Biopsychology

Nervous System & Brain
Endocrine System

Nervous System

- Divisions of the Nervous System
- Types of Nerves
- Reflexes

Divisions of the Nervous System

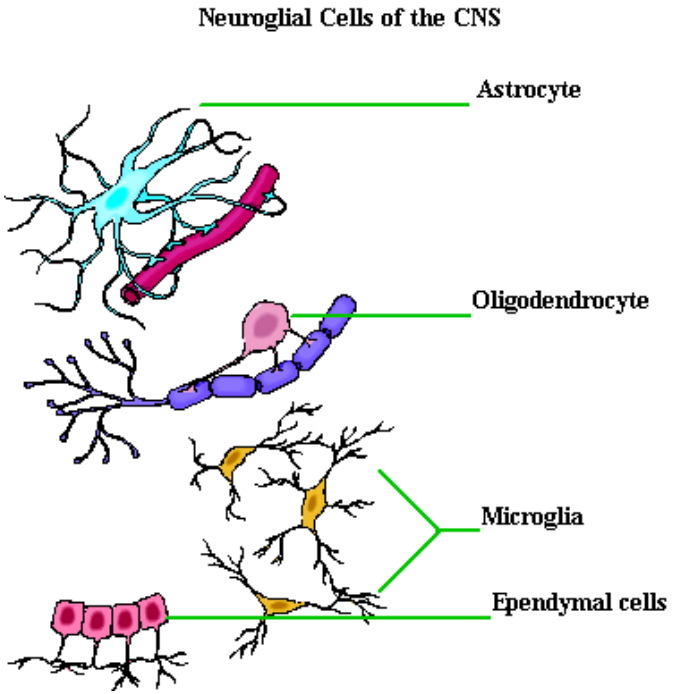
- Central NS: coordinates activity of all parts of the body
  - Brain and Spinal Cord
- Peripheral NS: carries sensory and motor info to and away from the CNS
  - Somatic: stimulate skeletal muscle (voluntary)
  - Autonomic: stimulate smooth and heart muscles (involuntary)
    - Sympathetic: pumps you up; “flight or flight”
    - Parasympathetic: calms you down; “rest & digest”

Types of Nerves

- Afferent Neurons/Sensory Nerves
  - Take info from the sensory receptors *to CNS*
- Efferent Neurons/Motor Nerves
  - Take info *from CNS* to muscles and glands
- Interneurons/Association Neurons
  - Neurons within the CNS
  - Middlemen between Afferent & Efferent
- Remember “SAME”

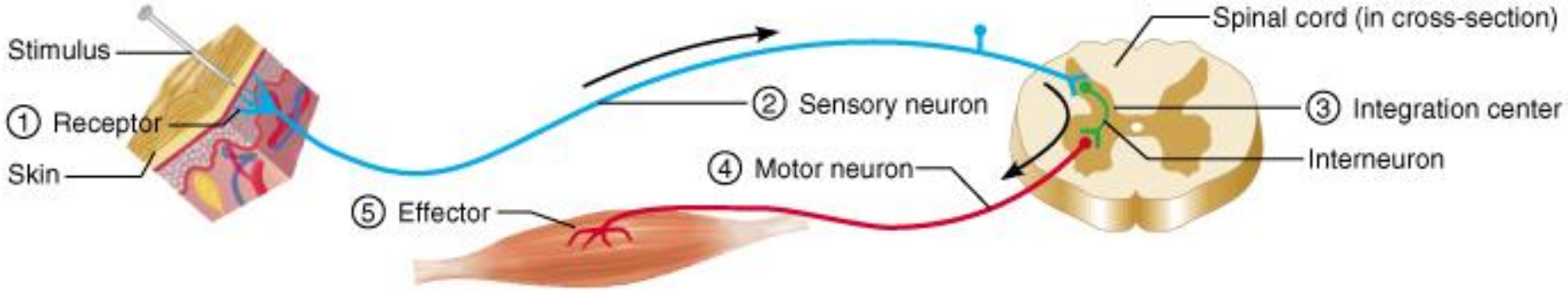
Types of Nerves

- **Neurons vs. Glial Cells**
  - Neurons send electrochemical messages
  - Glial cells support and nourish neurons



Reflexes

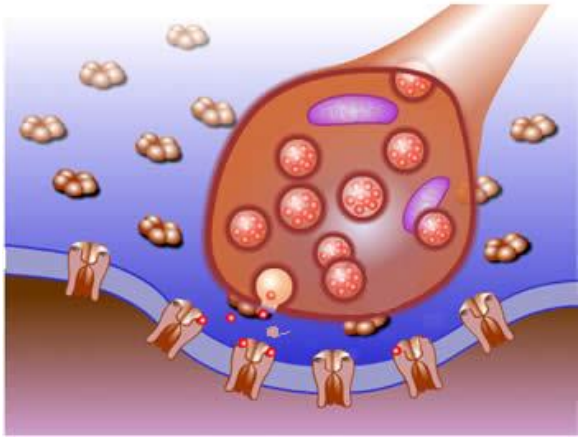
- Normal nervous system transmissions
  - Afferent → Spinal Cord → Brain → Spinal Cord → Efferent
- Reflexes
  - Afferent → Interneurons in Spinal Cord → Efferent
  - Brain gets message after spinal cord acts

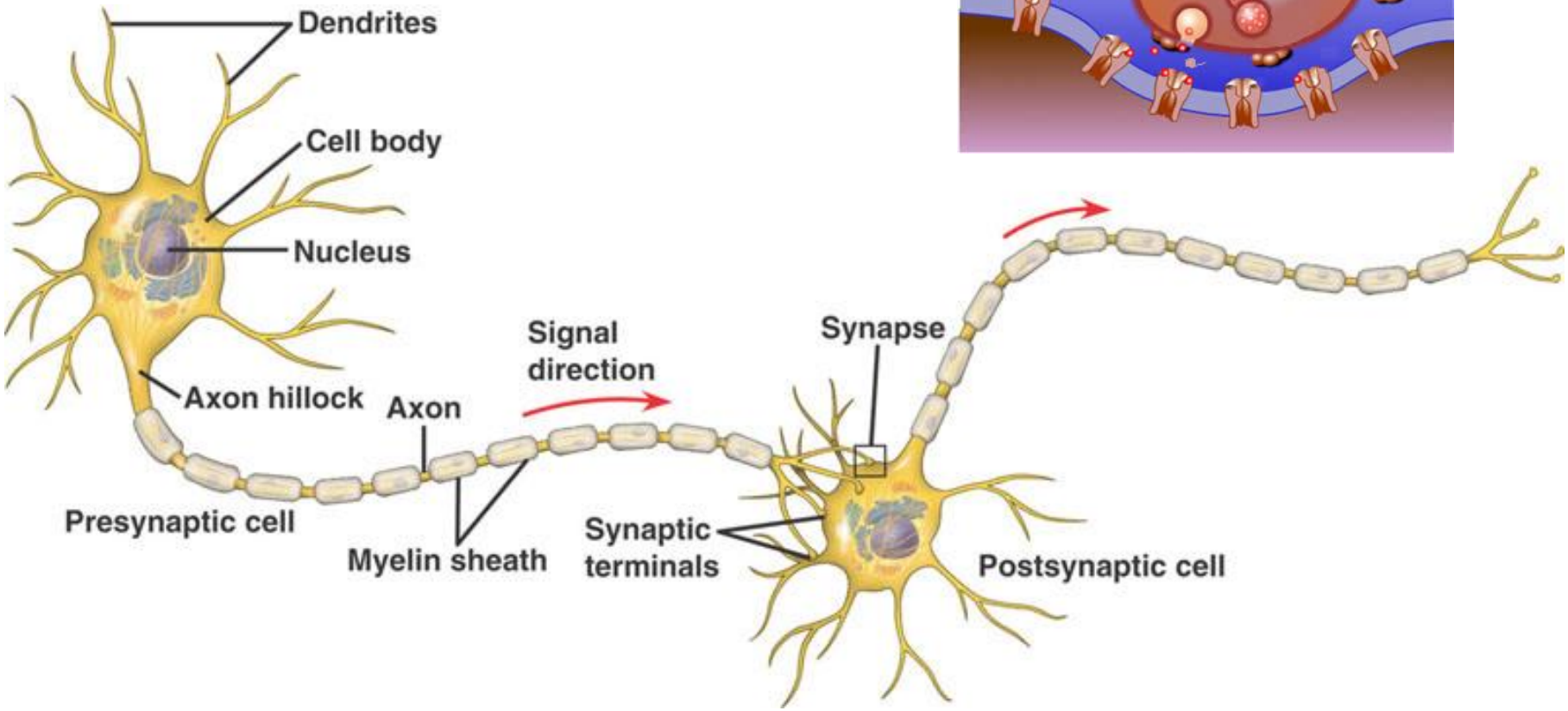


The Neuron

- Structure of the Neuron
- Neurotransmitters
- Synaptic Transmission

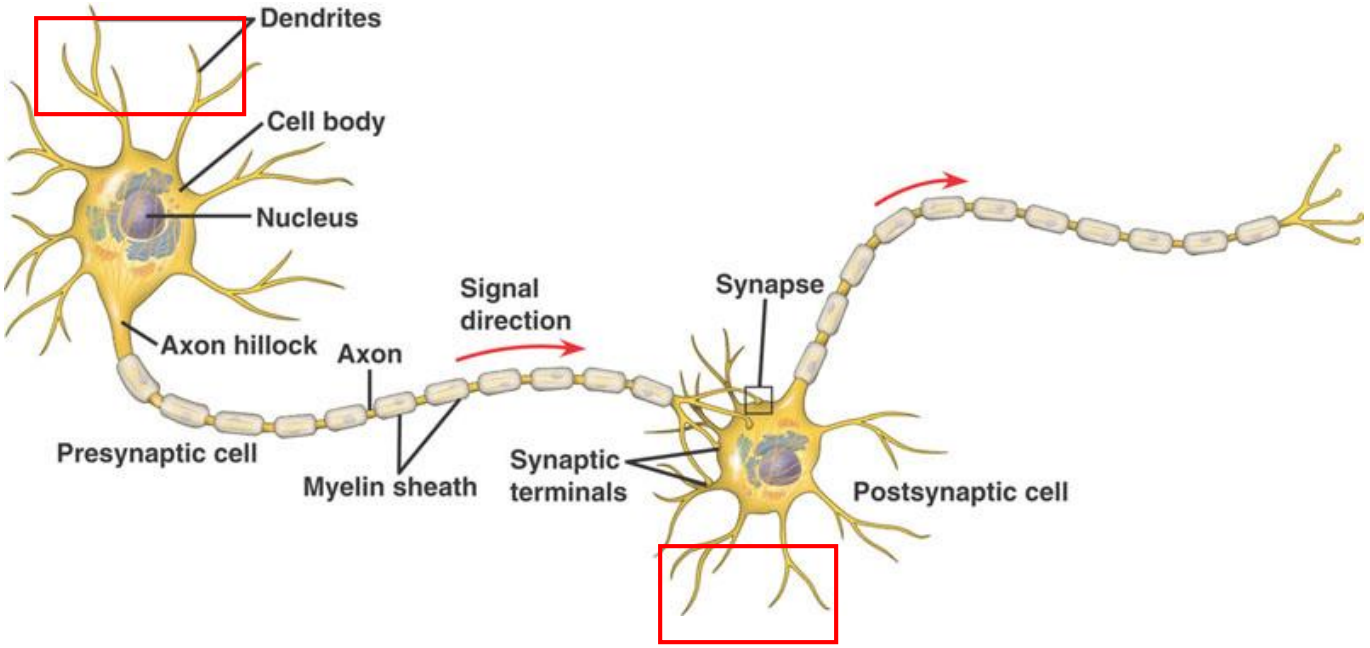
Structure of the Neuron





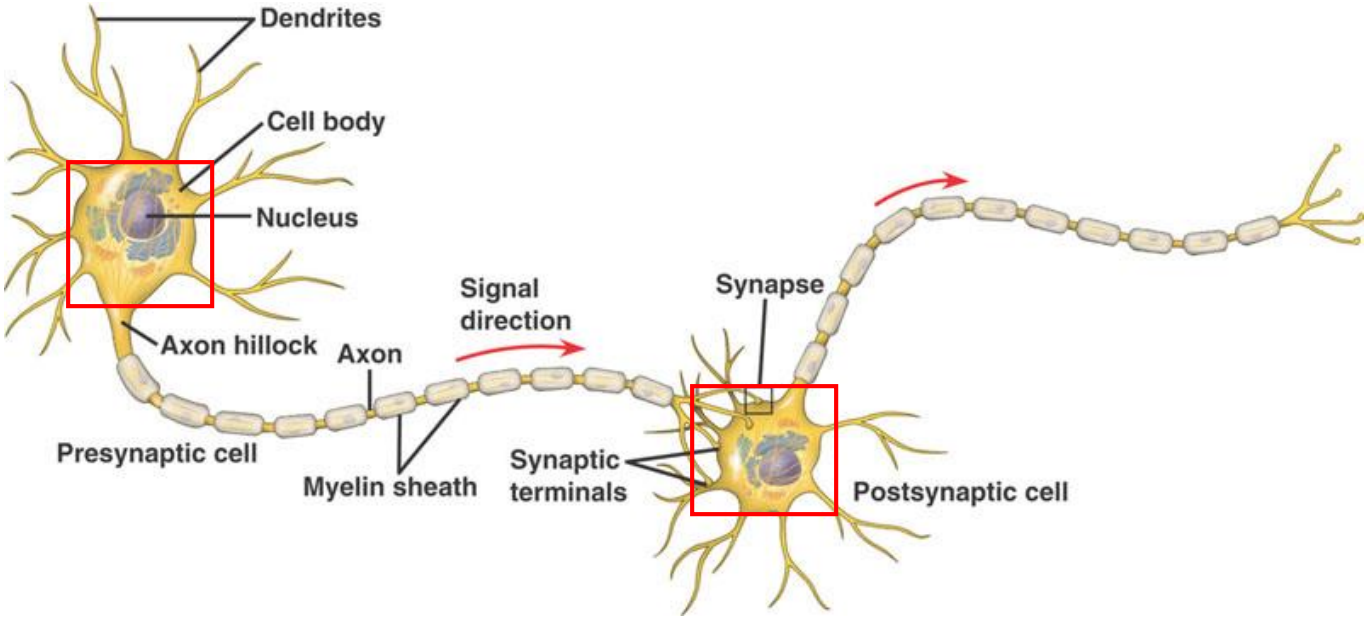
Structure of the Neuron

- **Dendrites**
  - Contain receptor sites which receive neurotransmitters from the presynaptic neuron



