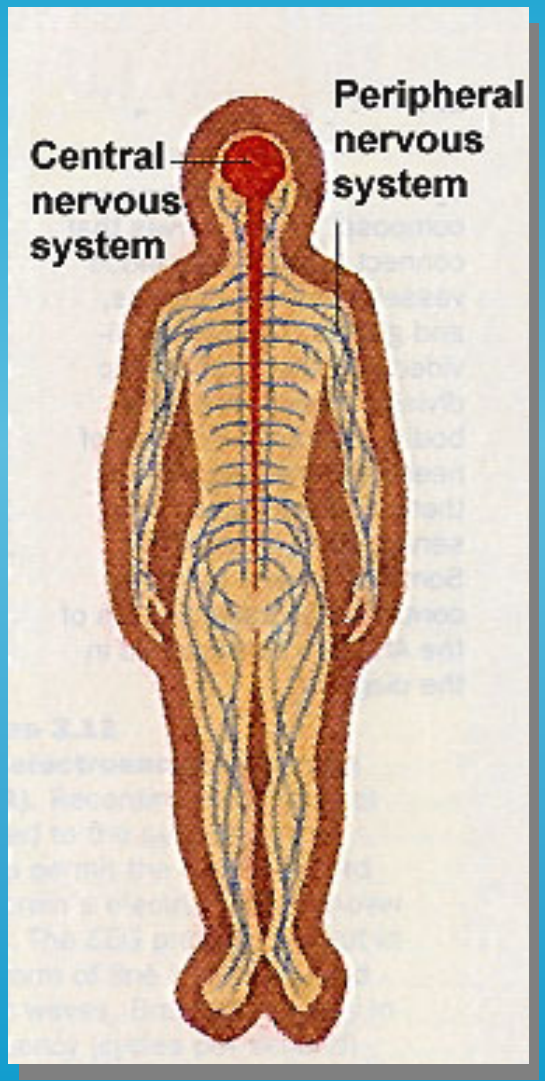
THE CENTRAL NERVOUS SYSTEM



The central nervous system consists of : the Brain and the spinal cord.

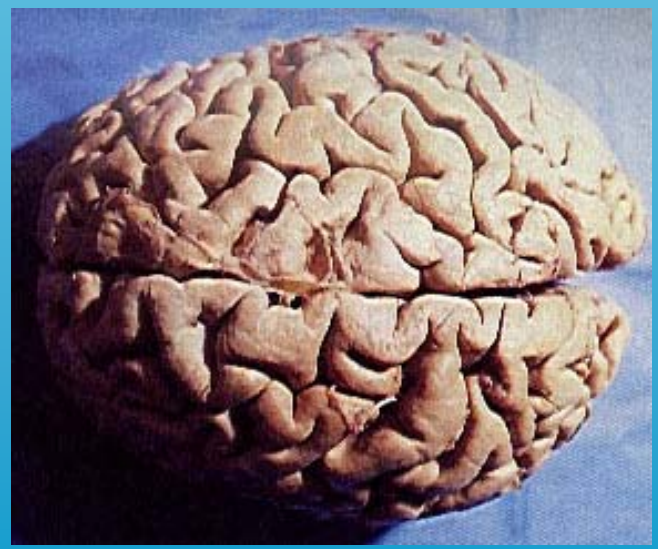
The Spinal Cord:

- is a complex bundle of large nerve fibers protected by bones and spinal fluid.
- Transmits messages between the brain and the peripheral nervous system.
- Permits some reflex movements.

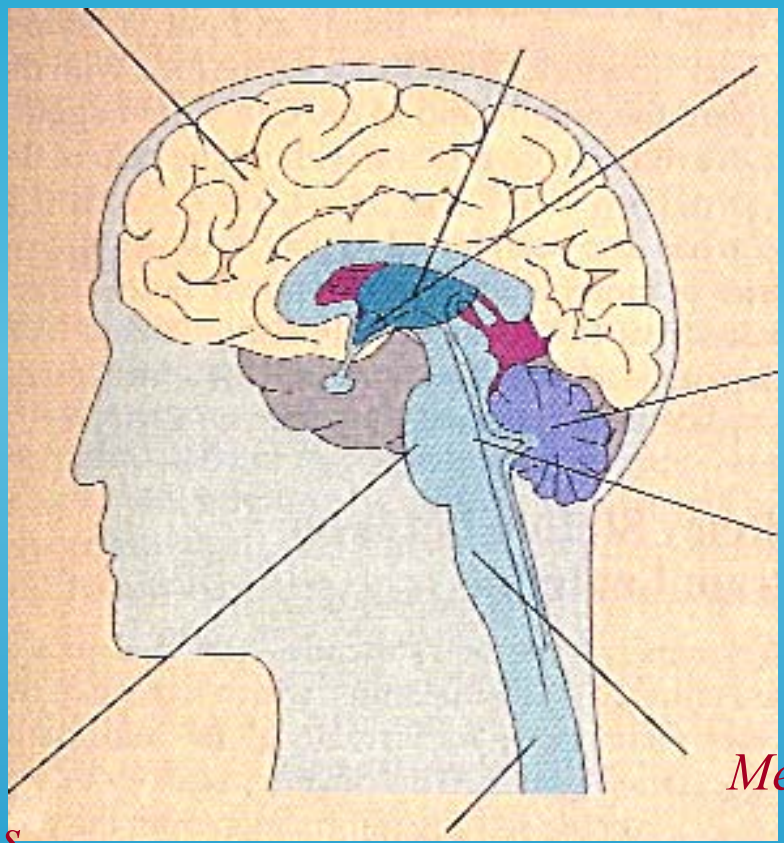
Human Brain

Three pounds of universe!

100 billions of neurons & 1 trillion of glial cells



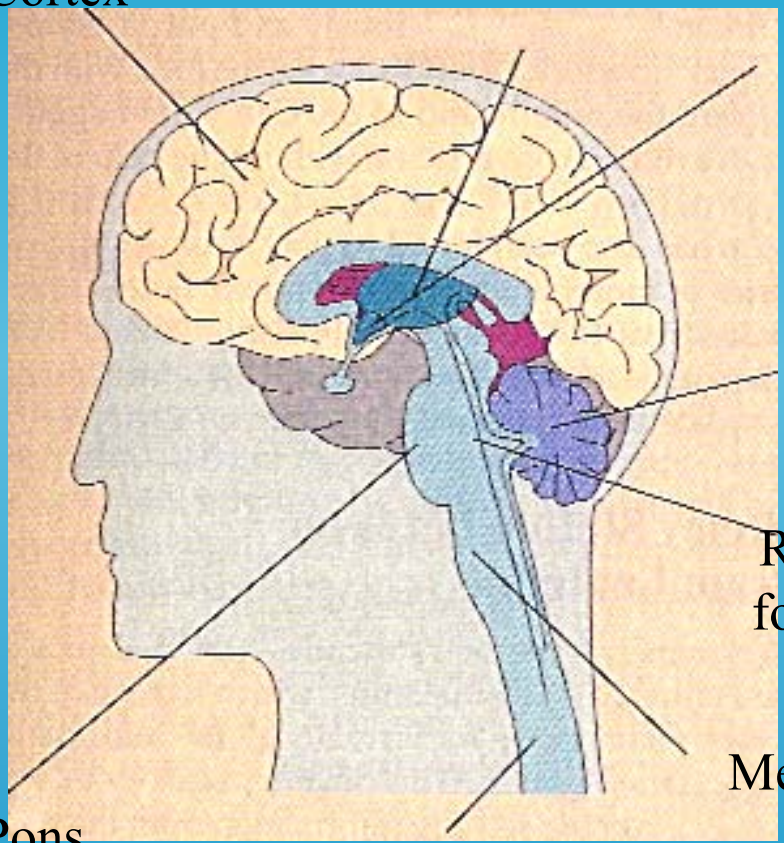
THE BRAINSTEM



The Brainstem:

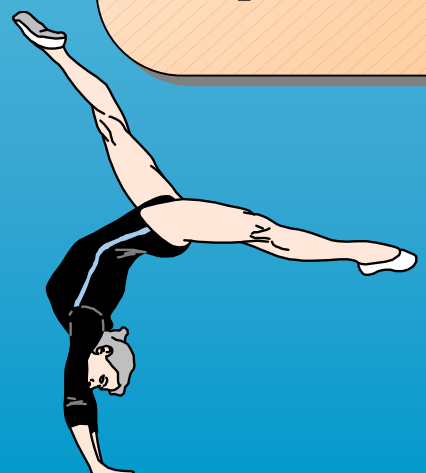
- *Medulla*: controls breathing, heart rate, and blood pressure.
- *Pons*: relays motor messages between cerebellum and motor cortex: influences sleep and dreaming.
- *Reticular Formation*: affects arousal and attention.

