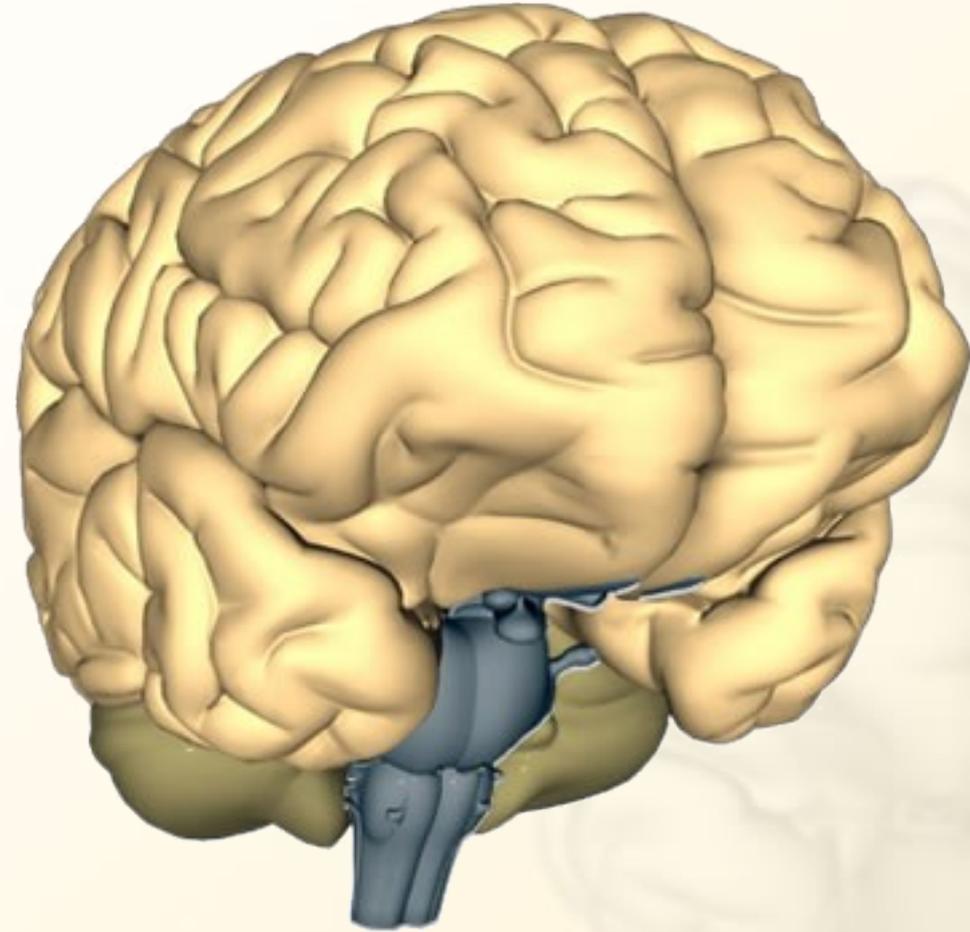


The Human Brain: Anatomy, Functions,



Brain Anatomy

- Skull Anatomy
- Interior Skull Surface
- Blood Vessels of the Brain
- Arteries of the Brain
- The Neuron
- The Meninges
- External Brain Structures
- The Cerebrum
- The Cerebrum – The Cortex
- The Neocortex
- Lobes of the Cerebrum
 - Frontal Lobe
 - Temporal Lobe
 - Parietal Lobe
 - Occipital Lobe
 - Limbic Lobe
- The Limbic System
- Cerebellum
- Thalamus
- Hypothalamus
- The Medulla Oblongata
- The Pons
- The Ventricles
- Cerebrospinal Fluid
- The Brainstem
- Brainstem Components
- Brainstem Divisions
- The Cranial Nerves



Skull Anatomy

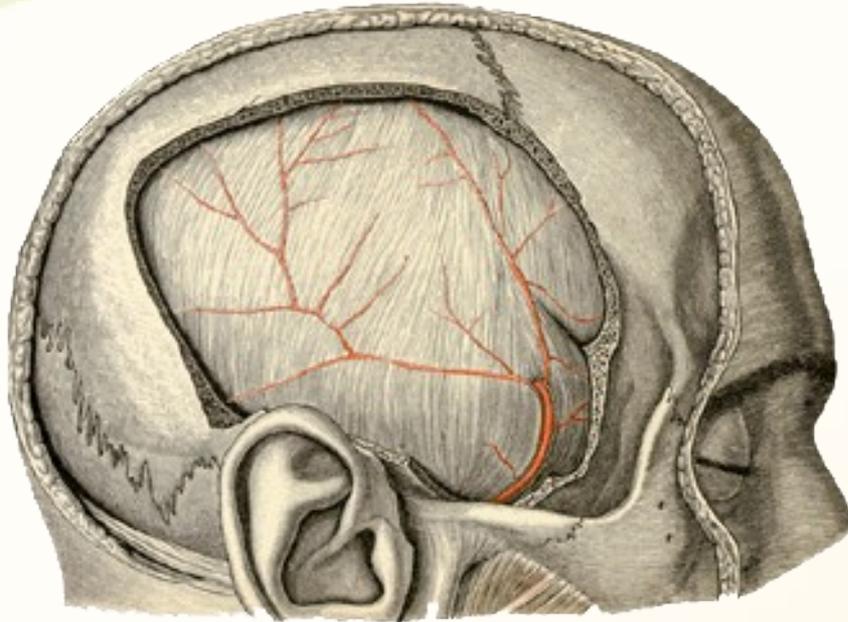
The skull is a rounded layer of bone designed to protect the brain from penetrating injuries.



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Blood Vessels of the Skull
Rough Interior of Skull

Blood Vessels of the Skull



The brain requires a rich blood supply, and the space between the skull and cerebrum contains many **blood vessels**.

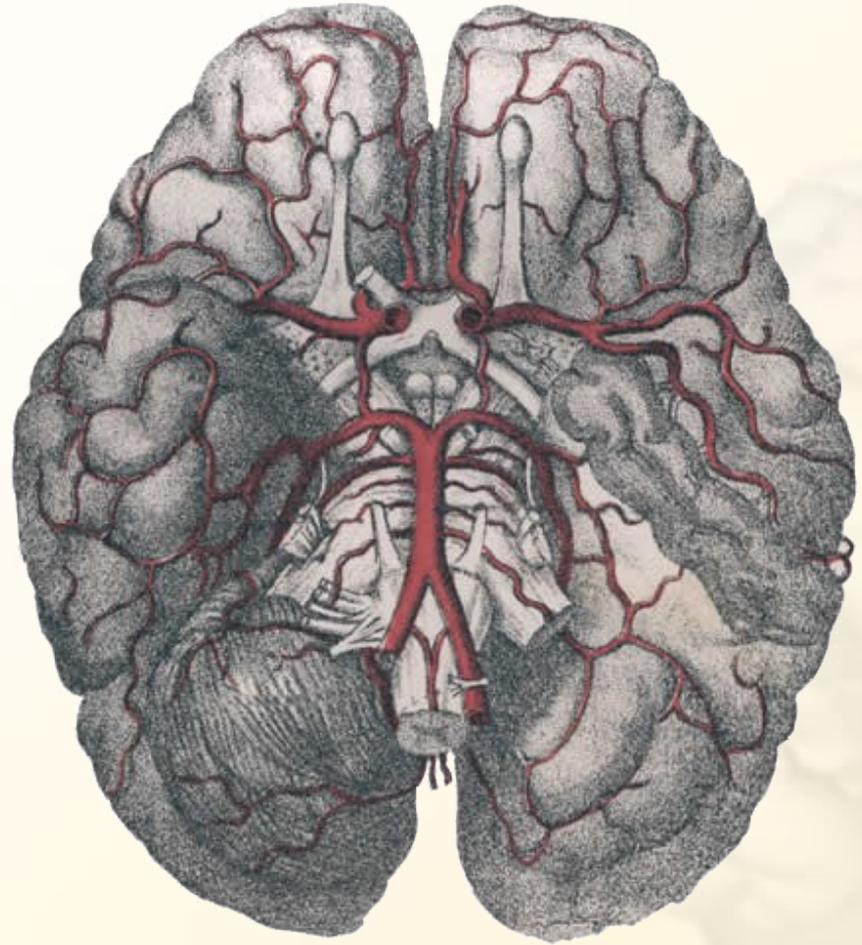
These blood vessels can be ruptured during trauma, resulting in bleeding.

Groove for middle meningeal artery



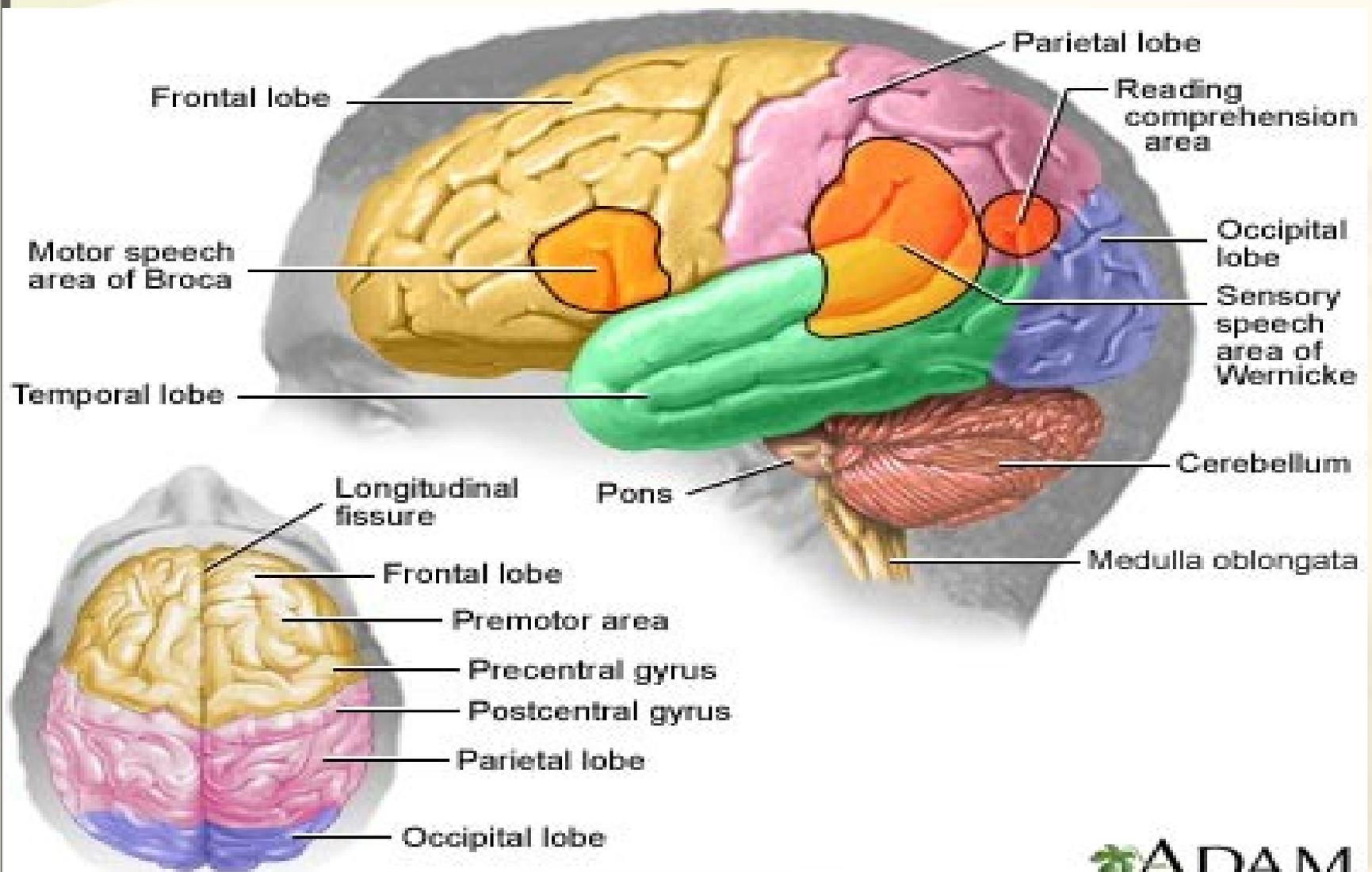
Arteries of the Brain

The human brain requires a constant supply of oxygen. A lack of oxygen of just a few minutes results in irreversible damage to the brain.

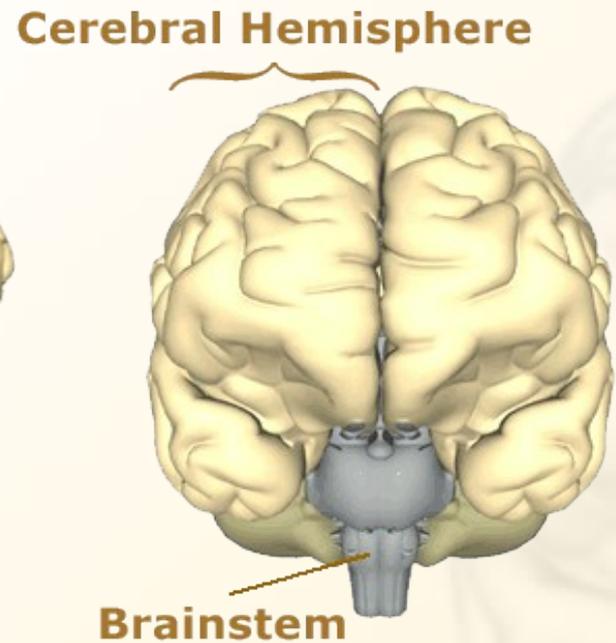
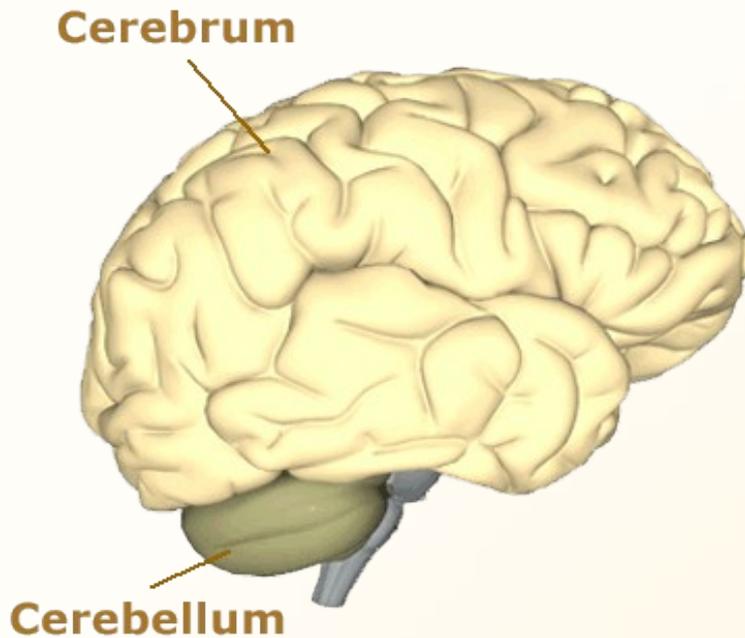