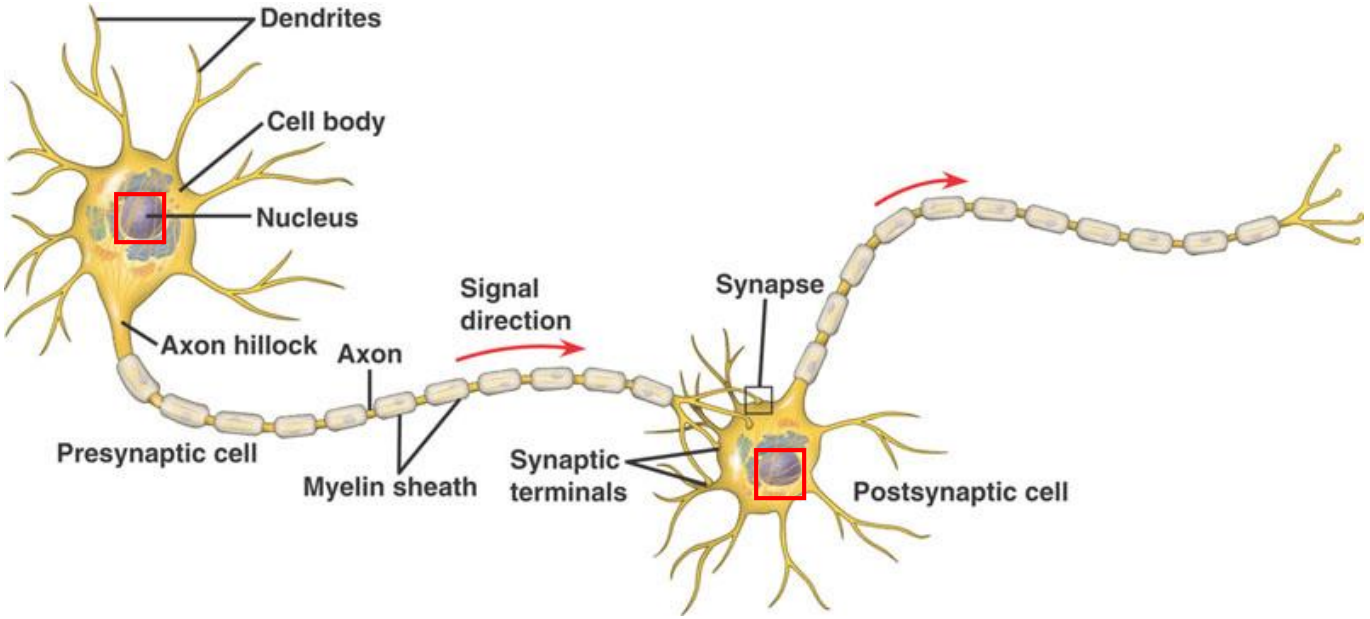
Structure of the Neuron

- **Soma**
  - aka cell body; contains cytoplasm; nucleus



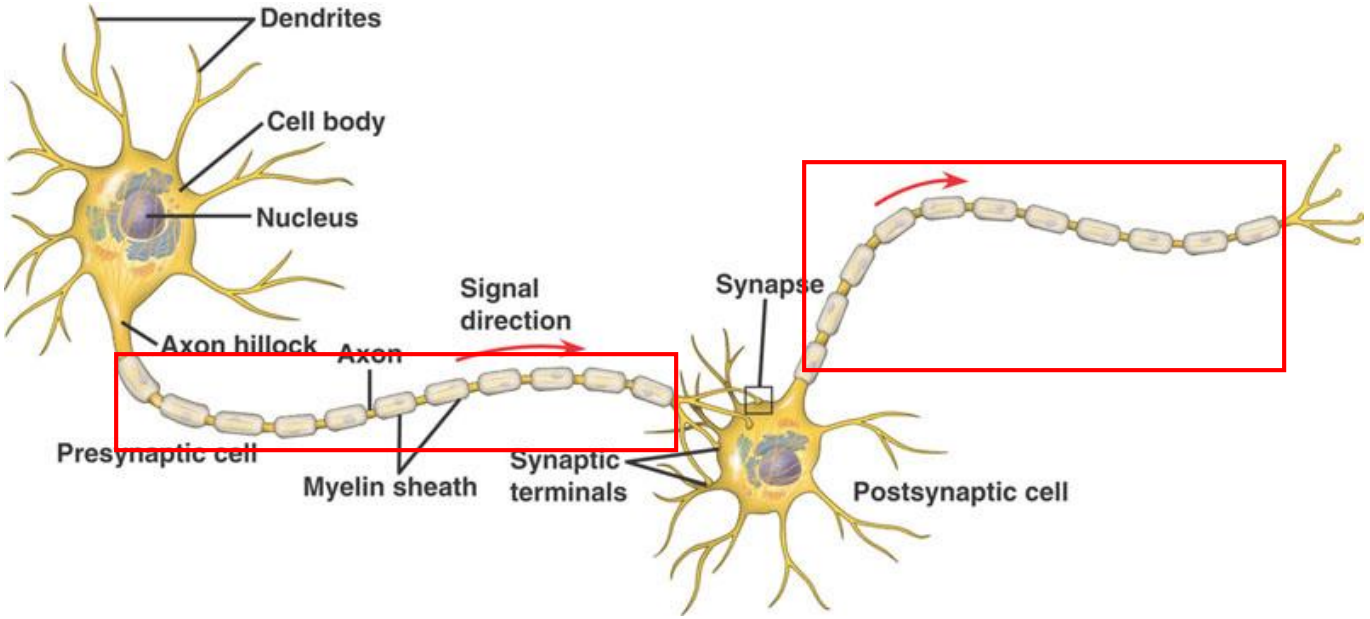
Structure of the Neuron

- **Nucleus**
  - directs production of neurotransmitters; contains DNA



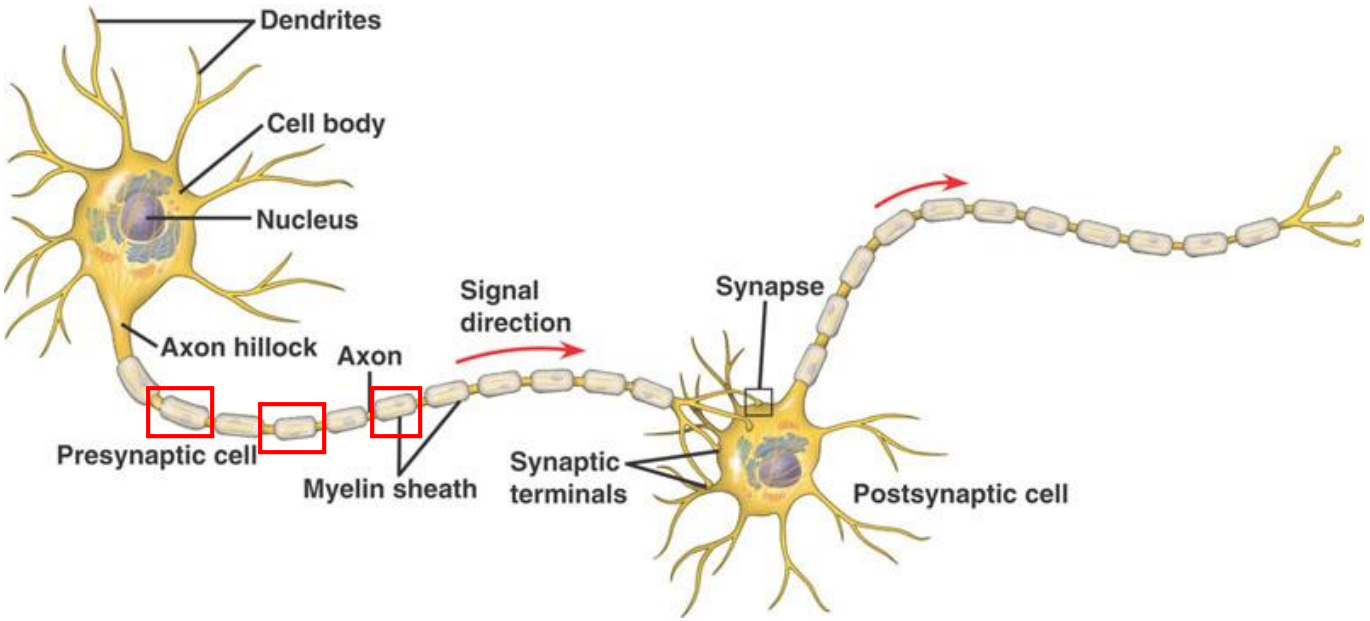
Structure of the Neuron

- **Axon**
  - what the neuron impulse travels down once threshold has been reached



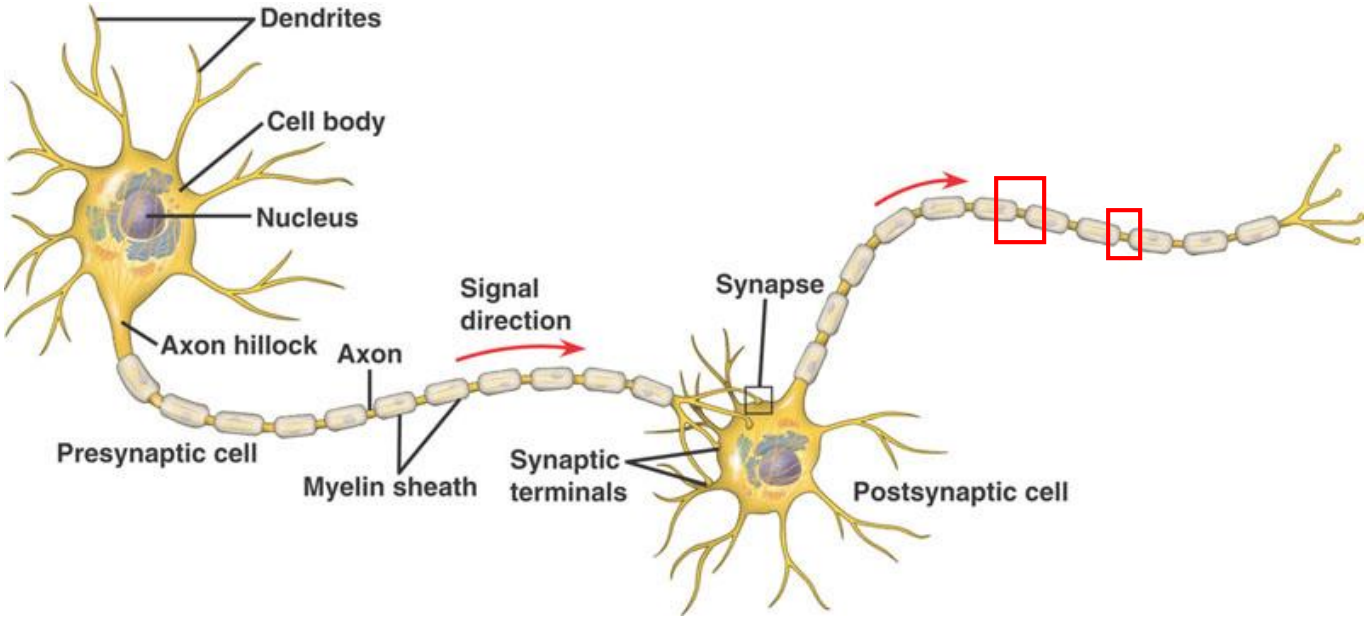
Structure of the Neuron

- **Myelin Sheath**
  - fatty tissue which insulates the axon; speeds up the neural impulse; made by glial cells



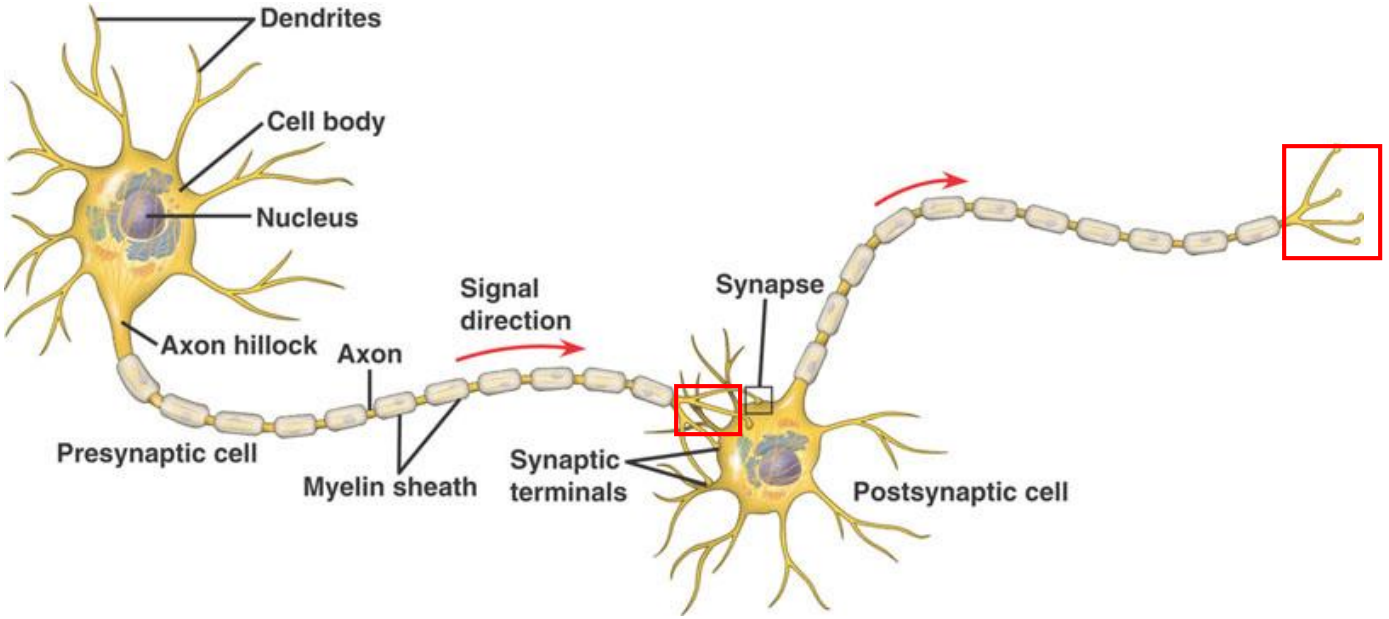
Structure of the Neuron

- **Nodes of Ranvier**
  - the spaces on the axon which are not covered by myelin; where ion flow occurs for depolarization



