PART III

NERVOUS SYSTEM ORGANIZATION

16.

ANATOMICAL TERMINOLOGY

Familiarity with the terminology used to describe location and relationships within the nervous system is critical as we move forward into examining brain systems.

Resources

- Key Takeaways
- Test Yourself
- Video Version

Directional Terms

Directional terms are used to locate one structure, usually in relation to another structure. Some terms, like dorsal or ventral, are relative to the axis of the central nervous system, so the direction these terms define changes if used for brain regions versus other body regions. Other terms, like superior or inferior, keep their meaning across the entire body.

- Anterior: In front of; toward the face
- Posterior: Behind; toward the back
- Superior: Above; toward the head
- Inferior: Below; toward the feet
- Medial: Toward the middle
- Lateral: Toward the edge
- Dorsal: Toward the top of the brain or the back of the spinal cord
- Ventral: Toward the bottom of the brain or the front of the spinal cord
- Rostral: Toward the front of the brain or the top of the spinal cord
- Caudal: Toward the back of the brain or the bottom of the spinal cord

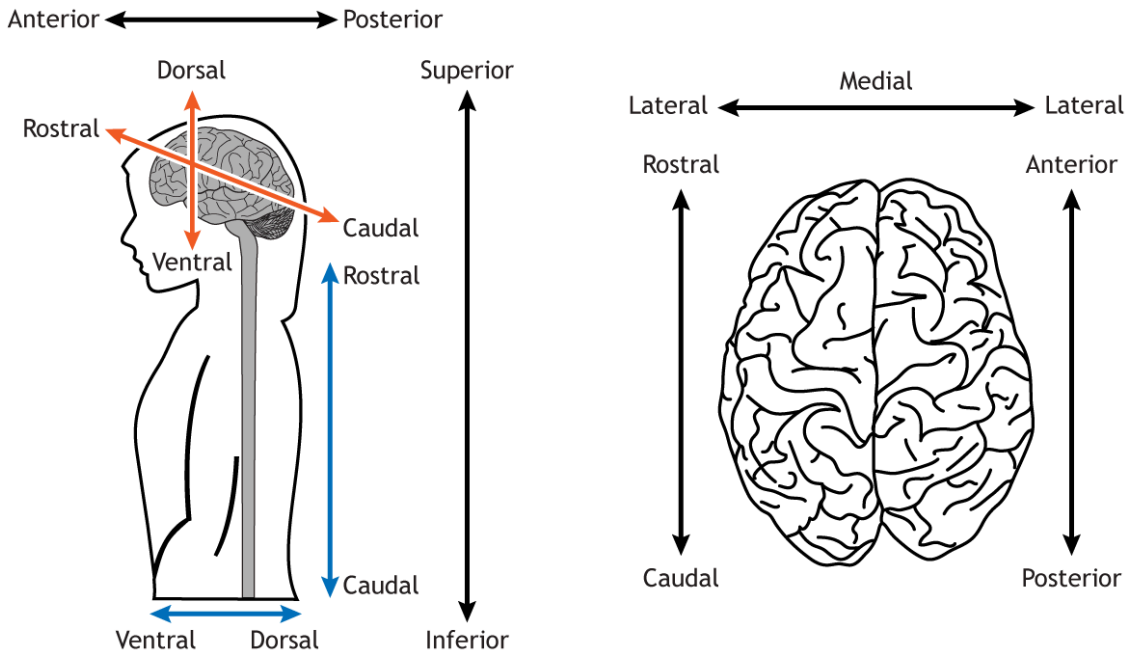

Figure 16.1. Directional terms used to locate nervous system structures. The dorsal / ventral and rostral / caudal pairs point in different directions depending on if they are referring to the axis of the brain (orange arrows) or the axis of the spinal cord (blue arrows). The definitions of each term are described in the text. 'Anatomical Directions' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

Anatomical Planes

There are planes or axes that can be used to examine the nervous system. The frontal or coronal plane is a vertical plane in a medial to lateral direction, dividing objects into front and back pieces. The sagittal plane is also a vertical plane but in a rostral-caudal direction, meaning it divides objects into right and left regions. Finally, the horizontal plane divides objects into top and bottom regions.

