Myers' *EXPLORING PSYCHOLOGY* *(5th Ed)*

Chapter 2

Neuroscience and Behavior

James A. McCubbin, PhD
Clemson University

Worth Publishers

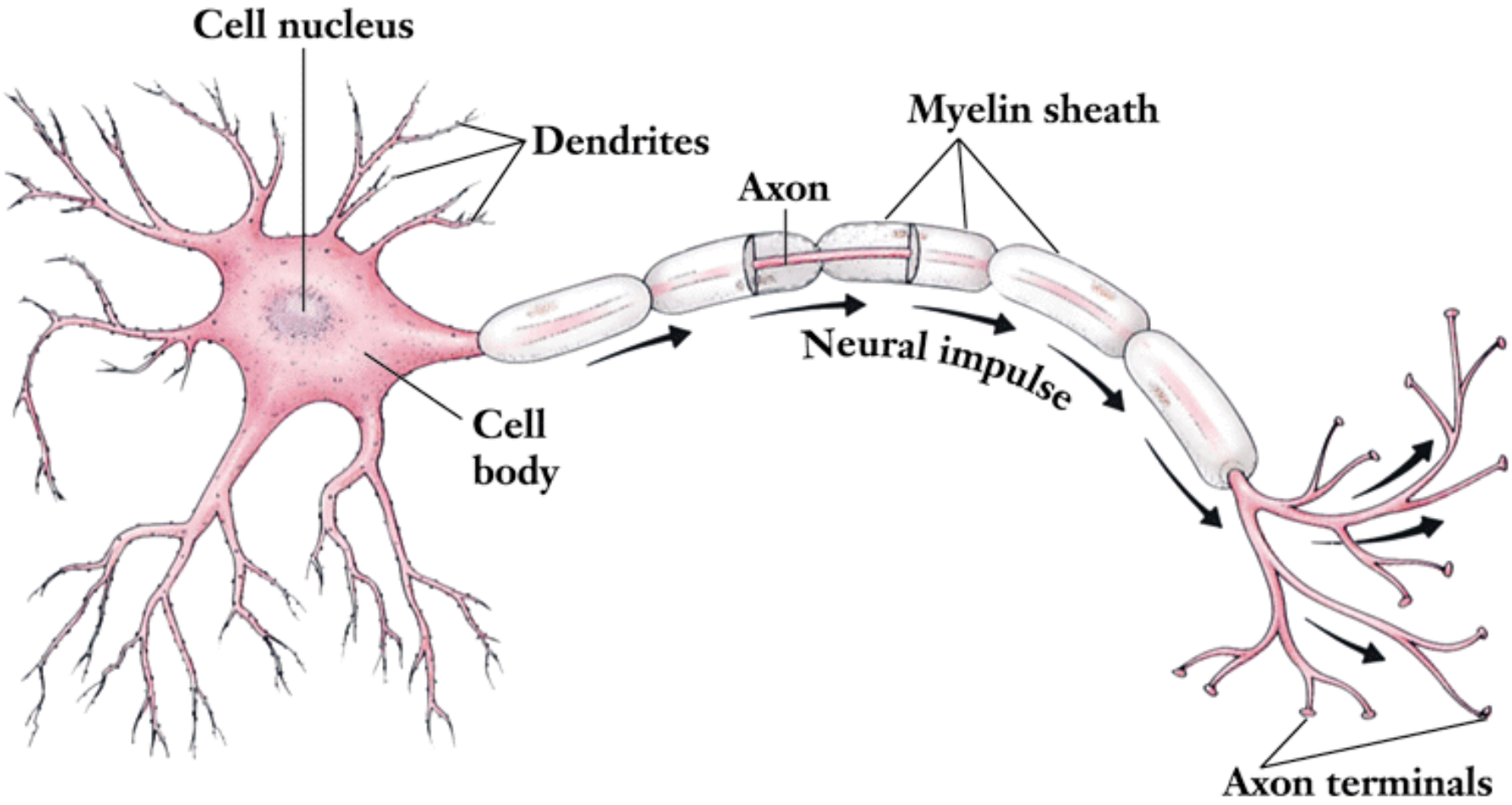
Neural Communication

- Biological Psychology
  - branch of psychology concerned with the links between biology and behavior
  - some biological psychologists call themselves behavioral neuroscientists, neuropsychologists, behavior geneticists, physiological psychologists, or biopsychologists
- Neuron
  - a nerve cell
  - the basic building block of the nervous system

Neural Communication

- Dendrite
  - the bushy, branching extensions of a neuron that receive messages and conduct impulses toward the cell body
- Axon
  - the extension of a neuron, ending in branching terminal fibers, through which messages are sent to other neurons or to muscles or glands
- Myelin [MY-uh-lin] Sheath
  - a layer of fatty cells segmentally encasing the fibers of many neurons
  - makes possible vastly greater transmission speed of neutral impulses

Neural Communication



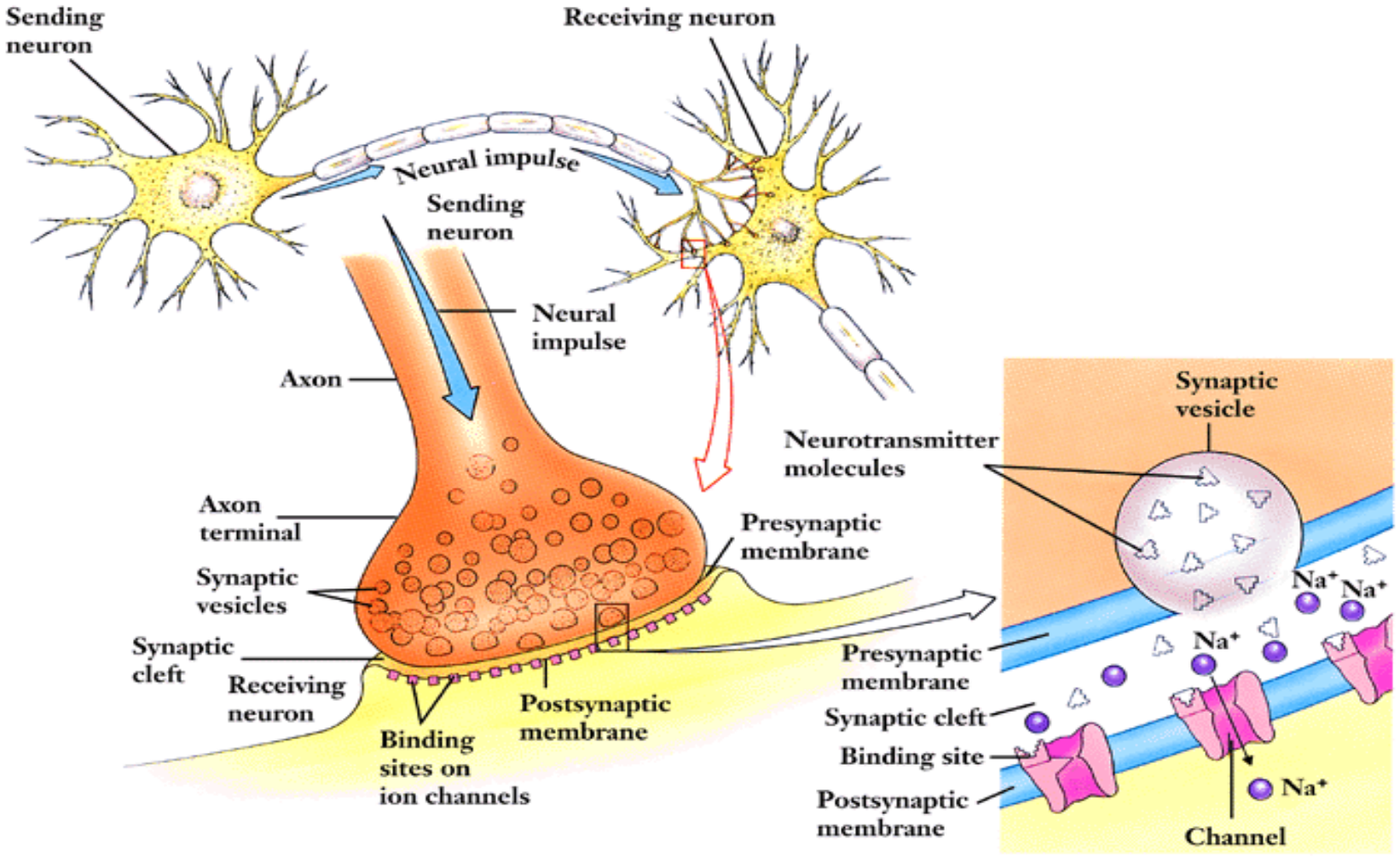
Neural Communication

- Action Potential
  - a neural impulse; a brief electrical charge that travels down an axon
  - generated by the movement of positively charged atoms in and out of channels in the axon's membrane
- Threshold
  - the level of stimulation required to trigger a neural impulse

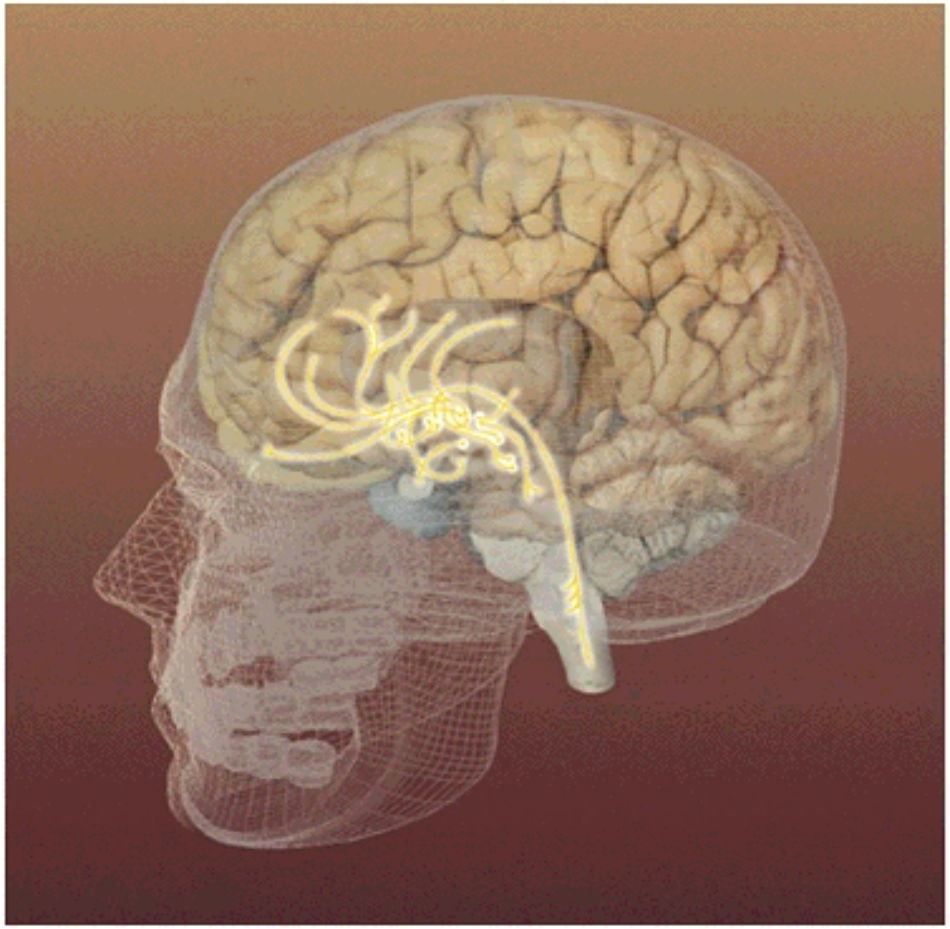
Neural Communication

- Synapse [SIN-aps]
  - junction between the axon tip of the sending neuron and the dendrite or cell body of the receiving neuron
  - tiny gap at this junction is called the synaptic gap or cleft
- Neurotransmitters
  - chemical messengers that traverse the synaptic gaps between neurons
  - when released by the sending neuron, neuro-transmitters travel across the synapse and bind to receptor sites on the receiving neuron, thereby influencing whether it will generate a neural impulse

