**The Brain**

**The following is a list of the tools and techniques used to help gather information on the brain:**

1. **Lesions**The surgical destruction or removal of brain tissue.

2. **Electroencephalogram (EEG)**A machine that measures brain electric activity.

3. **Computed Tomograph (CT or CAT Scan)**This apparatus takes x-ray photographs of brain and can reveal brain damage.

4. **Positron emission tomograph (PET Scan)**It detects radioactive glucose consumption in brain. Allows us to see active metabolic areas.

5. **Magnetic Resonance imaging (MRI)**Itgenerates detailed pictures of the brains soft tissues by making use of magnetic activity. Makes use of magnetic fields which appear to be less harmful than x-rays.

***Brain Structure***

The **Brainstem** the oldest portion (the central core) in brain is made up of three main structures:

1. 1. The **Medulla Oblongata**regulates involuntary processes like heartbeat and breathing.
   2. **The Pons**("*bridge*")- connects the two halves of the cerebellum lying above it and a portion of the reticular formation. It relays information about body movements that it receives from both higher brain centers and the spinal cord. It also appears to be involved in circuits that control sleep.
   3. **The Reticular formation-**(looks like a finger-shaped net) controls arousal, when you wake or sleep. Damage to this area may cause a person to lapse into a coma.

**The Cerebellum**(*"little brain"*)**-**found to the rear of the pons**,**looks like a miniature version of the forebrain with its two hemispheres. One area is involved in maintaining a sense of balance, another is involved in coordinating muscular movements while another part is involved in learning simple motor tasks.

The **Thalamus**lies above brainstem and is shaped like two eggs. Its function is to act as a*sensory*switchboard (visual and auditory information as well as information about touch pressure temperature and pain).relaying incoming signals to appropriate brain regions. **It does not relay sensory signals dealing with smell.**

The brain has two **Cerebral Hemispheres**, one on the *right* side and one on the *left*side. These two large structures that sit above the central core are the most recent development in the brains evolution. It consists of the *limbic system* and the *cortex* and is involved in the processes of learning, language, memory and reasoning. The right side of the brain is linked to sensations in the left side of the body while the left side of the brain is linked to sensations in the right side of the body. An exception to this would be visual sensations. Here, visual info from the left eye for example, does not solely go to the right hemisphere. In this case, the *left half of your field of vision* (in both eyes) goes to your right hemisphere while the *right half of your field of vision* (in both eyes) goes to your left hemisphere.

The **Corpus Callosum**joins the two hemispheres and is sometimes separated to cure epileptic seizures. People with this separation are referred to as **Split-brain**patients. They are unable to say what they see in their left visual field because this visual field's information is processed in the right hemisphere and cannot be sent to the left hemisphere where speech is processed.

Sign language is nevertheless language and is control by left hemisphere, if deaf people get a stroke in left hemisphere, signing will be disrupted.

Scientists have found **hemispheric specialization**. For example:

1. The**left hemisphere** appears to be more involved than the right in mathematics, language, logic, reasoning and the interpretation of events and behaviors.

2.The **right hemisphere** appears to be superior to the left at perceptual tasks such as copying drawings and information, face recognition, musical and artistic endeavors, and expressing emotion.

\* Read section on "Handedness" (right vs. left) in text.

The **Limbic System** sits directly above the central core and forms the innermost border of the cerebral hemispheres. The limbic systemincludes the:

1. 1. **Amygdala** influences **emotions**(fear, anger). Stimulation of the area can cause an animal to flee. Removal of amygdala results in emotionless organisms upon arousal.
   2. **Hippocampus**processes **memory** and damage to it means no new memories are processed.
   3. **Hypothalamus-**maintains body homeostasis (temperature, hunger, growth) and governs the pituitary gland. For example stimulation of the lateral (side) hypothalamus will cause an animal to overeat while stimulation of the ventromedial (lower middle) hypothalamus will cause an animal to stop eating.

The **Cerebral Cortex**, the outermost area of the cerebral hemispheres, is a thin layer of gray matter consisting of about 9 billion neurons covering the hemispheres. There are two deep fissures that subdivide each hemisphere into principle regions called **lobes.** The four main lobes are:

**1. Frontal Lobe**(behind forehead) has the **Motor Cortex**located at the back of frontal lobe and controls voluntary movement. The case with Phineas Gage showed researchers that damages in the frontal lobe could result in personality alterations because their normal "restraints" or inhibitions are erased. This was due to a tamping rod that shot from his left cheek and out his head, separating his internal motives and external judgment.

**2. Parietal Lobe**(top to back of head) has the **Sensory Cortex**located in the beginning of parietal lobe and receives information from the skin senses (touch, pressure, heat and pain) and for the sense of body position (vestibular sense).

**3. Occipital Lobe**(back of head) very important in the analysis of*visual* information.

**4.Temporal Lobe**(above ears, below parietal lobes) integrates sensory data with special attention to *auditory* data.

**Language**

Language requires the coordination of many brain areas of the cortex. Damage to any one of these areas may result in **aphasia** (language impairment). Such damage has allowed researchers to piece together the stages in which language occurs:

1. **Visual Cortex**(occipital lobe) allows us to see the visual stimulation (words).

2. **Angular Gyrus (**mid-side of parietal lobe) converts words into auditory code.

3. **Wernickes Area**(left temporal lobe) enables us to derive meaning from auditory code.

4. **Brocas Area (**left frontal lobe) controls **motor cortex** that in turn activates speech muscles to pronounce words.

If there is damage to #1- one cannot see, #2- one cannot read, #3- one cannot understand, and #4- one cannot physically speak.

75% of the brain is not committed to motor or sensory functions. Theses brain regions are called**Association Areas**areas that are involved in thinking, remembering, and speaking. With regards to evolution, the animal with the larger association area is the more intelligent the species with respect to anticipating future events.