Neural Communication

Biological Psychology

- Discipline of psychology concerned with physical ways neurons cooperate to compose mental processes
- Names:
  - Behavioral Neuroscientists
  - Neuropsychologists
  - Behavior Geneticists
  - Physiological Psychologists
  - Biopsychologists

Phrenology

- The study of the shape of skull and the making of inferences based off of that shape
  - Bumps on head indicate abilities or traits
- Developed by Franz Gall

The Neuron

- Anatomy
  - Soma = body of the cell
    - Receives action potentials from dendrites
  - Dendrites = branching bodies that connect to other dendrites or axon terminals
    - Receive action potentials via **neurotransmitters**
  - Axon = long, thin barrel with myelin sheath that uses electrotonic potential to relay signals from soma to axon terminals
    - Covered with myelin sheath to split transmission into brief, fast electrotonic potentials and connecting action potentials to keep voltage high
  - Myelin sheath = waxy layer composed of **Schwann Cells**
    - Serves to insulate stretches of the axon so that electrotonic potential can happen, speeding up transmisison
  - *Nodes of Ranvier* = gaps inbetween the myelin sheathing that allows an action potential to happen, keeping the voltage within the cell high enough to ensure the signal isn't lost
  - Synapse
    - The area where two neurons come near to each other
    - Cite of neurotransmitter release and intake

Action Potential

- Begin at resting potential(-70mV inside neuron)
- Stimulus opens Na+ channels and tons of sodium ions flow in
  - **Polarization**
- After a threshold is reached, K+ gates open, letting K+ out. Voltage drops as a result
  - **Depolorization**
- After a while, Sodium-Potassium pumps begin to create the gradient
  - **Repolarization**

Drugs that Target Neurotransmitters

- Action potential at dendrite is stimulated by neurotransmitter, typically
- Drugs can fit in those receptors
- **Antagonist**
  - The drug fits, but poorly; as a result, the *real* neurotransmitter can't fit
  - **Inhibits** the targetted neurotransmitter
- **Agonist**
  - The drug fits *really* well and simulates the neurotransmitter
  - **Excites** the neurotransmitter or increases activity

Neurotransmitters

- Dopamine
  - Used in movement, attention, and learning
  - Schizophrenia thought to be related to dopamine imbalance
    - Thought to be a surplus of dopamine
  - Parkinson's disease thought to be related to loss of dopamine-releasing neurons
    - Symptoms:
      - Movements are difficult to control
      - Shaking while at rest
      - Stooping posture or rigidity
      - Unbalance
    - Treatments
      - L-dopa = agonist that immitates dopamine

            - Fetal tissue transplants
            - Adrenal gland transplants
            - Electrical stimulation of thalamus = stops shaking
    - Part of "reward system" or limbic system
- Serotonin
    - Regulates sleeping patterns
    - Thought to be related to depression
        - Especially low-serotonin
        - High-serotonin is thought to cause mania
        - *Prozac* excites serotonin
            - **SSRI** = Selective Serotonin Reuptake Inhibitor
            - Examples: Welbutrin, Zoloft, Celexa
- Acetylcholine
    - First neurotransmitter we discovered
    - Abbreviated "ACh"
    - Used in motor neurons–stimulates muscles to contract
    - Used in learning, memory, and muscle contraction
    - Nicotine is an agonist for Norepinephrine and ACh
    - Thought to be related to Alzheiumer's Disease
        - Decay of memory, reasoning, and lanugage
- Endorphins
    - Regulates pain/pleasure
    - Pain is a stimulus for release
    - Agonists
        - Morphine
        - Codeine
    - Explains "runners high"
- Norepinephrine
    - Excitatory neurotransmitter that causes "fight or flight" response
    - Also related to depression
    - Used in physical arousal, learning, and memory
- GABA
    - Inhibitory
    - Thought to be related to Huntington's disease = death of neurons in *stratium* that make use of GABA
        - Jerky movements
        - Cognitive deterioration
- Glutamate
    - Very prevelant
    - Excitatory neurotransmitter
    - Excess glutamate and lack of GABA is associated with epilepsy

Neurons can be Excitatory or Inhibitory

- Excitatory = stimulates post-synaptic neuron to carry an action potential
- Inhibitory = Causes post-synaptic neuron to be less likely to start an action potential
  - GABA

Summary

- Stages
  - Relieved Dolby Rescued Harry = mneumonic for remembering stages of action potential
    - **R**elieved = **R**esting
    - **D**olby = **D**epolorization
    - **R**escued = **R**epolorization
    - **H**arry = **H**
- Ions
  - SIPO = mneumonic for remembering ions
    - **S**odium **I**n, **P**otassium **O**ut
- Agonists vs Antagonists
  - Agonists = mimic effect of neurotransmitter
    - Nicotine, Morphine
  - Antagonists = block or inhibit effect of neurotransmitter

The Nervous System

- Nerves = small strands of neurons that act as highways for action potentials
  - Serve to connect brain to peripheral sensory organs
- Nervous System = the organ system the body employs to communicate between organs
  - Composition
    - Nerve Cells
    - **Peripheral Nervous System(PNS)** = nerve framework that connects brain to peripheral sense organs
    - **Central Nervous System(CNS)** = the brain and spinal chord

Model of Nervous System

- Peripheral Nervous System
  - Autonomic Nervous System
    - Controls unconscious actions of organs
    - Sympathetic Nervous System = arousal
    - Parasympathetic Nervous System = calming effect
      - *Think of a parachute–slows you down*
  - Skeletal/Somatic Nervous System
    - Controls voluntary movement of skeletal muscle
- Central Nervous System
  - Brain
  - Spinal Chord

Types of Neurons

- Sensory Neurons
  - Serve as medium through which sensory information travels to brain
  - Sense Organs -> Brain
    - Uses **affarent neurons**
  - Brain -> Sense Organs
    - Uses **efferent neurons**
  - Mneumonic = SAME
    - **S**ensory **A**ffarent **M**otor **E**fferent
- Interneurons = linking neurons that connect other systems together
  - Only found in brain and spinal chord

Reflexes

- **Reflex** = a simple action undertaken via the **reflex arc**
- **Reflex Arc** = a pathway of nerves through which a reflex happens
  - Generally goes from sensory organ -> affarent neurons -> interneurons -> spinal chord -> interneurons -> efferent neurons -> motor neurons

Neural Networks

- Neural Networks = a web of inter-connected neurons that cooperate to process information
- Through experience and feedback, neural networks are modified

Lesions

- Lesions = destruction of tissue cause either naturally or by purpose
- Walter Freeman = got Nobel Prize for procedure wherein he quickly caused damage to a part of the brain to cure depression or anxiety

Brain Scan

- Electroencephalogram(EEG)
  - Places 8 electrodes around the brain and records electric brain activity
- Computed Tomography Scan(CAT Scan)
  - X-ray photoraphs taken from different angles
  - A computer generates a composite image
- Positron Emission Tomography Scan(PET Scan)
  - A radioactive form of glucose is ingested and sensors detect where glucose goes
- Magnetic Resonance Imaging Scan(MRI Scan)
  - Large electromagnets and radio waves make water in the brain orient itself in line with the magnetic field
  - Can generate very high-detail images