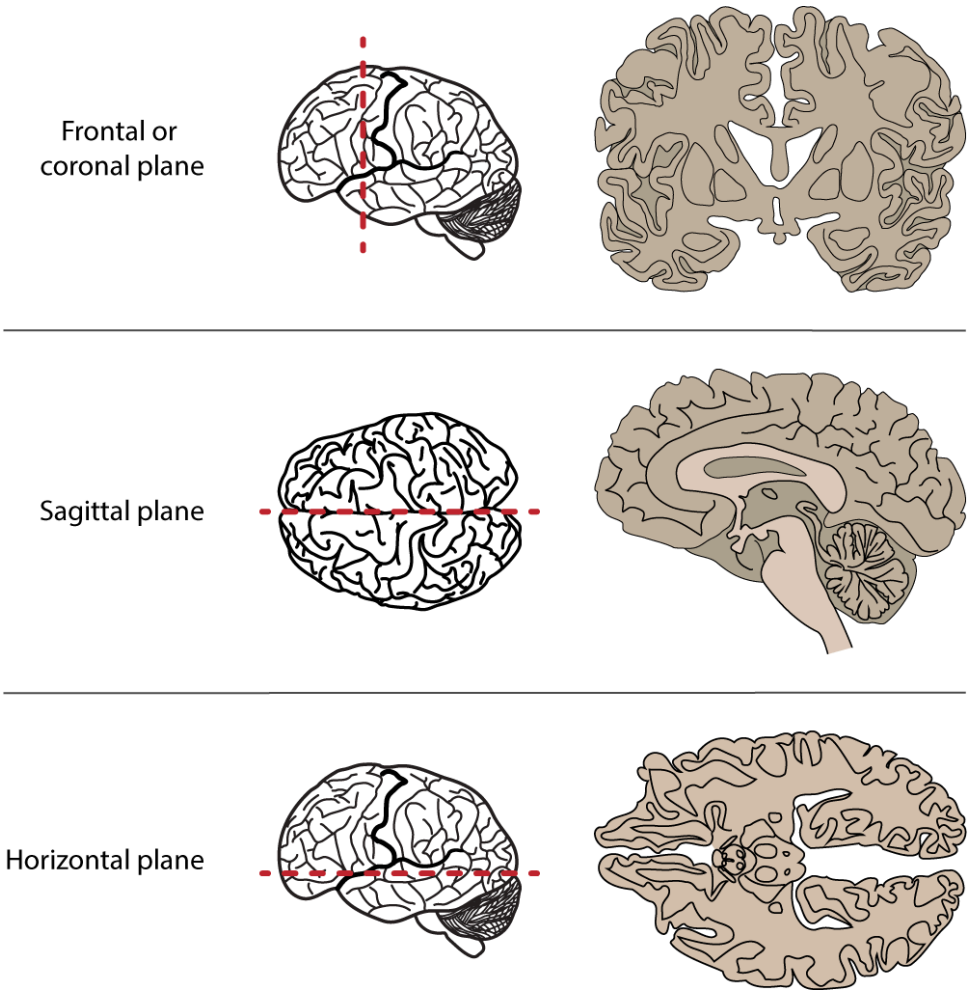

Figure 16.2. Three anatomical planes are used to divide the nervous system to be able to view internal regions and structures. The frontal or coronal plane is a vertical plane that runs parallel to the eyes or ears and will divide the body into front and back regions. The sagittal plane is a vertical plane that runs perpendicular to the eyes or ears and will divide the body into left and right regions. The horizontal plane runs parallel to the ground and will divide the body into top and bottom regions. 'Anatomical Planes' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

Nervous System Divisions

The nervous system is divided into two primary components. The central nervous system (CNS) is comprised of the brain and the spinal cord. The peripheral nervous system (PNS) is comprised of the cranial and spinal nerves. When information flow is described in the nervous system, it can either be

afferent communication, meaning it is moving from the periphery to the brain, or efferent communication, meaning it is moving from the brain to the periphery.