Neural Communication

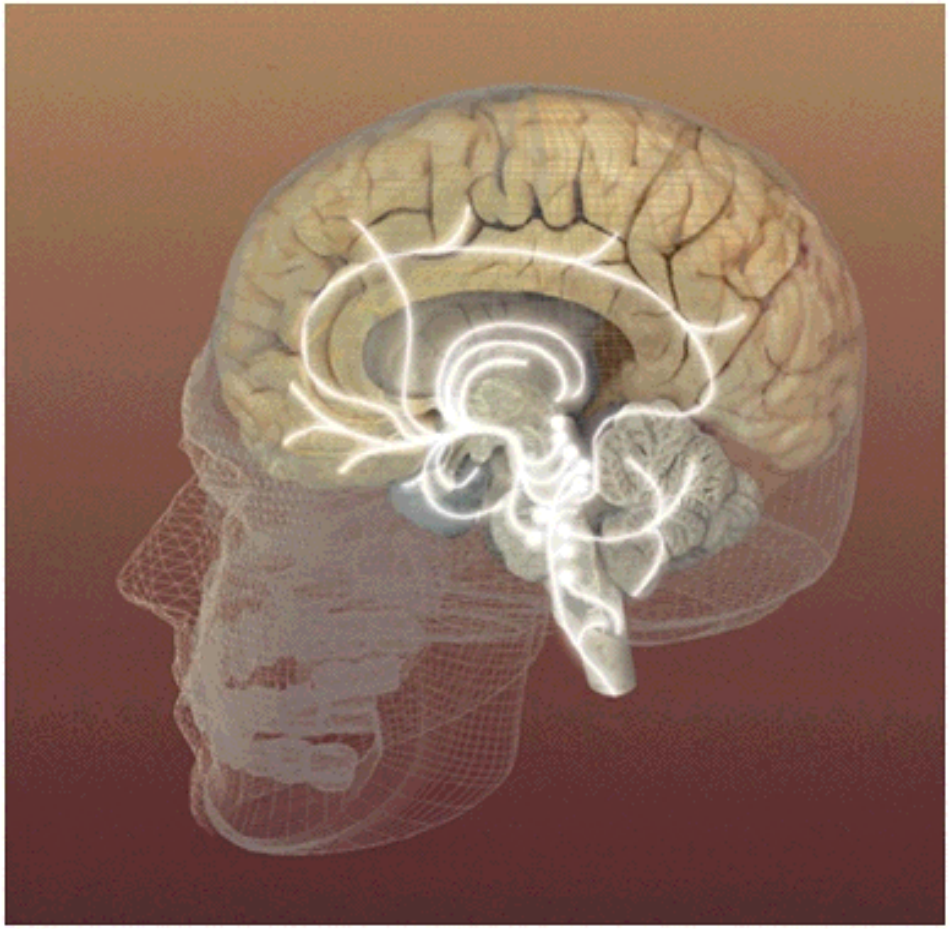


Neural Communication



Dopamine pathways

Neural Communication

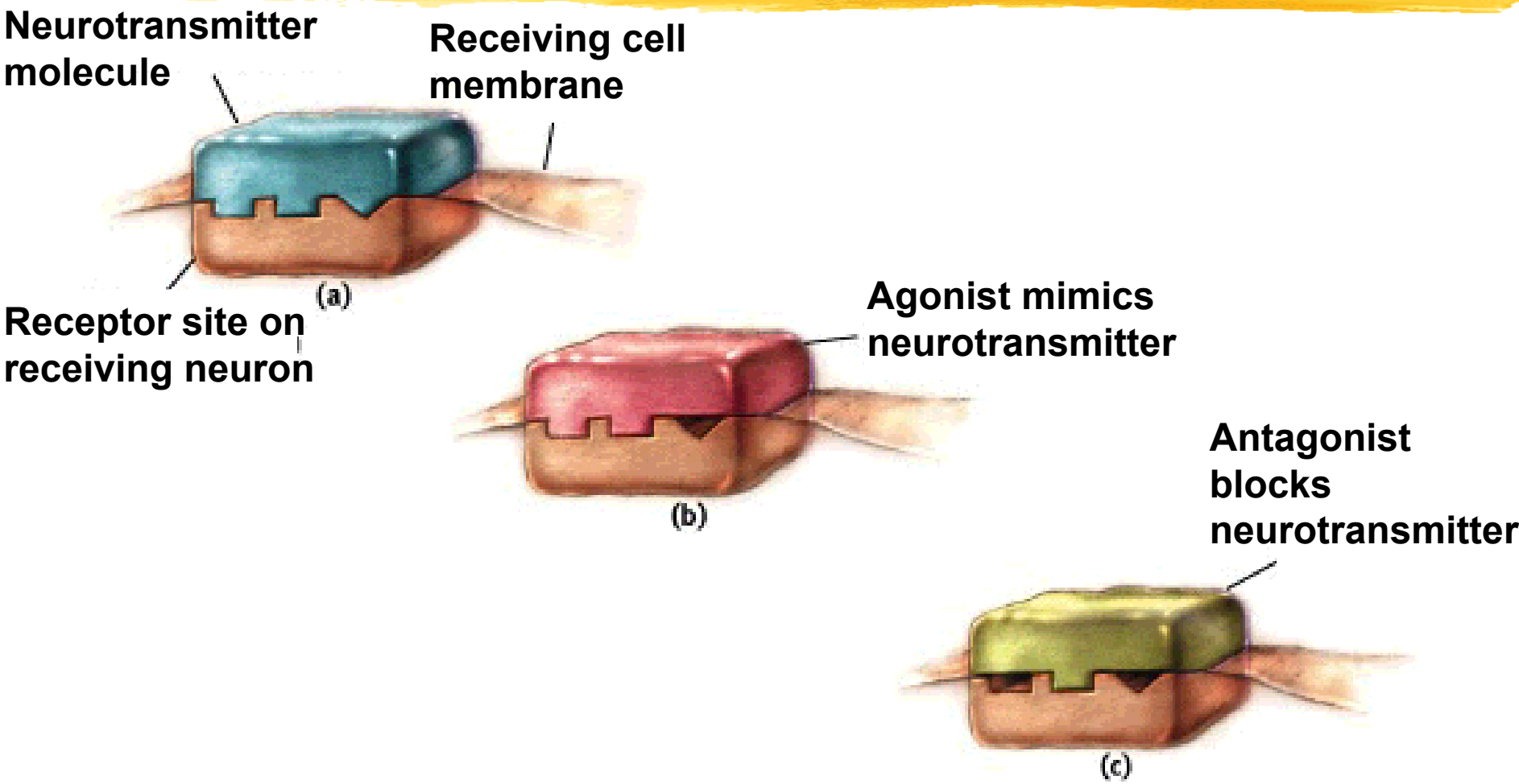


Serotonin pathways

Neural Communication

- Endorphins [en-DOR-fins]
  - "morphine within"
  - natural, opiatelike neurotransmitters
  - linked to pain control and to pleasure
- Nervous System
  - the body's speedy, electrochemical communication system
  - consists of all the nerve cells of the peripheral and central nervous systems