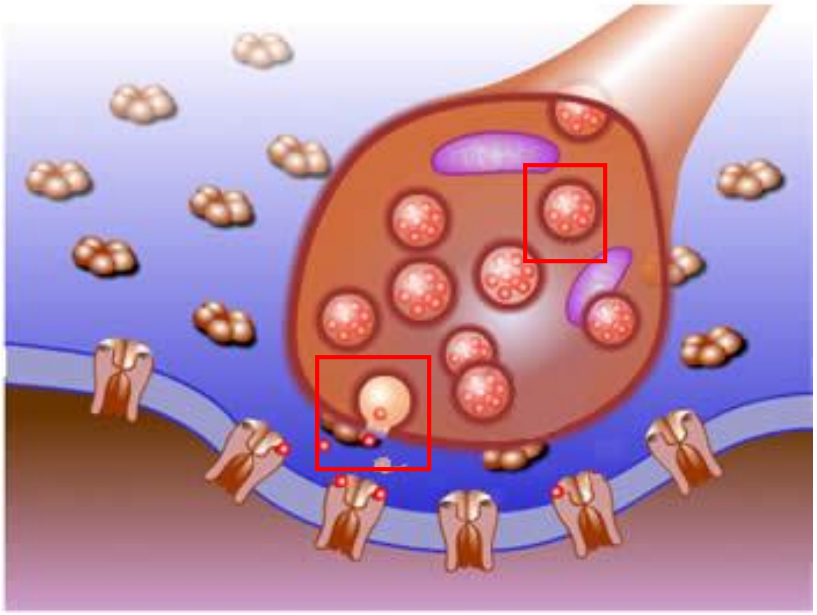
Structure of the Neuron

- **Axon Terminal/Terminal Button**
  - contains neurotransmitters which are released after depolarization and neural impulse



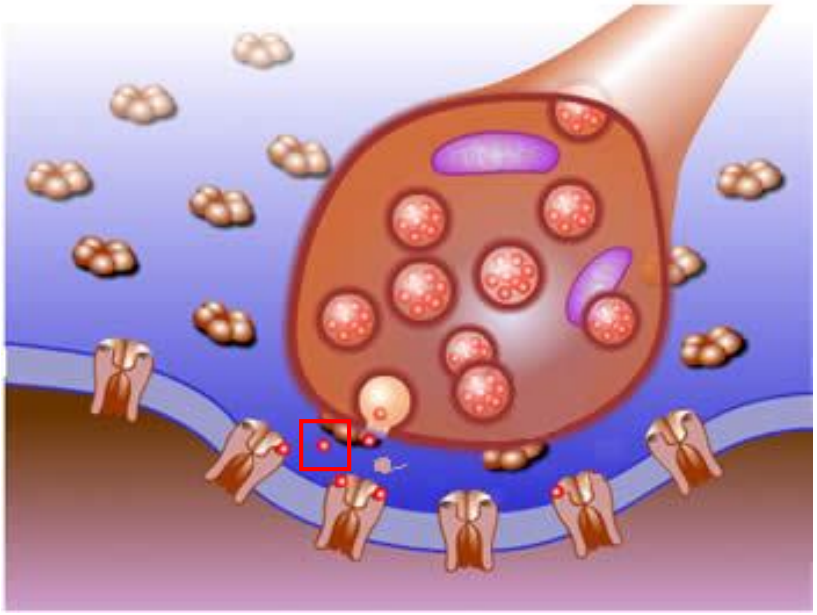
Structure of the Neuron

- **Vesicles**
  - contained within the axon terminals, these contain neurotransmitters, they surface and release neurotransmitters after depolarization



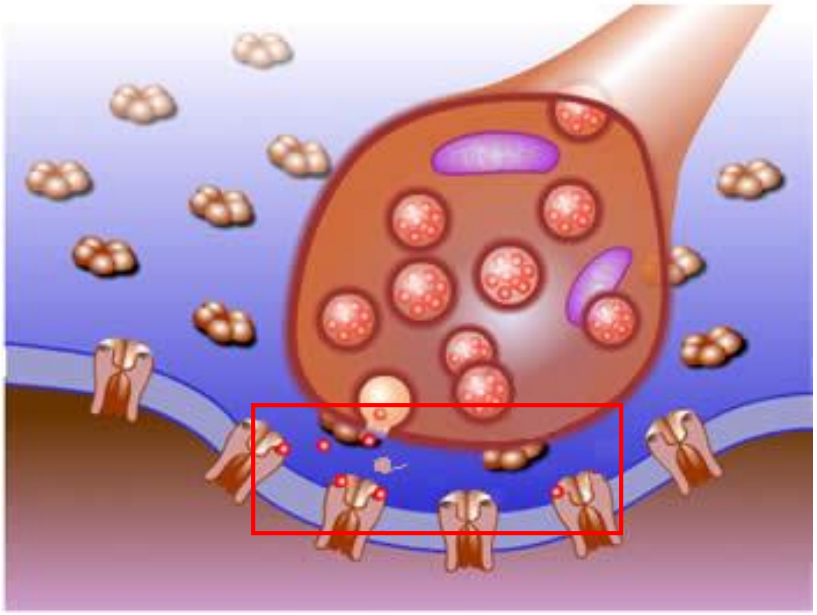
Structure of the Neuron

- **Neurotransmitters**
  - contained in the vesicles, and are released into the synapse to stimulate their respective receptor sites on the postsynaptic neuron



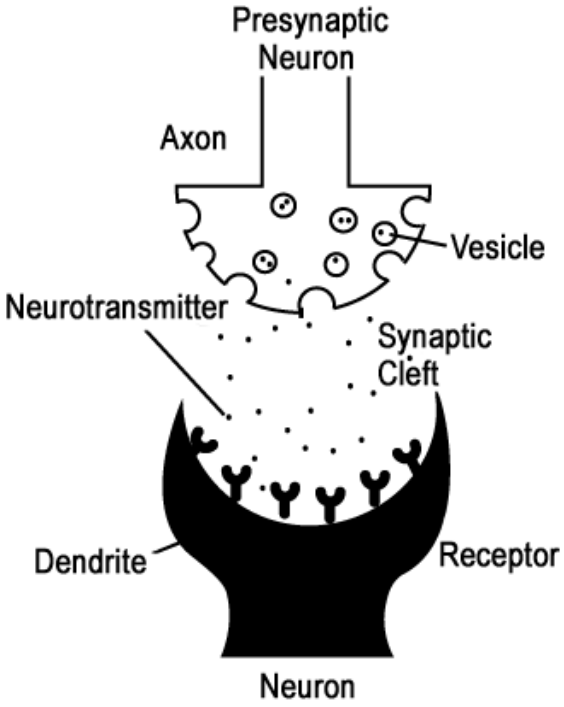
Structure of the Neuron

- **Synapse**
  - fluid-filled gap between terminal buttons of the presynaptic neuron and the dendrites of the postsynaptic neuron



Neurotransmitters

- **Excitatory vs. Inhibitory**
  - Excitatory: makes receiving neuron MORE likely to meet threshold and have an action potential
  - Inhibitory: makes receiving neuron LESS likely to meet threshold and have an action potential



Neurotransmitters

- **Serotonin**
  - Sleep and dreaming
  - Mood
  - Appetite
  - Sexual behavior
  - Related to Depression (too little)

Neurotransmitters

- **Acetylcholine (ACh)**
  - Learning
  - Memory
  - Voluntary motor activity
  - Related to Alzheimer's Disease (too little)

Neurotransmitters

- **Dopamine**
  - Involuntary motor activity
  - Reward pathway
  - Motivation
  - Cognition
  - Related to Schizophrenia (too much) and Parkinson's Disease (too little)

Neurotransmitters

- **Gamma-Aminobutyric Acid (GABA)**
  - The primary inhibitory neurotransmitter in the body
  - Related to anxiety and mood disorders (to little)

Neurotransmitters

- **Endorphins**
  - Body's natural painkiller
  - Pleasure
  - Lowered levels result from opiate use

Neurotransmitters

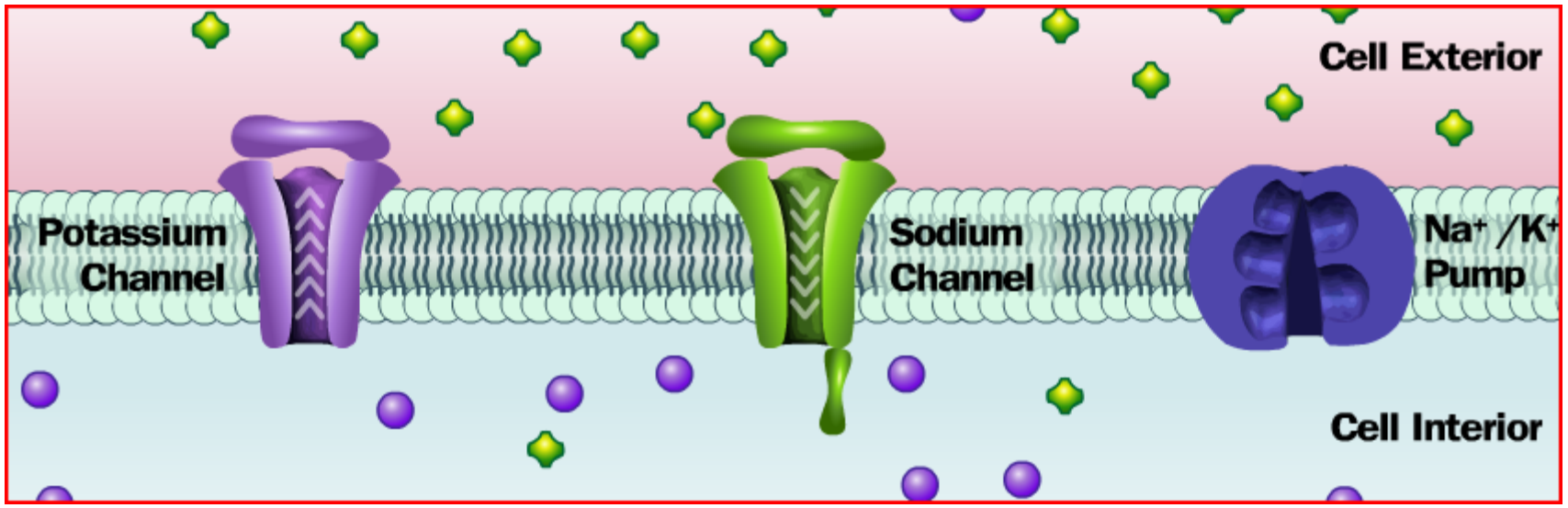
- **Glutamate**
  - The primary excitatory neurotransmitter in the body
  - Learning
  - Memory

Neurotransmitters

- **Noradrenaline**
  - Aka: Norepinephrine
  - Stress Response
  - Blood pressure
  - Heart rate
  - Also a hormone

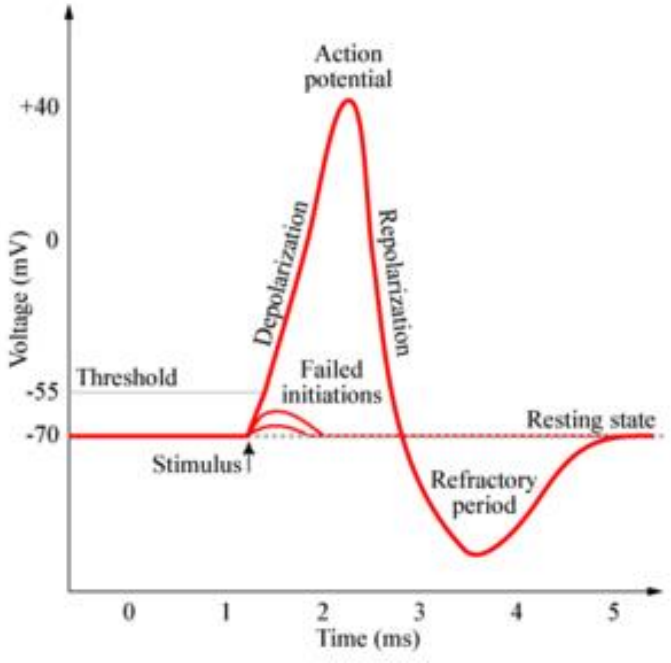
Synaptic Transmission

- **Resting Potential**
  - possible for the neuron to fire; axon has negative charge inside and outside is more positive; K^+ are on the inside of the axon, Na^+ is on the outside



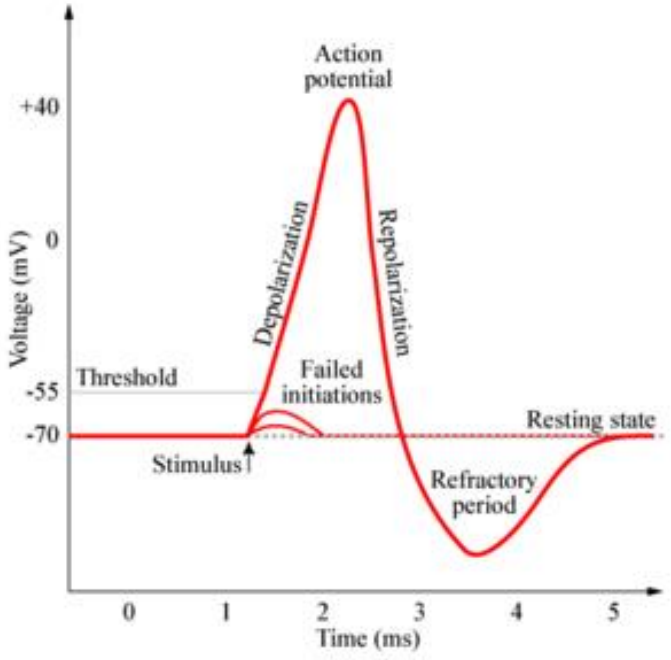
Synaptic Transmission

- **Action Potential**
  - change in potential across the neuron's membrane; the electrical impulse; depolarization of ions down the axon