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The Brain



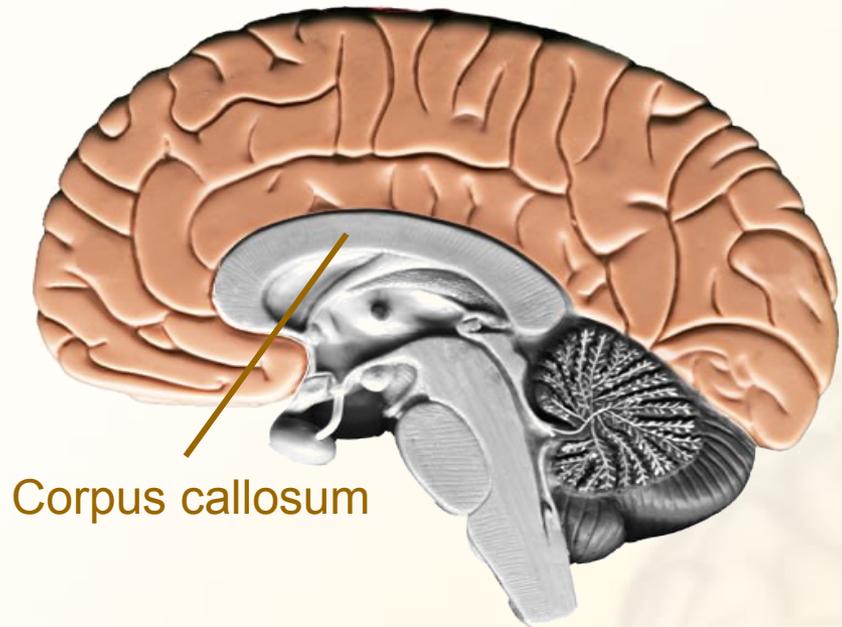
External Brain Structures



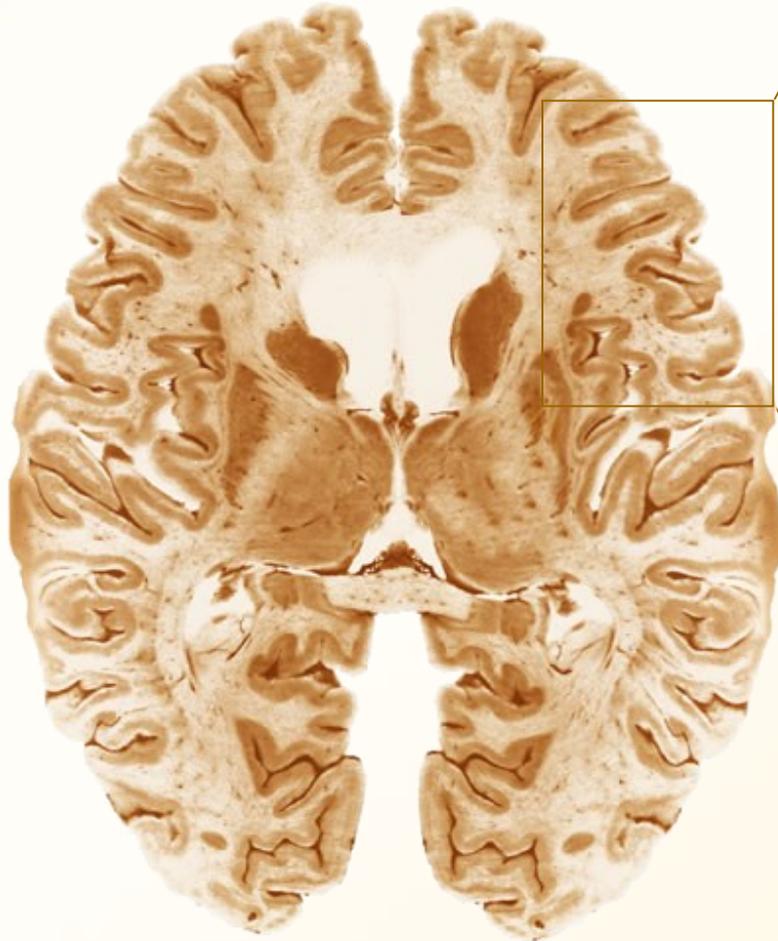
The Cerebrum

The largest portion of the brain is the cerebrum. It consists of two hemispheres that are connected together at the corpus callosum.

The cerebrum is often divided into **five lobes** that are responsible for different brain functions.



The Cerebrum



Neocortex

The cerebrum's surface—the **neocortex**—is convoluted into hundreds of folds.

The neocortex is where all the higher brain functions take place.

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The cerebrum p. 281

- is divided into two cerebral hemispheres
- has an outer surface,
or CORTEX,
made of “gray matter”

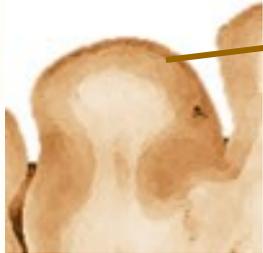


The Neocortex

The cerebral cortex is a thin layer of cells about 1.5 to 4 mm thick.

The cortex provides the connections and pathways for the highest cognitive functions, such as language and abstract thinking.

The cerebral cortex contains about 25 billion neurons, more than 62,000 miles of axons, and 300,000,000,000,000 synapses.



Neocortex layer



The thin layer of the neocortex is dense with neurons.

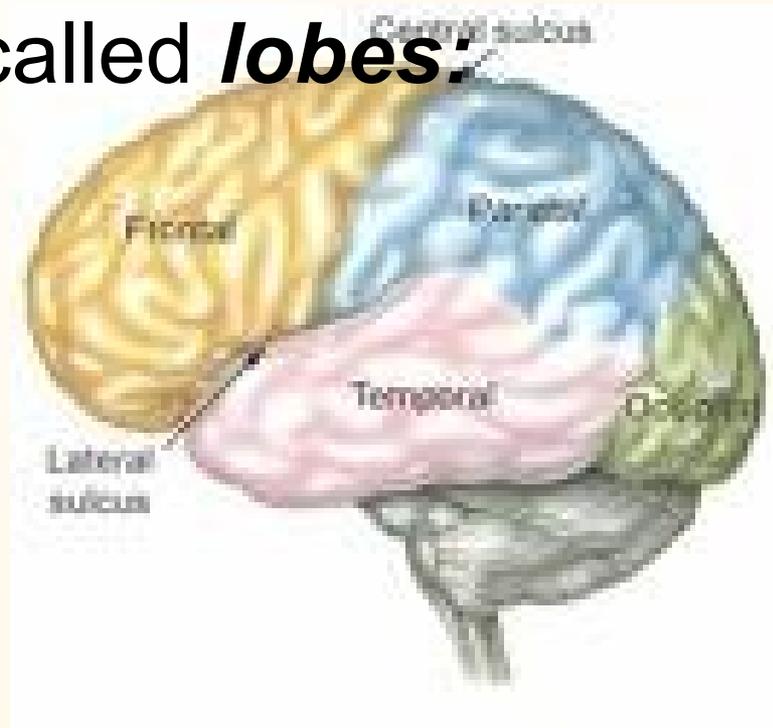
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The cerebral cortex p. 281

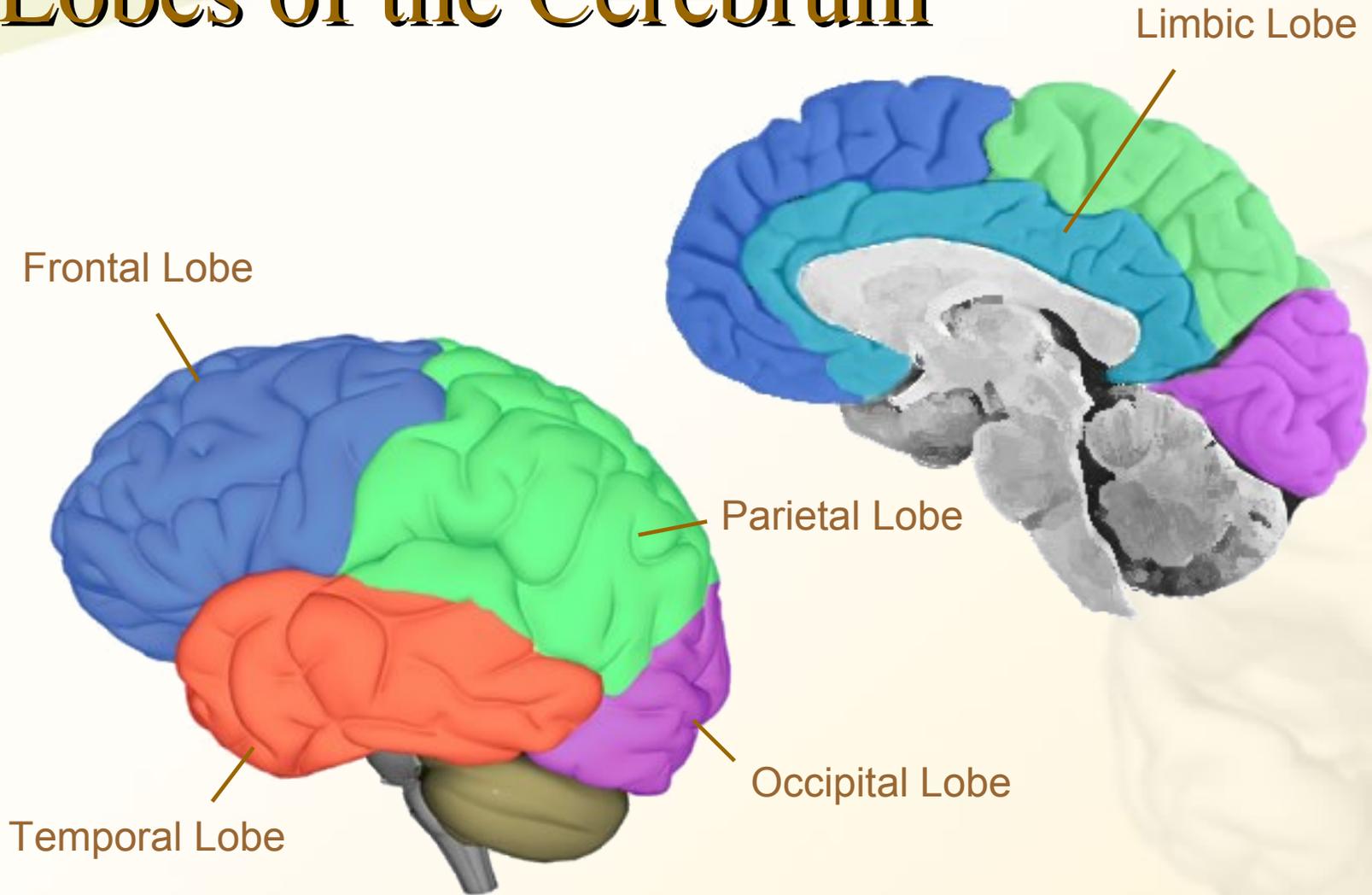
is divided into parts called **lobes**:

2. the frontal lobe
3. the parietal lobe
4. the temporal lobe
5. the occipital lobe



www.colorado.edu

Lobes of the Cerebrum



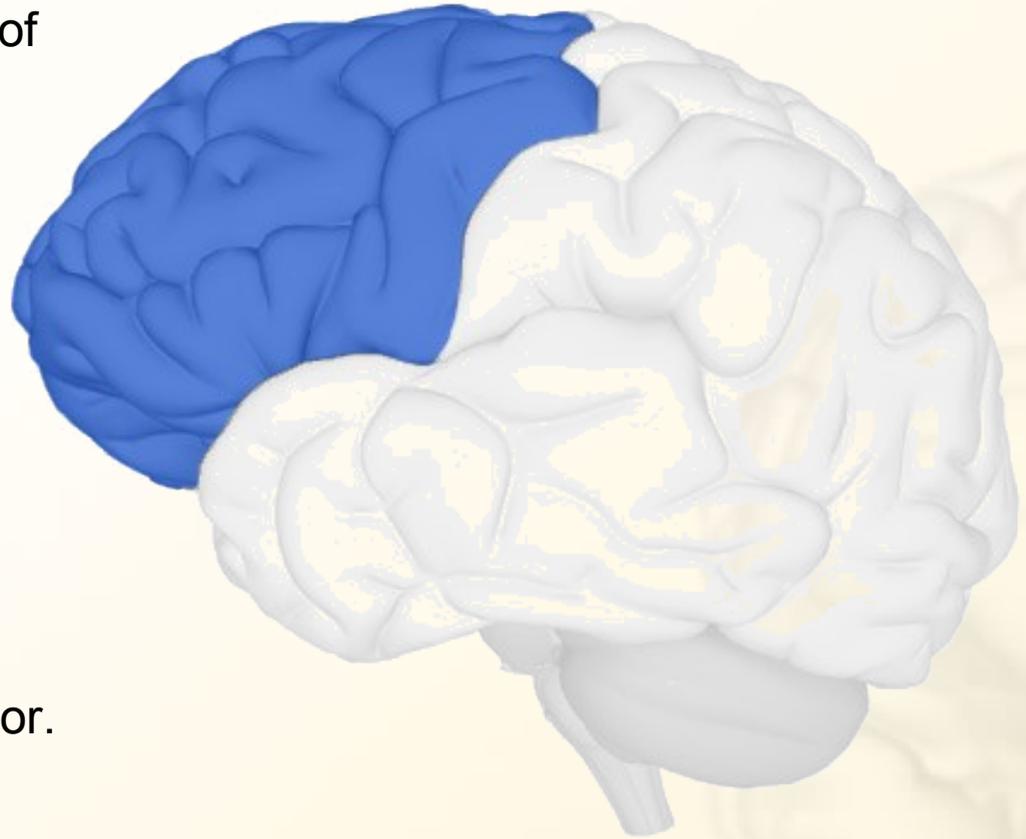
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Main Menu

Frontal Lobe

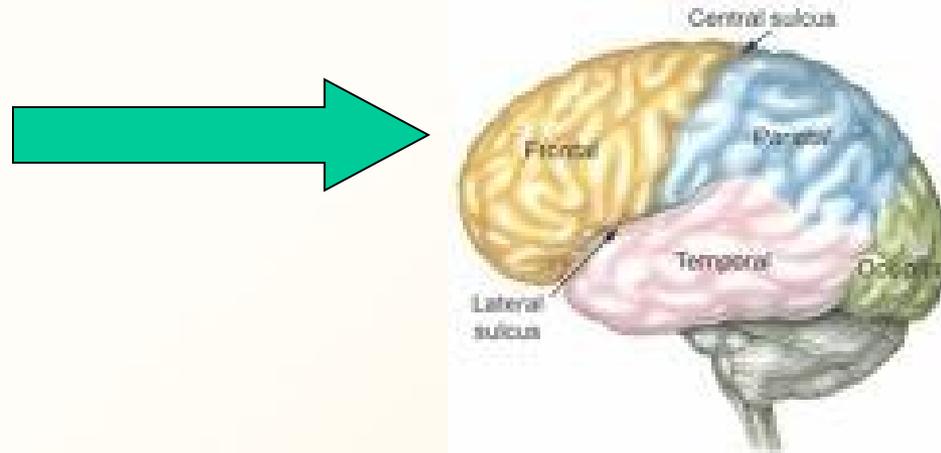
The frontal lobe is the area of the brain responsible for higher cognitive functions.

