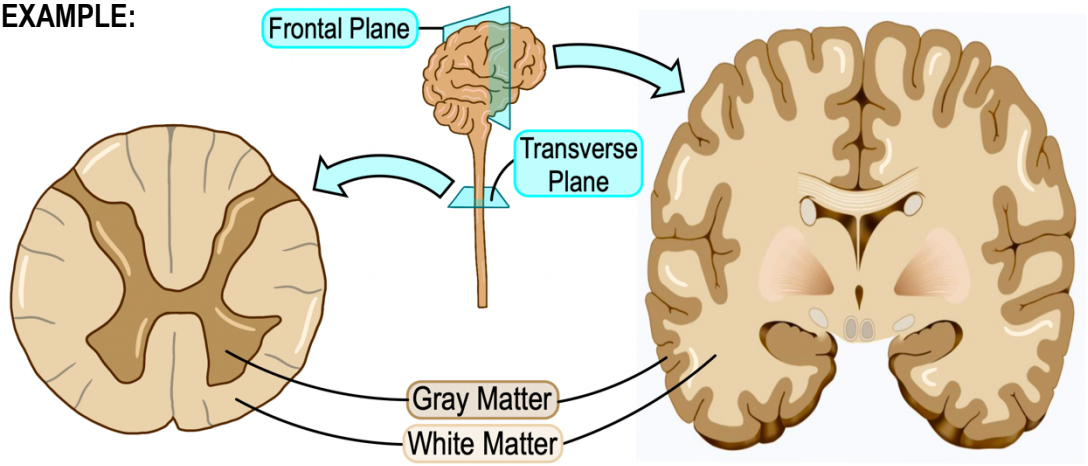
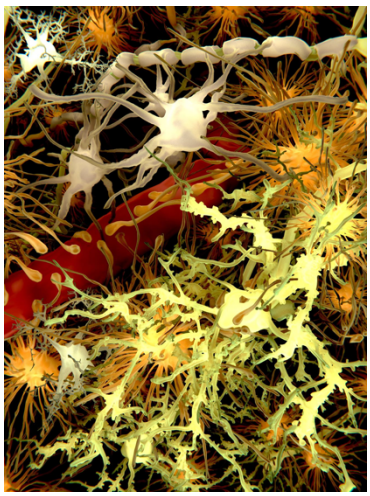
CONCEPT: NERVOUS SYSTEM

- ***Central nervous system*** (***CNS***) – division of the nervous system composed of the brain and spinal cord
  - ***Gray matter*** – mostly consists of neuron cell bodies
  - ***White matter*** – mostly consists of myelinated axons
    - Tract – axon bundle in the CNS
  - Ventricles – cavities in the brain where cerebrospinal fluid is produced
  - Central canal – hollow tub in spine
  - ***Blood-brain barrier*** – endothelium barrier that separates the extracellular fluid of CNS from blood
    - ***Astrocytes*** – major glial cells of the CNS, form the blood-brain barrier

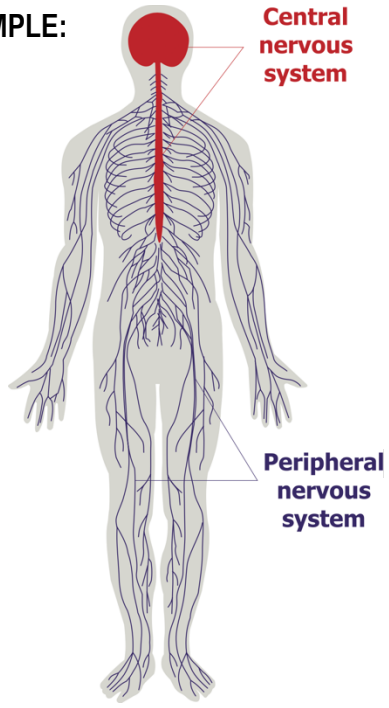
EXAMPLE:

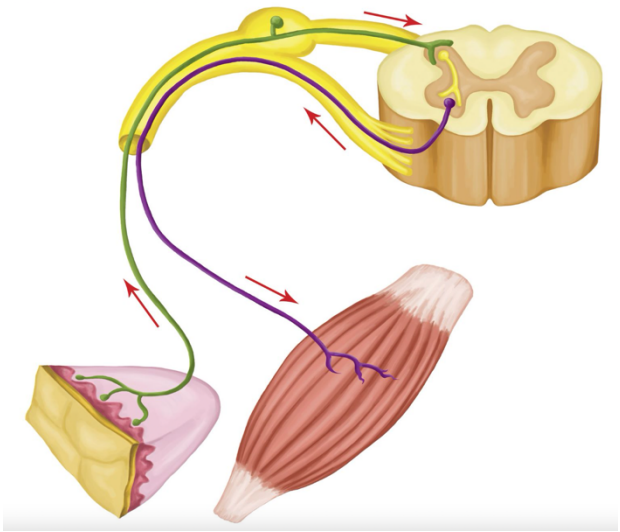




- ***Peripheral nervous system*** (***PNS***) – nerves and ganglia outside of the brain and spinal cord
  - ***Ganglia*** – cluster of cell bodies
  - ***Nerve*** – axon bundle in the PNS

