

Session Objectives

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

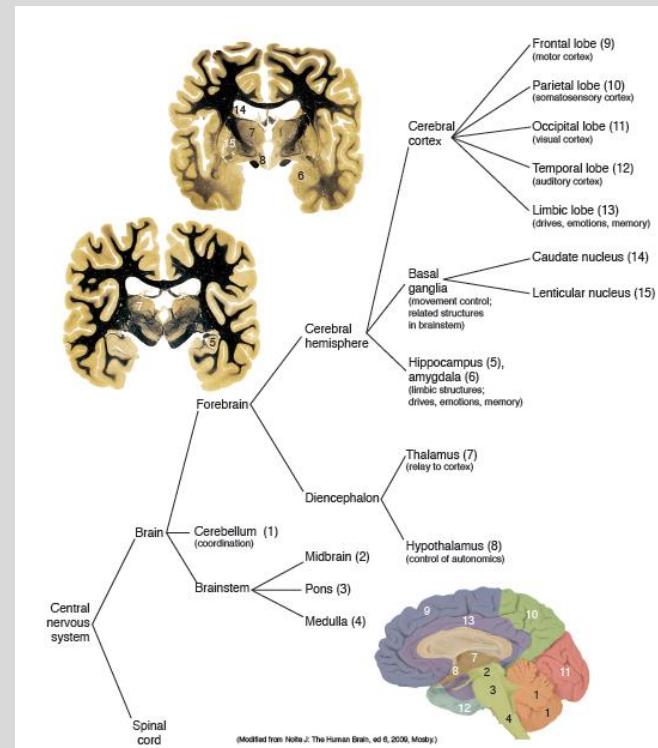
Nolte's Essentials of the Human Brain, 2nd edition

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>

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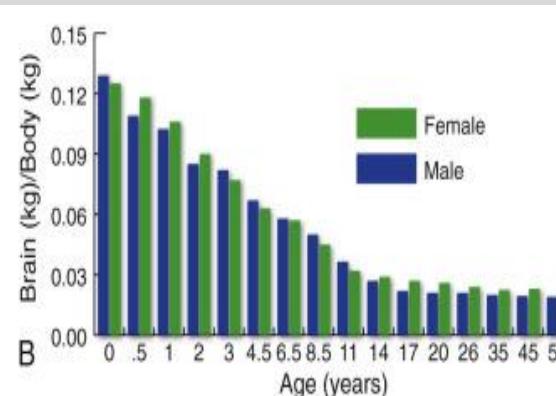
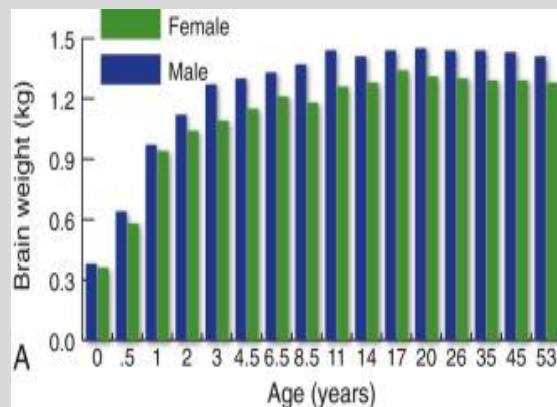
Please see the *detailed session objectives* in the CPG

Brain Fun Facts!

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

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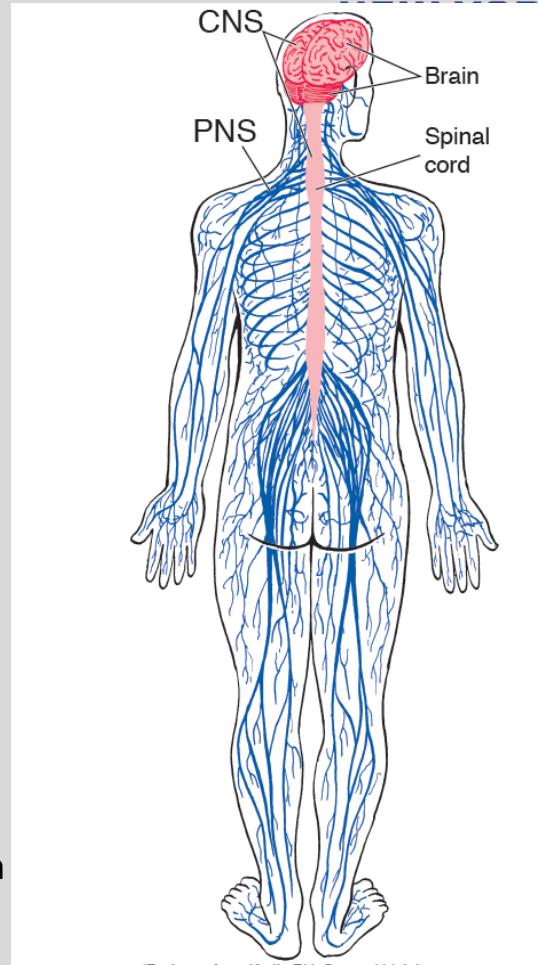
Anatomical Organization of the Nervous System

- 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

Gray Matter

- Cortex
- Nucleus
- Ganglion

White Matter

Basal Ganglia

Cortex

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Septal Nuclei

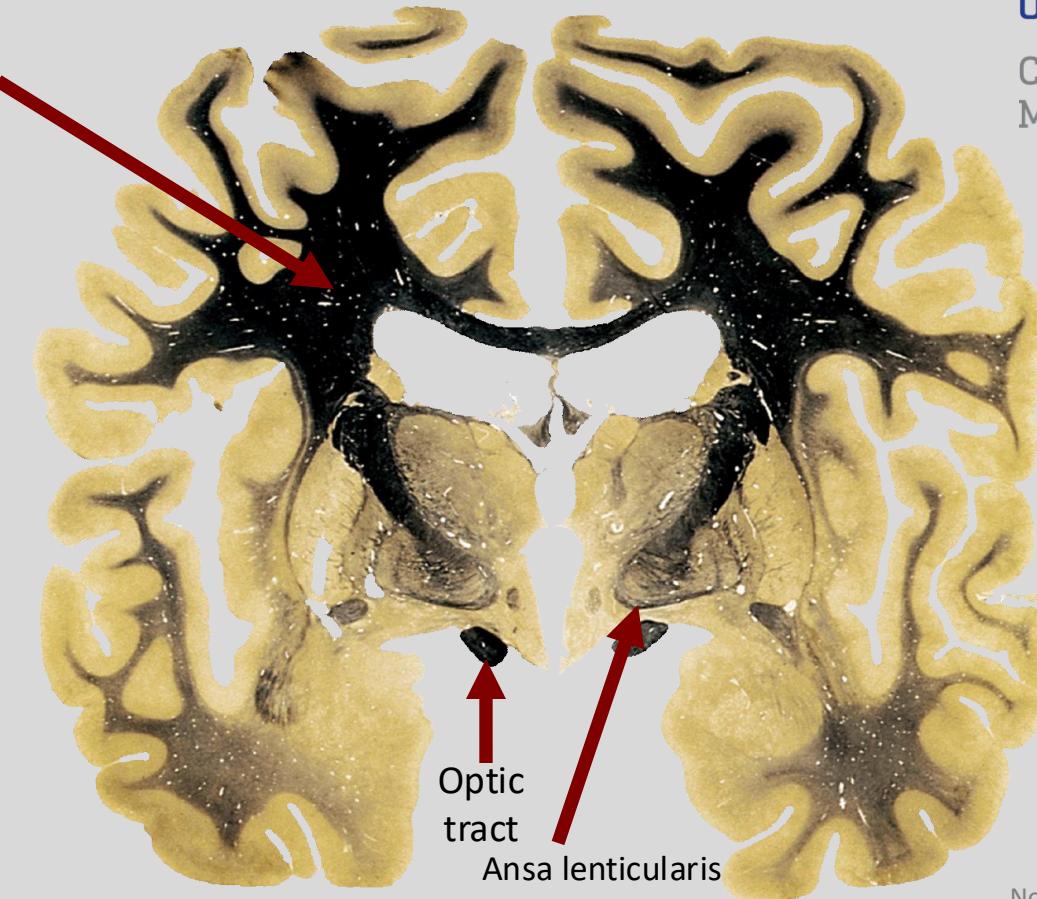
Anatomical Organization of the CNS

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White Matter

- Tract
- Lenticularis
- Fasciculus
- Lemniscus
- Peduncle

All means
“small bundle”



