[physiology]

cell physiology assumption: if you know how 1 cell works, you can assume all others work similarly regardless of what animal

- assumption is based on evolution
    - cells function the same way across all living things
    - sometimes cannot be applied to humans
- William Harvey: blood circulates and that tests need to be done on living things

homeostasis: maintaining constant internal conditions despite changing external conditions

- examples: temperature, blood glucose, CO2 concentration, sodium
- maintained by homeostatic mechanisms
    - negative feedback:
        - more common
        - sensor detects a change and then acts in the *opposite* direction
        - stabilizes systems
    - positive feedback:
        - sensor determines change and then *continues in the same* direction
        - ie. Temperature higher than 105 causes negative feedback to stop

cell movement over a membrane

- diffusion: the random movement of ions/atoms/etc. and is moved by thermal agitation
    - diffusion rate: the net rate of movements of ions from 1 side to another
        - proportionally :
            - concentration difference
            - temperature
            - area
                - greater cross-sectional area= greater rate of diffusion
        - inversely:
            - size of the molecule
            - viscosity
            - distance
- as you increase the concentration gradient, the rate will increase until it plateaus
- facilitated diffusion: requires no energy; uses proteins and can reversibly bind to more molecules; they provide a route for diffusion
- active transport:
    - involved carrier proteins
    - requires ATP
    - can go against concentration gradient
- electrical gradient:
    - all ions contribute to the electrical gradient
    - voltage is the driving force
    - net voltage is the sum of all ions
        - faster it moves causes a lower voltage
        - higher concentration gradient means higher voltage
    - written as –xmV
- osmosis:
    - the only way that fluids cross cell membranes in a *significant* amount
    - the diffusion of water down its concentration gradient
    - osmotic pressure: the force generated by diffusion of liquid

- molecules that are dissolved in water exert the same amount of pressure as a gas
- osmolality: molarity of all the things dissolved

Cells & Nervous System

Neuron

- the functional unit of the nervous system
- classification
  - morphology
    - unipolar
    - bipolar
    - multipolar
  - functional
    - afferent
    - efferent
    - interneuron
- glial cells
  - provide the environment for neurons
  - categories:
    - oligodendroglia
      - CNS
      - Mylenate CNS neurons
      - Mylenate multiple axons at one time
    - Neurolemmoglia
      - PNS
      - 1 axon
    - Astroglia
      - Touch capillaries or neuron cell bodies
      - Facilitate nutrients to neuron from blood and transfer waste to blood
    - Mircoglia
      - Accumulate at any site of injury
- Stimuli
  - They affect voltage across a membrane
  - Graded potentials: as you grade stimulus strength, you grade the response; cell body only
  - Hyperpolarization: makes voltage *more* negative
  - Depolarization: makes voltage *less* negative

Action Potential

- Completely depolarized cell
  - All or nothing
  - Propagating
  - Goes down the neuron's axon to the terminal buttons and branches
- Threshold is -50mV
- Gated ion proteins (open/closed)
  - Determined by voltage across the membrane
  - Opens when the voltage reaches threshold
- Axon is not all the same voltage during action potentials

- Can only go in 1 direction
    - Because of the absolute refractory period which means it can only go in one direction
    - Requires a much stronger stimuli to get another action potential
    - Only so many action potentials can be generated because of the refractory periods

Conduction Velocity of Axons:

- Nonmylenated 1-2m/second
- Mylenated axon
    - 20m/second
    - faster because the changed in diffusion occur more quickly because the neurolemma protect the axon from the ECF
    - theory 1: nodes or Ranvier-small portion of the total
    - theory 2: action potential jumps from 1 node to the next salutatory conduction

Synaptic Transmission

1. Electrical (via gap junctions)
2. Chemical (unique to neurons)
3. Neurotransmitters

- When receptors are stimulated, it causes a response
- Neurotransmitters are reversibly bound
- Acytelcholine: Ach
    - Cholinergic neurons
        - Ie. Preganglionic neurons and parasympathetic postganglionic neurons
    - Cholinergic receptors
- Biogenic amines
    - Aminergic neurons
        - Ie. Sympathetic postganglion neurons
    - Aminergic receptors
- Steps:
    1. Transmitter is destroyed.
    2. Binding to receptor initiates the release of a "second messenger" into the cytoplasm of a postsynaptic cell
        a. Ca ion
        b. CAMP
        c. cGMP
- inhibitory: hyperpolarization
    - Inhibitory Postsynaptic potential (IPSP)
- Excitatory: depolarization
    - Excitatory Postsynaptic potential (EPSP)

Summation

- When an IPSP or EPSP from a particular presynaptic neuron begins before an existing one has decayed, it is called ***temporal summation***
    - Multiple action potentials from the presynaptic neuron causes the postsynaptic neuron to reach threshold
- When an IPSP/EPSP are arriving form a postsynaptic cell from more than 1 presynaptic cell, it is called ***spatial summation***
    - When multiple different presynaptic neuron fire at 1 postsynaptic neuron which causes it to reach threshold
- Convergence: multiple presynaptic neurons go into one postsynaptic neuron