These include:

- Problem solving
- Spontaneity
- Memory
- Language
- Motivation
- Judgment
- Impulse control
- Social and sexual behavior.



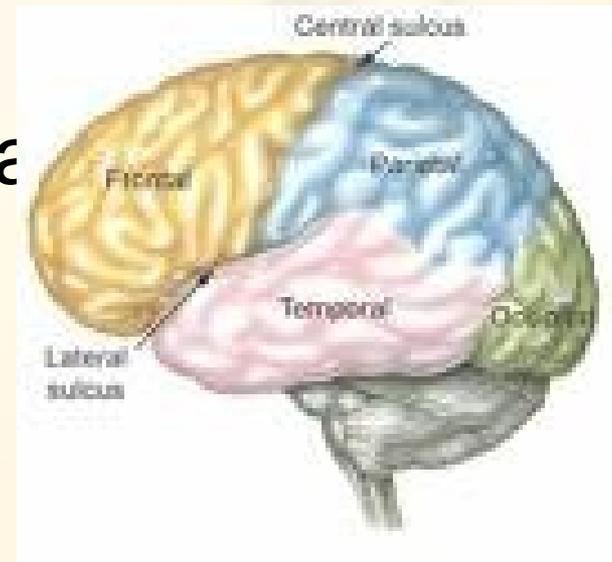
The frontal lobe p. 282



- is the center for voluntary movement
- is called the “motor area” (movement)
- includes the prefrontal area, for intelligence, creativity, memory, and ideas.

The temporal lobe p. 282

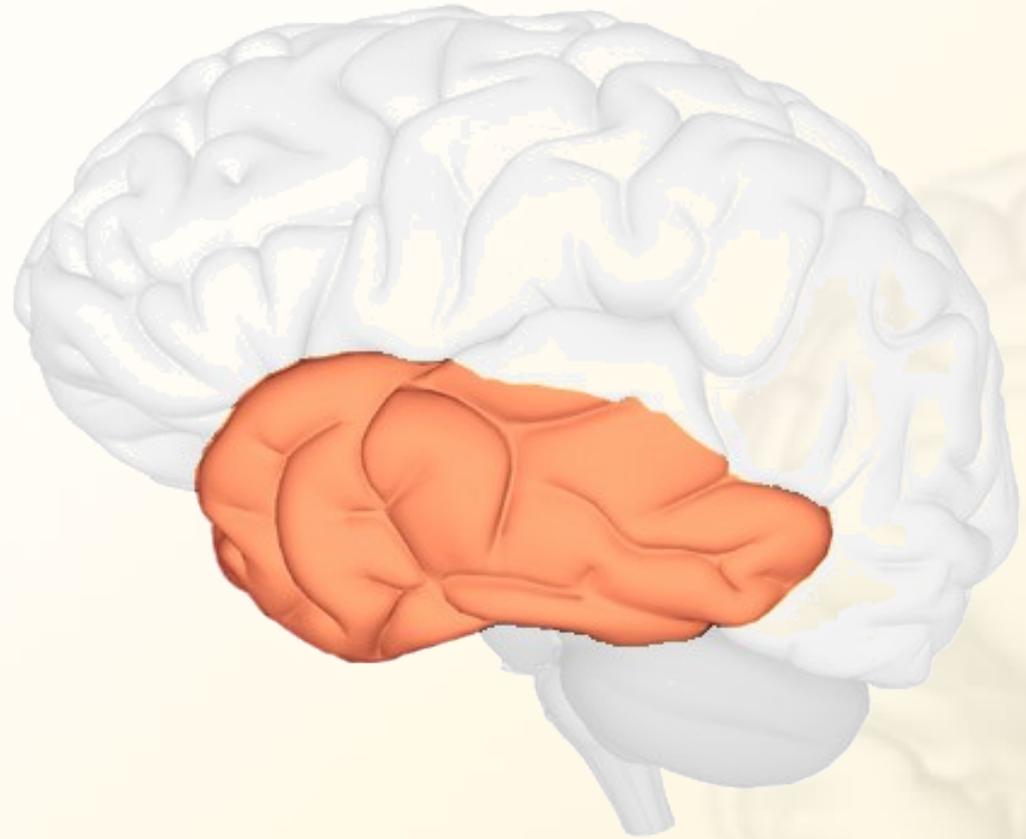
- processes auditory (hearing) information
- stores auditory (hearing) and visual (seeing) memories
- includes Broca's speech area



Temporal Lobe

The temporal lobe plays a role in emotions, and is also responsible for smelling, tasting, perception, memory, understanding music, aggressiveness, and sexual behavior.

The temporal lobe also contains the **language area** of the brain.



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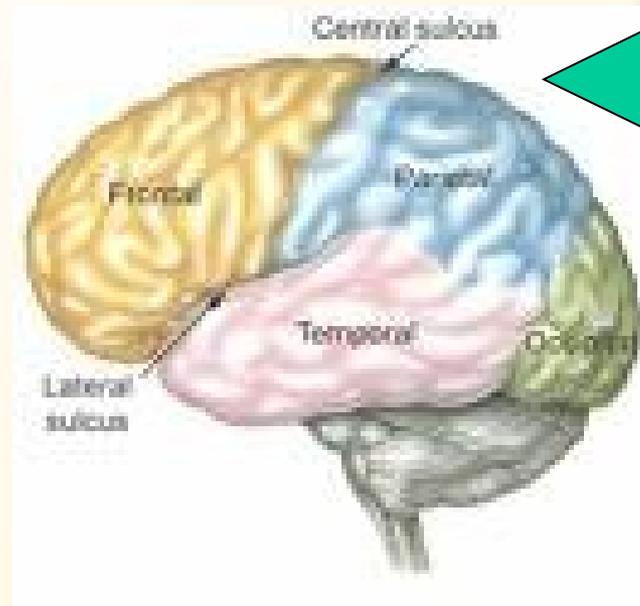
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The parietal lobe p. 282

Collects, recognizes, and organizes sensations:

feelings of

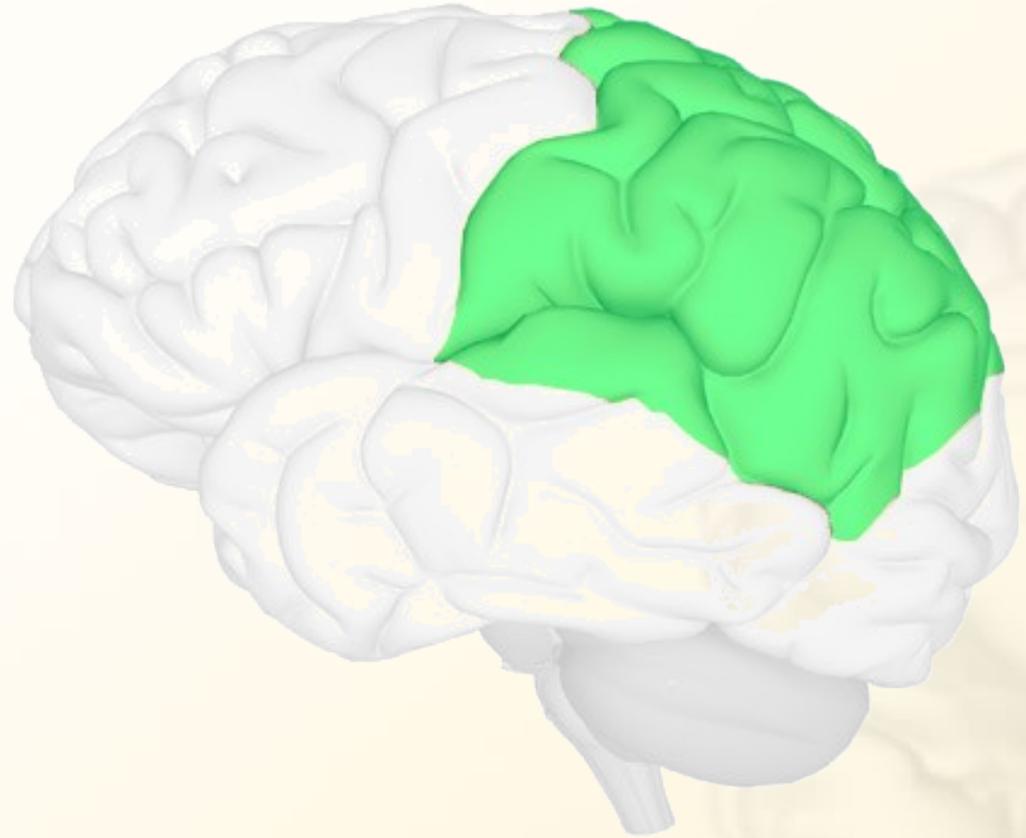
- ☀ pain
- ☀ temperature
- ☀ touch
- ☀ position
- ☀ movement



Parietal Lobe

The parietal lobe plays a role in our sensations of touch, smell, and taste. It also processes sensory and spatial awareness, and is a key component in eye-hand co-ordination and arm movement.

The parietal lobe also contains a specialized area called Wernicke's area that is responsible for matching written words with the sound of spoken **speech**.



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The occipital lobe p. 282

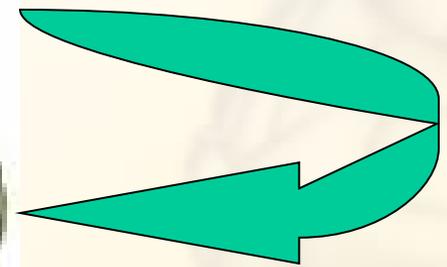
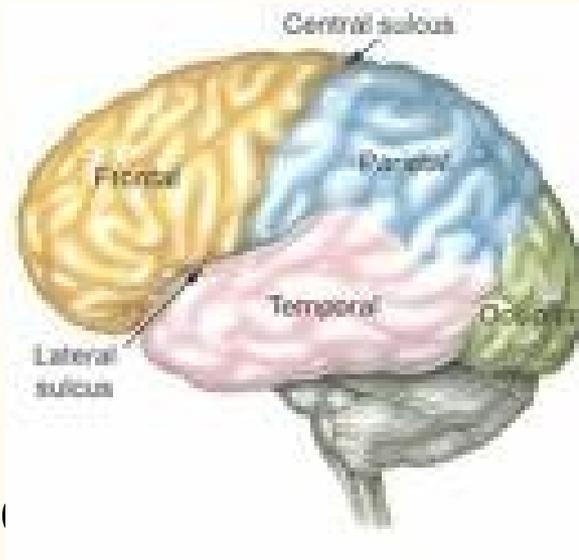
■ is at the back of the cerebral hemisphere

