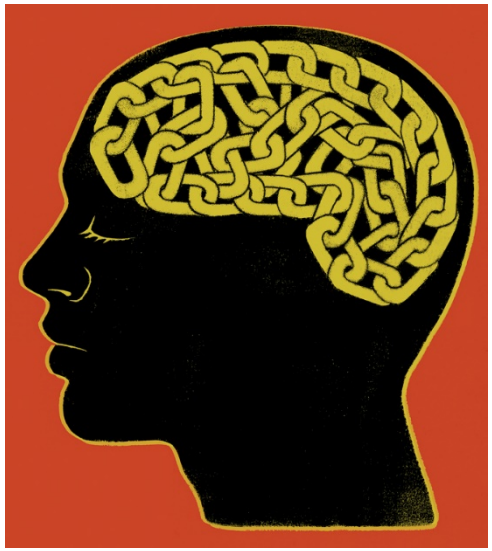


The Biology of Mind

Chapter 2

The Biology of Mind-Summary

Neural Communication

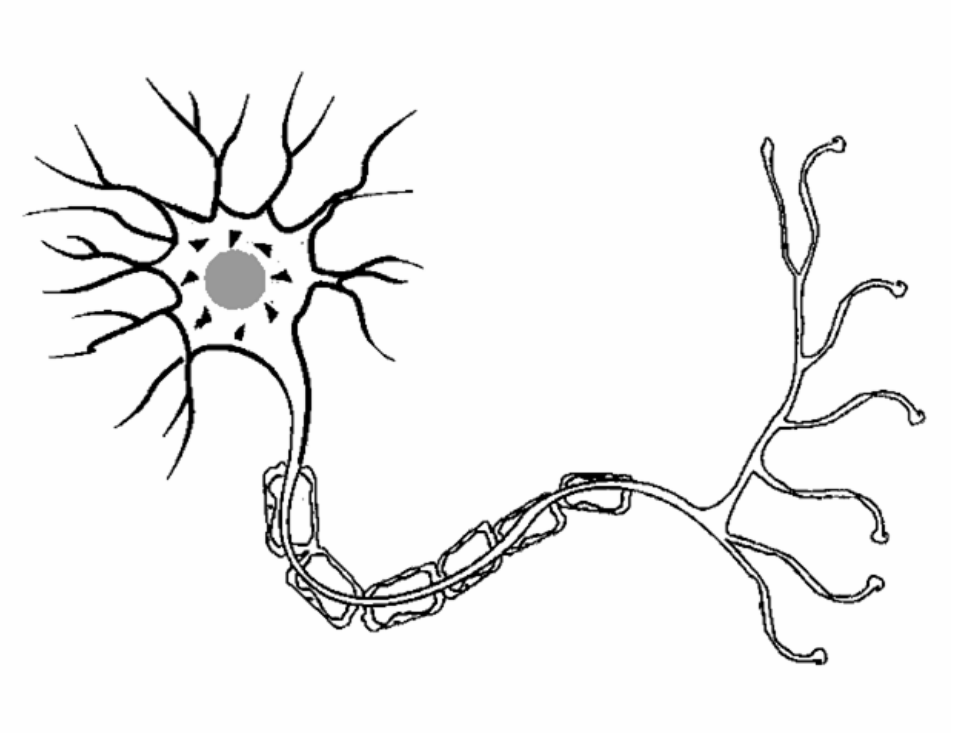
The Nervous System

The Endocrine System

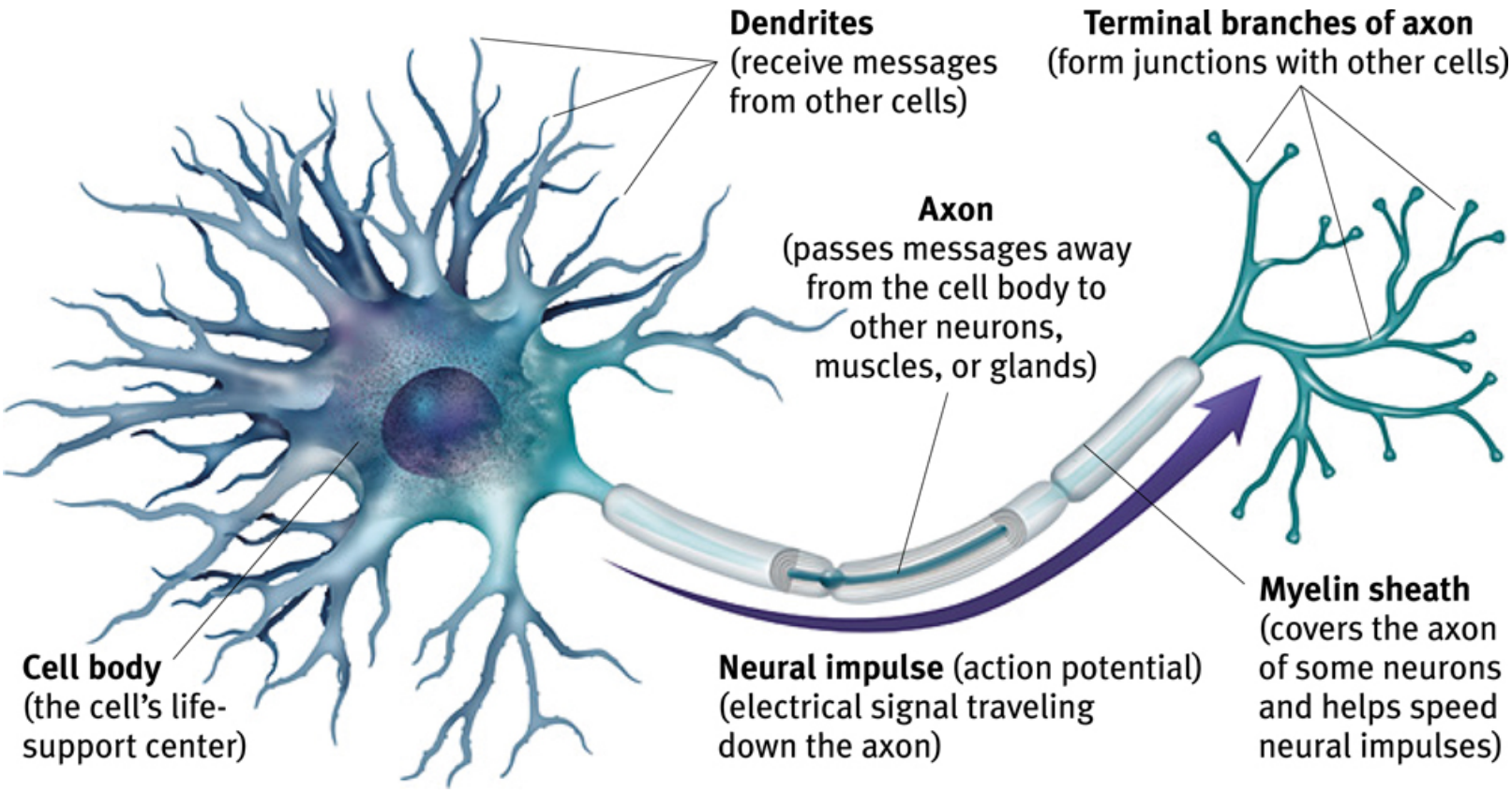
The Brain

1-Neurons

The body's information system is built from billions of interconnected cells called ***neurons***.



Neuron


Dendrites
(receive messages from other cells)
Terminal branches of axon
(form junctions with other cells)
Axon
(passes messages away from the cell body to other neurons, muscles, or glands)
Cell body
(the cell's life-support center)
Neural impulse (action potential)
(electrical signal traveling down the axon)
Myelin sheath
(covers the axon of some neurons and helps speed neural impulses)

Parts of a Neuron

Sensory Neurons-carry messages TO the brain from organs and tissues

Motor Neurons-carry messages FROM the brain to organs and tissues

Interneurons- communicate between sensory and motor input

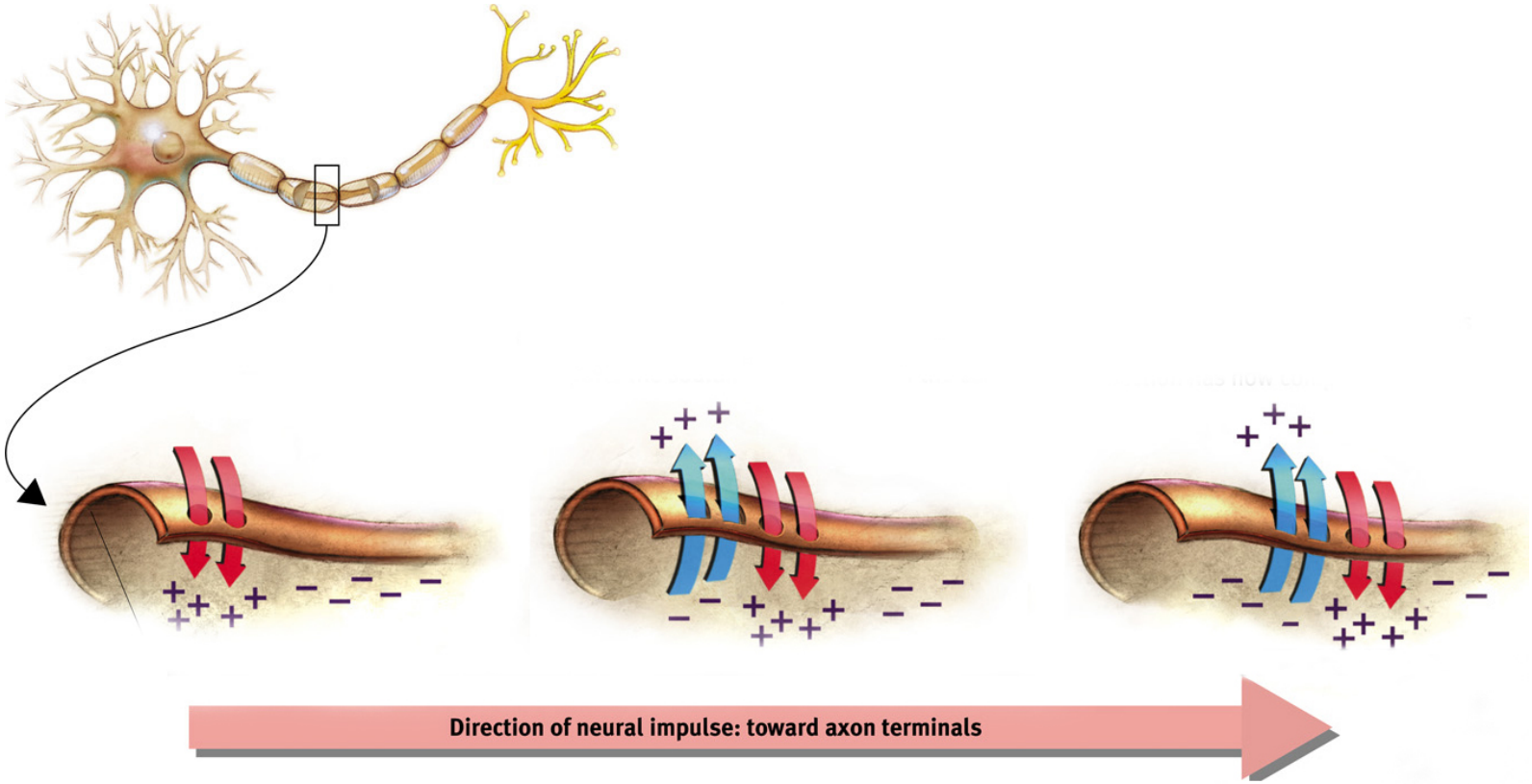
Dendrites: Branching extensions at the cell body. Receive **messages from other neurons.**

Axon: Long single extension of a neuron, covered with myelin [MY-uh-lin] sheath to insulate and speed up messages through neurons.

Terminal Branches of axon: Branched endings of an axon that transmit messages to other neurons.

Action Potential

A neural impulse. A brief electrical charge that travels down an axon and is generated by the movement of positively charged atoms in and out of channels in the axon's membrane.



Threshold

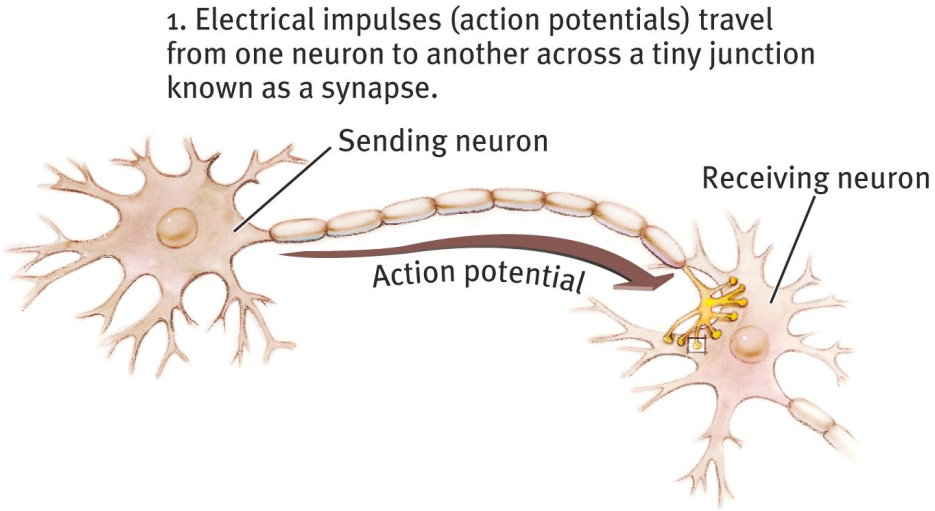
Each neuron receives excitatory and inhibitory signals from many neurons.