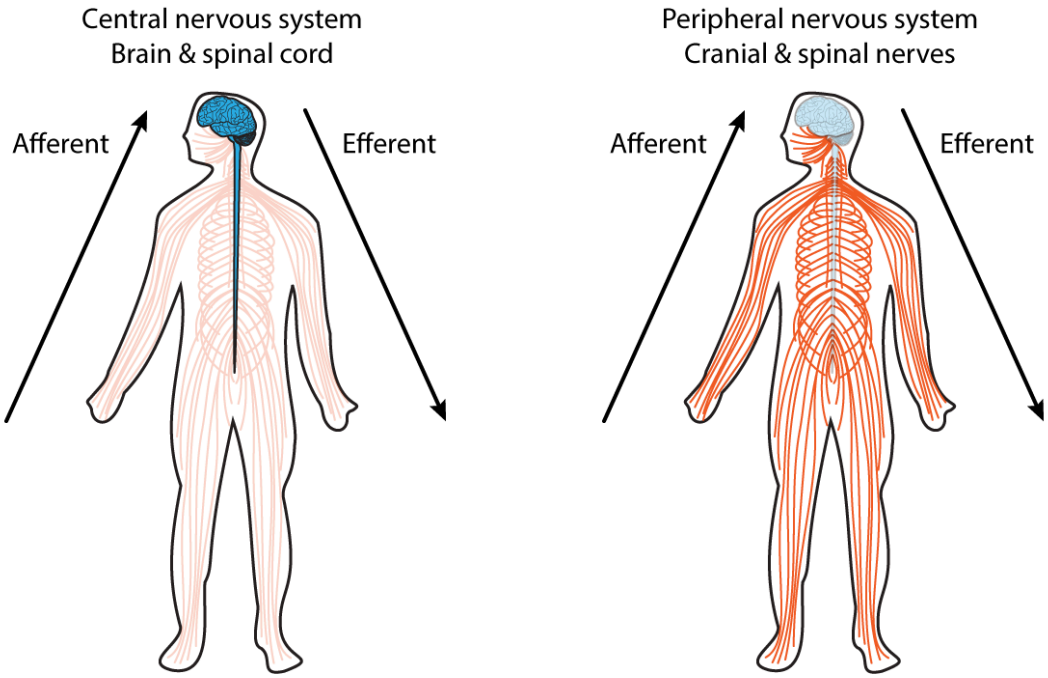

Figure 16.3. The nervous system is divided into the central nervous system, which includes the brain and spinal cord, and the peripheral nervous system, which includes the cranial and spinal nerves. Information traveling toward the brain is called afferent, whereas information traveling from the brain is called efferent. 'CNS and PNS' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

Tissue in the central nervous system can be further divided into either white matter or gray matter. White matter regions are comprised of axons. It appears white due to the myelin sheath on the axons. Gray matter regions are comprised of cell bodies and dendrites. Gray matter is the location of most synapses.