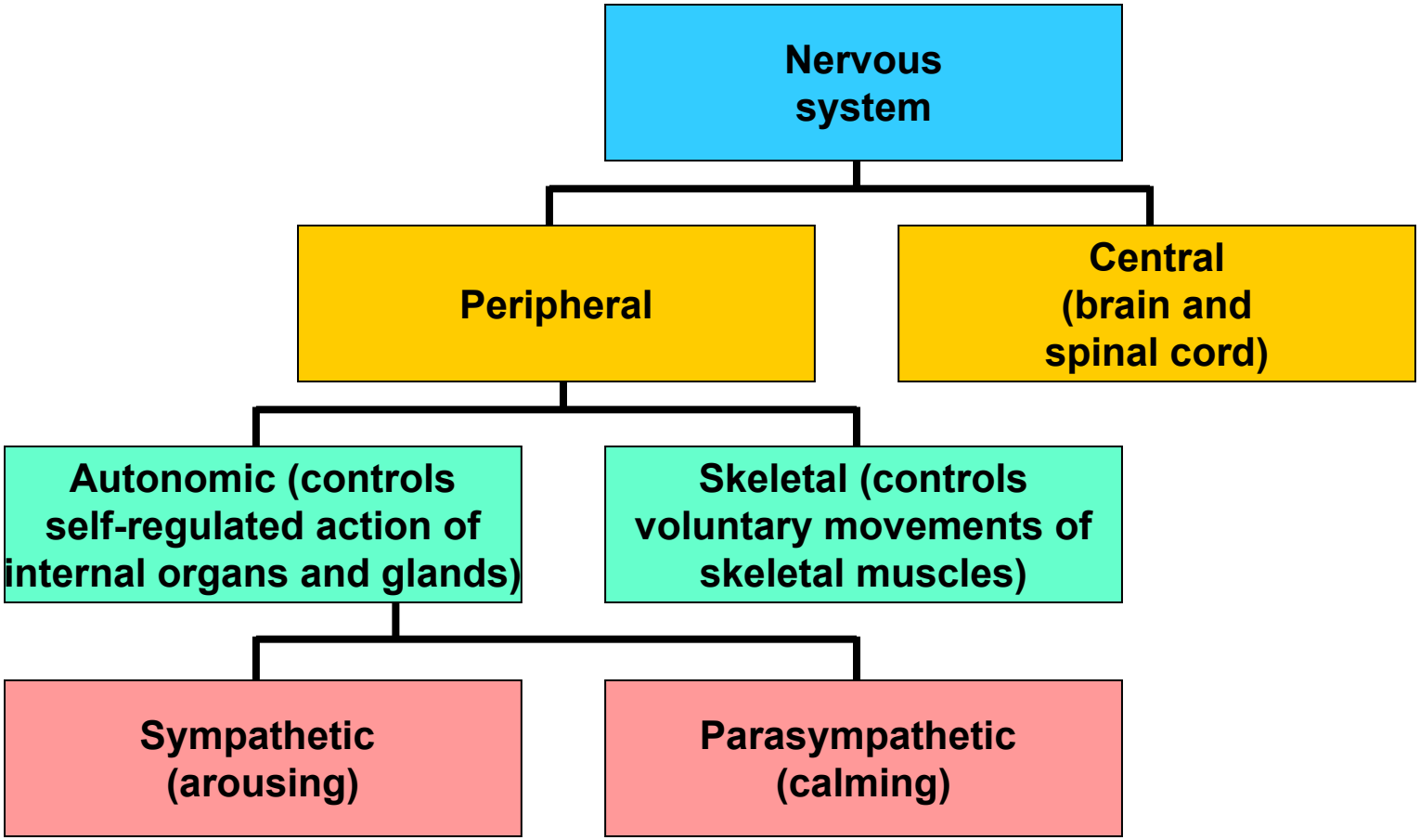
Agonists and Antagonists



Neural and Hormonal Systems

- Central Nervous System (CNS)
  - the brain and spinal cord
- Peripheral Nervous System (PNS)
  - the sensory and motor neurons that connect the central nervous system (CNS) to the rest of the body

Neural and Hormonal Systems



Neural and Hormonal Systems

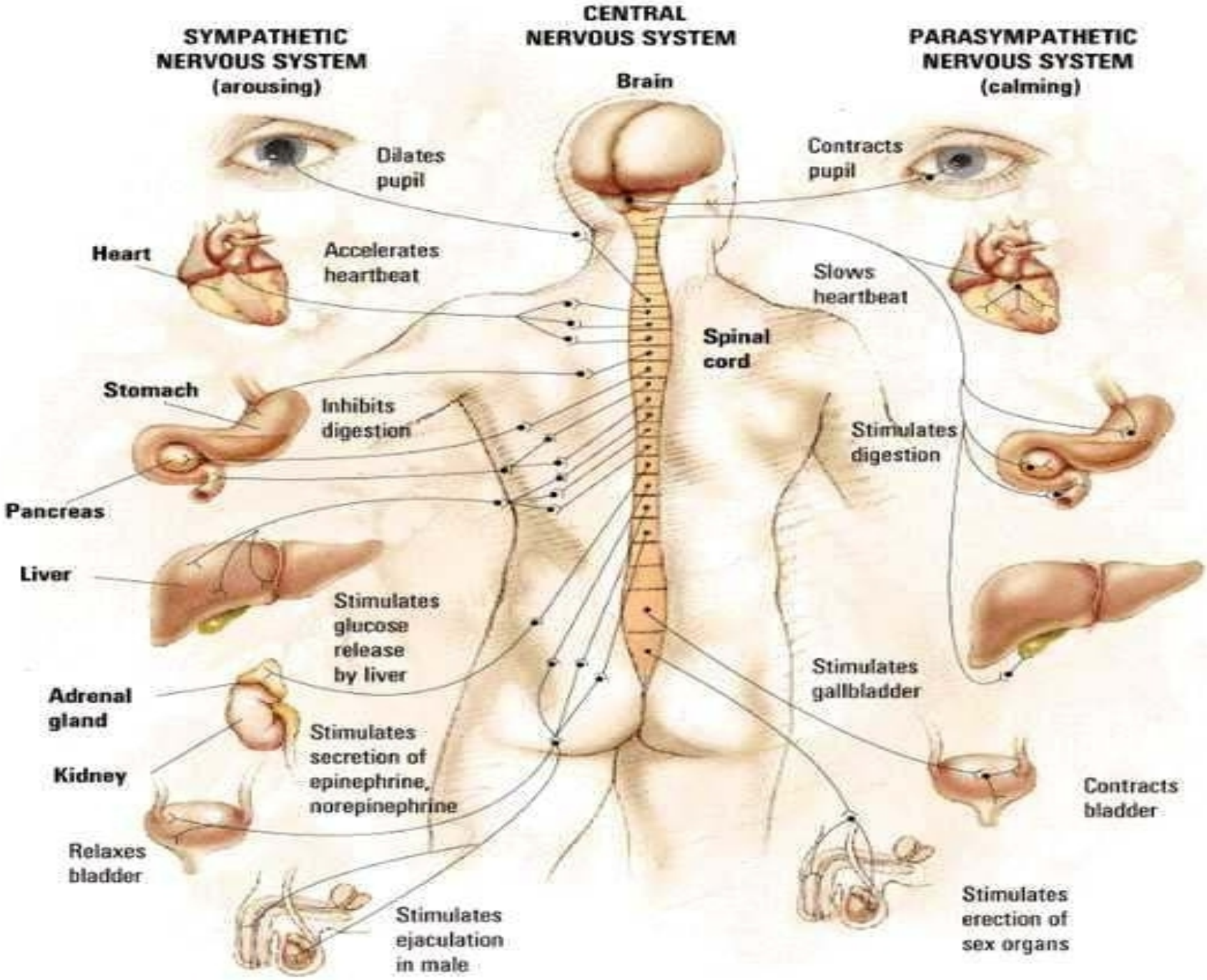
- Nerves
  - neural "cables" containing many axons
  - part of the peripheral nervous system
  - connect the central nervous system with muscles, glands, and sense organs
- Sensory Neurons
  - neurons that carry incoming information from the sense receptors to the central nervous system

Neural and Hormonal Systems

- Interneurons
  - CNS neurons that internally communicate and intervene between the sensory inputs and motor outputs
- Motor Neurons
  - carry outgoing information from the CNS to muscles and glands
- Somatic (Skeletal) Nervous System
  - the division of the peripheral nervous system that controls the body's skeletal muscles

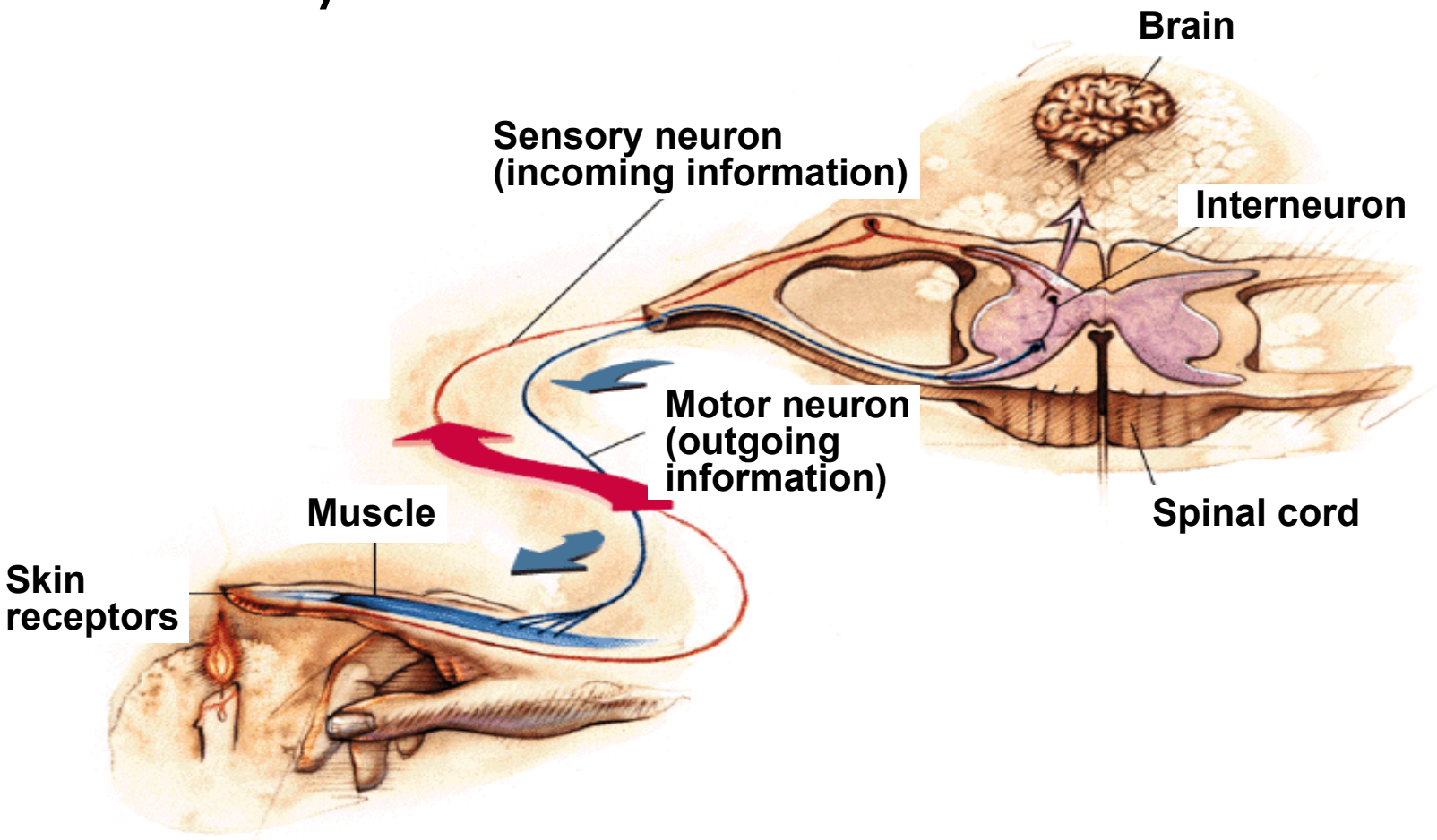
Neural and Hormonal Systems

- Autonomic Nervous System
  - the part of the peripheral nervous system that controls the glands and the muscles of the internal organs (such as the heart)
- Sympathetic Nervous System
  - division of the autonomic nervous system that arouses the body, mobilizing its energy in stressful situations
- Parasympathetic Nervous System
  - division of the autonomic nervous system that calms the body, conserving its energy