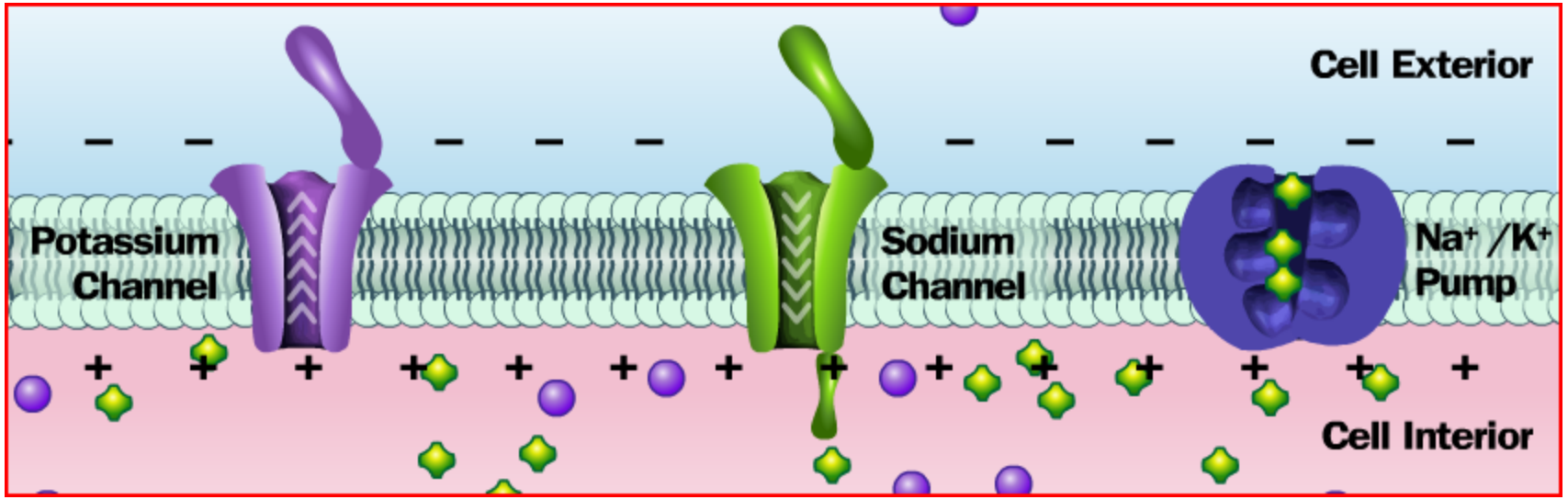
Synaptic Transmission

- **Threshold**
  - minimum stimulation required to trigger a neural impulse



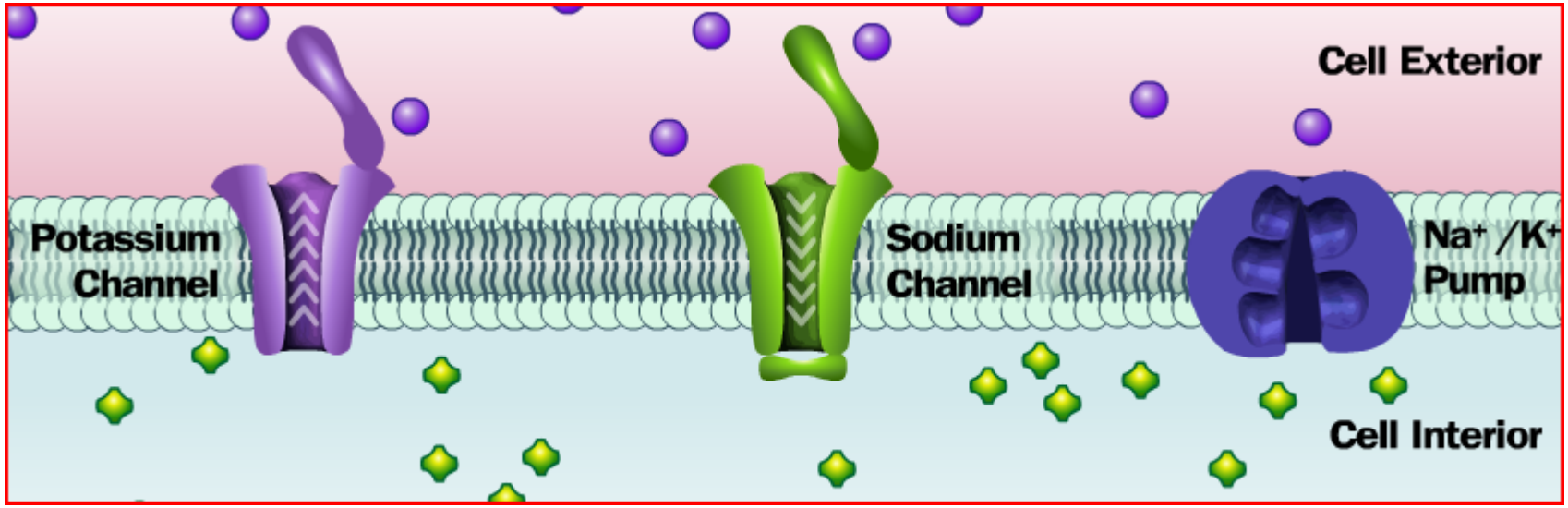
Synaptic Transmission

- **Depolarization**
  - Na^+ ions rush into the cell, changing the polarity on each side of the membrane, occurs on Nodes of Ranvier



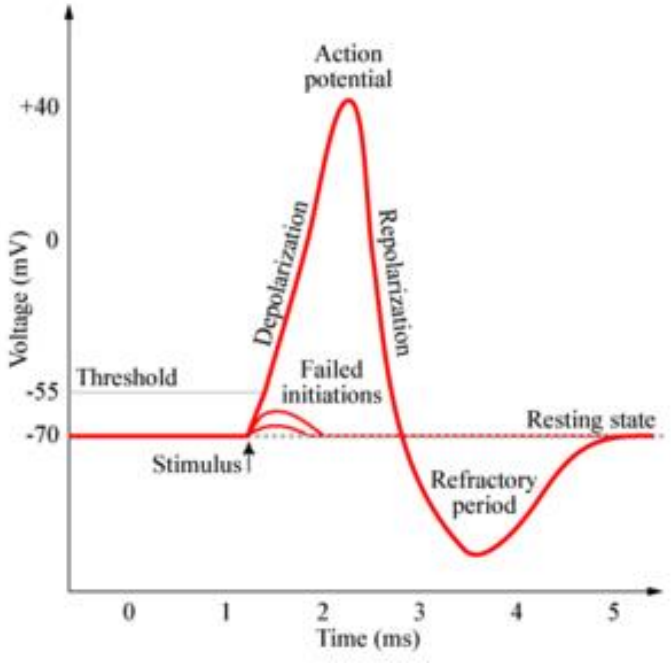
Synaptic Transmission

- **Repolarization**
  - after Na^+ ions have rushed into the cell, K^+ ions rush out of the cell to restore the balance and the original polarity



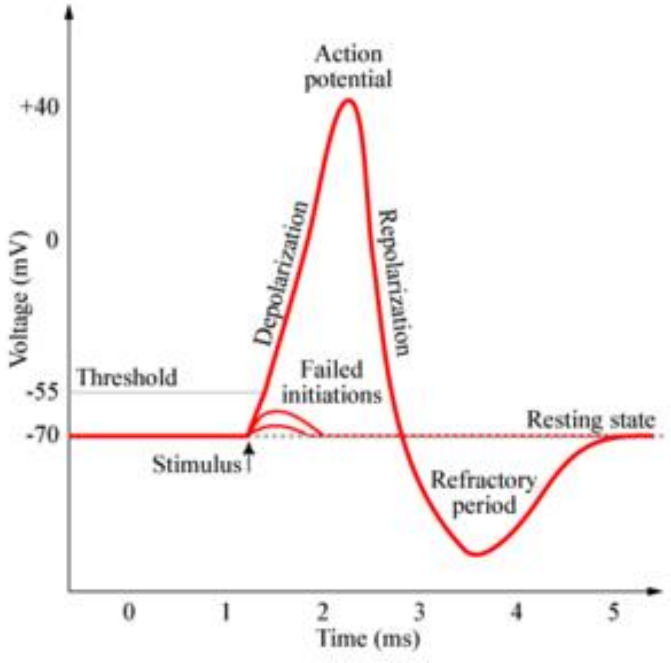
Synaptic Transmission

- **Refractory Period**
  - period in which the cell cannot fire while the Na^+ ions and the K^+ ions return to their original locations via Na^+/K^+ pumps



Synaptic Transmission

- **Hyperpolarization**
  - when axon is repolarizing, more K^+ ions leave the cell, causing the cell to become MORE negative than before it started



Synaptic Transmission

- **All-or-None Principle**
  - a neuron will fire with its full intensity or not at all

Synaptic Transmission

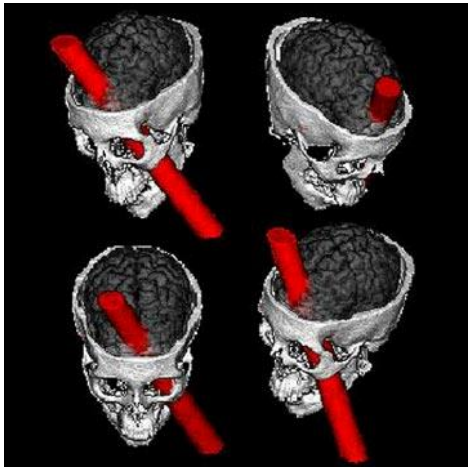
- **Electrochemical Reaction**
  - Electrical *within* the neuron (impulse)
  - Chemical *between* the neurons (neurotransmitters)

The Brain

- Examining the Brain
- Structures of the Brain
- Hemispheric Specialization

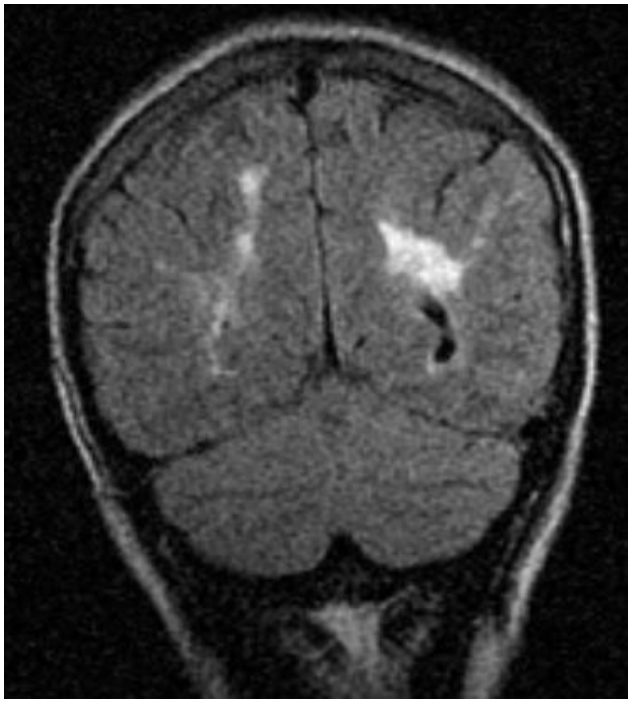
Studying the Brain

- **Accidents & Case Studies**
  - When people acquire some sort of brain damage, psychologists learn about the functions of the brain
  - Famous Example: Phineas Gage
    - Tamping rod flew through his frontal lobe
    - Frontal lobe research was furthered because of this new information



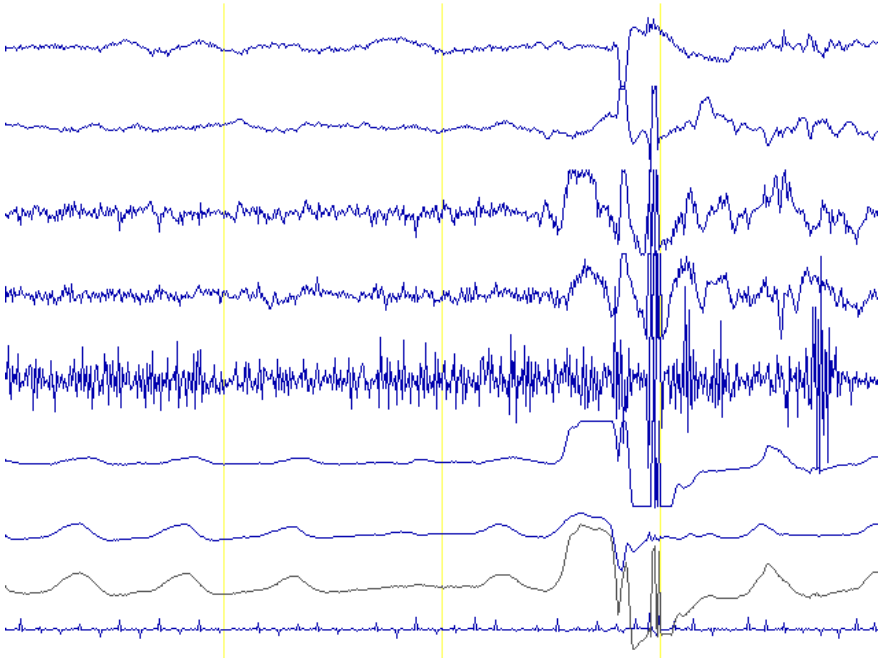
Studying the Brain

- **Lesions**
  - Destruction of brain tissue lets us know the function of that part of the brain
  - Accidental or purposeful



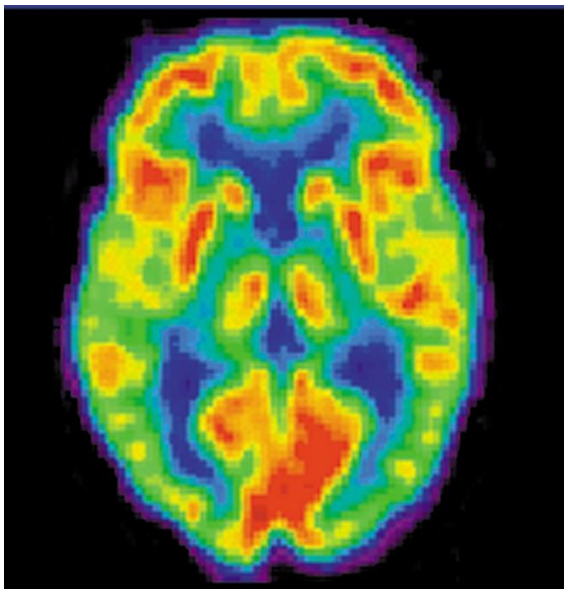
Studying the Brain

- **Electroencephalography (EEG)**
  - creates image of brain wave activity by eliciting evoked potentials
  - Function only