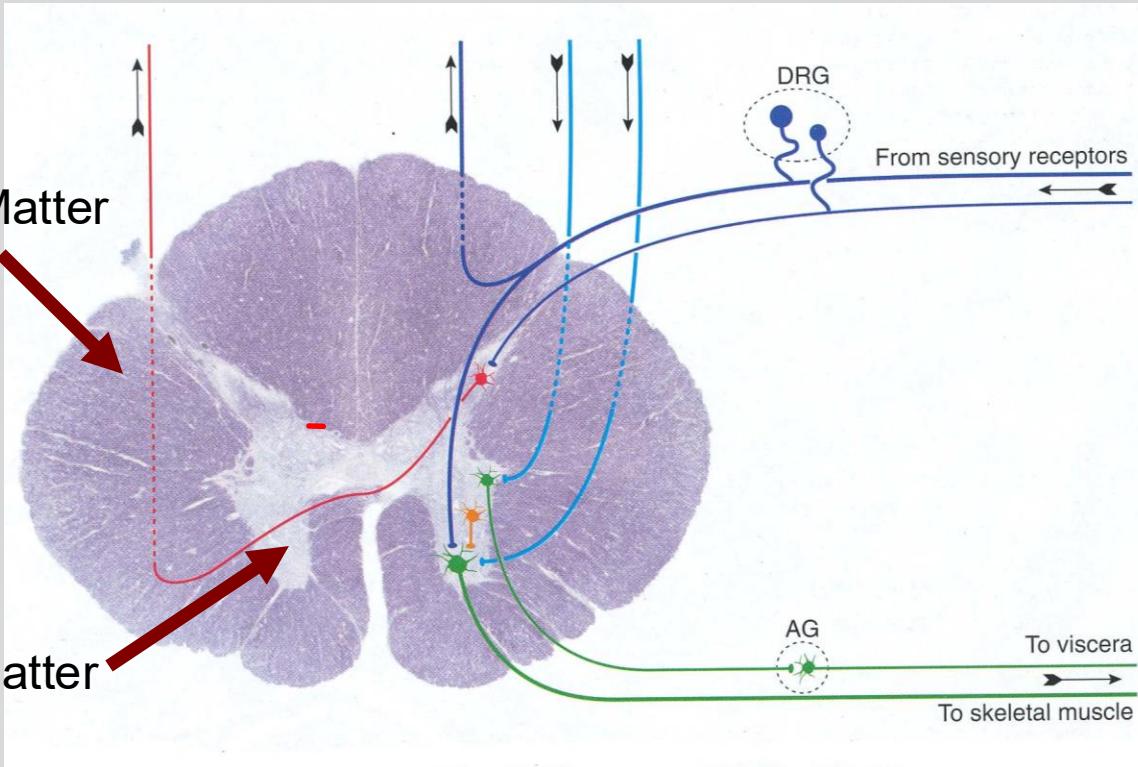
Anatomical Organization of the CNS

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White Matter

Gray Matter

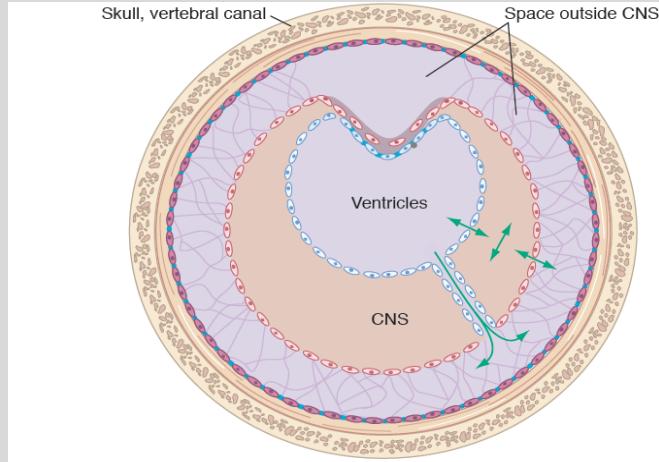


Anatomical Organization of the CNS

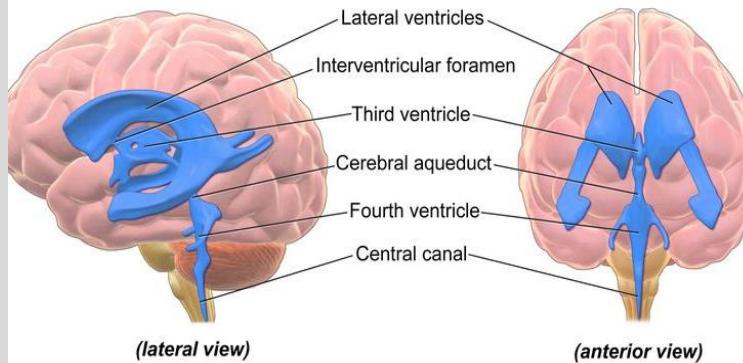
Spaces

- 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

Spaces

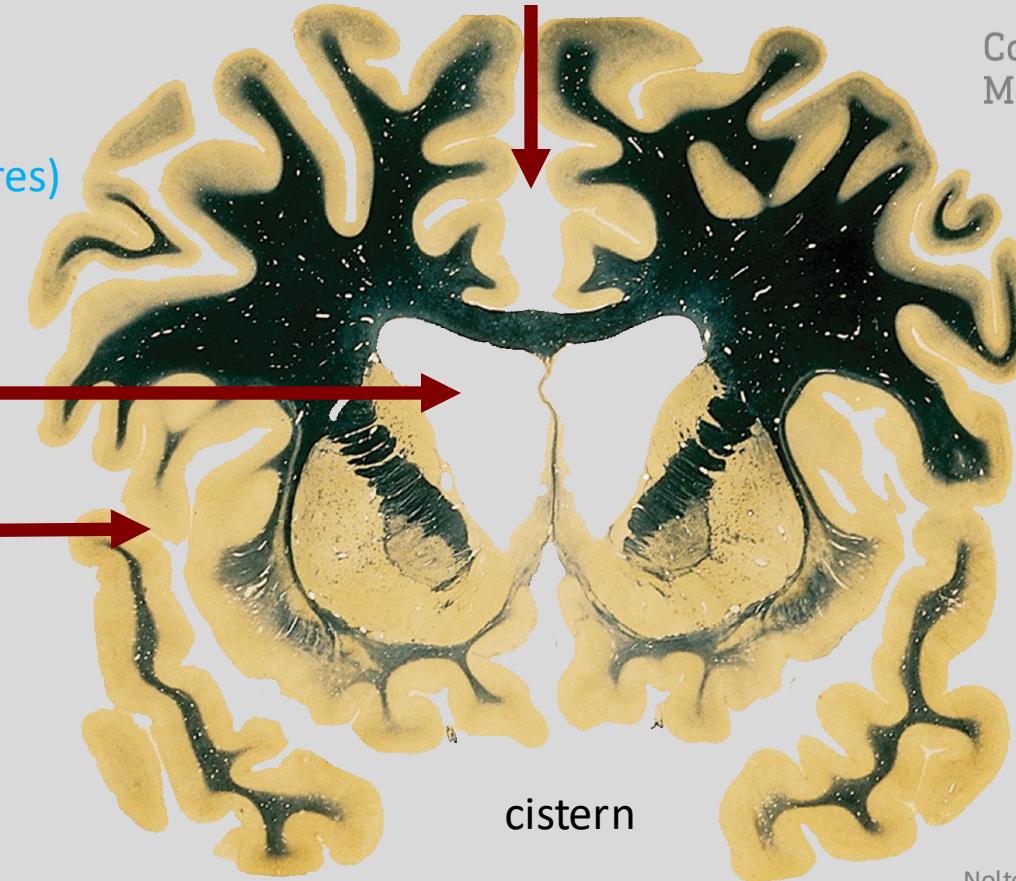
- ventricles
- aqueduct
- sulcus (fissures)
- cisterns

Longitudinal Fissure

Lateral Ventricle

Lateral Sulcus

cistern



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Anatomical Organization of the CNS

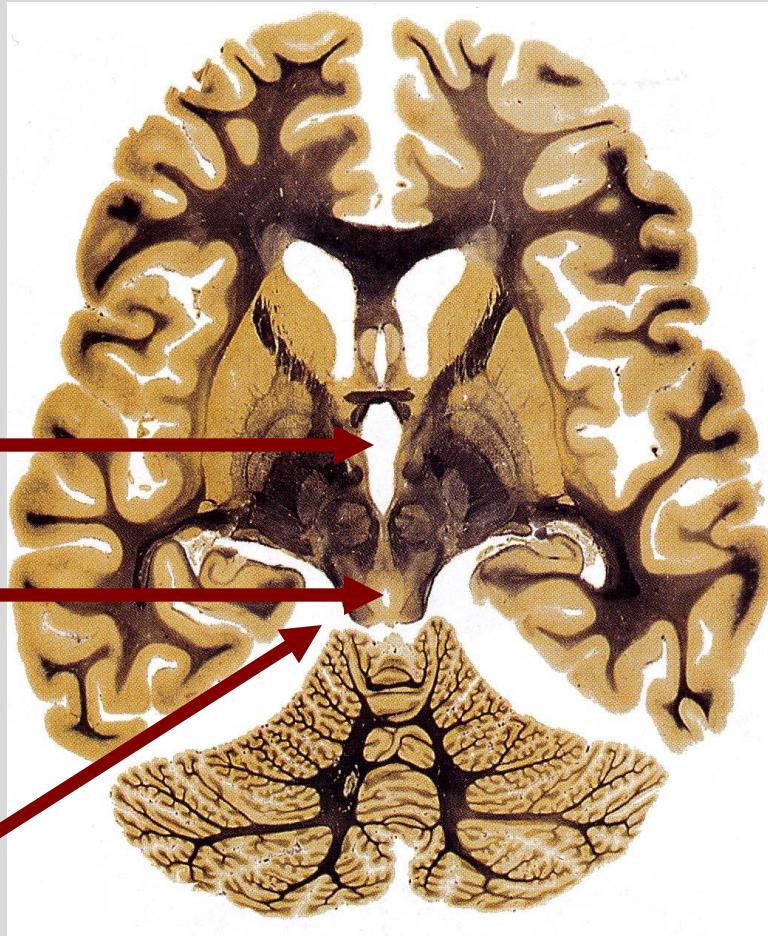
Spaces

- ventricles
- aqueduct
- sulcus (fissures)
- cisterns

Third
Ventricle

Aqueduct

Cistern



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Directions in the CNS

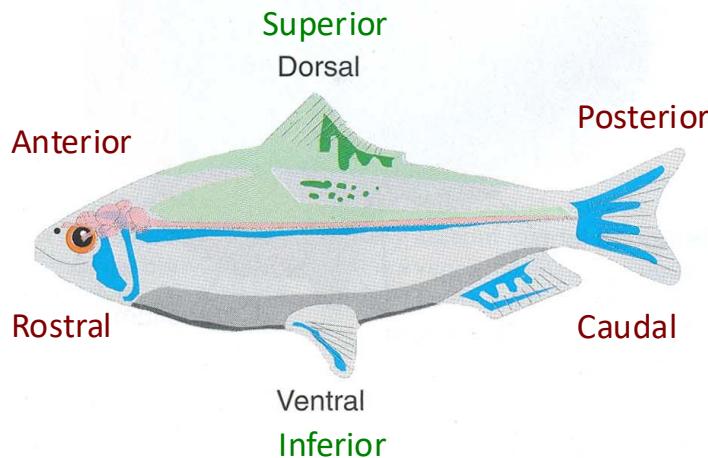
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Brain:

Dorsal = Superior

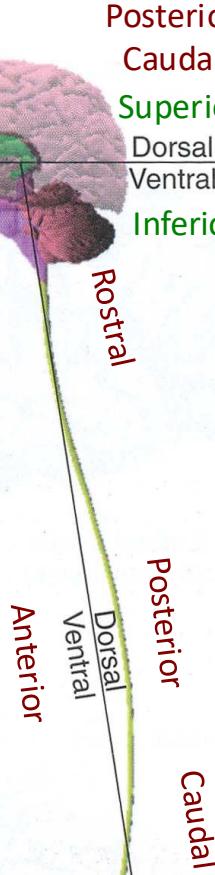
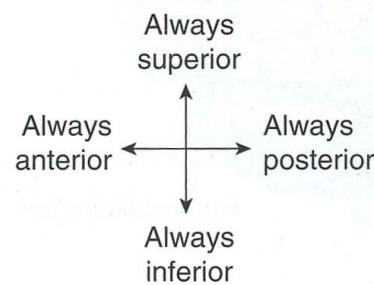
Brainstem and Spinal Cord:

Dorsal = Posterior



Anterior
Rostral

Posterior
Caudal
Superior
Dorsal
Ventral
Inferior

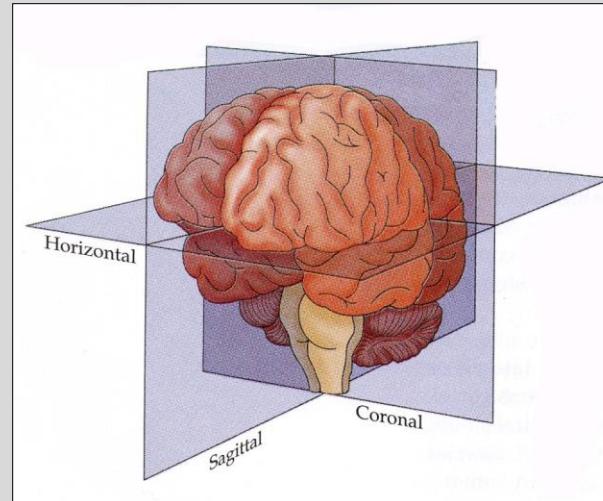


Orientation: Planes of Section

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- **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