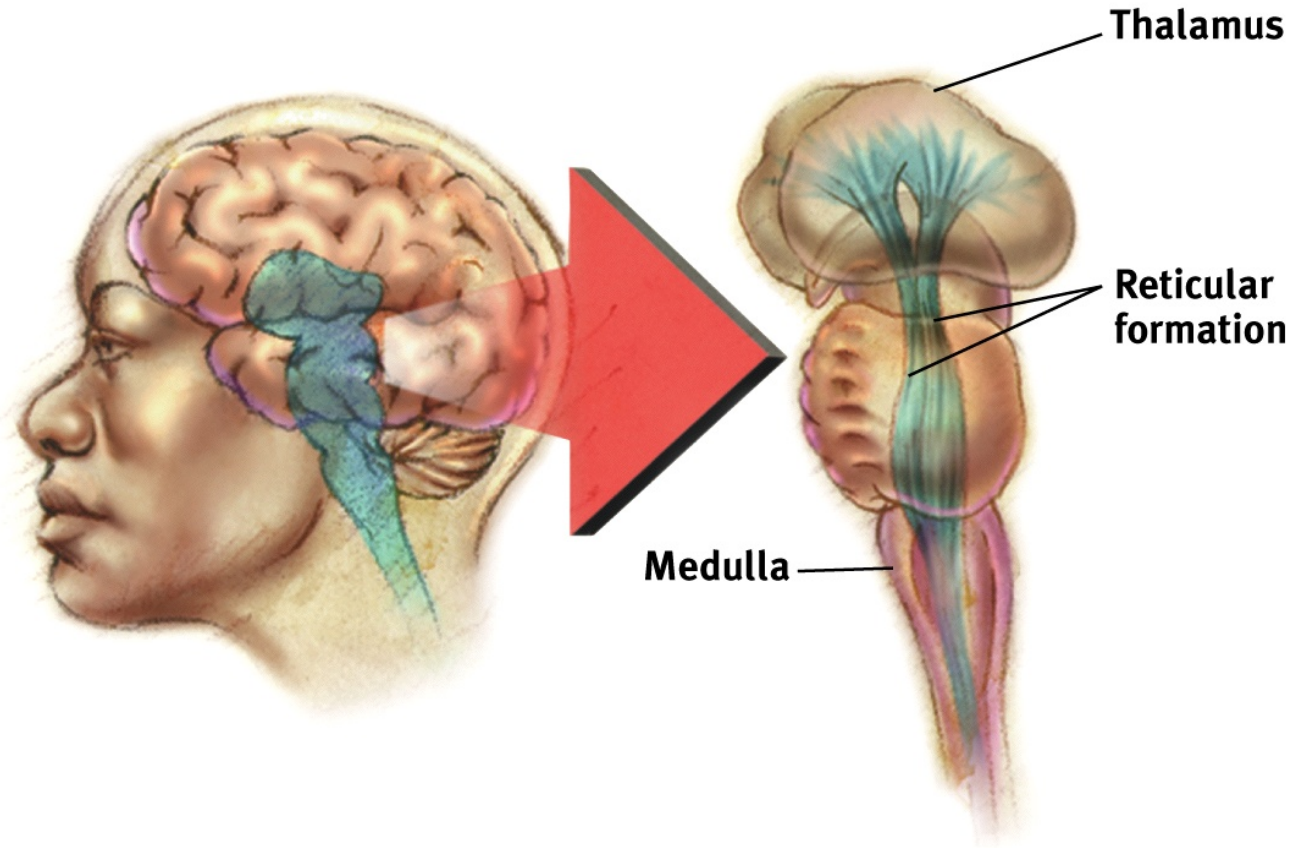

SYMPATHETIC NERVOUS SYSTEM (arousing)
CENTRAL NERVOUS SYSTEM
PARASYMPATHETIC NERVOUS SYSTEM (calming)
Brain
Dilates pupil
Contracts pupil
Heart
Accelerates heartbeat
Slows heartbeat
Spinal cord
Stomach
Inhibits digestion
Stimulates digestion
Pancreas
Liver
Stimulates glucose release by liver
Stimulates gallbladder
Adrenal gland
Stimulates secretion of epinephrine, norepinephrine
Kidney
Contracts bladder
Relaxes bladder
Stimulates ejaculation in male
Stimulates erection of sex organs

Reflex

- a simple, automatic, inborn response to a sensory stimulus



The Brainstem and Thalamus



The Brain

- Brainstem
  - the oldest part and central core of the brain, beginning where the spinal cord swells as it enters the skull
  - responsible for automatic survival functions
- Medulla [muh-DUL-uh]
  - base of the brainstem
  - controls heartbeat and breathing

The Brain

- Reticular Formation
  - a nerve network in the brainstem that plays an important role in controlling arousal

The Brain

- Lesion
  - tissue destruction
  - a brain lesion is a naturally or experimentally caused destruction of brain tissue

Electroencephalogram (EEG)

- an amplified recording of the waves of electrical activity that sweep across the brain's surface
- these waves are measured by electrodes placed on the scalp

The Brain

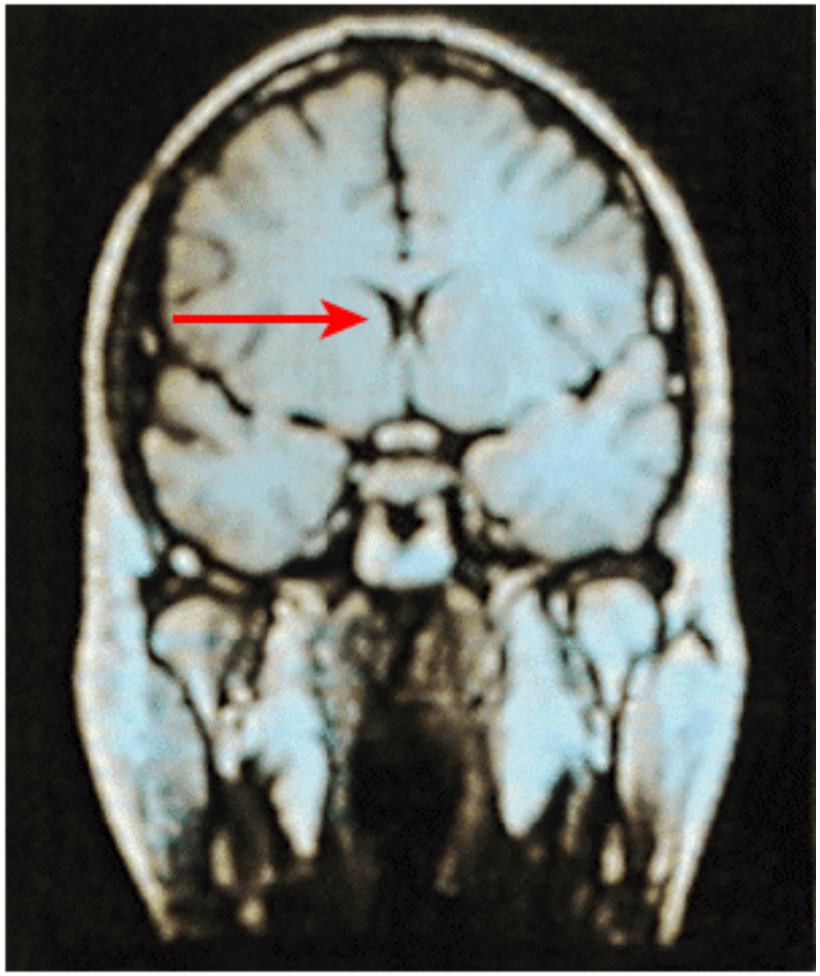
- CT (computed tomograph) Scan
  - a series of x-ray photographs taken from different angles and combined by computer into a composite representation of a slice through the body. Also called CAT scan.
- PET (positron emission tomograph) Scan
  - a visual display of brain activity that detects where a radioactive form of glucose goes while the brain performs a given task.

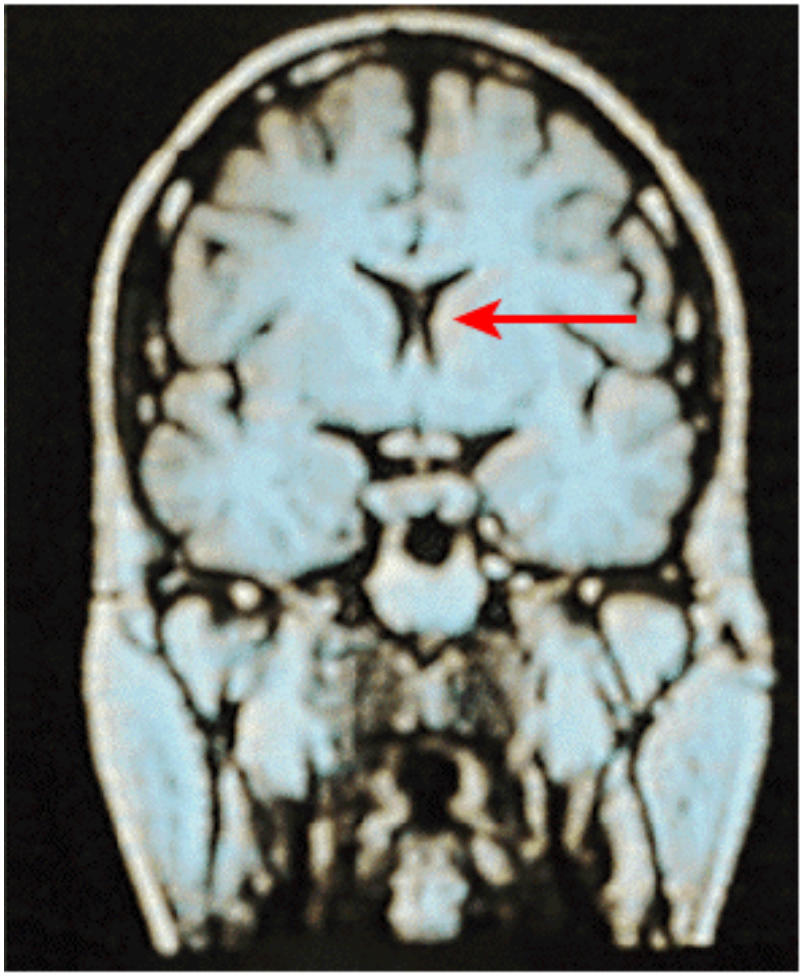
PET Scan

The Brain

- MRI (magnetic resonance imaging)
  - a technique that uses magnetic fields and radio waves to produce computer – generated images that distinguish among different types of soft tissue; allows us to see structures within the brain.