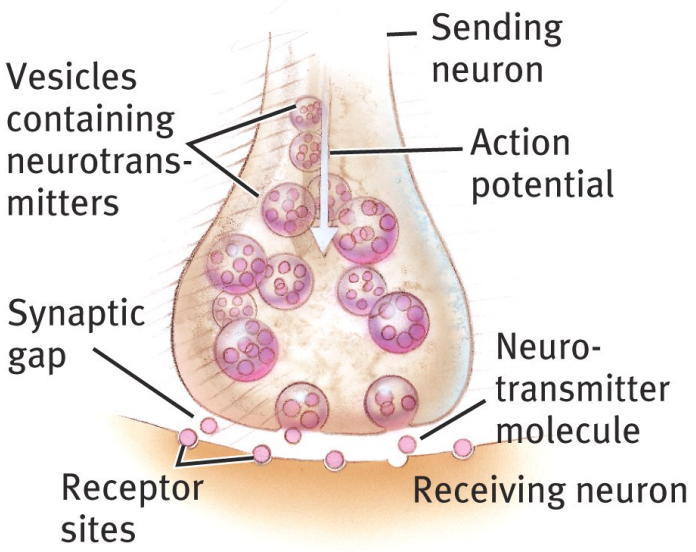
When the excitatory signals minus the inhibitory signals exceed a minimum intensity (threshold) the neuron fires an action potential.

Excitatory signals - inhibitory > minimum intensity (threshold) = neuron fires action potential

Communication

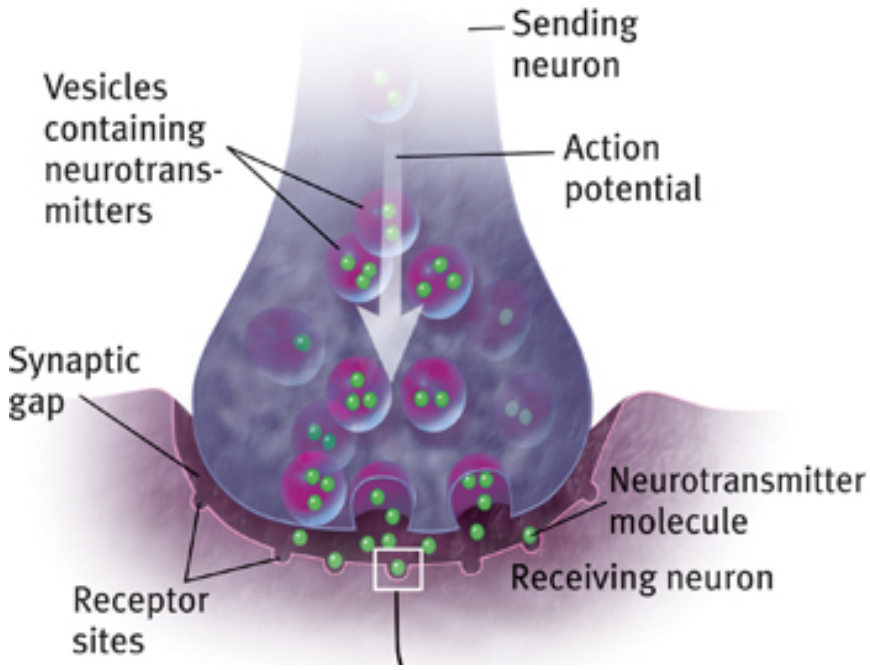
Synapse [SIN-aps] a junction between the axon tip of the sending neuron and the dendrite or cell body of the receiving neuron. This tiny gap is called the *synaptic gap* or *cleft*.





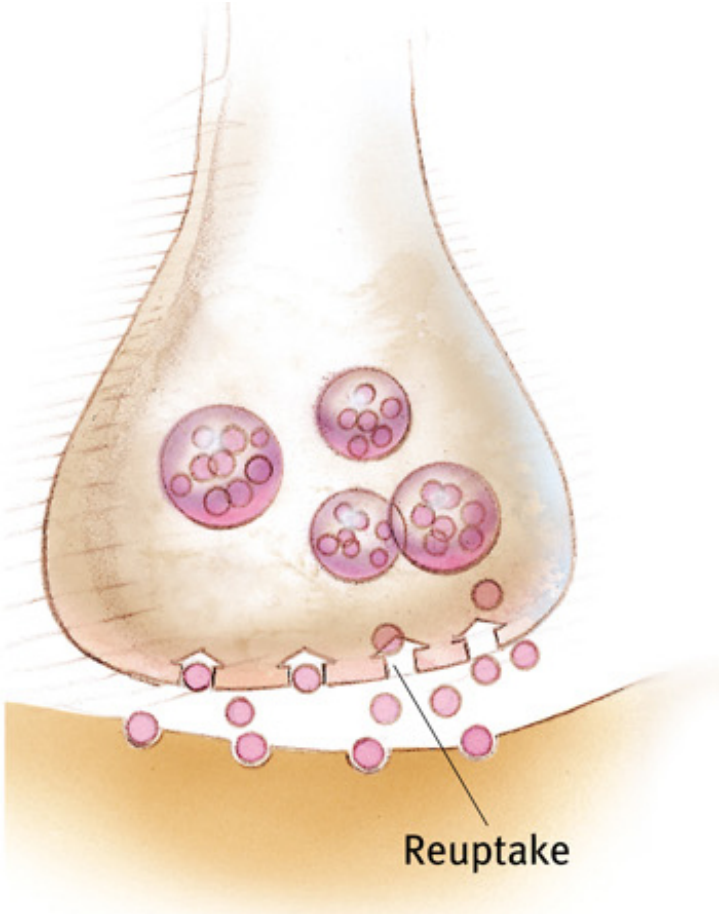
Neurotransmitters

Neurotransmitters (chemicals) released from the sending neuron travel across the synapse and bind to receptor sites on the receiving neuron, thereby influencing it to generate an action potential.



Reuptake

Neurotransmitters in the synapse are reabsorbed into the sending neurons through the process of reuptake. This process applies the brakes on neurotransmitter action.



How Neurotransmitters Influence Us

Endorphins are natural opiates, feel-good chemicals related to exercise, spicy food, love, orgasm

Serotonin affects mood, hunger, sleep

*low = depression

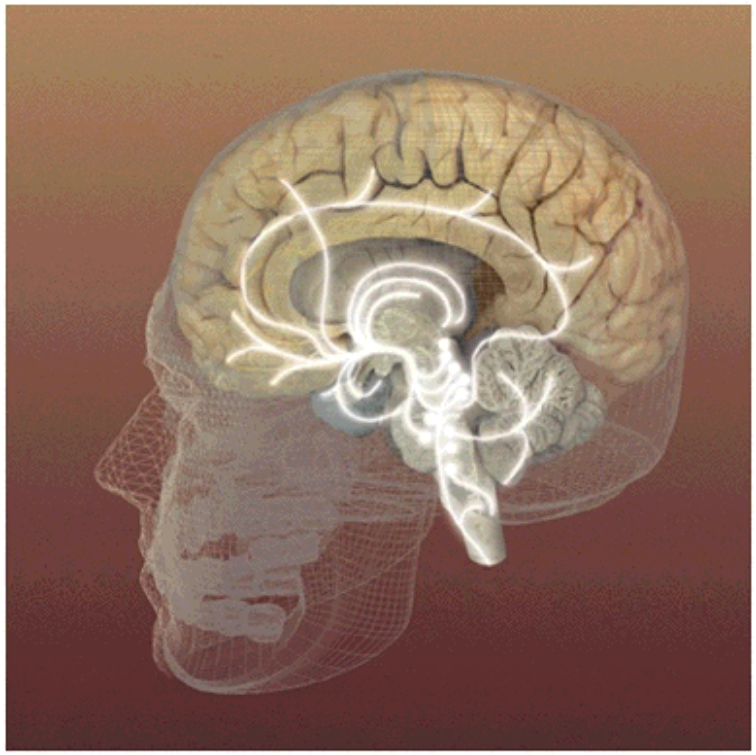
*low = anxiety

Dopamine affects motor function, attention and is a reward stimulant (addictions)

*low = Parkinson's

*low = ADHD

*high = Schizophrenia

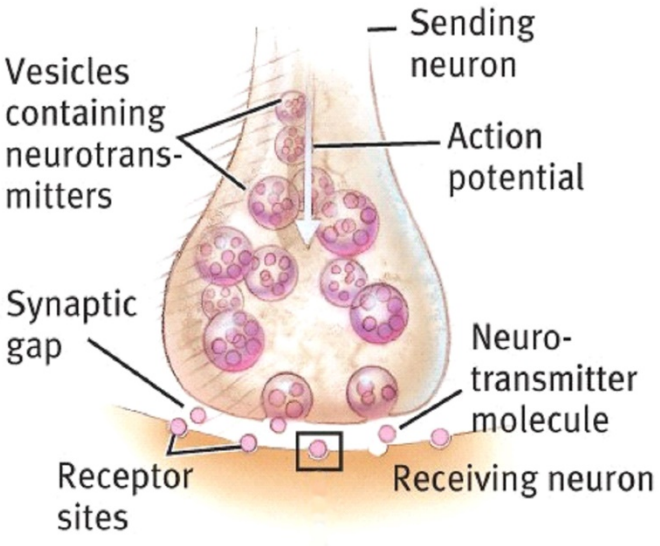


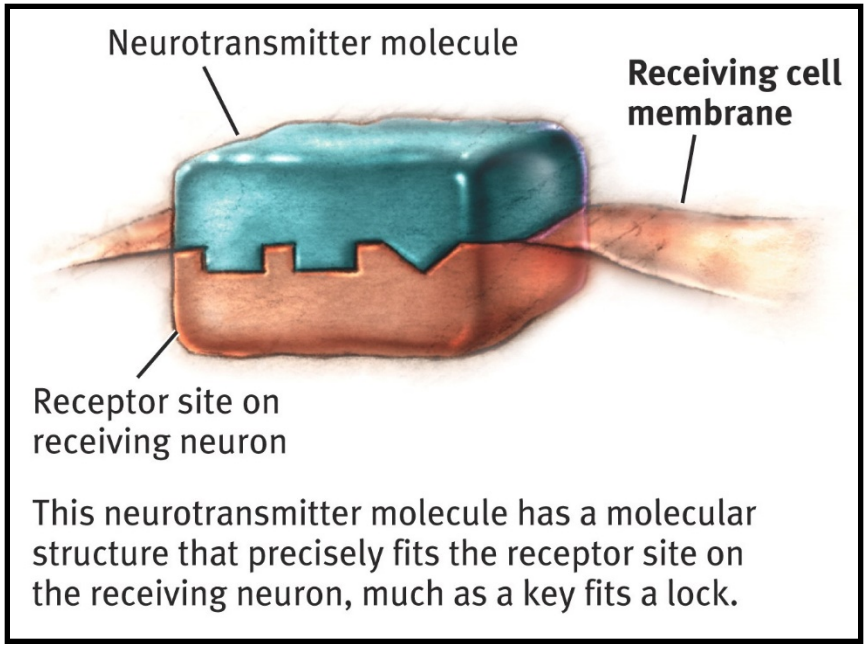
Serotonin pathways

From *Mapping the Mind,* Rita Carter, © 1989 University of California Press

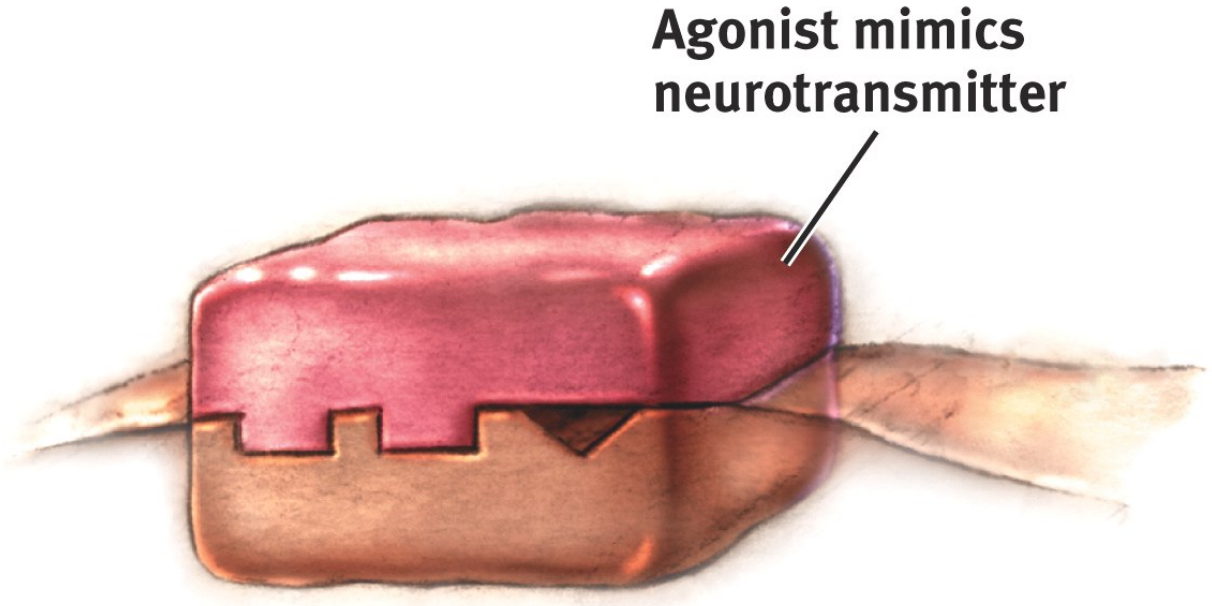
Lock & Key Mechanism

Neurotransmitters bind to the receptors of the receiving neuron in a key-lock mechanism.