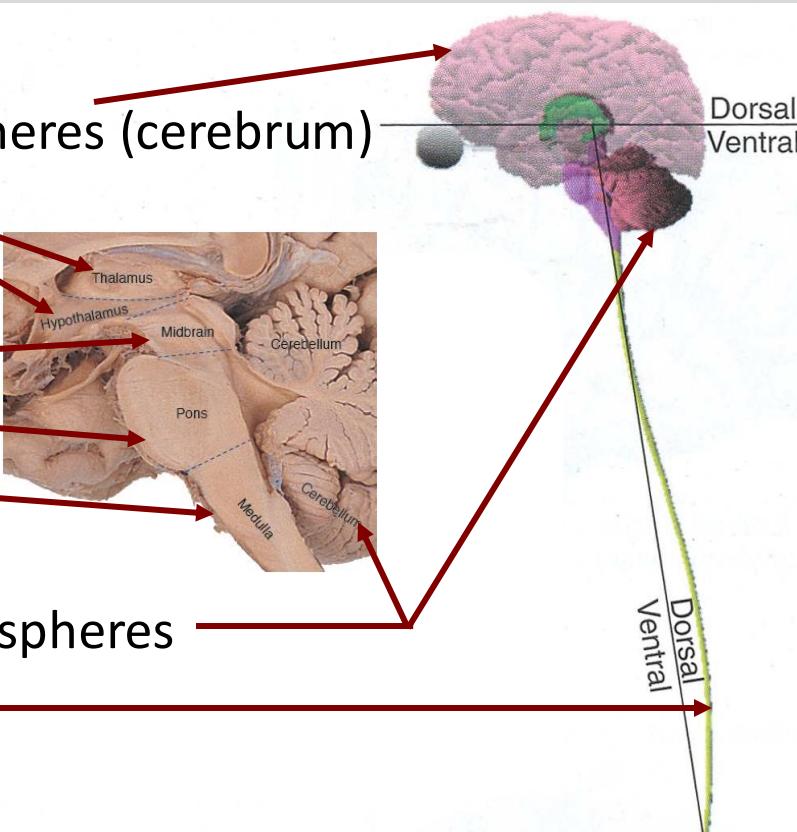
Brainstem

- midbrain
- pons
- medulla

Cerebellum

- 2 cerebellar hemispheres

Spinal Cord



Major Structures of the CNS using Imaging

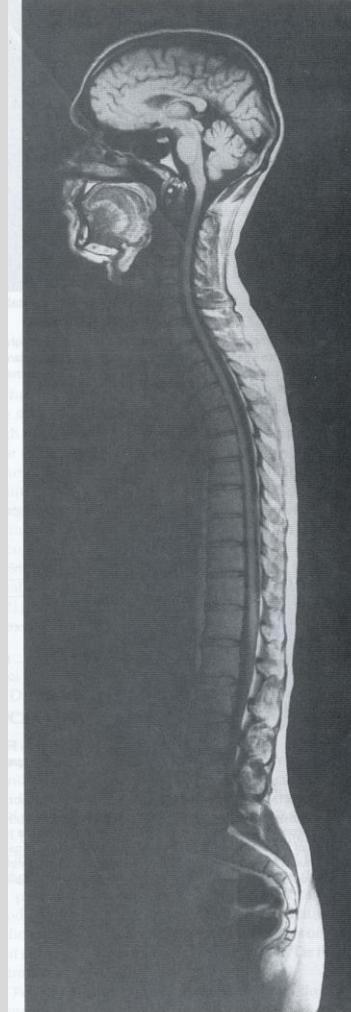


Forebrain

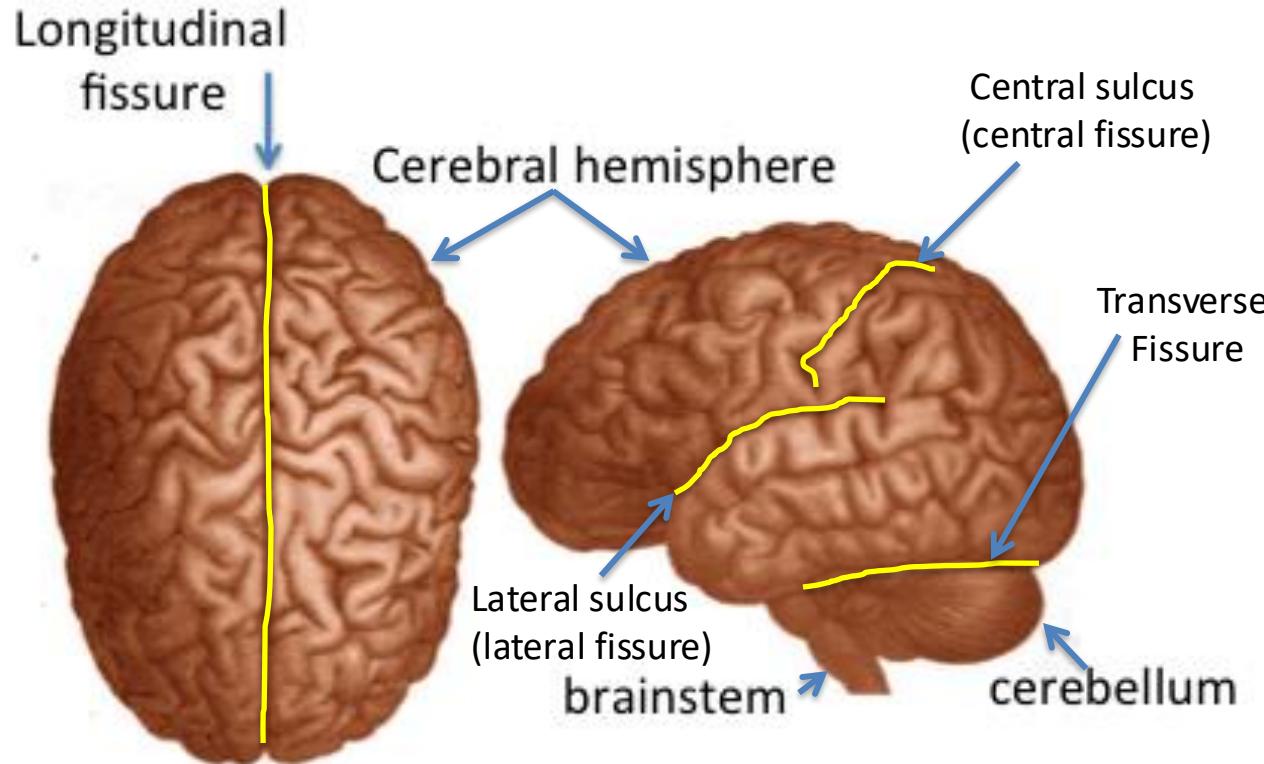
Brainstem

Cerebellum

Spinal Cord



Major Structures of the CNS



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

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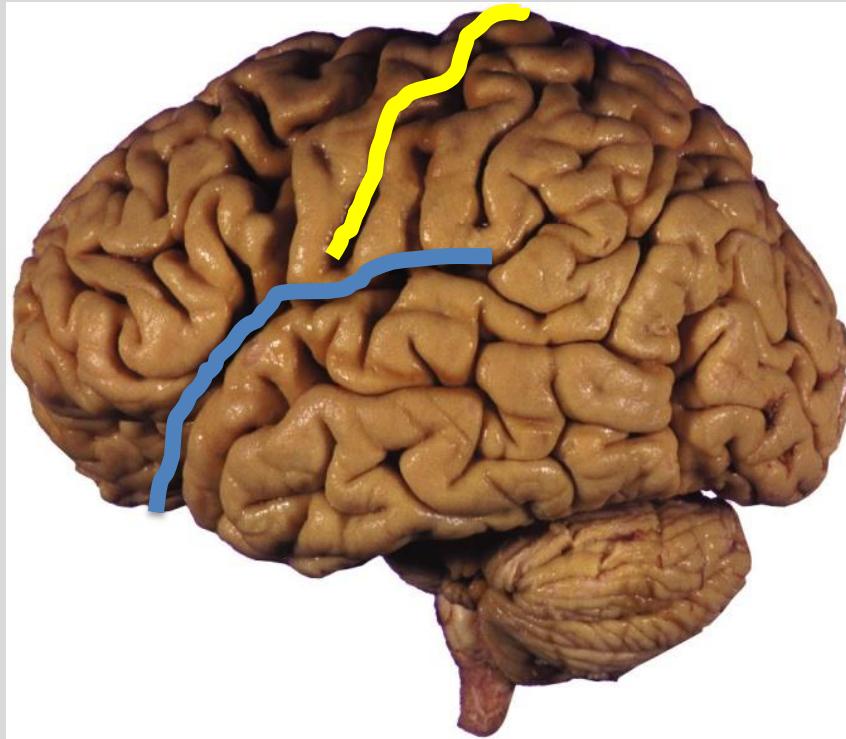
What's Where in the Cerebral Hemispheres

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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

Lobes:

Frontal Lobe

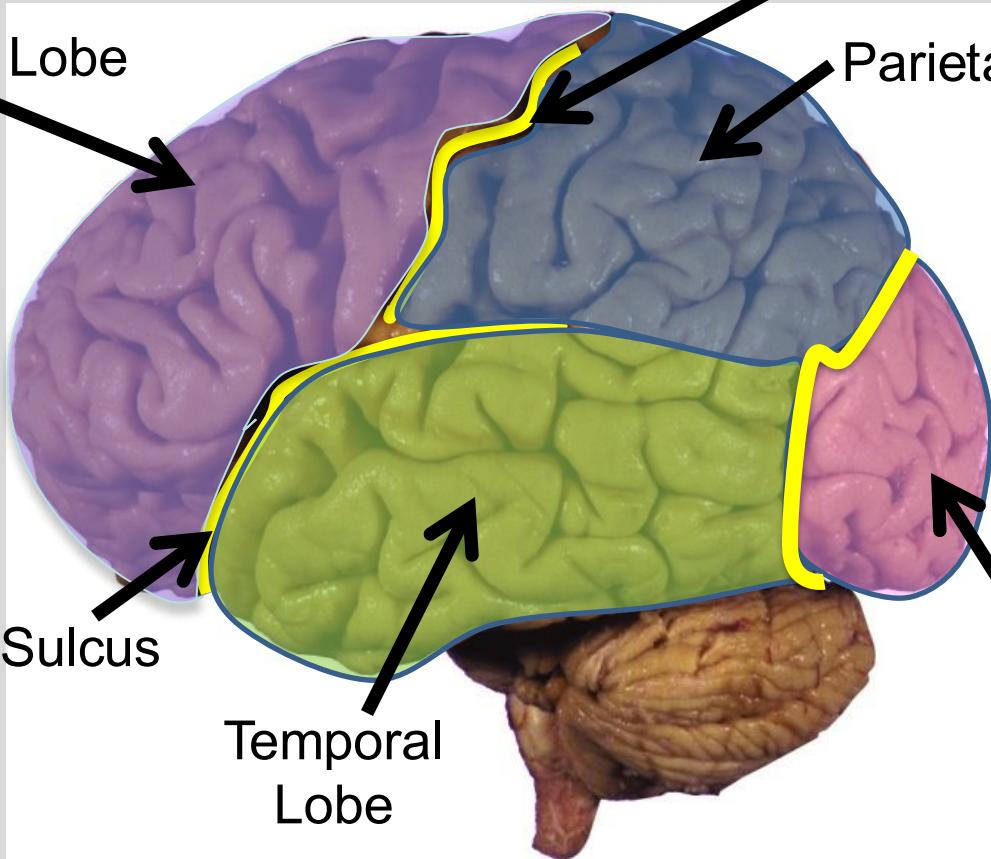
Central Sulcus

Parietal Lobe

Lateral Sulcus

Temporal Lobe

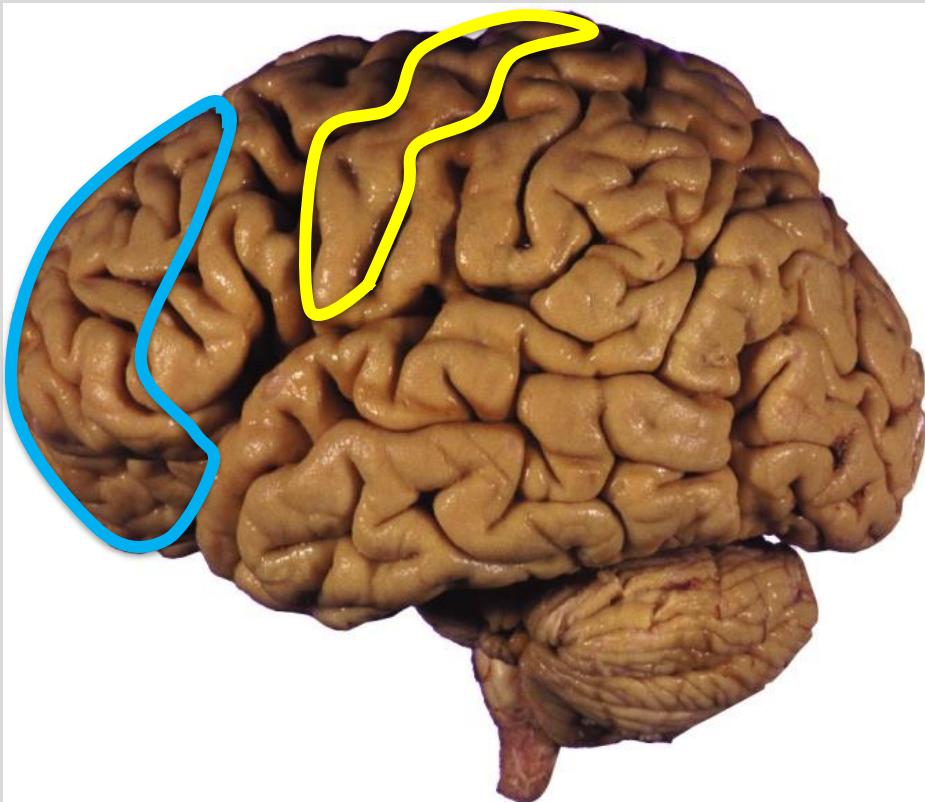
Occipital Lobe



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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