EXAMPLE:

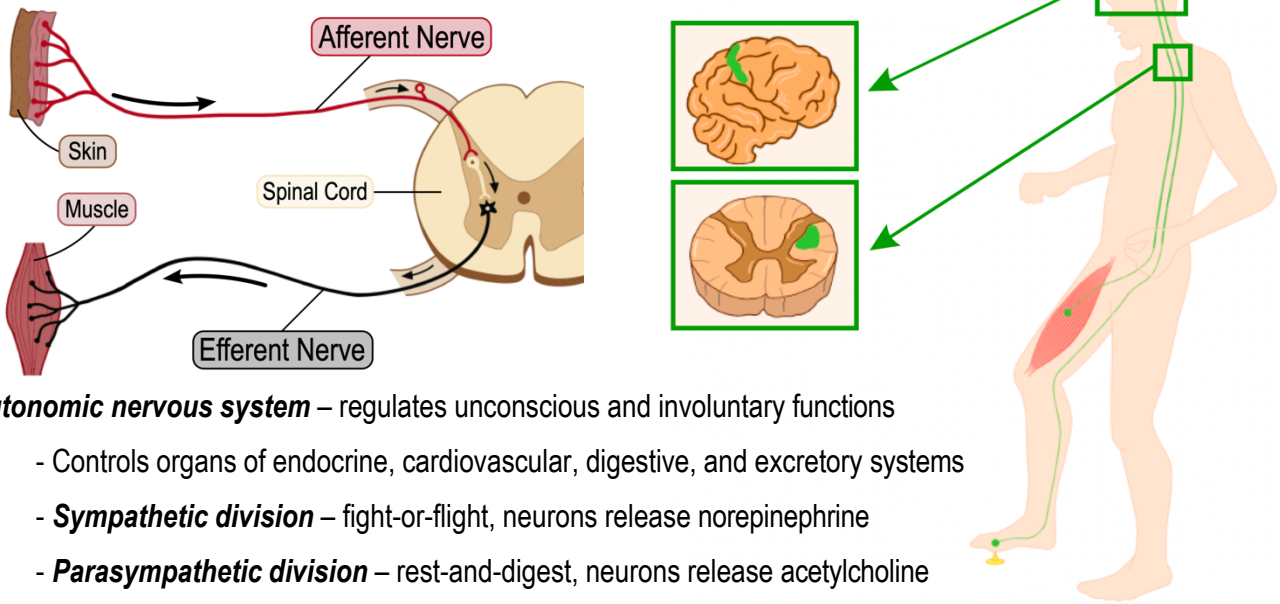




CONCEPT: NERVOUS SYSTEM

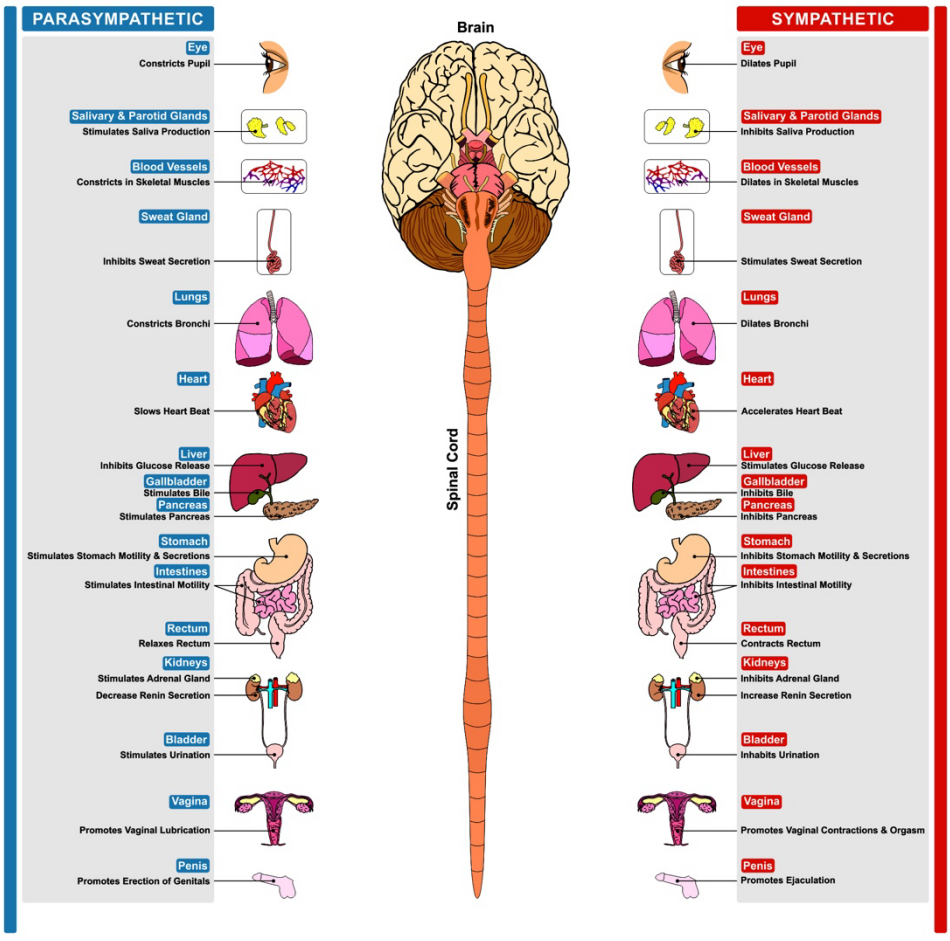
- Peripheral nervous system gathers information for, and relays commands from the CNS
  - ***Somatic nervous system*** (motor system) – controls voluntary movement
    - ***Afferent division*** – carries sensory information from sensory receptors to the CNS
    - ***Efferent division*** – carries signals from the CNS to the body

EXAMPLE:



  - ***Autonomic nervous system*** – regulates unconscious and involuntary functions
    - Controls organs of endocrine, cardiovascular, digestive, and excretory systems
    - ***Sympathetic division*** – fight-or-flight, neurons release norepinephrine
    - ***Parasympathetic division*** – rest-and-digest, neurons release acetylcholine
    - Enteric division – controls organs of digestive tract, pancreas and gallbladder

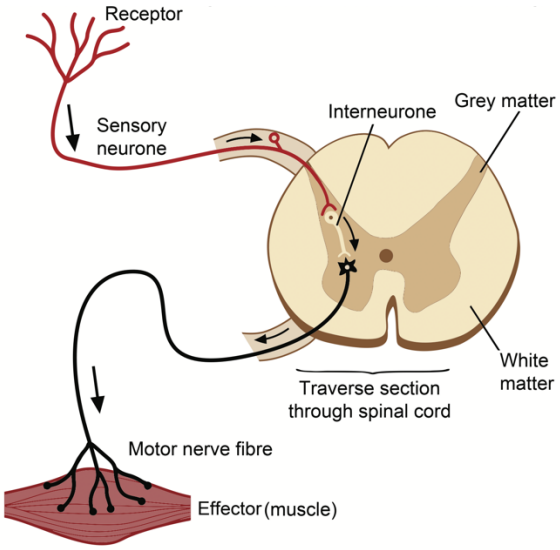
EXAMPLE:



CONCEPT: NERVOUS SYSTEM

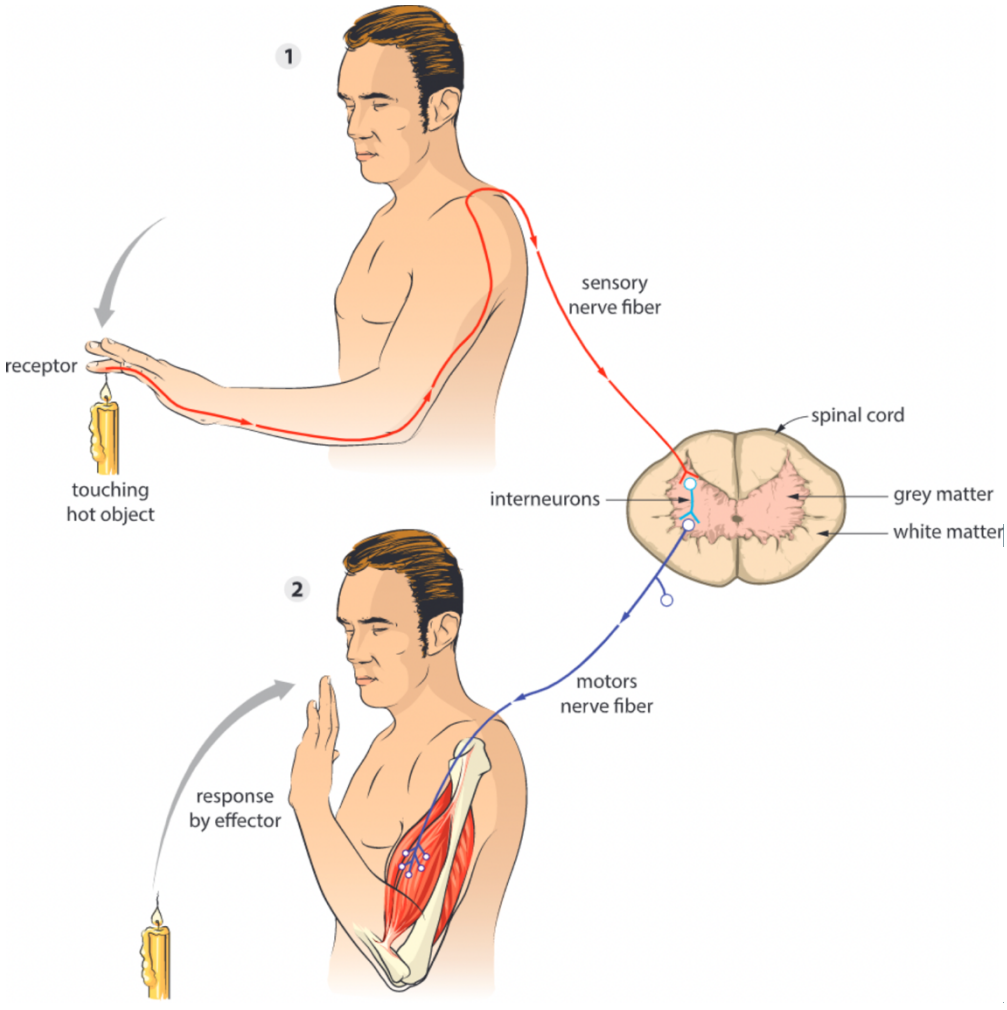
- ***Reflex arc*** – neural pathway controlling involuntary, instantaneous movement in response to stimulus
  - Sensory neurons carry information from stimulus into dorsal side of spine
  - Synapse directly on motor neuron, or on interneuron that synapses with motor neuron

EXAMPLE:



- Motor neuron leaves ventral side of spine, and synapses on muscle to generate movement

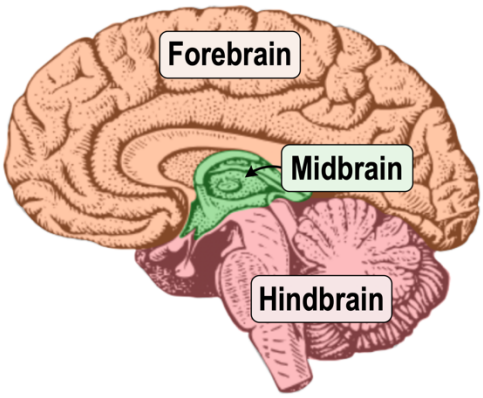
EXAMPLE:



CONCEPT: NERVOUS SYSTEM

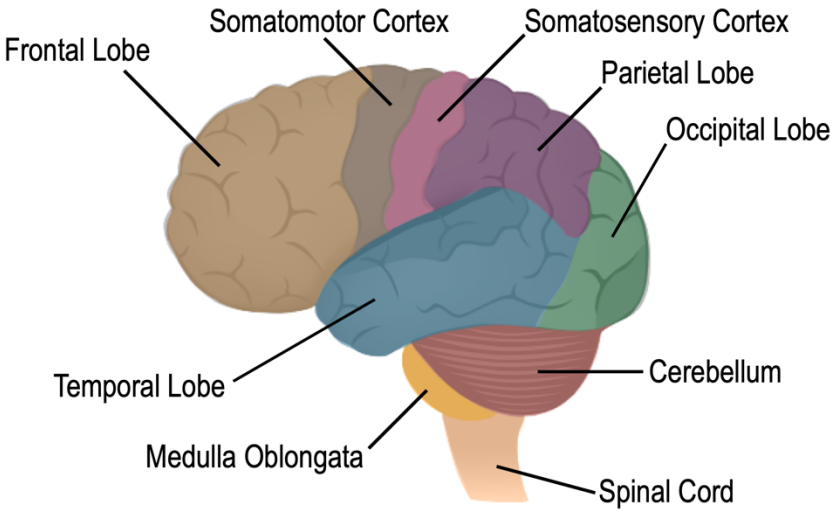
- The brain is organized into different regions and structures
  - ***Forebrain*** – includes the olfactory bulb, cerebrum, and hypothalamus
  - ***Midbrain*** – portion of brainstem
  - ***Hindbrain*** – includes medulla oblongata, pons, and cerebellum