The Cerebellum

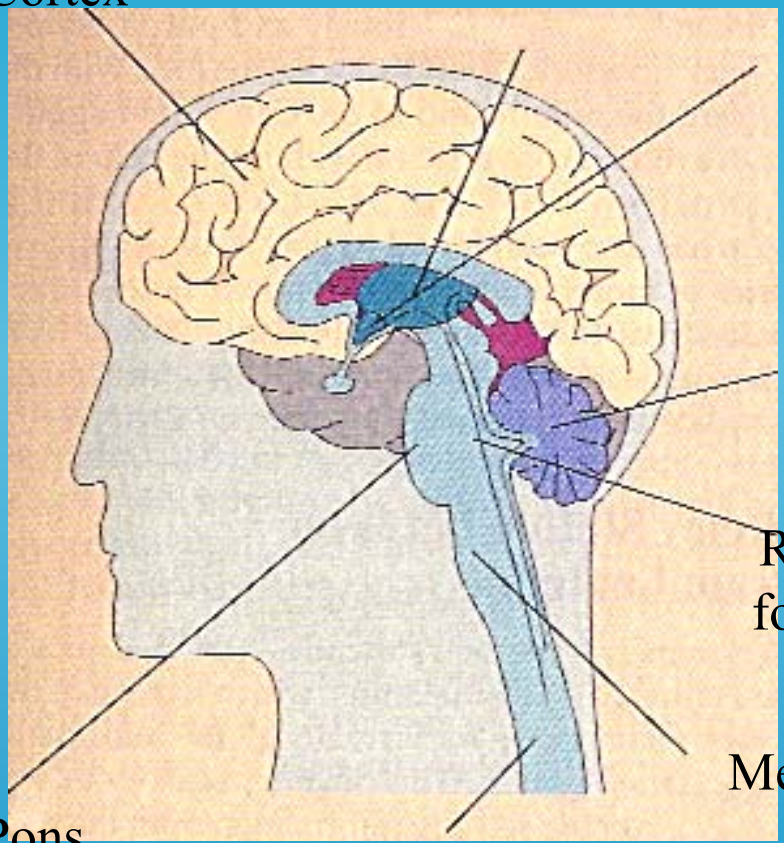


The Cerebellum:

- coordinates skilled movement and body balance.
- Regulates muscle tone and posture.



THALAMUS AND HYPOTHALAMUS



The Thalamus:

- is the relay station between cerebral cortex and lower brain centers
- relays incoming messages from sensory receptors (except smell).

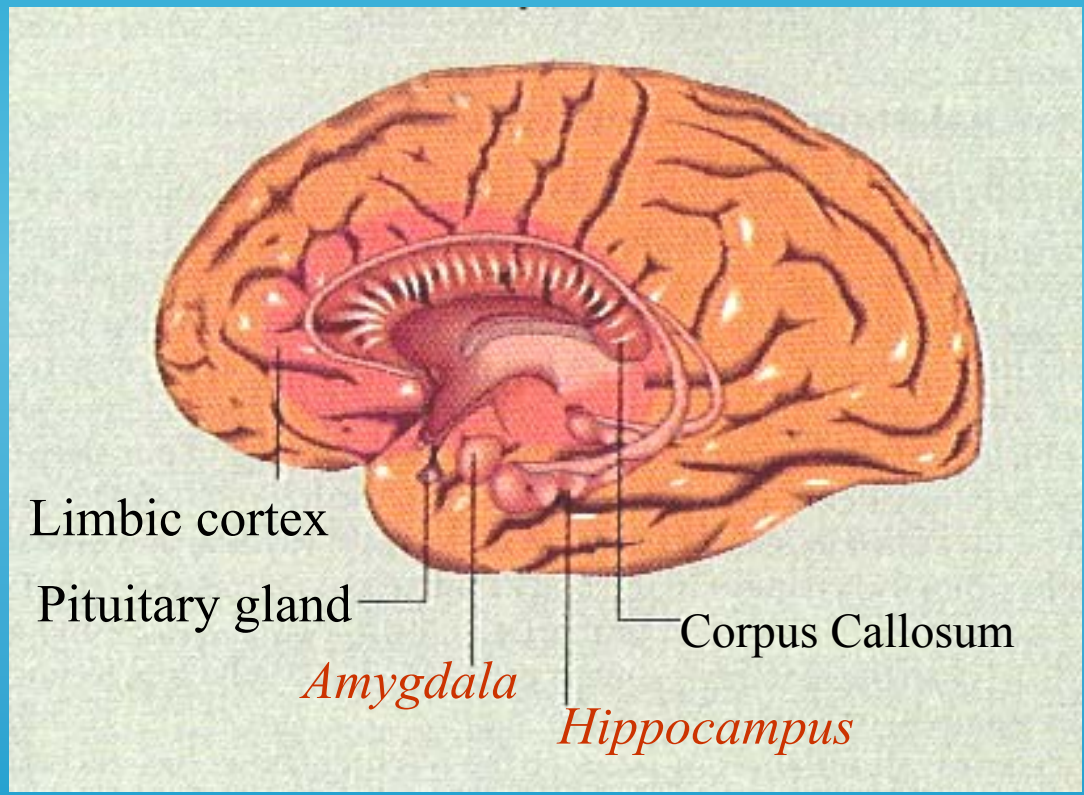
The Hypothalamus:

- controls hunger, thirst, body temperature, etc.
- involved in emotion.
- Regulates the pituitary gland.