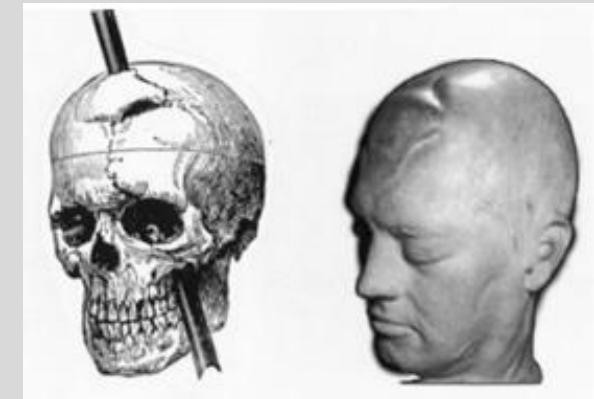
Harvard's Countway Library of Medicine

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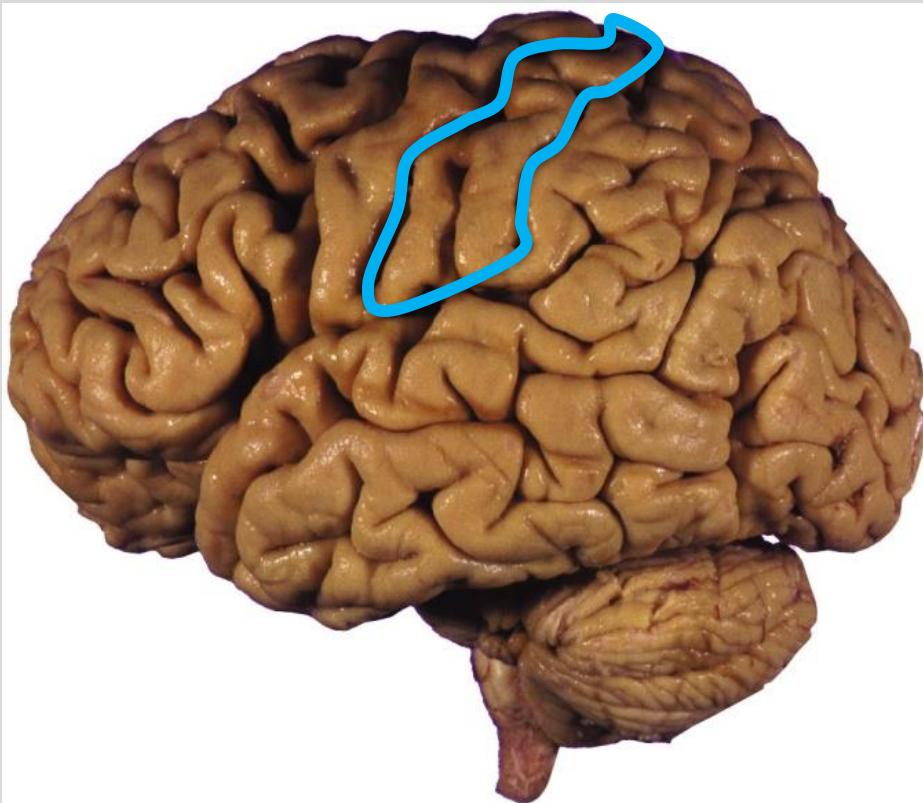
Frontal Lobe

- Personality
- (Mr. Phineas Gage)



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

Major Functions of the Cerebral Hemispheres



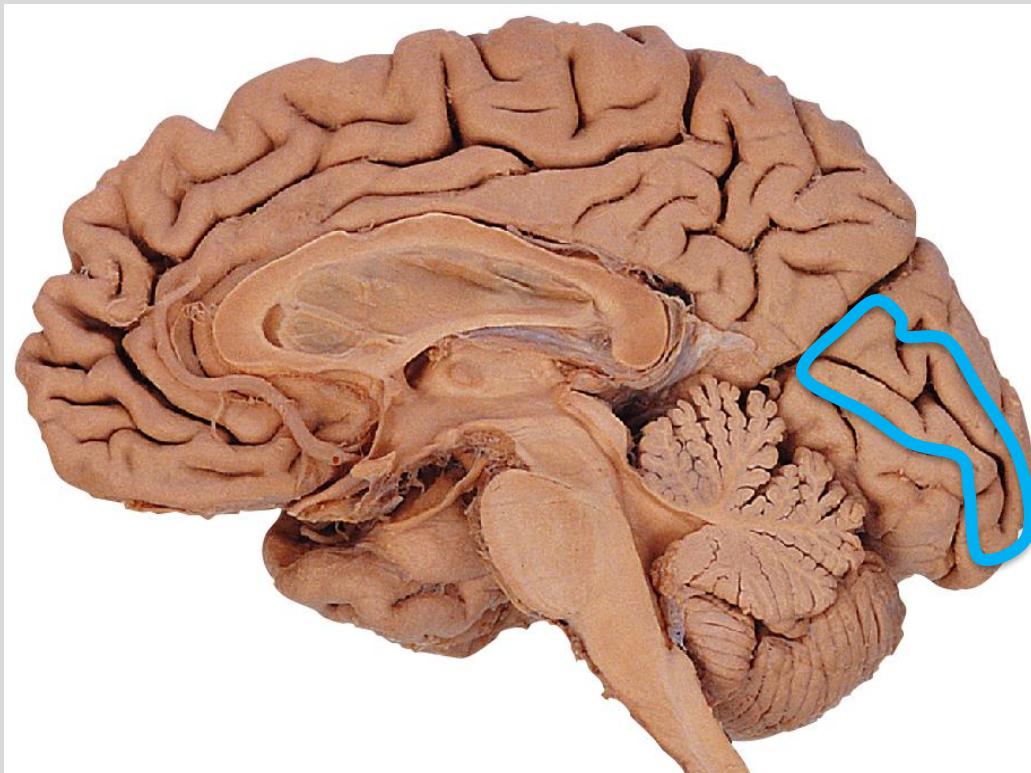
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Parietal Lobe

- Primary somatosensory cortex: postcentral gyrus
- Spatial awareness

Major Functions of the Cerebral Hemispheres



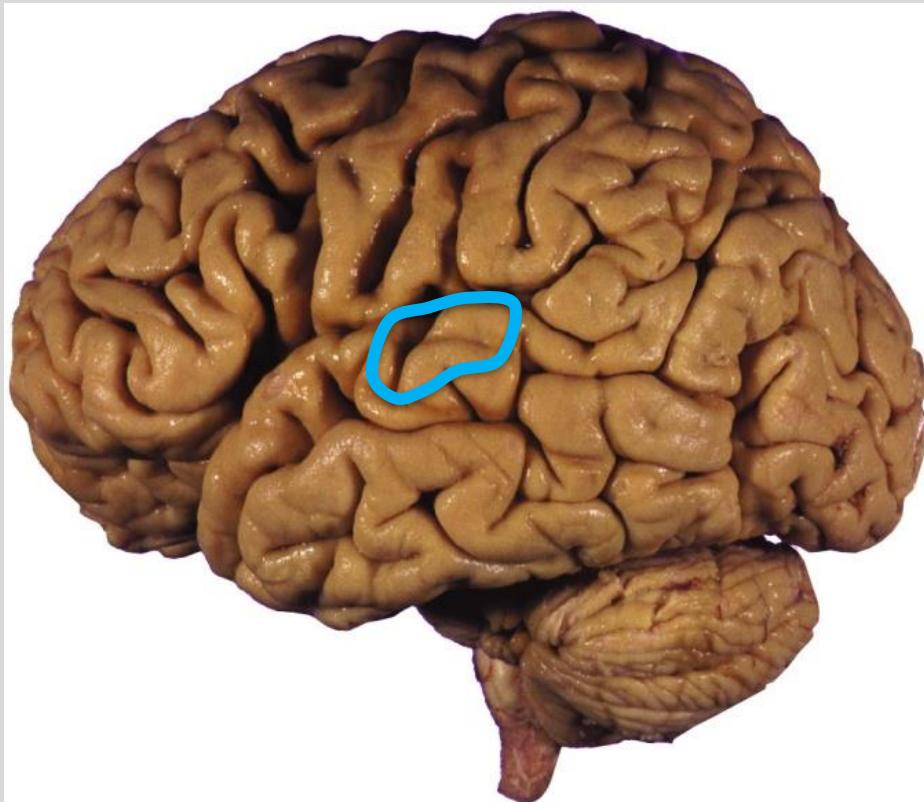
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Occipital Lobe

- Primary visual cortex

Major Functions of the Cerebral Hemispheres



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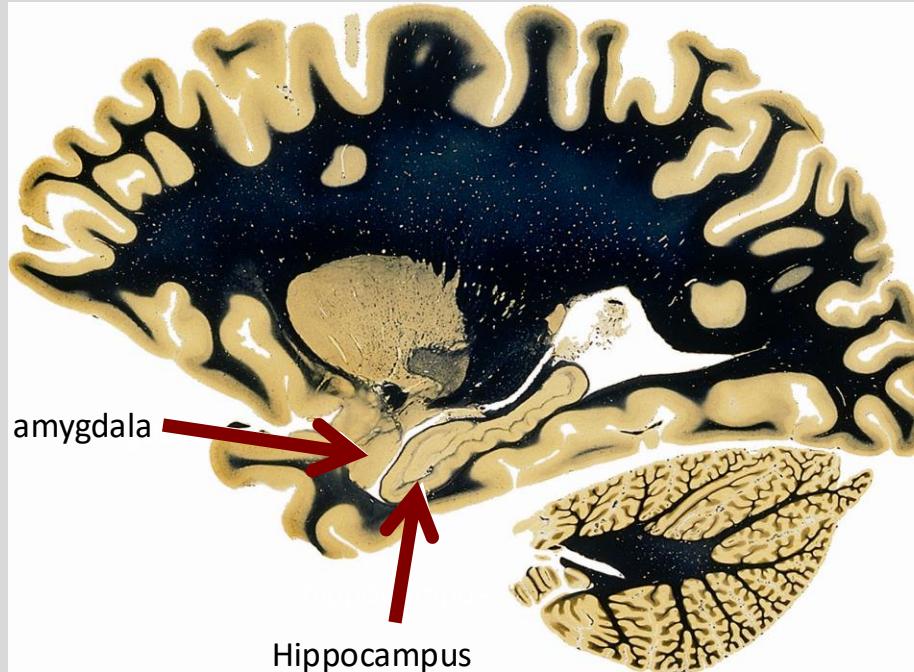
Temporal Lobe

- Primary auditory cortex

Major Functions of the Cerebral Hemispheres

Temporal Lobe

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



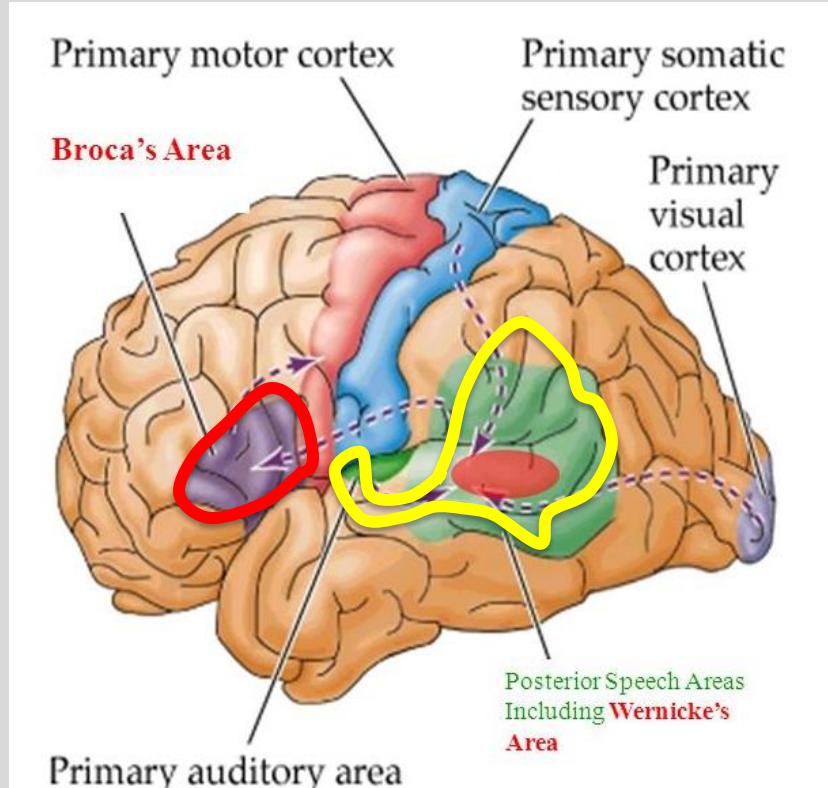
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Major Functions of the Cerebral Hemispheres

