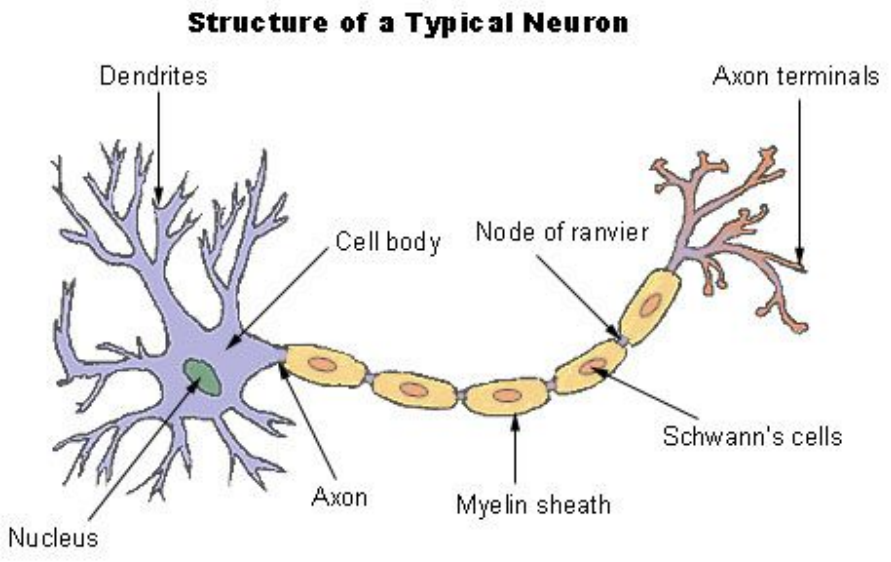
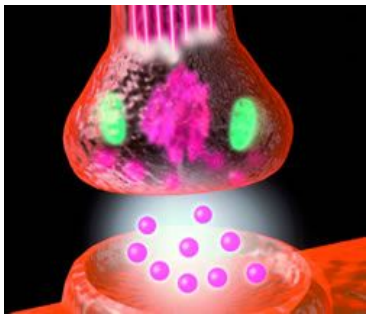
Part II: Neuroscience

- Units of the nervous system
    - Neurons – Nerve cells throughout the body that connect to one another, allowing for communication
        - Majority in brain
        - Range from less than a millimeter to over a meter
        - Nerve is a bundle of neurons



        - 3 Parts of a neuron
            - Cell Body
                - Produces energy that fuels/nourishes the cell
            - Dendrites
                - Extensions of the cell body that receive messages and send them to the cell body
            - Axon
                - An extension away from the cell body that carries messages away
                    - Myelin Sheath – Insulation or covering of axon that aids in speed of transmission
                        - As we age: Thickness decreases and neural transmission shows
                        - Multiple sclerosis – Disease that affects the myelin sheath
        - Neural Transmission – "All-or-Nothing Principle"

- When the neural message is transmitted from one end of the neuron to the other end
- All-or-None = Intensity of neural transmission as strong when a message stops as when it starts



Synaptic Transmission

- Transmission from one neuron to the next
- From axon of one to dendrites of another
- There is a space between axon of one neuron and dendrites of another
    - Synapse
    - Synaptic Gap
        - Synaptic Vesicle – Stores neurotransmitters
        - Neurotransmitters –Chemical substances that allow for communication to take place across the synaptic gap
        - Receptor site – Located on membrane of the next neuron and receive neurotransmitter during synaptic transmission
- <u>Selected Neurotransmitters</u>
    - Acetylcholine
        - Contracts body's large muscles
        - Associated with the wakefulness of the brain in terms of memory functioning
    - Dopamine
        - One set involved in large muscle movements
        - Second set more specifically associated with pleasure and neural systems
            - Often associated with drug use
    - Serotonin
        - Relation between serotonin and sleep levels
        - Also associated with appetite
        - Associated with anxiety and depression
    - Norepinephrine
        - Plays greatest role in attention
        - Sudden fear, etc
    - Glutamate
        - Very associated with cognition
        - Allows brain to continue to grow