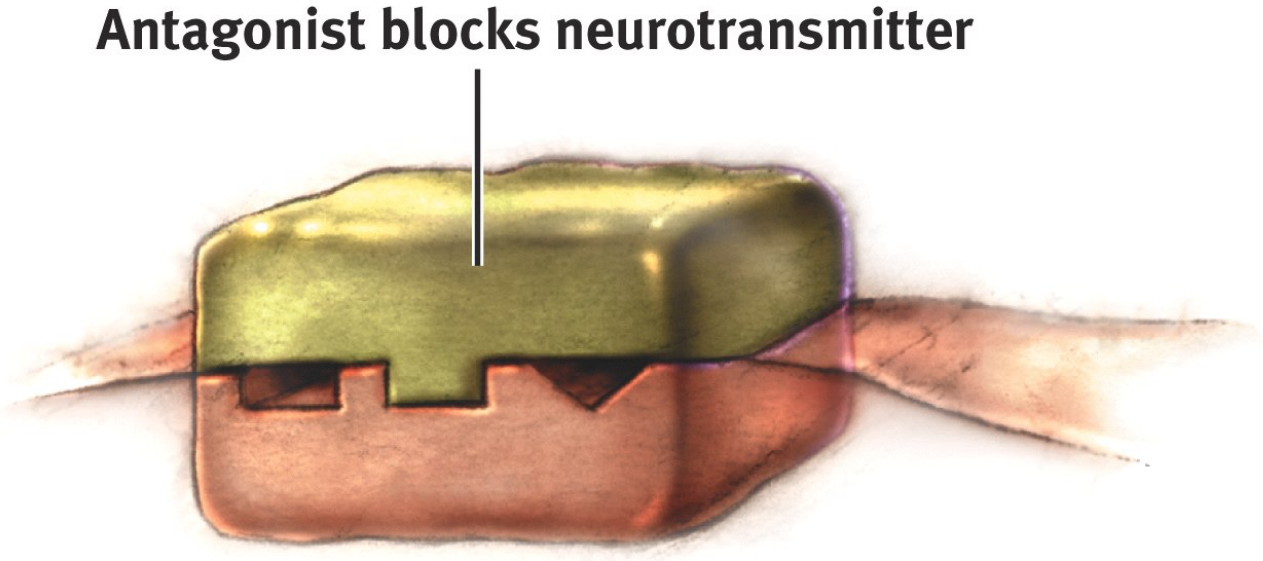


Agonists



This agonist molecule excites.It is similar enough in structure to the neurotransmitter molecule that it mimics its effects on the receiving neuron. Morphine, for instance, mimics the action of endorphins by stimulating receptors in brain areas involved in mood and pain sensations.

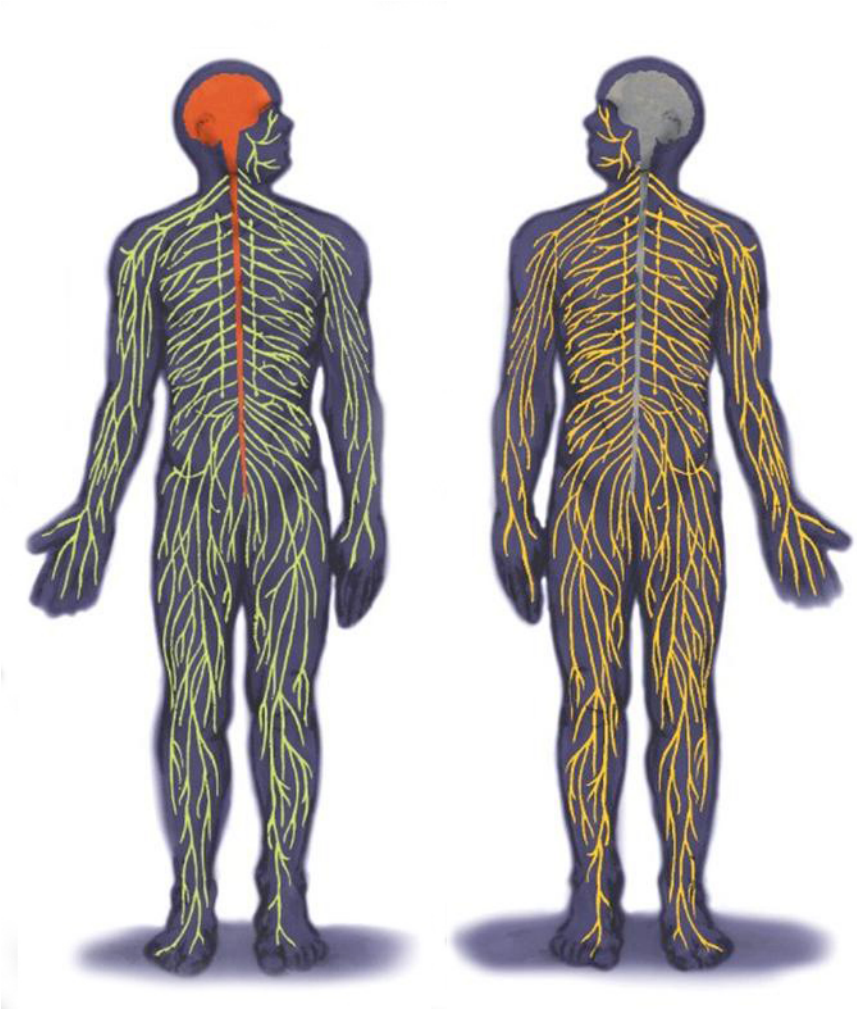
Antagonists



This antagonist molecule inhibits. It has a structure similar enough to the neurotransmitter to occupy its receptor site and block its action, but not similar enough to stimulate the receptor. Curare poisoning paralyzes its victims by blocking ACh receptors involved in muscle movement.

Nervous System

Central Nervous System (CNS)



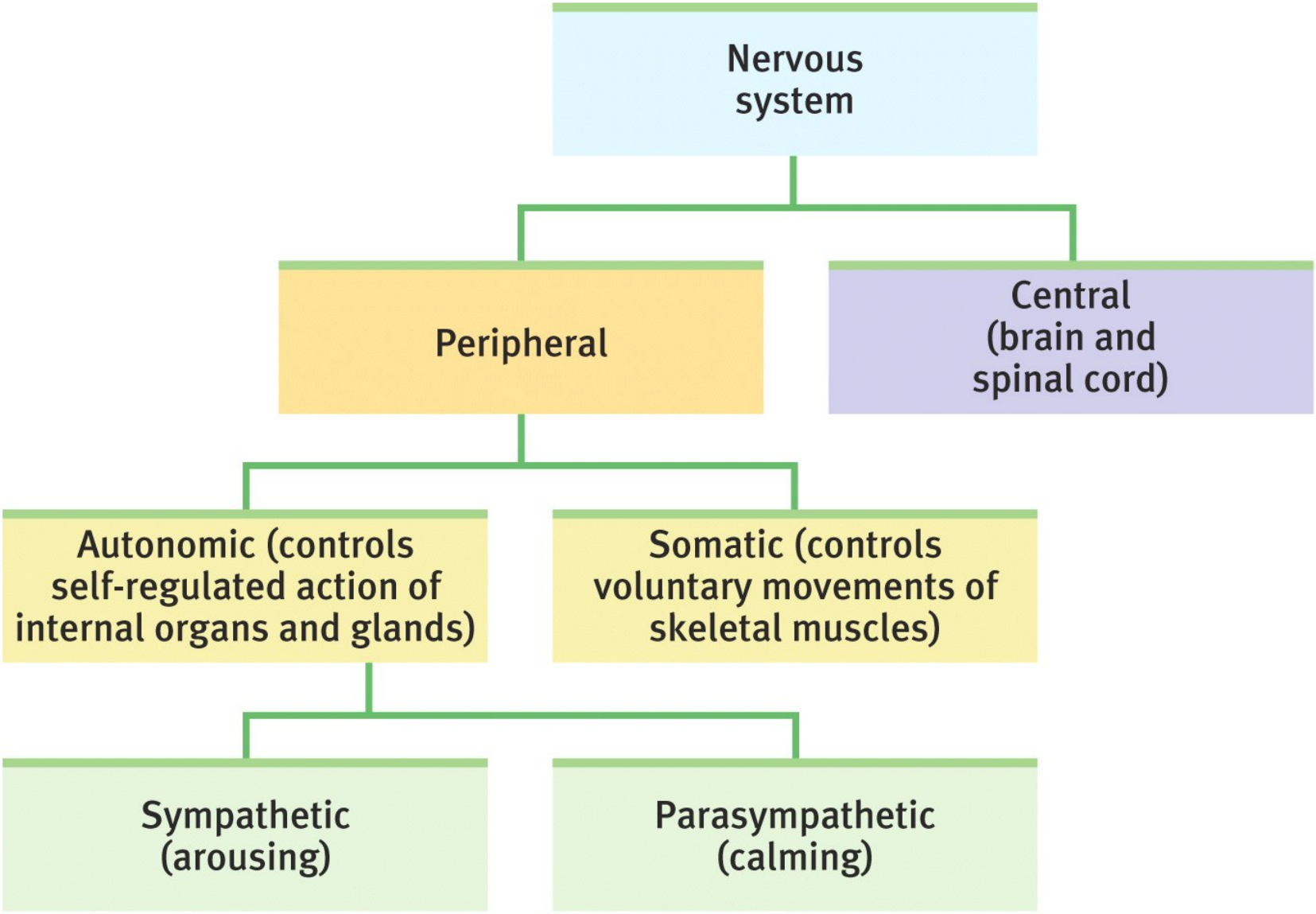
Peripheral Nervous System (PNS)

The Nervous System

Nervous System: Consists of all the nerve cells. It is the body's speedy, electrochemical communication system.

- Central Nervous System (CNS): the brain and spinal cord.

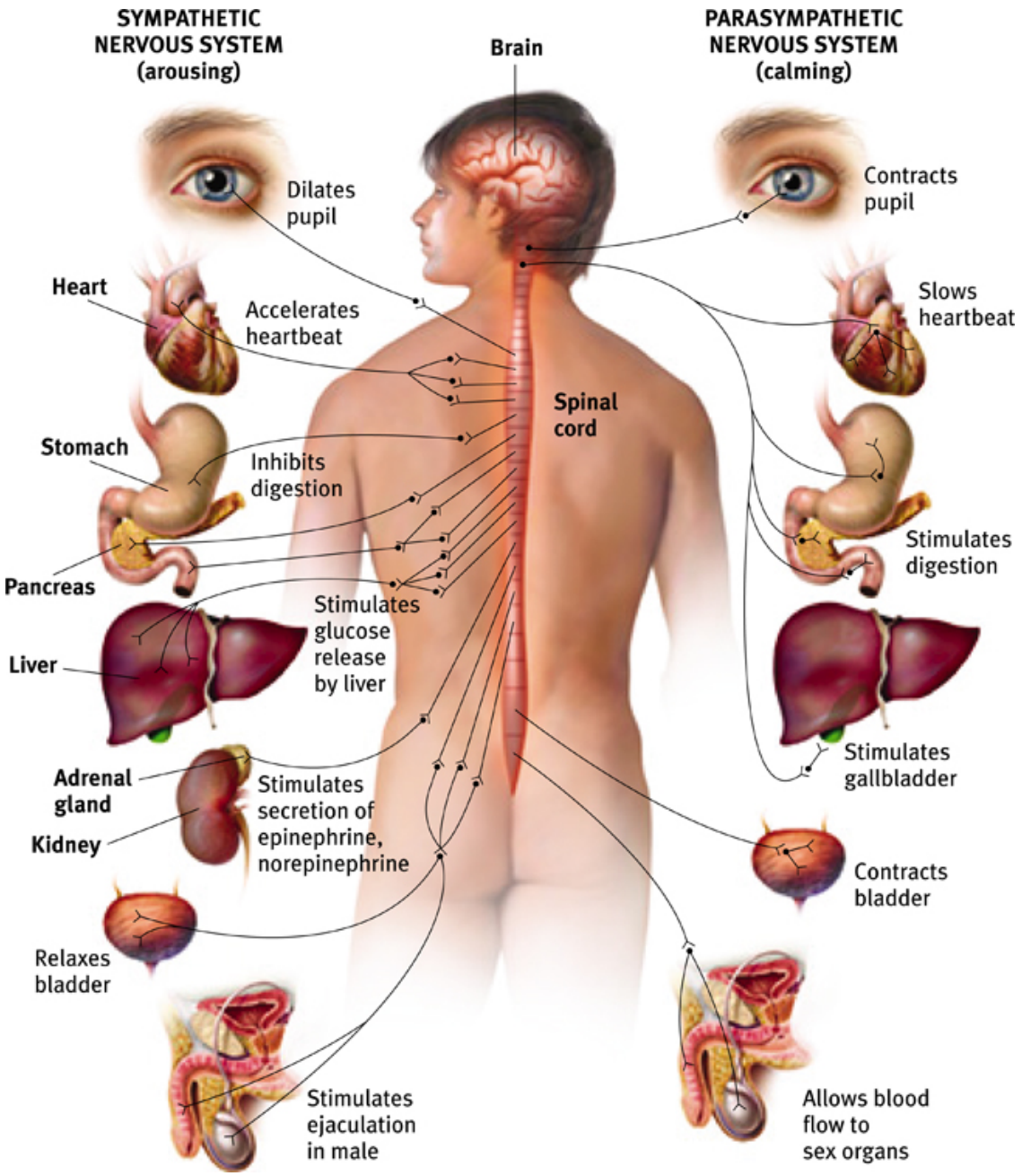
- Peripheral Nervous System (PNS): the sensory and motor neurons that connect the central nervous system (CNS) to the rest of the body.