■ involves

■ vision

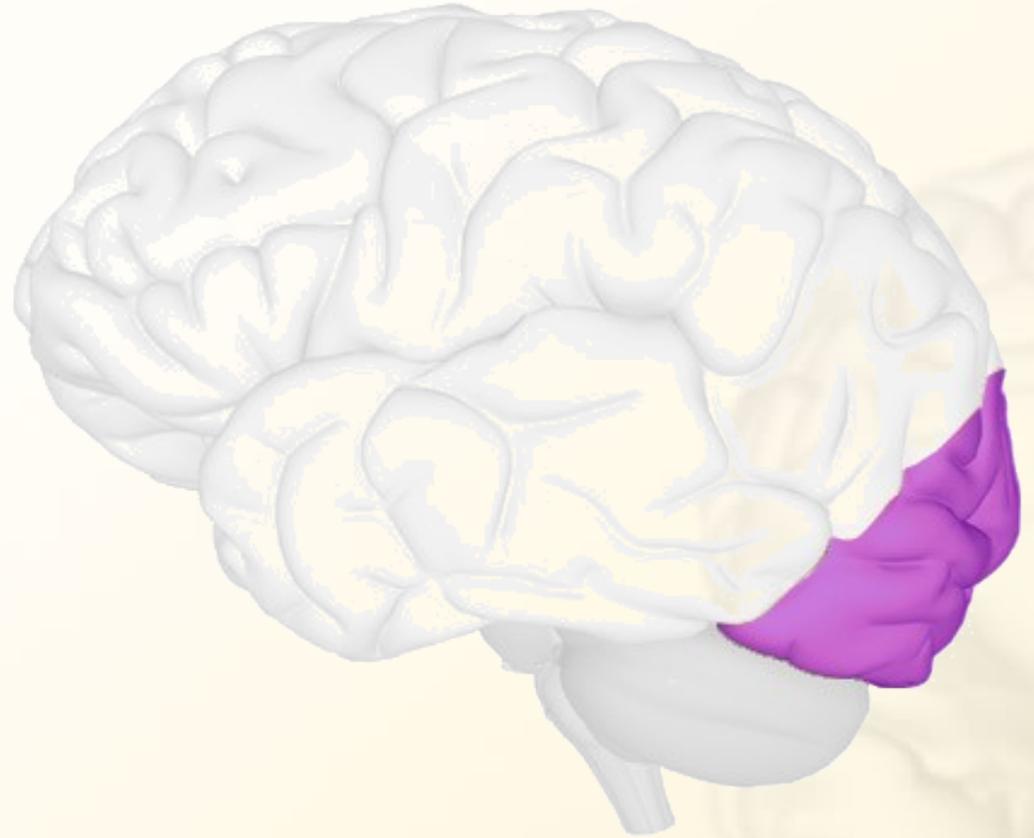
■ visual mem

■ eye movements



Occipital Lobe

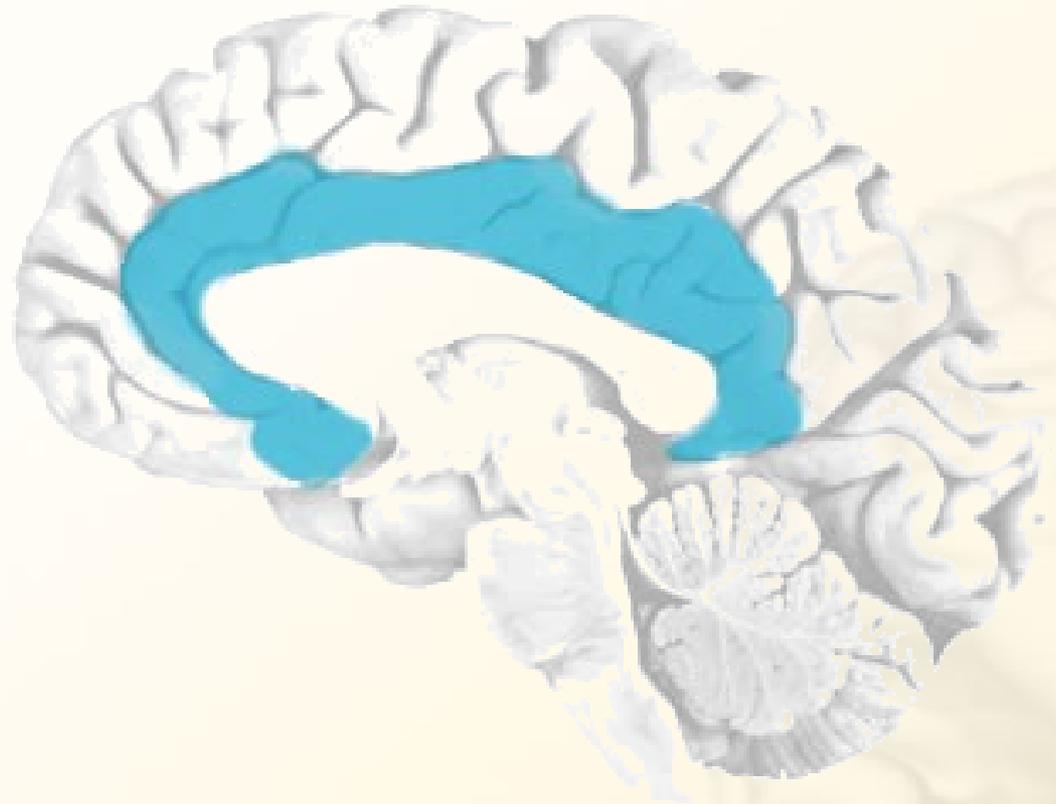
The occipital lobe is at the rear of the brain and controls **vision** and recognition.



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Limbic Lobe

The limbic lobe is located deep in the brain, and makes up the **limbic system**.

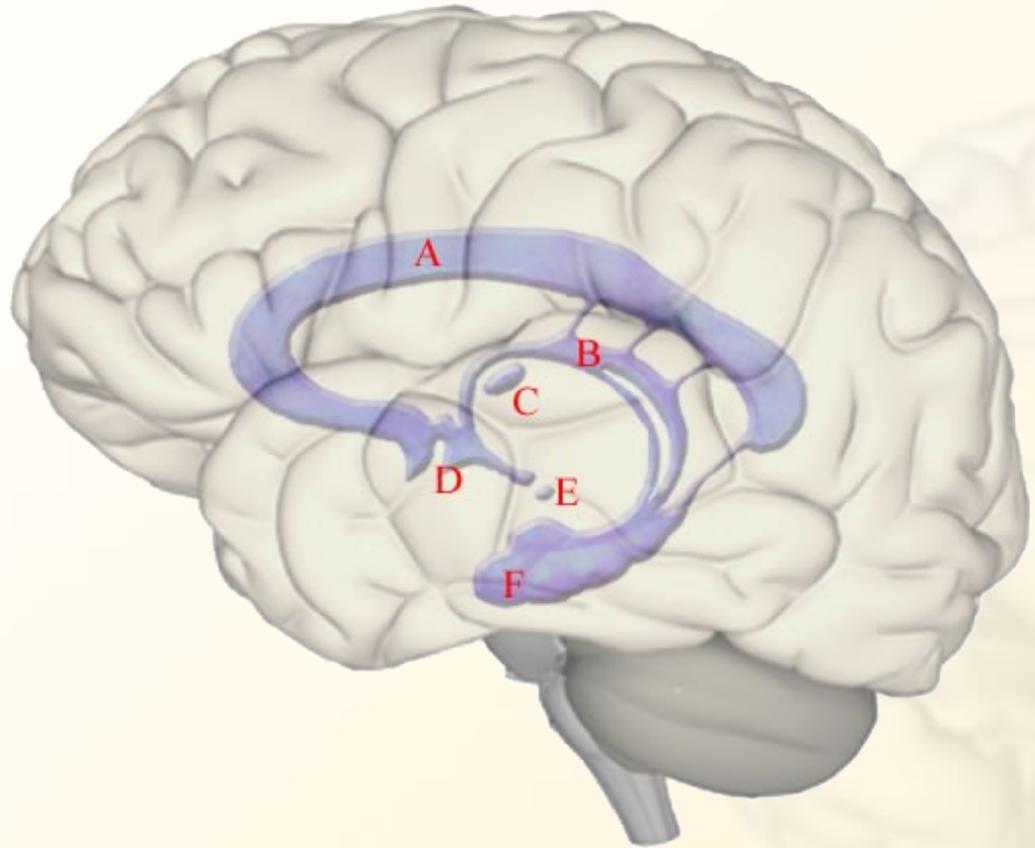


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The Limbic System

The limbic system is the area of the brain that regulates emotion and memory. It directly connects the lower and higher brain functions.

- A. Cingulate gyrus
- B. Fornix
- C. Anterior thalamic nuclei
- D. Hypothalamus
- E. Amygdaloid nucleus
- F. Hippocampus



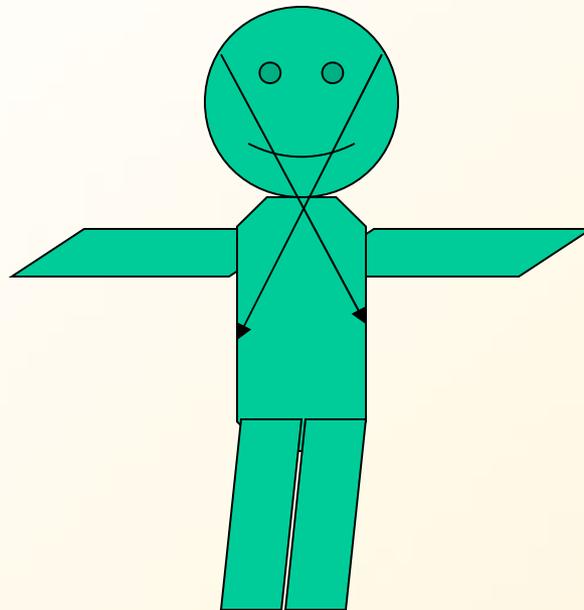
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Side to side? p. 282

The **right**
hemisphere

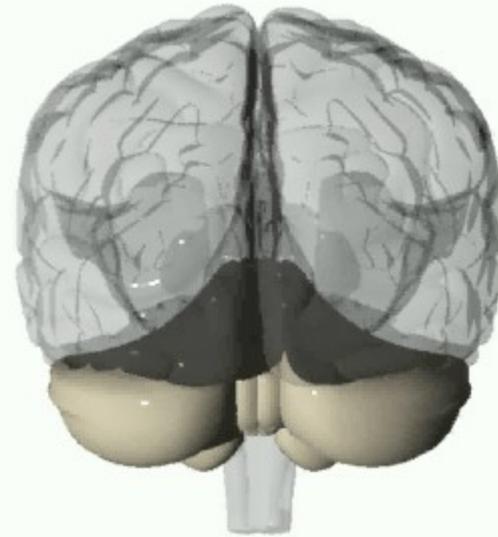
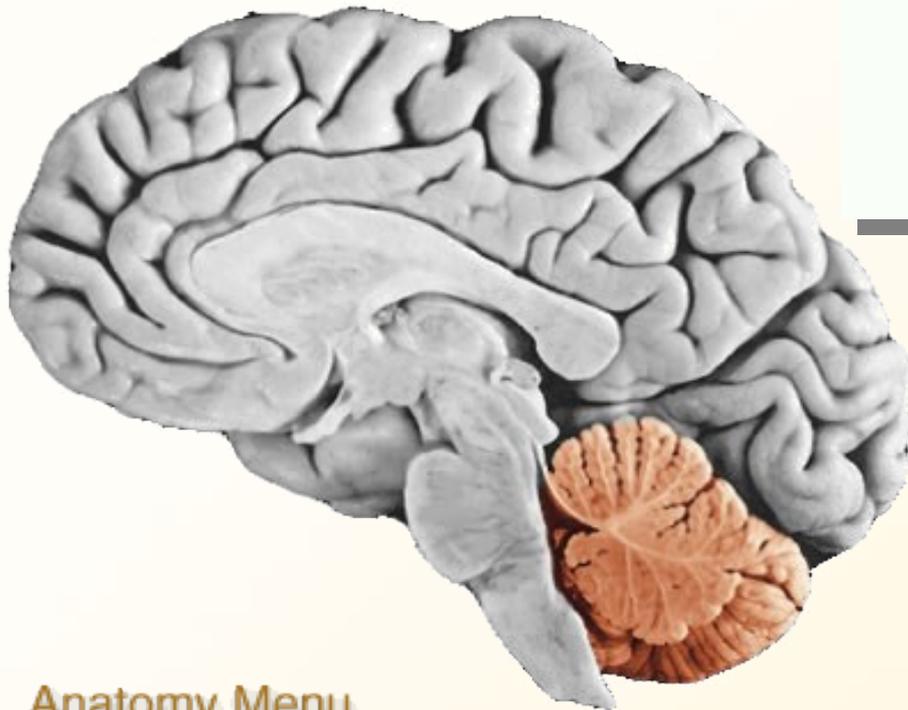
controls the **left**
side of the body!



The
left
hemisphere
controls the
right
side of the
body!

Cerebellum

The cerebellum is connected to the brainstem, and is the center for body movement and balance.



[Click image to play or pause video](#)

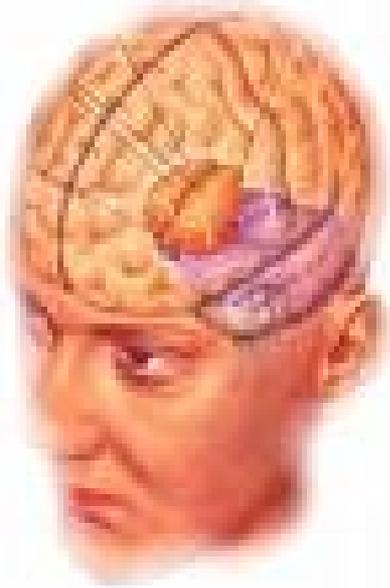
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The cerebellum p. 281

- coordinates muscle activity.
- has three parts:
 - the vermis
 - the right cerebellar hemisphere
 - the left cerebellar hemisphere



The diencephalon p. 281

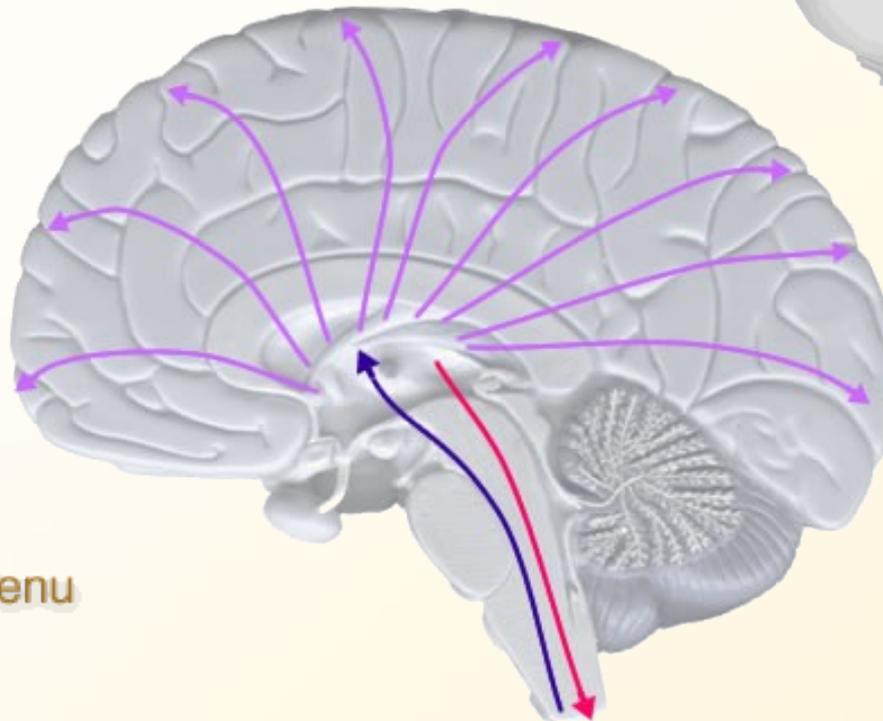


- **is located between the midbrain and the cerebrum**
- has three parts:
- the **thalamus**: receives sensory information and sends it to the cerebral cortex.
- the **epithalamus**: contains the pineal body and olfactory centers.
- the **hypothalamus**: connects the endocrine and nervous systems.

Thalamus

Thalamus means “inner room” in Greek, as it sits deep in the brain at the top of the brainstem.

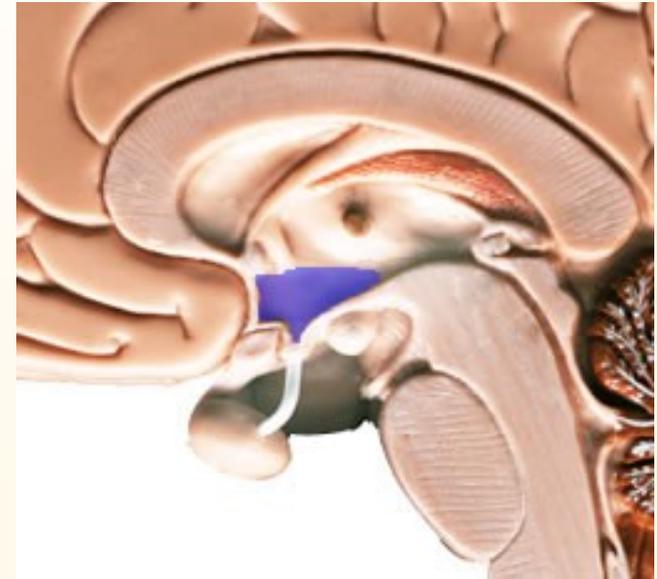
The thalamus is called the gateway to the cerebral cortex, as nearly all sensory inputs pass through it to the higher levels of the brain.