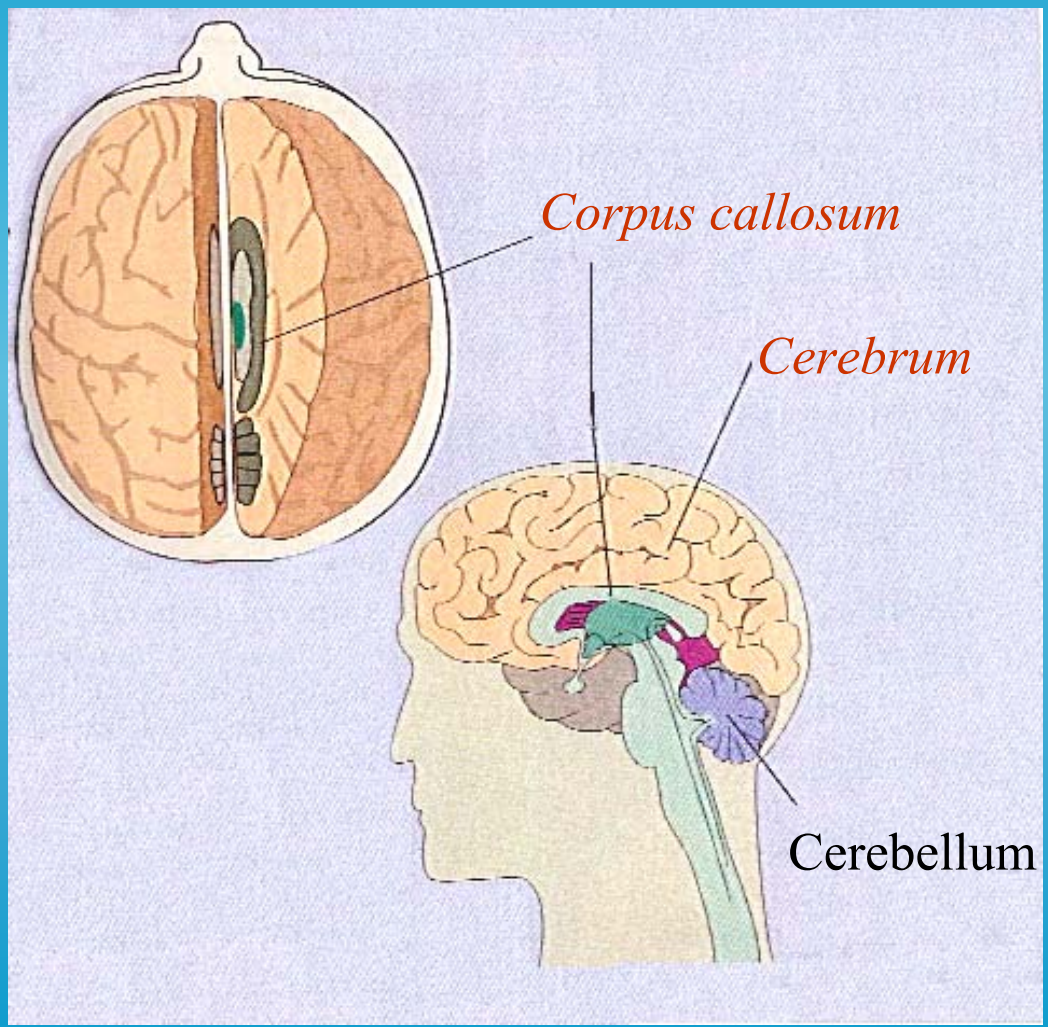
THE LIMBIC SYSTEM

The limbic system (the pink area) consists of a group of brain structures which are involved in emotional expression, memory, and motivation.

- *Amygdala* is important in emotional expressions, and learned emotional responses, especially fear.
- *Hippocampus* plays a key role in the formation of memories.



CEREBRUM AND ITS CORTEX: TWO CEREBRAL HEMISPHERES



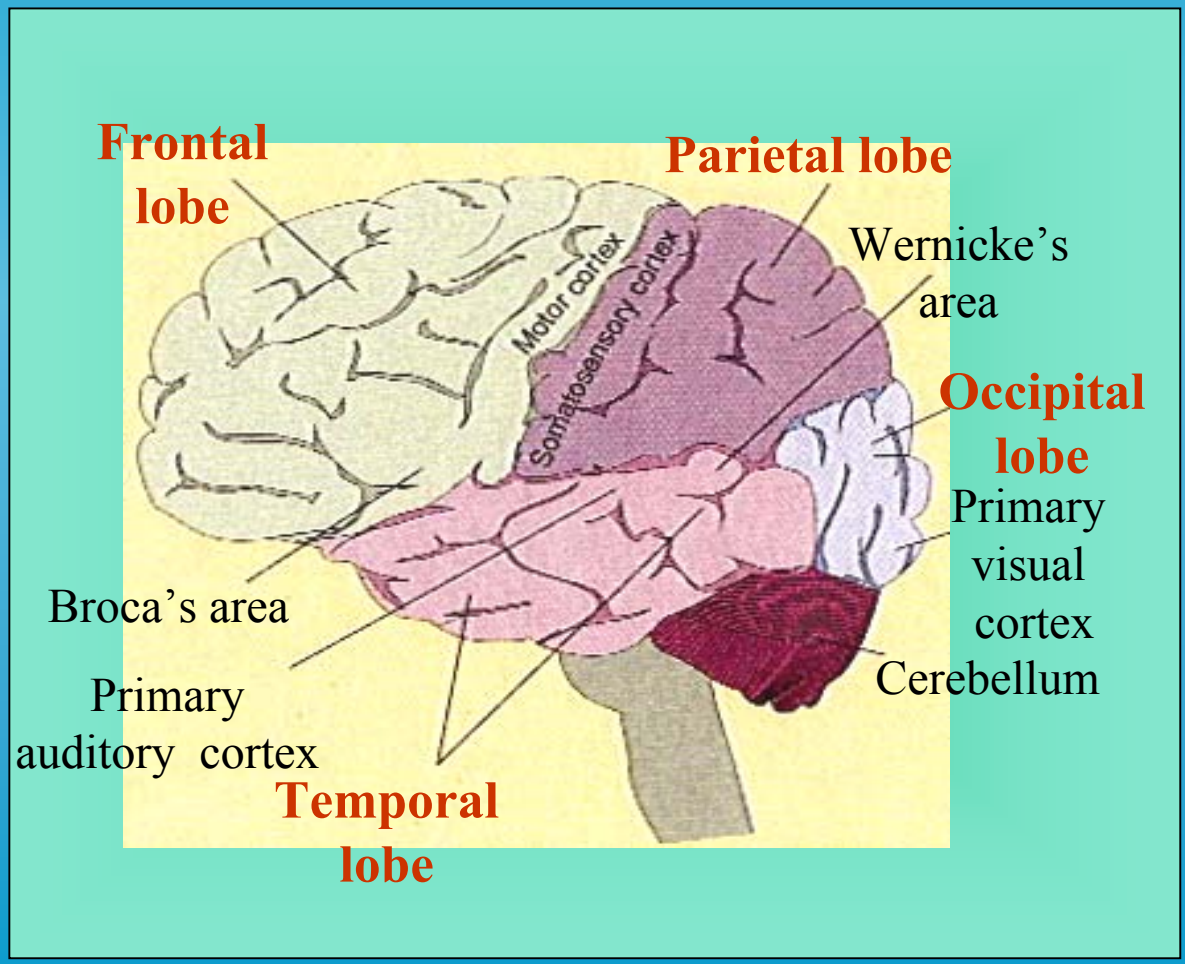
Cerebrum processes sensory information, handles thinking, learning, and controls voluntary movement.

Cerebrum is composed of two cerebral hemispheres.

Corpus callusum connects the two hemispheres and pass information between them.

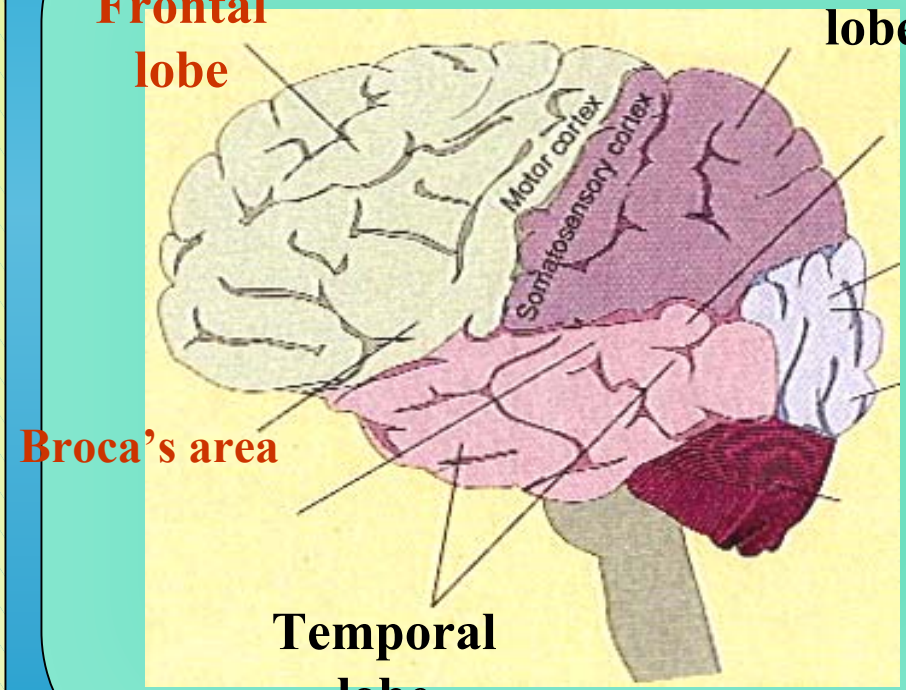
THE LOBES OF THE BRAIN

In each cerebral hemisphere there are four lobes - the frontal lobe, the parietal lobe, the occipital lobe, and the temporal lobe.