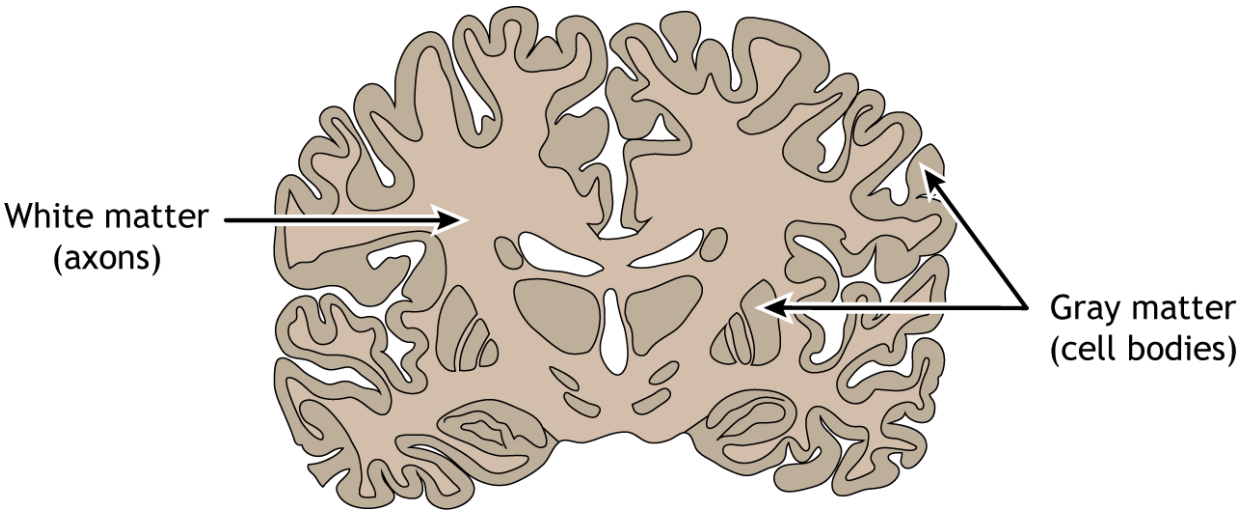

Figure 16.4. The central nervous system tissue can be divided into white and gray matter. White matter is primarily myelinated axons. Gray matter is primarily neuronal cell bodies and dendrites. In the brain, the surface of the cerebral cortex is a layer of gray matter. White matter can be found below the gray matter layer and is the location of the axons traveling to and from the cortical cell layer. Gray matter can also be found deep in the brain in subcortical regions that play critical roles in behavior. 'White and Gray Matter' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

Key Takeaways

- Anatomical terminology is critical for determining neurological landmarks

Test Yourself!

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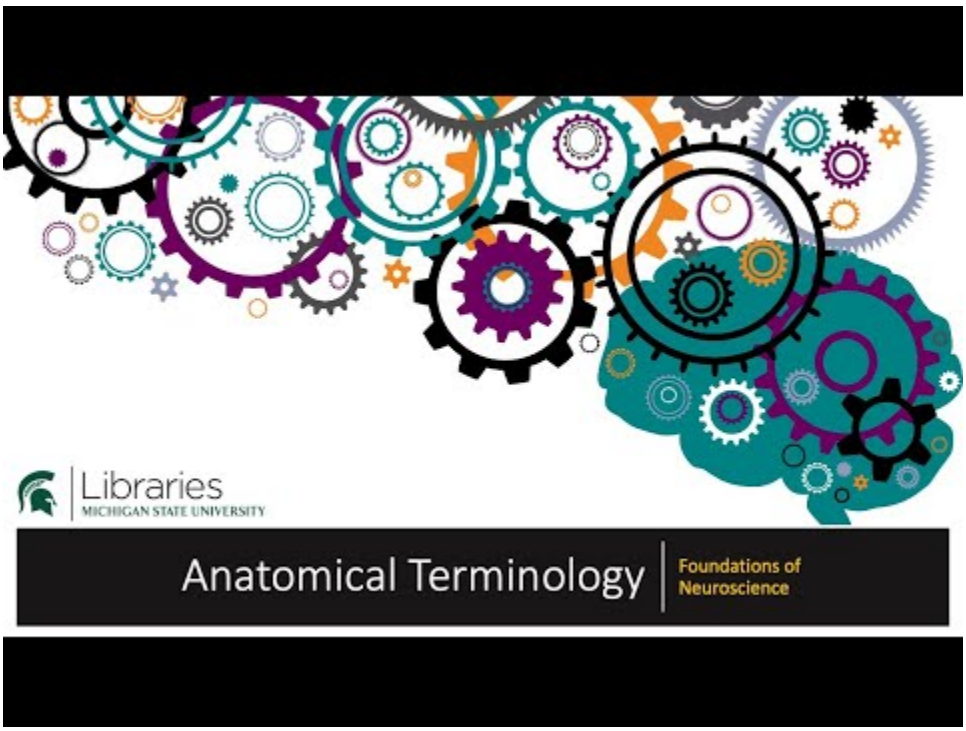
https://openbooks.lib.msu.edu/neuroscience/?p=1127#h5p-16

Video Version of Lesson



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17.

EXTERNAL BRAIN ANATOMY

The brain is comprised of the cerebrum, cerebellum, and brainstem. The cerebrum is the most prominent region of the brain. It is divided into left and right hemispheres. The hemispheres have many of the same functions, for example, each perceives touch on one side of the body, but some functions demonstrate laterality, meaning they are primarily controlled on one side of the brain. The cerebral hemispheres in humans have many folds to increase the surface area of the brain. The ridges are called gyri and the grooves are called sulci. Large sulci are often called fissures.