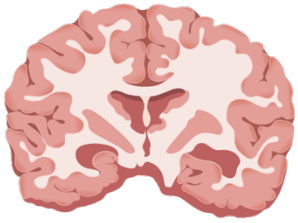
EXAMPLE:



- ***Cerebrum*** – large, outer part of the brain that includes the cortex, and other subcortical structures like the hippocampi
  - Cerebrum is divided laterally between two hemispheres that connect via the corpus callosum
  - ***Corpus callosum*** – large flat bundle of axons that transmits information between the hemispheres
  - ***Cerebral cortex*** – outer layer of the cerebrum composed of gray matter
    - ***Frontal lobe*** – contains areas that are involved in decision making, and the primary motor cortex
    - ***Parietal lobe*** – involved in sensory information processing, contains primary somatosensory cortex
    - ***Temporal lobe*** – contains areas involved in hearing, language, and higher level visual processing
    - ***Occipital lobe*** – contains visual cortex, and other areas involved in processing visual information

EXAMPLE:

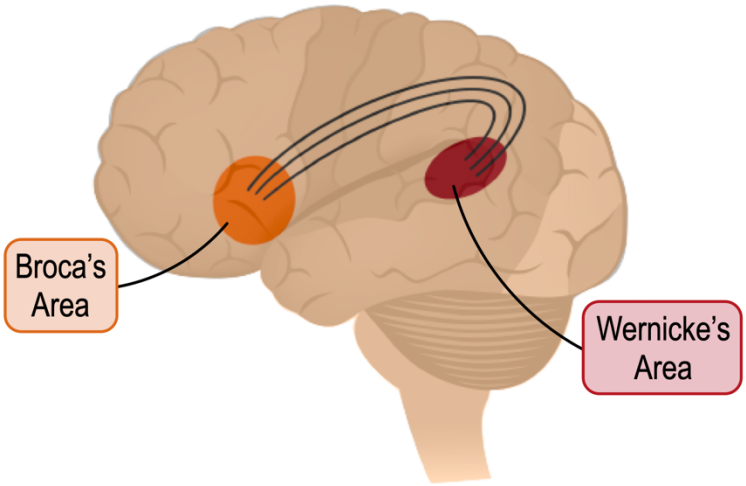




CONCEPT: NERVOUS SYSTEM

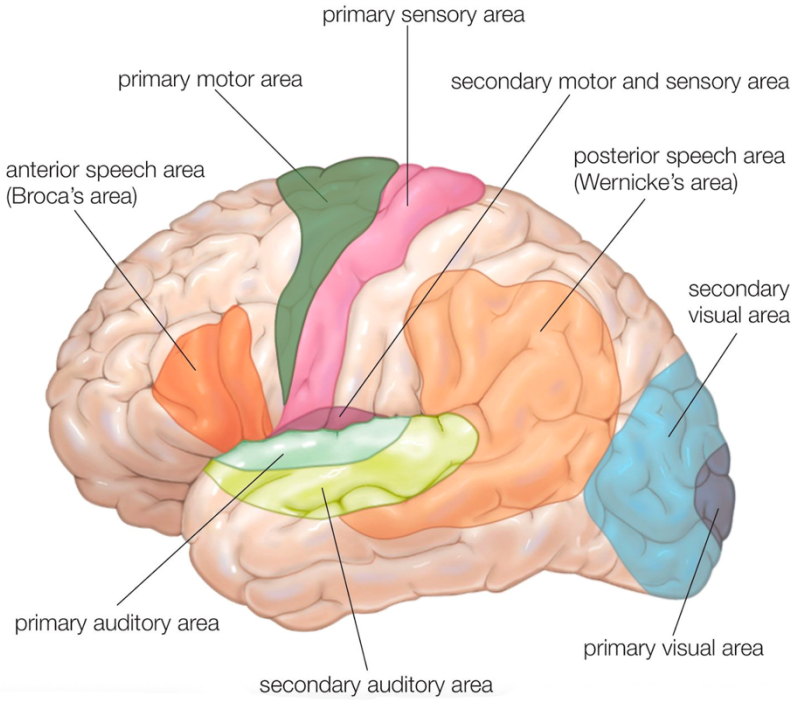
- ***Lateralization*** – differences in cognitive processes between hemispheres, like language being left-hemisphere dominant
    - Functions are localized to different specialized areas of the brain
    - Broca's area – area in left frontal lobe involved in speech production
    - Wernike's area – area in left temporal lobe involved in language comprehension