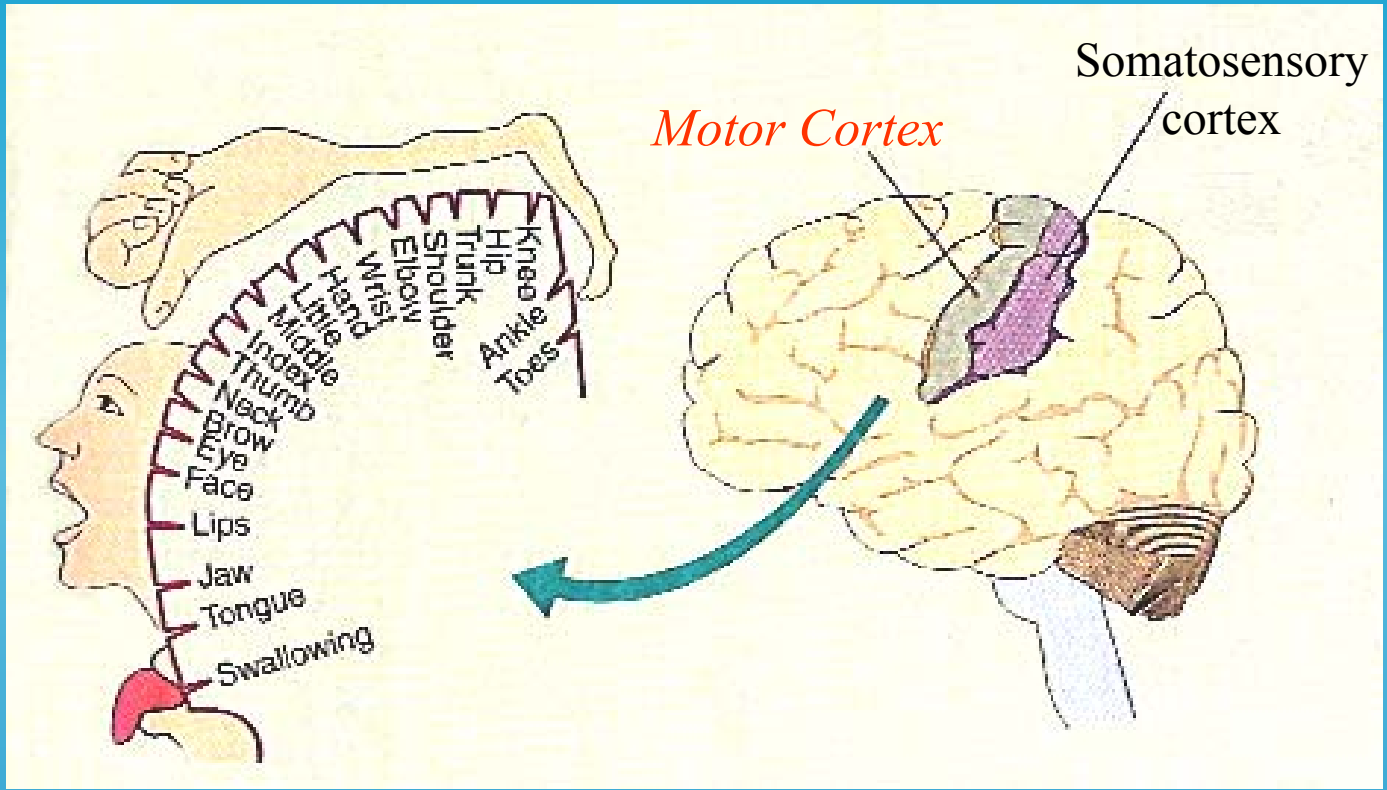


THE FRONTAL LOBE:
For Moving, Speaking, and Thinking

- *The motor cortex* controls voluntary body movement.
- *Broca's area (in left hemisphere)* is important for language production (speaking).
- *Association areas are* involved in higher mental processes such as thinking, problem solving, motivation, self-awreness, impulse control, future planning, and emotional responses.

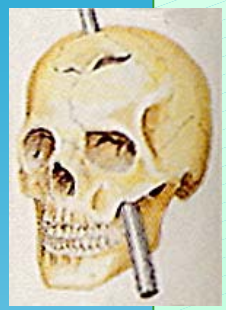


THE FRONTAL LOBE:
The Motor Cortex

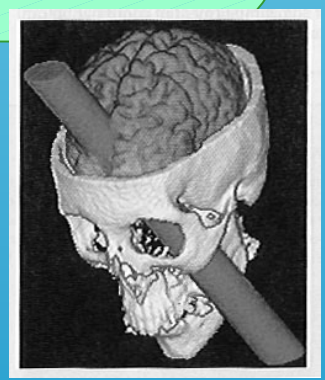


The motor cortex controls movement on the opposite side of the body. The body map indicates the amount of motor cortex that controls each body part. A large part of the motor cortex is devoted to body parts capable of finer coordination.

THE FRONTAL LOBE:
The Skull of Phineas Gage and Prefrontal Lobotomy

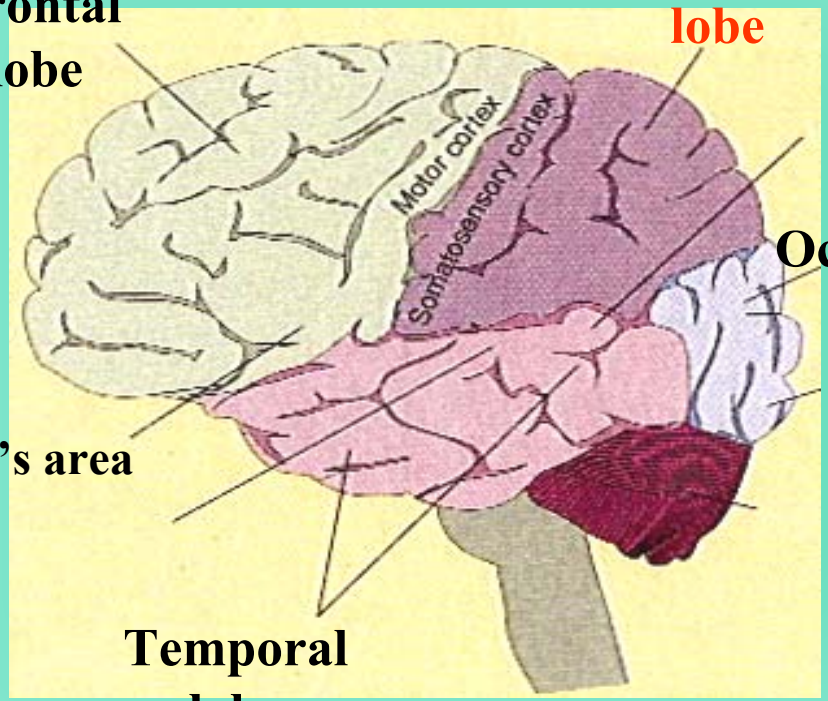


On September 13, 1848, Phineas Gage suffered an explosion accident on his railroad job. The accident damaged his frontal lobes, as shown by the pictures. Gage recovered from the accident, but was a changed man. Before the accident, he was polite, dependable, and well liked. After the accident, he became loud-mouth, rude and impulsive. He had difficulty focusing on a task and was not motivated. He no longer planned for the future. The case of Phineas Gage provided valuable clues for understanding the functions of the frontal lobe, especially the frontal association areas.



