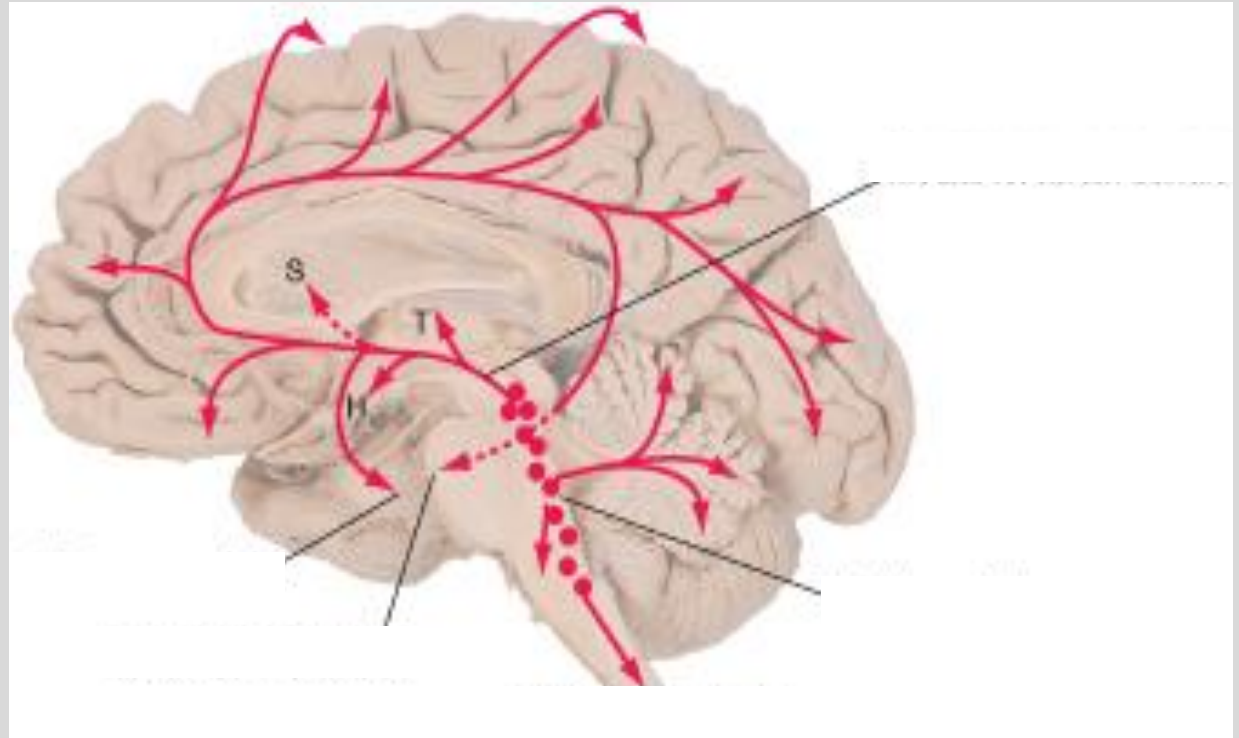
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Midbrain

Pons

Medulla

- Autonomic control
- Cranial nerves
- Long tracts
- Levels of consciousness
(modulatory pathways
& reticular activating
system)