Hypothalamus

The hypothalamus sits under the thalamus at the top of the brainstem. Although the hypothalamus is small, it controls many critical bodily functions:

- Controls autonomic nervous system
- Center for emotional response and behavior
- Regulates body temperature
- Regulates food intake
- Regulates water balance and thirst
- Controls sleep-wake cycles
- Controls endocrine system



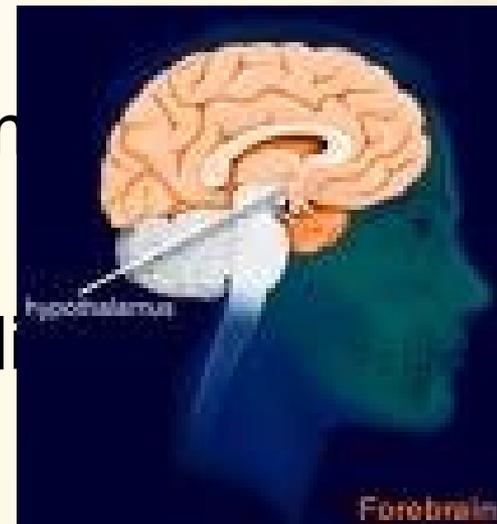
The hypothalamus is shaded blue. The pituitary gland extends from the hypothalamus.

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The hypothalamus p. 281

- connects the endocrine and nervous systems.
- controls
 - the autonomic nervous system
 - body temperature
 - carbohydrate and fat metabolism
 - appetite
 - emotions

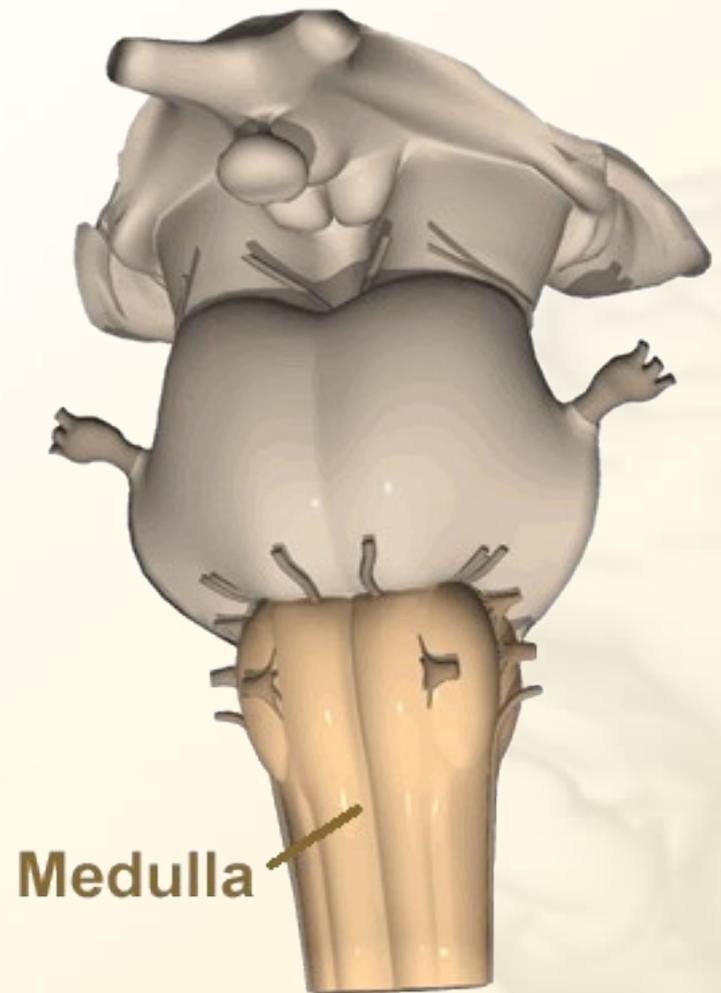


The Medulla Oblongata

The medulla oblongata merges seamlessly with the spinal cord and creates the base of the **brainstem**.

The medulla is primarily a control center for vital involuntary reflexes such as swallowing, vomiting, sneezing, coughing, and regulation of cardiovascular and respiratory activity.

The medulla is also the origin of many **cranial nerves**.



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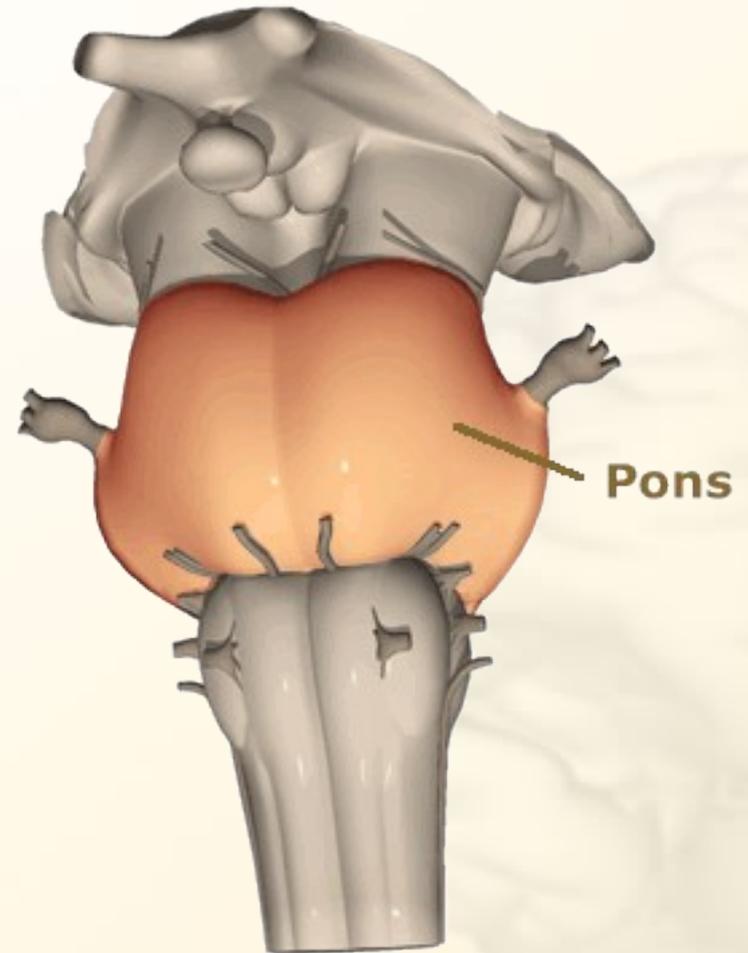
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The Pons

The pons is the rounded **brainstem** region between the midbrain and the medulla oblongata. In fact, pons means “bridge” in Latin.

The main function of the pons is to connect the cerebellum to the rest of the brain and to modify the respiratory output of the medulla.

The pons is the origin of several **cranial nerves**.



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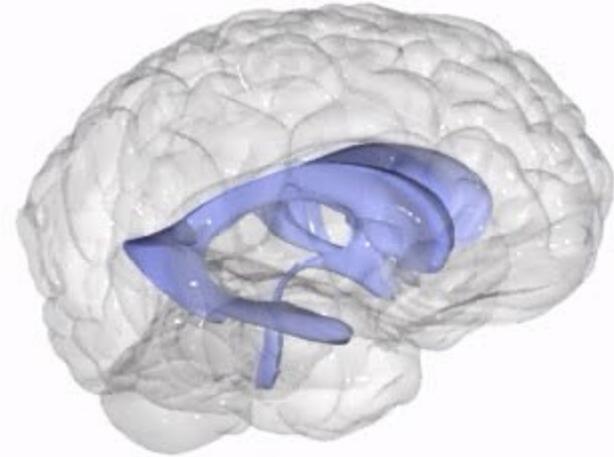
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The Ventricles

The ventricles are a complex series of spaces and tunnels through the center of the brain.

The ventricles secrete **cerebrospinal fluid**, which suspends the brain in the skull.

The ventricles also provide a route for chemical messengers that are widely distributed through the central nervous system.



[Click image to play or pause video](#)

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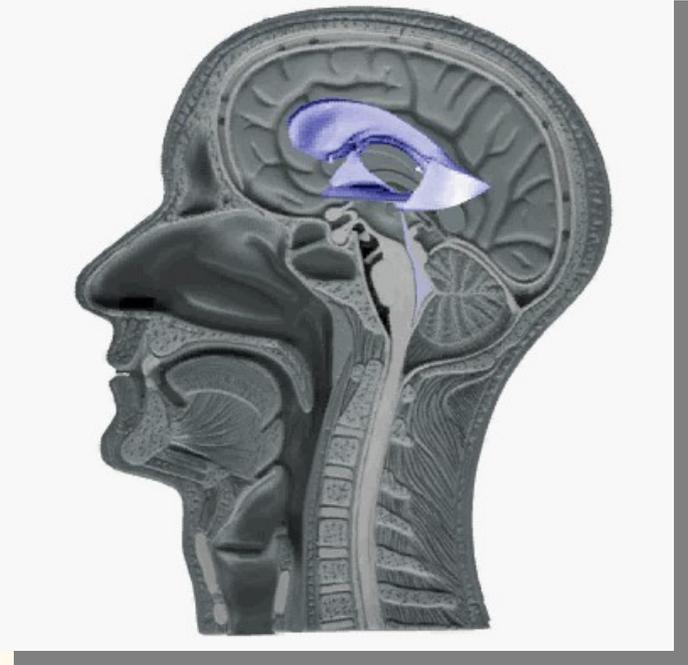
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Cerebrospinal Fluid

Cerebrospinal fluid is a colorless liquid that bathes the brain and spine.

It is formed within the ventricles of the brain, and it circulates throughout the central nervous system.

Cerebrospinal fluid fills the **ventricles** and **meninges**, allowing the brain to “float” within the skull.



[Click image to play or pause video](#)

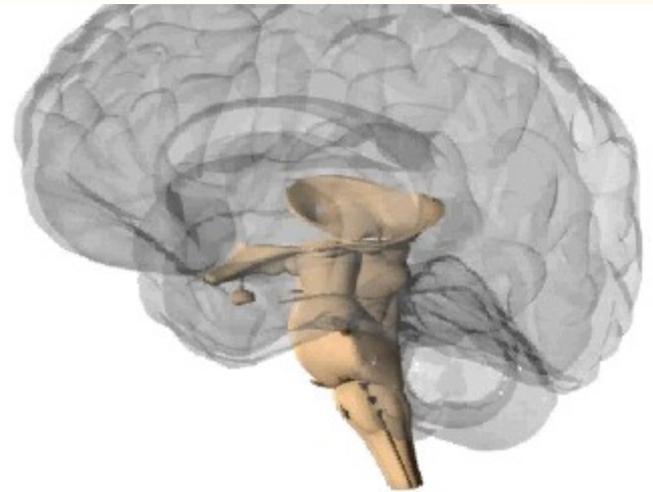
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The Brainstem

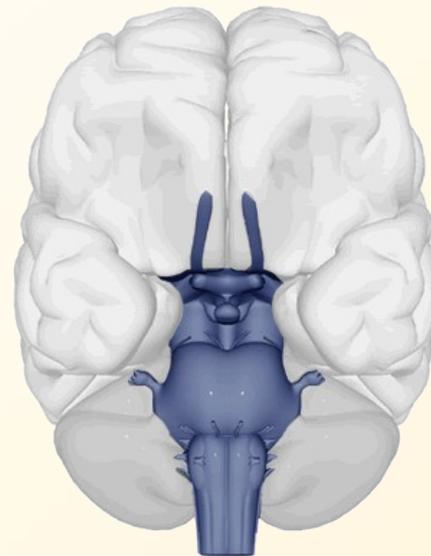
The brainstem is the most primitive part of the brain and controls the basic functions of life: breathing, heart rate, swallowing, reflexes to sight or sound, sweating, blood pressure, sleep, and balance.

The brainstem can be divided into **three major sections**.

Detailed brainstem anatomy.



[Click image to play or pause video](#)



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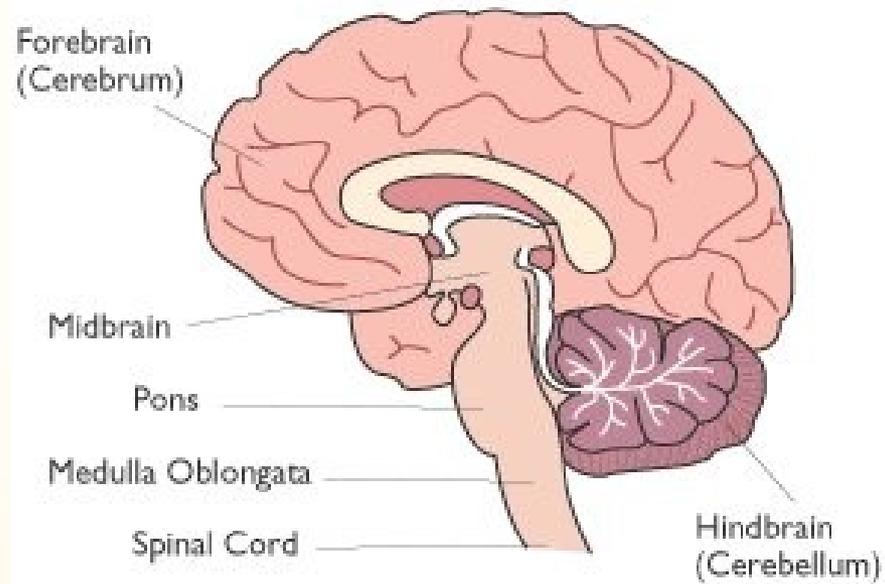
Parts of the brainstem

p. 280

- pons: connects the medulla oblongata, the cerebellum, and cerebrum
- midbrain: contains auditory (hearing), visual (sight), and muscle control centers.
- medulla oblongata: lowest and most posterior (at the back of the brain)