Resources

- Key Takeaways
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- Video Version

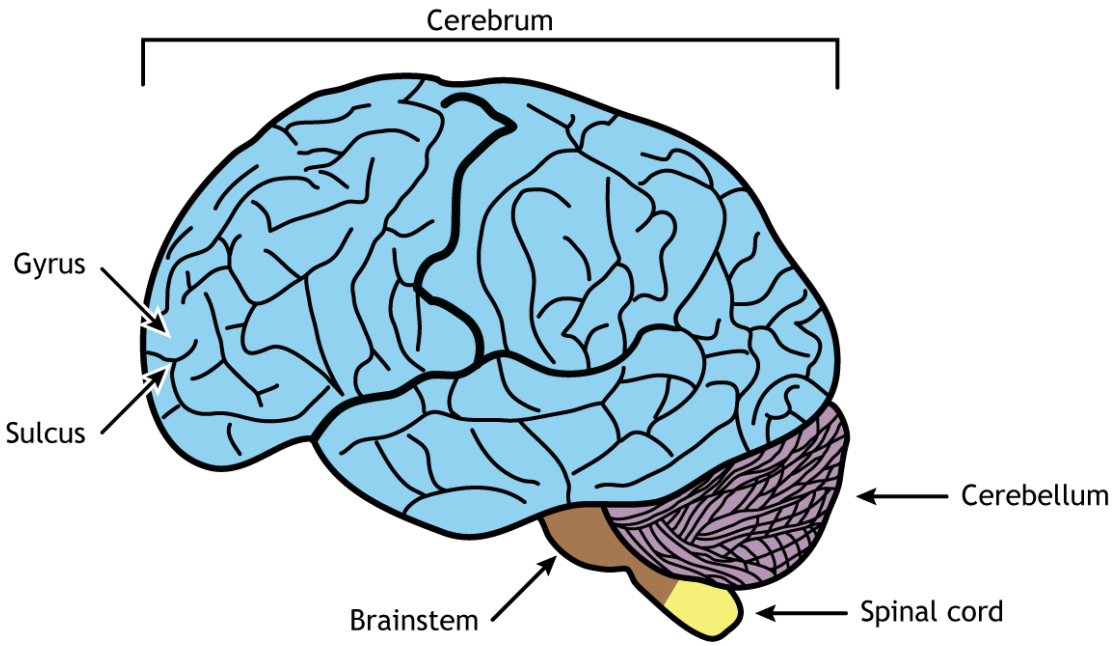

Figure 17.1 An external, side view of the parts of the brain. The cerebrum, the largest part of the brain, is organized into folds called gyri and grooves called sulci. The cerebellum sits behind (posterior) and below (inferior) the cerebrum. The brainstem connects the brain with the spinal cord and exits from the ventral side of the brain. 'External Brain Regions' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

Frontal Lobe

The cerebral hemispheres of the brain are divided into four lobes. The frontal lobes are the most rostral, located in the front of the brain and are responsible for higher level executive functions, like attention, critical thinking, and impulse control. They are the last brain region to fully develop, not completing development until individuals reach their 20s. The frontal lobes are also the location of the primary motor cortex, the region of the brain responsible for planning and executing movement. The primary motor cortex is located in the precentral gyrus.

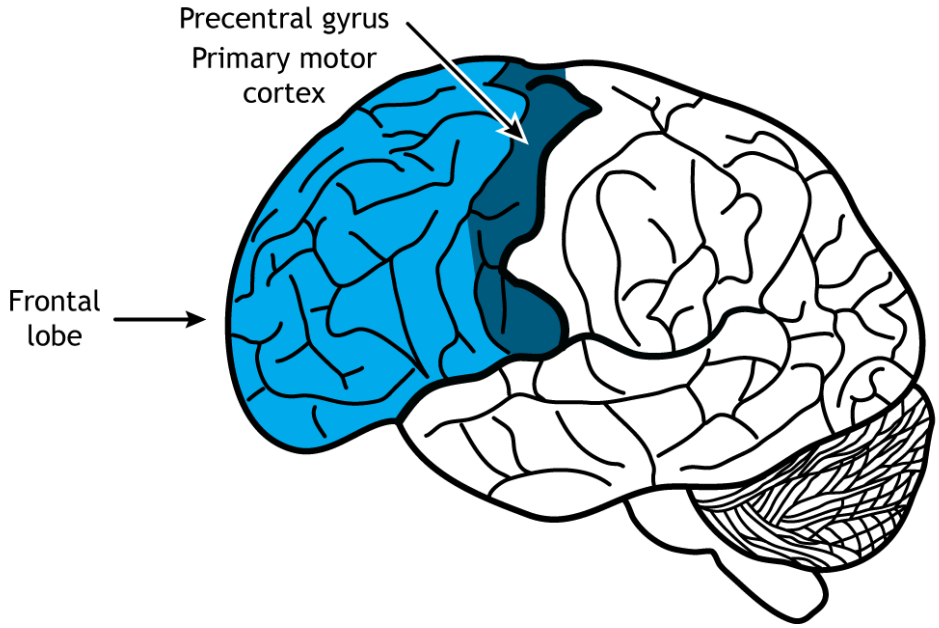

Figure 17.2. The frontal lobe is located in the front of the brain. It includes the precentral gyrus, the location of the primary motor cortex. 'Frontal Lobe' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

