

Left cerebral hemisphere

Right cerebral hemisphere

A Tour of the Brain

A user-friendly guide to the components of the human brain and how they function

by Jon Caswell

Imagine carrying the responsibility of accepting, organizing and interpreting floods of incoming and outgoing information every second of every day. Just think of the stress of having to regulate the temperature, warning systems and mechanical functions of absolutely everything, including those critical to keeping your world alive. Getting a headache just thinking about it?

We're learning more and more about the workings of the brain as scientists continue to experiment and probe our inner universe. Still, just trying to fathom the complexity of an organ that handles our walking, talking, thinking, dreaming, heart rate, liver function and tear ducts boggles — well — the mind.

For stroke survivors and caregivers, having an understanding of the different areas of the brain and their functions can shed new light on what they're experiencing after a stroke.

The human brain weighs an average of 3 lbs. in men and 2 lbs. 12 oz. in women and has about 100 billion cells called neurons. The brain's structure is almost complete at birth, although it continues to grow until about age 20, with increases in the size of individual cells and the amount of tissue connecting the neurons.

The brain is made up of distinct parts that developed through human evolution. The oldest evolutionary parts, which are responsible for life-supporting functions such as breathing, blood circulation and sleeping, are found at the base of the brain, joined to the spinal cord. This area is called the "brain stem" and includes the midbrain, pons and medulla oblongata. The more recently developed areas — the cerebellum and the cerebrum — surround the brain stem.

The **cerebellum** is a cauliflower-shaped structure, located just above the brain stem, beneath the occipital lobes at the base of the skull.

The cerebellum regulates muscle tone, coordinates movement and helps maintain posture and balance. The cerebellum has two halves, similar to the cerebrum. It does not initiate movements, but is responsible for their smooth and balanced execution, for maintaining muscle tension and making movements work together in complex action such as walking. It comprises approximately 10 percent of the brain's volume, contains at least half its neurons and is connected to the brain stem via three major bundles of input and output fibers called peduncles.

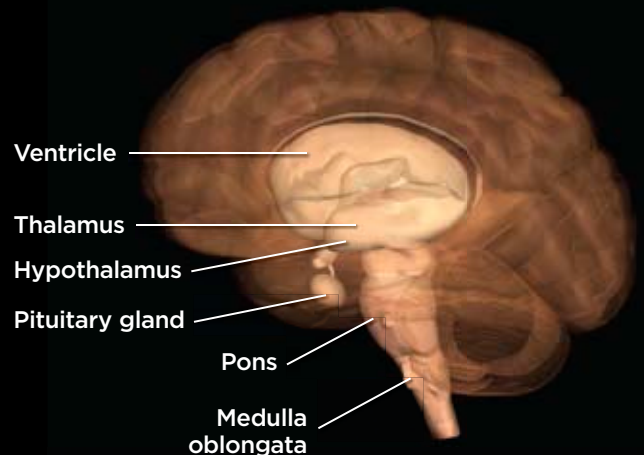
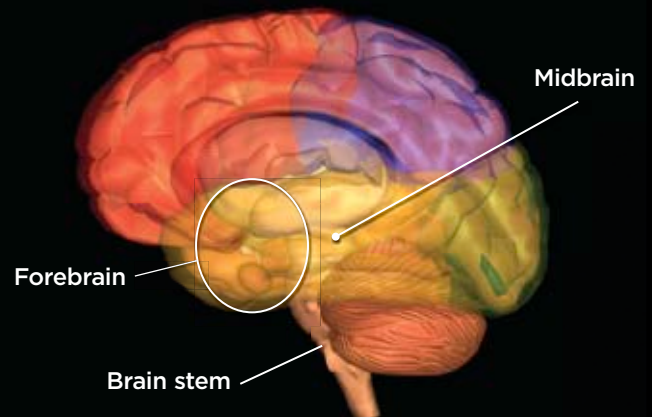
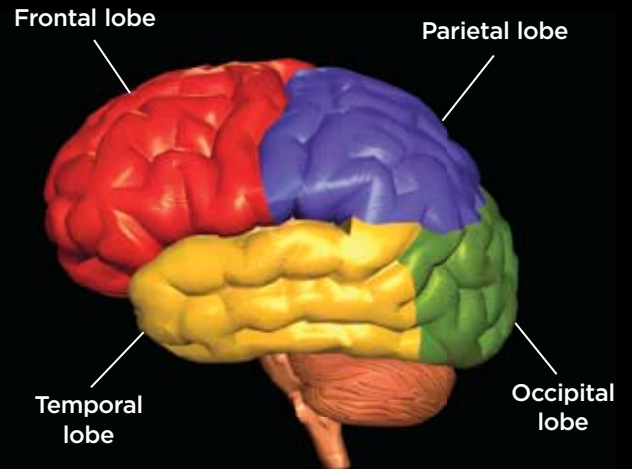
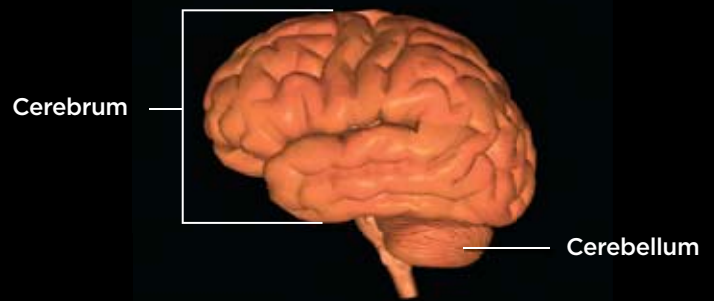
The **cerebrum**, a large rounded structure, is closely related to functions including thought, reason, emotion and memory. It occupies most of the cranial cavity and is divided into two hemispheres that are joined at the bottom by the **corpus callosum**. The two hemispheres are mirror images of each other and control opposite sides of the body. The **left cerebral hemisphere** controls speech and academic and analytical processes; the **right cerebral hemisphere** deals with more artistic and imaginative activities, and also controls facial perception and music.

Each cerebral hemisphere is subdivided into four lobes: occipital, temporal, frontal and parietal.

- The **occipital lobes** are pyramid-shaped structures located at the back of the brain that receive and analyze visual information.
- The **temporal lobes**, located on the skull side of each hemisphere (near the ears), deal with hearing.
- The **frontal lobes**, at the front of each hemisphere behind the forehead, are responsible for cognitive thought processes (knowing, thinking, learning and judging). They also regulate voluntary movements. The prefrontal areas of these lobes are involved with intelligence and personality.
- The **parietal lobes**, located above the occipital lobes, are mainly associated with our sense of touch and balance and are important in interpreting sensory information from various parts of the body, and in the manipulation of objects.

Both cerebral hemispheres are covered by the **cerebral cortex**, which has many folds and resembles a walnut kernel. The gray outer layer of the cerebral cortex contains neurons and dendrites — branched projections that conduct electrical stimulation to the cell body. This outer layer surrounds a thicker layer of white matter made up of nerve fibers.

The **brain stem** contains the midbrain, pons and



medulla oblongata. The **midbrain** — the uppermost part — has fibers that connect the brain stem to the cerebrum and cerebellum; this area is very important in the control of skeletal movements. The **pons**, which lies between the midbrain and medulla oblongata, relays sensory information between the cerebrum and cerebellum. The **medulla oblongata** contains centers for the control of breathing and cardiovascular function.

Another area, the **forebrain**, contains the thalamus, hypothalamus and pituitary gland. It is almost completely surrounded by the cerebral hemispheres and contains a cavity known as the third ventricle. The **thalamus** is a tightly packed cluster of nerve cells that relays impulses from the sense organs to the cortex. The **hypothalamus** controls hunger, thirst, temperature, aggression and sex drive; it also controls the **pituitary gland**, which controls the secretion of many hormones.

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The **reticular formation** is an intricate network of nuclei and nerve fibers within the medulla oblongata, pons, midbrain, thalamus and hypothalamus that functions as the reticular activating system. This contains the sensory pathways from the spinal cord to the brain and is important in maintaining a state of alert consciousness.

Looped around the brain stem and hypothalamus are the structures of the **limbic system**, which are thought to be involved in emotional responses such as fear, aggression and mood changes.

The brain also has four fluid-filled cavities called **ventricles** where cerebrospinal fluid is produced.

The singular most amazing thing about the human brain may be its plasticity. We are learning more all the time about the ability of our brains to adjust, adapt and relearn, even after something as devastating as the brain injury caused by a stroke. And *that* is nothing short of awe-inspiring. **SC**