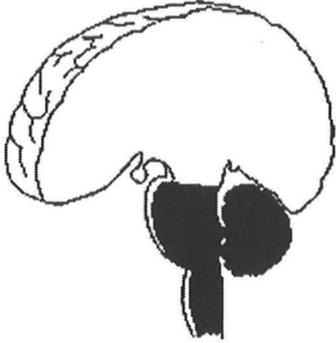


# The Architecture of the Brain

The brain is like a committee of experts. All the parts of the brain work together, but each part has its own special properties. The brain can be divided into three basic units: the forebrain, the midbrain, and the hindbrain.

## The hindbrain



The hindbrain includes the upper part of the spinal cord, the brain stem (including the pons and medulla), and a wrinkled ball of tissue called the cerebellum

## The midbrain



The uppermost part of the brainstem is the midbrain, which controls some reflex actions and is part of the circuit involved in the control of eye movements and other voluntary movements. This portion of the brain contains the reticular formation.

## The forebrain



The forebrain is the largest and most highly developed part of the human brain: it consists of the limbic system, thalamus, cerebrum and the cerebral cortex.

## Major Parts of the Brain

### Can someone be shot in the head but not die?

We'll begin our exploration of the brain by looking at its three major parts—forebrain, midbrain, and hindbrain—beginning with the forebrain.

A human brain (right figure), which can easily be held in one hand, weighs about 1,350 grams, or 3 pounds, and has the consistency of firm Jell-O. The brain is protected by a thick skull and covered with thin, tough, plasticlike membranes. If shot in the head, a person may or may not die depending on which area was damaged. For example, damage to an area in the forebrain would result in paralysis, damage to an area in the midbrain would result in coma, but damage to an area in the hindbrain would certainly result in death.



## 2 Midbrain

If a boxer is knocked unconscious, part of the reason lies in the midbrain.

The *midbrain* has a reward or pleasure center, which is stimulated by food, sex, money, music, attractive faces, and some drugs (cocaine); has areas for visual and auditory reflexes, such as automatically turning your head toward a noise; and contains the reticular formation, which arouses the forebrain so that it is ready to process information from the senses (Holroyd & Coles, 2002).

If the reticular formation were seriously damaged—by a blow to the head, for example—a person would be unconscious and might go into a coma because the forebrain could not be aroused (E. Goldberg et al., 1989; Parvizi & Damasio, 2003).

## 3 Hindbrain

The structures and functions of the hindbrain, which are found in very primitive brains, such as the alligator's, have remained constant through millions of years of evolution. The *hindbrain* has three distinct structures: the pons, medulla, and cerebellum.

### 3a Pons

If someone has a serious sleep disorder, it may involve the pons. In Latin, *pons* means “bridge,” which suggests its function.

The *pons* functions as a bridge to transmit messages between the spinal cord and brain. The pons also makes the chemicals involved in sleep (Purves et al., 2004).

### 3b Medulla

If someone dies of a drug overdose, the cause of death probably involved the medulla.

The *medulla*, which is located at the top of the spinal cord, includes a group of cells that control vital reflexes, such as respiration, heart rate, and blood pressure.

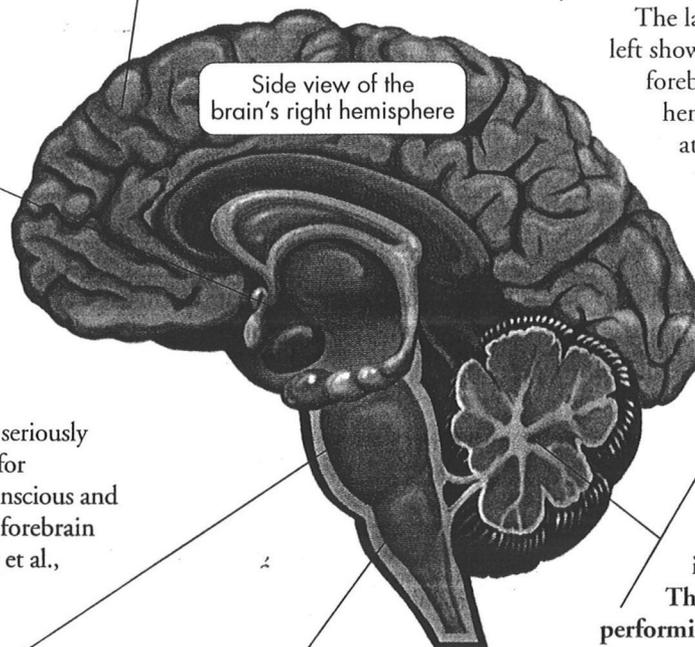
Large amounts of alcohol, heroin, or other depressant drugs suppress the functions of cells in the medulla and cause death by stopping breathing.

## 1 Forebrain

When you look at the brain, what you are actually seeing is almost all forebrain (figure above).

The *forebrain*, which is the largest part of the brain, has right and left sides that are called hemispheres. The hemispheres, connected by a wide band of fibers, are responsible for an incredible number of functions, including learning and memory, speaking and language, having emotional responses, experiencing sensations, initiating voluntary movements, planning, and making decisions.

The large structure outlined in orange to the left shows only the right hemisphere of the forebrain. The forebrain's right and left hemispheres are both shown in the figure at the top right. The forebrain is very well developed in humans.



### 3C Cerebellum

A person suspected of drunken driving may fail the test of rapidly touching a finger to the nose because of alcohol's effects on the cerebellum.

The *cerebellum*, which is located at the very back and underneath the brain, is involved in coordinating motor movements but not in initiating voluntary movements.

The cerebellum is also involved in performing timed motor responses, such as those needed in playing games or sports, and in automatic or reflexive learning, such as blinking the eye to a signal, which is called classical conditioning (discussed in Module 9) (Hazeltine & Ivry, 2002; Spencer et al., 2003).

Because alcohol is a depressant drug and interferes with the functions of the cerebellum, an intoxicated person would experience decreased coordination and have difficulty rapidly touching a finger to the nose, which is one of the tests for being drunk.

Of the brain's three parts, the forebrain is the largest, most evolved, and most responsible for an enormous range of personal, social, emotional, and cognitive behaviors. For those reasons, we'll examine the forebrain in more detail.