- Divisions of the nervous system
    - Central Nervous System – Consists of the brain and the spinal cord
    - Afferent Neurons – (Sometimes referred to as sensory neurons) transmit messages from the peripheral to the central nervous system

    - Efferent Neurons (Motor Neurons) – Transmit messages away from central nervous system
    - Spinal Reflexes – When spinal cord initially interprets incoming info and sends out a response
        - Touch something too hot
        - Knee jerk
- Peripheral Nervous System – Everything outside of central nervous system
    - Basic duty is to send/receive messages to/from the spinal cord and brain
    - Divisions of Peripheral
        - Somatic Nervous System
            - Transmits Sensory information to the central nervous system
            - Allows body to react based on information
        - Autonomic Nervous System
            - The system psychologists most interested in outside of the brain
            - Regulates the body's vital functions
            - Emotions (Anxiety, Fear)
        - Divisions of Autonomic
            - Sympathetic Nervous System
                - Fight-or-flight system
                - Prepares body to deal with/respond to stress
                - Increases the vitals
                - Things sympathetic nervous system activates/inhibits
                    - Opens pupils to be more focused
                    - Decreases salivation (digestion inhibited)
                    - Speeding of heart rate
                    - Opening of lung passageways
                    - Releases glycogen (sugar) from liver
                    - Stimulates adrenal glands
                    - Inhibits contraction of urinary bladder
                    - Increases muscle tension
            - Parasympathetic Nervous system
                - Restores body to normal after sympathetic response
                - Decreases vitals
                - Stores/conserves energy for when it becomes necessary in sympathetic responses
- Structures and functions of the Brain
    - A lot of unknowns
    - Images of the brain at work
        - Electroencephalogram (EEG)
            - Records and monitors electrical activity of the brain
            - Most used for studying sleep patterns

        - Seizures diagnosed with EEG
    - Positron Emission Tomography (PET)
        - Studies brain under certain conditions
        - Uses radiation
        - Not as used today
    - Magnetic Resonance Imaging (MRI)
        - No radiation
        - Takes pictures of parts of the brain
    - Functional MRI (FMRI)
        - Variation of MRI used for specific things
- Hindbrain & Midbrain: Housekeeping Chores (Nickname) & reflexes
    - Hindbrain most involved in regulating the vitals
        - Located where brain stem meets the spinal cord
        - Medulla
            - Most associated with autonomic reflexes (Heartbeat, breathing)
            - Posture
        - Pons
            - Directly above medulla
            - More associated with the parasympathetic system
            - Balance
            - Hearing
            - A bridge between the medulla and cerebellum
        - Cerebellum
            - Consists of 2 rounded structures
            - Coordination of muscle movements
            - Learning and memory of certain coordinated physical movements
                - Reticular formation
                    - Bundle of neurons that spans the hindbrain
                    - Plays role in maintaining muscle tone (Downward extension)
                    - Upward part has to do with attention, arousal, wakefulness
    - Midbrain
        - Very small section in the middle above the hindbrain
        - Plays a role in reflexes of our eyes and ears
        - Allows them to orient themselves
    - Forebrain: Cognition, Motivation, Emotions, & Action
        - Makes up 70% of the entire brain
        - Everything is eventually processed in the forebrain
        - Divided into 2 areas
        - Lower Area (Smaller)

- Thalamus
    - Takes in sensory messages, relay station for sensory information
    - Filters out the unimportant and sends the rest to the fore part of the brain
- Hypothalamus
    - Below thalamus
    - Involved in emotions and vital functions
    - Regulates digestive process, heart-rate, breathing, body temperature
    - Controls the endocrine system
    - Considered a pleasure center
        - Food or sexual pleasure
- Limbic System
    - Involved in emotion and memory as well as more complex thinking
    - Amygdala
        - Most associated with aggression
        - Allows us to recognize the emotions of others
        - Very involved in memory forming of emotionally charged events
    - Hippocampus
        - Near memories
        - Center of the Limbic System
    - 2 Associated Areas
        - Septal Area – Involved in putting meaning to emotion
        - Cingulate cortex
            - Expands across limbic system and into cerebral cortex
            - Also to do with thought and emotions
            - Also known as go/no go system