MRI Scan

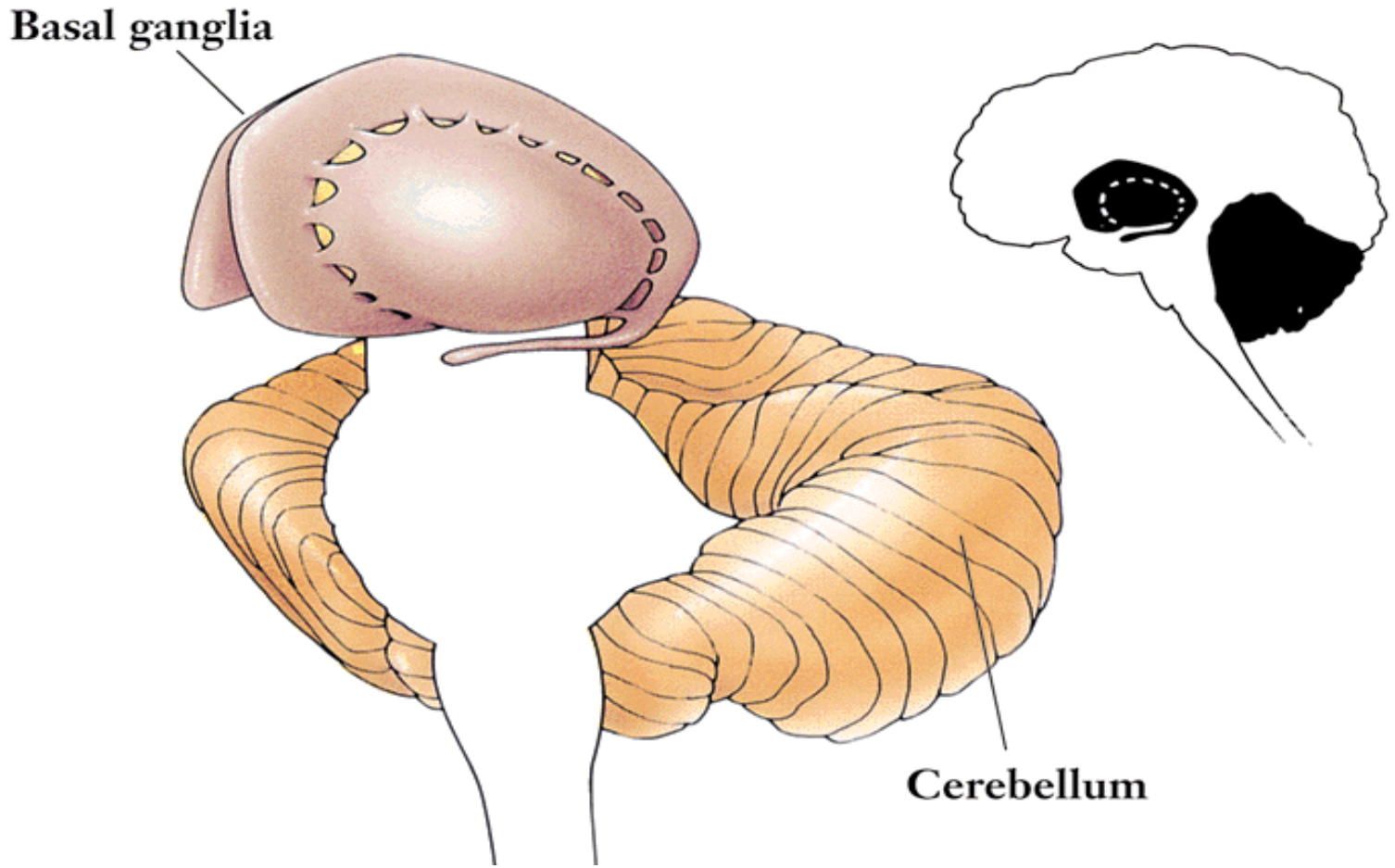




The Brain

- Thalamus
  - the brain's sensory switchboard
  - directs messages to the sensory receiving areas in the cortex and transmits replies to the cerebellum and medulla
- Cerebellum [sehr-uh-BELL-um]
  - the "little brain" attached to the rear of the brainstem
  - it helps coordinate voluntary movement and balance

The Cerebellum



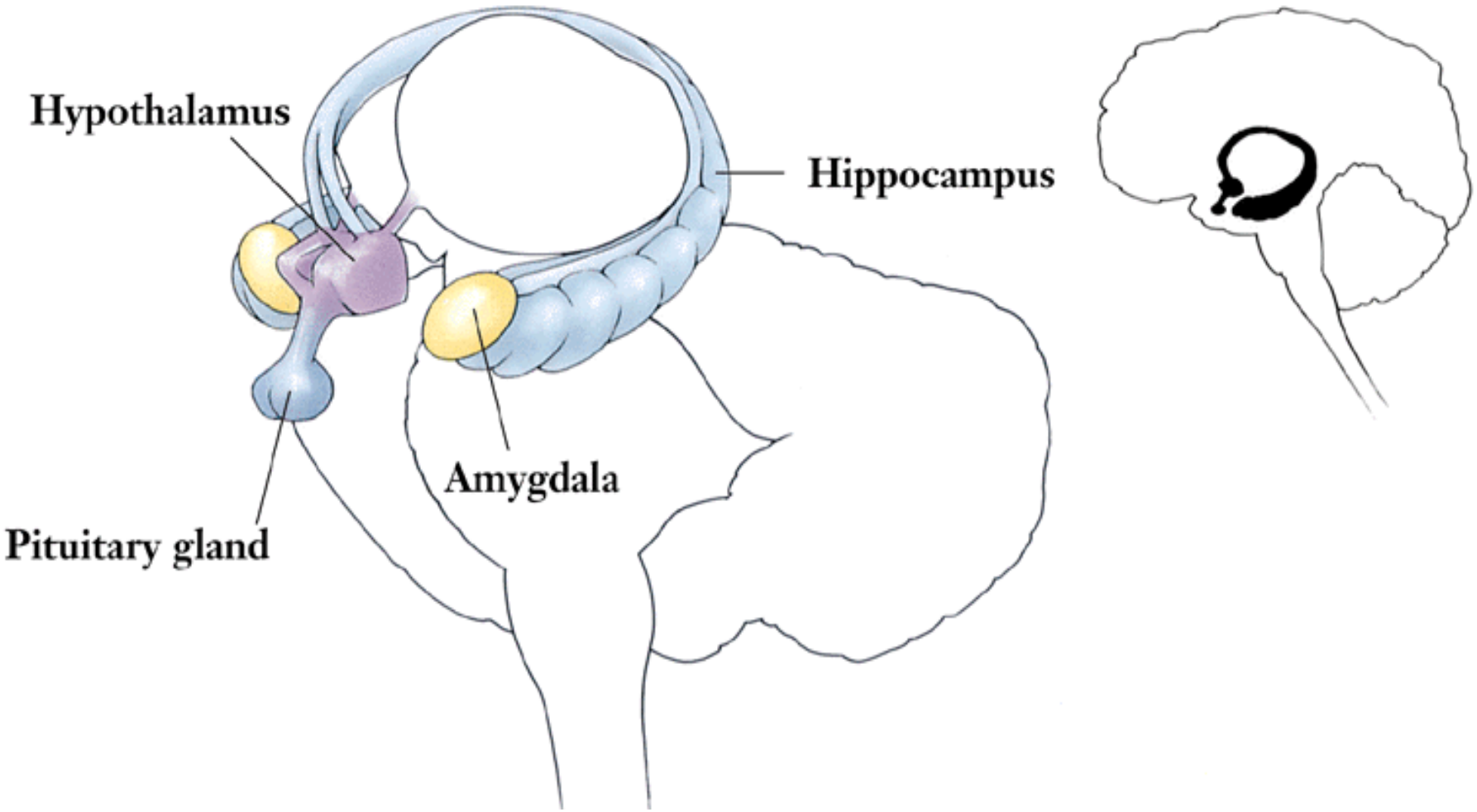
The Brain

- Limbic System
  - a doughnut-shaped system of neural structures at the border of the brainstem and cerebral hemispheres
  - associated with emotions such as fear and aggression and drives such as those for food and sex
  - includes the hippocampus, amygdala, and hypothalamus.

The Brain

- Amygdala [ah-MIG-dah-la]
  - two almond-shaped neural clusters that are components of the limbic system and are linked to emotion

The Limbic System

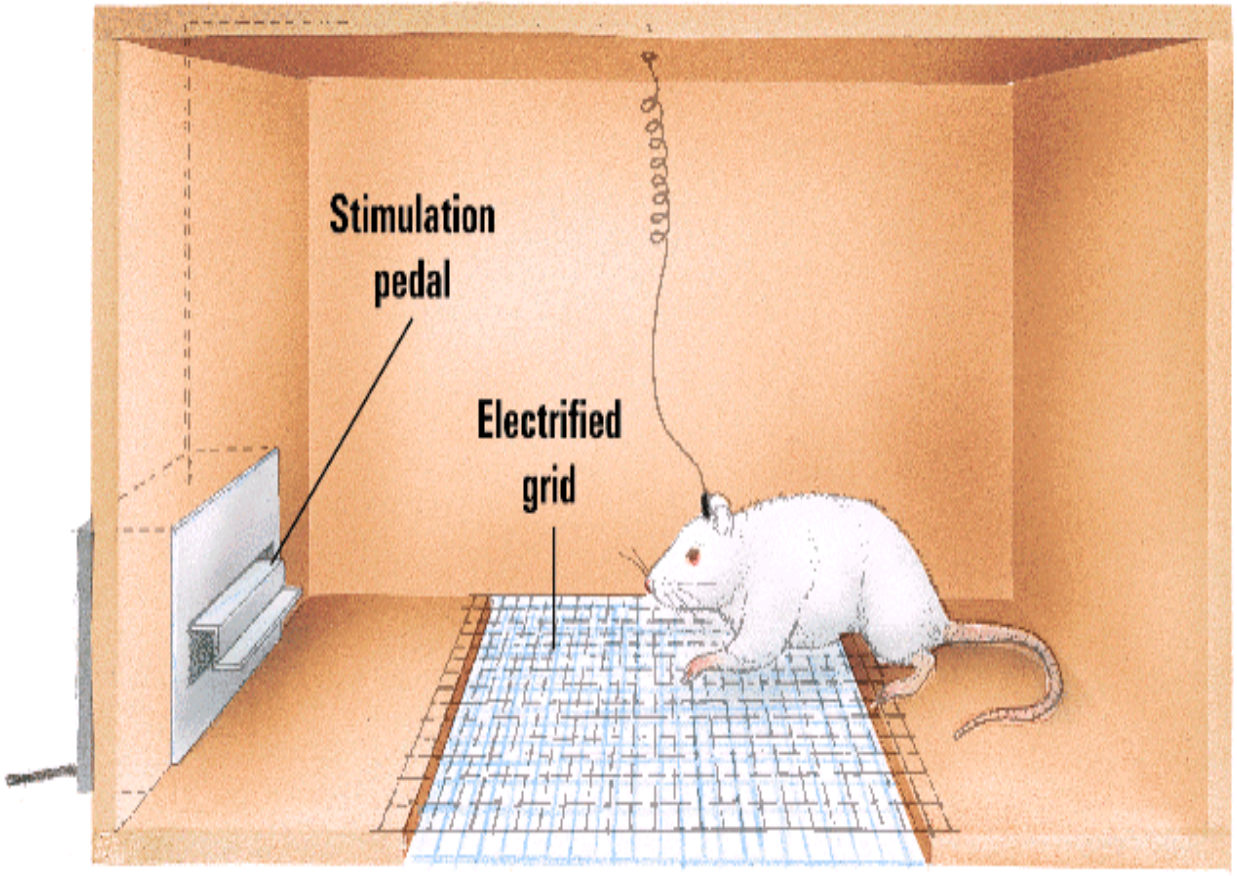


The Limbic System

- Hypothalamus
  - neural structure lying below (hypo) the thalamus
  - directs several maintenance activities
    - eating
    - drinking
    - body temperature
  - helps govern the endocrine system via the pituitary gland
  - linked to emotion