View the frontal lobe using the BrainFacts.org 3D Brain

Parietal Lobe

The central sulcus lies caudal to the frontal lobe and divides the frontal lobes from the parietal lobes. The parietal lobes are important for processing sensory information. The primary somatosensory cortex is located in the postcentral gyrus of the parietal lobe and is responsible for the perception of touch and pain. The parietal lobes also perform higher-level visual processing.

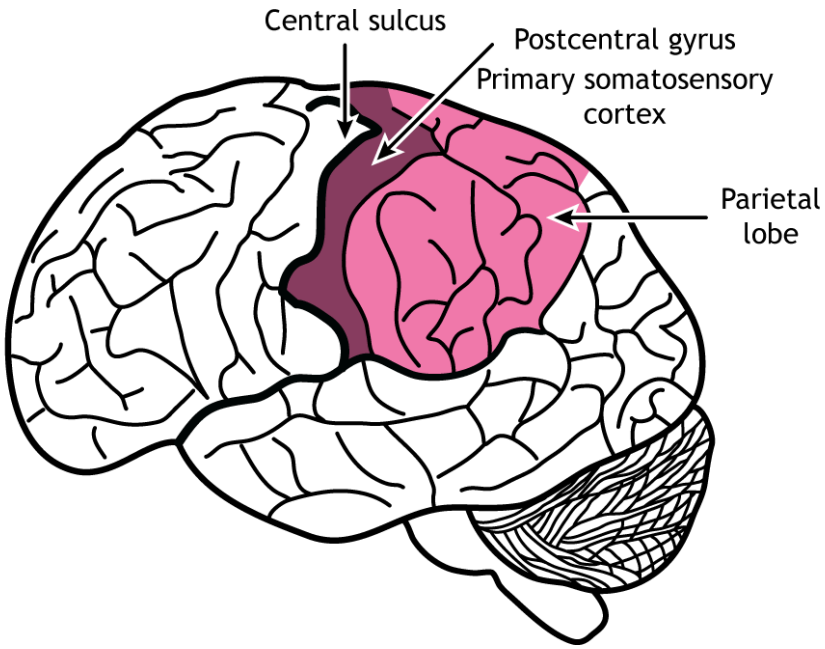

Figure 17.3. The parietal lobe is located on the top of the brain. It includes the postcentral gyrus, the location of the primary somatosensory cortex. The central sulcus divides the parietal lobe from the frontal lobe. 'Parietal Lobe' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

View the parietal lobe using the BrainFacts.org 3D Brain

Temporal Lobe

The temporal lobes are located on the side of the brain, separated from the frontal and parietal lobes by the lateral fissure. Like the parietal lobe, the temporal lobe plays a role in sensory processing, specifically with hearing, smell, taste, and higher-level visual processing. The temporal lobe is also important for speech and memory. Beneath the cerebral cortex, deep in the temporal lobes, lie the hippocampus and amygdala, two regions of the limbic system, a circuit important for emotion and memory.