- Cerebral Cortex
    - Keeps 2 hemispheres together
    - Involved in EVERYTHING
    - Lobes in the cortex
        - Frontal Lobe
            - Very involved in planning, organizing, decision making, voluntary body movements,
            - Left Lobe involved in speech
            - Broca's area
            - Ability to generate speech
            - (Expressive Aphasia) – Inability to generate speech

- Motor Area
  - Involved in voluntary movement
  - Area left controls throat, tongue and mouth (works with broca's area)
- Phineas Gage
  - Railroad worker, who had a rod through his head, and survived, but personality severely altered
- Parietal Lobes – Most associated with processing sensory information from the skin (touch)
  - Somatosensory Area
    - Parallel to Motor Cortex
    - Functions with motor cortex
    - Associated with somatic nervous system
- Temporal Lobes
  - Associated with processing auditory Information
  - Auditory Area
    - Wernicke's Aphasia (Only in left temporal Lobe)
    - Inability to comprehend language
- Occipital Lobes
  - Main function = Sight
- Association Areas (Of the cerebral cortex)
  - Do not have specific known functions
  - Very general non-specific functions
  - "Silent Areas of the Brain"
- Functions of the cerebral hemisphere
  - Right side vs left side
  - Left – Linguistic Hemisphere
  - Right – Non-linguistic Hemisphere
  - Work together and communicate with each other made possible through corpus collosum – Bundle of nerves that connect the hemispheres and allows for communication
  - Corpus collosum also related to seizures, (electrical messages)
  - Brain plasticity
    - Ability of one area of the brain to pick up functions of another area that has been damaged
    - Ability greater in association areas

- Endocrine System
  - A system of glands that works hand-in-hand with nervous system

- Messages carried through blood stream rather than nerves
- Glands are what produce hormones or neuropeptides
    - Chemicals produced by glands
        - Neuropeptides
            - Communicate between various glands
        - Hormones
    - Important glands
        - Pituitary Gland (Master Gland)
            - Controls the other glands
            - Located at the bottom of the brain
            - Very much associated with body growth and development
            - Produces growth hormone
        - Adrenal glands
            - In the kidney area
            - 2 Adrenal glands
            - Involved in physical and emotional arousal
            - Associated with sympathetic nervous system
            - 3 main hormones of adrenal glands
                - Epinephrine
                    - Increases blood pressure by sending message to the heart to beat faster
                    - Also sens message to the liver to release stored energy
                - Norepinephrine
                    - Increases blood pressure by sending message to muscles to constrict
                - Cortisol
                    - Regulating immune system
        - Islets of Langerhaus
            - Cells located in pancreas
            - Allow pancreas to produce two hormones
                - Glycogen
                    - Hormone that causes liver to release sugar into bloodstream
                - Insulin
                    - Reduces level of sugar in bloodstream
            - Gonads
                - Produces sex cells and hormones important in sexual arousal
                - Play a large part in secondary sex characteristics
                - Ovaries – Female gonad

        - Testes – Male gonad
        - These produce estrogen and testosterone
    - Thyroid Gland
        - Located near the voice box
        - Most associated with regulating body's metabolism
        - Produces hormone called thyroxin
            - Associated with energy levels in adults
            - Necessary for proper mental development in children
            - Low levels of thyroxin results in cretinism
                - Form of mental retardation
    - Parathyroid glands
        - 4 glands embedded in thyroid glands
        - Produce hormone parathormone
            - Regulates excitability of the nervous system
            - Too much inhibits nervous system and leads to sluggish behavior
            - Too little results in excessive nervous activities
        - Pineal gland
            - Regulation of biological rhythms (Circadian rhythm)
            - Produces melatonin
            - Keeps moods and cycles stable
            - Production very associated with sunlight
            - Low melatonin – Seasonal Affective Disorder
- Genetic Influences on behavior
    - Psychological Characteristics
        - Personality
        - Intelligence
        - Levels of Addiction
    - Nature vs Nurture
        - Nature – Everything is genetic
        - Nurture – Environment allows us to adapt