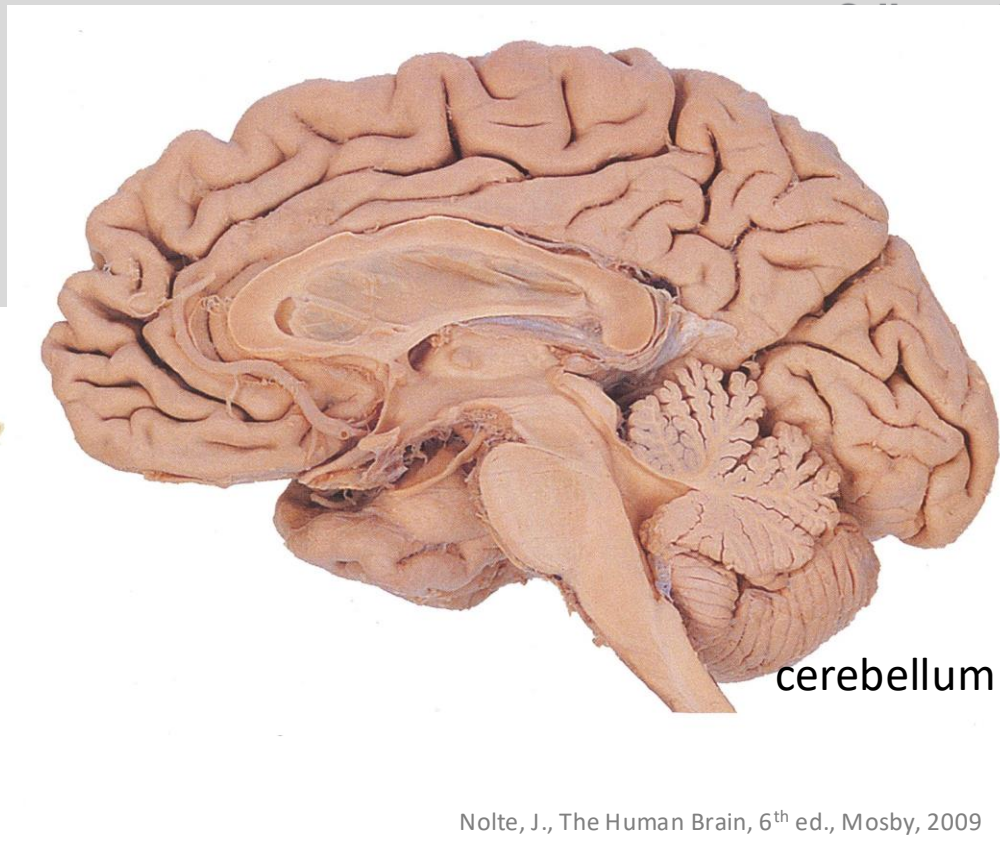
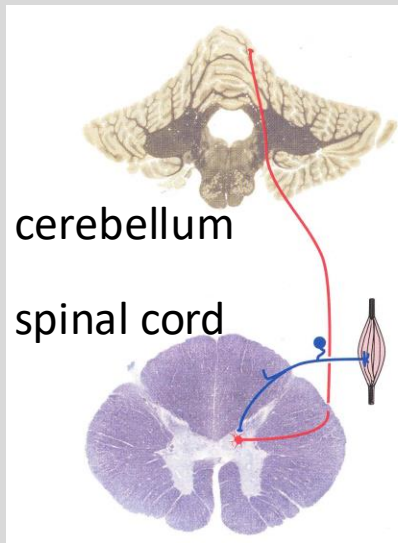
Major Functions of the Cerebellum