EXAMPLE:



- Cerebral cortex has sensory, motor, and association areas
    - ***Sensory areas*** – receive and process sensory information
        - Visual, auditory, and somatosensory cortices receive information from the eyes, ears, and body
    - ***Motor areas*** – process voluntary motor movements
        - Primary motor cortex is parallel to primary somatosensory cortex
    - ***Association areas*** – function to extract meaning from sensory information to generate perception of the world

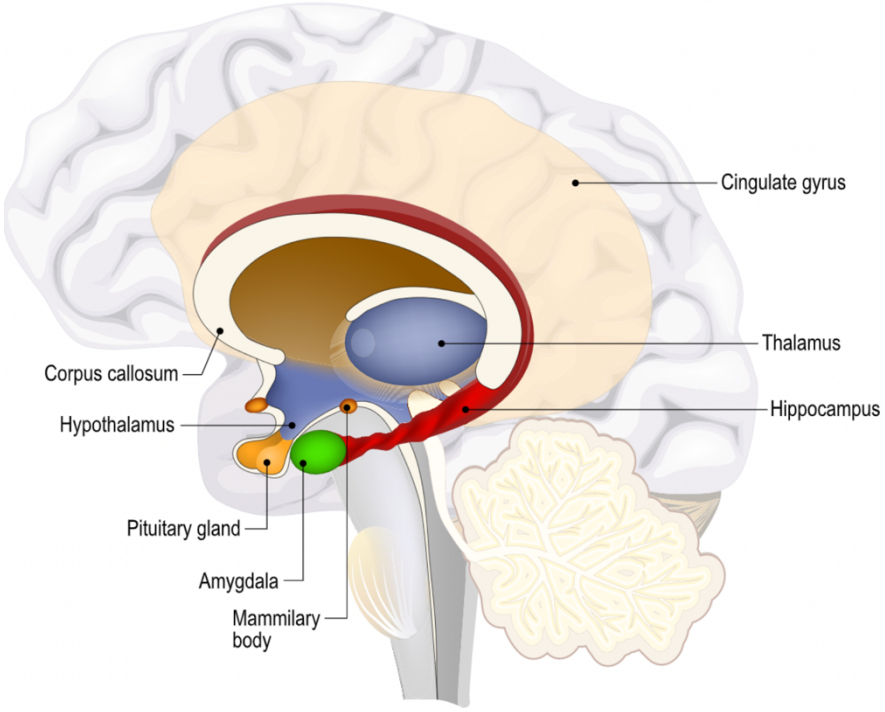
EXAMPLE:



CONCEPT: NERVOUS SYSTEM

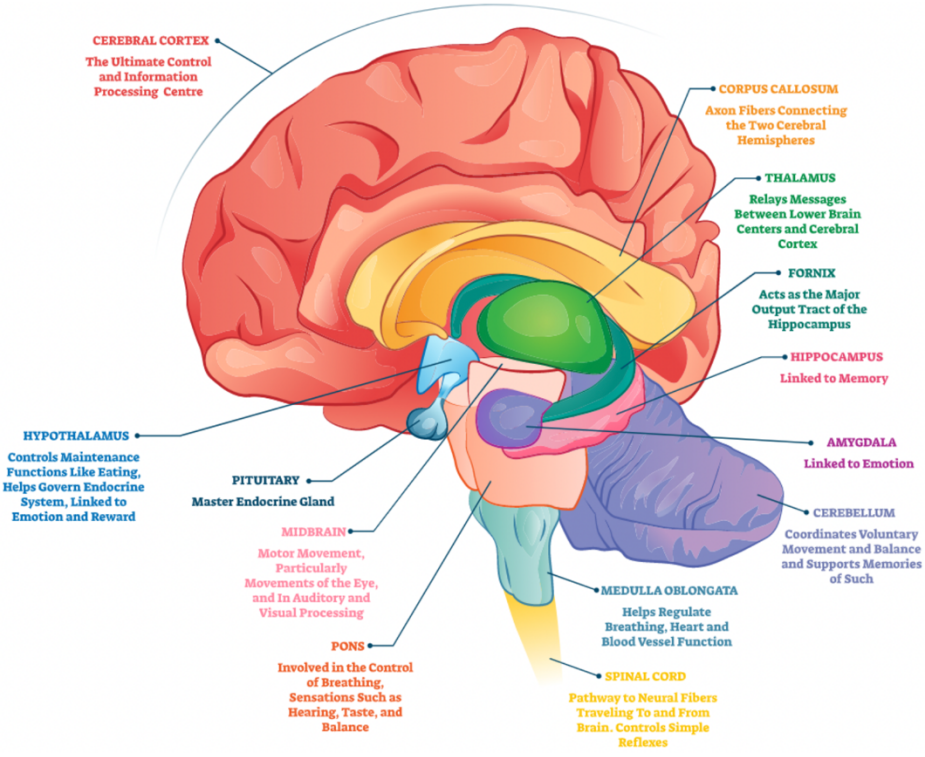
- ***Diencephalon*** – part of forebrain that contains the thalamus and hypothalamus
  - ***Thalamus*** – acts as a relay center for the cortex, plays an important role in visual processing
  - ***Hypothalamus*** – involved in homeostasis, links nervous and endocrine system interacting with pituitary gland