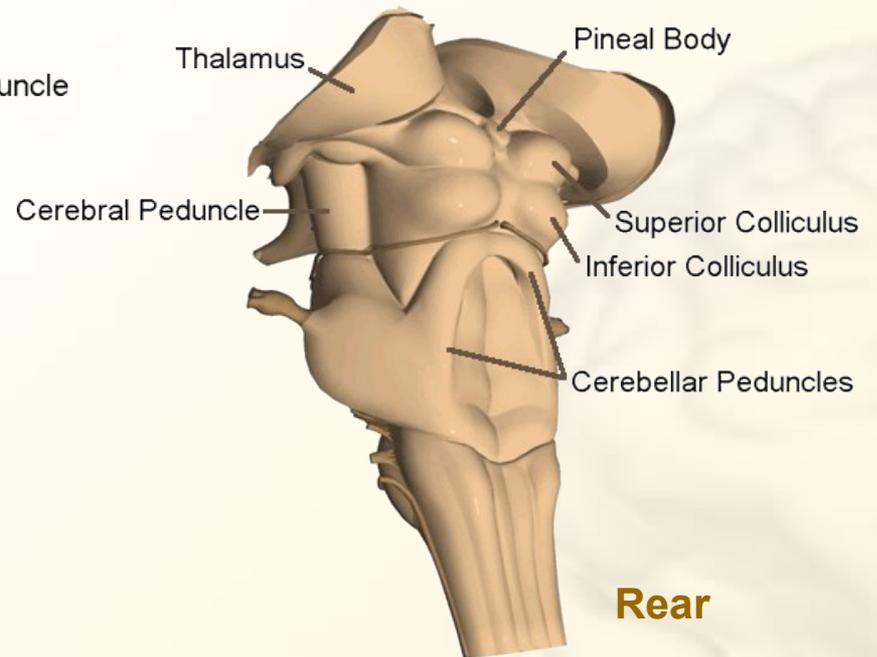
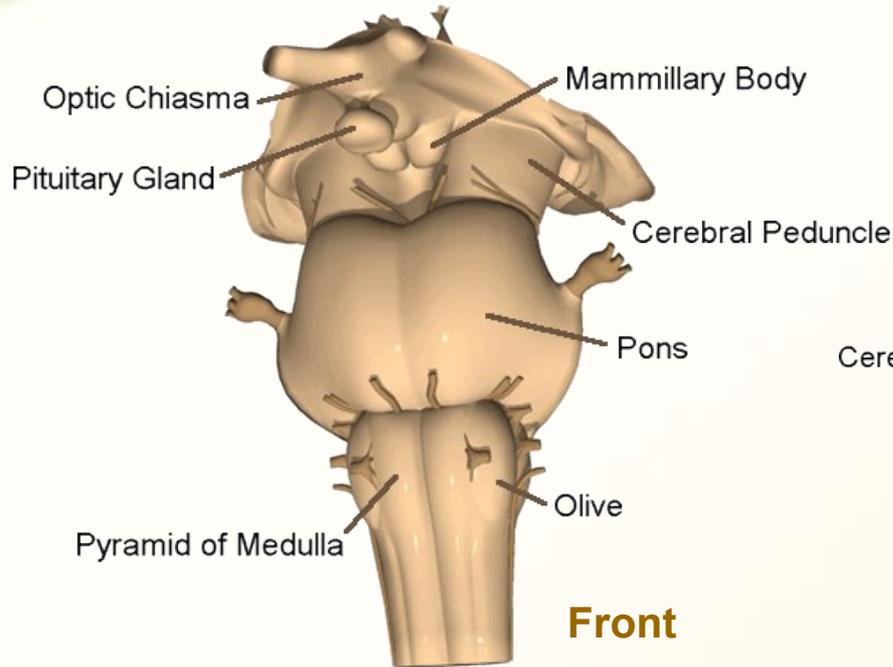
The **hindbrain** includes the **pons** and the **medulla**.

The brainstem



www.daviddarling.info/images/brainstem.jpg

Brainstem Components



More Information:

[Medulla](#)

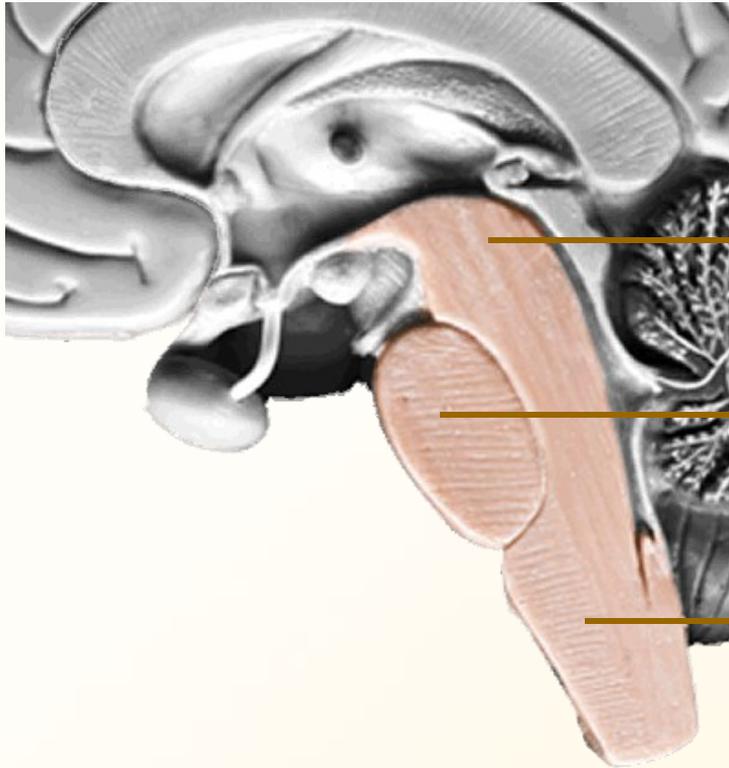
[Thalamus](#)

[Pons](#)

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Brainstem Divisions



Midbrain

Pons

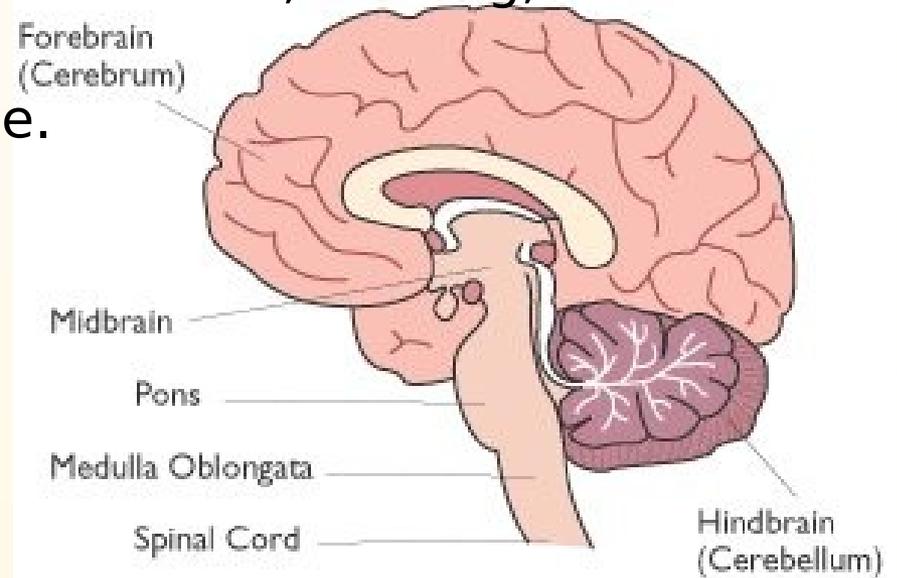
Medulla Oblongata

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The pons (the bridge) p. 280

Connects the medulla oblongata, cerebellum, and cerebrum

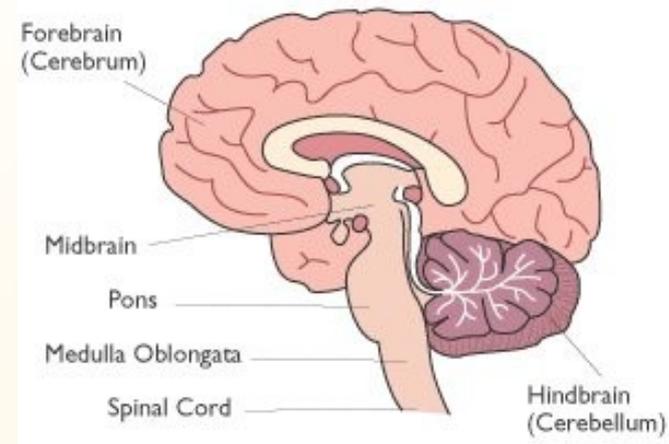
- ☀ Associates with sensory nerves: taste, hearing, and balance.
- ☀ Controls muscles of the face.



The medulla oblongata p. 280

■ controls

- alertness
- heart action
- respiration (breathing)
- blood pressure



■ connects the CEREBRUM with the SPINAL CORD

- the RIGHT side of the brain controls the LEFT side of the body.
- the LEFT side of the brain controls the RIGHT side of the body.

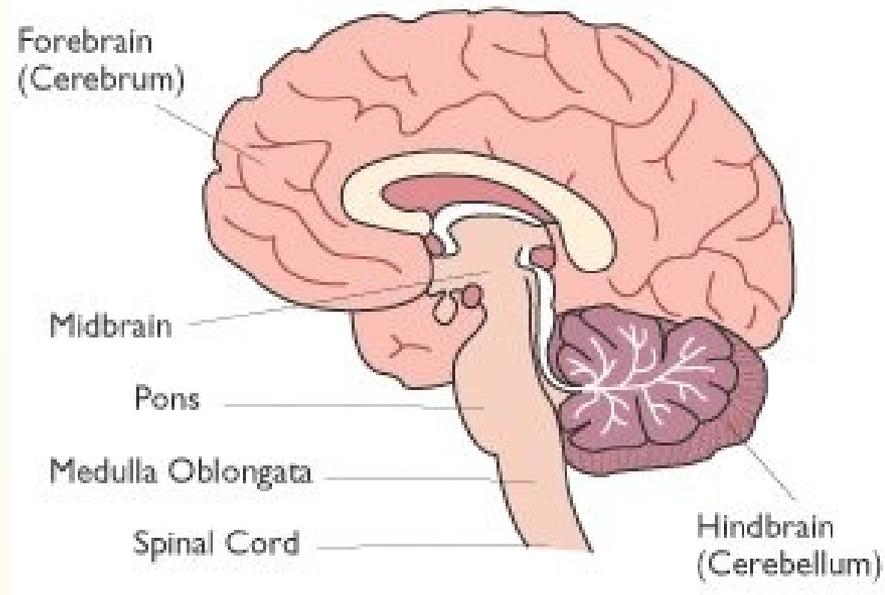
The midbrain p. 280

controls

☀ vision

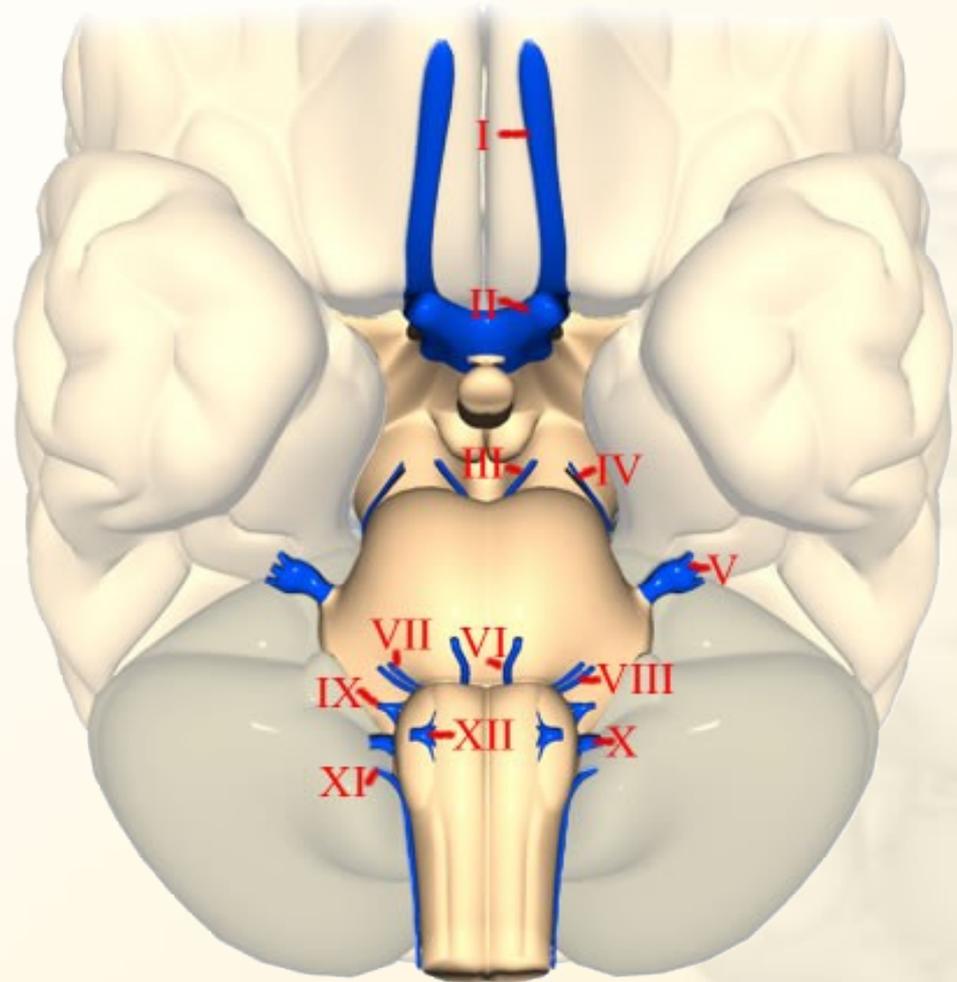
☀ hearing

☀ muscles



The Cranial Nerves

- I. Olfactory nerve
- II. Optic nerve
- III. Oculomotor nerve
- IV. Trochlear nerve
- V. Trigeminal nerve
- VI. Abducens nerve
- VII. Facial nerve
- VIII. Vestibulocochlear nerve
- IX. Glossopharyngeal nerve
- X. Vagus nerve
- XI. Accessory nerve
- XII. Hypoglossal nerve



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Brain Functions

- Vision
- Taste
- Cognition
- Emotion
- Speech
- Language
- Hearing
- Motor Cortex
- Sensory Cortex
- Autonomic Functions

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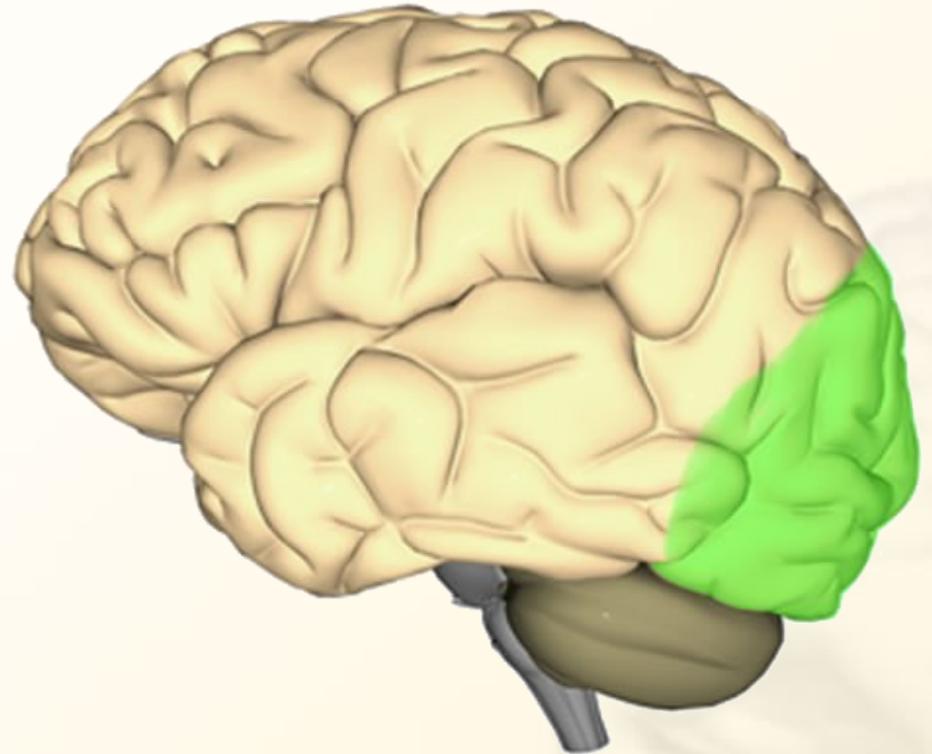


Vision

The visual cortex resides in the **occipital lobe** of the brain.