The Limbic System

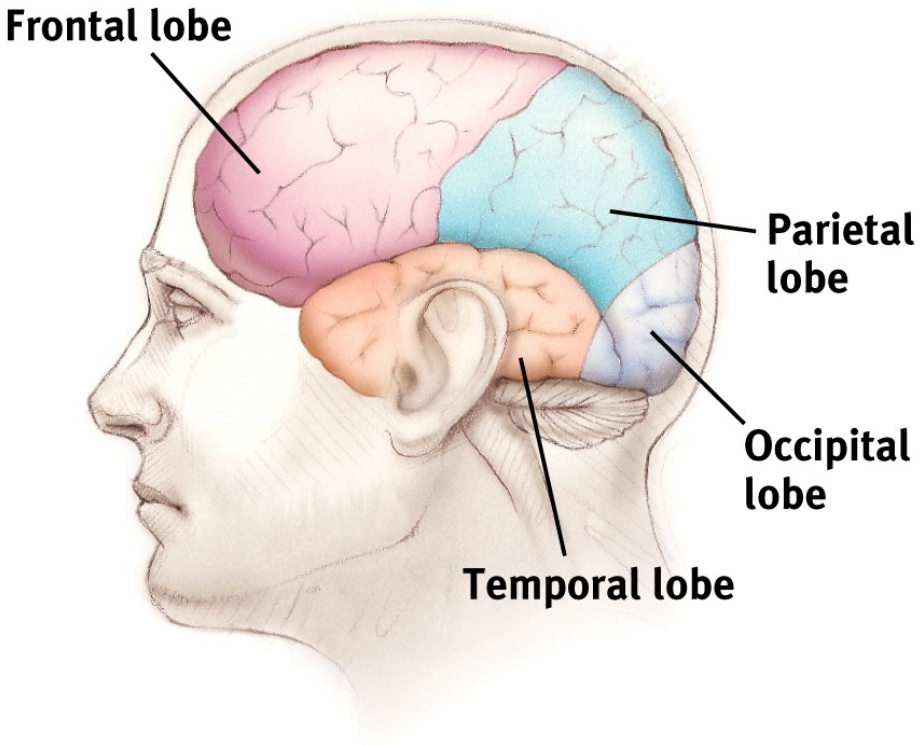
- Electrode implanted in reward center



The Cerebral Cortex

- Cerebral Cortex
  - the intricate fabric of interconnected neural cells that covers the cerebral hemispheres
  - the body's ultimate control and information processing center
- Glial Cells
  - cells in the nervous system that are not neurons but that support, nourish, and protect neurons

The Cerebral Cortex



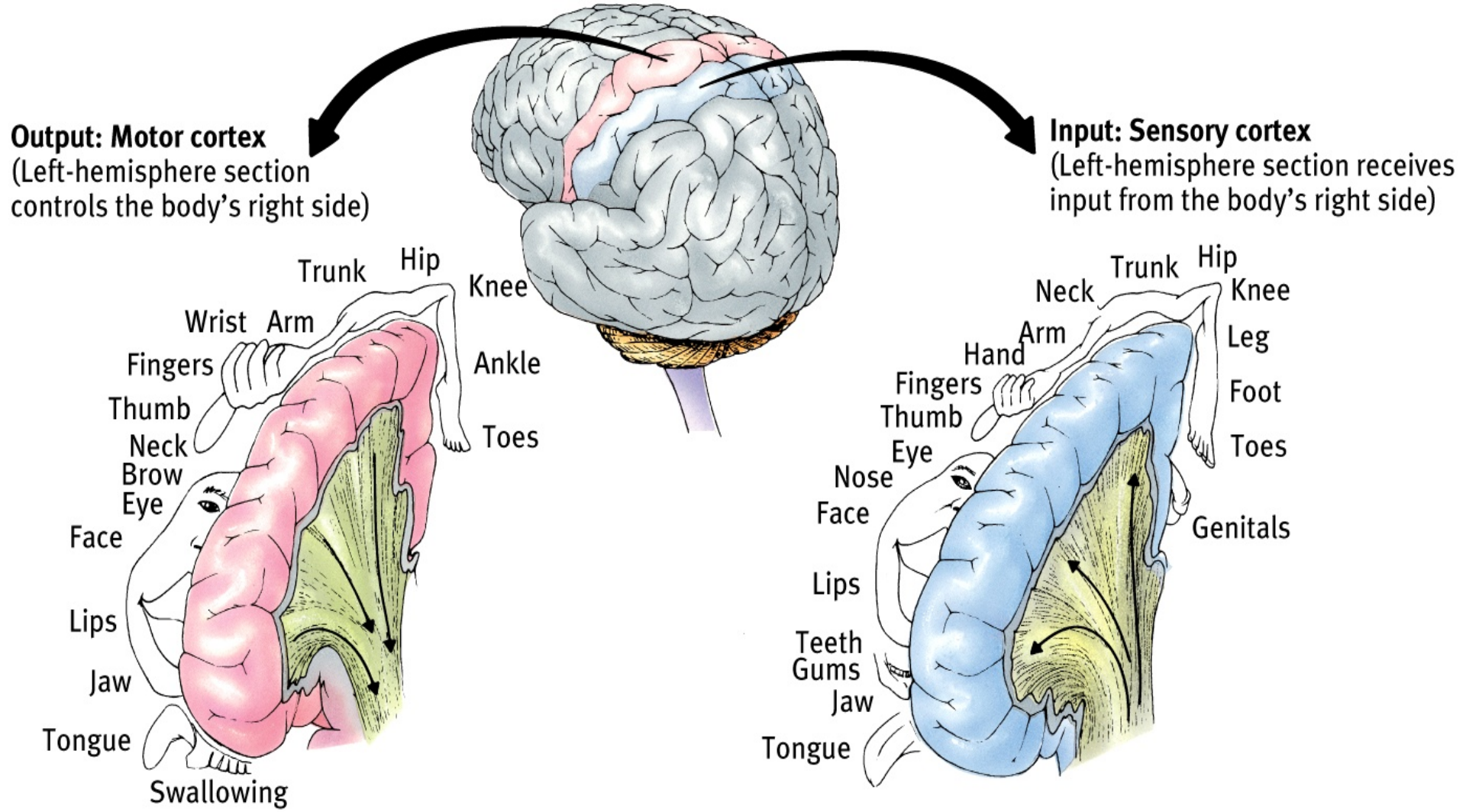
The Cerebral Cortex

- Frontal Lobes
  - involved in speaking and muscle movements and in making plans and judgments
- Parietal Lobes
  - include the sensory cortex

The Cerebral Cortex

- Occipital Lobes
  - include the visual areas, each of which receives visual information from the opposite visual field
- Temporal Lobes
  - include the auditory areas, each of which receives auditory information primarily from the opposite ear