Nervous system
Peripheral
Central (brain and spinal cord)
Autonomic (controls self-regulated action of internal organs and glands)
Somatic (controls voluntary movements of skeletal muscles)
Sympathetic (arousing)
Parasympathetic (calming)

Autonomic Nervous System (ANS)

Sympathetic NS "Arouses" (fight-or-flight)

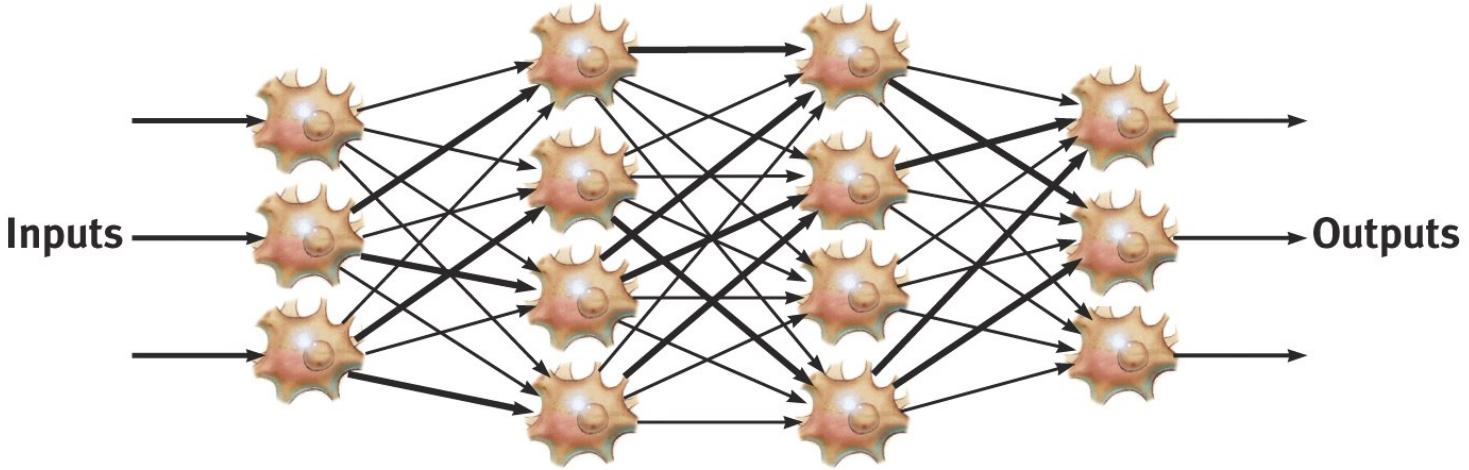
Parasympathetic NS "Calms" (rest and digest)



Central Nervous System

The Brain and Neural Networks

Interconnected neurons form networks in the brain. Theses networks are complex and modify with growth and experience.



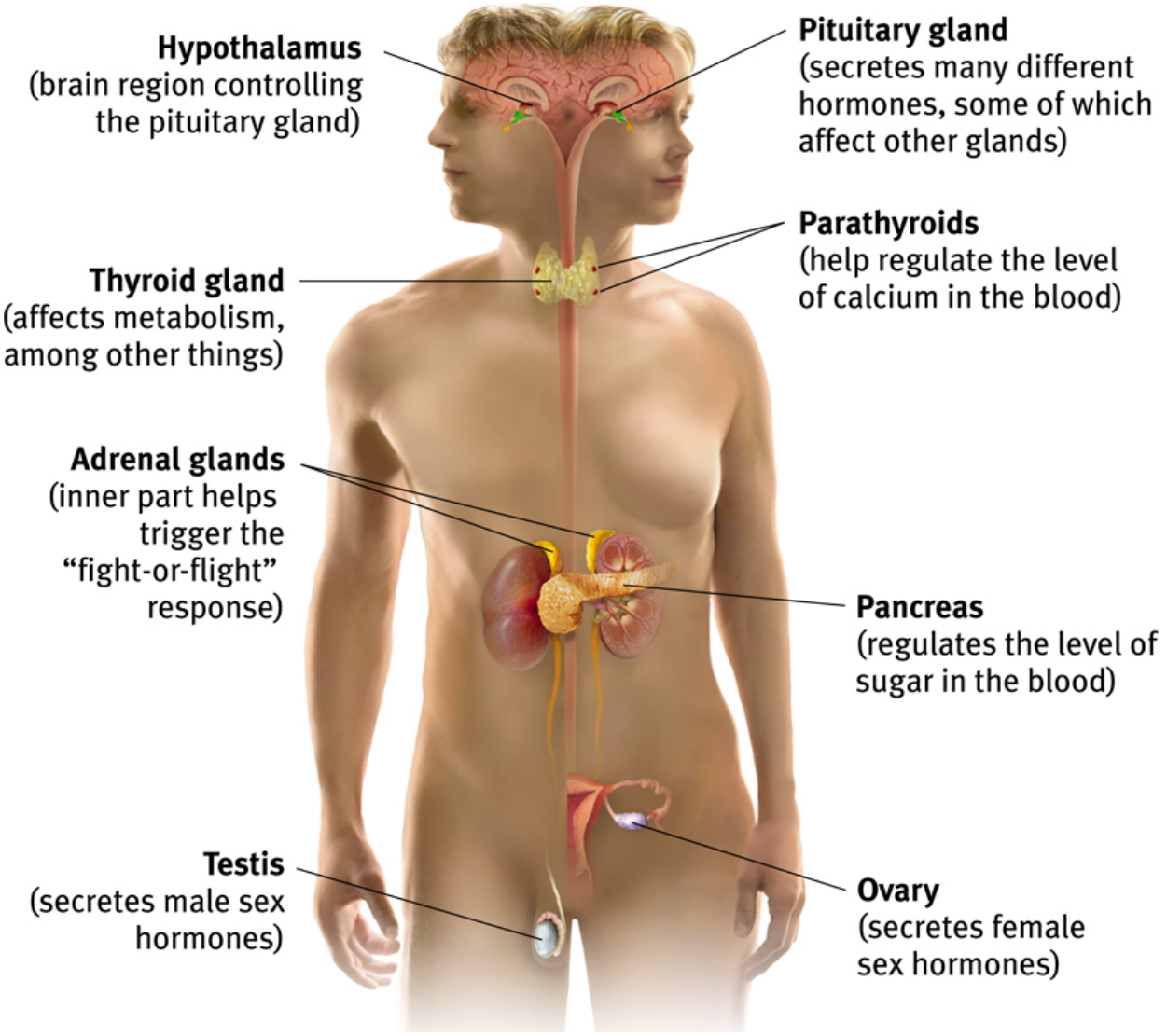
Complex Neural Network

The Endocrine System

The Endocrine System is the body's "slow" chemical communication system.

Communication is carried out by hormones synthesized by a set of glands.

Messages trudge along in the bloodstream, taking longer than the speedy nervous system



Hormones

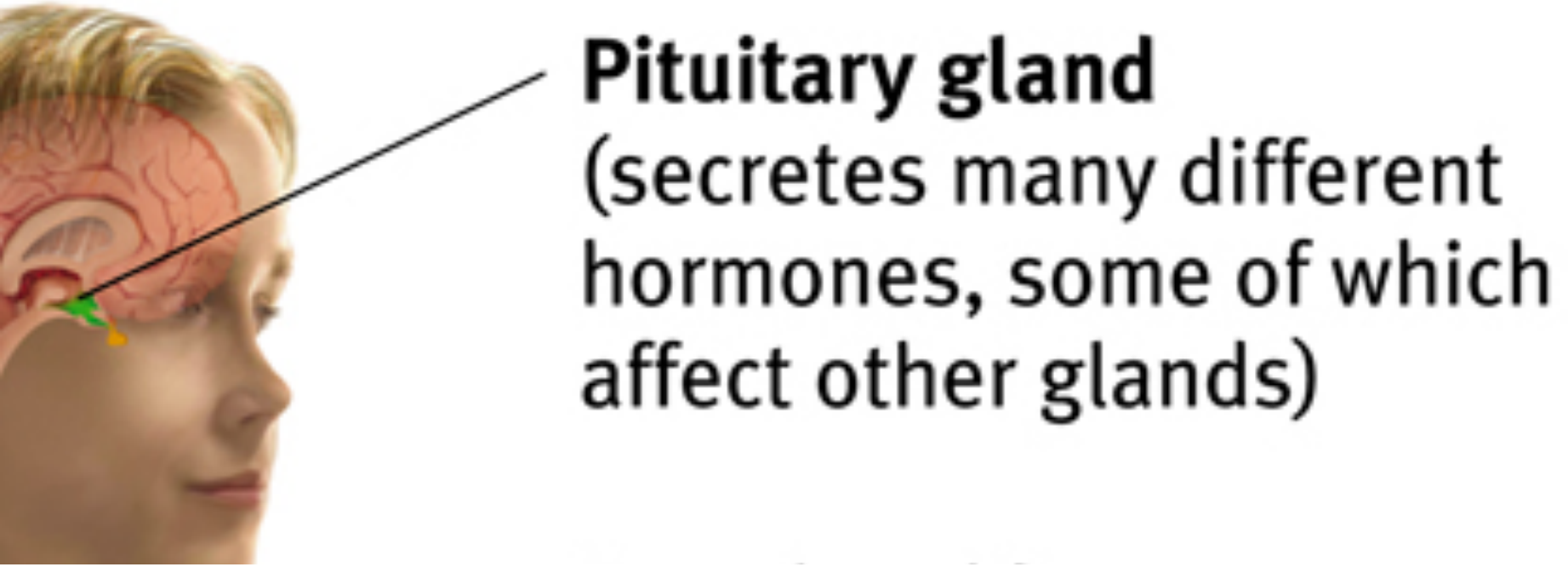
Hormones are chemicals synthesized by the endocrine glands that are secreted in the bloodstream. Hormones affect the brain and many other tissues of the body.

For example, epinephrine (adrenaline) increases heart rate, blood pressure, blood sugar, and feelings of excitement during emergency situations.

Some hormones are chemically identical to neurotransmitters. However, endocrine messages tend to outlast the effects of neural messages. This helps explain why upset feelings may linger, sometimes beyond our thinking about what upset us.

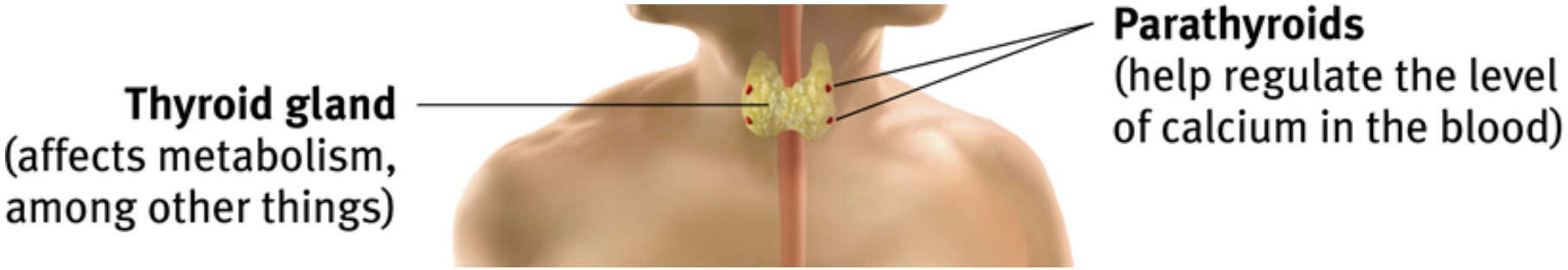
Pituitary Gland

Is called the “master gland.” It produces hormones that control other parts of the endocrine system—growth, puberty, thyroid stimulating.



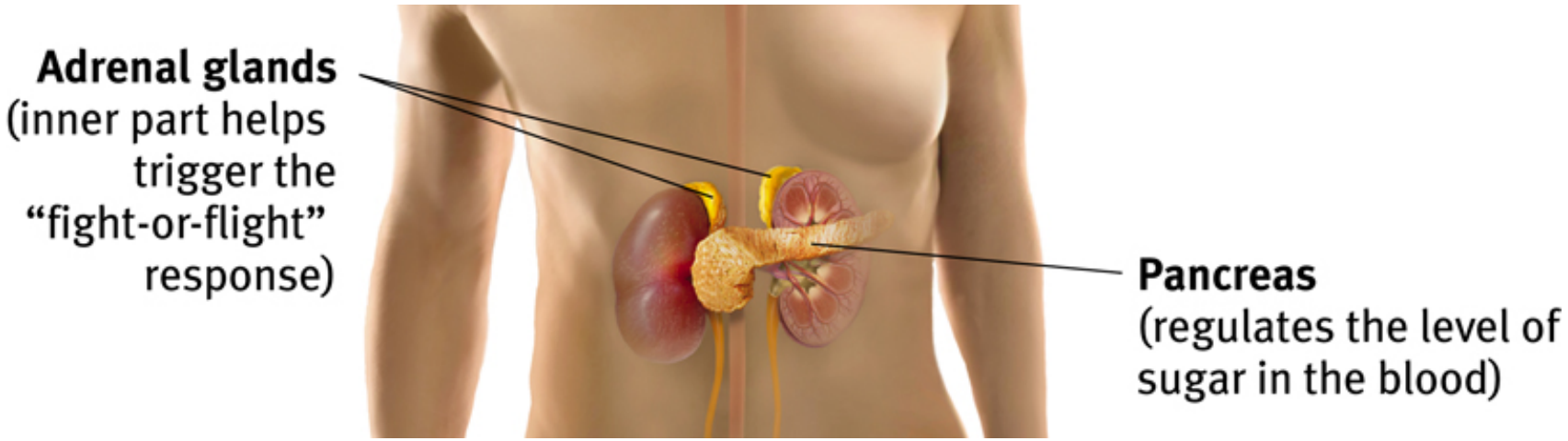
Thyroid & Parathyroid Glands

Regulate metabolic and calcium rate (in our bones, in our blood). The thyroid gland regulates breathing, heart rate, body weight, menstrual cycle, body temperature, and more.