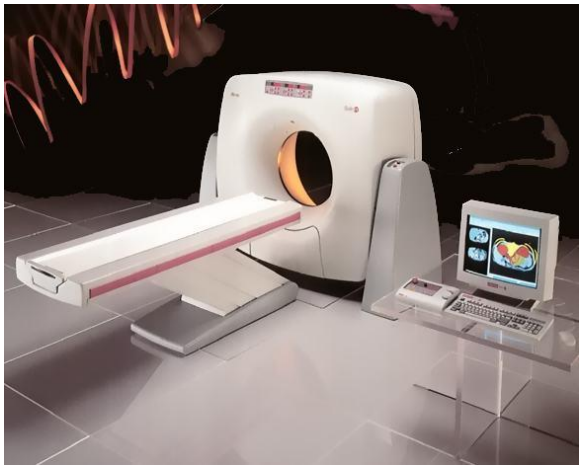
Studying the Brain

- **Positron Emission Tomography (PET)**
  - creates image which looks at glucose usage in the brain after injection of radioactive form of glucose
  - Function only



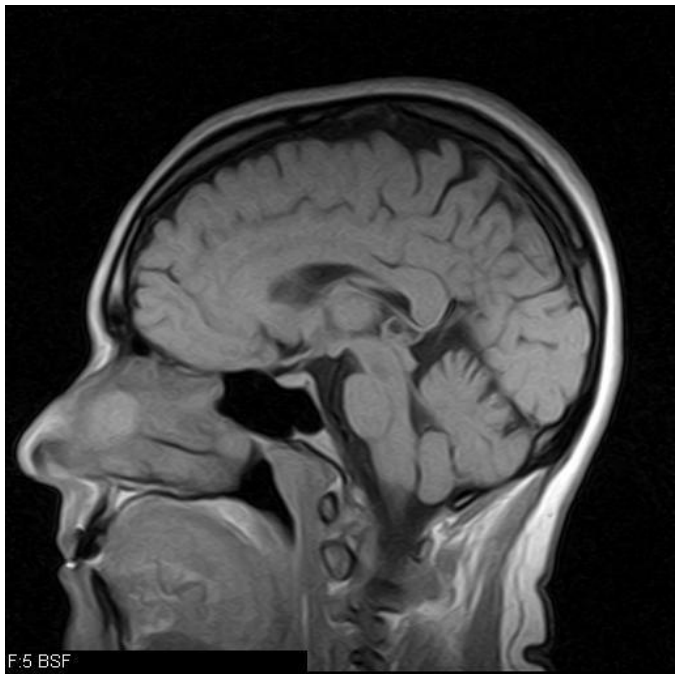
Studying the Brain

- **Computerized Axial Tomography (CAT/ CT)**
  - provides image of brain structure including soft tissue and bones; specialized type of x-ray
  - Structure only



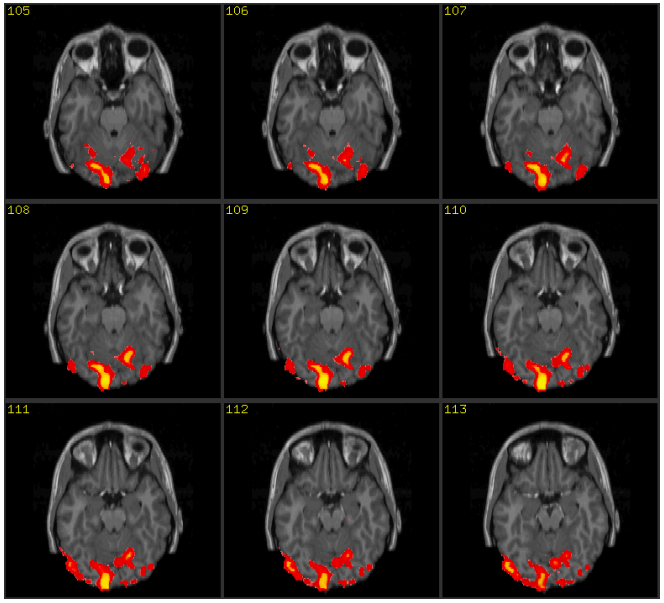
Examining the Brain

- **Magnetic Resonance Imaging (MRI)**
  - uses magnetic fields in order to examine structure of brain tissues
  - Structure only



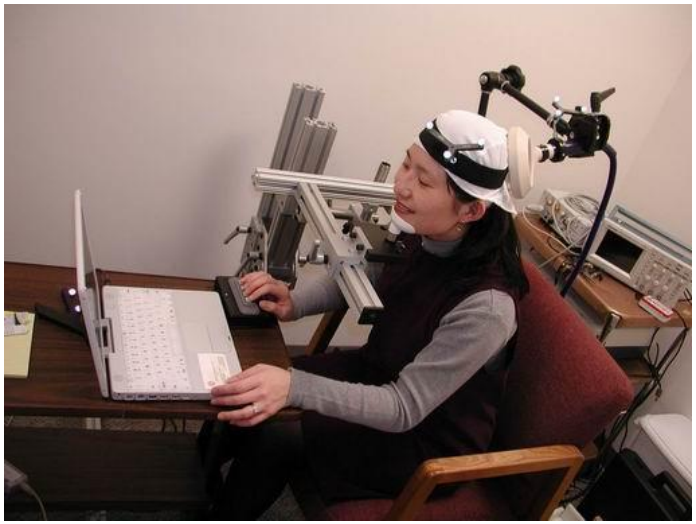
Examining the Brain

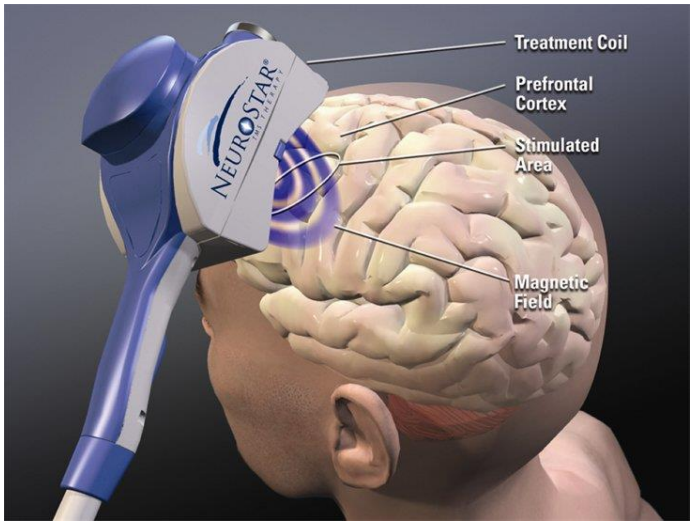
- **Functional Magnetic Resonance Imaging (fMRI)**
  - brain imaging technique which provides information about both structure and function



Examining the Brain

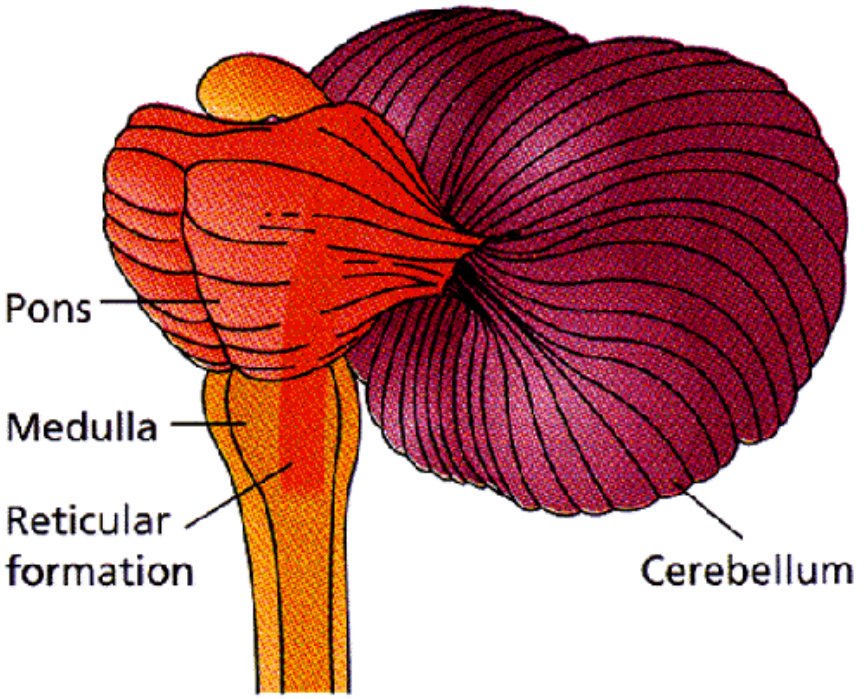
- **Transcranial Magnetic Stimulation (TMS)**
  - Stimulation of areas of the brain using magnetic field to influence activity of neurons (to depolarize or hyperpolarize)





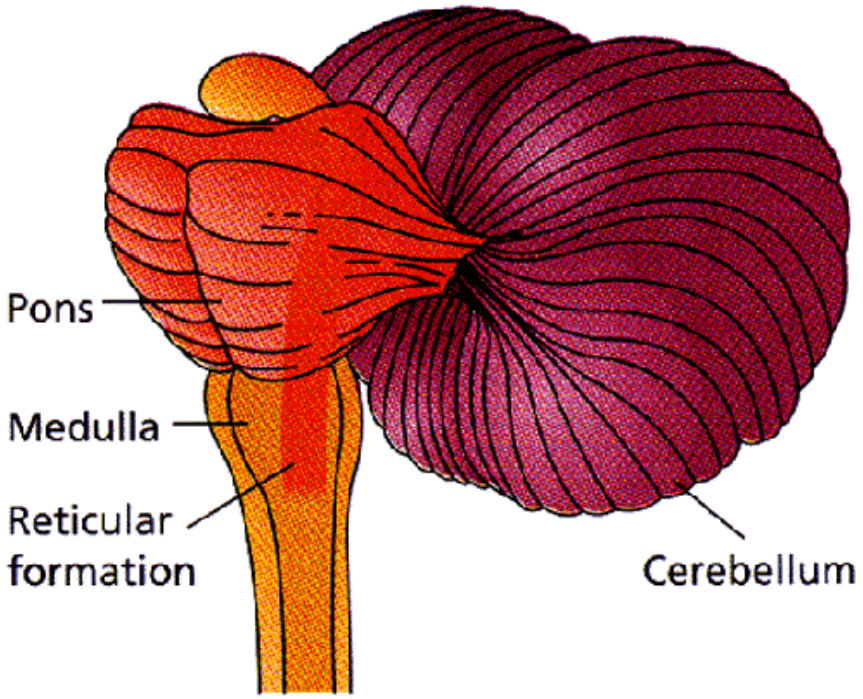
Structures of the Brain

- **Hindbrain**
  - Brainstem
    - Medulla
      - in charge of respiration, blood pressure, heart rate
    - Pons
      - helps relay sensory info., has a role in controlling arousal and dreaming
    - Reticular Formation
      - controls awareness and arousal



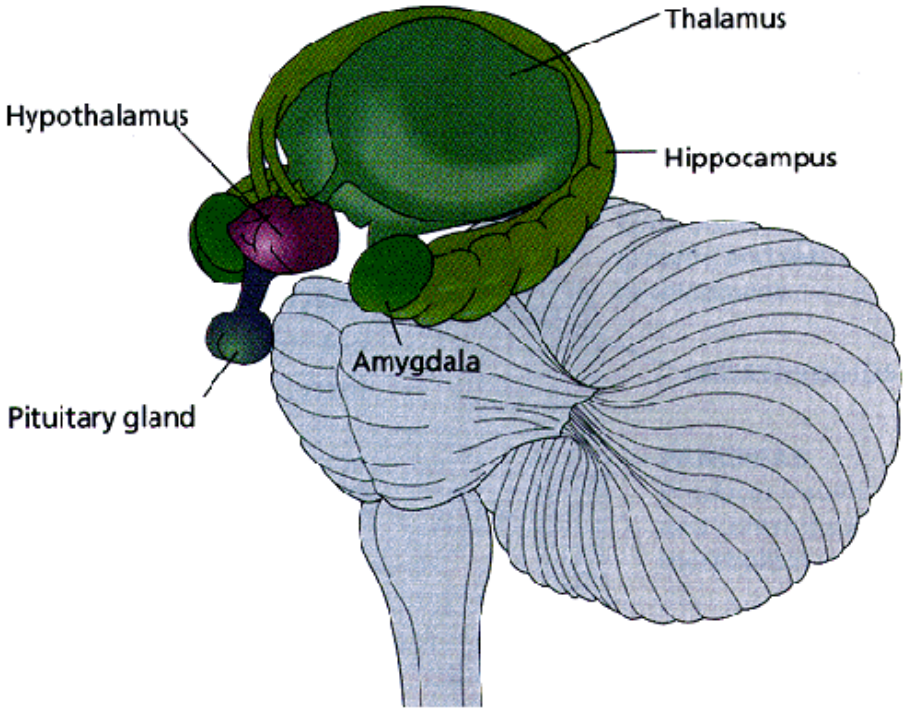
Structures of the Brain

- **Hindbrain**
  - Cerebellum
    - coordinates motor control and maintains balance and posture



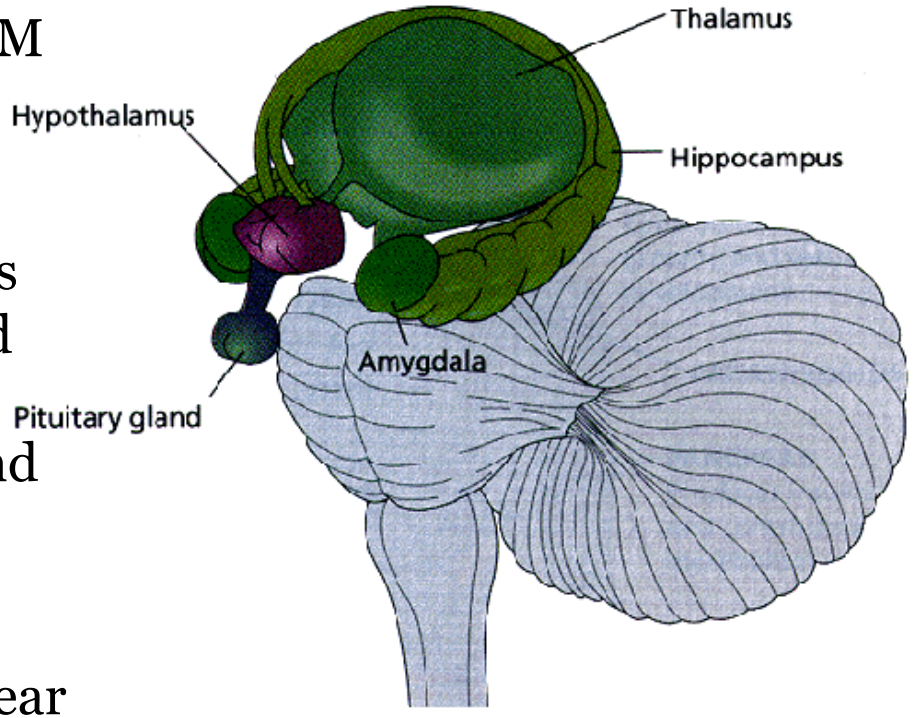
Structures of the Brain

- **Forebrain**
  - Thalamus
    - sensory switchboard of the brain for all senses except olfaction