EXAMPLE:



- ***Limbic system*** – set of brain structures in the fore- and midbrain that are involved in memory, behavior, emotion
  - ***Hippocampus*** – involved in learning and memory, especially long-term and spatial memory formation
  - ***Amygdala*** – involved in emotional processing

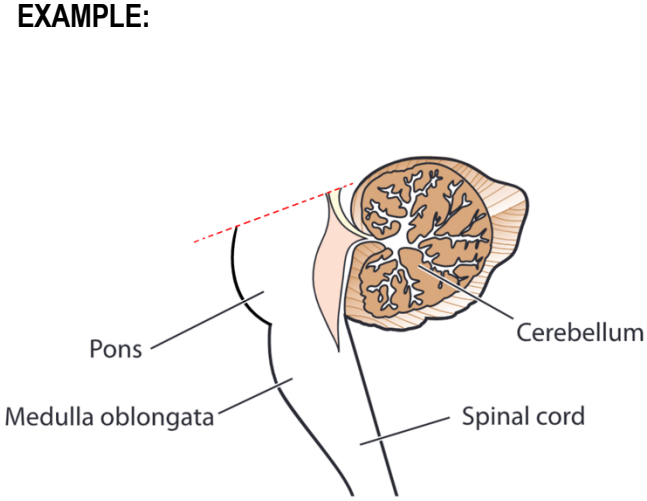
EXAMPLE:

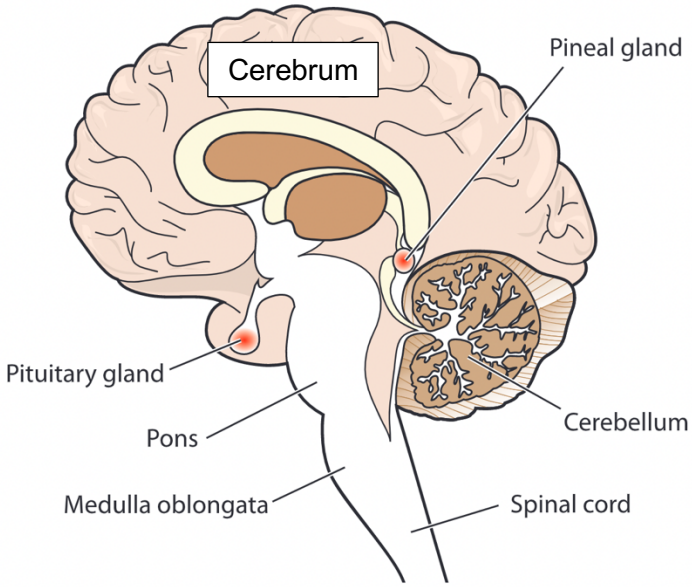


CONCEPT: NERVOUS SYSTEM

- ***Cerebellum*** – involved in integrating motor functions, and fine motor movements