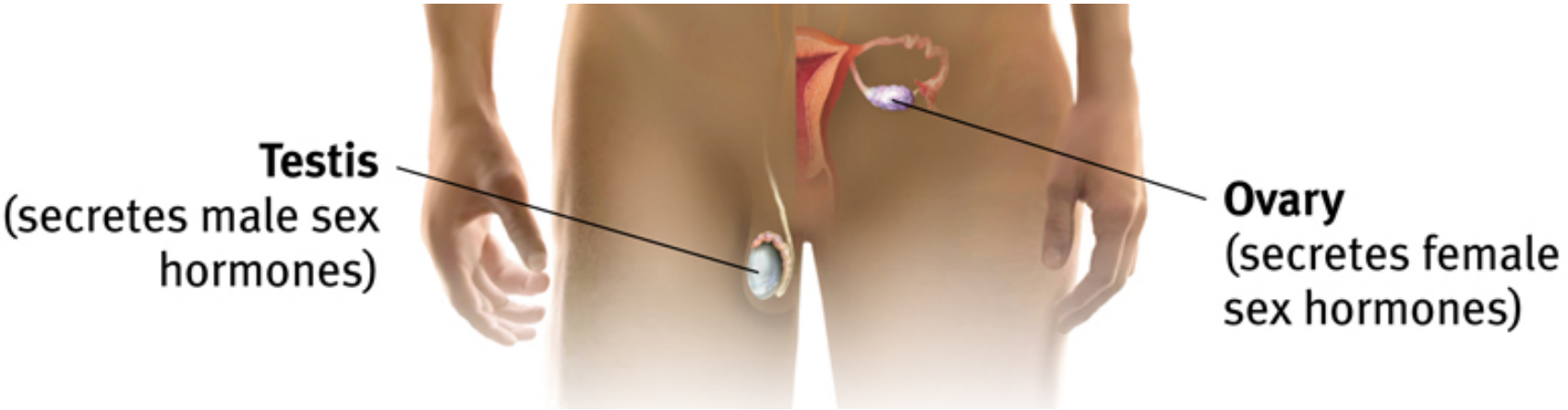
Adrenal Glands

Adrenal glands consist of the adrenal medulla and the cortex. The medulla secretes hormones (epinephrine and norepinephrine) during stressful and emotional situations, while the adrenal cortex regulates salt and carbohydrate metabolism.



Gonads

Sex glands are located in different places in men and women. They regulate bodily development and maintain reproductive organs in adults.



Neuroimaging

EEG- reads electrical activity on the brain's surface

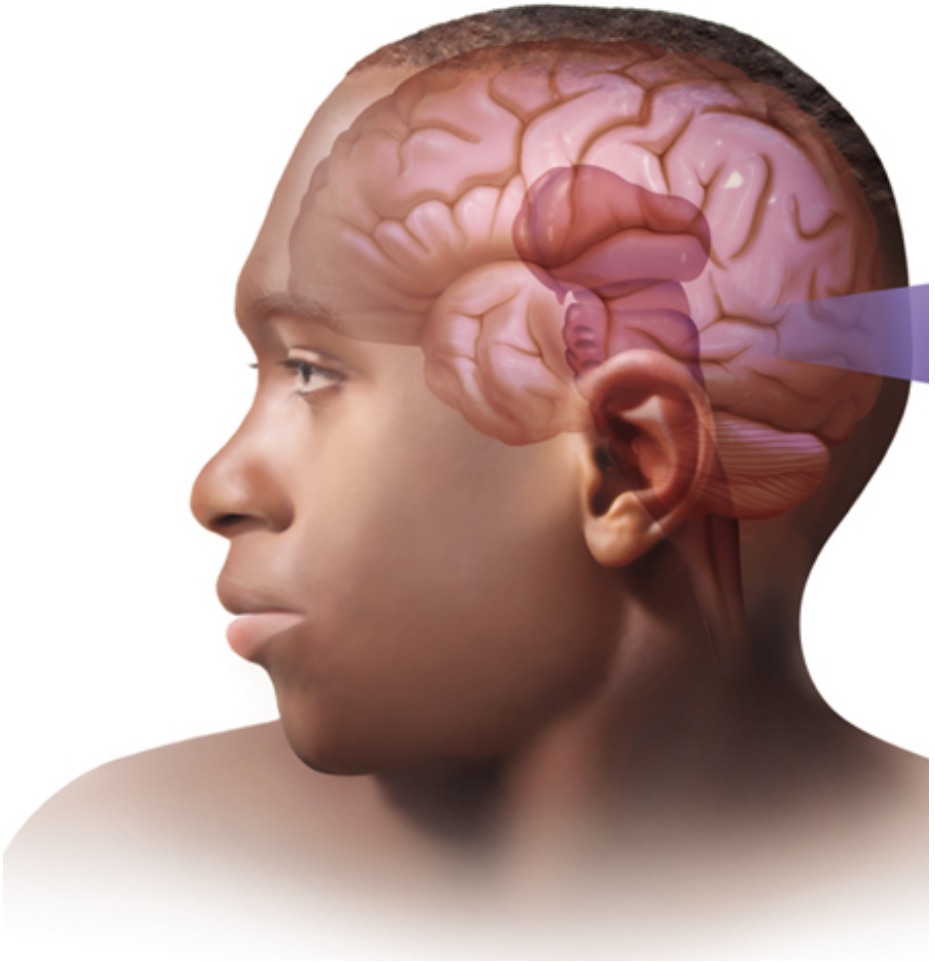
PET Scan- shows the use of glucose by the brain- like a weather radar

MRI- shows brain structures

fMRI- shows activity in the brain

Older Brain Structures

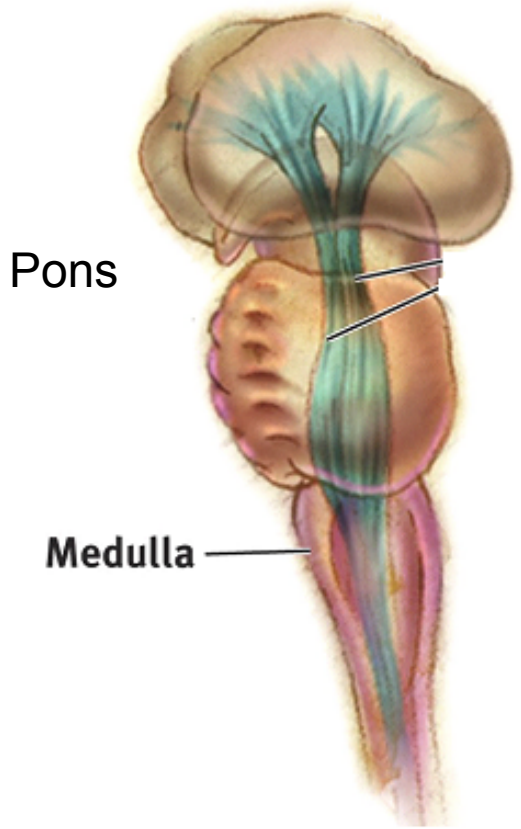
The **Brainstem** is the oldest part of the brain, beginning where the spinal cord swells and enters the skull. It is responsible for automatic survival functions.



Brainstem

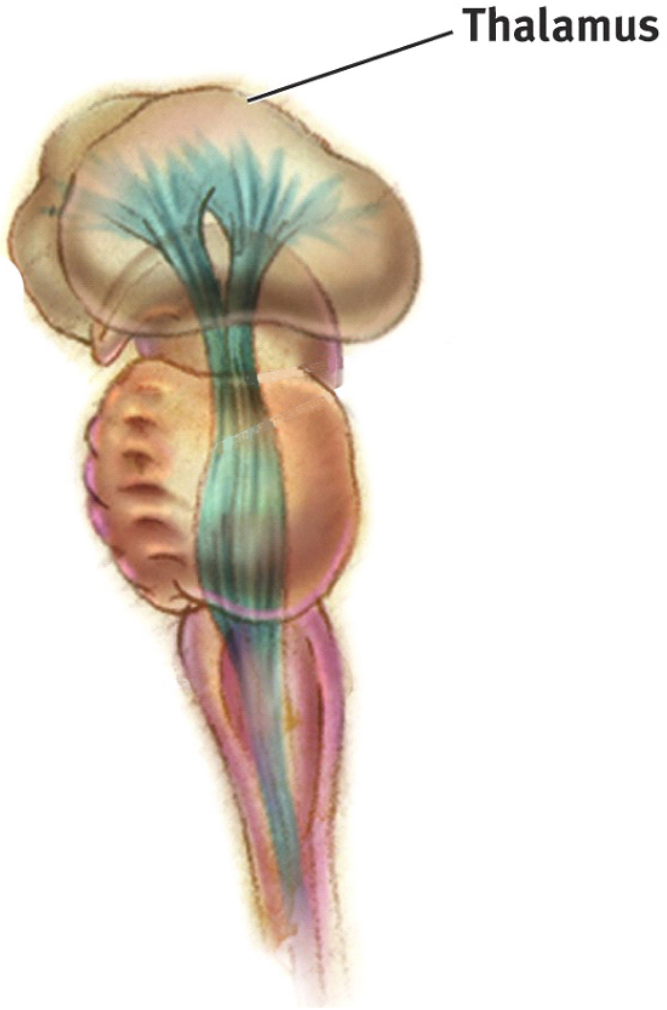
The **Medulla** is the base of the brainstem that controls **heartbeat and breathing**.

The **Pons** is in between the Thalamus and the Medulla and is responsible for **relaying messages and sleep regulation.**



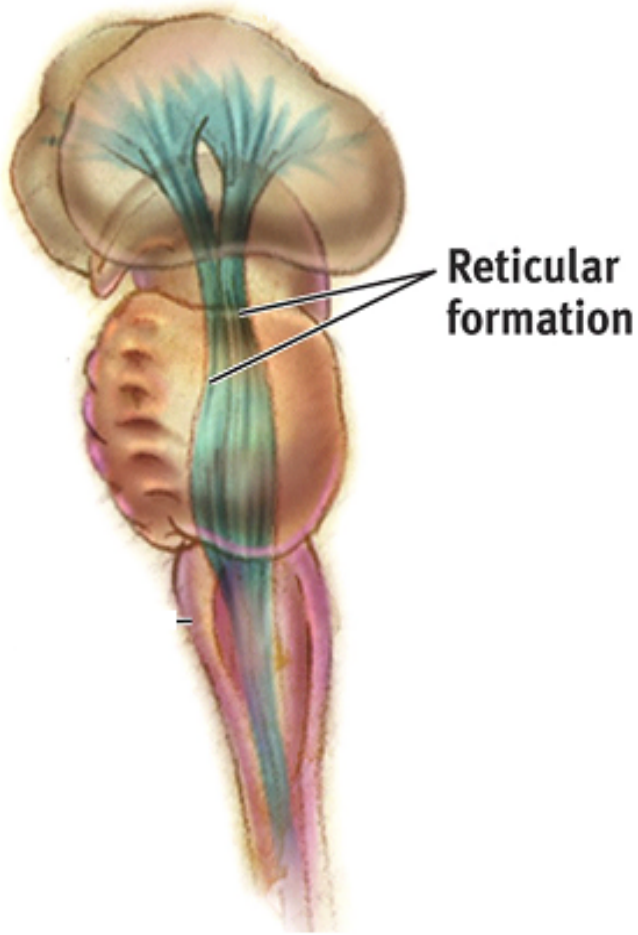
Brainstem

The **Thalamus** [THAL-uh-muss] is the brain's **sensory switchboard**, located on top of the brainstem. It directs messages to the sensory areas in the cortex and transmits replies to the cerebellum and medulla.



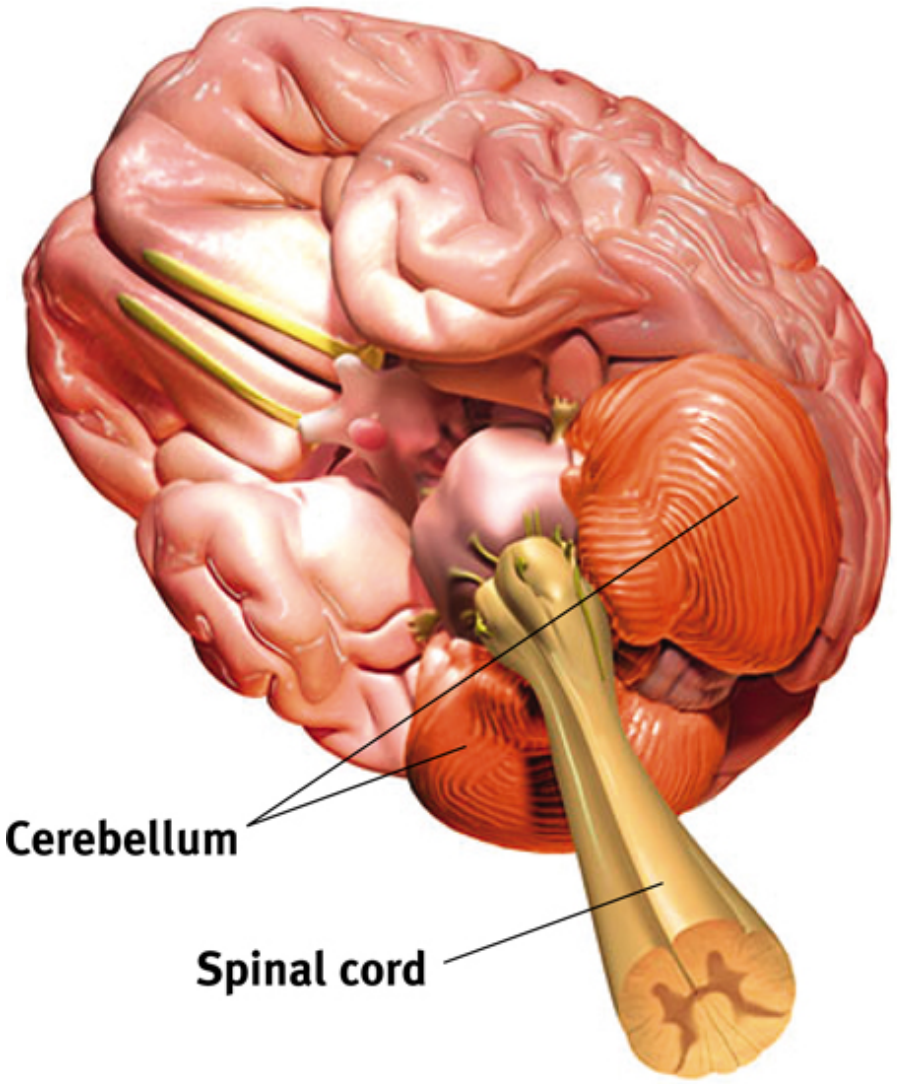
Brainstem

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



Cerebellum

The “little brain” attached to the rear of the brainstem. It helps coordinate **voluntary movements and balance**.

