

Overview of the Brain

Center for Educational Outreach
Baylor College of Medicine

Digitally enhanced MRI of the human head showing the brain, spinal cord and other tissues.
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Image Reference

Digitally enhanced MRI of the human head showing the brain and spinal cord in orange/yellow and other tissues in blue and pink. Image B0005622 © Mark Lythgoe and Chloe Hutton, Wellcome Images CC-BY-NC-ND 4.0. <http://wellcomeimages.org/>

Key Words

brain, human, nervous system, communication, coordination, behavior

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Major Components of the Brain

- The brain is a highly complex organ at the center of the human nervous system.
- The brain can be divided into three major parts.
 - **Forebrain** – Includes the cerebrum (largest part of the brain), cerebral cortex, corpus callosum, thalamus, hypothalamus and the limbic system
 - **Midbrain** – Part of the brainstem above the pons (about 2 cm long); connects the forebrain to the spinal cord
 - **Hindbrain** – Part of the brainstem below the midbrain (including the pons and medulla oblongata), and the cerebellum



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Major Components of the Brain

The brain provides the integrative power that underlies the complex behavior of all vertebrates. Mammals' brains are particularly large, relative to their body mass, due mostly to the great enlargement of the cerebrum, the dominant part of the mammalian brain.

In discussing brain organization, biologists often refer to subdivisions that are apparent at particular stages of embryonic development. The brain can be divided into the forebrain, midbrain, and hindbrain. In humans, the medulla oblongata, pons, and midbrain make up the brainstem.

Note: The spinal cord lies in the vertebral canal and in adults, begins at the top of the first cervical vertebra and stops at the bottom of the first lumbar vertebra (a distance of between 42 and 45 cm).

References

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2. Brain Explorer: Brain Atlas. The Lundbeck Institute, Copenhagen, Denmark.

http://www.brainexplorer.org/brain_atlas/Brainatlas_index.shtml

3. Campbell, N.A., and Reece, J.B. (2008). *Biology, 8th Edition*. San Francisco, CA: Pearson Benjamin Cummings.

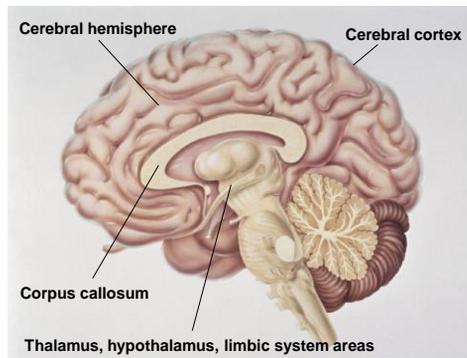
Key Words

brain, human, nervous system, behavior, forebrain, midbrain, hindbrain

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Cerebrum

- The cerebrum sits above the cerebellum and brain stem, and is made up of two hemispheres connected by a bundle of nerves called the corpus callosum.



- The cerebrum enables one to think, learn, reason, remember, feel sensations and emotions, and move muscles purposefully.



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Cerebrum

The region of the cerebral cortex responsible for judgment, organization and reasoning appears to be one of the last brain areas to reach maturity.

Reference

Moreno, N.P., B.T. Tharp, and T. GrandPré. (2013). *Brain Chemistry Teacher's Guide*. Houston, TX: Baylor College of Medicine.

Image Reference

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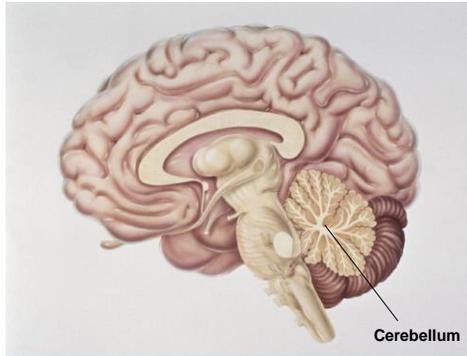
Key Words

brain, human, nervous system, cerebrum, cerebral cortex, corpus callosum, think, learn, reason, senses, emotions, remember, muscle movement

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Cerebellum

- The cerebellum helps coordinate motor, perceptual and cognitive functions.
- It also is involved in learning and remembering motor skills.



Cerebellum

The cerebellum, which develops as part of the hindbrain, coordinates movement and balance. It functions in coordination and error-checking during motor, perceptual and cognitive performance. The cerebellum also monitors motor commands issued by the cerebrum. The cerebellum uses this information to provide automatic coordination of movements and balance. The cerebellum also is involved in learning and remembering motor responses.

Reference

Campbell, N.A., and Reece, J.B. (2008). *Biology, 8th Edition*. San Francisco, CA: Pearson Benjamin Cummings.

Image Reference

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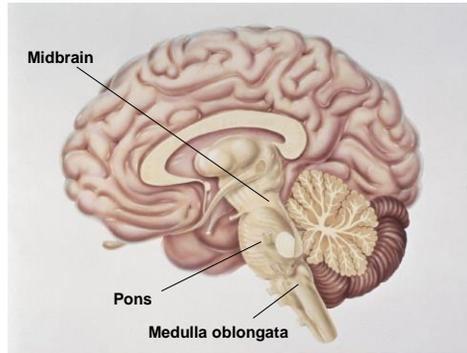
Key Words

brain, human, nervous system, cerebellum, motor skills, cognition, perception, coordination

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Brainstem

- The brainstem functions in homeostasis, coordination of movement and conduct of information to and from higher brain centers.
- Components of the brainstem:
 - Midbrain
 - Pons
 - Medulla oblongata



Brainstem

The transfer of information is one of the most important functions of the pons and medulla oblongata, commonly called the medulla. The medulla and pons also help to coordinate large-scale body movements, such as walking. The medulla controls several automatic functions, such as breathing, swallowing and digestion. The pons also helps regulate breathing centers in the medulla. The midbrain contains centers for receiving and integrating sensory information, and it sends coded information along neurons to the forebrain. The midbrain also coordinates visual reflexes. The brainstem as a whole affects attention, alertness, appetite, and motivation.

Reference

Campbell, N.A., and Reece, J.B. (2008). *Biology, 8th Edition*. San Francisco, CA: Pearson Benjamin Cummings.

Image Reference

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Key Words

brain, human, nervous system, brainstem, midbrain, pons, medulla oblongata, communication, movement, behavior

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Diencephalon

- Components of the diencephalon:
 - Hypothalamus
 - Thalamus
- The hypothalamus and thalamus are major integrating centers that act as relay stations for information flow in the body.

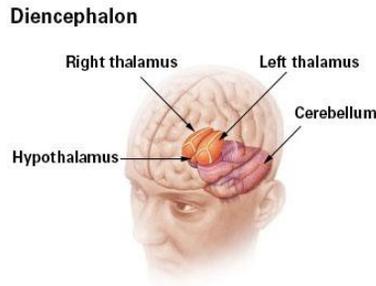


Illustration courtesy of the National Cancer Institute, NIH.

Diencephalon

The diencephalon develops into the thalamus and hypothalamus in the adult brain. The thalamus is the main input center for sensory information going to the cerebrum and the main output for motor information leaving the cerebrum.

The hypothalamus contains the body's "thermostat," as well as centers for regulating hunger, thirst and other basic survival mechanisms, such as sexual and mating behaviors, circadian rhythms and the fight-or-flight response. It is also a source of posterior pituitary hormones, and it releases hormones that act on the anterior pituitary.

Reference

Campbell, N.A., and Reece, J.B. (2008). *Biology, 8th Edition*. San Francisco, CA: Pearson Benjamin Cummings.

Image Reference

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http://commons.wikimedia.org/wiki/File:Illu_diencephalon_.jpg

Key Words

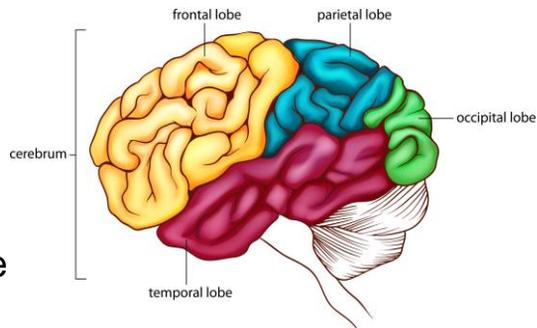
brain, human, diencephalon, thalamus, hypothalamus, sensory, motor, regulation, circadian rhythm

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Cerebral Cortex

Main regions of the cerebral cortex:

- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe



Cerebral Cortex

The cerebral cortex is divided into right and left sides, each of which is responsible for the opposite half of the body. Each side of the cerebral cortex is described as having four lobes: frontal, temporal, occipital and parietal. Visual information is directed to the occipital lobe, auditory input to the temporal lobe, somatosensory information to the parietal lobe, and olfactory information to the frontal lobe.

In addition, the frontal lobe receives integrated sensory information, which it uses to help plan actions and movement. It also is associated with executive functions and speech.

Reference

Campbell, N.A., and Reece, J.B. (2008). *Biology, 8th Edition*. San Francisco, CA: Pearson Benjamin Cummings.

Image Reference

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Key Words

brain, human, cerebral cortex, frontal lobe, parietal lobe, temporal lobe, occipital lobe

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Functions of the Brain

- The brain is part of the nervous system.
- The brain is a complex network of billions of nerve connections controlling all conscious and unconscious thoughts and actions.
- The brain controls organ systems by activating muscles or secreting chemicals, such as hormones.
- Humans have an enlarged cortex that allows for higher-order functions, such as thinking and planning.



Functions of the Brain

The human brain sets us apart from other animals. It consists of some ten billion nerve cells and has a highly convoluted cortex, which is the source of human thought and creativity. The cerebrum, the most highly evolved structure of the mammalian brain, is the center for correlation, association and learning. It is divided into two hemispheres.

Information from all parts of the body is carried by sensory nerves to the brain, where it is integrated with direct input from external senses. Instructions for action then are sent along motor neurons to muscles. The brain also controls automatic processes of the body, such as breathing, heart rate and digestion.

References

1. Campbell, N.A., and Reece, J.B. (2008). *Biology, 8th Edition*. San Francisco, CA: Pearson Benjamin Cummings.
2. Clark, Joe O.E. (1999). *A Visual Guide to the Human Body*. London: Barnes and Noble, Inc.

Key Words:

brain, human, nervous system, neuron, senses, motor skills, thought, autonomic

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