Structures of the Brain

- **Forebrain**
  - Limbic System
    - Hippocampus
      - converts info from STM to LTM
    - Hypothalamus
      - homeostasis, regulates hunger and thirst, and sexual behavior, controls pituitary gland
    - Amygdala
      - role in emotions, especially anger and fear

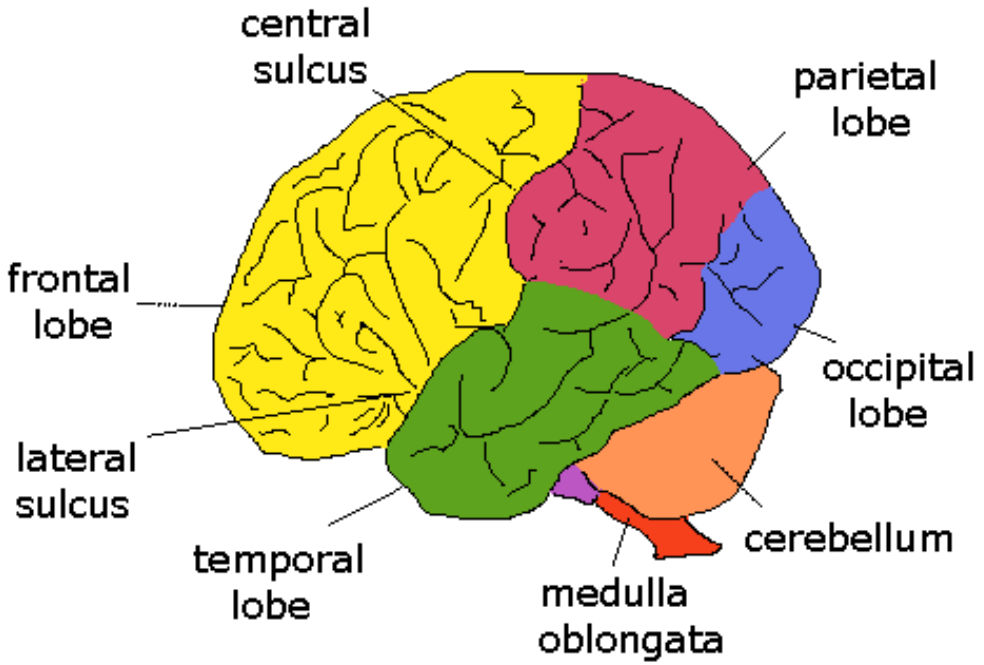


Structures of the Brain

- **Forebrain**
  - Cerebral Cortex - Association Areas
    - Frontal Lobe
      - personality, problem-solving, initiation, judgment, impulse & emotion control, speech (L)
    - Temporal Lobe
      - auditory perception, memory, facial recognition (R), language comprehension (L)
    - Parietal Lobe
      - spatial processing (R), math (L), sensory organization
    - Occipital Lobe
      - visual perception

Structures of the Brain

- **Forebrain**
  - Cerebral Cortex - Association Areas



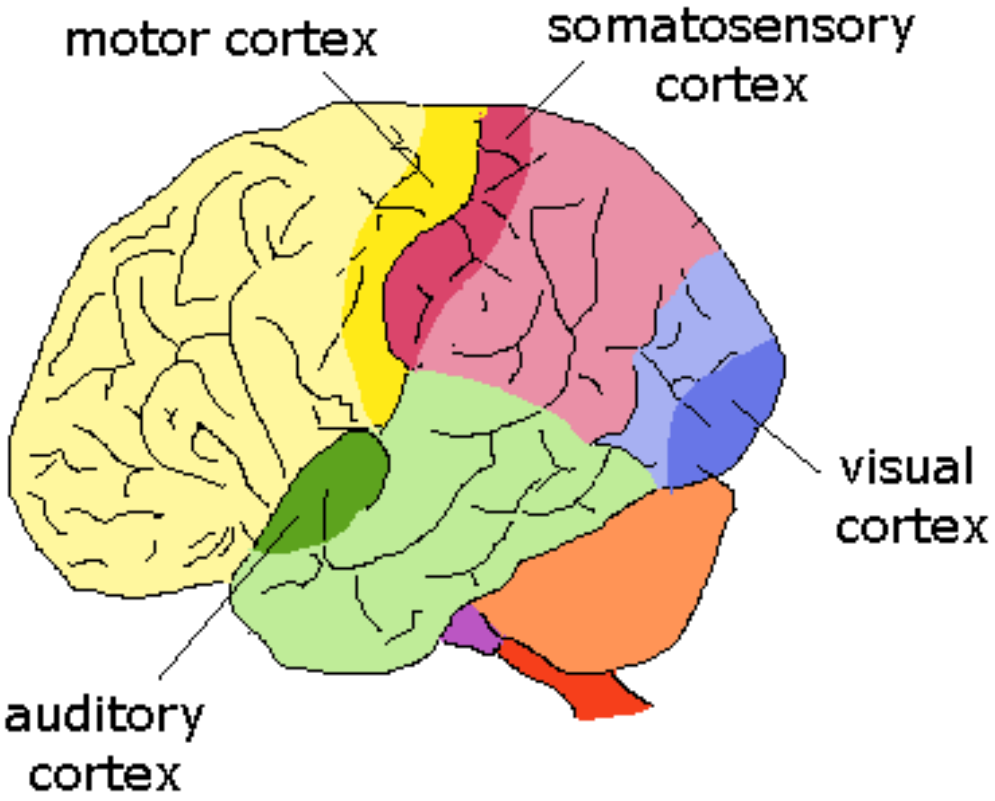
exterior of the cerebrum from the left side

Structures of the Brain

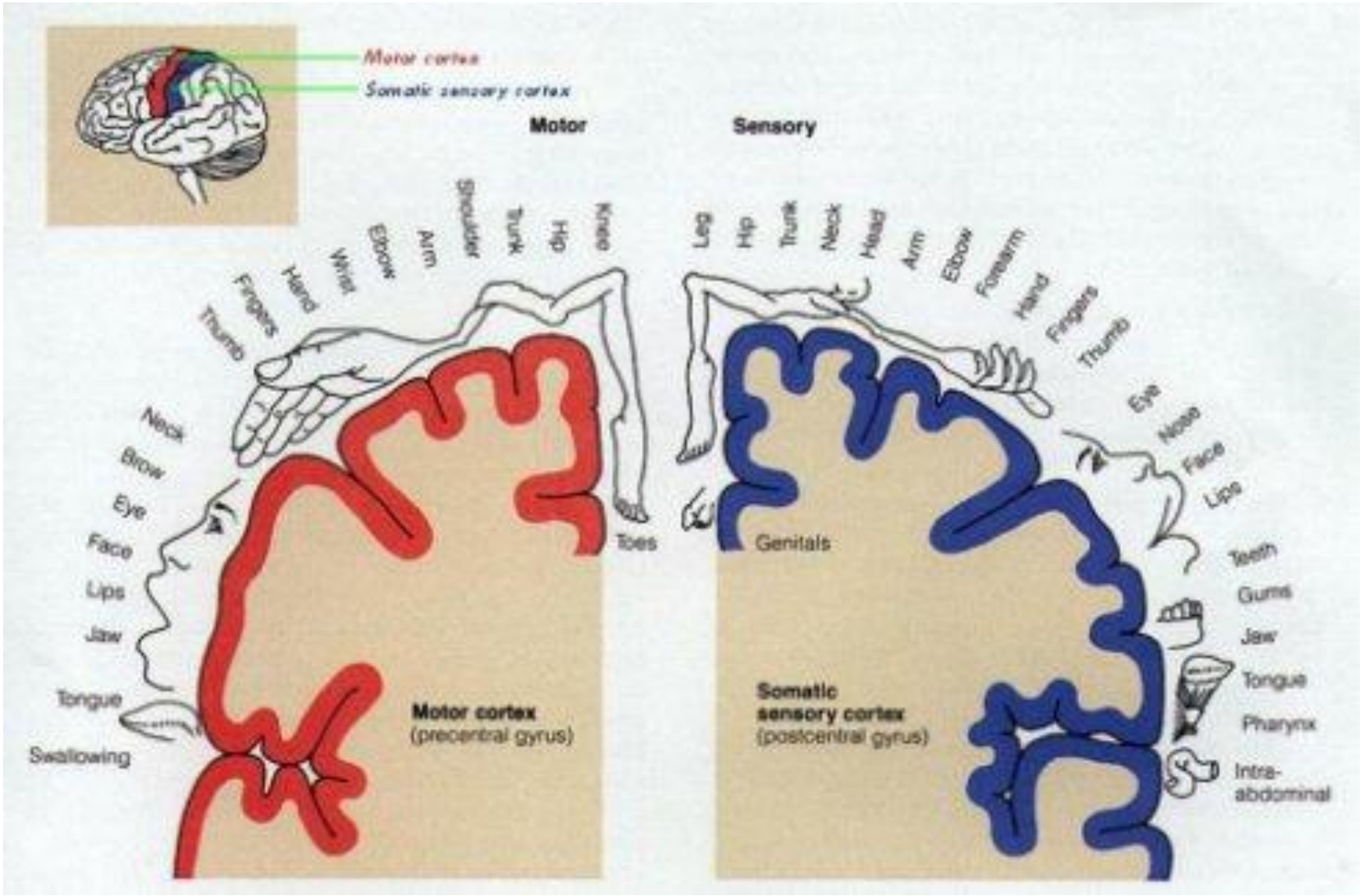
- **Forebrain**
  - Cerebral Cortex - Sensorimotor Areas
    - Motor Cortex
      - controls voluntary movement (frontal)
    - Somatosensory Cortex
      - skin sense, tactile sensation (parietal)
    - Visual Cortex
      - visual processing (occipital)
    - Auditory Cortex
      - Auditory processing (temporal)

Structures of the Brain

- **Forebrain**
  - Cerebral Cortex - Sensorimotor Areas



Structures of the Brain

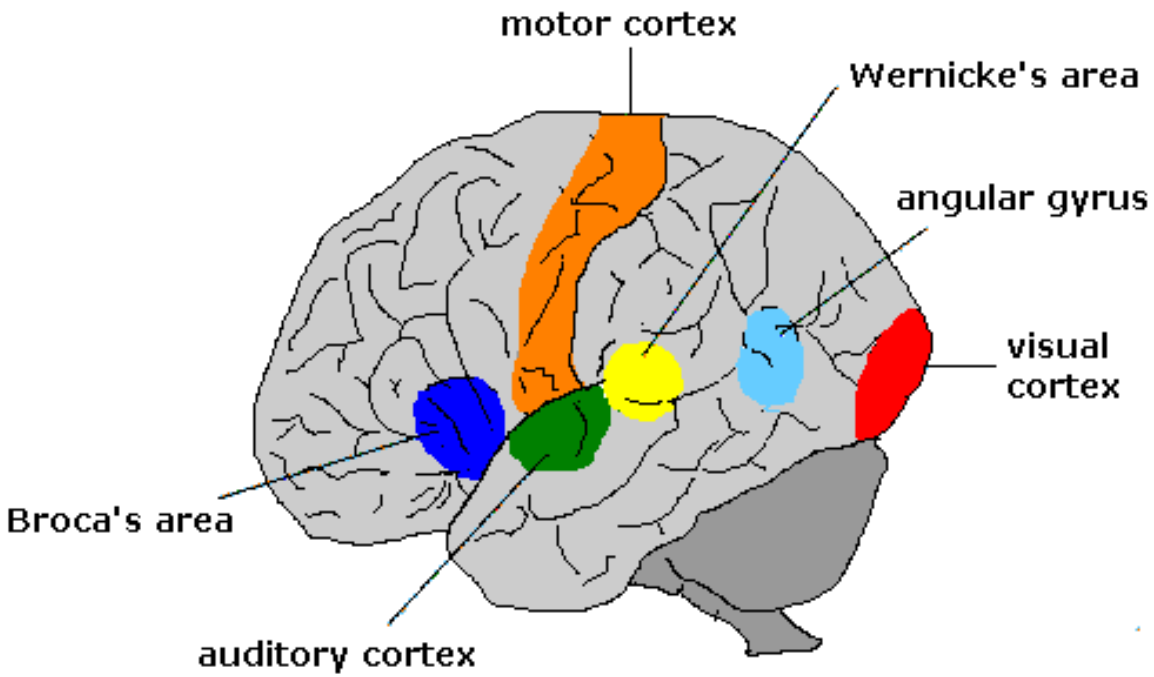


Structures of the Brain

- **Forebrain**
  - Cerebral Cortex – Language Areas
    - Broca's Area
      - part of the frontal lobe on left side; controls the ability to form words
    - Wernicke's Area
      - part of the temporal lobe on left side; controls the ability to comprehend language
    - Angular Gyrus
      - related to reading, turns visual symbols to auditory code
  - Aphasia
    - damage to area responsible for language

Structures of the Brain

- **Forebrain**
  - Cerebral Cortex – Language Areas



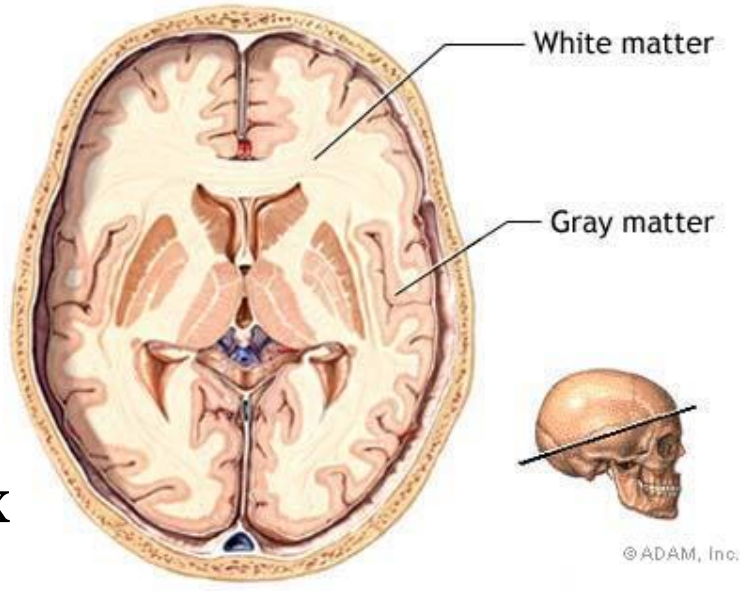
Speech Areas

Structures of the Brain

- **Gyri vs. Sulci**
  - Gyrus
    - peak in cerebral cortex
  - Sulcus
    - valley of cerebral cortex
  - Wrinkles provide more surface area for cerebral cortex