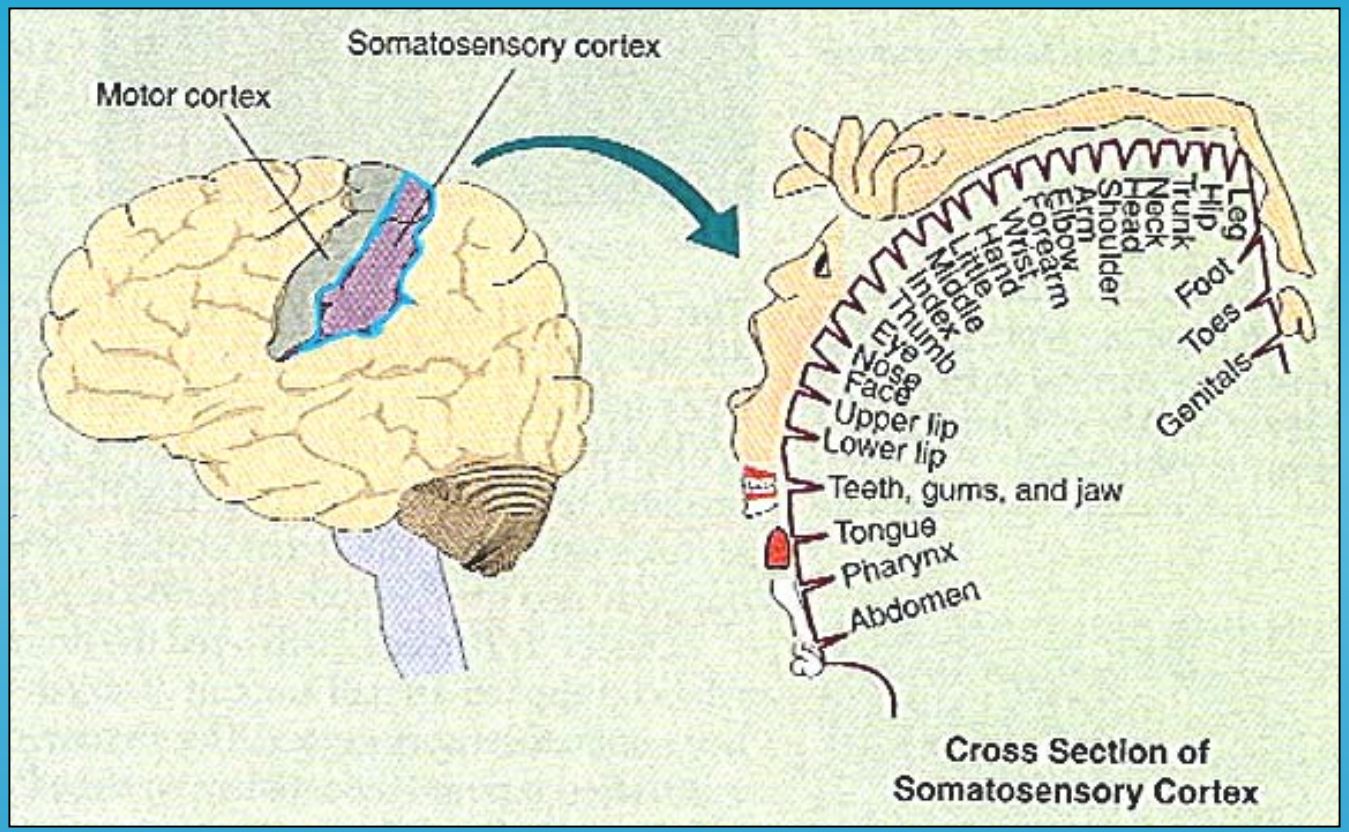
Another line of evidence for the functions of the frontal lobe came from the procedure of prefrontal lobotomy. In 1940s and 1950s, approximately 40,000 mental patients went through the procedure, which damaged some synaptic connections of the frontal lobes. After the procedure, the patients tended to become docile, unfocused, and unemotional.

THE PARIETAL LOBE:
Vital to Our Sense of Touch



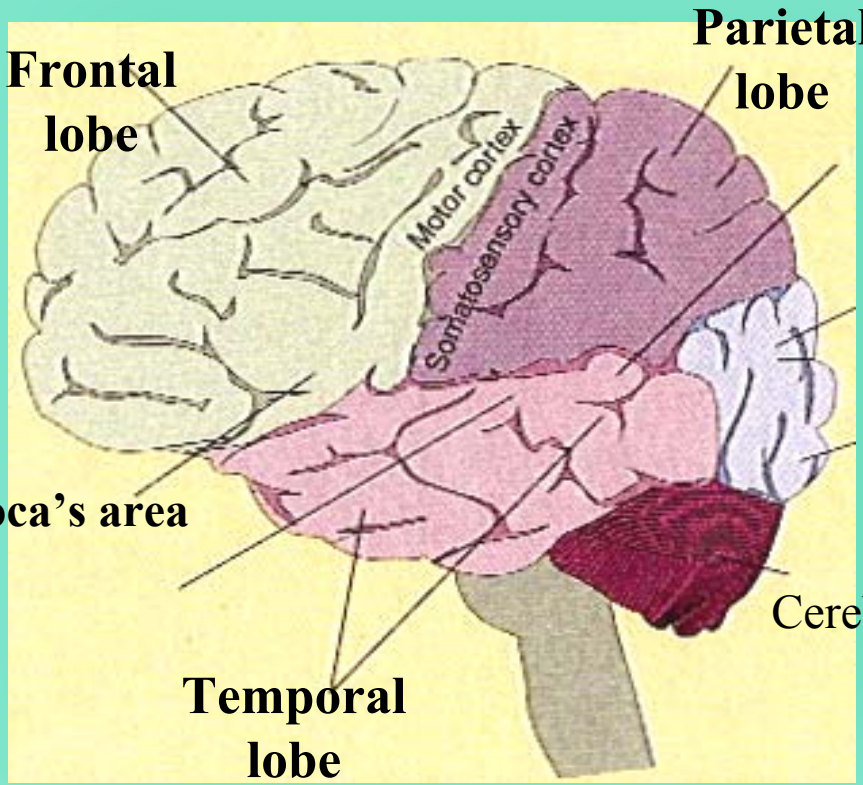
- *The somatosensory cortex* registers touch, pressure, temperature, and pain.
- *Association areas* house memories of how objects feel.

THE PARIETAL LOBE:
Somatosensory Cortex



The somatosensory cortex registers touch, pressure, temperature, and pain sensations from the opposite side of the body. The more senstitive the body parts are, the greater the areas of somatosensory cortex are involved.