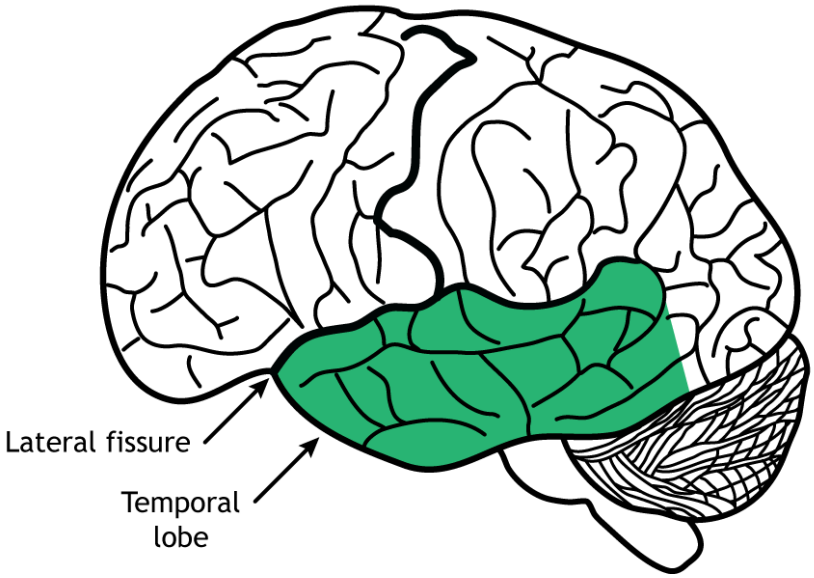

Figure 17.4. The temporal lobe is located on the side of the brain. The lateral fissure divides the temporal lobe from the frontal and parietal lobes. 'Temporal Lobe' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

View the temporal lobe using the BrainFacts.org 3D Brain

Occipital Lobe

The last lobes are the occipital lobes, the most caudal lobes located in the back of the brain. The occipital lobes' primary function is processing of visual information.

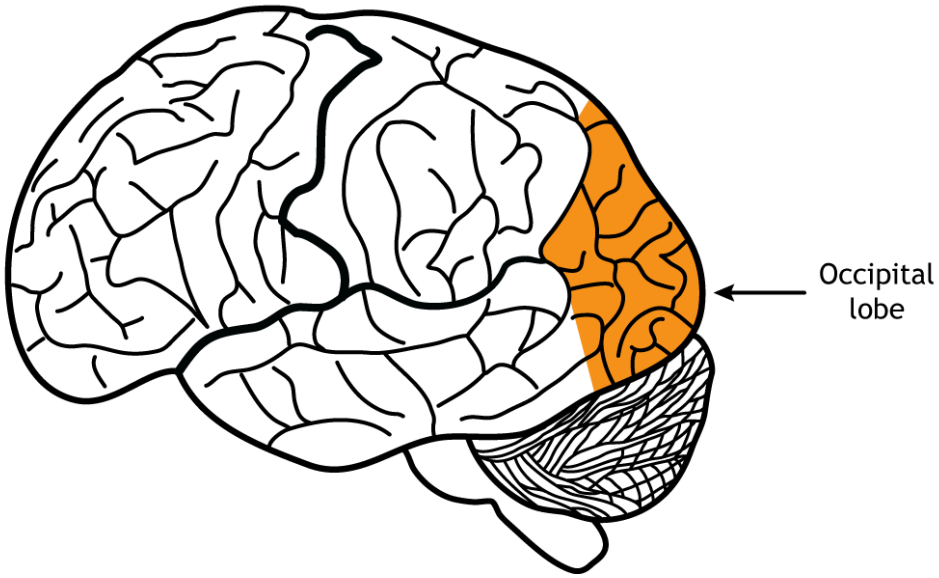

Figure 17.5. The occipital lobe is located in the back of the brain. 'Occipital Lobe' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

View the occipital lobe using the BrainFacts.org 3D Brain

Non-Cerebral Components

The cerebellum lies inferior to the occipital lobes. The cerebellum is also divided into two hemispheres, like the cerebral cortex. The cerebellum is best known for its role in regulation and control of movement, but it is also involved in cognitive functions like emotions.

The brainstem is located between the cerebrum and the spinal cord. It is important for regulating critical functions like heart rate, breathing, and sleep. It is also the location of most of the cranial nerves.

The spinal cord, which is part of the central nervous system but not part of the brain, is responsible for receiving sensory information from the body and sending motor information to the body. Involuntary motor reflexes are also a function of the spinal cord, indicating that the spinal cord can process information independently from the brain.