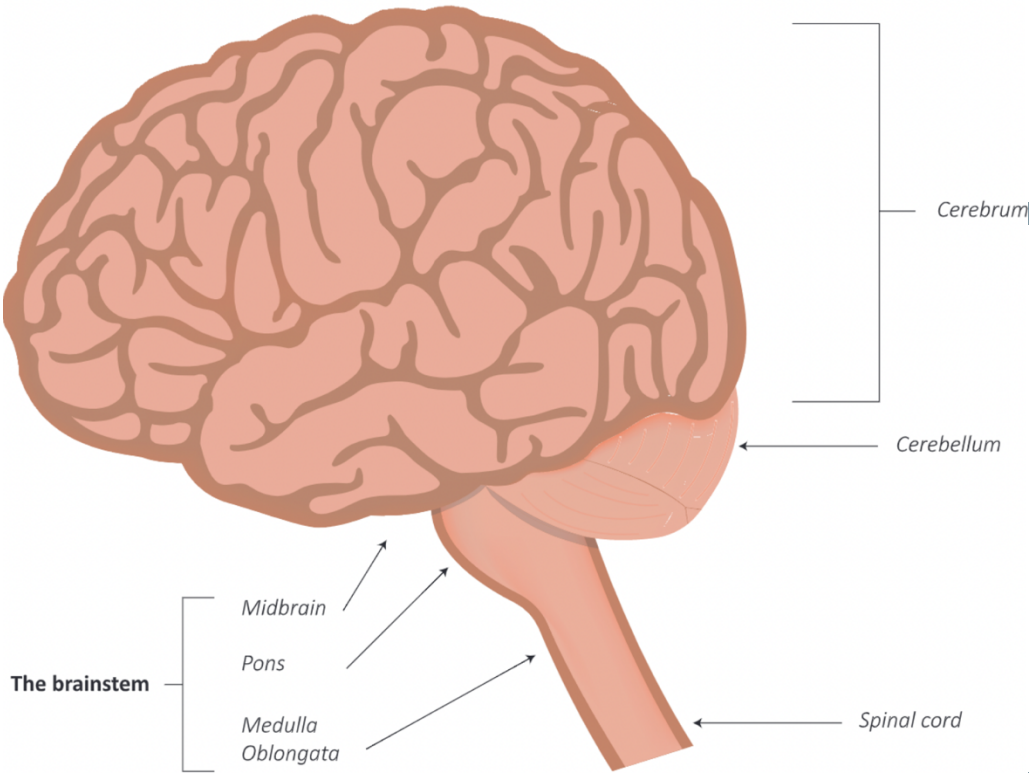
EXAMPLE:





- ***Brain stem*** – contains the pons and medulla oblongata, and is continuous with the spinal cord
  - ***Pons*** – involved in swallowing, breathing, eye movement, posture, and dream production
  - ***Medulla oblongata*** – involved in maintaining heart rate, breathing, and blood pressure

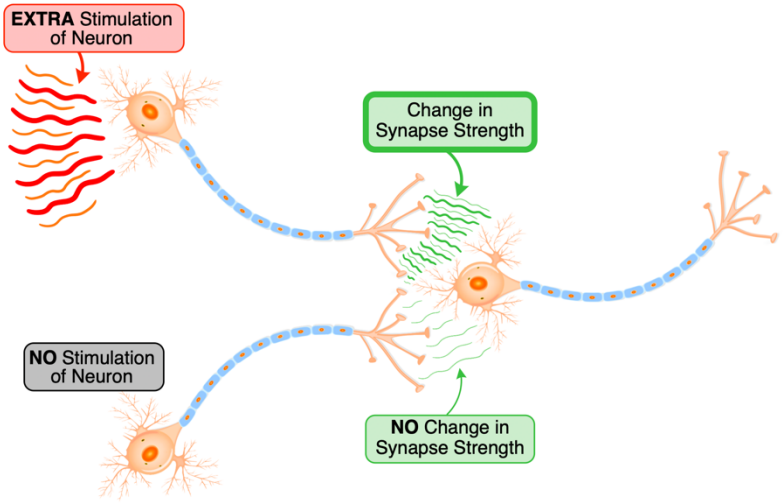
EXAMPLE:



CONCEPT: NERVOUS SYSTEM

- ***Neuroplasticity*** – neurons can reorganize themselves, modifying and forming new connections
- ***Synaptic plasticity*** – ability of synapses to strengthen or weaken based on activity patterns
- ***Neurogenesis*** – growth of new nervous tissue, mostly occurs during embryogenesis

EXAMPLE:



- ***Learning*** – acquiring new, modifying, or reinforcing existing knowledge, behaviors, or skills
- ***Memory*** – encoding, storage, and retrieval of information
  - Sensory memory – transiently (~1 second) holds sensory information
  - ***Short-term memory*** – limited ability to recall a small number of items of information without rehearsal
  - ***Long-term memory*** – information and knowledge that can be stored and recalled for a long time
- ***Long-term potentiation*** – long-term strengthening of a synapse based on activity patterns
  - Thought to be a cellular mechanism behind learning and memory

EXAMPLE: