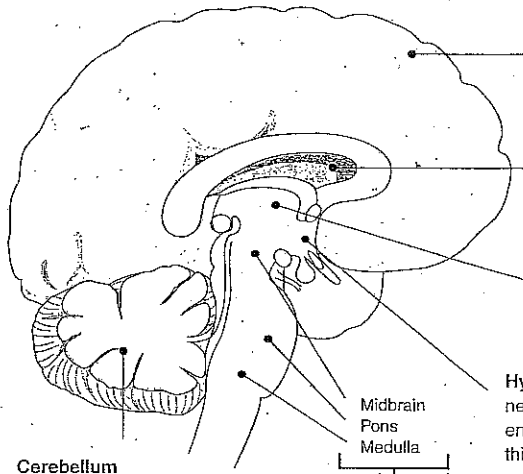


# The Human Brain

The brain is one of the largest organs in the body. It is protected by the skull, the meninges, and the cerebrospinal fluid (CSF). The brain is the body's control center. It receives a constant flow of sensory information, but responds only to what is important at the time. Some responses are very simple (e.g. cranial reflexes), whilst others require many levels of processing. The human

brain is noted for its large, well developed cerebral region, with its prominent folds (gyri) and grooves (sulci). Each cerebral hemisphere has an outer region of gray matter and an inner region of white matter, and is divided into four lobes by deep sulci or fissures. These lobes: temporal, frontal, occipital, and parietal, correspond to the bones of the skull under which they lie.

## Primary Structural Regions of the Brain



**Cerebellum** coordinates body movements, posture, and balance.

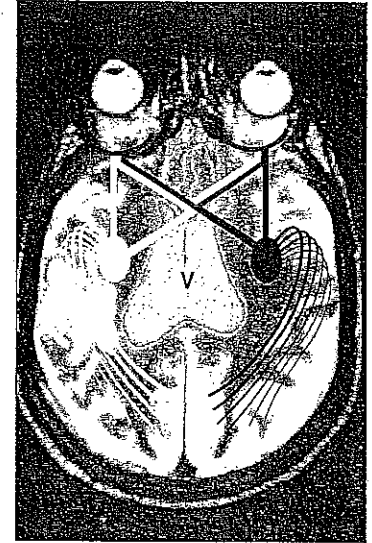
**Brainstem:** Relay center for impulses between the rest of the brain and the spinal cord. Controls breathing, heartbeat, and the coughing and vomiting reflexes.

**Cerebrum:** Divided into two cerebral hemispheres. Many, complex roles. It contains sensory, motor, and association areas, and is involved in memory, emotion, language, reasoning, and sensory processing.

**Ventricles:** Cavities containing the CSF, which absorbs shocks and delivers nutritive substances.

**Thalamus** is the main relay center for all sensory messages that enter the brain, before they are transmitted to the cerebrum.

**Hypothalamus** controls the autonomic nervous system and links nervous and endocrine systems. Regulates appetite, thirst, body temperature, and sleep.

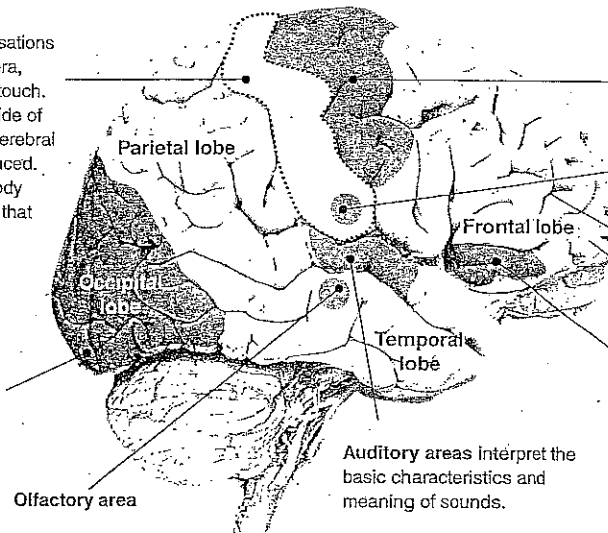


MRI scan of the brain viewed from above. The visual pathway has been superimposed on the image. Note the crossing of some sensory neurons to the opposite hemisphere and the fluid filled ventricles (V) in the center.

## Sensory and Motor Regions in the Cerebrum

**Primary somatic sensory area** receives sensations from receptors in the skin, muscles and viscera, allowing recognition of pain, temperature, or touch. Sensory information from receptors on one side of the body crosses to the opposite side of the cerebral cortex where conscious sensations are produced. The size of the sensory region for different body parts depends on the number of receptors in that particular body part.

**Visual areas** within the occipital lobe receive, interpret, and evaluate visual stimuli. In vision, each eye views both sides of the visual field but the brain receives impulses from left and right visual fields separately (see photo caption above). The visual cortex combines the images into a single impression or perception of the image.



**Primary motor area** controls muscle movement. Stimulation of a point one side of the motor area results in muscular contraction on the opposite side of the body.

**Primary gustatory area** interprets sensations related to taste.

Sulci (grooves)

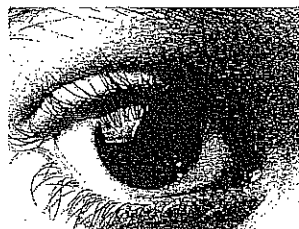
Gyri (elevated folds)

**Language areas:** The motor speech area (Broca's area) is concerned with speech production. The sensory speech area (Wernicke's area) is concerned with speech recognition and coherence.

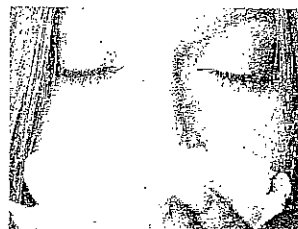
**Auditory areas** interpret the basic characteristics and meaning of sounds.



Touch is interpreted in the primary somatic sensory area. The fingertips and the lips have a relatively large amount of area devoted to them.



Humans rely heavily on vision. The importance of this special sense in humans is indicated by the large occipital region of the brain.



The olfactory tract connects the olfactory bulb with the cerebral hemispheres where olfactory information is interpreted.



The endothelial tight junctions of the capillaries supplying the brain form a protective blood-brain barrier against toxins and infection.

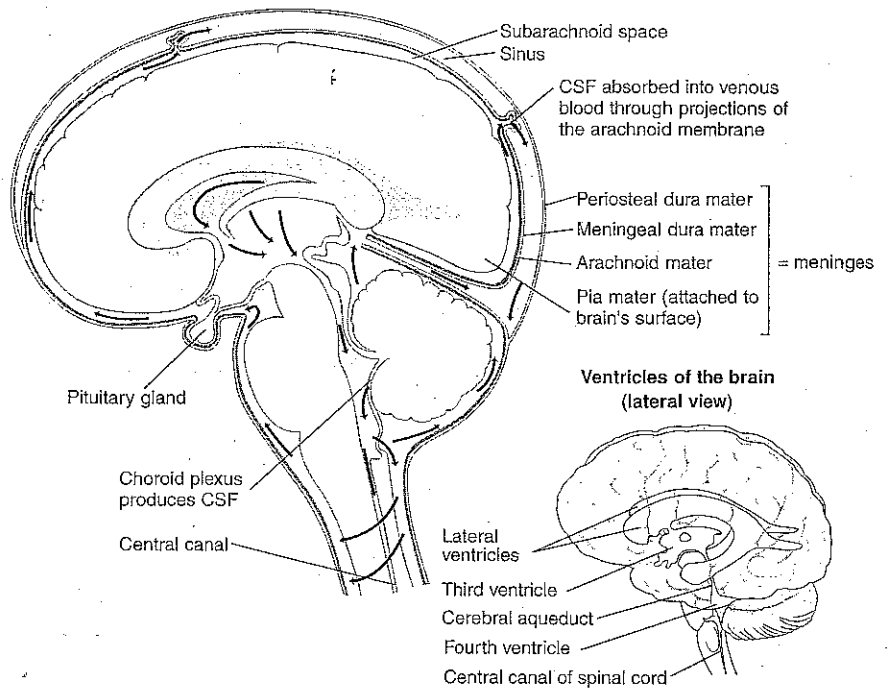
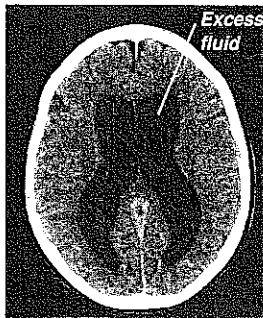
## The Ventricles and CSF

The delicate nervous tissue of the brain and spinal cord is protected against damage by the **bone** of the skull and vertebral column, the membranes overlying the brain (the **meninges**), and the watery but nutritive **cerebrospinal fluid (CSF)**, which lies between the inner two of the meningeal layers.

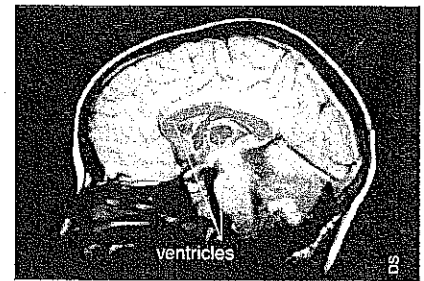
The meninges are collectively three membranes: a tough double-layered outer **dura mater**, a web-like middle **arachnoid mater**, and an inner delicate **pia mater** that adheres to the surface of the brain. The CSF is formed from the blood by clusters of capillaries on the roof of each of the brain's ventricles (choroid plexuses). The CSF is constantly circulated through the ventricles of the brain (and into the spinal cord), returning to the blood via specialized projections of the middle meningeal layer (the arachnoid).

If the passages that normally allow the CSF to exit the brain become blocked, the CSF accumulates within the brain's ventricles causing a condition called hydrocephalus.

The accumulated fluid can be seen in this MRI scan.



MRI scanning is a powerful technique to visualize the structure and function of the body. It provides much greater contrast between the different soft tissues than computerized tomography (CT) does, making it especially useful in neurological (brain) imaging, especially for indicating the presence of tumors or fluid, and showing up abnormalities in blood supply. In the scan pictured right, the fluid within the lateral and third ventricles is clearly visible.



- For each of the following bodily functions, identify the region(s) of the brain involved in its control:
  - Breathing and heartbeat: \_\_\_\_\_
  - Memory and emotion: \_\_\_\_\_
  - Posture and balance: \_\_\_\_\_
  - Autonomic functions: \_\_\_\_\_
  - Visual processing: \_\_\_\_\_
  - Body temperature: \_\_\_\_\_
  - Language: \_\_\_\_\_
  - Muscular movement: \_\_\_\_\_
- Explain how the brain is protected against physical damage and infection: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
- Describe where CSF is produced and how the CSF returns to the blood: \_\_\_\_\_  
 \_\_\_\_\_
  - Explain the consequences of blocking this return flow of CSF: \_\_\_\_\_  
 \_\_\_\_\_