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Cerebellum

- Motor coordination
- Limited sensory function

Osteopathic



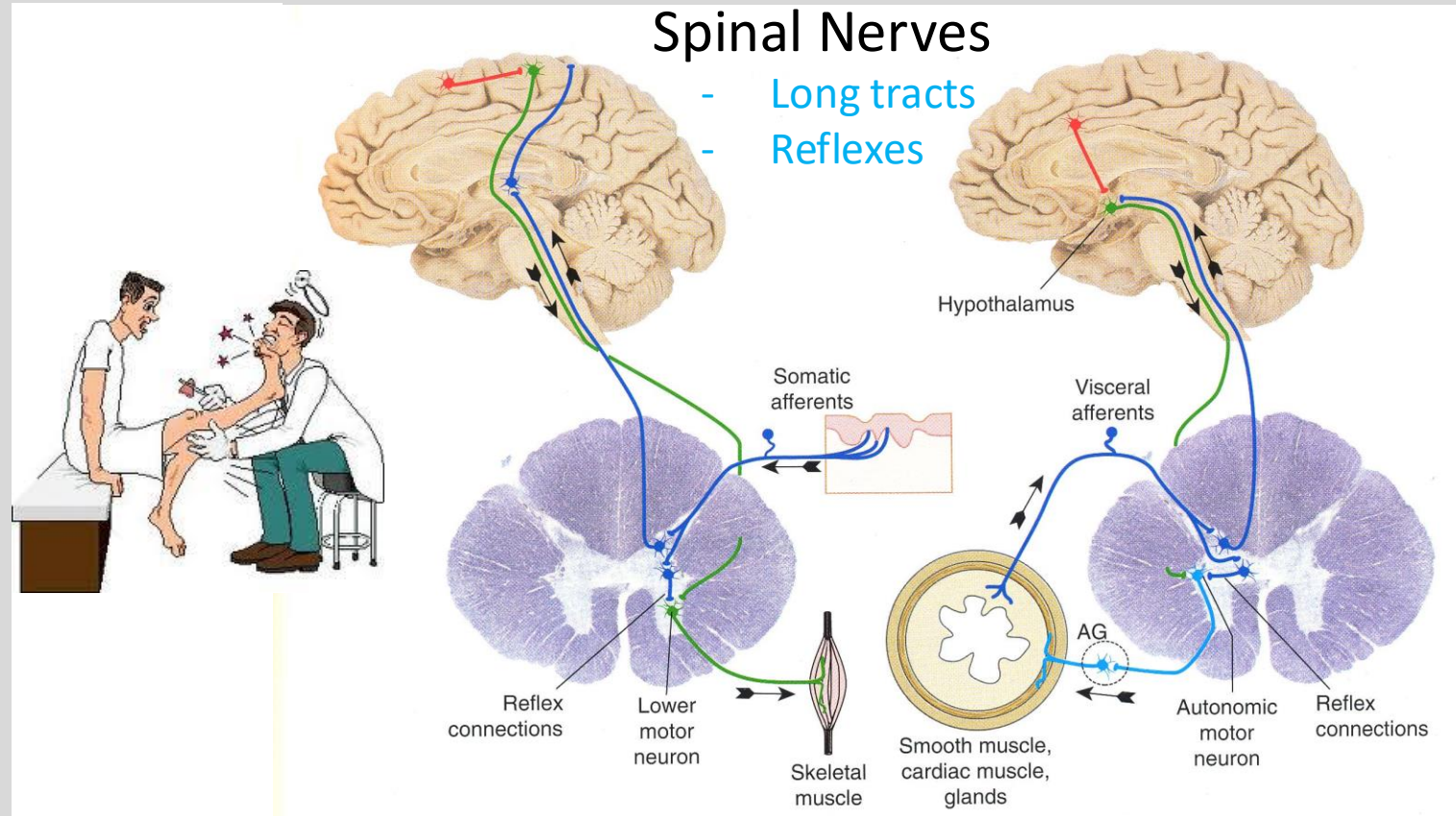
Major Functions of the Spinal Cord

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Osteopathic

Spinal Nerves

- Long tracts
- Reflexes



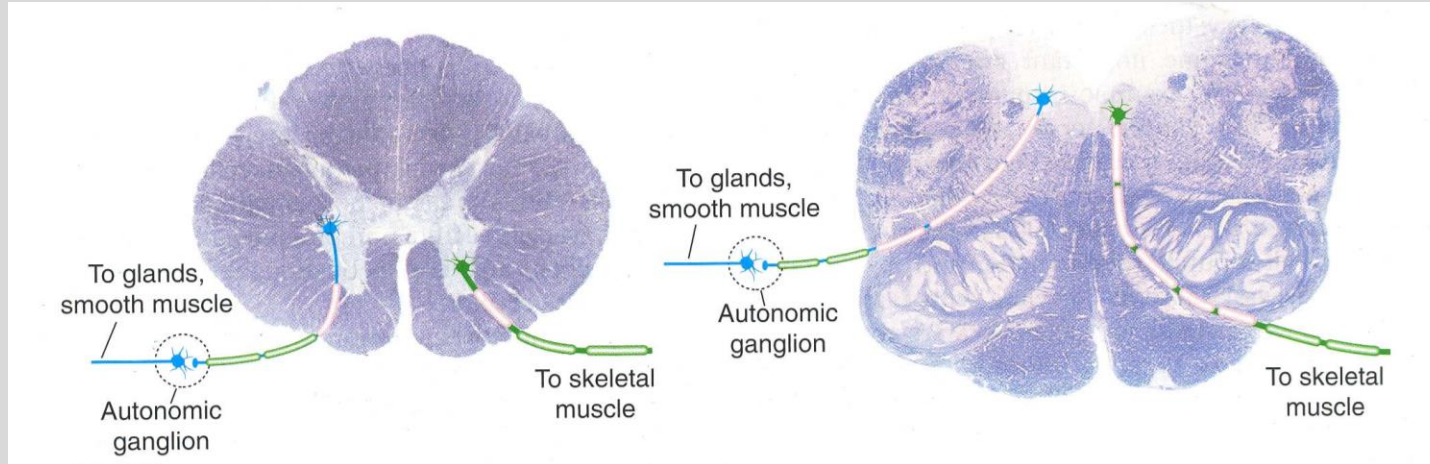
Major Functions of the Spinal Cord

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Spinal Nerves

- Reflexes
- Long tracts
- Relay station for the **autonomic** NS
(also found in brainstem)