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Language areas

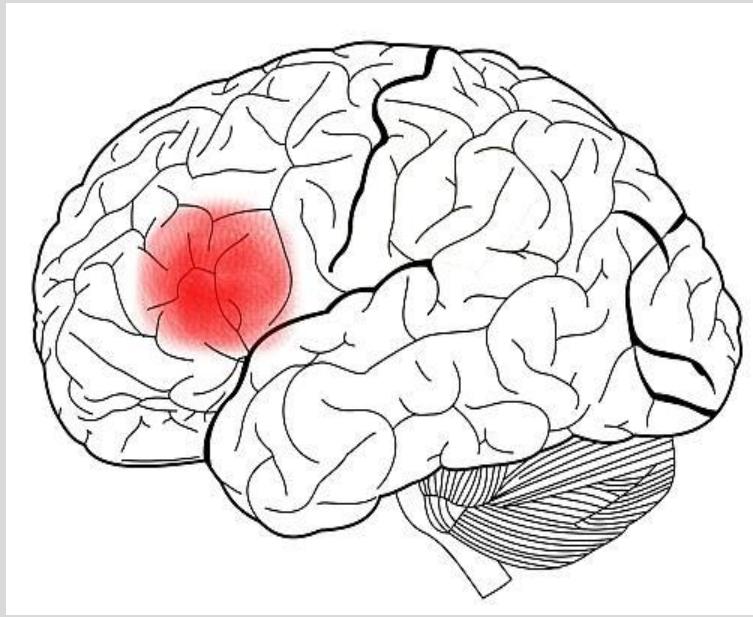
- bordering **lateral sulcus**
 - **Broca's area**
 - **Wernicke's area**

Clinical Correlation: Broca's Aphasia

- 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”

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

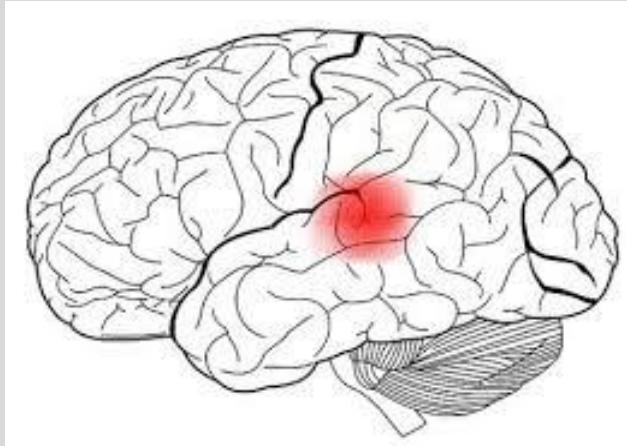
<https://www.lifepersona.com/broca-s-area-functions-anatomy-and-diseases>

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



Wernicke's Aphasia



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

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

What's Where in the Cerebral Hemispheres

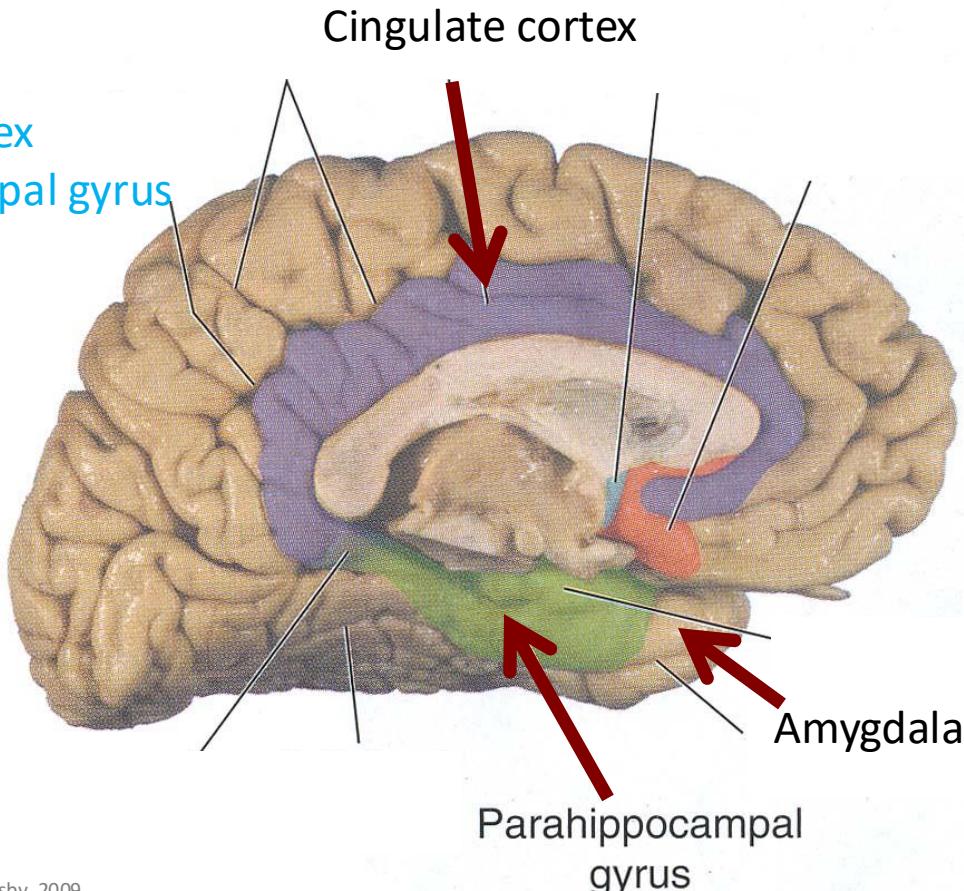
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Limbic Lobe

- Cingulate cortex
- Parahippocampal gyrus
- Amygdala

- Five F's:

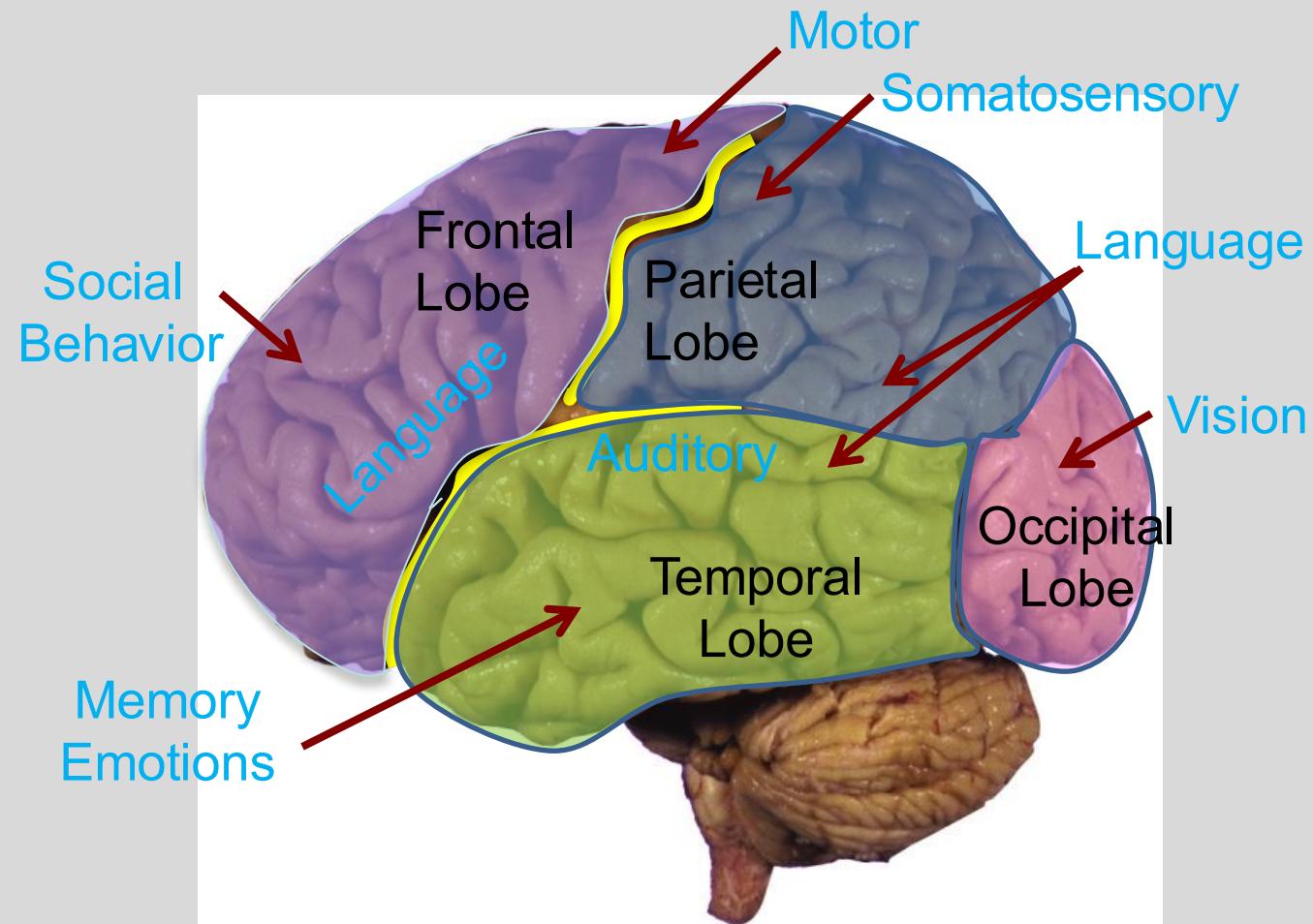
- Feeling
- Feeding
- Fleeing
- Fighting
- "Sex"