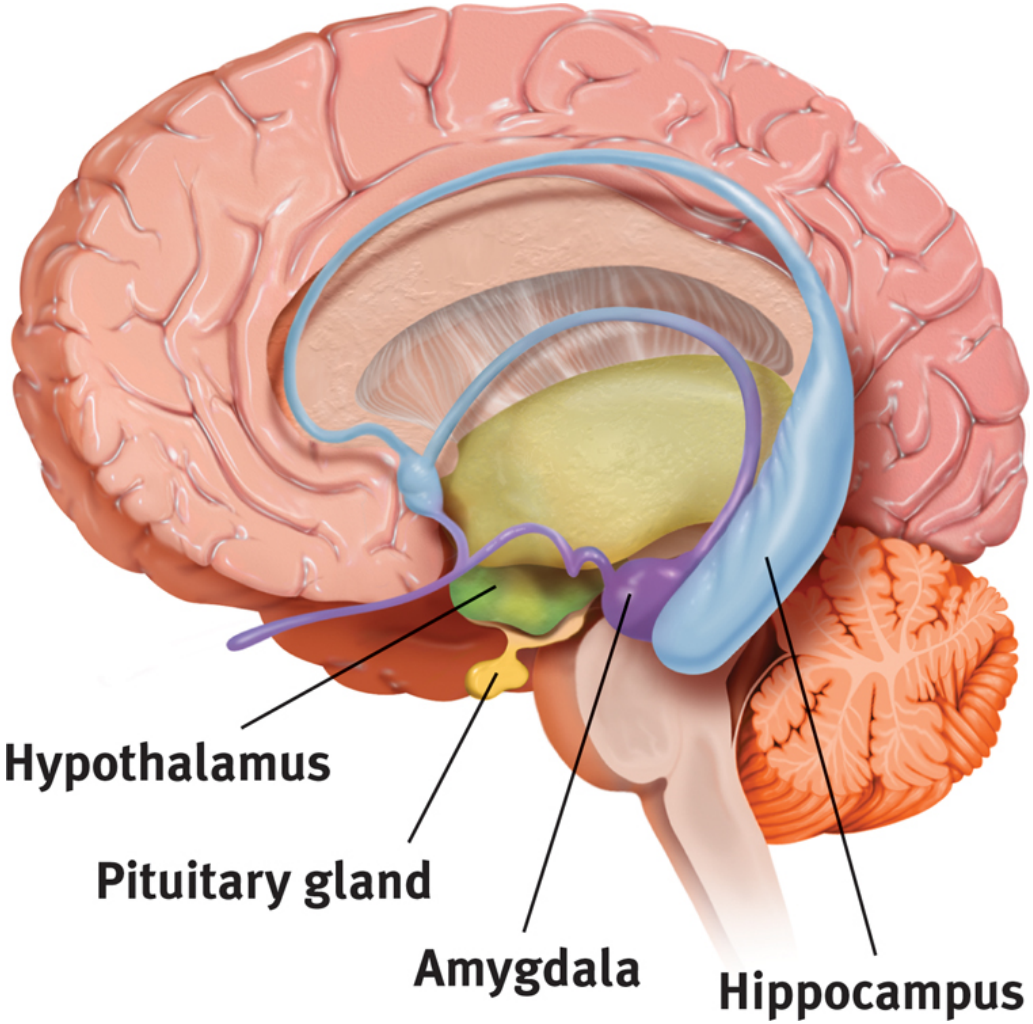


The Limbic System = Primal Urges!

The **Limbic System**-**associated with emotions such as fear, aggression and drives for food and sex**.

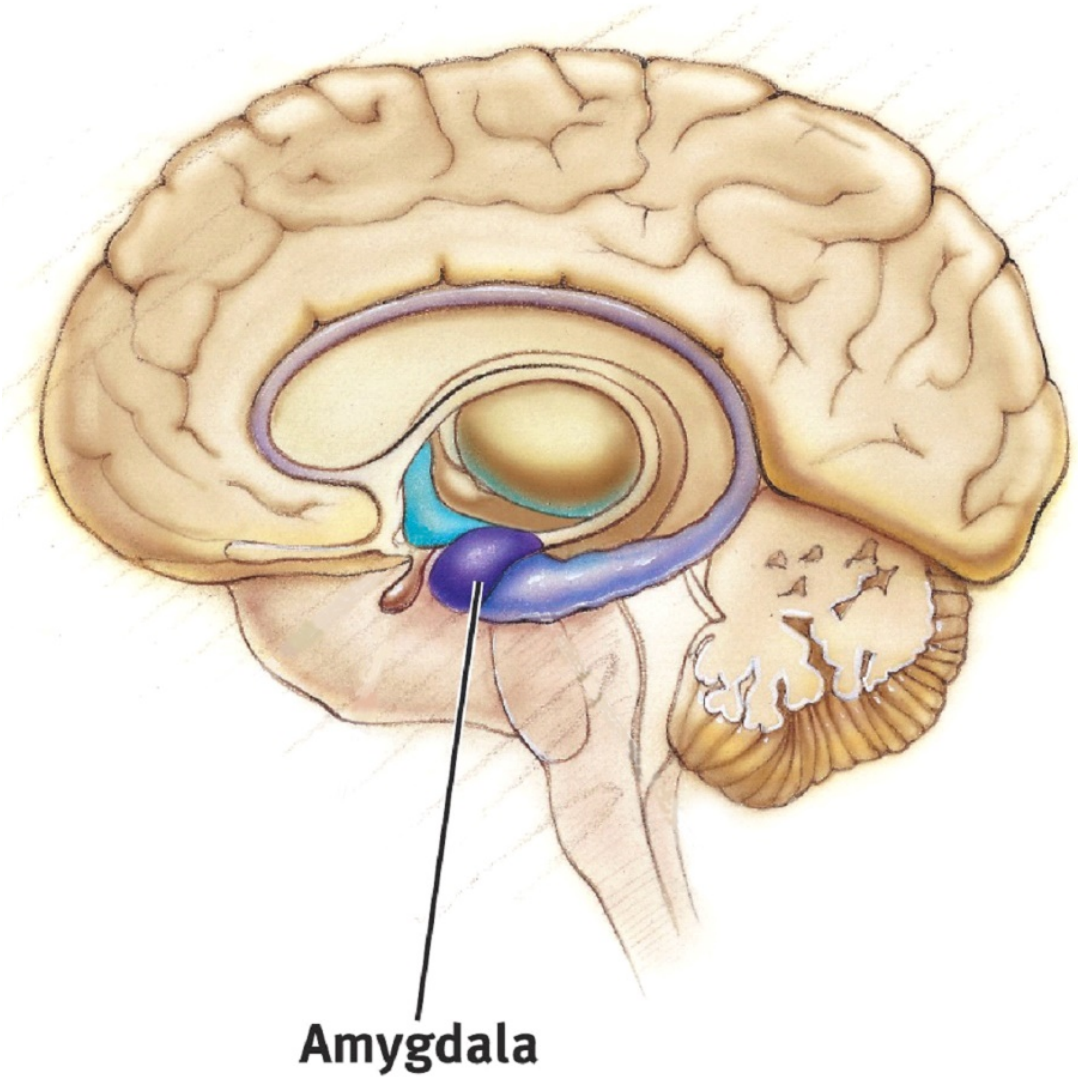
It includes the hippocampus, amygdala, and hypothalamus.

The **Hippocampus**-**processes memories for storage.**



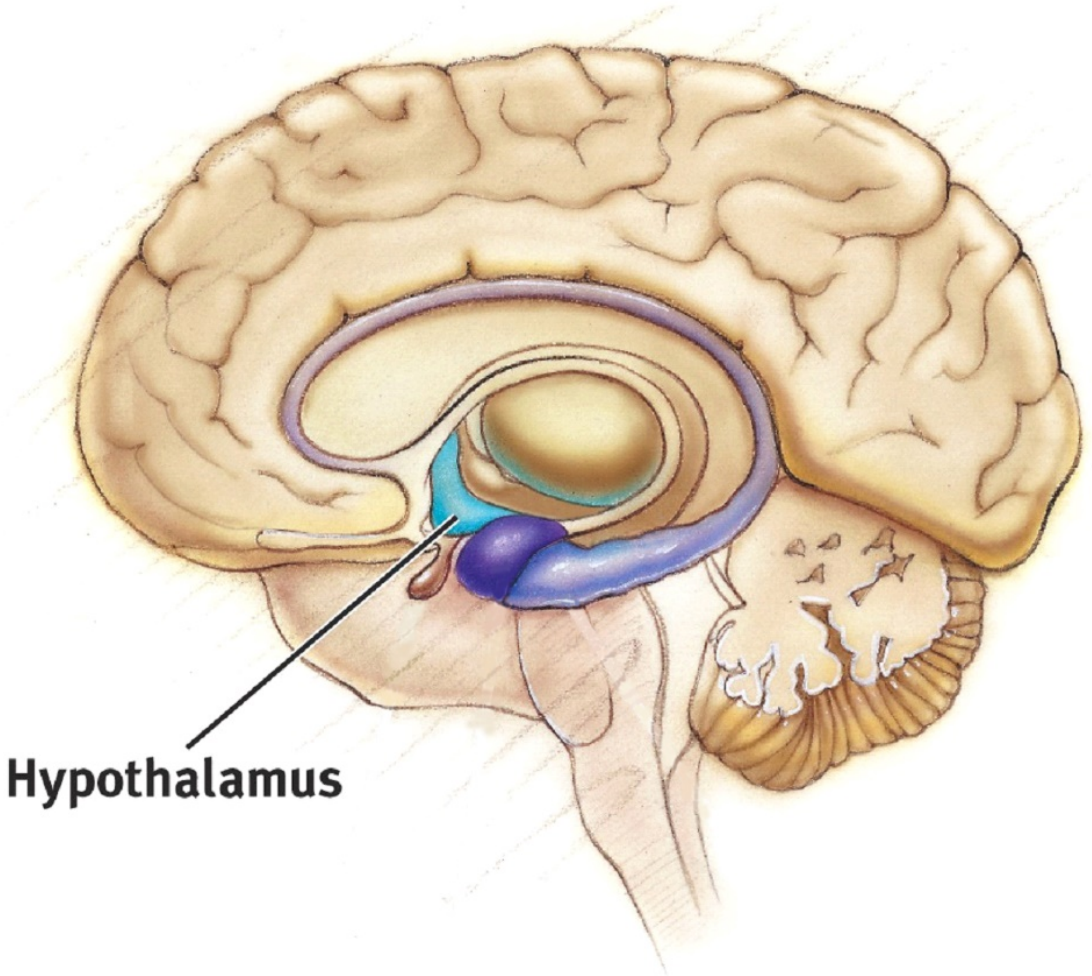
Amygdala

The **Amygdala** [ah-MIG-dah-la] consists of two lima bean-sized neural clusters linked to the **emotions of fear and anger**.



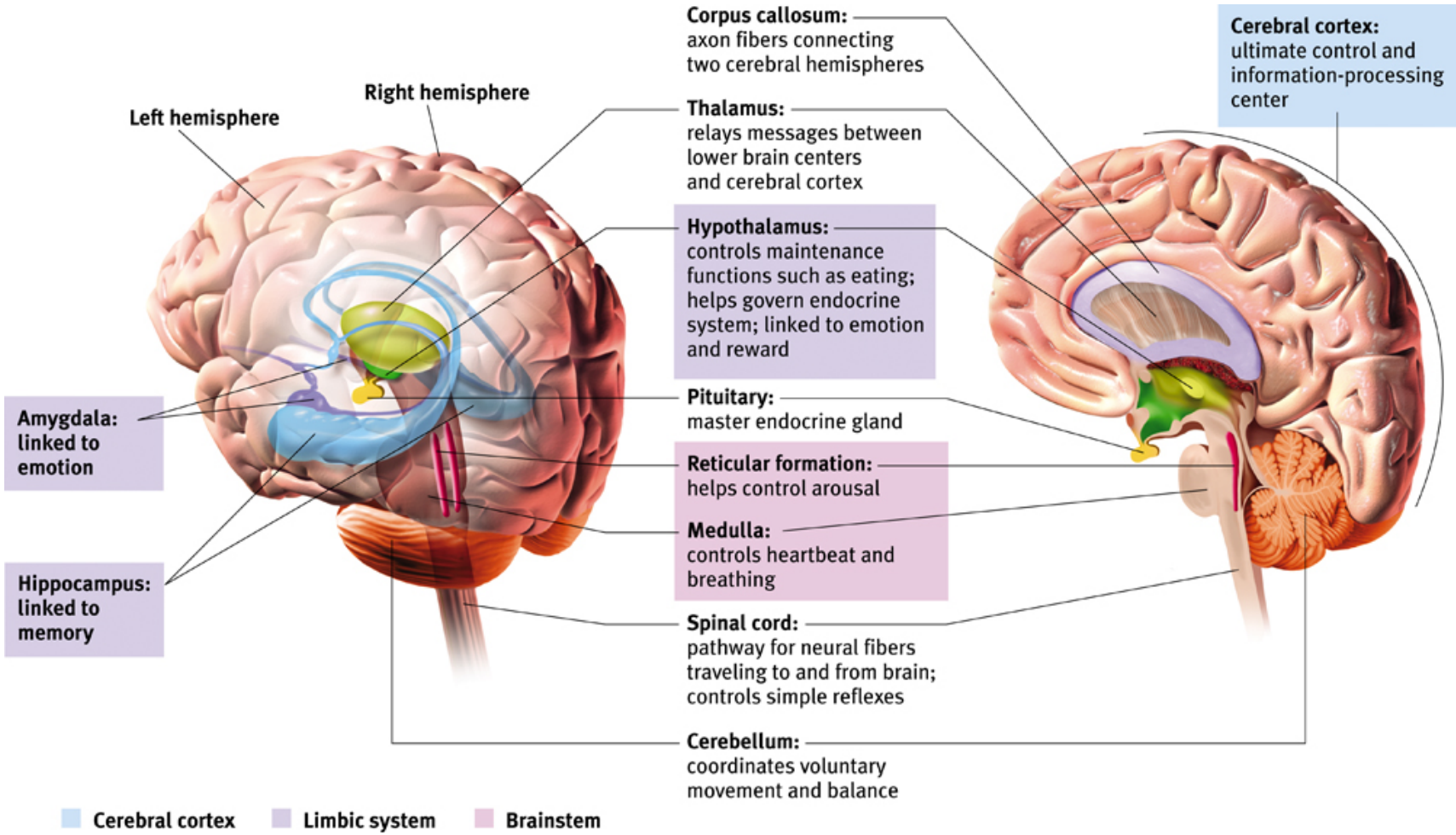
Hypothalamus

The **Hypothalamus** lies below (*hypo*) the thalamus. It directs several **maintenance activities like eating, drinking, body temperature, and control of emotions**. It helps govern the endocrine system via the pituitary gland.



The Cerebral Cortex

The intricate fabric of interconnected neural cells that covers the cerebral hemispheres. It is the body's ultimate control and information processing center.



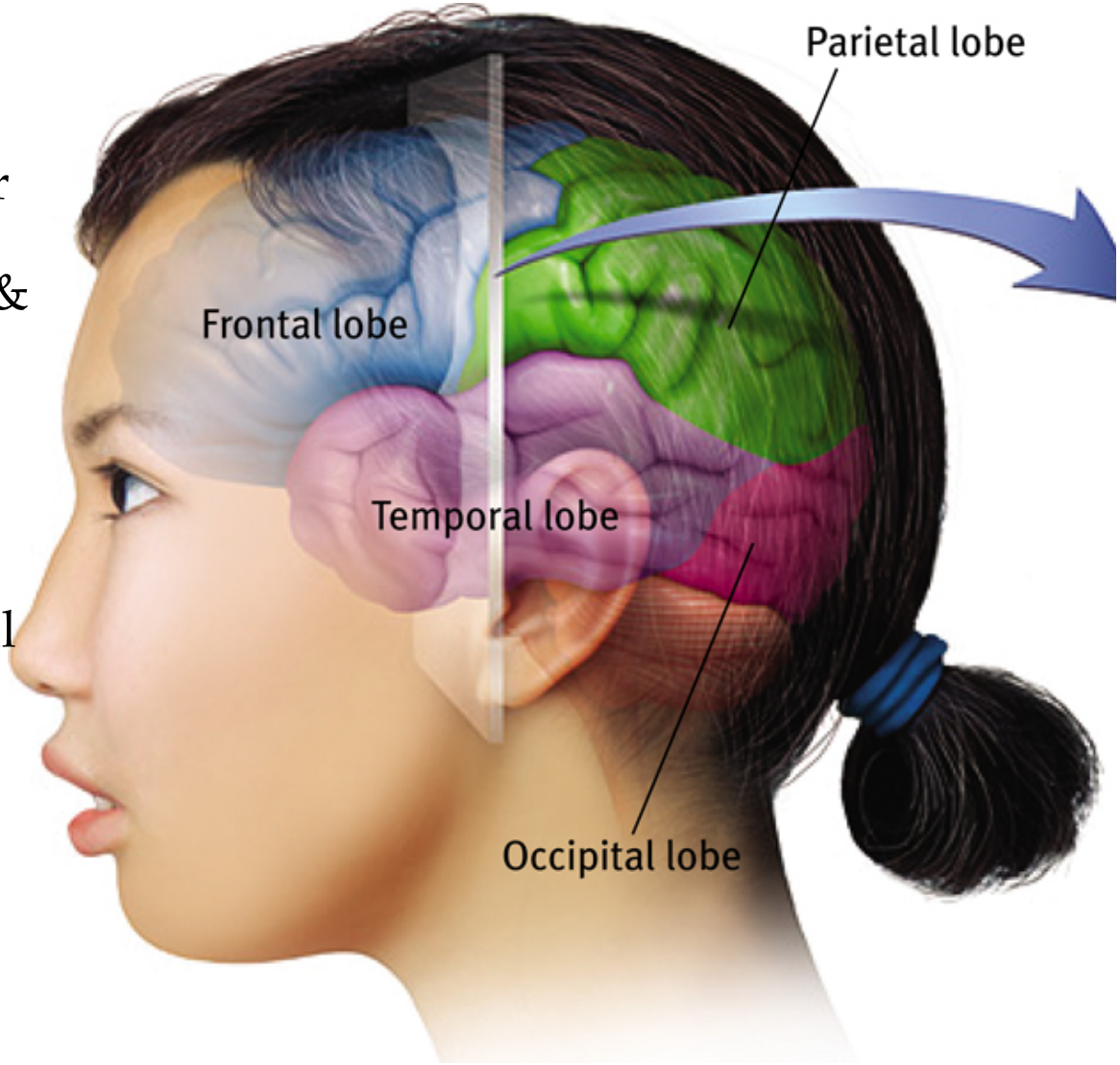
Structure of the Cortex

FRONTAL LOBE - speaking, personality, muscle movement (motor cortex), and executive functions (making plans & judgment)

PARIETAL LOBE- touch sense (sensory cortex)

OCCIPITAL LOBE- visual info (visual cortex input from eyes)

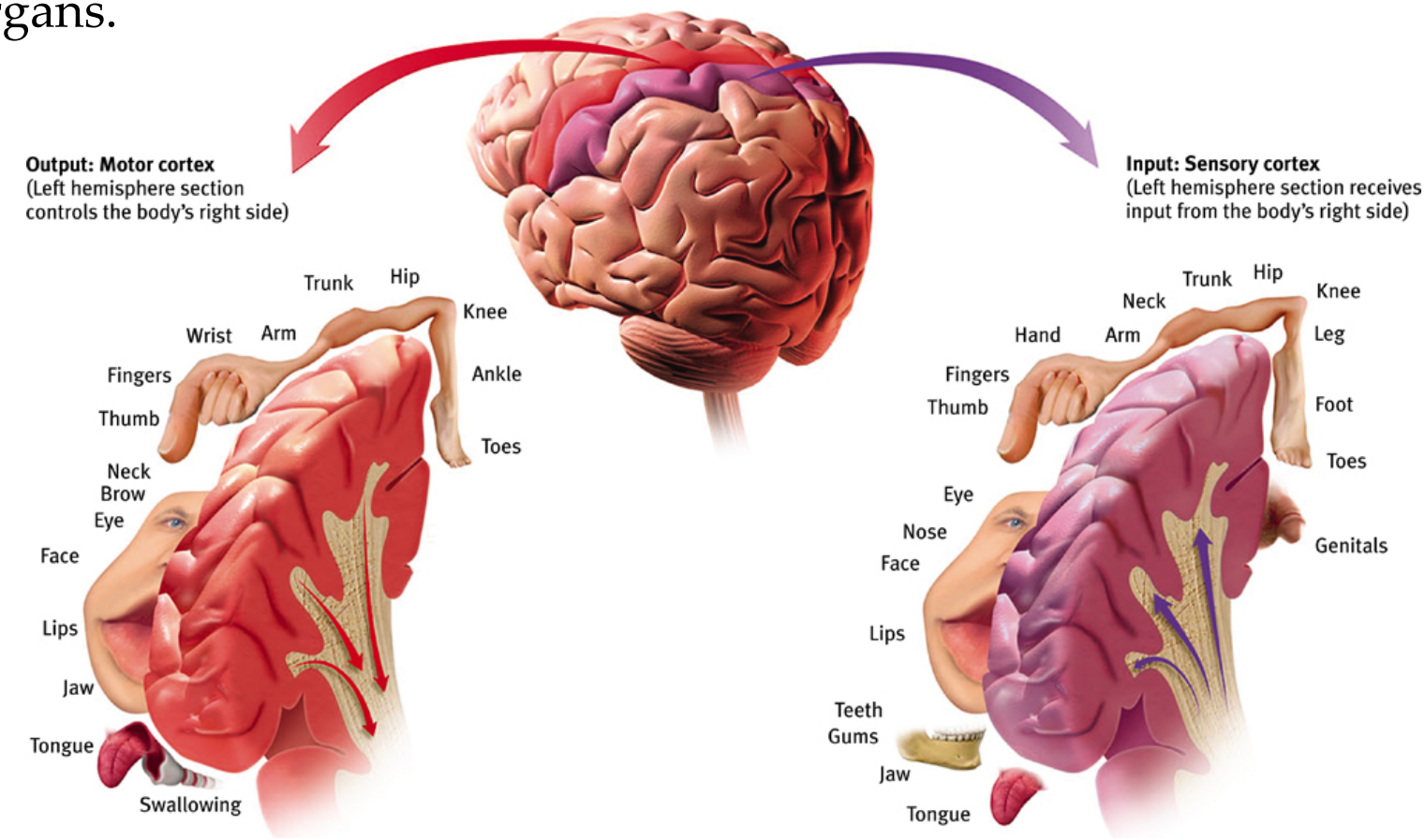
TEMPORAL LOBE- auditory info (auditory cortex above ears input from ears)



Functions of the Cortex

The Motor Cortex is the area at the rear of the frontal lobes that control voluntary movements.

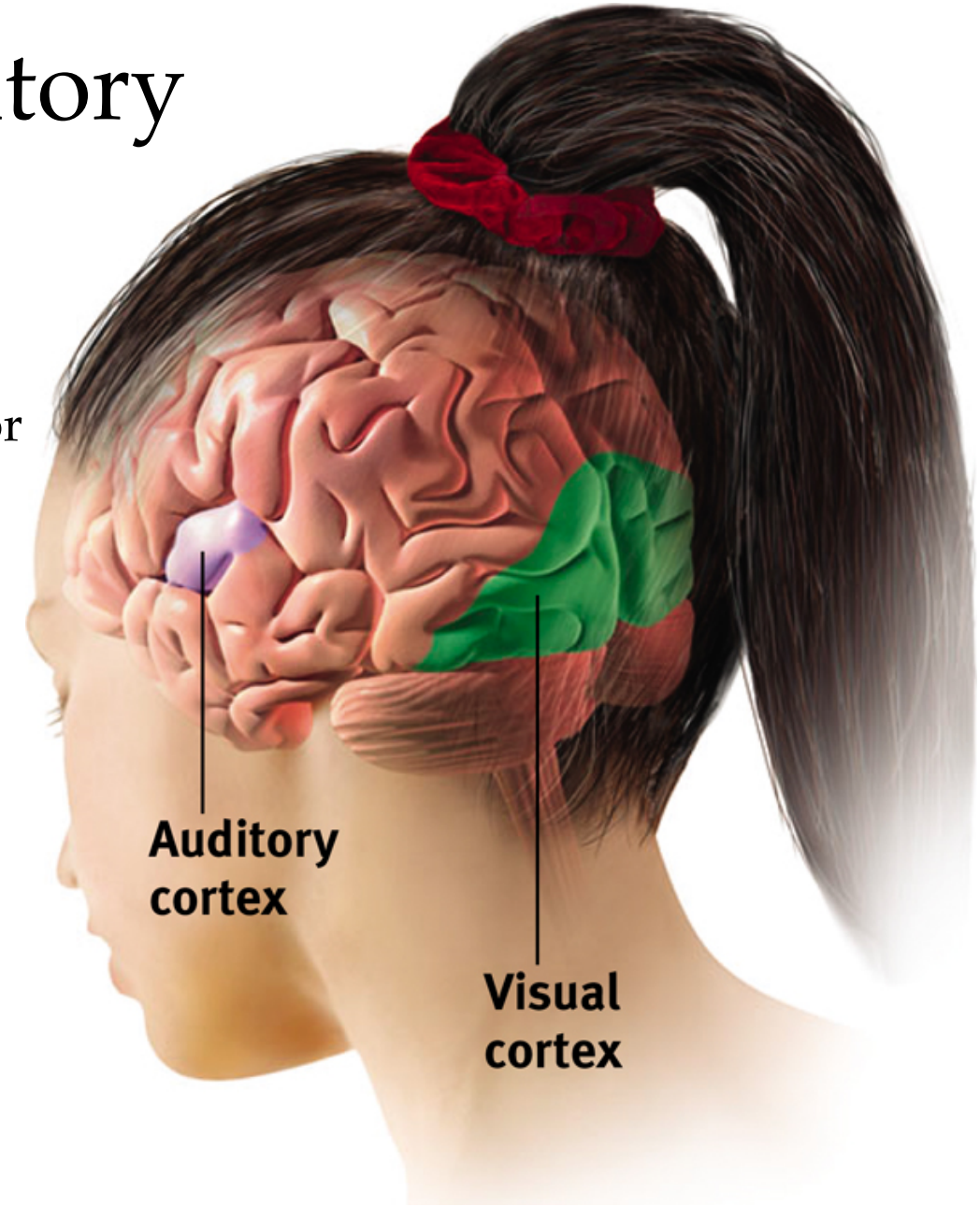
The Sensory Cortex receives information from skin surface and sense organs.



