The Brain

Slide One:

The brainstem is the oldest, innermost region of the brain, responsible for automatic survival functions. The brain stem includes the medulla, which controls your heartbeat and breathing and the reticular formation, which plays an important role in controlling arousal. Without your reticular formation you would be lethargic and could sleep through most violent thunderstorms.

On top of the brainstem is the thalamus which is the brain's sensory switchboard. The thalamus receives information from all the senses except smell and sends the messages to the higher brain regions that deal with seeing, hearing, tasting, and touching. The thalamus is akin to the role London plays for England's trains.

The cerebellum, known as the "little brain" is attached to the rear of the brainstem and coordinates movement and balance and helps process sensory information. The cerebellum enables one type of nonverbal learning and memory and helps us judge time, modulate our emotions, and discriminate sounds and textures. With an injured cerebellum you and would have difficulty walking, keeping balance or shaking hands.

Slide Two:

The doughnut shaped limbic system is the neural structure at the border of the brainstem and cerebrum. The limbic system includes the hippocampus, amygdala, and hypothalamus. The limbic system is responsible for self-preservation.

The hypothalamus, below (or *hypo*) the thalamus, and directs several maintenance activities like eating, drinking, and body temperature. The hypothalamus also helps govern the endocrine system via the pituitary gland.

The Amygdala has two almond-shaped neural clusters and is linked to the emotion of fear and anger. The hippocampus helps with the creation of new memories.

Slide Three:

The cerebral cortex is much larger in humans than in any other animal. The cerebral cortex is divided into four different lobes.

The frontal lobes are involved in speaking, muscle movements, planning and making judgments. The parietal lobes receive sensory input for touch and body position. The occipital lobes contain the visual cortex. The temporal lobes process auditory information. While each lobe has a particular specialty they also continuously interact with other areas of the cortex.

Slide Four:

The arch-shaped motor cortex region at the rear of the frontal lobes controls voluntary muscle movements on the opposite side of the body. Body parts requiring the most precise control occupy the greatest amount of the cortical space.

The sensory cortex is the region at the front of the parietal lobes registering and processing body sensation. The most sensitive body parts require the largest amount of space in the sensory cortex.

As you can see from the illustrations, the motor cortex and sensory cortex match up on the top of the brain so that the sensory cortex can quickly provide the input for the motor cortex to provide the correct output. Damage to the left-side of the motor cortex will affect the function of the right-side of the body.

Slide Five:

More intelligent animals, such as humans, have increased “uncommitted” or association areas of the cortex. The association areas interpret, integrate, and act on information processed by the sensory areas. The association areas are involved in higher mental functions such as learning, remembering, thinking, and speaking. Association areas are found in all four lobes. Complex human abilities, such as memory and language, result from the intricate coordination of many brain areas.

Slide Six:

Language depends on a chain of events in several brain regions. When we read the sentence aloud, the words register in the visual area.

Then they are relayed to the angular gyrus which transforms the words into an auditory code. This is why when you read written words you “hear” them in your thoughts and why when you cannot remember a word you often try to recall it by how it sounds.

Next Wernicke’s area translates the words and gives them meaning .

Finally the language is sent to Broca’s area, which controls the motor cortex and directs the mouth and tongue to create the pronounced word.

Aphasia is an impairment of language. Depending on which link in this chain is damaged, a different form of aphasia occurs. For example, damage to the angular gyrus leaves the person able to speak and understand but unable to read. Damage to Wernicke's area disrupts understanding the meaning of words. Damage to Broca's area disrupts the person's ability to speak but not their ability to read or write.

Slide Seven:

This illustration demonstrates the specialization and integration which takes place in our brain when we speak with other people.

Hearing words takes place in the auditory and Wernicke's area.

Seeing words takes place in the visual cortex and angular gyrus.

Speaking words utilizes Broca's area and the motor cortex.

As you can see, our neural networks are extremely complex and important.

Slide Eight:

In 1997 an entire hemisphere was removed from this girl to stop frequent seizers. Brain plasticity allows her to cognitively and physically develop with few set backs.

The brain is sculpted by our genes but also by our experiences.
Plasticity refers to the brain's ability to modify itself after some type of injury or illness. Research indicates that some neural tissue can reorganize in response to injury or damage. When one brain area is damaged, others may in time take over some of its function.

New evidence reveals that adult humans can also generate new brain cells. Our brains are most plastic when we are young children. In fact, children who have had an entire hemisphere removed still lead normal lives.

Slide Nine:

Let's review the main parts of the central nervous system.

The spinal cord provides a pathway for neural fibers traveling to and from the brain.

The brain has a number of parts with specific functions.

The medulla controls your heartbeat and breathing.

The reticular formation helps control your level of arousal and focus.

The cerebellum coordinates your voluntary movement and balance.

The thalamus relays messages between lower brain centers and the cerebral cortex.

The hypothalamus controls maintenance functions such as eating and governs the endocrine system.

The amygdala controls the emotions of anger and fear linked to self-preservation.
The hippocampus helps with the creation of new memories.

The cerebral cortex directs higher-order thinking and information processing.