Sensory impulses travel from the eyes via the **optic nerve** to the visual cortex.

Damage to the visual cortex can result in blindness.

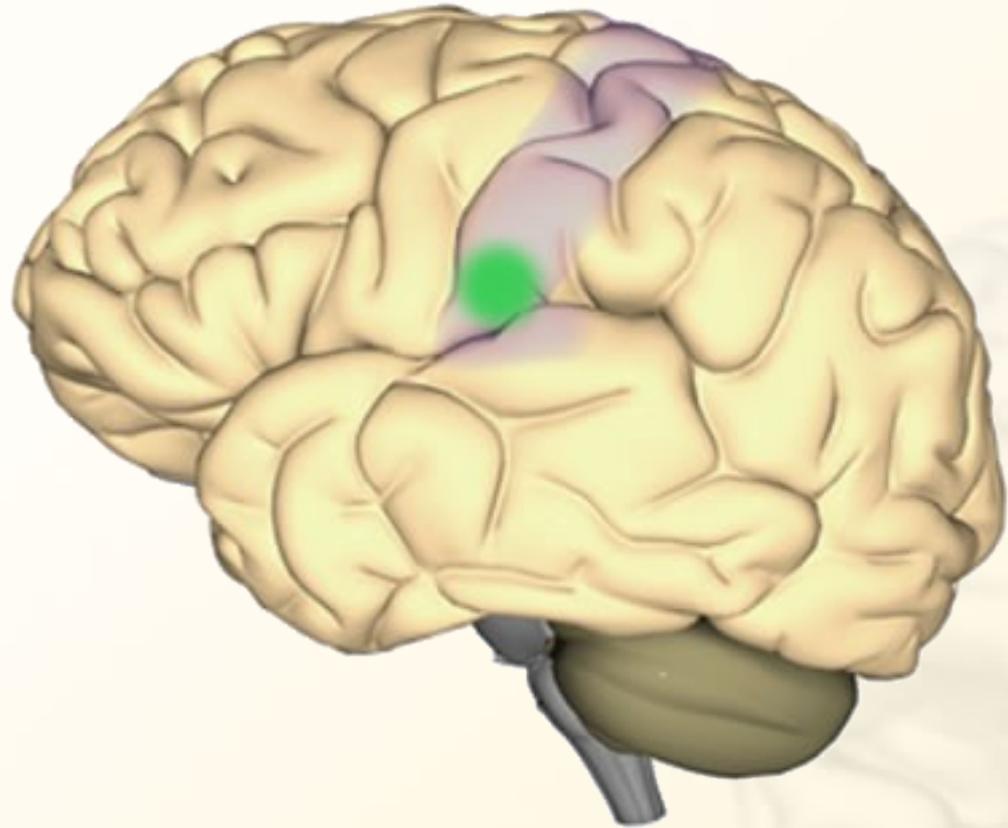


[Functions Menu](#)

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Taste

The gustatory complex (green circle) is the part of the **sensory cortex** (purple area) that is responsible for taste.



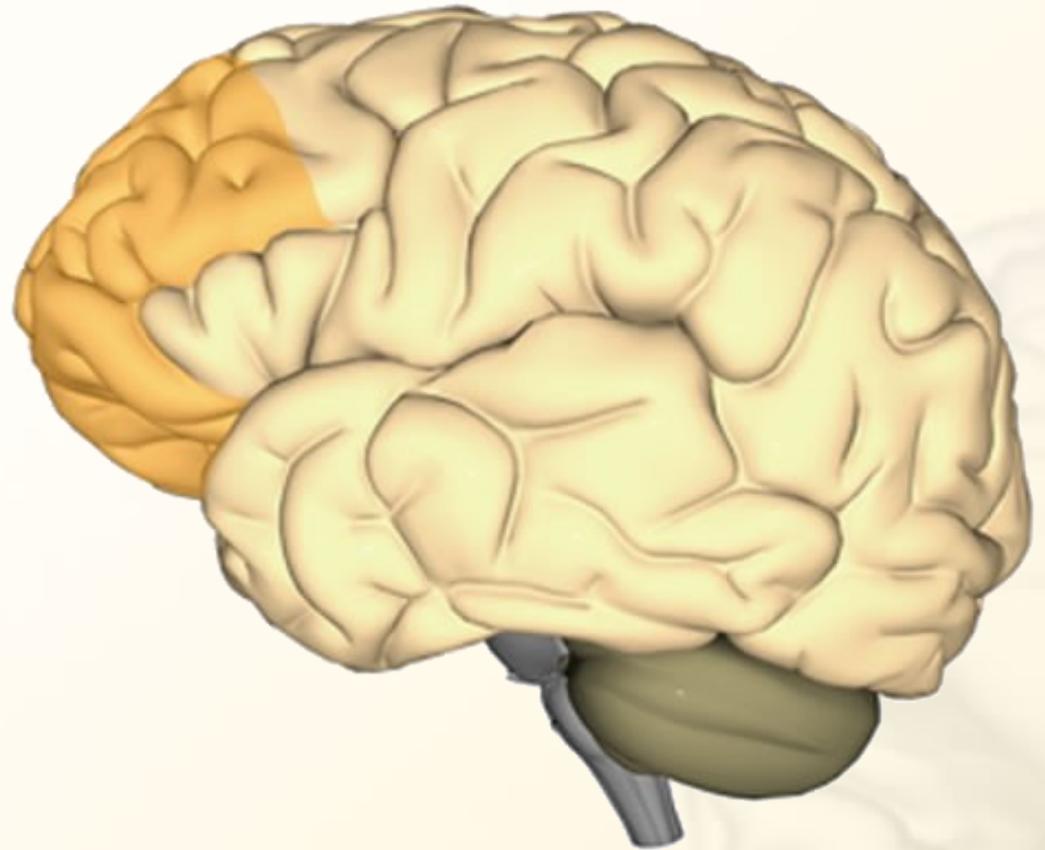
[Functions Menu](#)

[Main Menu](#)

Cognition

The prefrontal cortex is involved with intellect, complex learning, and personality.

Injuries to the **front lobe** can cause mental and personality changes.



[Functions Menu](#)

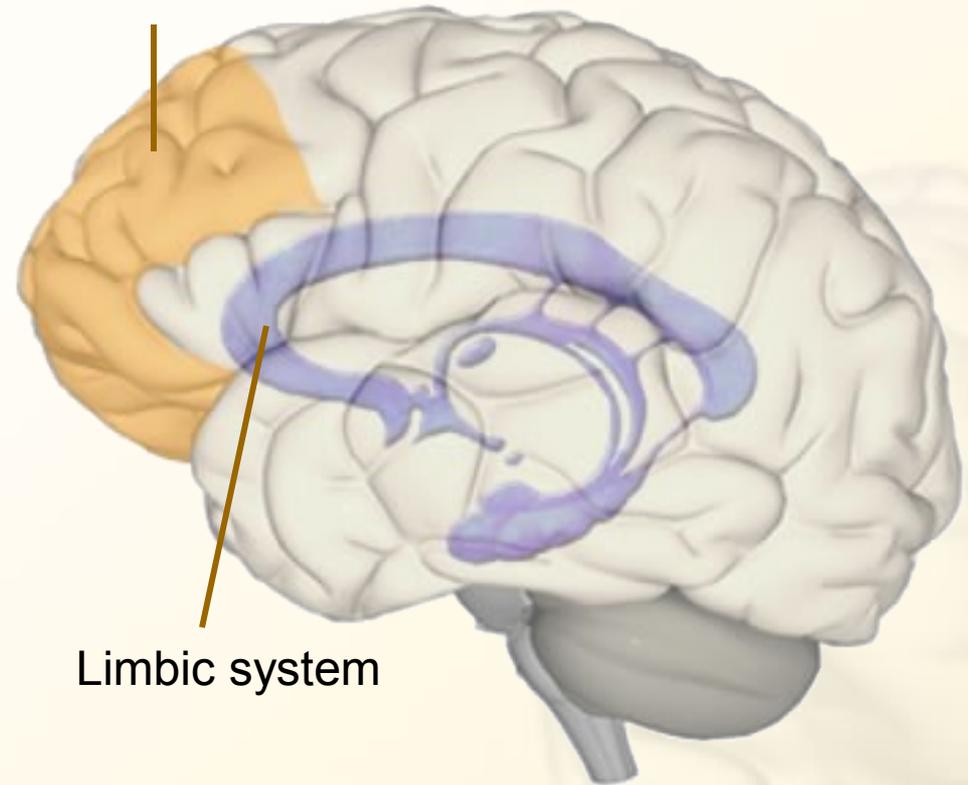
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Emotion

Emotions are an extremely complex brain function. The emotional core of the brain is the **limbic system**. This is where senses and awareness are first processed in the brain.

Mood and personality are mediated through the **prefrontal cortex**. This part of the brain is the center of higher cognitive and emotional functions.

Prefrontal cortex



Limbic system

[Functions Menu](#)

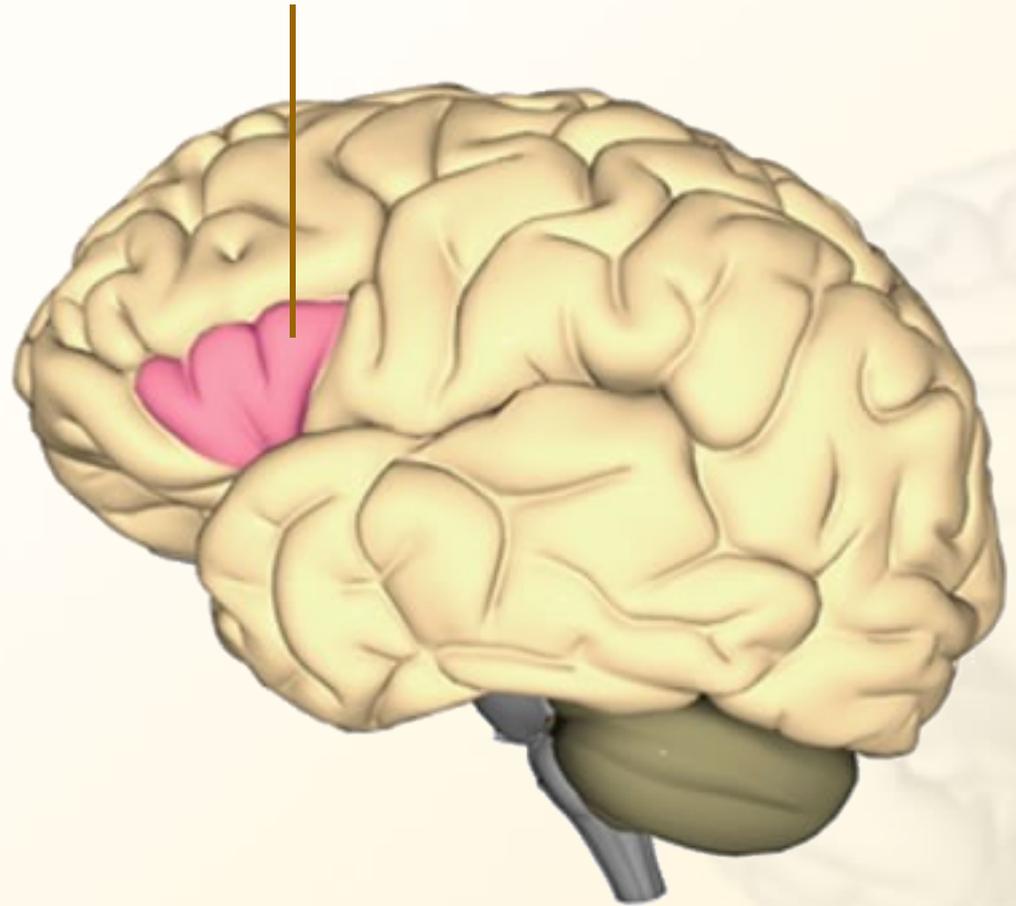
[Main Menu](#)

Speech

Broca's Area

Broca's area is where we formulate speech and the area of the brain that sends motor instructions to the **motor cortex**.

Injury to Broca's area can cause difficulty in speaking. The individual may know what words he or she wishes to speak, but will be unable to do so.