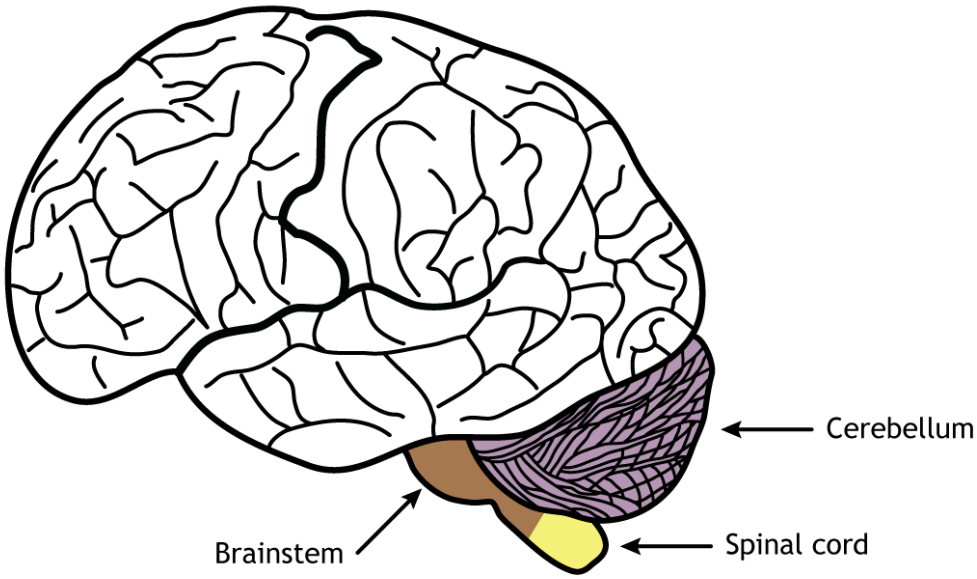

Figure 17.6. The cerebellum, brainstem, and spinal cord are located below the brain. 'Hindbrain' by Casey Henley is licensed under a Creative Commons Attribution Non-Commercial Share-Alike (CC BY-NC-SA) 4.0 International License.

View the brainstem using the BrainFacts.org 3D Brain

View the cerebellum using the BrainFacts.org 3D Brain

Key Takeaways

- The four lobes of the cerebral cortex each have specific functions
- The cerebral cortex has gyri and sulci to increase the surface area
- The cerebral cortex, underlying structures, cerebellum, brainstem, and spinal cord form the central nervous system

Test Yourself!

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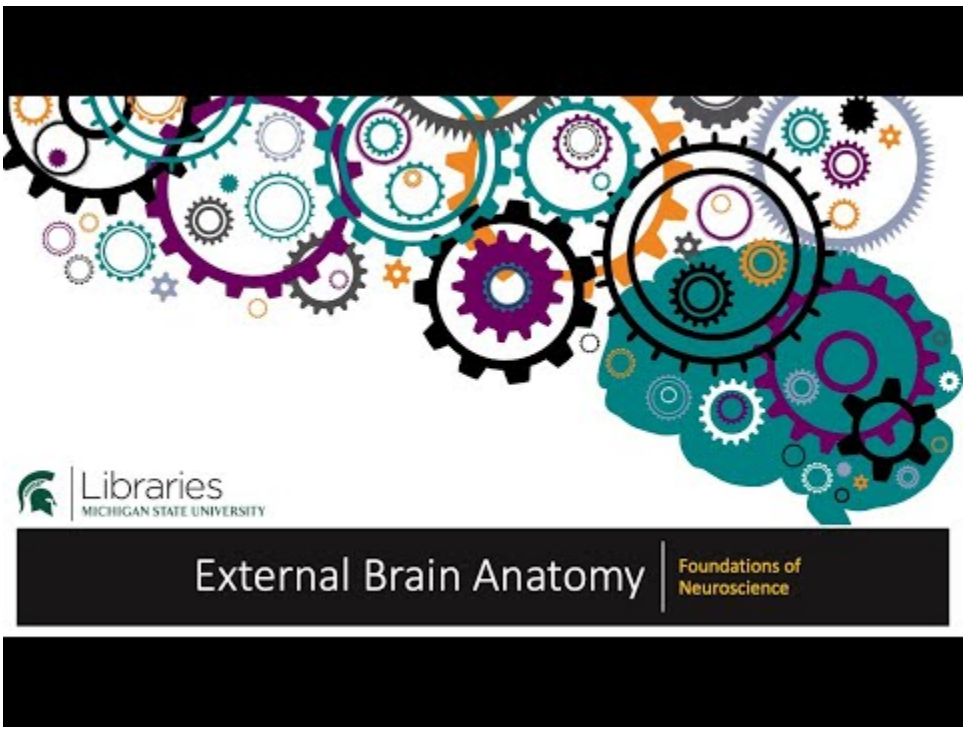

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