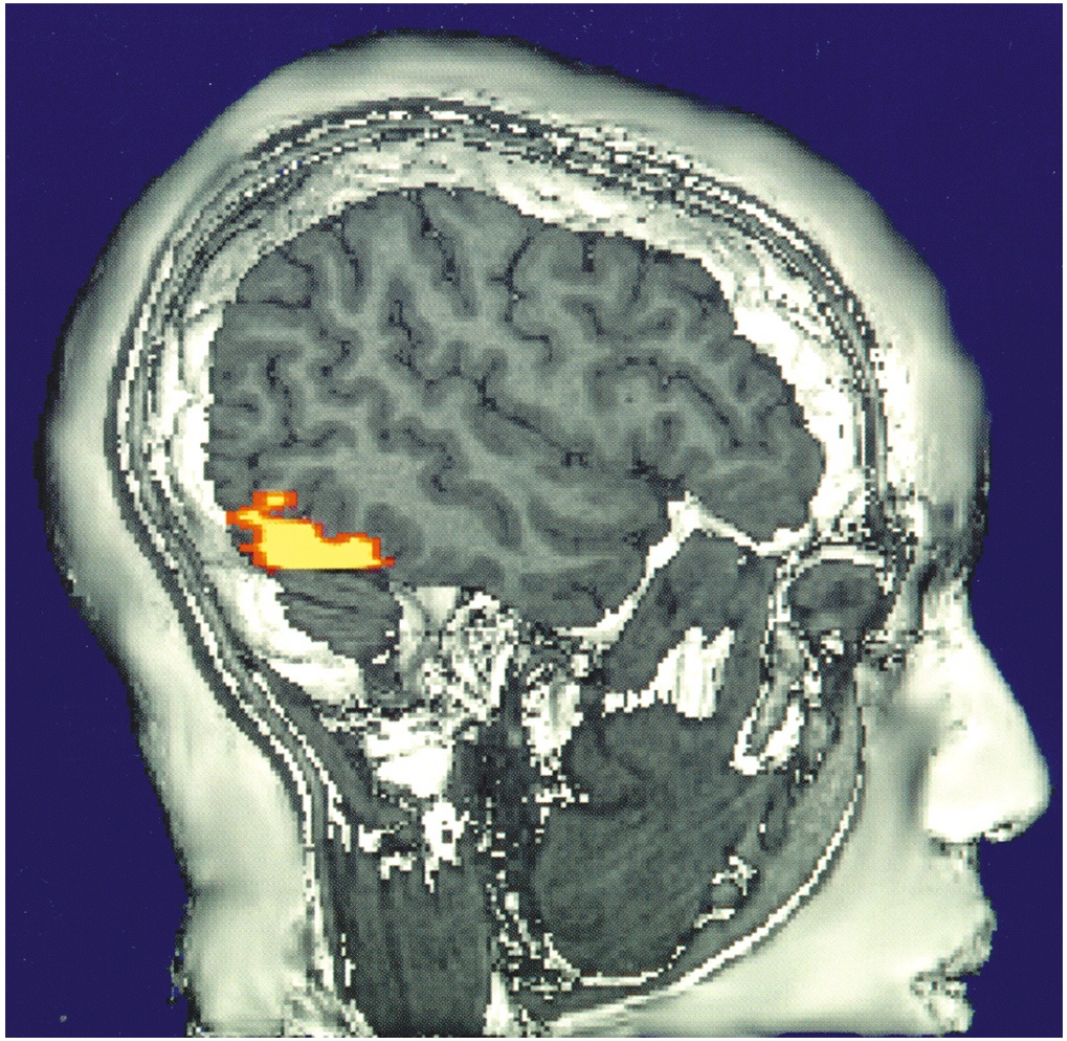
The Cerebral Cortex



The Cerebral Cortex

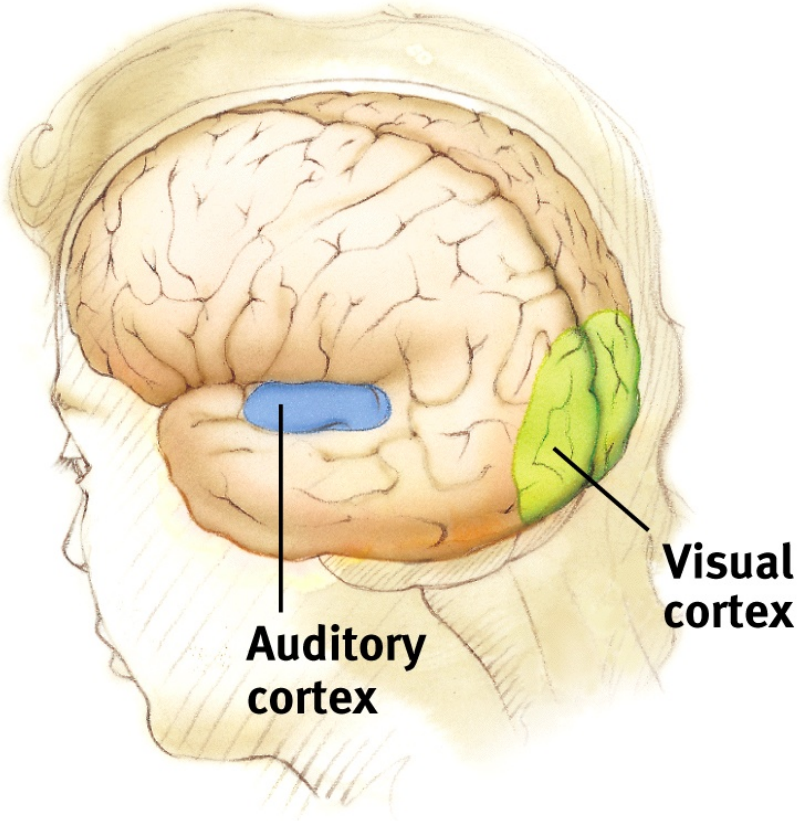
- Motor Cortex
  - area at the rear of the frontal lobes that controls voluntary movements
- Sensory Cortex
  - area at the front of the parietal lobes that registers and processes body sensations

The Cerebral Cortex

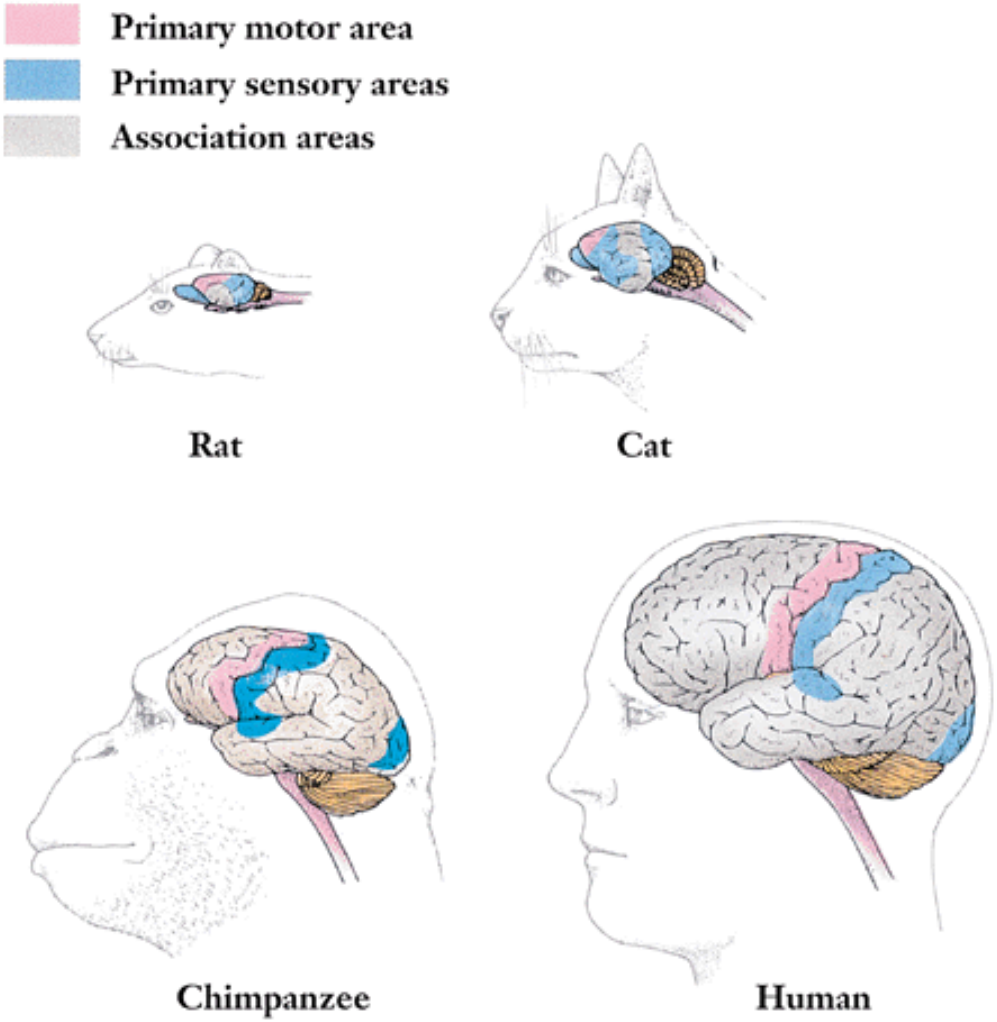


- Functional MRI scan of the visual cortex activated by light shown in the subject's eyes

Visual and Auditory Cortex



Association Areas

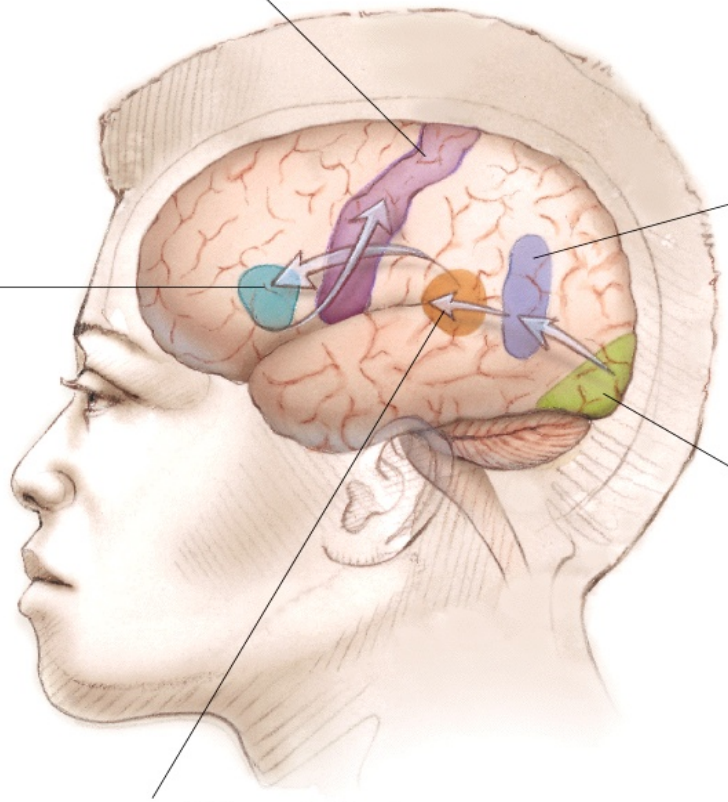


- Areas of the cerebral cortex that are not involved in primary motor or sensory functions
- Involved in higher mental functions such as learning, remembering, thinking, and speaking

The Cerebral Cortex

- Aphasia
  - impairment of language, usually caused by left hemisphere damage either to Broca's area (impairing speaking) or to Wernicke's area (impairing understanding)
- Broca's Area
  - an area of the frontal lobe that directs the muscle movements involved in speech
- Wernicke's Area
  - an area of the left temporal lobe involved in language comprehension and expression

Specialization and Integration



5. Motor cortex
(word is pronounced)

2. Angular gyrus
(transforms visual representations into an auditory code)

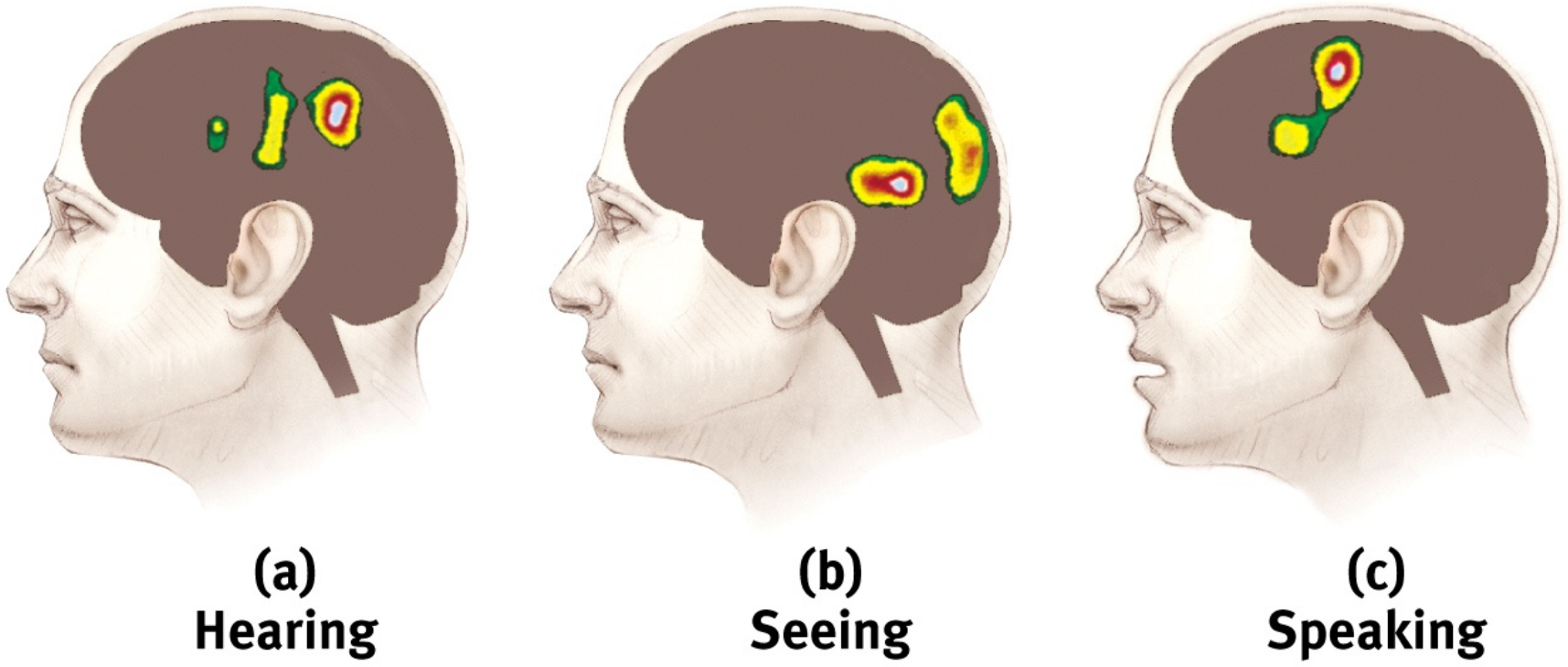
4. Broca's area
(controls speech muscles via the motor cortex)