Visual & Auditory

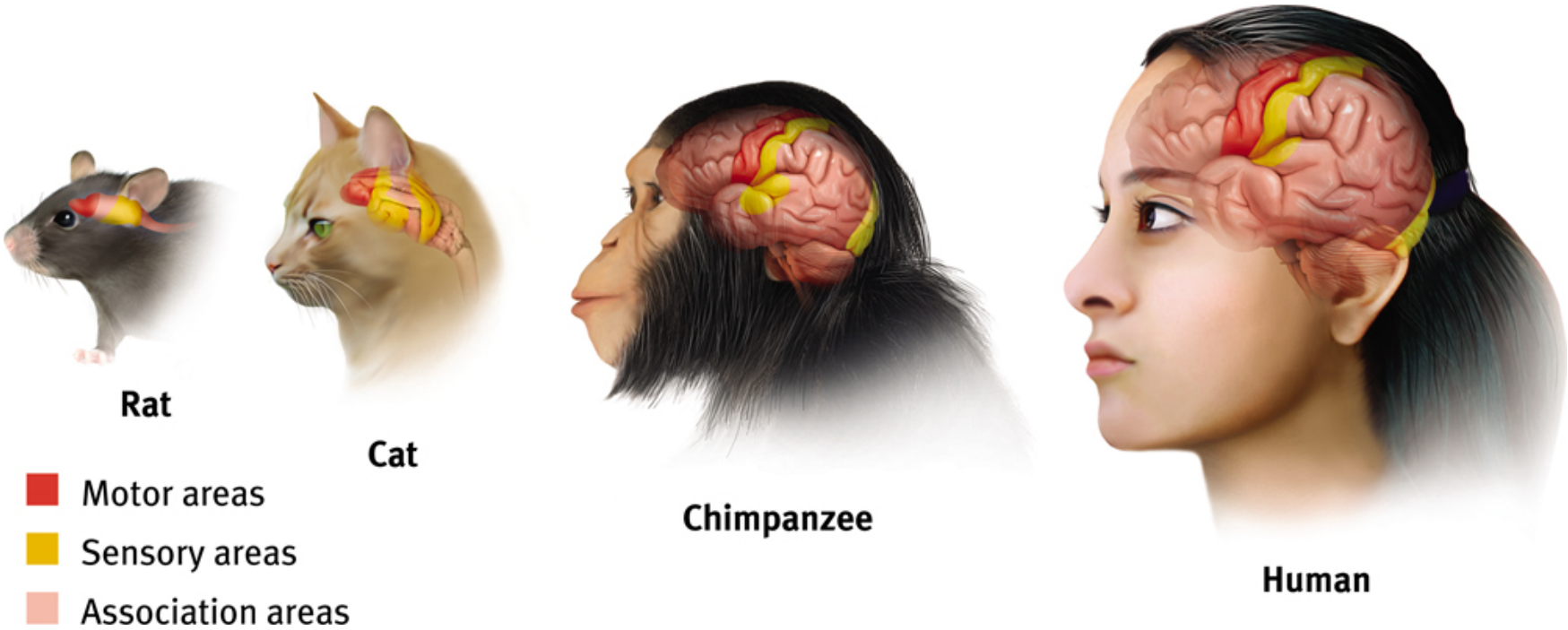
VISUAL CORTEX – In occipital lobes input from eyes. Hit too hard, can go blind or see flashes of light or color. In a sense, eyes in the back of our heads.

AUDITORY CORTEX- auditory info above ears input from ears in temporal lobes.



Association Areas

More intelligent animals have increased "uncommitted" or association areas of the cortex, which are responsible for integrating and acting on info received and processed by sensory areas. Links info with stored memories—important part of thinking.

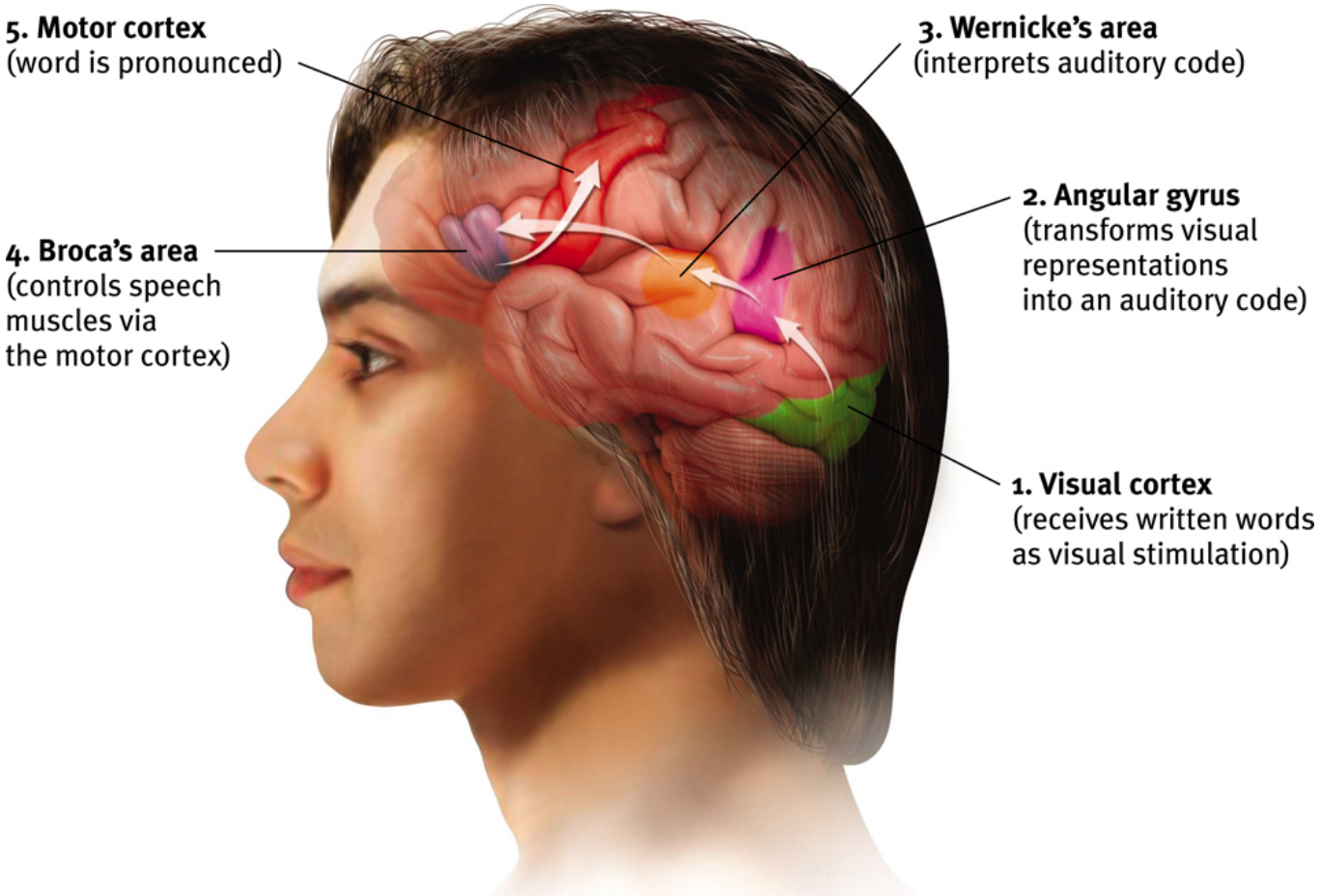


Language

Aphasia is an impairment of language, usually caused by left hemisphere damage either to

Broca's area (impaired speaking) or to

Wernicke's area (impaired hearing/understanding-in auditory cortex)



The Brain's Plasticity

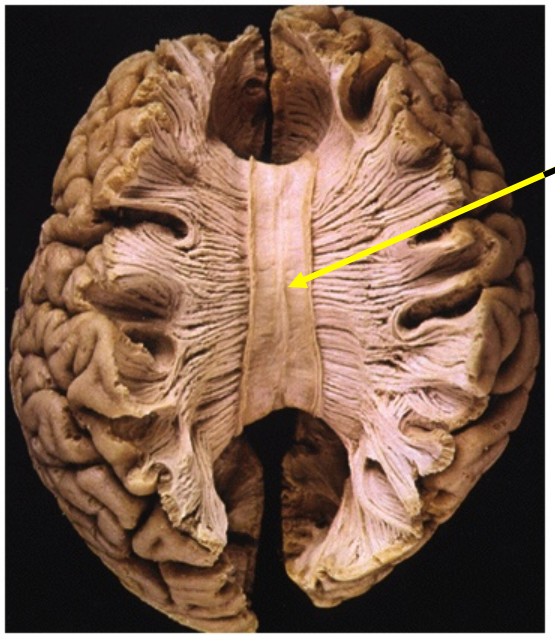
The brain is sculpted by our genes but also by our experiences.

Plasticity refers to the brain's ability to modify itself after some types of injury or illness.

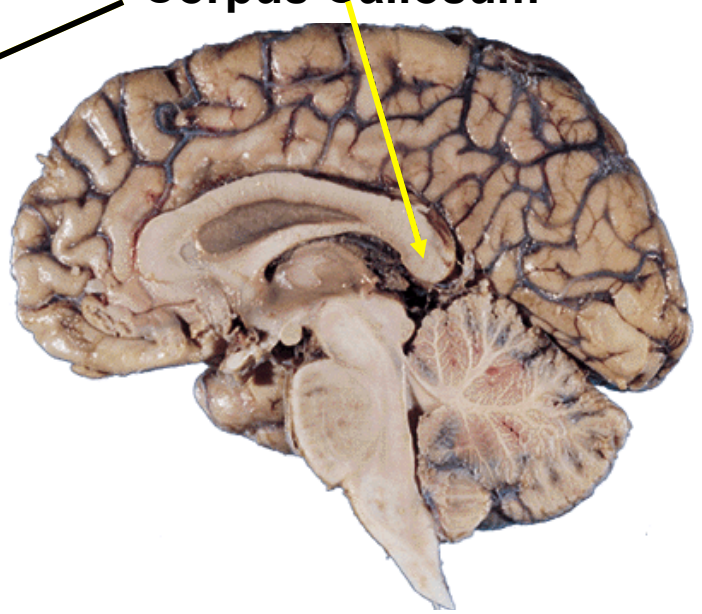
Splitting the Brain

In the 1960s, Sperry and Gazzaniga split the brains of cats and monkeys without serious problems.

Splitting the brain by cutting the **corpus callosum** then became a treatment for people with severe seizures.

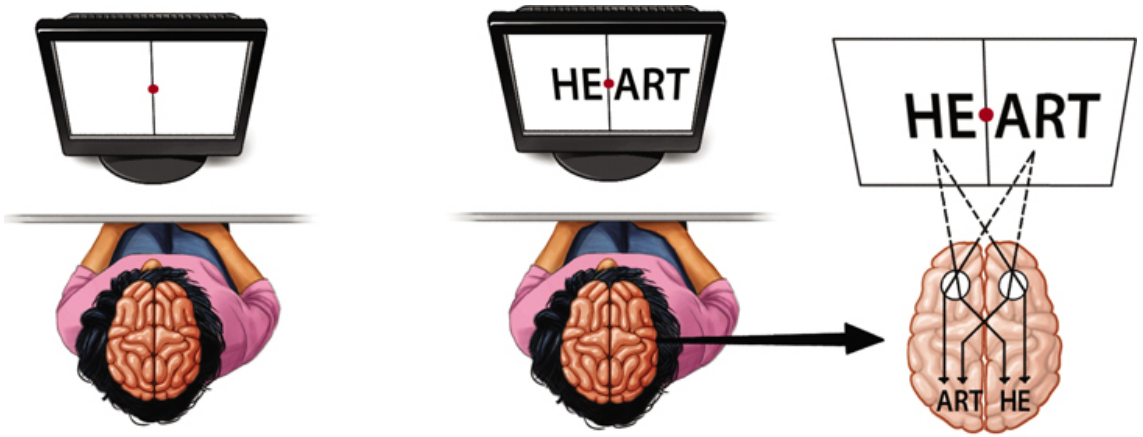


Courtesy of Terence Williams, University of Iowa



Martin M. Rother

Divided Consciousness

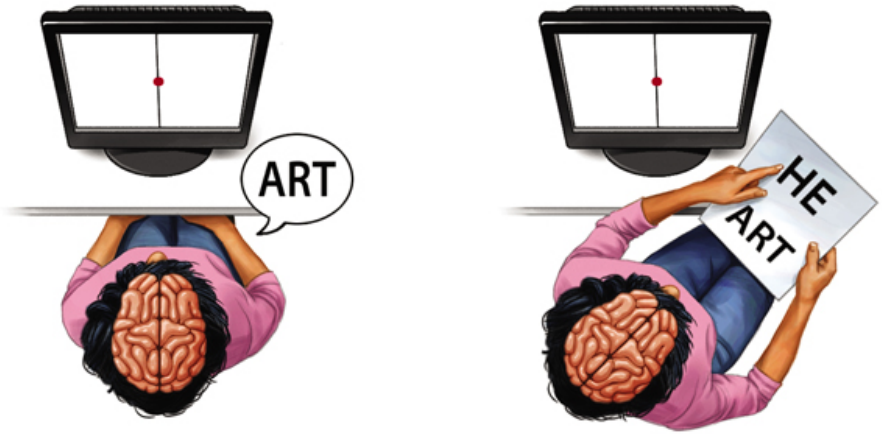


"Look at the dot."

(a)

Two words separated by a dot are momentarily projected.

(b)



"What word did you see?"

or

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

(c)

Split Brain Patients

With the corpus callosum severed, objects (apple) presented in the right visual field can be named. Objects (pencil) in the left visual field cannot.