THE OCCIPITAL LOBE:
Processing Visual Information

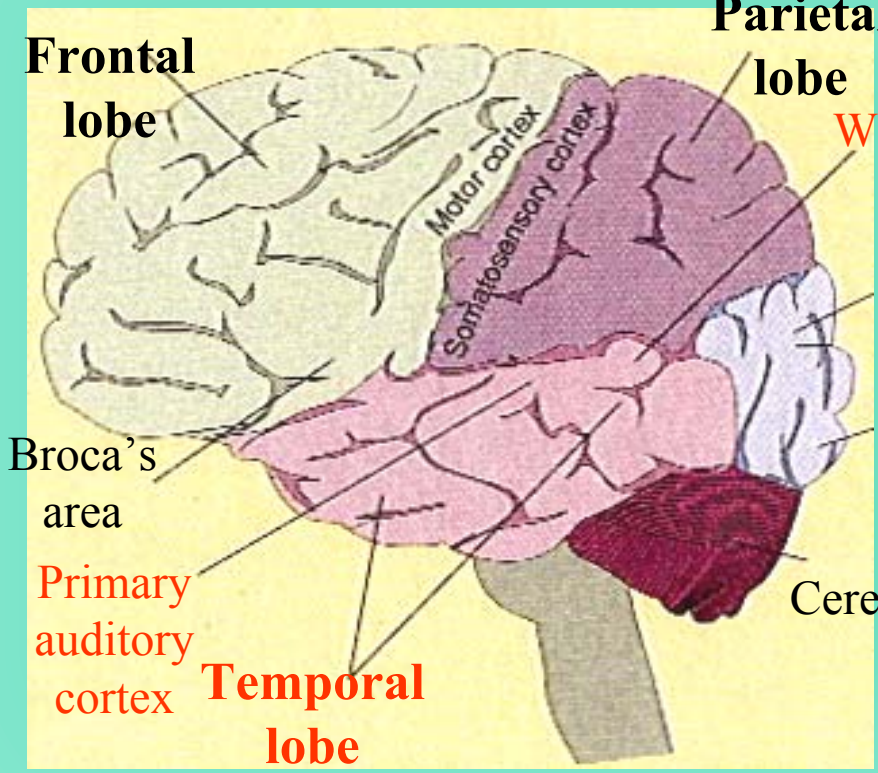


- *The primary visual cortex* is where vision registers.

- *Association areas* hold memories of past visual experience and are involved in the interpretation of visual information.

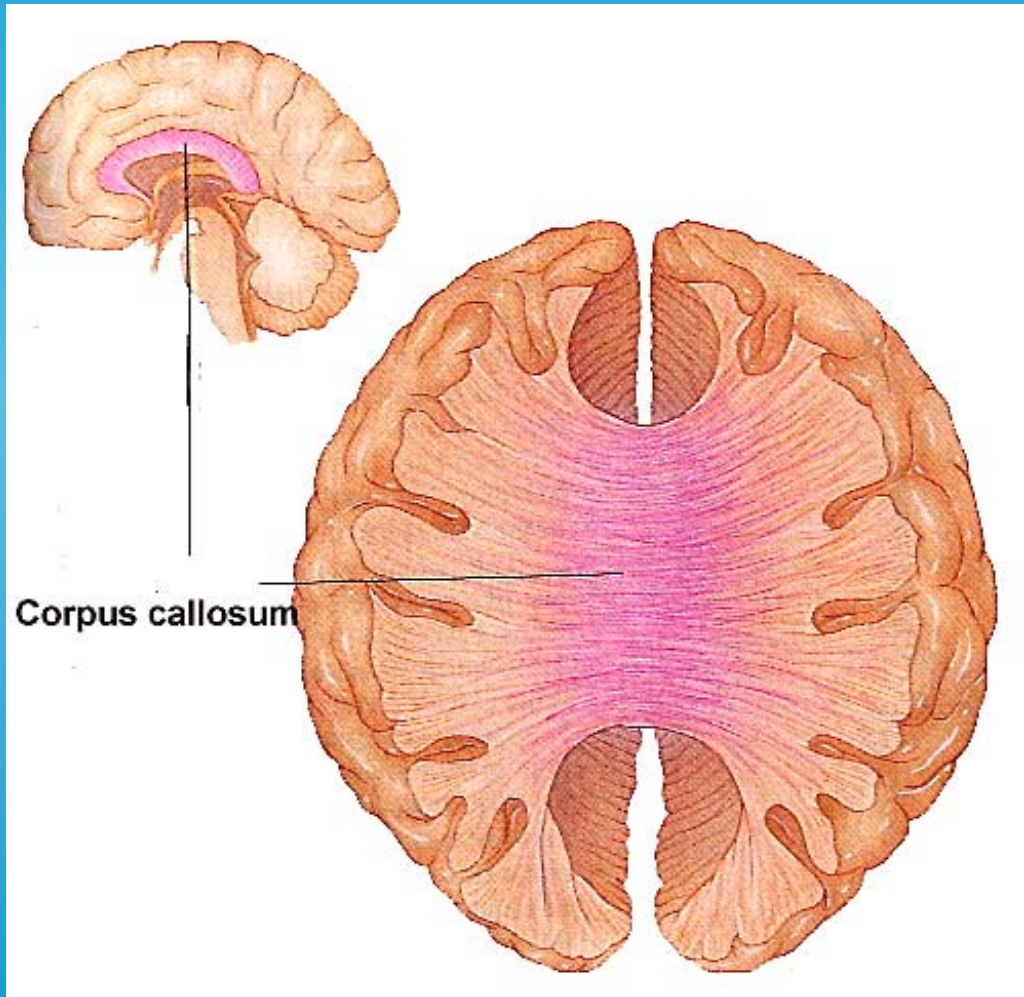
THE TEMPORAL LOBE:
Processing Auditory Information

- *The primary auditory cortex* is where hearing registers.
- *Wernicke's area* (in left hemisphere) is involved in language comprehension and formation of coherent written and spoken language.
- *Association areas* hold memories of past auditory experience and are involved in the interpretation of auditory stimuli.

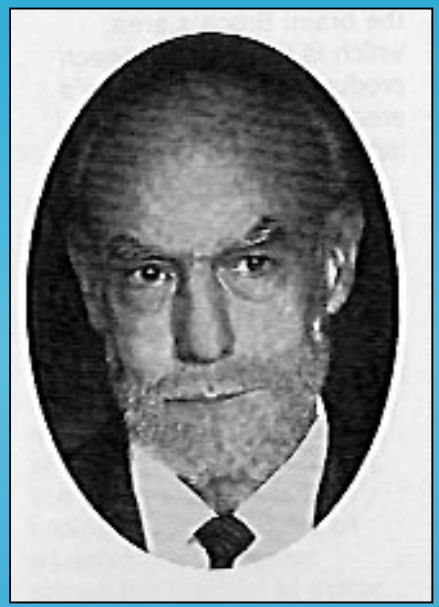


CEREBRAL HEMISPHERES:
Corpus Callosum

Corpus callosum connects the two hemispheres and pass information between them. It is a large set of nerve fibers or axons. A horizontal section (right) shows how each axon of the corpus callosum links a spot in the left hemisphere to a corresponding spot in the right hemisphere.



CEREBRAL HEMISPHERES:
Split-Brain Research



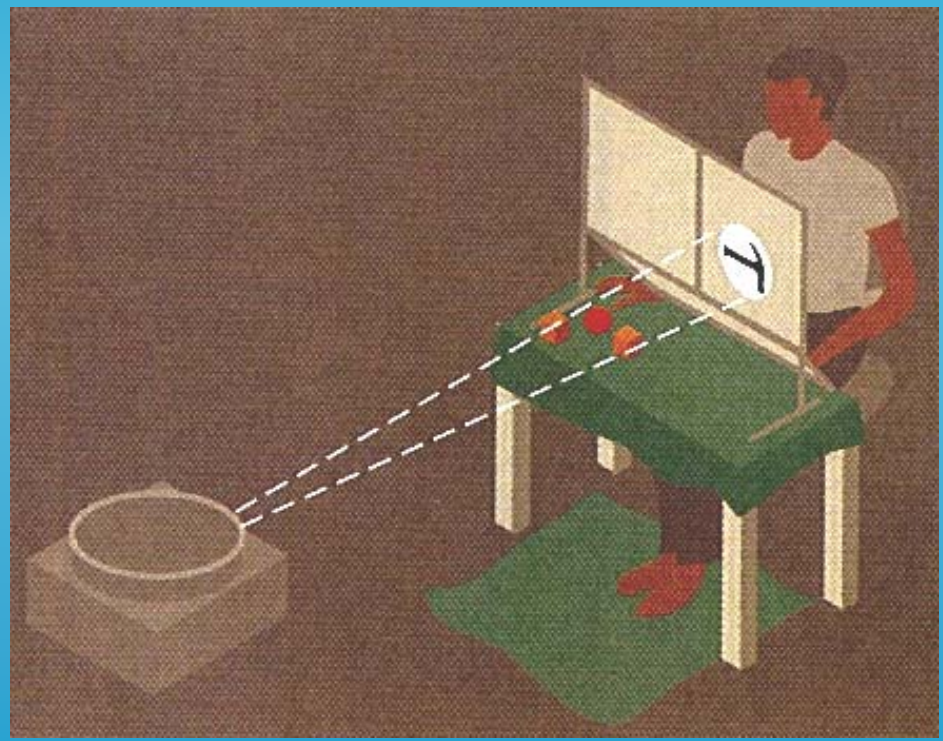
Roger Sperry received a Nobel prize (1981) in physiology/medicine for his "split-brain research".