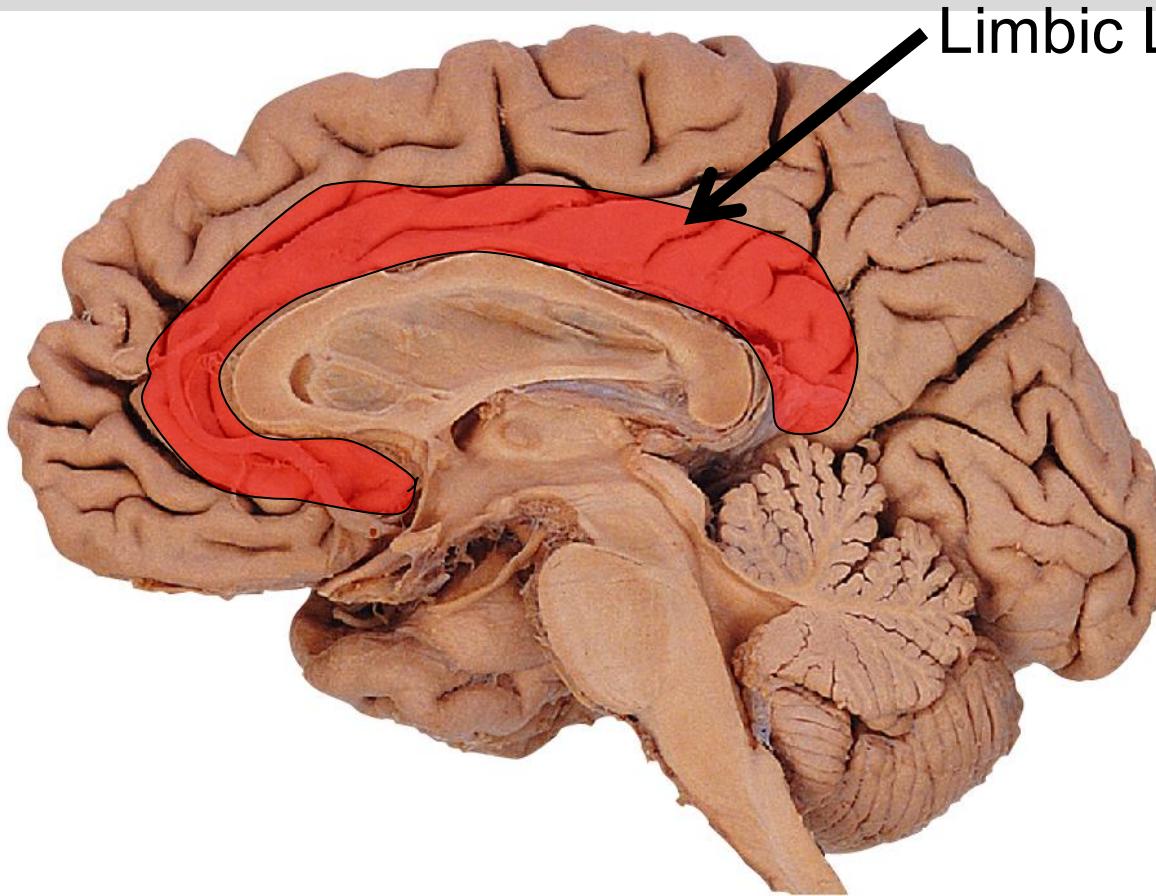
Neuroanatomy & Physiology (review)

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Neuroanatomy & Physiology (review)



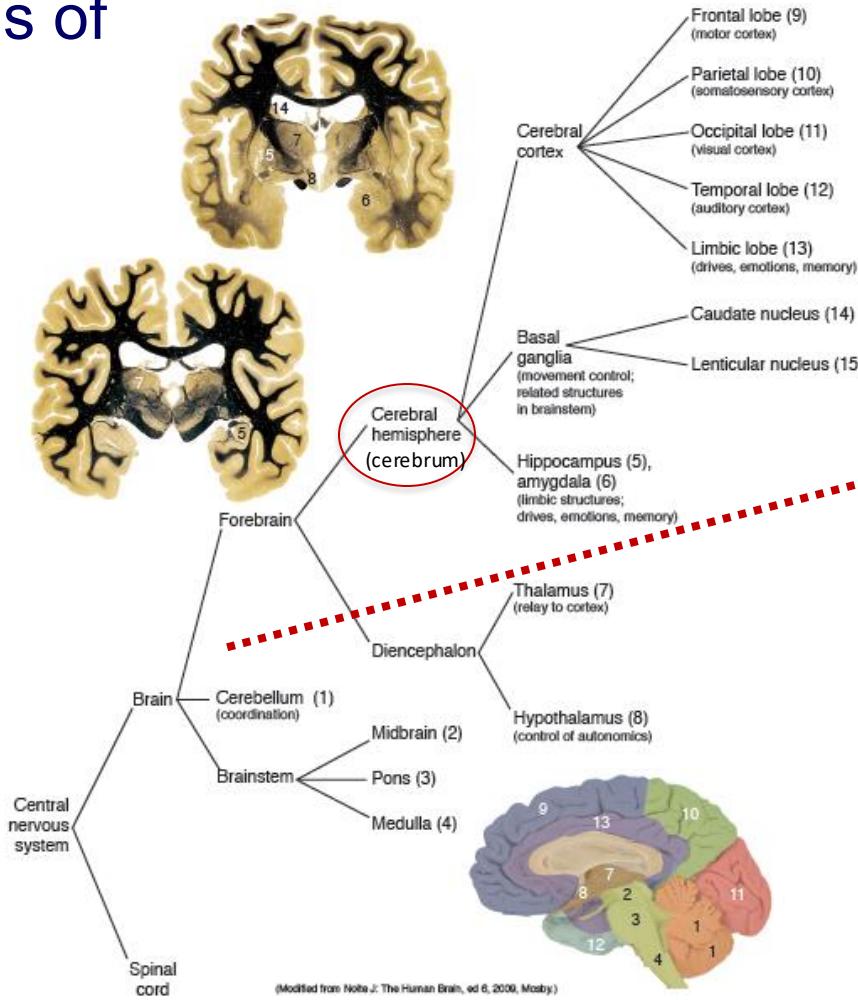
Limbic Lobe

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Learning,
Higher cognitive
function (emotions)

Goss Divisions of the CNS



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Major Functions of the Diencephalon

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Thalamus

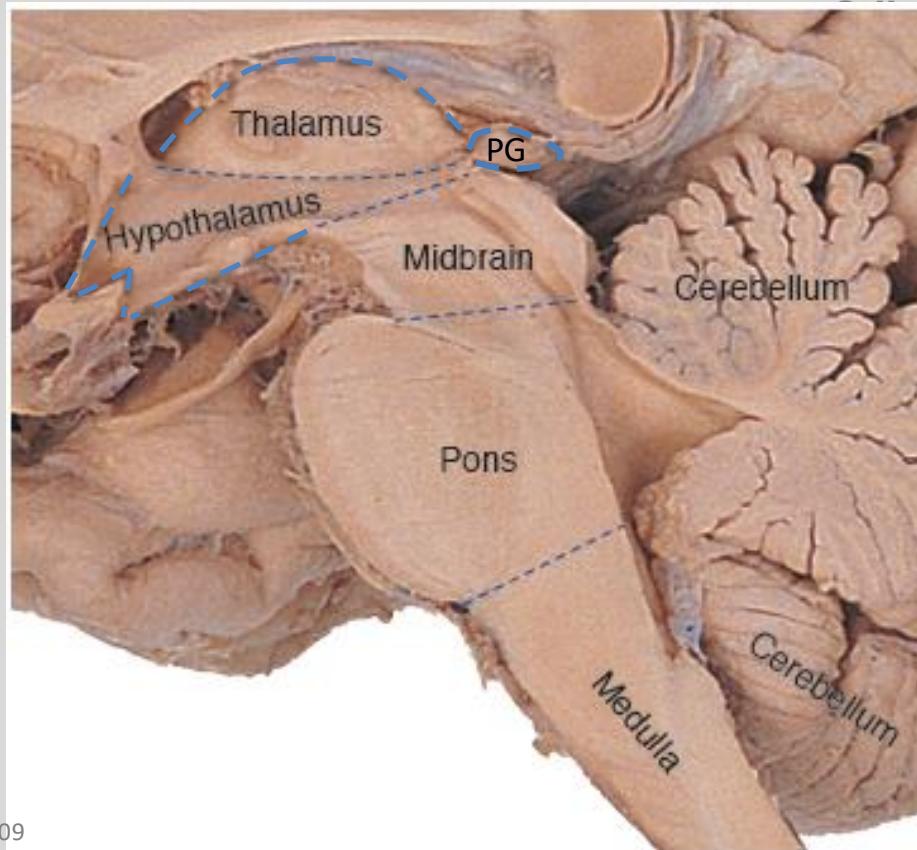
- “Relay Centers” to cortex for sensory and motor info

Hypothalamus

- maintain homeostasis
- autonomic control

Pineal Gland

- circadian rhythms

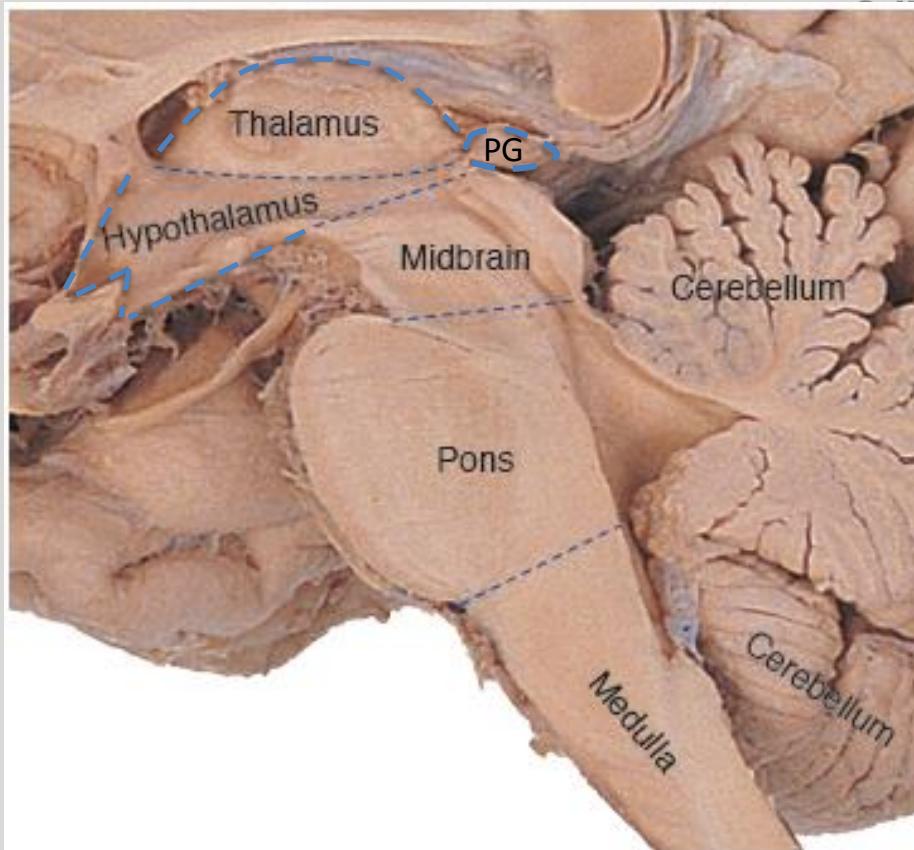


Major Functions of the Brainstem

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Midbrain Pons Medulla

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



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Basal Ganglia

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Cerebrum:

- caudate
- putamen
- globus pallidus
- nucleus accumbens

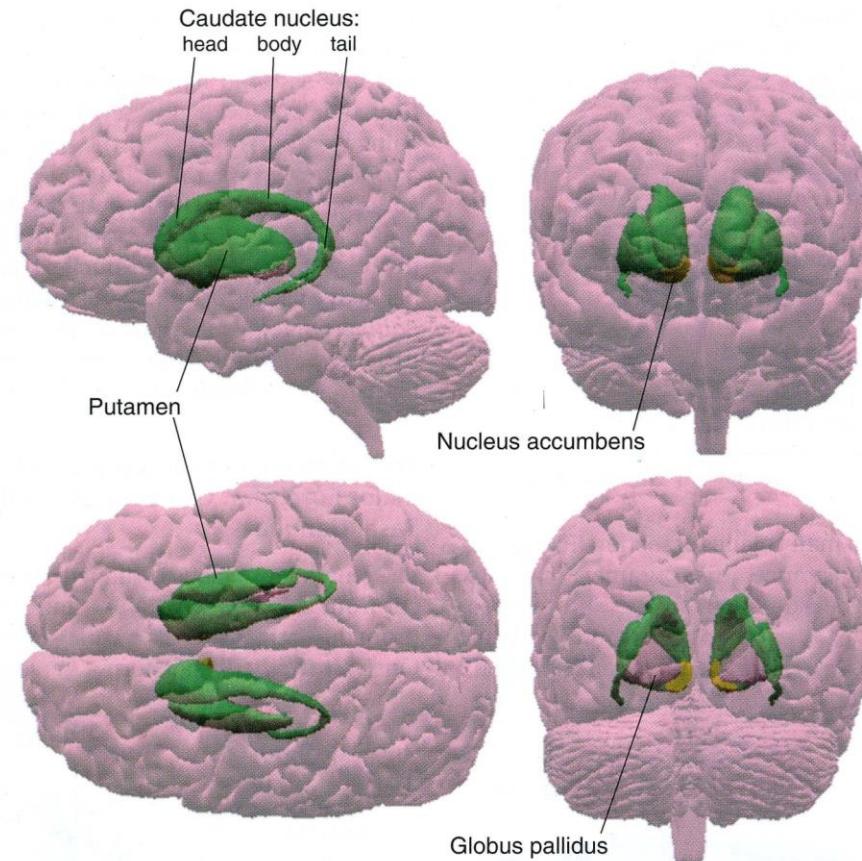
Midbrain:

- Substantia nigra

Diencephalon:

- Subthalamic nucleus

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



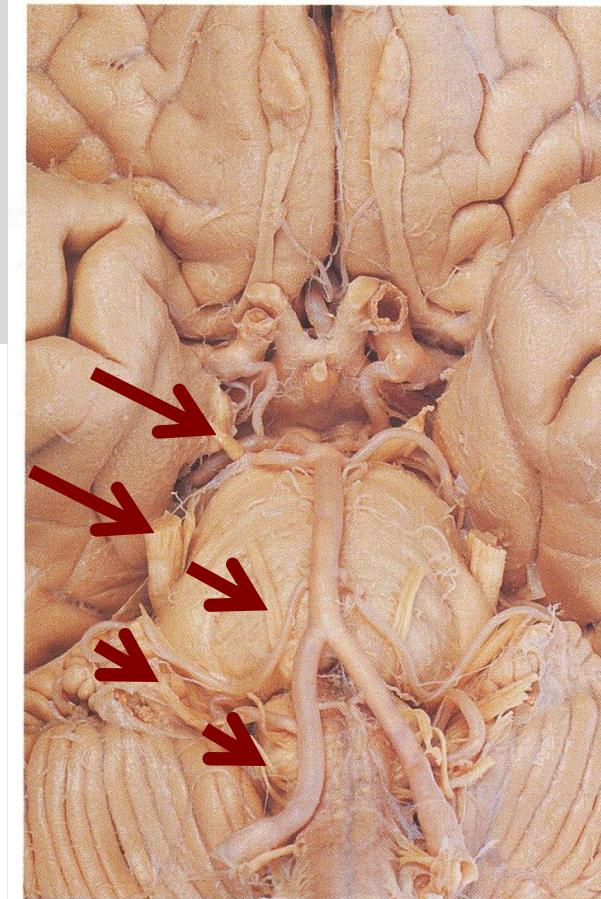
Parkinson's Disease Symptoms



Major Functions of the Brainstem

Midbrain
Pons
Medulla

- Autonomic control
- Cranial nerves
(reflexes)



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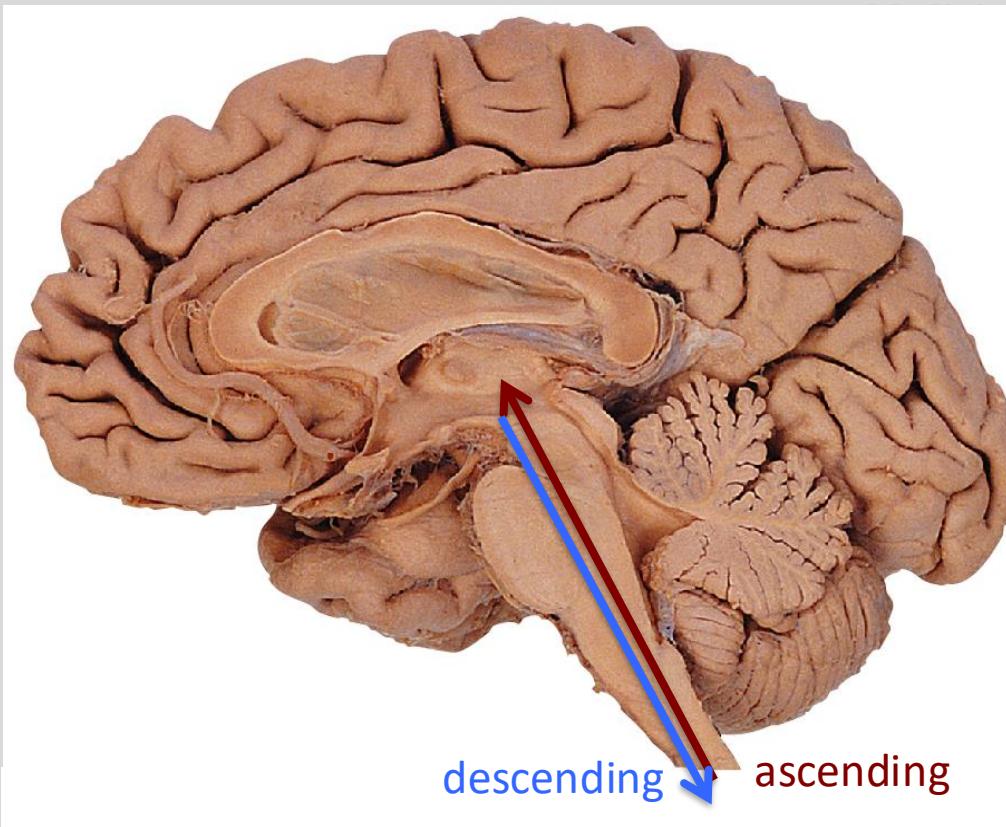
Major Functions of the Brainstem

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Midbrain
Pons
Medulla

- Autonomic control
- Cranial nerves
- Long tracts



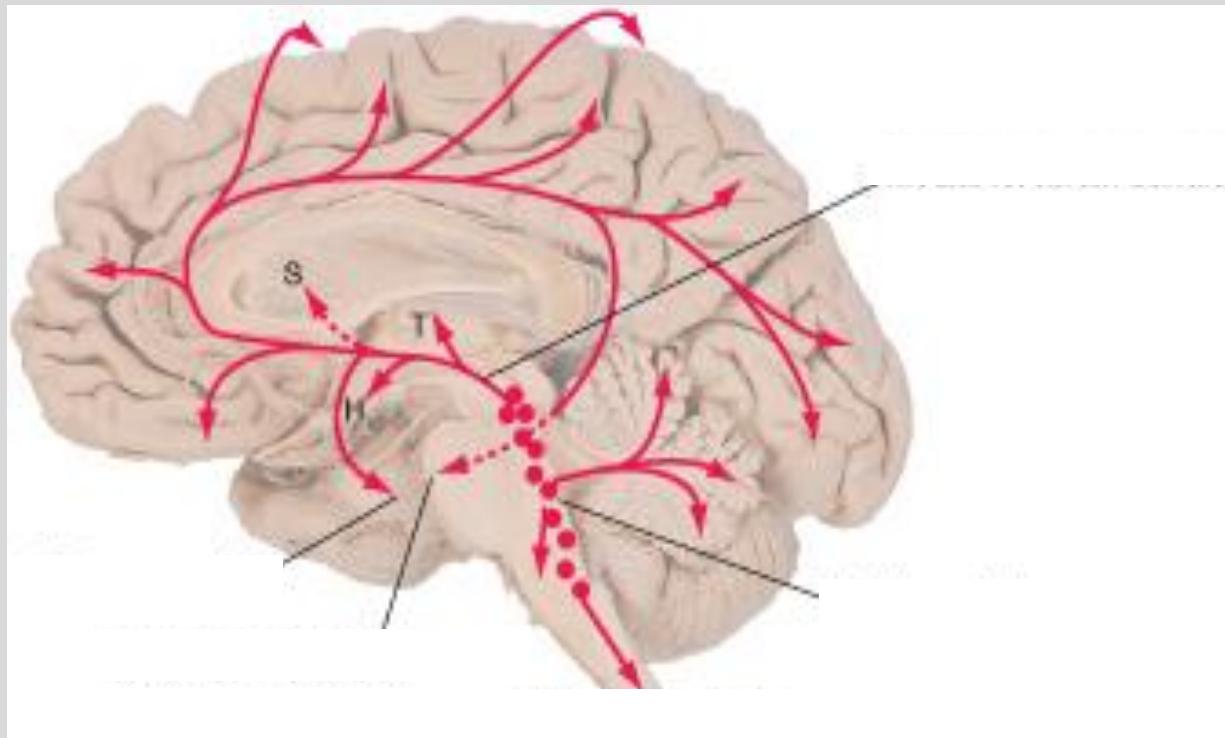
Major Functions of the Brainstem

Midbrain
Pons
Medulla

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

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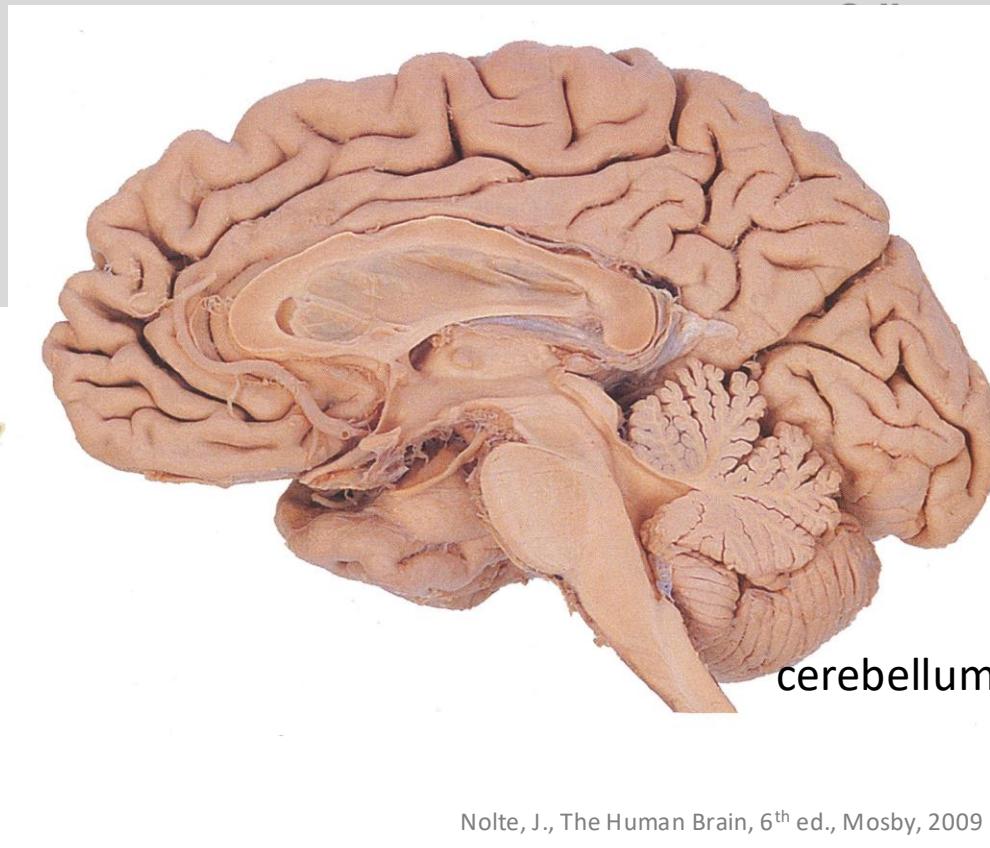
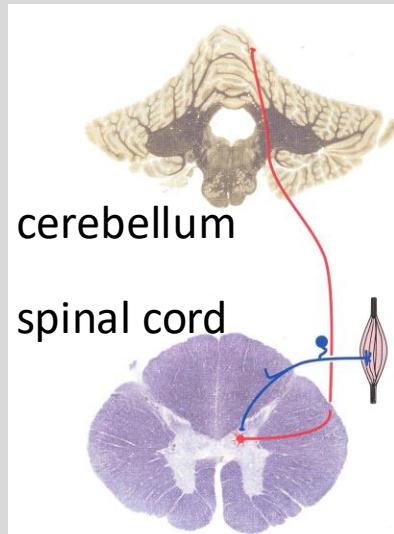