1. Visual cortex
(receives written words as visual stimulation)

3. Wernicke's area
(interprets auditory code)

Brain Structures

Brain activity when hearing, seeing and speaking words



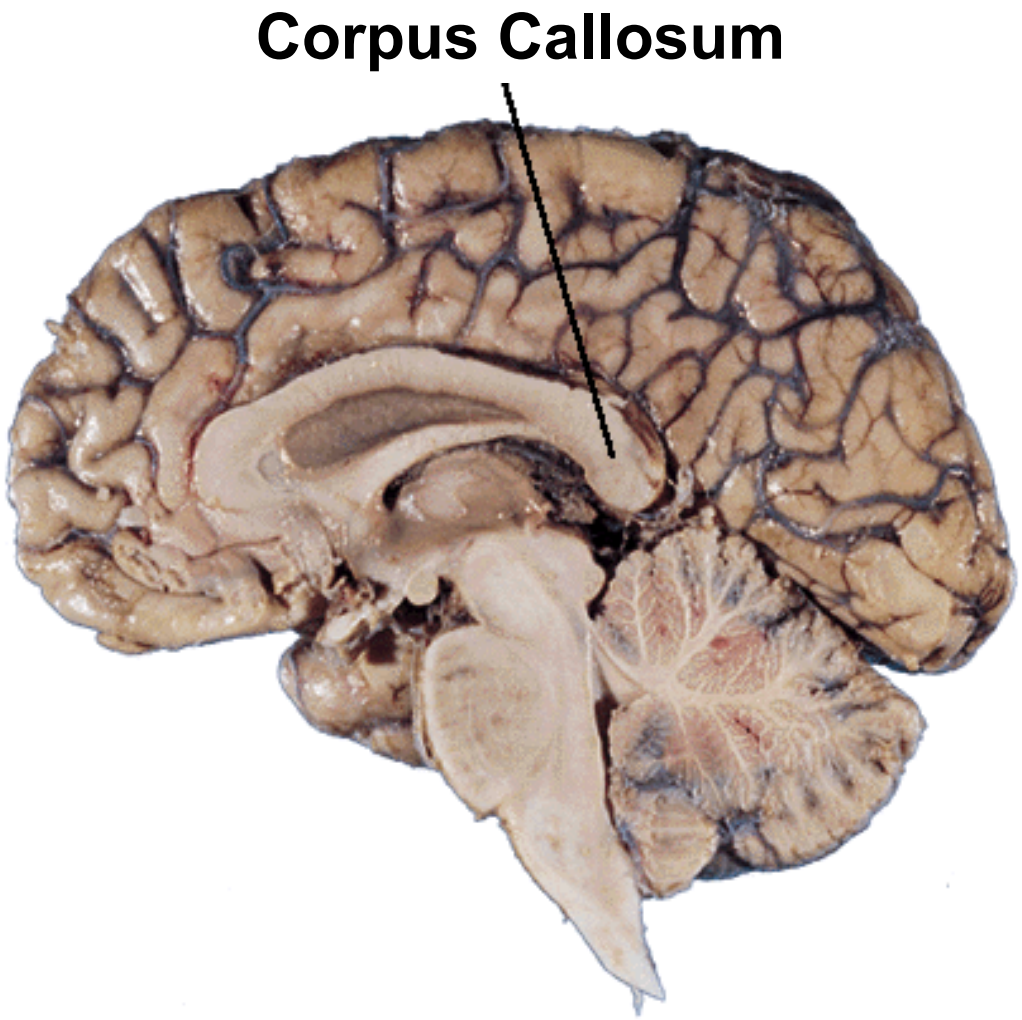
Brain Reorganization

- Plasticity
  - the brain's capacity for modification as evident in brain reorganization following damage (especially in children) and in experiments on the effects of experience on brain development

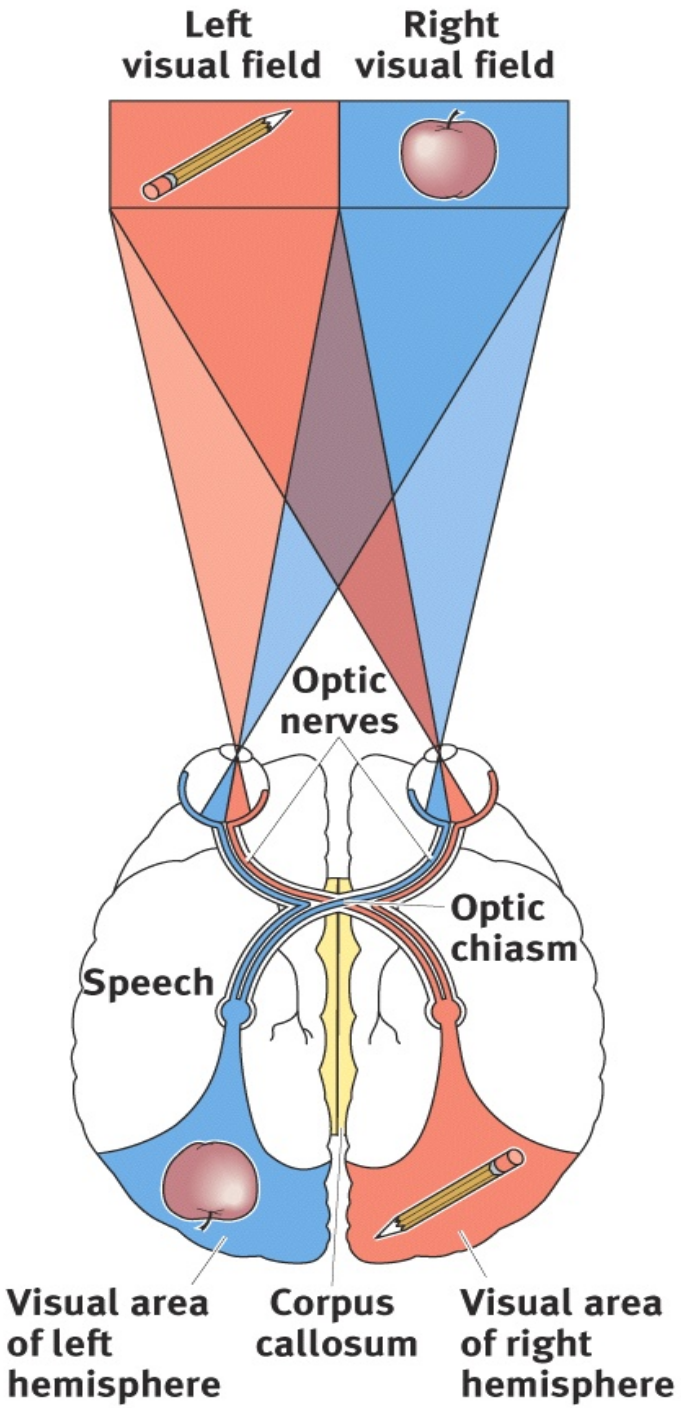
Brain Reorganization

- Corpus Callosum
  - large bundle of neural fibers connecting the two brain hemispheres and carrying messages between the hemispheres
- Split Brain
  - a condition in which the two hemispheres of the brain are isolated by cutting the connecting fibers (mainly those of the corpus callosum) between them

Brain Reorganization



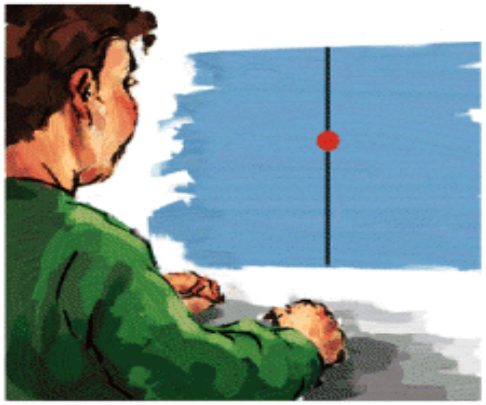
Brain Reorganization



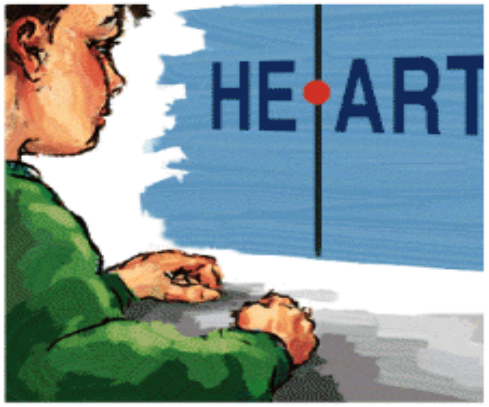
- The information highway from the eyes to the brain

Splitting the Brain

- Testing the divided brain



"Look at the dot."



Two words separated by red dot appear projected in front of person.

"What word did you see?"

or

"Point with your left hand to the word you saw."

Neural and Hormonal Systems

- Endocrine System
  - the body's "slow" chemical communication system
  - a set of glands that secrete hormones into the bloodstream
- Hormones
  - chemical messengers, mostly those manufactured by the endocrine glands, that are produced in one tissue and affect another

Neural and Hormonal Systems

- Adrenal Glands
  - a pair of endocrine glands just above the kidneys
  - secrete the hormones epinephrine (adrenaline) and norepinephrine (noradrenaline), which help to arouse the body in times of stress
- Pituitary Gland
  - under the influence of the hypothalamus, the pituitary regulates growth and controls other endocrine glands

Neural and Hormonal Systems