Roger Sperry and his colleagues started performed some landmark research to undertand the differences in functions between two cerebral hemispheres in 1960s. They studied the individuals who had undergone the "split-brain" surgery to treat their epilepsy.

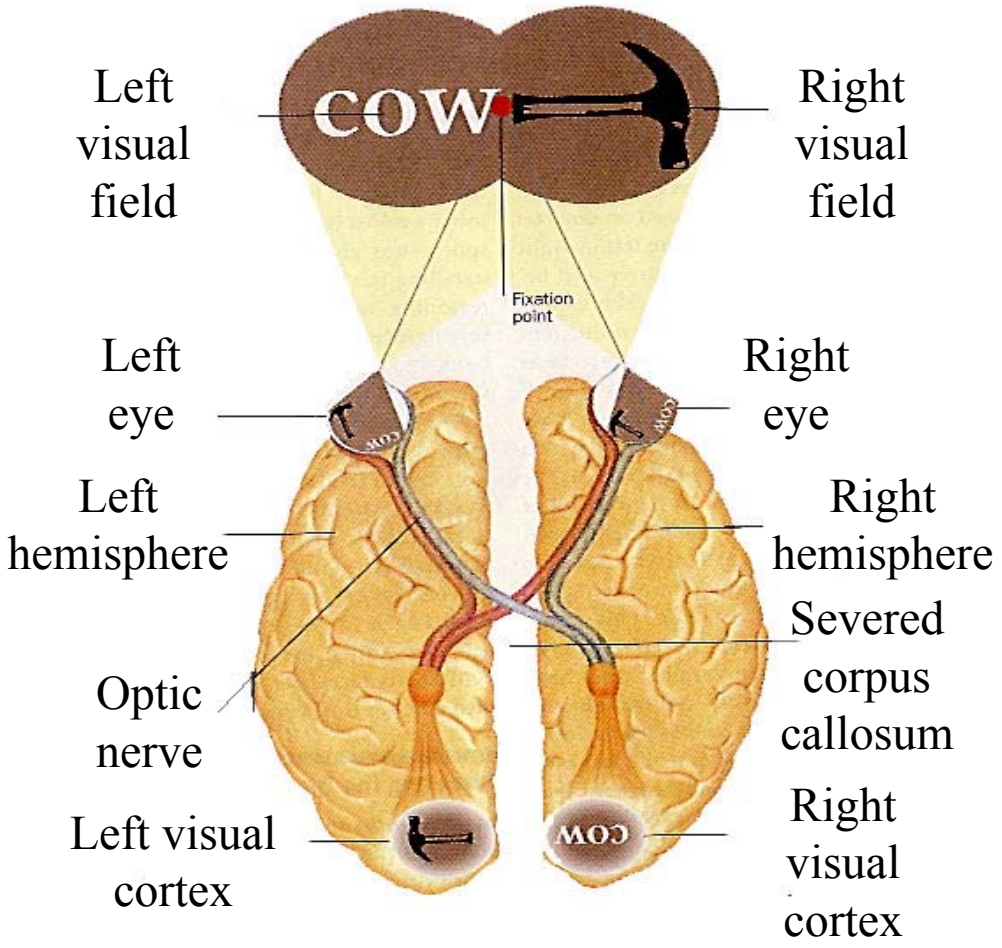
In *Split-brain* surgery the corpus callosum is cut to reduce severity of epileptic seizures. The left and right hemispheres of these "split-brain" patients thus became disconnected.

CEREBRAL HEMISPHERES:
Split-Brain Research: Experimental Apparatus

In split-brain research, a special slide projector is used. It can present images very briefly, before the subject's eyes can move. The image is, therefore, only projected to one hemispere in the split-brain patient. The portion of the apparatus beneath the screen is constructed to prevent subjects from seeing objects that they may be asked to handle.



CEREBRAL HEMISPHERES:
Human Visual System and Visual Input in the Split Brain



Input from the right visual field strikes the left side of each eye and is transferred to the left hemisphere. Input from the left visual field strikes the right side of each eye and is transmitted to the right hemisphere. Normally, the hemispheres share the information through corpus callosum. In split brain patients, the two hemispheres cannot communicate. Therefore, the experimenter can present a visual stimulus to just one hemisphere.

CEREBRAL HEMISPHERES:
Specialization of functions

Left Cerebral Hemisphere:

- Receives sensory inputs from the right side of the body.
- Controls right side movements
- Language function
- Analytical and logical
- Math and sciences

Right Cerebral Hemisphere:

- Receives sensory inputs from the left side of the body.
- Controls left side movements
- Nonverbal (visual-spatial) functions
- Wholistic and intuitive
- Arts and music

Brain Imaging Techniques

- **EEG (electroencephalogram):** records Brain's electrical activities, generating brain-wave patterns.
- **CT Scan (computerized axial tomography):** uses X-rays to produce computerized cross-sectional images.
- **MRI (magnetic resonance imaging):** uses no X-rays, producing higher-resolution images than CT scan.
- **PET Scan (positron-emission tomography):** shows brain in action. maps the patterns of blood flow, oxygen use, and glucose consumption (or metabolic activity) of the brain, using low-level radioactive-laced substance.
- **functional MRI (fMRI):** can image both brain structure and brain activity. requires nothing (radioactive or otherwise) to be injected. It can image locations of activity more precisely than PET can, and detect changes that take place in less than a second, compared to around a minute for PET.

Polygraph ("the Lie Detector")

* The polygraph(the Lie detector)measures physiological changes associated with emotional arousal.

The assumption is that when people lie, they feel anxious, and their anxiety causes physiological changes in blood pressure, heart rate, breathing, and perspiration.