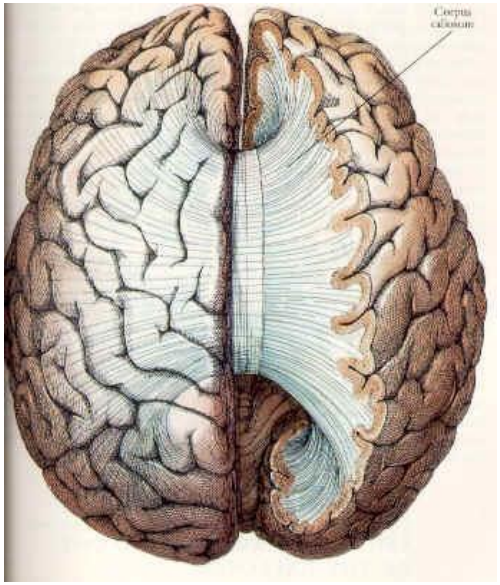
Structures of the Brain

- **White vs. Grey Matter**
  - White Matter
    - neural tissue containing mostly myelinated axons
    - relays info. to cerebral cortex
  - Grey Matter
    - closely packed neuron cell bodies on the surface of the brain



The Brain

- **Corpus Callosum**
  - White matter structure which connects left and right hemispheres
  - Allows communication between hemispheres



Hemispheric Specialization

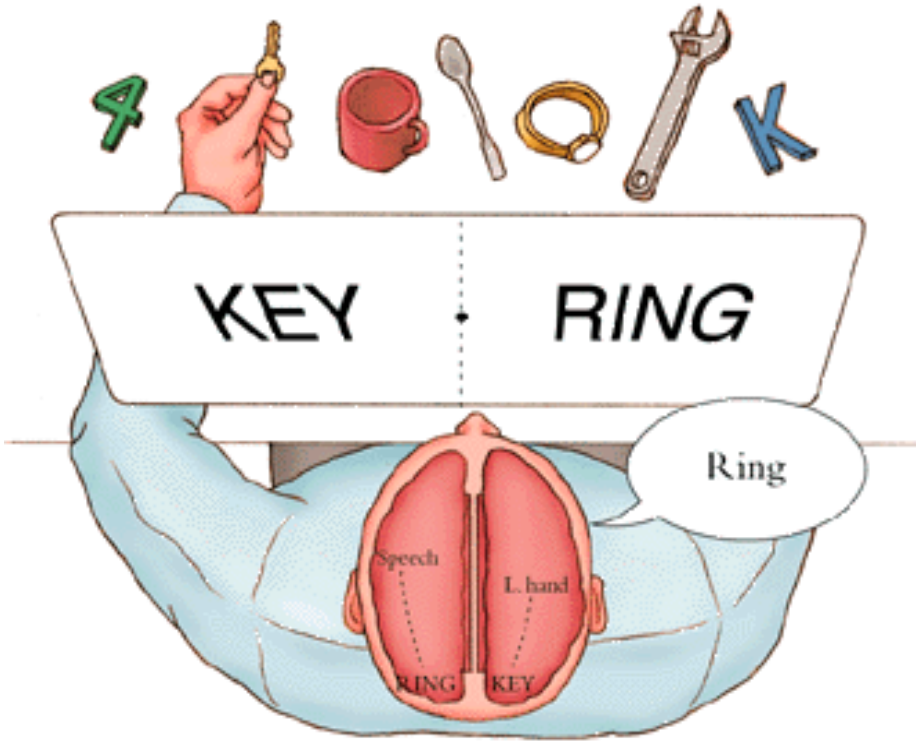
- Longitudinal Fissure
  - separates left and right hemispheres
- Contralaterality
  - one side of brain controls the other side of the brain

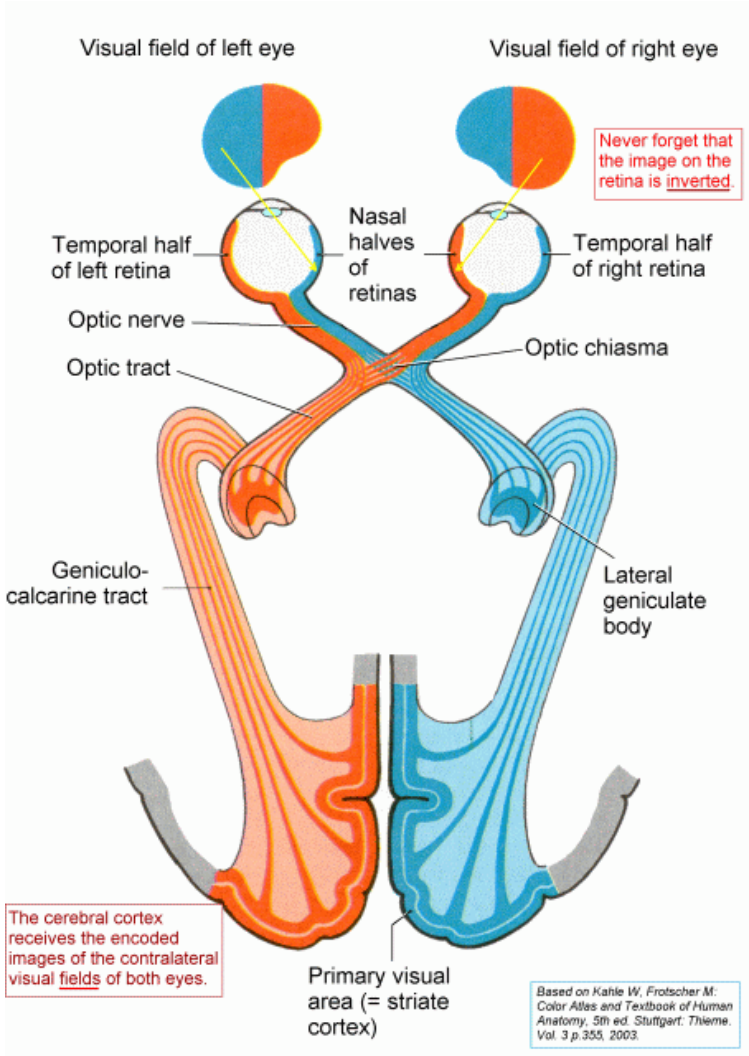
Hemispheric Specialization

- **Left vs. Right Brain**
  - Left
    - analytical, speech (frontal), language comprehension (temporal), sequential, logical, interprets what is in right visual field (occipital), controls right side of body
  - Right
    - intuitive, holistic, language emphasis, facial recognition (temporal), spatial interpretation (Parietal), creativity, art, music appreciation, interprets what is in left visual field (occipital), controls left side of body

Hemispheric Specialization

- **Split Brain Research**
  - Michael Gazzaniga & Roger Sperry's Research





The Brain

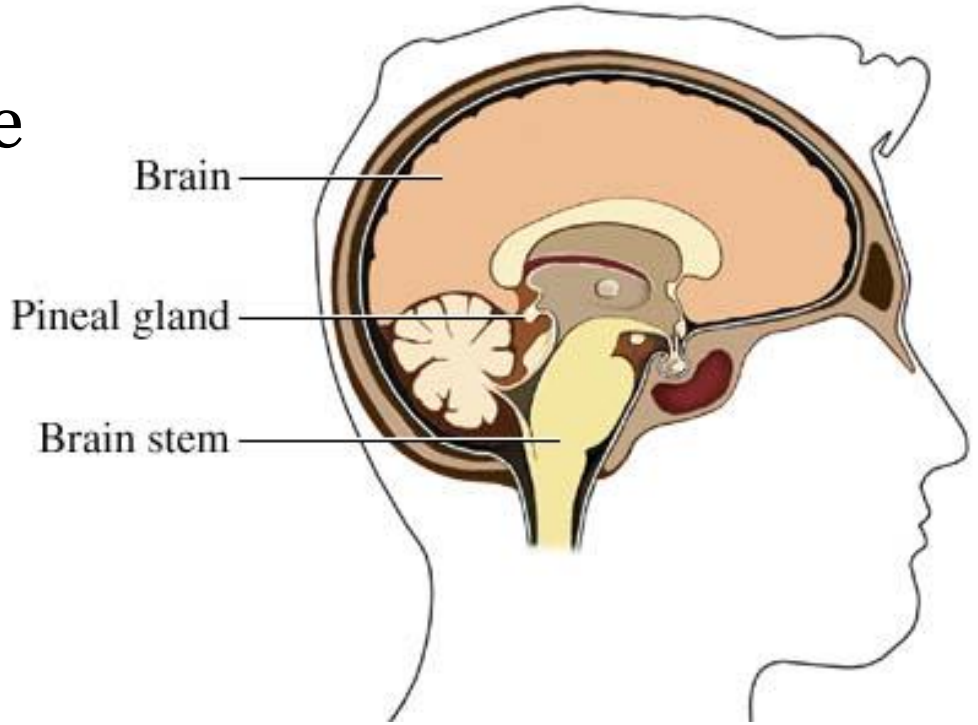
- **Brain Plasticity**
  - Ability for brain to make up for damage by having neurons of brain take on functions of damaged areas
  - Age-dependent (doesn't occur as well in older brains)

Endocrine System

- Glands
- Hormones

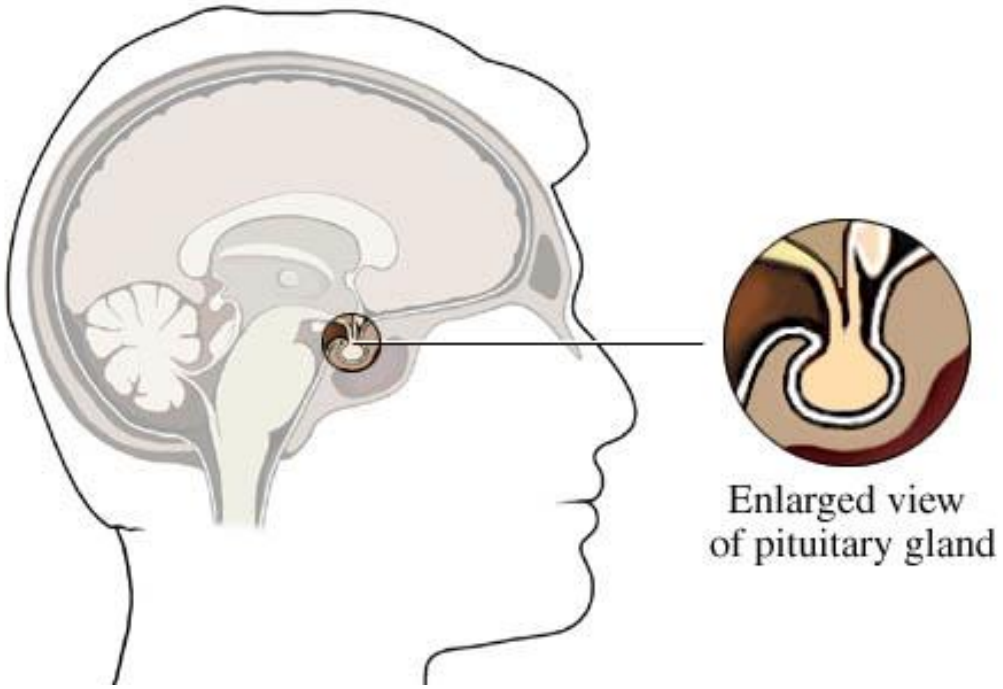
Glands

- **Pineal Gland**
  - Produces melatonin (according to lightness or darkness of environment)
  - Helps modulate sleep/wake cycle



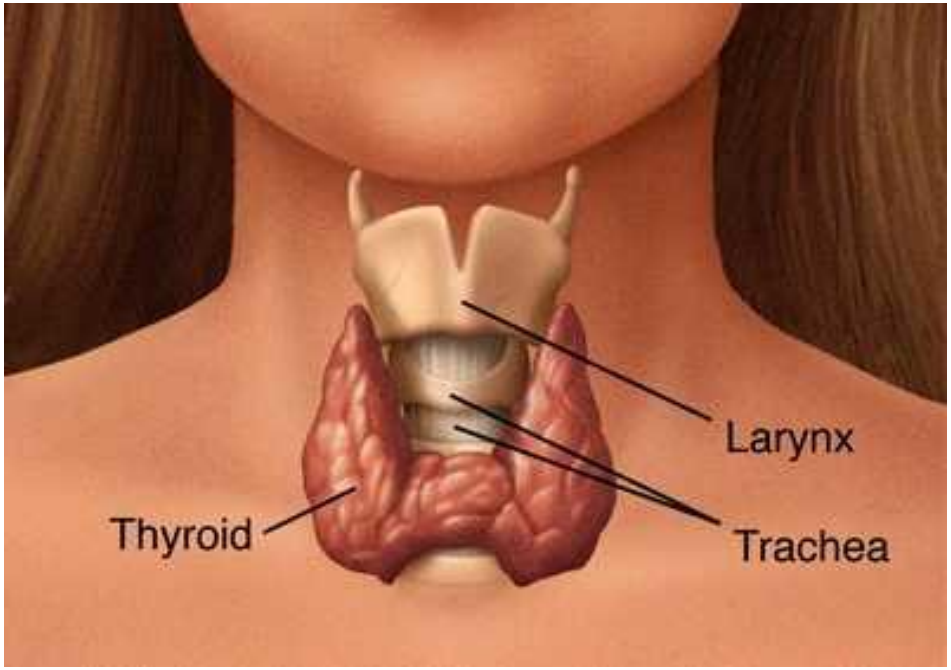
Glands

- **Pituitary Gland**
  - Produces Human Growth Hormone (HGH)
  - Regulates homeostasis
  - Regulates sexual development & functioning
  - Contributes to physical growth
  - Regulates water in the body



