Brain Basics

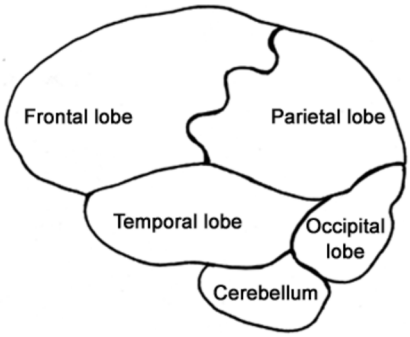
The Hemispheres

The brain is not a mass of neural cells; instead, it is a highly organized, complex, multi-functional organ. The brain is divided into two hemispheres that are connected by the *corpus callosum*, a band of nerve fibers which carries messages between the left and right hemispheres.

The brain's right hemisphere controls the muscles on the left side of the body, while the left hemisphere controls the muscles on the right side of the body. Each hemisphere performs a fairly distinct set of operations. In general, the left hemisphere is dominant in language: processing what we hear and handling most of the duties of speaking. It's also in charge of carrying out logic and exact mathematical computations. The right hemisphere is mainly in charge of spatial abilities, facial recognition and processing music. It plays a role in language also, particularly in interpreting context and a person's tone.

The Lobes

Each hemisphere is divided into lobes. While each lobe has been associated with specific tasks, they are subdivided into interlocking networks of neurons (brain cells) that coordinate overlapping and complex tasks such as talking; which simultaneously requires memory, forethought, and motor coordination of tongue and lips.



At the base of the brain is the cerebellum which is also comprised of small lobes and receives information from the balance system of the inner ear, spinal cord, sensory nerves, and the auditory and visual systems. The cerebellum integrates this information to coordinate and fine-tune motor activity. It is also involved in motor memory and learning, and learning simple tasks such as the motor coordination in managing a fork or chop sticks to complex ballet or basketball maneuvers. Recent research has also demonstrated highly autonomic motor skills, such as typing, are also housed in the cerebellum.

Frontal lobes - concerned with emotions, reasoning, planning, movement, and parts of speech. Frontal lobes are also involved in purposeful acts such as creativity, judgment, problem solving, planning and impulse control.

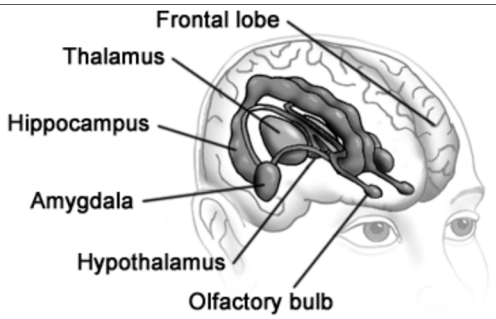
Parietal lobes - concerned with processing of input from the senses and are responsible for sensory integration, such as touch, pain, taste, pressure, temperature and spatial relations.

Temporal lobes - responsible for hearing, memory, meaning, and language. The temporal lobes are concerned with interpreting/processing primarily auditory stimuli.

Occipital lobes - responsible for primary visual processing which includes perception of light, line, curve, color and secondary processing of vision, which entails recognizing objects.

The Limbic System

Deep within our brain is the limbic system. The limbic system is responsible for memory and emotion, motivation, behavior, and various autonomic functions, such as the sensation of hunger and thirst and the ability to smell through the olfactory bulbs. This simple diagram of the limbic system gives emphasis to the four structures known to make up this brain region.



The thalamus is about the size of a walnut, and it serves as a primary processor of most incoming information entering the brain. It functions like a relay station, deciding where to send incoming information for further processing. The thalamus is continuously monitoring the *external* environment for input. As a regulator of sensory information, the thalamus also controls sleep and plays a major role in regulating arousal, level of awareness, and activity (Leonard, 2006).

The hypothalamus is about the size of an olive and is constantly monitoring the body's *internal* environment for input. The hypothalamus produces hormones that control thirst, hunger, body temperature, sleep, moods, sex drive, and the release of hormones from various glands, primarily the pituitary gland. The hypothalamus regulates homeostasis in the human body, meaning it is in charge of making sure that everything in our bodies is always in balance. For example, if you have had too many salty foods the hypothalamus 'tells' you and gives you a thirst sensation – therefore causing you to drink some water to put your system back in balance.

The amygdala is about the size of an almond. We have two amygdales, one in each hemisphere. The amygdales perform a primary role in the formation and storage of memories associated with *emotional events.* These structures are constantly monitoring the environment for any threat to our survival. The amygdala is the seat of the flight, fight or freeze decisions that are made in the face of threat. Once activated, it takes a primary position in the way the body allocates energy.

The hippocampus* is critical to the storage and retrieval of memory. The hippocampus works like a filing system, determining *if* something is worth remembering and then determining *where to file it* so that this particular memory can be found again. The hippocampus is essential in forming new memories and connecting emotions and senses, such as smell and sound, to memories. It acts as a memory indexer by sending memories out to the appropriate part of the cerebral hemisphere for long-term storage and retrieving them when necessary. In addition, the hippocampus also appears to serve as a cognitive map that helps humans and other mammals with spatial orientation – in other words helping humans know where they are and how to get there.

Brain Development

The brain's growth and development is not uniform; that is, not all parts of the brain develop at the same time. Brain growth takes place in three different directions in a predictable way. This progression of growth happens simultaneously: from back-to-front, from inside-out, and from bottom-up.

Understanding this progression helps to explain human growth both emotionally, cognitively, and physically. For example, in order for a baby to survive outside of their mother's womb the brain stem (at the bottom of the brain) must be fully functional. The heart must maintain a regular beat, the lungs must breathe automatically, and the baby's body must be able to maintain a normal temperature.