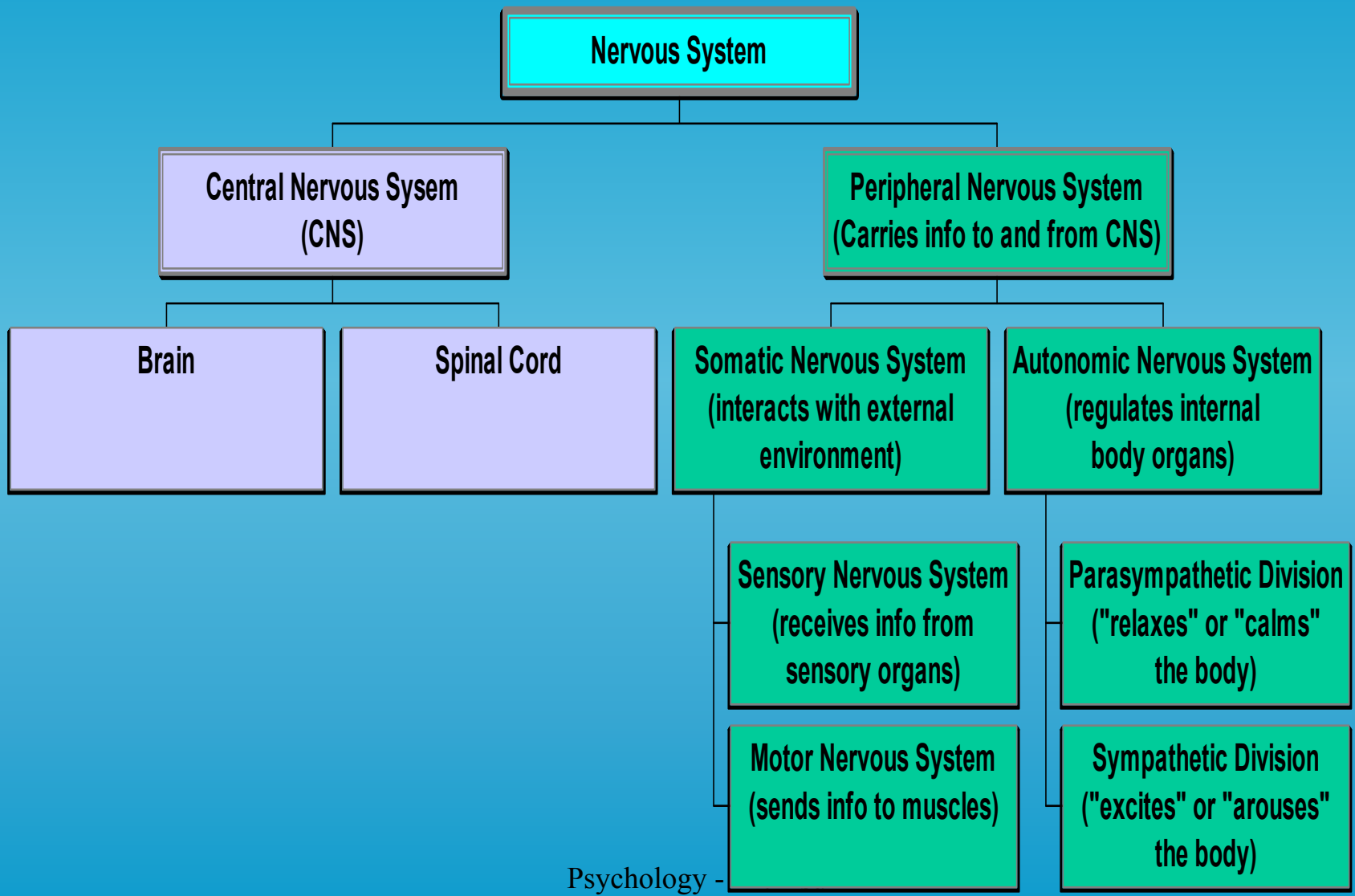
(Reliability): Polygraph is not very reliable in detecting whether someone is lying or not. Evidence from the polygraph is not admissible in half of the states in the United States. The Employee Polygraph Protection Act of 1988 prohibits most polygraph testing outside the government.

Plasticity of the Brain

Plasticity **refers to the ability of the brain to reorganize and compensate for brain damage.**

Plasticity is greatest in young children before the specialized functions of hemispheres have been established.

Organization of the Nervous System



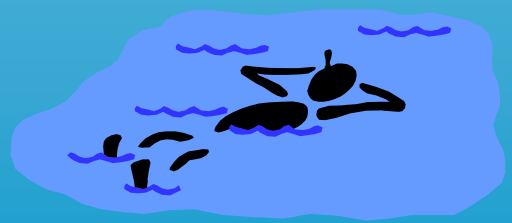
The Autonomic Nervous System

Autonomic Nervous System

consists of:

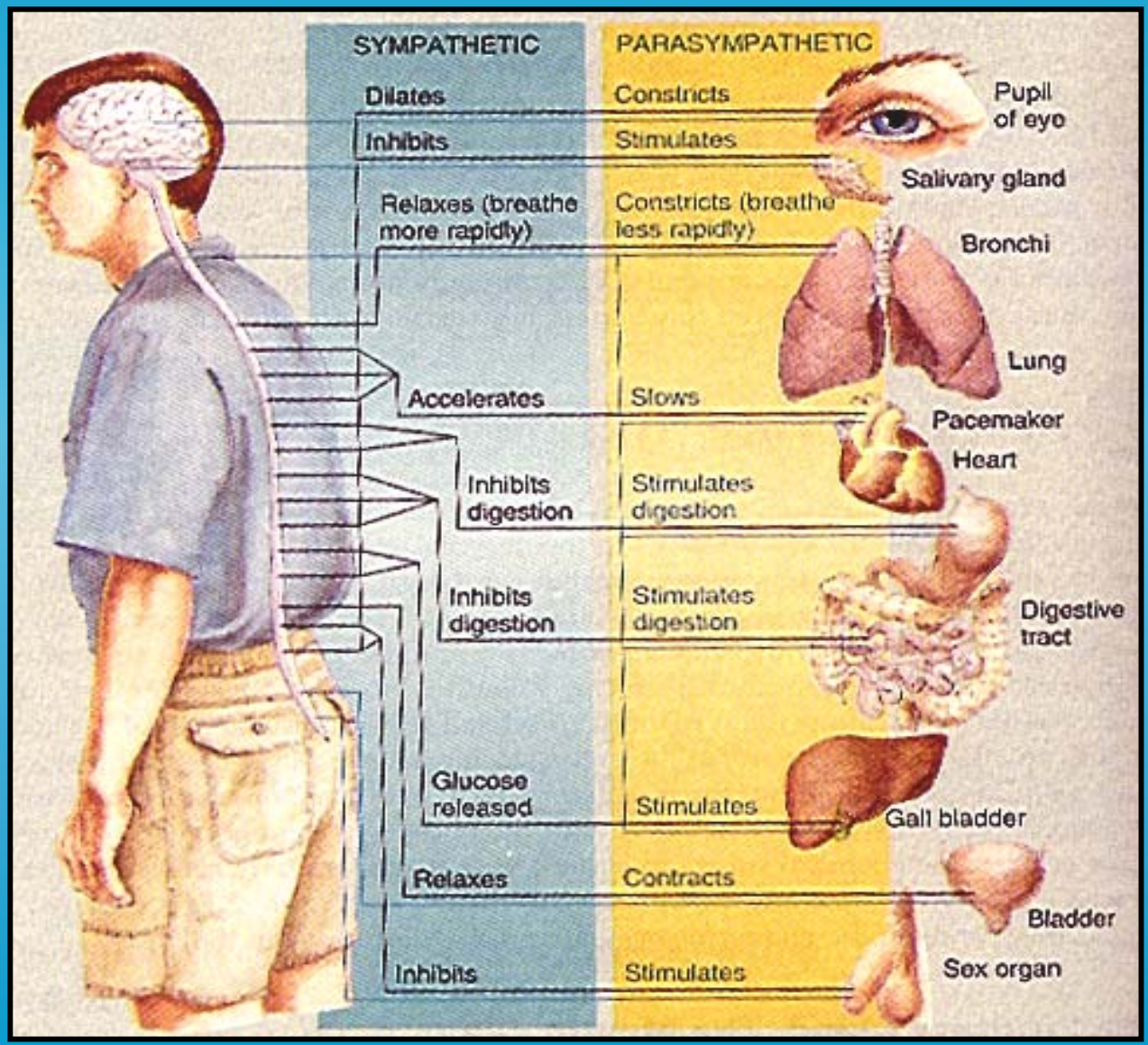
- *Sympathetic Nervous System*: which mobilizes the body's resources during emergencies or during stress.

- *Parasympathetic Nervous System*: which brings the heightened bodily responses back to normal after an emergency.



Sympathetic VS. Parasympathetic Nervous System:

Opposite effects on various parts of the body



Endocrine System

- *Pituitary gland (the master gland):* releases hormones that affect other glands. Produces growth hormones.
- *Thyroid gland:* releases hormone thyroxin that regulates the body's rate of metabolism.
- *Pancreas:* releases hormones insulin and glucagon that regulates the sugar levels in the blood.
- *Adrenal glands:* release hormones epinephrine and norepinephrine that affect body's stress reaction.