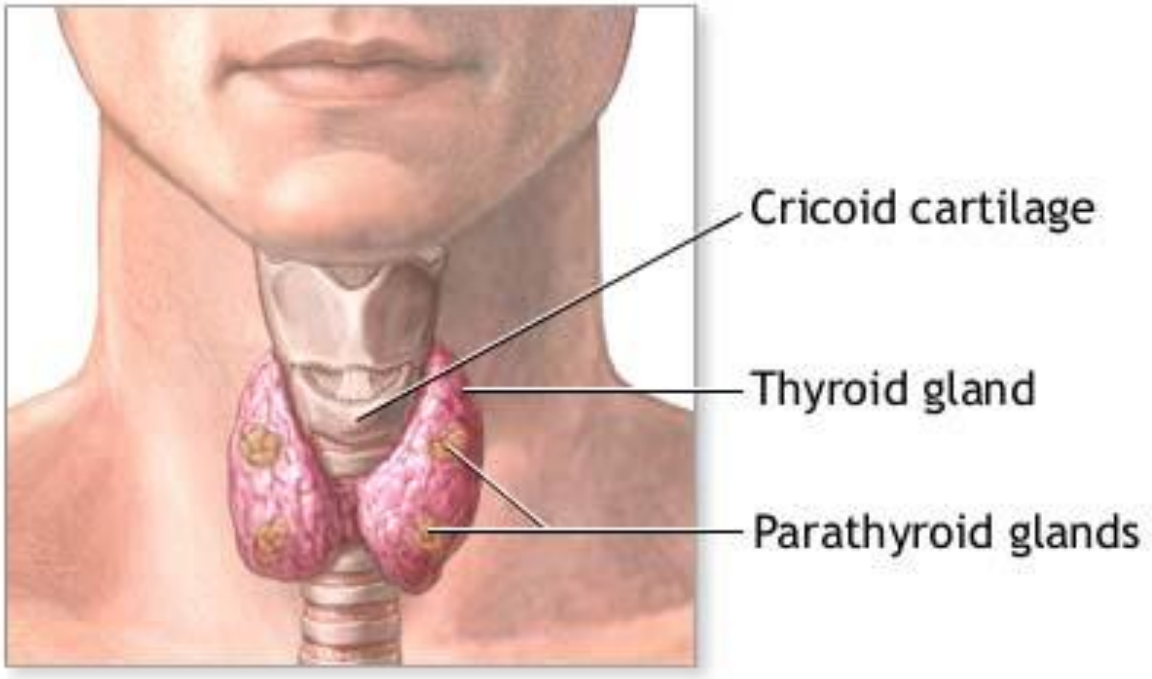
Glands

- **Thyroid Gland**
  - Produces Thyroxine
  - Controls metabolism



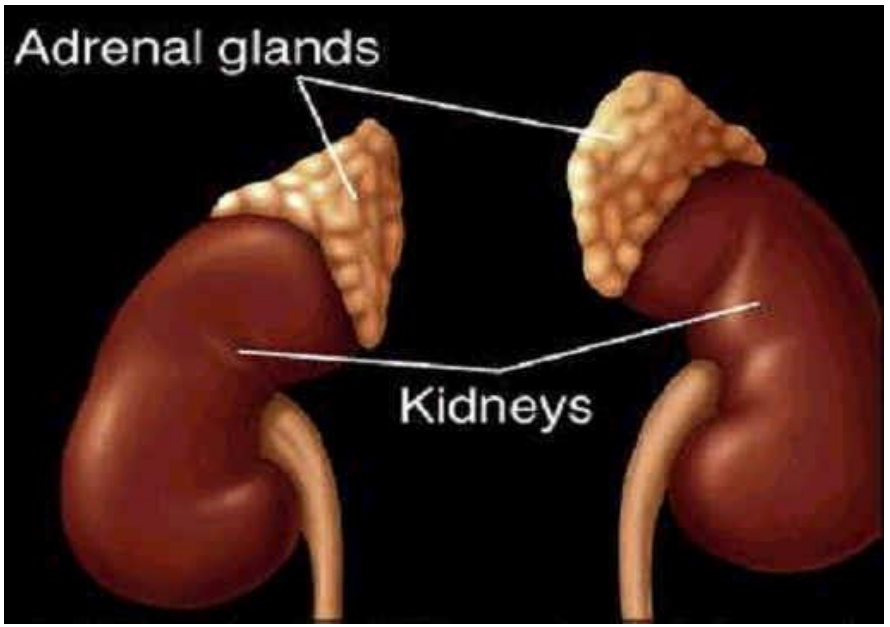
Glands

- **Parathyroid Glands**
  - Regulate calcium levels in the body (remember, calcium is necessary for neurons to fire)



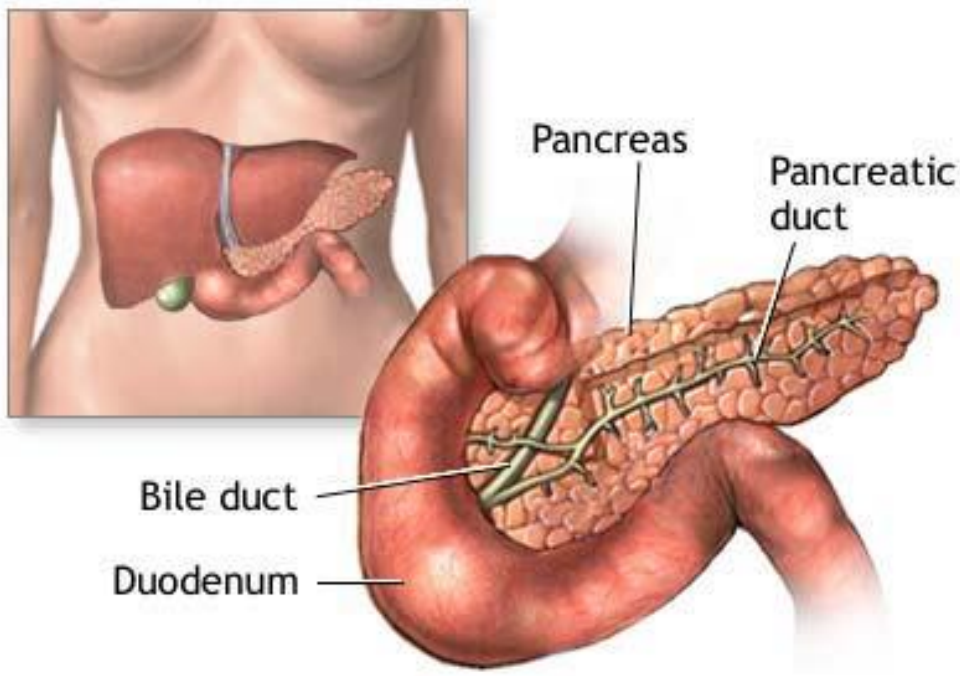
Glands

- **Adrenal Glands**
  - Produce noradrenaline, adrenaline and cortisol
  - Regulate responses to stress and “fight or flight”



Glands

- **Pancreas**
  - Produces insulin and glucagon
  - Regulates blood glucose level
  - Aids in digestion



Glands

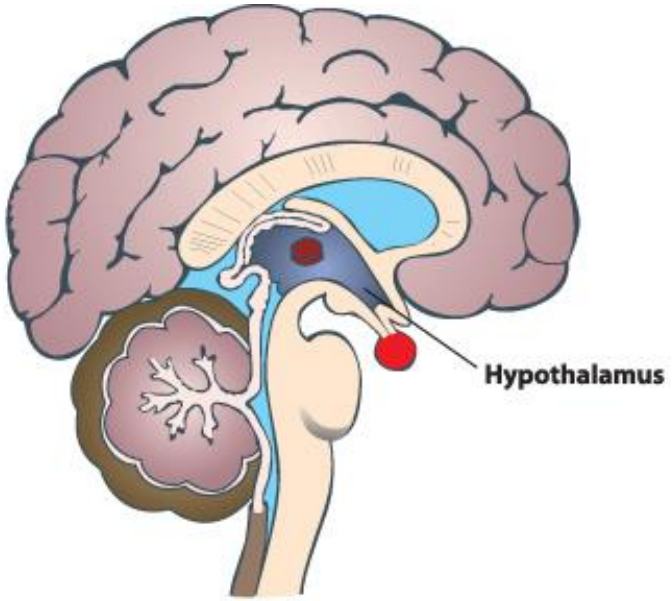
- **Ovaries**
  - Produce estrogen and progesterone
  - Produce ova (eggs) for reproduction
  - In charge of the production of secondary sex characteristics (i.e. breasts, hips)
  - The female counterpart of the testes (male gonads)

Glands

- **Testes**
  - Produce testosterone
  - Produce sperm for reproduction
  - In charge of the production of secondary sex characteristics (i.e. facial hair, deep voice)
  - The male counterpart of the ovaries (female gonads)

Glands

- **Hypothalamus**
  - Controls pituitary gland
  - Secretes hormones related to hunger
  - Link between the endocrine & nervous systems

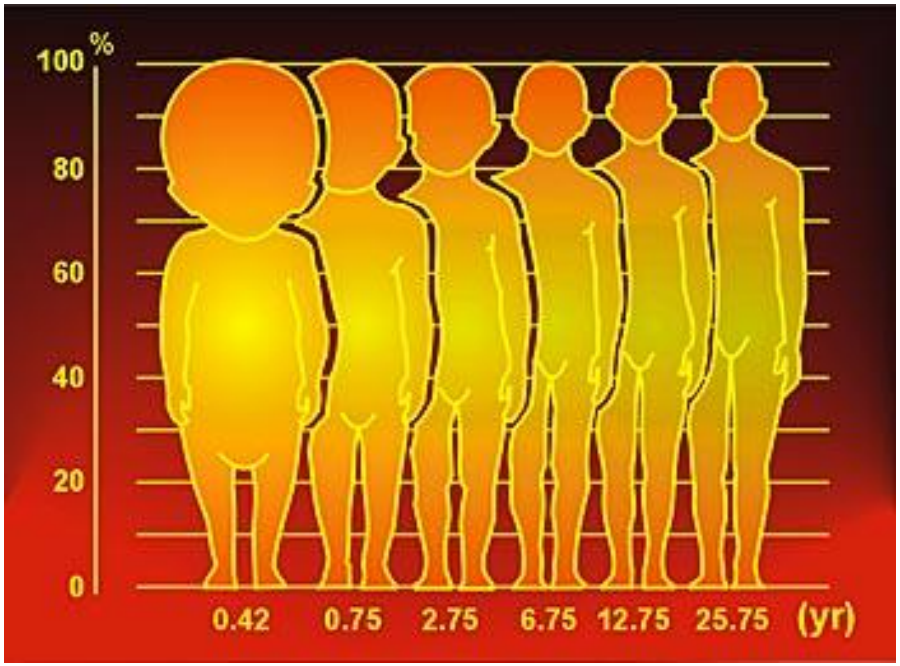


Hormones

- **Melatonin**
  - Produced by the pineal gland
  - Helps control sleep/wake cycle
  - Production is inhibited by light and facilitated by dark

Hormones

- **Human Growth Hormone (HGH)**
  - Produced by the pituitary gland
  - Stimulates growth and cell reproduction



Hormones

- **Adrenaline**
  - Aka epinephrine
  - Produced by the adrenal glands
  - Plays role in stress reactions & “fight or flight”
  - Pumps body up (Sympathetic NS activity)

Hormones

- **Noradrenaline**
  - Aka norepinephrine
  - Produced by the adrenal glands
  - Plays role in stress reactions & “fight or flight”
  - Pumps body up (Sympathetic NS activity)
  - Also a neurotransmitter

Hormones

- **Cortisol**
  - Produced by the adrenals
  - Released in stressful situations
  - Involved in “fight or flight” response

Hormones

- **Insulin**
  - Produced in the pancreas
  - Regulates glucose metabolism and blood glucose levels
  - Released when blood glucose is elevated, decreases glucose level

Hormones

- **Glucagon**
  - Produced in the pancreas
  - Released when blood glucose is low, increases glucose level

Hormones

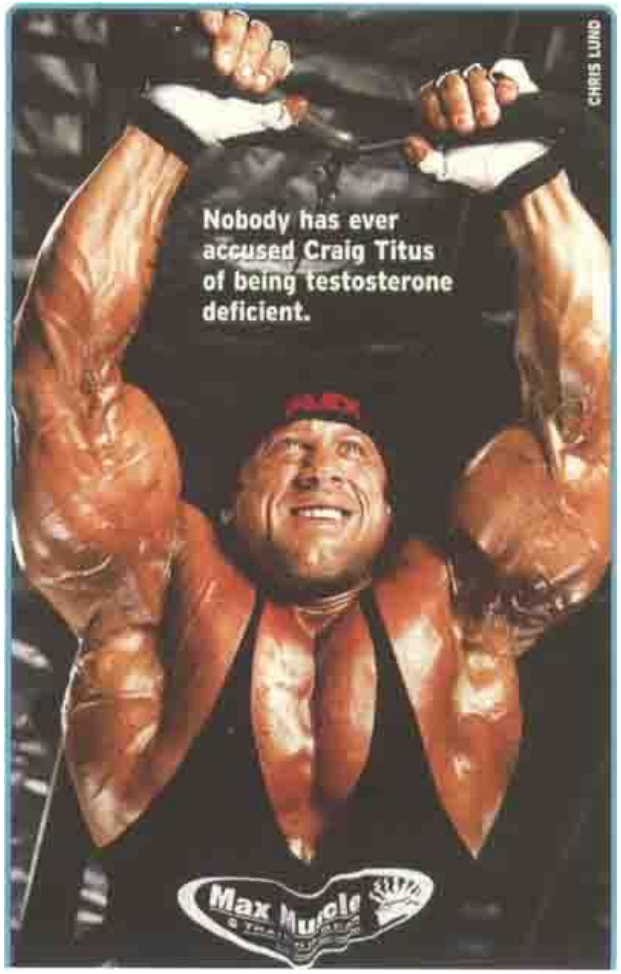
- **Estrogen**
  - Produced by ovaries
  - Primary female sex hormone
  - Aids in sexual development and functioning

Hormones

- **Progesterone**
  - Produced by ovaries
  - Involved with menstrual cycle and pregnancy

Hormones

- **Testosterone**
  - Produced by the testes
  - Primary male sex hormone
  - Aids in sexual development and functioning
  - Linked to aggression



Hormones

- **Thyroxine**
  - Produced in thyroid
  - Controls rate of bodily metabolic processes