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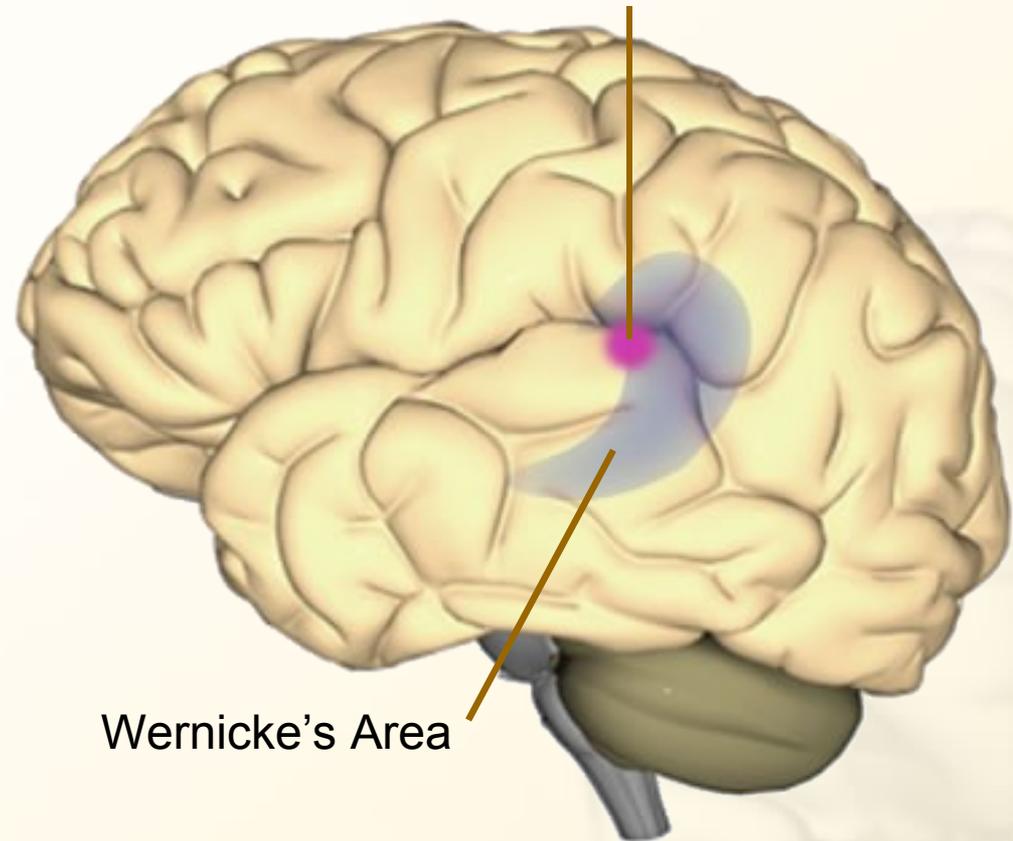
Language

Wernicke's area is a specialized portion of the parietal lobe that recognizes and understands written and spoken language.

Wernicke's area surrounds the **auditory association area**.

Damage to this part of the brain can result in someone hearing speech, but not understanding it.

Auditory Association Area



Wernicke's Area

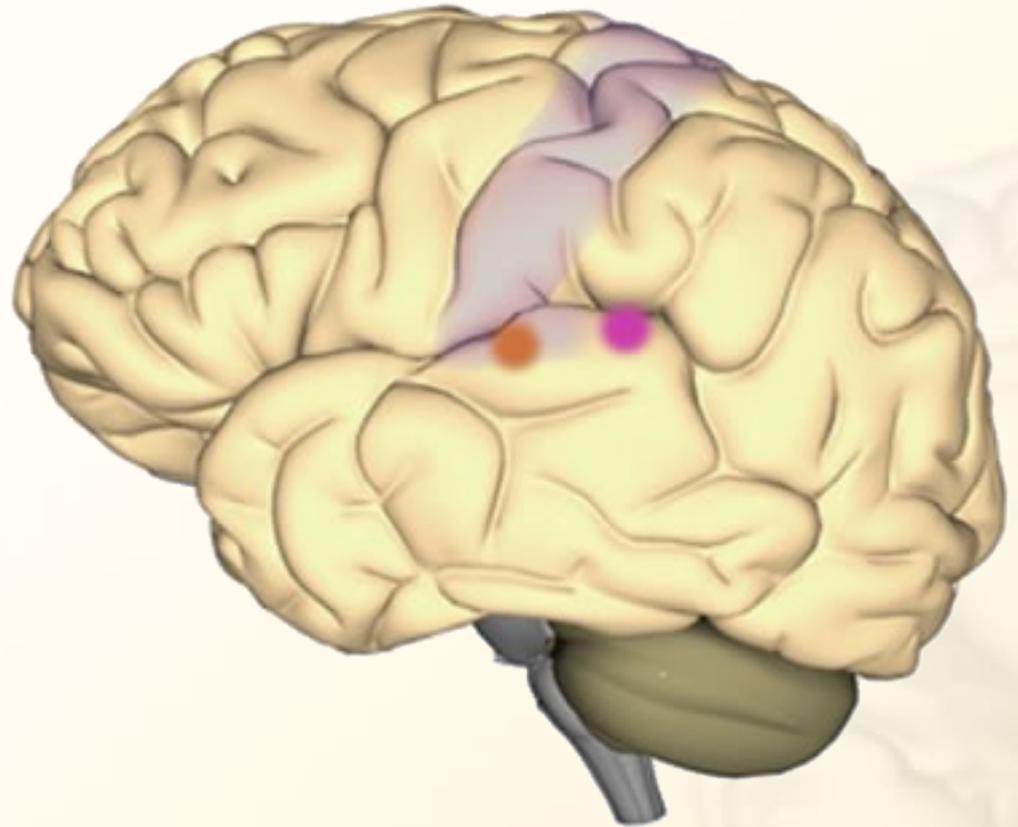
[Functions Menu](#)

[Main Menu](#)

Hearing

There are two auditory areas of the brain:

- The primary auditory area (brown circle) is what detects sounds that are transmitted from the ear. It is located in the **sensory cortex**.
- The auditory association area (purple circle) is the part of the brain that is used to recognize the sounds as speech, music, or noise.



[Functions Menu](#)

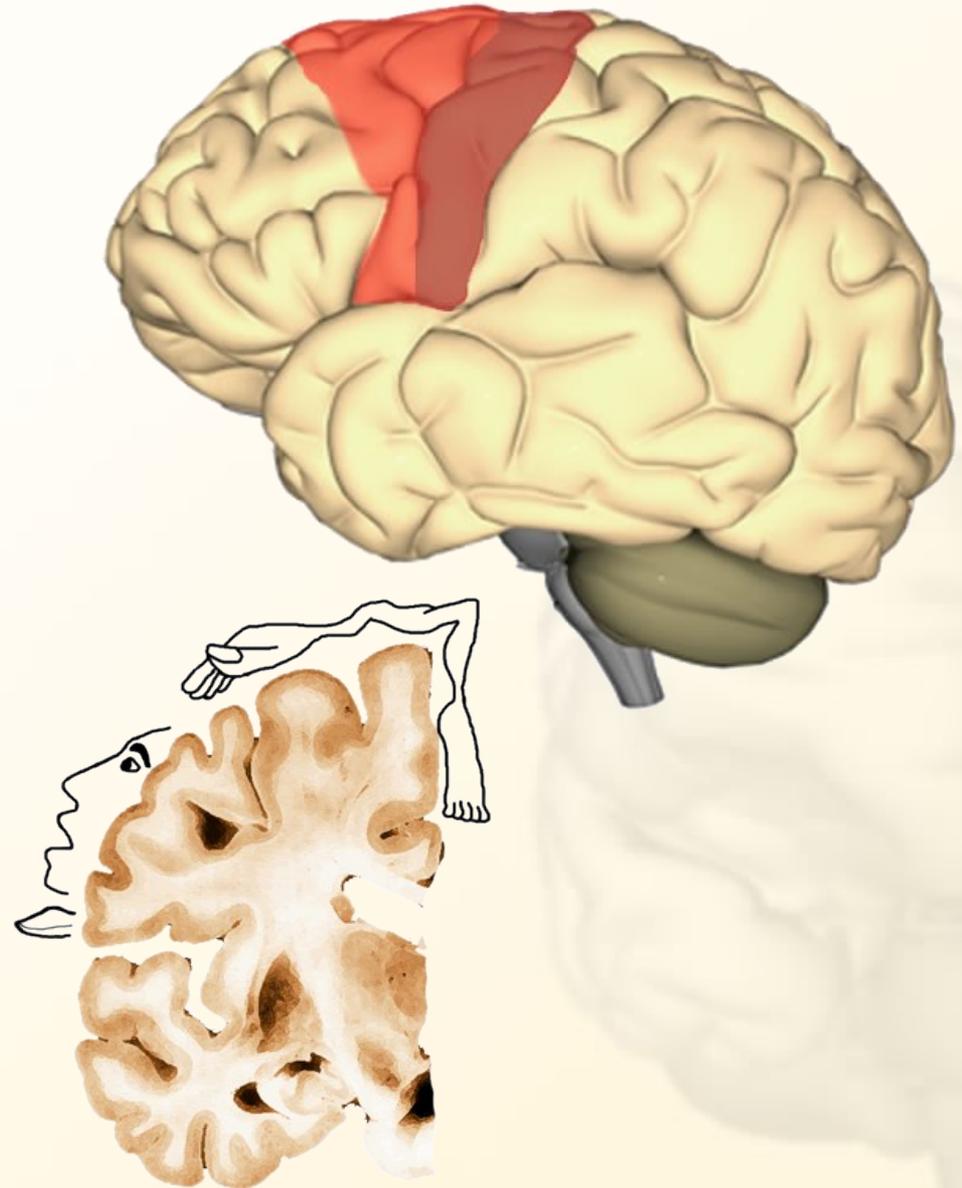
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Motor Cortex

The motor portion of the cerebrum is illustrated here. The light red area is the premotor cortex, which is responsible for repetitive motions of learned motor skills. The dark red area is the primary motor area, and is responsible for control of skeletal muscles.

Different areas of the brain are associated with different parts of the body.

Injury to the motor cortex can result in motor disturbance in the associated body part.



[Functions Menu](#)

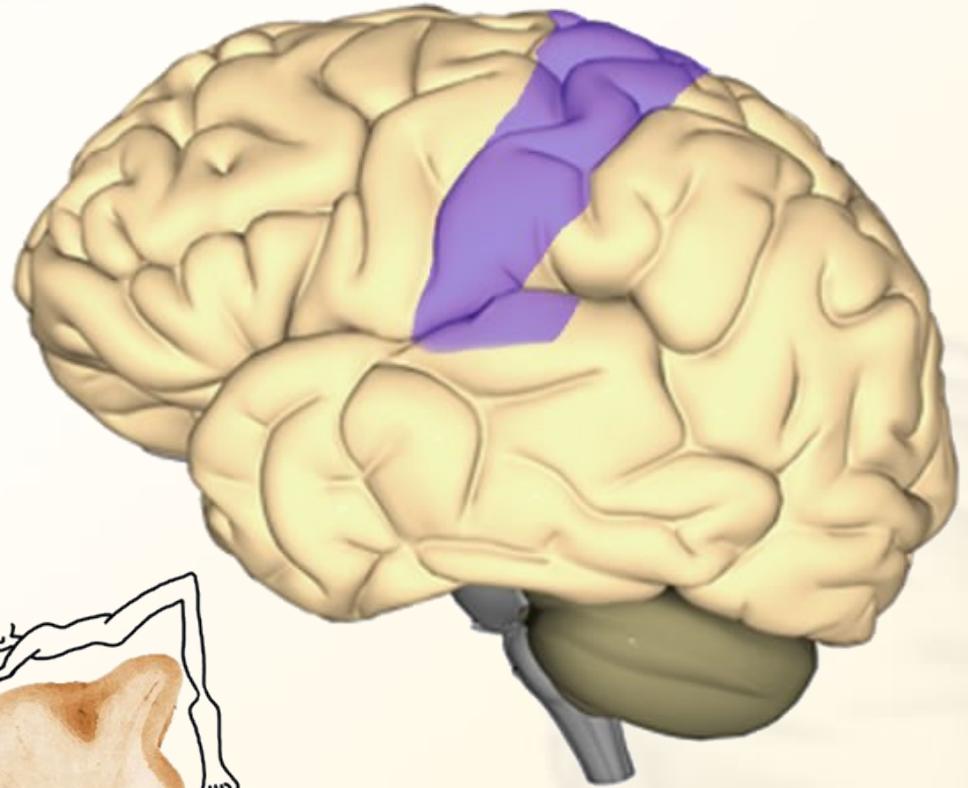
[Main Menu](#)

Sensory Cortex

The sensory portion of the cerebrum is illustrated here.

Different areas of the brain are associated with different parts of the body, as can be seen below.

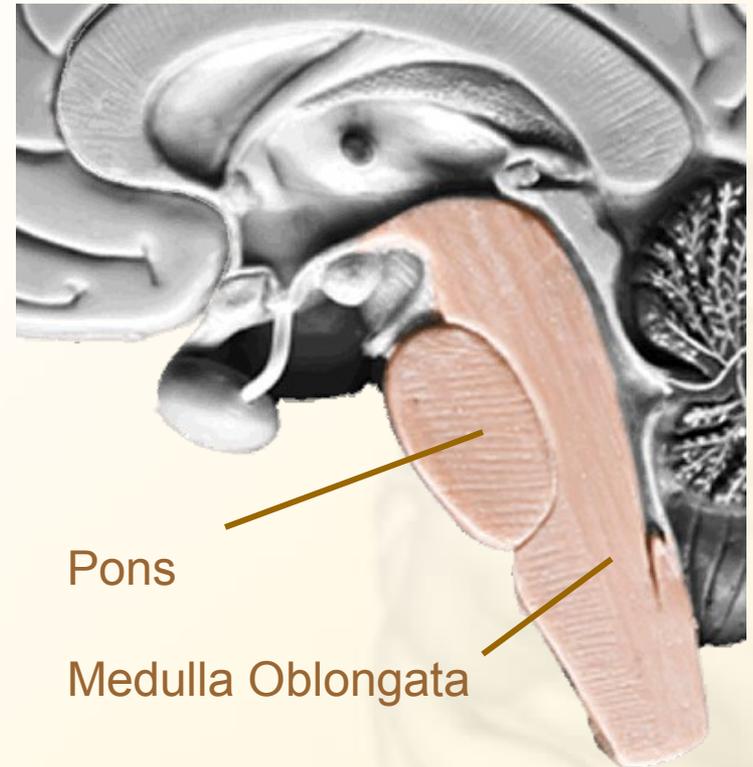
Injury to the sensory cortex can result in sensory disturbance in the associated body part.



Autonomic Functions

The brainstem controls the basic functions of life. Damage to these areas of the brain are usually fatal:

- The **pons** plays a critical role in respiration.
- The **medulla oblongata** is responsible for respiration and cardiovascular functions.



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Bibliography

The following are excellent resources and were the basis of the anatomical and functional components of this presentation:

- The Human Brain: An Introduction to Its Functional Anatomy, Fifth Edition. John Nolte, Mosby, 2002. ISBN: 0-323-01320-1 [Purchase Here](#)
- Coping with Mild Traumatic Brain Injury. Dr. Diane Stoler, Avery Penguin Putnam, 1998. ISBN: 0895297914 [Purchase Here](#)
- Human Anatomy and Physiology, Fifth Edition. Elaine N. Marieb, Benjamin/Cummings, 2000. ISBN: 0805349898. [Purchase Here](#)



Thanks For All