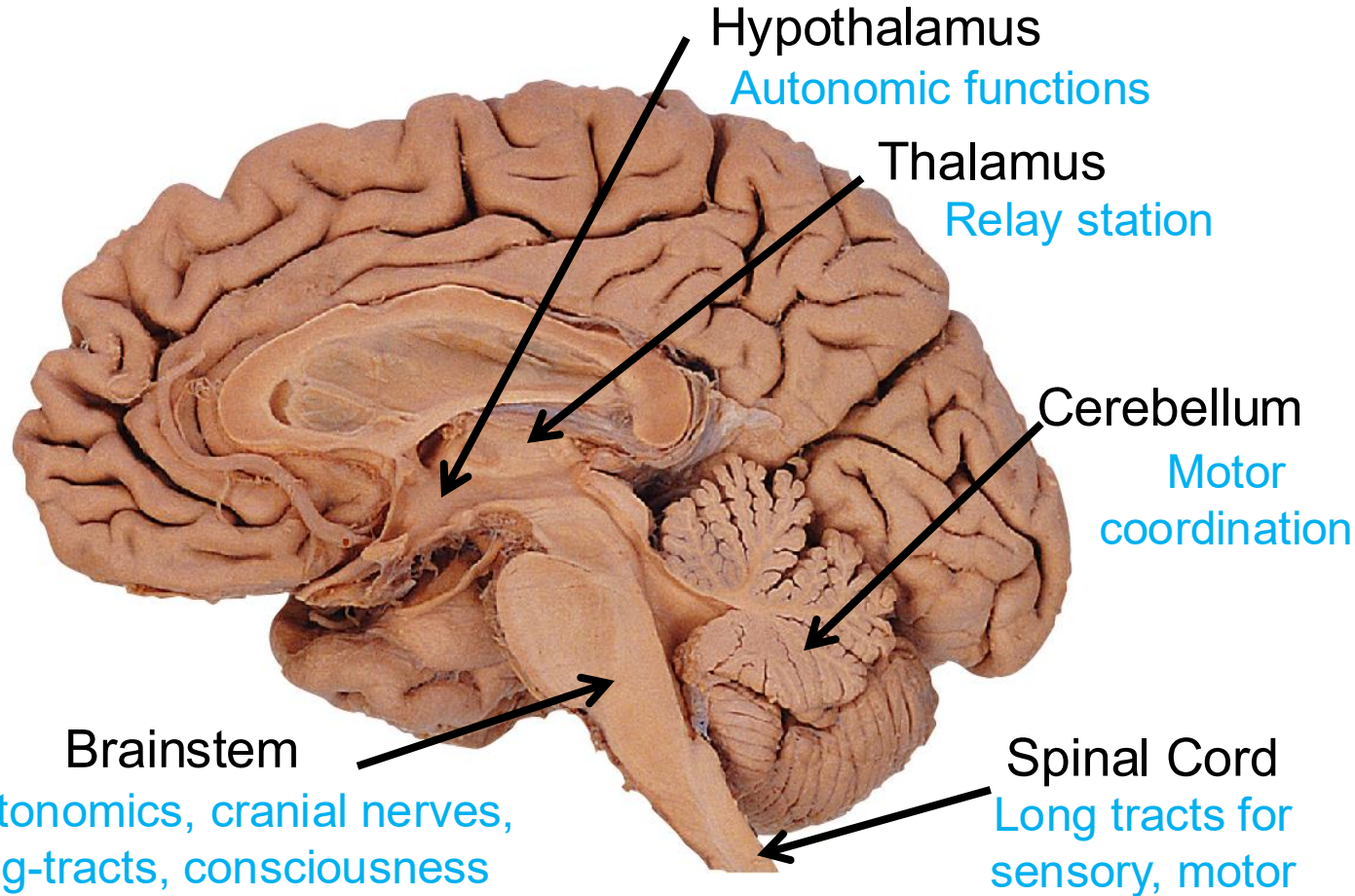


Neuroanatomy & Physiology (review)

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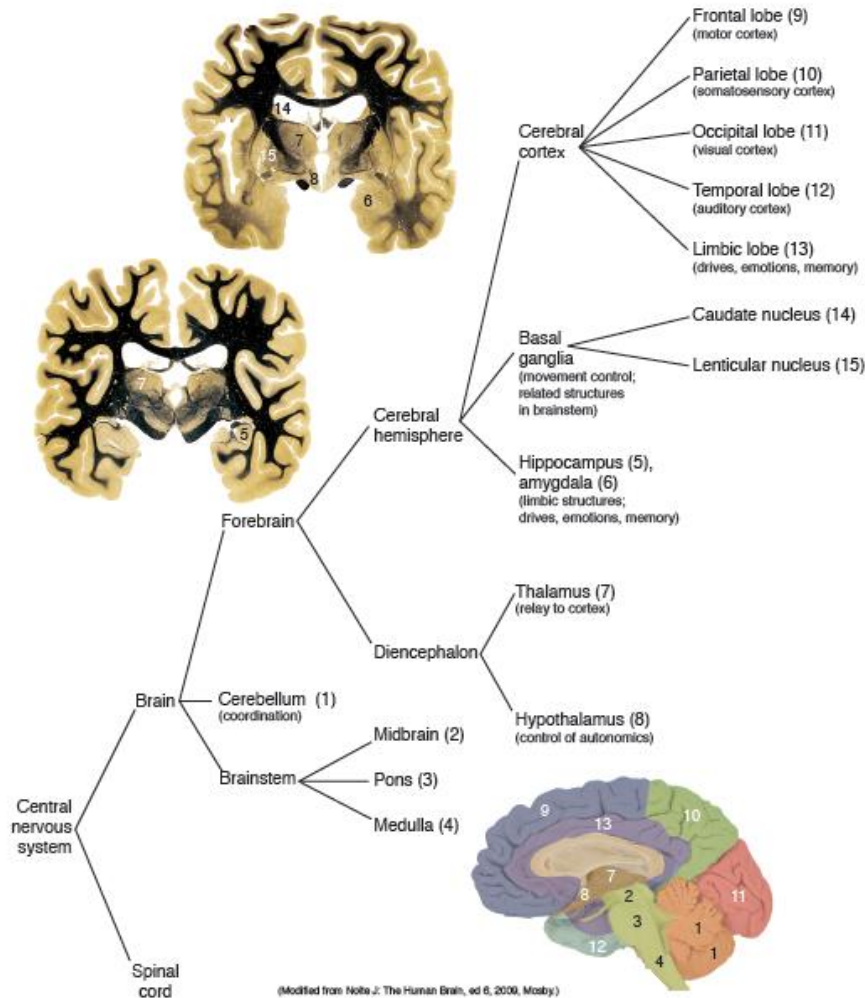


Gross Division of the CNS



Central
nervous
system

Anatomical outline of the CNS



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Lecture and Lab Feedback Form_

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<https://comresearchdata.nyit.edu/redcap/surveys/?s=HRCY448FWYXREL4R>

Nolte's Essentials of the Human Brain, 2nd edition

Chapter 3. "Gross Anatomy and General Organization of the Central Nervous System"

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<https://www-clinicalkey-com.arktos.nyit.edu#!/content/book/3-s2.0-B9780323529310000080>

Email: jennifer.xie@nyit.edu