Major Functions of the Cerebellum

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Cerebellum

- Motor coordination
- Limited sensory function



Osteopathic

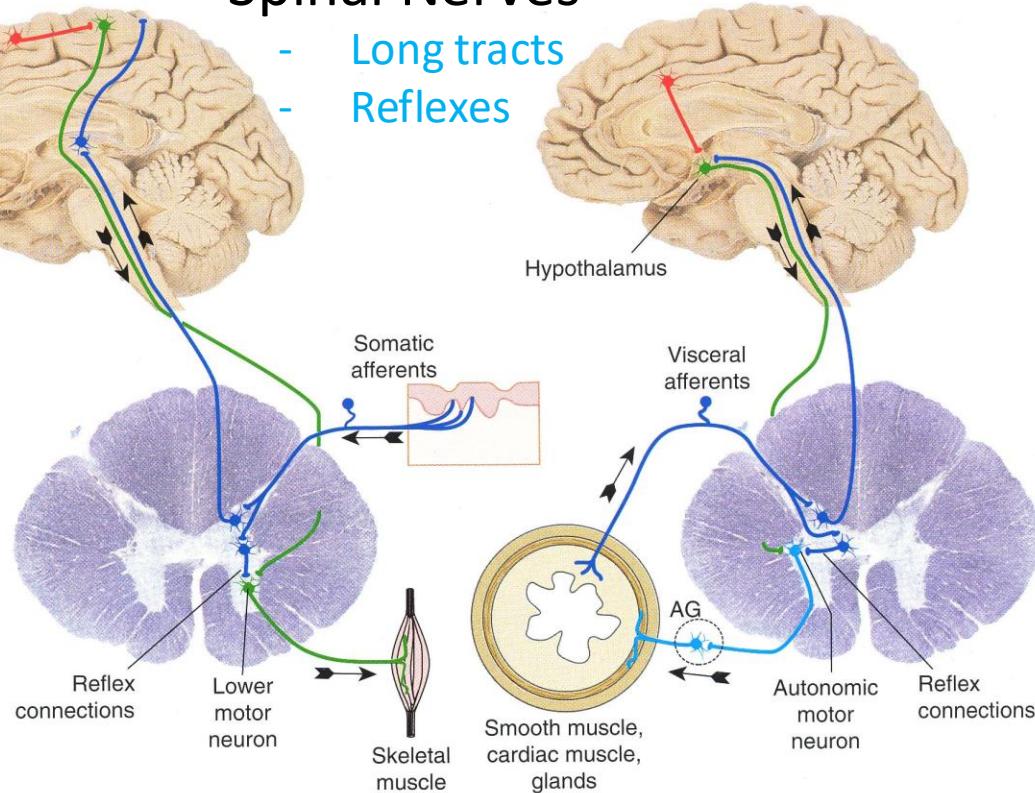
Major Functions of the Spinal Cord

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Osteopathic

Spinal Nerves

- Long tracts
- Reflexes



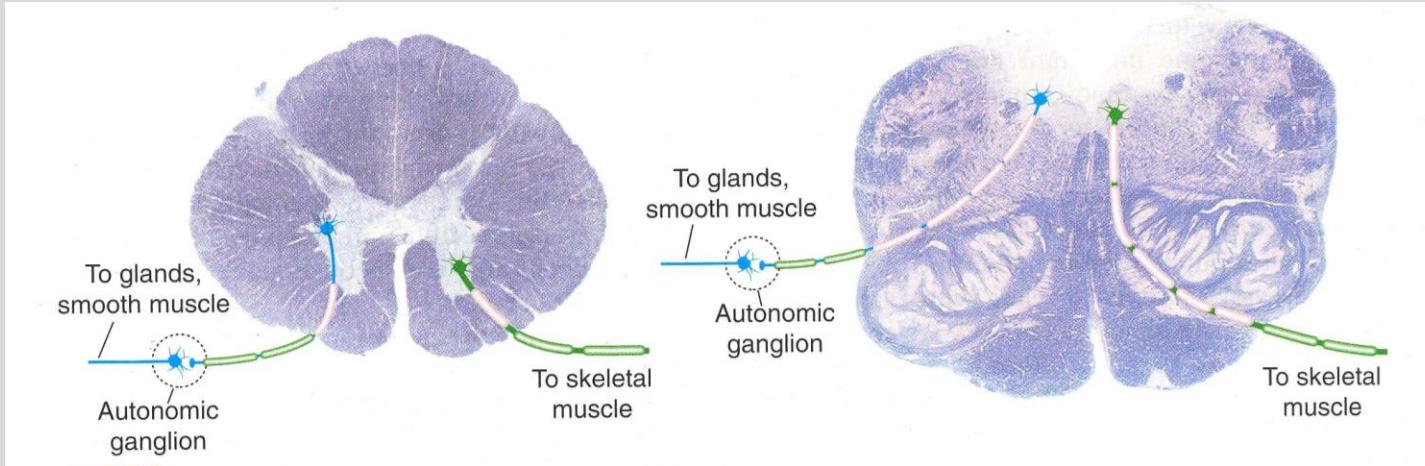
Major Functions of the Spinal Cord

Spinal Nerves

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

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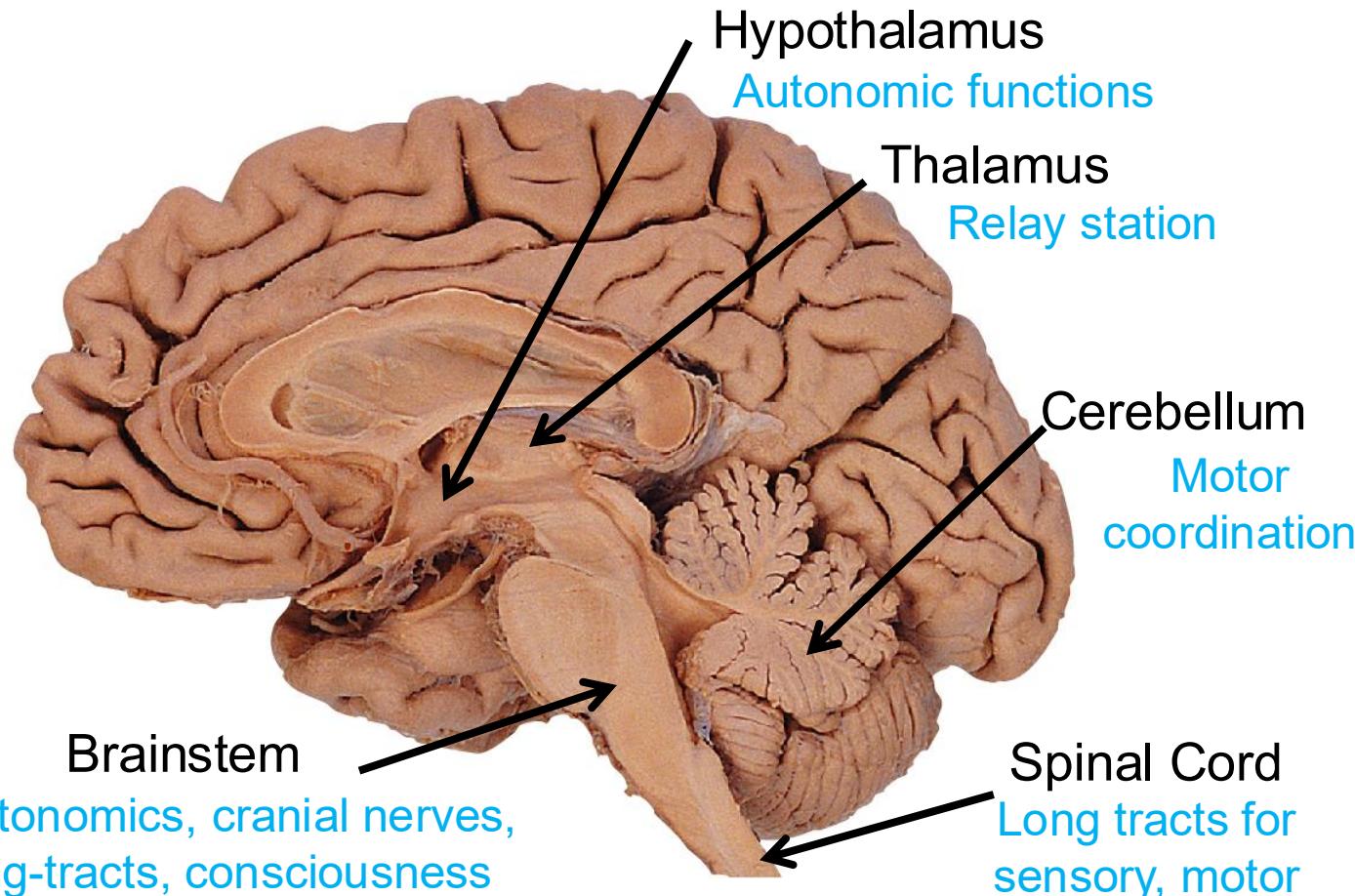
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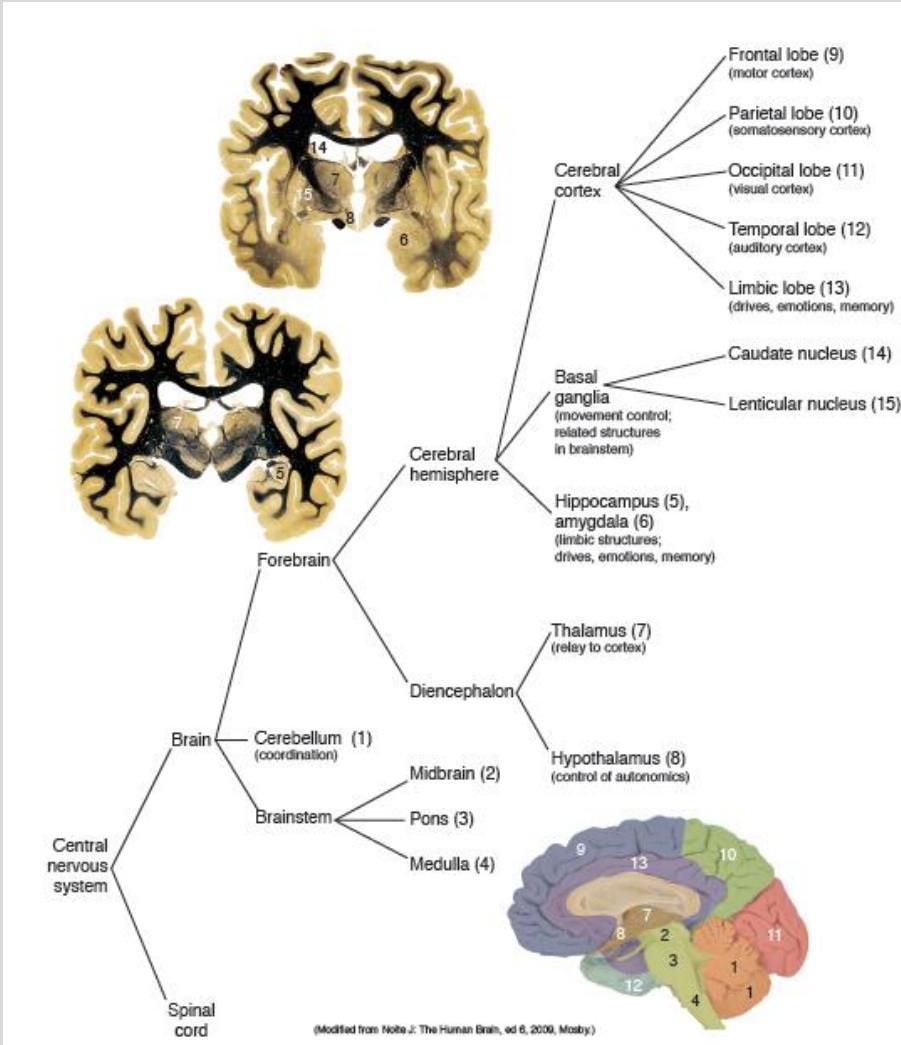
Central
nervous
system

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Gross Division of the CNS

Anatomical outline of the CNS



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Lecture and Lab Feedback Form_

Dr. Jennifer Xie:

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